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FOLLOW-UP STUDY OF THE DEVELOPMENT IMPACT OF CARE FOOD FOR WORK ROADS IN BANGLADESH

Final Report

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EXECUTIVE SUMMARY

The Problem: Poor Rural Infrastructure in Bangladesh. Despite continuing progress in agriculture and family planning, Bangladesh remains one of the poorest and most densely populated countries in the world. Severe structural problems, including excessive rural unemployment and primitive transportation and communication networks, continue to limit access to health and educational facilities, inhibit agricultural output, and create conditions highly vulnerable to natural disasters. Most foreign assistance in Bangladesh is targeted to the small, marginal farmers and landless laborers residing in the countryside.

U.S. Assistance. USAID supports numerous projects in Bangladesh aimed at strengthening rural infrastructurue. The focus of this study, the Food for Work (FFW) Project, began in 1976 and provides payment in food grains for labor on earthwork structures. The FFW Project, implemented by CARE under the auspices of the Ministry of Relief and Rehabilitation, has distributed more than one million metric tons of wheat since its inception and comprises about one-third of the Bangladesh FFW Program. The project operates throughout two-thirds of the country and employs up to 830,000 laborers for 30 days during the dry season. The goal of the FFW Project is to improve access to rural Bangladesh for the agents of development through the creation and improvement of rural infrastructure and to generate employment opportunities during annual periods of scarcity.

Study Purpose and Methodology In 1983, Abt Associates conducted the first major assessment of the AID/CARE FFW Project designed to: (1) assess the development impact of Food for Work road and road/embankment projects, and (2) identify the significant determinants of positive development impact. The first study employed a cross-sectional retrospective research design involving interviews with over 900 respondents in 18 randomly selected upazillas and found evidence of improved communications, reduced travel times and transport costs, and increased commercial activity, primary school attendance, and use of new farm technology and family planning services associated with rural road reconstruction. The final report, issued in May 1984, recommended increased emphasis on appurtenant structures (bridges and culverts) and local maintenance. The purpose of the follow-up study, conducted in the Spring of 1986, was to validate the findings of the original study using longitudinal (before and after) data for CARE roads reconstructed in 1984. The 1986 study employed a nonrandomized control group design involving interviews with 683 farmers, businessmen, and others in villages near 17 CARE roads built in 1984 and 18 comparison sites from the same upazillas visited in 1983. Field observations of road condition, road usage, and road environment were also obtained and included for 18 older (1980) CARE roads to adjust for seasonal effects. The major challenges faced in implementing the research design for the study were: (1) dealing with respondents inherently biased in favor of the project, and (2) adjusting for seasonal differences resulting from having conducted the original study during the rainy season and the follow-up study during the dry season.

Findings. The roads reconstructed under Food for Work in 1980 and 1984 were found to be in much better condition and more heavily travelled than

the roads proposed for reconstruction in 1987. Only 12 percent of the comparison roads were passable at least halfway by rickshaw, compared with 69 percent of the 1984 CARE roads and 83 percent of the 1980 CARE roads. The superior condition of the older FFW roads is largely attributed to more recent maintenance under the new Women's Maintenance Program (WMP). No four-wheeled motor vehicles were observed on any of the 53 roads.

Examined several different ways, the data from this study consistently support the following development impacts of the FFW Project: improved local communications, reduced travel times and transport costs, increased local maintenance, use of new farm technology, increased commercial activity, increased access to health services, and increased primary school attendance. Some evidence was also found to link the project to increased agricultural production, higher farmgate prices, and lower input costs for most major crops. On the other hand, the FFW roads seem to cause a decrease in the use of local health clinics (perhaps because of increased access to the upazilla hospital and/or health centers). No evidence was obtained to support FFW impacts on crop mix, primary school absenteeism, use of the road by local women, or agricultural extension and family planning outreach.

The road and road/embankment projects with the highest estimated development impacts overall tended to be those a) passable by rickshaw, b) with fewer unbridged gaps, c) recently maintained, d) with good or excellent surface conditions, e) near electric lines or a bank, and f) in areas with doash (mixed) soil rather than sandy soil. The most significant predictor of overall development impact for the 1984 CARE roads was whether or not the road was fully passable by cycle rickshaw two years after reconstruction.

These results are highly consistent with those of our original study, with the most noteworthy exceptions being the new indications of increased local maintenance and higher producer surpluses brought about by the FFW road reconstruction, and the failure to confirm positive impacts of rural roads on the use of local health and family planning services and the use of fertilizer and better seeds.

Recommendations. The 1986 followup study found, on average, one new concrete bridge or culvert per year per six-mile FFW road and significant improvements in local road maintenance. Nevertheless, the study team observed too many roads with too few bridges and too little maintenance, in March and April of 1986, and recommends that USAID and CARE:

1) Continue to support and expand the AID/CARE Appurtenant Structures Project; and

2) Continue to encourage the expansion of the Women's Maintenance Program and provide support if necessary.

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FOLLOWUP STUDY OF THE DEVELOPMENT IMPACT OF TITLE II FOOD FOR WORK ROADS IN RURAL BANGLADESH

I. INTRODUCTION

A. Background

With over 100 million people living in an area of about 55,600 square miles, Bangladesh is the most densely populated country in the world. The terrain is extremely flat and is interlaced with an intricate system of rivers and tidal channels which serve as regional boundaries and major transportation routes, and poses serious threats to adjacent, low-lying areas from July to October (monsoon season). The most important geopolitical subdivision is the upazilla (formerly called the thana), of which there are about 460 covering an average area of 250 square miles with a population of about 200,000. Each upazilla is composed of some 10 to 15 unions which are governed by an elected chairman and a committee of local officials (union parishad). Agriculture employs nearly 80 percent of the labor force and accounts for more than half of the Gross Domestic Product. Major crops are three forms of rice (aus, aman, and boro), wheat, jute, sugar cane, and potatoes. The most common public vehicle for land transportation is the cycle rickshaw. Somewhat less common in rural areas are motorized (auto) rickshaws or baby taxis.

Bangladesh has the world's largest voluntary agency community and the largest Food for Work (FFW) Program, about half of which is supported by USAID in concert with CARE. The program, which provides payment in food grains for labor and earthwork structures, has been ongoing in Bangladesh since 1976 and operates under the auspices of the Ministry of Relief and Rehabilitation. In 1986, more than 2,000 earthwork projects were completed, the majority of which were road and road/embankment projects. The USAID/CARE FFW Project operates through 315 of the 460 upazillas and has utilized more than one million metric tons of bulk wheat as payment to laborers in the 10 annual work seasons since its inception. The Project employed approximately 837,000 laborers during the 1986 dry season. The goal of the FFW Program is to improve access to rural Bangaldesh for the agents of development through the creation and improvement of rural infrastructure and to generate employment opportunities during annual periods of scarcity.

In 1983, Abt Associates conducted the first major assessment of the degree to which the USAID/CARE FFW Project is meeting its secondary goal relating to positive development impact. The study employed a cross-sectional retrospective research design to identify positive and negative impacts of CARE roads on socioeconomic conditions in rural Bangladesh from 1980 to 1983. The final report, issued in May 1984, found evidence of improved communications, reduced travel times and transport costs, and increased commercial activity, primary school attendance, and use of family planning services associated with rural road reconstruction. Positive development impacts appeared to be significantly higher in electrified areas where development-related criteria were used in the selection of roads for reconstruction and where the roads had been recently maintained. The study recommended increased emphasis on appurtenant structures (bridges, sluice gates, and culverts), increased

coordination of the Food for Work Program with the Rural Electrification and Family Planning programs, and targeting of future projects to upazillas and unions committed to local road maintenance.

B. Study Objectives

As specified in the contract Scope of Work, the objectives of this study were:

- To use longitudinal data to validate or invalidate the findings of the original study concerning the socioeconomic impacts of PL480 Title II road and road/embankment projects;

- To identify the significant determinants of positive development impact;

- To prepare a manual for local staff or contractors that details the procedures used to collect and analyze the data needed for this study; and

- To recommend criteria for design and implementation of FFW road projects that may result in positive development impact, and may be incorporated into future upazilla level planning documents.

Using evidence from our 1983-1984 study and recent studies of the impacts of rural roads in other developing countries, we identified the following potential development impacts for investigation:

Economic Impacts

- **Transportation costs, farmgate prices:** Transportation costs may decrease through more efficient transportation. Farm prices may change in response to increased production or decreased transportation costs.

- **Farm technology:** Use of fertilizer, better seeds, and more modern irrigation techniques may increase through increased access to fertilizer and agricultural extension services.

- **Agricultural production:** Crop yields may increase through expansion of cultivated land and/or use of new farm techniques. Crop mix may change in the direction of more profitable but more perishable crops, through increases in transportation efficiency.

- **Land values:** Land values may increase through changes in the ecology of the project area and improved access to goods and services.

- **Commercial activity:** New businesses may appear in response to improvements in communication, road access, and road usage.

Social Impacts

- **Communication:** The quality of communication among villages and between upazilla headquarters and the project area may increase. This increase may in turn stimulate other social changes.

- **Education:** Attendance and enrollments at primary schools may increase for males -- and perhaps even more so for females -- through improved communication with guardians and access to schools.

- **Health:** Use of family planning and other health services may increase through improved communication (including outreach) and ease of transportation.

- **Distribution of benefits:** Large landholders may reap most of the economic benefits of the improved road, thereby widening the gap between the rich and poor.

- **Environment and Other:** Flood control may improve or deteriorate depending upon the extent to which the road is technically well-designed. Women may use the road more frequently and perhaps become more community-related. Robbery and theft may increase through increases in commercial activity and village accessibility.

Based on our initial study of FFW road (and road/embankment) projects in Bangladesh, we planned to reinvestigate the following conditions of effectiveness in promoting long-term socioeconomic development:

Effectiveness

- Other things being equal, there is a time lag of two to three years until the majority of the development impact of an FFW road takes place.

- Other things being equal, the development impact of an FFW road is a function of the ecology of the project area, particularly soil composition.

- Other things being equal, the development impact of an FFW road is related directly to the extent to which the project is integrated with other rural development projects to form a network of development infrastructure.

- Other things being equal, the development impact of an FFW road is related directly to the extent to which development related criteria are considered in project selection.

- Other things being equal, the development impact of an FFW road is related directly to the extent to which appurtenant structures, such as bridges, culverts, and sluice gates, accompany the project.

- Other things being equal, the development impact of an FFW project is related directly to the extent to which the road is maintained.

Within limited time and resource constraints, we sought to develop a research plan that would address all hypothesized impacts in one or more ways. The next section describes a multi-dimensional longitudinal approach to impact assessment that was adopted for this study to explore the above hypotheses and test the validity of our 1984 study findings and conclusions.

METHODOLOGY

A. Research Design

For this study, we returned to the same sample of 18 upazillas drawn in 1983 using the CARE/Dhaka microcomputer, from all districts where USAID and CARE continue to support Food for Work activities. Excluding the Sylhet, Chittagong, Rangamati, and Bandarban regions, these upazillas constitute a five percent sample of the total number of upazillas. Staff from Abt Associates Inc., USAID, CARE, and the Ministry of Food agreed that the sample upazillas, listed below and depicted in Figure 1, were representative of the range of demographic and economic contexts within which the program currently operates.

	Upazilla	District
1.	Begumganj	Noakhali
2.	Matlab	Comilla
3.	Brahmanpara	Comilla
4.	Gopalpur	Tangail
5.	Araihazar/Narsingdi*	Dhaka
6.	Bhaluka	Mymensingh
7.	Madarganj	Jamalpur
8.	Nakla	Jamalpur
9.	Dacope	Khulna
10.	Satkhira	Khulna
11.	Daulatpur	Khulna
12.	Sarsha	Jessore
13.	Pirgacha	Rangpur
14.	Singra	Rajshahi
15.	Ishwardi	Pabna
16.	Khansama	Dinajpur
17.	Thakurgaon	Dinajpur
18.	Nandigram	Bogra

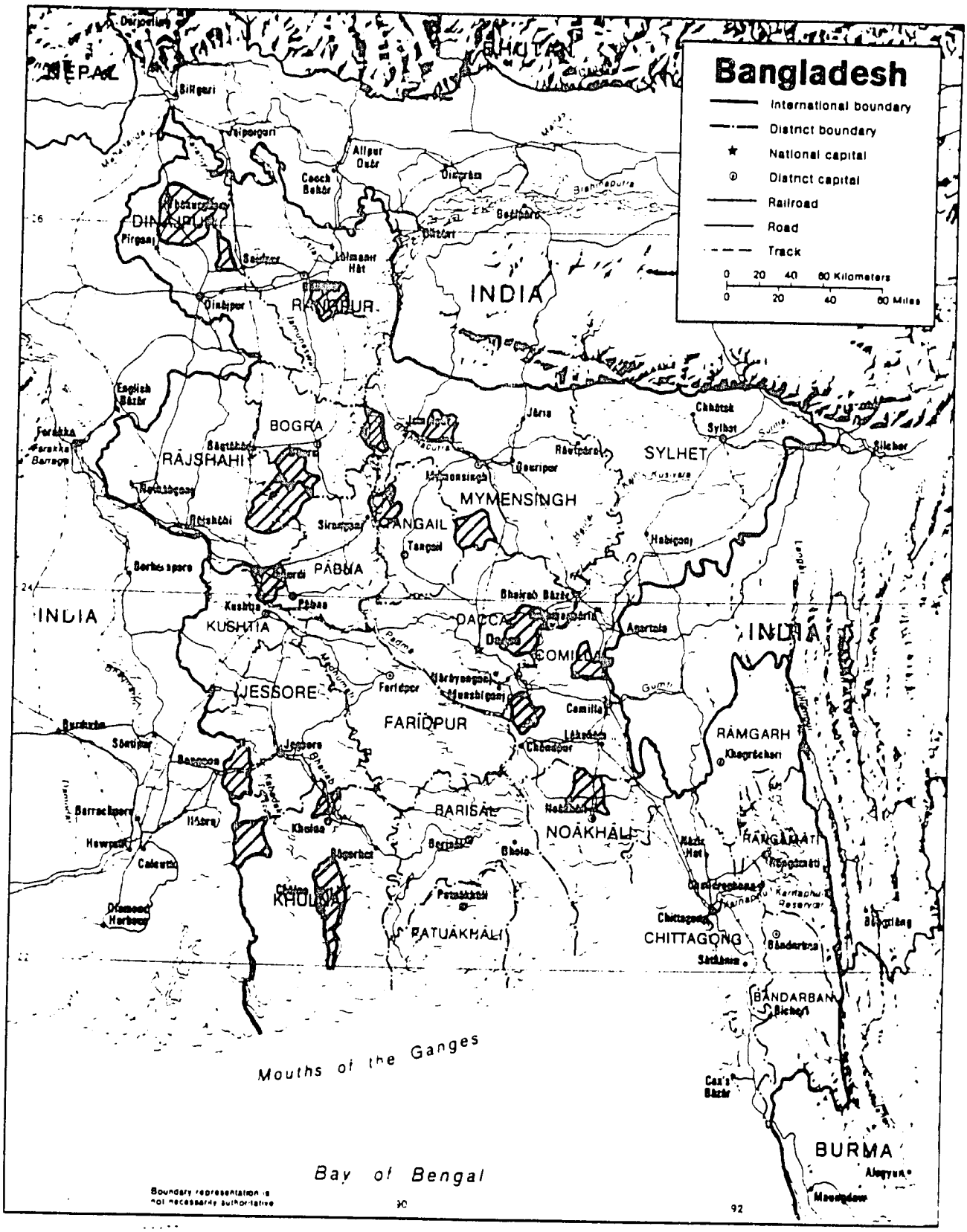
In each upazilla, three sites (roads) were chosen for observation and data collection as follows:

Site 1. This site was the comparison site (Site 3) from our earlier study, having been randomly selected from proposed 1983-1984 CARE road or road/embankment projects. These roads constitute the primary study sites since complete data are available both before and after road reconstruction. They are referred to throughout the remainder of the report as the Site 1 roads or the 1984 project sites.

*These two contiguous upazillas were treated as one upazilla since Araihazar contained no 1980 CARE roads and Narsingdi contained no 1984 CARE roads.

Figure 1

Country Map Showing Selected Study Upazillas



Site 2. This site was randomly selected within each upazilla from a list of proposed 1986-1987 CARE road schemes. If only one such project was identified, this road was selected. Some proposed schemes were dropped from consideration in this study due to their excessive road lengths. These roads are referred to throughout the remainder of the report as the Site 2 roads or the comparison sites.

Site 3. This site was included as Site 1 in our earlier study, having been randomly selected from 1979-1980 CARE road projects. If it was discovered in discussions with upazilla officials that the road was the site of ongoing FFW activity or recent major repairs, our Site 2 from the 1983 study (a 1981-1982 CARE road) was substituted. These roads were included in the follow-up study to adjust for seasonal effects and measure changes in socioeconomic conditions in the upazilla unrelated to the road reconstruction. They are referred to throughout the remainder of the report as the Site 3 roads or the 1980 project sites.

Identification and descriptions of the specific sites visited during the course of this study are contained in Volume II.

In 1983, we employed a retrospective, cross-sectional quasi-experimental design to identify impacts and test our research hypotheses in the absence of longitudinal data. For the follow-up study, however, longitudinal data formed the heart of our analysis and most retrospective questions asking respondents about their farm, business, or health practices three years prior to the time of the study were dropped from the interview. Our 1986 research design may be described as a modified nonrandomized control group design as illustrated in Figure 2 below:

Figure 2

	1980	1981	1982	1983	1984	1985	1986	1987
Site 1				O_{11}	X		O_{12}	
Site 2							O_{22}	X
Site 3	X			O_{31}			O_{32}	

Where O_{ij} indicates field observations and interviews at Site i for Time j, and X indicates reconstruction of the road under the Food for Work Program.

If roads were randomly assigned to the three groups, we could simplify our analysis by ignoring the 1983 data and comparing O_{12} and O_{32} with O_{22} in Figure 2 to identify the medium- and long-term development impacts of road reconstruction under the Food for Work Program. Since the process of selecting roads for reconstruction in 1980, 1984, and 1986, however, was not random, it becomes necessary to consider the changes observed from 1983 to 1986 in the Site 1 and Site 3 roads. Changes in road condition, road environment, and road usage attributable to reconstruction under FFW were determined by comparing $O_{12} - O_{11}$ with $O_{32} - O_{31}$ as well as by comparing O_{12} with O_{22} from the road observation data. Such multiple comparisons are necessary to adjust for seasonal differences (our 1983 observations were made during the rainy season whereas our 1986 observations were made during the dry season) and to adjust for changes in demographic and socioeconomic conditions from 1983 to 1986 that might have occurred near the road even without any FFW program intervention. Note that our research design assumes that changes at Site 3 from 1983 to 1986 are unrelated, for the most part, to the 1980 FFW reconstruction.

For the survey data, economic and social impacts of FFW road reconstruction projects were determined by drawing multiple comparisons between Site 1 and Site 2 designed to screen out respondent and interviewer bias and isolate genuine development impacts from other reported development impacts. Conducting an objective assessment using local interviewers and respondents sympathetic to, and with self-interests in, the program was the major challenge faced by the Abt study team in 1983 and again in 1986. Using commercial activity near the road as an example, the following methods were employed to test for positive or negative impacts of the road reconstruction:

1. Longitudinal and cross-site comparisons of roadside observations of commercial activity at the 1984 project sites before and after reconstruction of the roads. Changes in the number of fertilizer shops, markets, rice mills, and other mills located near Site 1 roads are compared to corresponding changes in commercial activity near Site 3 roads over the same three-year period.

2. Cross-site comparisons of the percentage of all respondents who feel that commercial activity in the area near the road has increased since 1983. The initial portions of the interviews focus on perceived changes in specific aspects of village conditions since 1983 <u>without</u> alerting respondents to the road reconstruction as the focus of the study.

3. Longitudinal and cross-site comparisons of changes in business production or sales over the past three years among businessmen interviewed and reasons given for the increase or decrease. Section I of the interviews was specific to each category of respondent and was designed to obtain more precise estimates of changes since 1983 from those respondents most qualified to address each topic.

4. Longitudinal and cross-site comparisons of the percentage of tradespeople interviewed who reported that their business did not exist three years prior to the time of the interview. Since strict random sampling procedures were not followed in selecting survey respondents of each occupational category living near the roads, comparisons of 1983 group means with 1986 group means are interpreted with caution.

5. The percentage of all respondents at Site 1 who cite increases in commercial activity in the area as the most important or next most important good or bad effect of the road reconstruction. Midway through the interviews, respondents are alerted to the road reconstruction as the focus of the study and asked open-ended questions about good and bad effects <u>without</u> cueing them as to hypothesized impacts.

6. The percentage of all respondents at Site 1 who definitely agree that commercial activity in the area increased as a result of the road reconstruction. Toward the end of the interviews respondents are read a list of hypothetical impacts of the reconstructed road and are asked to what extent they would agree or disagree with each statement. Since most respondents tended to agree with the interviewer, we worded some statements in the negative form and we focused our analysis on those who <u>definitely</u> agreed or disagreed.

This evaluation strategy provided the study team with several "windows" through which to view any one room (impact), thereby increasing our likelihood of drawing complete and accurate conclusions from the data. At each site, our field teams sought to interview 20 respondents consisting of ten farmers, four businessmen, two union chairmen, two primary school teachers, and two health workers. The objective of this quota-type sampling was to arrive at a total sample of approximately 700 respondents composed of the above five categories of individuals in numbers most appropriate to the research questions being asked. Since most of the hypothesized road impacts were agricultural, one half of the sample was allocated to farmer interviews. Strict random sampling was not employed in the selection of individual respondents within these categories. Instead, the field teams were instructed to select one union chairman, one teacher, and one health worker from each half of the road, as well as two businessmen and five farmers. As the teams came across a primary school, health clinic, or rice mill, one of the team members would remain behind to interview the headmaster, head nurse, or mill owner, etc. About one half of the farmers were interviewed in their homes; others were selected elsewhere in the village and in the fields in order to obtain a broad cross-section including tenant farmers owning little or no land themselves. Further discussion of the survey procedures used in this study is provided in Section IID.

The research design described above incorporates numerous precautions to ensure high quality data and represents a more rigorous methodology than our 1983 retrospective approach to impact assessment of AID/CARE FFW roads. Several limitations of the design, however, should be noted. First of all, as in 1983, the design does not permit conclusions to be drawn at the upazilla level as to the aggregate impacts associated with multiple, overlapping projects. If, for example, high concentrations of FFW activity create disincentives to wheat growers in the area by forcing down wheat prices, our site-level approach would not be likely to confirm such an impact. Second, the data are most meaningful when compared over time, across sites, or across subgroups of respondents (i.e., in relative form), and less meaningful when viewed individually (i.e., in absolute form). The inherent biases of the respondents threatens the validity of our sample means (for example, average land values) but not the validity of the variation in these means (for example, changes in reported land values from 1983 to 1986). Finally, since the roads selected for study were not randomly assigned to treatment groups (sites), we cannot be assured that the baseline scenarios (in our example, land values) at Site 2 are fully comparable to baseline conditions at Site 1. For this reason, we refer to the Site 2 roads as comparison sites rather than control sites, and our analyses do not rely solely on Site 1 versus Site 2 comparisons.

B. Questionnaire Design

Other than dropping questions asking respondents to recall local conditions in 1980 and adding questions to the farmer interview to obtain more detailed information on crop yields, prices, and inputs, we used the same survey instruments designed for the 1983 study. Appendix B contains English translations of the survey instruments. Considerable care was taken in designing the questionnaire to minimize respondent bias. In the introduction to the interview, the interviewers identified themselves as Abt Associates employees and not CARE or government employees. The interviewers carried a letter issued by Abt Associates to verify their affiliation. No interviews with other respondents were conducted in the presence of union or upazilla officials. The term "Food for Work Impact" was not mentioned in the interviews until toward the end; rather, respondents were initially asked about local socioeconomic conditions in 1986, and changes in these conditions from 1983 to 1986.

Each interview form contained five sections and required about 25 minutes to administer, with the exception of the farmer interview which required about 40 minutes. Section I varied according to type of respondent and sought information that would best be provided by them. The five respondent modules are described below:

- **Local officials.** These individuals, usually union chairmen, were asked questions about their criteria for selection of roads for reconstruction, the process of supervision during construction, union maintenance budgets, and various 1983 and 1986 union statistics.

- **Health workers.** Doctors, pharmacists, nurses, and other local health or family planning personnel were asked to provide information on changes in health and family planning services and practices in the area since 1983, and their perceptions of reasons for any reported changes.

- **School teachers.** Headmasters or teachers of primary schools provided quantitative and qualitative data on school attendance and enrollment during seasonal time periods and were also asked reasons for any reported changes since 1983.

- **Businessmen.** Mill owners, shopkeepers, and other merchants provided a profile of their business through such information as the number of years in operation, the amount of product produced or sold, and the number of people employed during seasonal time periods.

- **Farmers.** A cross-section of farmers along the road were asked detailed questions on farm size, crop mix, crop yields and prices, farm inputs, transport costs, etc. during 1986, and their perceptions of reasons for any reported changes since 1983.

Sections II to V of the interview forms were identical for all respondents. In Section II, respondents were queried about the condition of the road, including any recent deterioration observed and the types of maintenance work done or needed on the road. In Section III, respondents were asked about changes in specific economic and social conditions in the area between 1983 and 1986. Section IV alerted respondents to the focus of the study and asked open-ended questions about the most important good and bad effects of the road reconstruction. These questions were followed by agree/disagree statements concerning possible impacts of the road reconstruction. Since this section related specifically to FFW roads, it was excluded from interviews at the comparison sites. Finally, Section V obtained background information on the respondent's age group, marital status, religion, and educational level.

The two road forms used in the earlier study and shown in Appendix B were also used in this study: (a) the Road Characteristics Form, and (b) the Road Usage Form. The Road Characteristics Form recorded details of the road condition and environment at the time of the survey. One form was completed for each half of a road in the sample. The top part of the form identifies the road and road segment, the date FFW activity was completed, the amount of wheat allocated and actually used in the process of reconstructing the road, and the road length. The latter term was defined as the distance between the starting and ending points of the portion of the road that was reconstructed (or proposed for reconstruction) under FFW. This form was revised slightly from the 1983 version to accommodate seasonal differences in road conditions and to record evidence of road damage caused by soil erosion, bullock carts, or rodents.

The main body of the form is divided into three sections describing the general surface condition, number and types of gaps, and characteristics of the environment within one half mile of the road. At two representative points on each half of the road, the surface condition was rated by using letter grades signifying the following:

E = Excellent; motorable and smooth;
G = Good; motorable but rough;
F = Fair; passable by rickshaw; or,
P = Poor; passable by foot or cart only.

High surface ratings do not imply that motorized vehicles or rickshaws actually travel the road but only indicate that if such a vehicle is put on that segment of road, the surface condition will allow its passage. Whether or not the road is actually used or passable by those vehicles is determined by information from the second section of the form on the number and type of bridged and unbridged gaps, and information from the Road Usage Form.

To collect information on the road environment, it was necessary to define an area of influence surrounding a given project. Consistent with our 1983 study, we selected one half mile on either side of the road as a practical approximation of this area, and one that could be assessed accurately by field observers.

The Road Usage Form was used to obtain accurate hourly traffic counts for our selected sites. Each form was used to measure traffic in one direction at one point of the road in the morning for one hour, and traffic in the other direction for one hour in the afternoon. This was repeated the next day at another location but in reverse directions. Field observers also noted whether the individual or vehicle was transporting produce, whether or not it was a market day and, in the case of pedestrians, whether they were male or female.

Other data, such as upazilla statistics, were entered directly onto coding forms and used in the study without formal data abstraction instruments. The resulting data set consisted of about 300 variables at four different levels of aggregation (upazilla, site, union, and individual). Each analysis was conducted at the lowest level of aggregation for which variables were to be considered.

C. Selection and Training Procedures

Our experience and contacts developed from the original survey in 1983 helped us in selecting qualified and reliable field staff. We located and rehired three of the interviewers who worked with us in the first survey and who therefore had previous experience with the survey instruments, field procedures, and site locations. For the others, we tried to get a mixture of experienced and inexperienced interviewers. Interviewers with field experience in similar research were desired to handle field logistics and proper conduct interviews with local officials and other senior townspeople. It was

particularly important that the interviewers not be perceived by the respondents as members of an urban elite. On the other hand, the recent college graduates were also desired as they would inject dedication and enthusiasm into the survey teams.

The number of interviewers required for the study was determined by the number of sites and interviews to be completed and the period within which the interviews had to be done. Given the same number of sites and upazillas to visit and faced with similar time constraints as the first survey in 1983, we selected 12 interviewers and followed similar procedures as the first survey.* The data collection work would be done in three waves, covering six upazillas at one time and each upazilla would be visited by a two-member team for seven to eight days. The two-member team size worked well logistically and for quality control purposes. This three-wave approach also allowed the Abt field investigators to visit three to four upazillas in each wave.

We designated two categories of interviewers. Six senior interviewers, called senior research officers (SROs), were responsible primarily for inspecting the road and completing the Road Characteristics Form as well as writing a description of the sites they visited. They were also required to interview local officials and to supervise the work of their other team member. As such, in addition to their dependability and interviewing experience, the SROs' writing and supervisory skills were also considered.

The six other interviewers designated as research officers (ROs), were primarily responsible for interviewing farmers and tradespeople using the structured questionnaires, and also to complete the Road Usage Form (traffic counts) at each site.

Training of the interviewers began on March 10, 1986 and involved both formal classroom instruction and practical in-field training. Classroom instruction was done in three sessions. The first covered the following topics:

- Purpose and scope of the study
- Sample upazillas and sites
- Staff roles and responsibilities
- Suggested sequence of activities during data collection
- Guidelines for getting started
- Guidelines for interviewing

Among the guidelines for interviewing, two points particularly emphasized were the importance of objective questioning and conducting interviews without the presence of local officials or other individuals. The interviewers were also instructed to identify themselves as independent researchers employed by Abt Associates and not as government or CARE employees. In the

*Following the first wave of interviewing, we reduced our field staff from 12 to 10 interviewers since farmers and businessmen were not interviewed at Site 3 roads.

second session, the various forms and questionnaires used in the survey were introduced. Each question was discussed separately by questionnaire type. Most of the training was done in Bangla.

The pretest at Sreepur was a full pilot test of the main study, using all interviewers, questionnaires, and road forms. The Abt Associates evaluation team, together with two members from USAID and CARE, were present at all times to supervise and monitor the field activities. Interviews were verified and frequently observed. Details of the Road Characteristics forms, as completed by the interviewers, were checked on the spot and problems were also discussed and resolved.

Several modifications, especially to the farmer questionnaire, were made after the pretest at Sreepur. With the expanded crop section, the farmer questionnaire was requiring more than one hour to administer, and farmers were unable to provide reliable information on crops prices and inputs used three years earlier. We subsequently dropped all retrospective questions related to crop yields, prices, and inputs for 1983 from the farmer survey and reduced its average interview time to 40 minutes. The final training session, on March 16 conducted after the pretest, was designed to bring the interviewers up-to-date on all changes and also to resolve any problems that the interviewers faced in the pretest and that might occur in the field.

D. Field Visits and Survey Procedures

The total number of completed interviews by type of respondent, upazilla, and site are shown in Table 1. A total of 683 interviews were completed with virtually no refusals. However, several business and health interviews could not be completed because appropriate facilities were not found in the area of influence at some sites.

The three waves of data collection were done over a period of four weeks between March 10 and April 24, 1986, involving visits to all 18 sampled upazillas. Each upazilla was covered by one SRO and one RO who used available public transport to reach the area. Once there, they met with the Upazilla Nirbahi Officer (UNO) and/or Upazilla Chairman and the Project Implementation Officer (PIO). They introduced themselves, explained the purpose of the visit, and sought help regarding accommodations for overnight stay and locations of the various road projects in our sample. Letters of introduction issued by the Ministry of Relief and Rehabilitation and Abt Associates were instrumental in stimulating cooperation at the upazilla level.

Once settled, the team began their data collection, usually at Site 1. Each site normally required two days to complete all interviews and road forms. On the first day, they completed the first half of the road. The SRO travelled the entire first half of the road, inspecting the road condition and completing other details of the Road Characteristics Form. He also interviewed the Union Parishad Chairman or other local officials, primary school teachers, and health professionals.

Table 1

Total Number of Completed Interviews
by Type of Respondent, Upazilla, and Site

		Completed Interviews
Type of Respondent		
1.	Local officials	70
2.	Health workers	62
3.	Teachers	70
4.	Businessmen	134
5.	Farmers	347
		683
Upazilla		
1.	Begumganj	41
2.	Matlab	42
3.	Brahmanpara	41
4.	Gopalpur	40
5.	Araihazar/Narsingdi	38
6.	Bhaluka	40
7.	Madarganj	21
8.	Nakla	37
9.	Dacope	39
10.	Satkhira	38
11.	Daulatpur	39
12.	Sarsha	42
13.	Pirgacha	42
14.	Singra	39
15.	Ishwardi	39
16.	Khansama	36
17.	Thakurgaon	36
18.	Nandigram	33
		683
Site		
1.	1983-1984 CARE roads	302
2.	Proposed 1986-1987 CARE roads	358
3.	1979-1980 CARE roads	23
		683

During this time, the RO interviewed farmers and businessmen and also took two traffic counts for one hour each at the mid-point of that half of the road. The traffic counts in the morning hours measured the traffic flow in one direction and the afternoon counts measured traffic flow in the other direction. The second half of the road was completed likewise on the second day. Site 2 was done similarly. Site 3 data collection required only one day and involved completing the Road Characteristic forms, the traffic counts and interviews only with local officials.

During each wave, which covered seven to eight days, the Abt Associates evaluation/management team visited three to five upazillas to monitor field activities and view, firsthand, as many sites as possible. The team usually visited local officials at the upazilla headquarters first, and then visited the selected sites within that upazilla, covering as much of the road as possible and resolving any problems experienced by the interviewers. During these visits, the Abt management team completed Road Characteristics forms, verified some completed interviews by going back to the respondents and inquiring about the interview process, and talked informally with passersby about village or road characteristics.

Field work was hard and tiring. Interviewing for hours on exposed rural roads with poor transportation was physically exhausting. Every effort was made to minimize interviewer fatigue and discomfort. The interviewers were encouraged to use any transportation available to them. Air travel was sometimes used, where appropriate. The interviewers were given three days of rest between each wave, during which time the SROs wrote descriptions of the sites visited.

III. SITE CHARACTERISTICS

A. Road Conditions and Maintenance

Table 2 provides a summary of the three groups of roads as they were observed in March and April of 1986 and, for 1984 (Site 1) and 1980 (Site 3) CARE roads, compares these observations to our earlier observations in October of 1983. Looking first at the condition of the three groups of roads in 1986, we can see that at the time of our visit, the CARE roads reconstructed in 1980 and 1984 were in good to excellent condition with more than three-fourths of the roads being passable at least halfway by rickshaw. The proposed 1987 CARE roads, on the other hand, were in fair to poor condition with less than one-fourth of the road being passable at least halfway by rickshaw. Compared with our 1983 site characteristics for the same roads, the data show dramatic improvements in road condition for the 1984 CARE roads and significant improvements as well in the condition of the 1980 CARE roads. Seasonal effects and recent maintenance no doubt account for most of the improvement in road condition for the 1980 (Site 3) roads, since our 1986 site visits were made during the dry season while our 1983 site visits were made during the rainy season. Comparing changes for the 1980 and 1984 roads in Table 2, we attribute about half of the improvement in the condition of the Site 1 roads to seasonal differences and the other half to the reconstruction of the roads in 1984.

Not shown in Table 2 is information pertaining to the types of road damage observed along the project sites. As in our earlier study, cuts for drainage and soil erosion were the most common forms of road damage, with evidence of both problems observed on 45 (85 percent) of the 53 selected roads. In the rainy months of 1983, we also observed frequent road damage caused by bullock cart traffic through muddy soil (illustrated in Appendix A of the 1984 report). During the dry months of the followup study in 1986, however, a more frequently observed type of road damage was an extensive network of rat holes burrowed into the surfaces and sides of the Food for Work roads. Road damage caused by rats was observed along 33 (63 percent) of the study sites compared with 27 (51 percent) of the roads for which road damage was caused by bullock carts. Regarding gaps and cuts in the roads, it should be point out in Table 2 that the total number of unbridged gaps, including bamboo bridges and unfilled cuts for drainage, declined at the 1984 project sites from an average of more than two per mile before reconstruction to fewer than one per mile after reconstruction. Appendix A of this report contains photographs of the condition of many of the roads observed in the followup study.

Another dramatic change from 1983 to 1986 at the Site 1 roads shown in Table 2 is the percentage of the roads that had been maintained by the local unions within the last year. For each study site, we determined whether or not some part of the road had been maintained within the last 12 months by examining: (a) the responses of the local union officials to Question 2 of the interview, Section II, (b) the opinion of the majority of the other villagers interviewed at the site, and (c) any evidence of recent maintenance to the road, such as repaired bridges or surface levelling, observed by our field teams during their two-day site visit. In most cases, all three sources of information were in agreement; in other cases, we tended to favor whichever two sources of information were in agreement. Before reconstruction, about

Table 2

Summary of Site Characteristics

	Site 1 (1984 FFW Rds)		Site 2 (Prop. FFW Rds)	Site 3 (1980 FFW Rds)	
	1986	1983	1986	1986	1983
Number of roads observed	17	17	18	17	18
Mean road length (miles)	6.1	6.1	6.2	4.8	4.8
Percentage of roads:					
maintained in the last year	69	18	21	78	69
maintained under the Women's Maintenance Program (WMP)	25	0	0	67	0
with excellent road surfaces*	26	0	0	33	16
with good surface conditions	62	11	10	50	19
with fair surface conditions	6	24	43	17	42
with poor surface conditions	6	65	47	0	23
passable completely by rickshaw	38	0	0	39	17
passable halfway by rickshaw	31	12	21	44	50
passable < halfway by rickshaw	31	88	79	17	33
near a union council office*	88	71	68	61	78
near a bazar (daily market)	94	82	84	89	94
near a high school	88	76	95	89	89
near a health clinic	69	59	47	67	50
near electric lines	63	71	37	56	56
Mean number of observed:					
concrete culverts	4.6	3.2	2.2	3.4	4.4
concrete or wooden bridges	1.9	1.8	0.9	2.8	2.8
bamboo bridges	0.1	1.1	0.4	0.5	1.3
unbridged gaps (excl. cuts)	2.4	6.7	4.8	1.8	1.5
unfilled cuts for drainage	2.9	4.9	7.2	1.1	2.2
primary schools	7.9	4.6	7.0	8.5	5.4
rice mills	5.4	3.5	2.8	5.2	5.2
hats (bi-weekly markets)	2.9	2.4	2.6	1.4	2.2
deep tubewells	2.4	1.5	2.8	2.8	2.2
feeder roads	12.5	7.5	10.8	10.9	11.1
auto/cycle rickshaws per hour	3.9	1.0	1.4	9.6	4.2
motorcycles/bicycles per hour	14.6	6.6	7.7	18.6	10.6
bullock carts per hour	4.2	2.6	2.3	3.7	4.6
male pedestrians per hour	51.8	54.2	33.3	57.4	67.8
female pedestrians per hour	11.9	16.0	8.3	15.3	19.8

*As defined in Section IIB.

one-fifth of the Site 1 and Site 2 roads had had some maintenance work performed on them in the 12 months prior to our visit. Three years after reconstruction under the Food for Work project, however, more than two-thirds (69 percent) of the Site 1 and Site 3 roads had been recently maintained based upon the same criteria. Six years after reconstruction in 1980, this percentage climbed even higher to 78 percent of the Site 3 roads. It would appear, therefore, that one important impact of the FFW road reconstruction is to stimulate most of the local communities to take care of the new road by performing at least a minimum amount of routine annual maintenance on the road. The Women's Maintenance Program (WMP) a recently expanded nationwide program of road maintenance designed to provide full-time employment and direct cash payments to destitute women, was observed on four of the Site 1 roads, none of the Site 2 roads, and 12 of the Site 3 roads. Since the selection of roads to be maintained under the WMP is made by the Union Parishad, this variation in WMP activity found across the three groups of study sites is a further indication that the roads targeted for maintenance work each year are not necessarily those most in need of maintenance but rather those reconstructed roads requiring routine minor maintenance that is affordable and can be completed using local labor in a single work season.

B. Road Environment and Usage

Table 2 also indicates that most of the FFW sites in our study were located in favorable socioeconomic environments for development impact. Prior to reconstruction, a high school and bazar could be found within one half mile of at least three-fourths of the Site 1 and Site 2 roads. About half of the roads had a health clinic present before reconstruction, and this percentage increased to two-thirds of the roads by 1986 for both groups of 1980 and 1984 CARE roads. From 1983 to 1986, the mean number of primary schools, rice mills, bi-weekly markets, deep tubewells, and feeder roads observed within one half mile of the Site 1 roads increased significantly; however, we must compare these increases to those observed a the 1980 FFW sites over the same period to determine which increases may be truly attributed to the reconstruction of the Site 1 roads in 1984. Based solely upon the information presented in Table 2, we attribute increases in the number of rice mills, bi-weekly markets, and access or feeder roads at Site 1 to the road reconstruction performed in 1984 since similar increases did not occur from 1983 to 1986 within one half mile of the old FFW roads. The differences in road environment observed between project and comparison sites and between 1983 and 1986 are explored further in Section IV.

Using the Road Usage Form (shown in Appendix B), our field teams monitored traffic patterns from 9:00 A.M. to 10:00 A.M. and from 4:00 P.M. to 5:00 P.M. for two days at each site. As in 1983, no trucks, buses, jeeps, or cars were observed during these four intervals on any of the 53 roads in the study, due largely to the presence of at least one unmotorable gap on 40 (or 75 percent) of the roads. Hourly traffic, summarized in Table 2, shows an increase in cycle traffic with a decrease in pedestrian traffic from 1983 to 1986 at both Site 1 and Site 3 roads. Again there is a seasonal effect in road usage indicated by the changes at Site 3, and supported by our own field observations. During the dry months, cyclists are more likely to use the FFW roads since most of the unbridged gaps become passable by bicycle or motorcycle. On

the other hand, we observed pedestrians using the roads less often in the dry season due to the passability of the dry rice fields which offer a shorter route to their destinations than the winding Food for Work roads. One way to draw accurate conclusions regarding the impact of road reconstruction on road usage patterns is to compare the 1986 traffic counts for Site 1 with those for Site 2 and to compare the 1983 traffic counts for Site 1 with those for Site 3. Both comparisons show an increase in all five types of traffic attributable to the road reconstruction. Another method, which we prefer, is to statistically adjust the 1986 traffic counts for Site 1 using the changes observed at Site 3 to correct for seasonal effects. Following reconstruction of the Site 1 roads under the Food for Work Project, we observed a 35 percent increase in vehicular traffic (rickshaws, motorcycles, bicycles, and bullock carts), an increase in male pedestrian traffic of about 13 percent, and a four percent decrease in female pedestrian traffic after using the latter method to adjust for seasonal differences. Not shown in Table 2 is the high within-group variation in road usage that was found in our sample. Total traffic of all types ranged from as few as 16 persons or vehicles per hour to as many as 213 persons or vehicles per hour. The mean was 80. At least some rickshaw traffic was observed on 44 percent of the 1980 CARE roads (Site 3), on 37 percent of the 1984 CARE roads (Site 1), and on 21 percent of the proposed 1987 CARE roads (Site 2).

IV. IMPACT ASSESSMENTS

A. Economic Impacts

In this section, we review the available evidence of specific economic impacts assembled from the survey data, road observation data, and local statistics. Wherever possible, we have structured the tables and described the results in the same sequence in which the data were gathered, as follows:

1) **Interview Section I:** Estimates of actual 1983 and 1986 values by specific respondent groups constitute our strongest indicator of development impact. We present the mean and median values for each year within sites, and the average percentage increase in the mean values since 1983.

2) **Interview Section III:** The percentage of all respondents at each site who reported a specific change since 1983, not necessarily attributed to the road reconstruction, is presented without adjusting the percentage for missing values.

3) **Interview Section IV (Part 1):** The percentage of all respondents at each site who mentioned a specific impact as either the most important or next most important good (or bad) effect of the road reconstruction, in response to open-ended questions at Site 1 only, is presented without adjusting for missing values.

4) **Interview Section IV (Part 2):** The percentage of all respondents at each site who definitely agreed (or disagreed) with a specific impact statement is presented also with no adjustment for missing values. In this study, respondents more often expressed opinions rather than replying "Don't Know" to any agree/disagree item. For this reason, we focus on the percentage of respondents who <u>definitely</u> agreed or disagreed with each impact statement.

5) **Road Observations:** Any relevant data obtained from the Road Characteristics Form or the Road Usage Form, as summarized in Table 2, are also included in this section.

Some relationships were explored in greater detail and/or in more ways than others depending upon their relative complexity and importance as potential development impacts.

<u>Transportation costs, travel times, and farmgate prices</u>. Farmers at each site were asked how much it cost them to transport one maund (80 lbs.) of produce to and from the local market. As Table 3 reveals, reported nominal transport costs along 1984 CARE-constructed roads increased by 19.4 percent since 1983 from an average 3.6 taka per mile to 4.3 taka in 1986. However,

Table 3

Transportation Costs and Farmgate Prices

		Site 1 (1984 CARE Rds) 1986	Site 1 (1984 CARE Rds) 1983	Site 2 (Prop. CARE Rds) 1986
Farmers		(N = 168)	(N = 120)	(N = 179)
Reported cost of transportation to and from the local market in taka per maund	$\bar{X}$	4.3	3.6	5.1
	Md.	4.0	3.4	4.7
	%Δ	19.4		
Reported price of jute in the local market in taka per maund	$\bar{X}$	151.7	197.9	170.9
	%Δ	-23.3		
Reported cost of fertilizer in taka per maund for urea	$\bar{X}$	194.2	157.5	195.5
	%Δ	23.3		
All Respondents		(N = 302)	(N = 246)	(N = 357)
Percentage who reported an increase over the past three years in the number of rickshaws using the road	%	63.6	25.2	21.8
Percentage who reported a decrease over the past three years in the time it takes to reach the local market	%	58.6	32.5	22.7
Percentage who cited reduced transportation costs or travel times as an important good effect of the road	%	25.5	NA	NA
Percentage who definitely agreed that the road reconstruction led to a decrease in the time it takes to reach the nearest market	%	69.2	NA	NA

$\bar{X}$ = mean Md. = median % Δ = % change since 1983 NA = Not applicable

the higher transport costs at Site 2 (TK. 5.10 per md.) suggest that the road reconstruction has held down the inflationary increase in transportation costs. Increases in cycle rickshaw and cycle van traffic, reductions in travel time, and improved ease of pedestrian movement resulting from road reconstruction are likely explanations for the net reduction in transport costs in real terms between 1983 and 1986 at the 1984 CARE roads. In 1983, only a fourth of the respondents at Site 1 reported increases since 1980 in the number of rickshaws using the road compared to 63.6 percent at the same roads three years later. In 1986 at the proposed CARE roads, only 21.8 percent of the respondents reported an increase in rickshaw traffic since 1983. Similarly, in 1986 most respondents (58.6 percent) at the 1984 CARE roads reported a drop in travel time to the nearest market since 1983, compared to a third in 1983 and a fifth (22.7 percent) at the proposed roads in 1986. Table 3 also highlights data pertaining to farm input prices and producer crop prices that was available from both 1983 and 1986. Additional data collected in 1986 for other types of inputs and crops are discussed later in this section. The cost of urea fertilizer per maund has risen by 23 percent since 1983 at the 1984 project sites, but this increase appears to be unaffected by the road reconstruction since 1986 prices for urea are about the same at the project and comparison sites. Jute prices have been highly unstable in Bangladesh since 1983 and our data show a 23 percent decline in the price of jute in areas surrounding 1984 CARE roads from 198 taka per maund in 1983 to 152 taka per maund in 1986. Since the price of jute at the comparison sites in 1986 was reported to be 171 taka per maund on average, it would seem that a significant proportion (about 40 percent) of the decline in jute prices at Site 1 was brought about by the road reconstruction in 1984. In this instance, the causal relationship is unclear and, as will be seen later in this section, does not follow the same pattern observed for other farmgate prices near Site 1 and Site 2 roads.

Use of new farm technology. The number of deep tubewells for irrigation in unions crossed by the 1984 CARE roads increased slightly between 1983 and 1986, as shown in Table 4 (from an average of 6.2 to an average of 6.4, respectively). The average number of deep tubewells reported in unions crossed by the proposed 1987 CARE roads is 5.7. Within one half mile of the road, we observed increases in the number of deep tubewells at all project sites from 1983 to 1986 (see Table 2), but the 1986 observation means show only slight variation from Site 1 to Site 2 to Site 3. A more dramatic change is observed in the number of power pumps in unions crossed by 1984 CARE roads in 1983 and 1986. These pumps, which include both diesel and electric pumps that transfer surface water from rivers and canals to nearby croplands, have increased from an average of 8.6 pumps before reconstruction in 1984 to an average of 15.4 pumps in 1986. Since the average number of pumps in unions crossed by the proposed 1987 CARE roads is only slightly higher than the baseline level for Site roads, and since we observed nearly ten more shallow tubewells at each project site than at the comparison sites, we attribute these differences to the 1984 road reconstruction. The increased use of urea fertilizer at the 1984 project sites since 1983 (10.3 mds. in 1986 versus 8 mds. in 1983) appears to be unrelated to the road reconstruction, as does the change in agricultural extension activity in the area since 1983. The number of visits to Site 1 farmers by agricultural extension agents in the last three months dropped from 1.3 in 1983 to about one, and the percentage of farmers

Table 4

Farm Technology

		Site 1 (1984 CARE Rds) 1986	Site 1 (1984 CARE Rds) 1983	Site 2 (Prop. CARE Rds) 1986
Local Officials		(N = 24)	(N = 22)	(N = 24)
Reported number of deep tubewells in the union	$\bar{X}$	6.4	6.2	5.7
	Md.	2.5	2.8	2.3
	%Δ	3.2		
Reported number of power pumps in the union	$\bar{X}$	15.4	8.6	9.5
	Md.	3.5	4.0	7.0
	%Δ	79.1		
Farmers		(N = 168)	(N = 120)	(N = 178)
Reported maunds of fertilizer (urea) used in the last year	$\bar{X}$	10.3	8.0	12.0
	%Δ	28.8		
Reported number of visits by agricultural extension agents in the last three months	$\bar{X}$	1.0	1.3	0.9
	Md.	0.2	0.4	0.2
	%Δ	-23.1		
Percentage who reported at least one visit by an agricultural extension worker in the last three months	%	27.9	41.5	29.1
All Respondents		(N = 302)	(N = 246)	(N = 357)
Percentage who definitely agreed that the road reconstruction led to increased use of fertilizer and better seeds by farmers	%	50.0	NA	NA
Road Observations		(N = 16)	(N = 17)	(N = 19)
Number of deep tubewells within one half mile of the road	$\bar{X}$	2.4	1.5	2.8
	Md.	1.5	0.9	0.7
	%Δ	60.0		
Number of shallow tubewells within one half mile of the road	$\bar{X}$	30.7	NA	21.1
	Md.	14.0	NA	9.5

$\bar{X}$ = mean Md. = median %Δ = % change since 1983 NA = Not applicable

who reported that they have not been visited at all by any agricultural extension agents during this period increased at Site 1 from 58 percent in 1983 to 72 percent in 1986.

Agricultural production and cost. For the 1986 followup study, we collected agricultural production and cost data from the farmer respondents for 14 major crops.[1] Agricultural practices, as reported and observed, were by and large traditional and at the subsistance level. Besides HYV boro paddy and a few cases of transplanted aman paddy (27 cases) which used improved seeds and modern inputs, there were only 41 cases of use of improved varieties of seeds out of a total of 1,271 crop cases. Of the total production of all crops a little more than a quarter (28.8 percent in Site 1 and 27.2 percent in Site 2) enter the market. The mean size of respondent land holdings in Site 1 is 5 acres of which 4.07 acres are owner-cultivated. The comparable figures for Site 2 are 4.7 acres and 3.7 acres. Approximately 42 percent of the farmer respondents at Site 1 and 34% in Site 2 own less than 3 acres of land.

In a rural economy, the long-term agricultural benefits to farmers of rural roads projects will depend on the magnitude of the increase in producers' prices and/or the decrease in input prices brought about by savings in transportation costs passed on to the farmers. In addition, farmers may gain by substituting one crop for another. Improved transportation may lead to cultivation of more perishable but more profitable commodities like fruits and vegetables. The net financial gain for the producer, which also determines the production level, is governed by the spread between total revenue and production cost.

In this section, we attempt to determine the economic gains to farmers due to reconstruction of FFW CARE roads. However, in the absence of 1983 data for most of the crops and farm inputs, we make the following assumptions:

i) Differences in the prices of commodities between Site 1 and Site 2 may be attributed to the roads.

ii) Transport cost savings brought about by the FFW road project are reflected in higher farmgate prices and lower input prices.

iii) Fixed costs are the same for both Site 1 and Site 2. In addition, per acre cost of irrigation, agricultural implements for land preparation, and prices for labor and seeds are the same for either sites.[2]

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[1]Sugar cane has been dropped later from our analysis because some of its production data were collected in terms of gur (molasses) while others were collected in terms of canes.

[2]The implication of this assumption is that any difference in the total costs of those inputs is attributed to the difference in the amount used.

iv) All production may be valued at market prices.

v) The market is assumed to enjoy perfect competition, implying financial costs and gains represent true social costs and benefits, and changes in production do not affect the market price.

Brief summaries and detailed comparisons of production and revenue data for all major crops at Site 1 and Site 2 are shown in Tables 5A and 5B, respectively. Table 5A shows that most respondents at Site 1 (56.3 percent) definitely agree that the road reconstruction in 1984 has led to increased agricultural production in the area; although jute sales in 1986 were lower at Site 1 than at the same sites in 1983 (before reconstruction) or at the comparison sites in 1986. Only 11 percent of the respondents at Site 1 mentioned increased agricultural production as an important good effect of the road reconstruction. Table 5B reveals that, with the exception of jute, mung and other dal, representing 16.5 percent and 23.1 percent of cropped areas in Site 1 and Site 2, respectively, mean prices for all crops are higher at Site 1 than at Site 2. On the average, Site 1 respondents reported 4.6 percent higher prices than at Site 2 (TK. 243.4 and TK. 232.7, respectively). Similarly, total production per acre was 20.2 percent higher at Site 1 than Site 2 (23.1 maunds and 19.2 maunds, respectively). At Site 1, an acre of cropped area yields a revenue of TK. 3777.4, whereas at Site 2 it earns a farmer TK. 3142.6. Almost all crops bring in more revenue per acre at Site 1 than at Site 2, suggesting positive impacts of FFW road projects on agricultural production not found in our earlier study.

The cost data for various inputs are provided by crop in Tables 6A and 6B. As the data indicate, prices of urea and potash are lower and that of T.S.P. slightly higher in Site 1 than in Site 2. Total expenditure on chemical fertilizers on an acre of cropped area is TK. 343.6 and TK. 359.6, respectively for Site 1 and 2. Expenses on other inputs are shown in Table 6B. The cost on all inputs on an acre of cropped land amounts to TK. 2312.8 in Site 1 and TK. 2183.4 in Site 2. Cost of growing any of the 13 crops in an acre of land is shown on the column under "Cost per Acre" in Table 6B. Beside urea and potash more of each of the other inputs considered are used in an acre of land in Site 1 than in Site 2 to obtain higher output as discussed earlier.

The net incremental producer surplus or value added per acre of cultivated land (cropped area) can be calculated as follows:

Site 1:

Revenue per acre of cropped land

= TK. 3777.4

Total variable cost per acre of cropped land

= TK. 2312.8

Net producer surplus or value added = TK. 1464.6

Table 5A

Agricultural Production (Brief)

		Site 1 (1984 CARE Rds) 1986	Site 1 (1984 CARE Rds) 1983	Site 2 (Prop. CARE Rds) 1986
Farmers		(N = 168)	(N = 120)	(N = 179)
Reported maunds of jute sold over the past year	$\bar{X}$	7.1	7.4	9.0
	%Δ	-4.0		
Reported crop yields per acre in maunds for:				
Aus	$\bar{X}$	15.8	NA	15.5
Aman	$\bar{X}$	21.1	NA	22.5
Boro	$\bar{X}$	42.4	NA	42.5
Wheat	$\bar{X}$	15.9	NA	13.4
Jute	$\bar{X}$	15.8	NA	16.2
Potato	$\bar{X}$	101.6	NA	100.6
Masur	$\bar{X}$	9.7	NA	6.3
Fruits & Veg.	$\bar{X}$	40.7	NA	32.0
All Respondents		(N = 302)	(N = 246)	(N = 357)
Percentage who reported an increase in agricultural production over the past three years	%	63.9	73.6	61.9
Percentage who reported an increase in annual fishing over the past three years	%	20.2	38.2	6.4
Percentage who cited increased agricultural production as an important good effect of the road reconstruction	%	11.3	NA	NA
Percentage who definitely agreed that the road reconstruction led to increased agricultural production	%	56.3	NA	NA
Percentage who definitely disagreed that the road reconstruction led to decreased agricultural production	%	58.9	NA	NA

$\bar{X}$ = mean Md. = median %Δ = % change since 1983 NA = Not applicable

Table 5B

AGRICULTURAL PRODUCTION
(Detailed)

Site 1 (1984 CARE ROADS)

CROPS	Cropped Area (Acre)	P.C. of Cropped Area (%)	Yield Per Acre (Maund)	Price Per Maund (Taka)	Total Pro-duction (Maund)	Revenue Per Acre (Taka)	Revenue by Cropped Area (Taka)	Quantity Sold (Maund)	SAMPLE SIZE (N=591)
AUS	1.7	14.1	15.8	158.8	26.1	2513.0	4150.9	3.2	92
AMAN	2.8	23.6	21.1	166.5	58.4	3510.4	9716.7	27.6	158
BORO	1.6	13.6	42.4	153.4	67.7	6499.3	10389.4	26.6	99
WHEAT	0.9	7.5	15.9	160.3	14.0	2518.3	2247.0	1.8	64
JUTE	0.8	7.2	15.8	151.7	13.3	2396.9	2024.9	7.1	87
POTATO	0.5	4.6	101.6	95.8	54.7	9732.3	5241.7	6.7	22
MASUR DAL	0.4	3.0	9.7	336.6	3.4	3268.3	1152.6	0.0	18
MUNG DAL	0.5	4.6	12.1	230.0	6.5	2784.7	1495.1	0.1	2
OTHER DAL	0.5	4.7	7.6	216.3	4.1	1634.4	896.5	0.1	8
MUSTARD	0.7	6.0	6.0	372.0	4.2	2226.3	1556.2	0.3	25
SESAME	1.0	8.3	9.3	375.0	9.1	3477.6	3394.1	0.1	2
FRUIT & VEG.	0.2	1.5	40.7	153.3	7.3	6244.0	1123.9	0.1	4
CHILI	0.1	1.2	9.6	594.3	1.4	5717.6	806.2	0.0	10
TOTAL	11.7	100.0	23.7	243.4	270.3	4042.61	44195.2	73.6	591

Site 2 (Proposed 1987 CARE ROADS)

CROPS	Cropped Area (Acre)	P.C. of Cropped Area (%)	Yield Per Acre (Maund)	Price Per Maund (Taka)	Total Pro-duction (Maund)	Revenue Per Acre (Taka)	Revenue by Cropped Area (Taka)	Quantity Sold (Maund)	SAMPLE SIZE (N=680)
AUS	1.8	14.1	15.5	149.1	27.4	2316.1	4089.2	7.8	95
AMAN	2.4	19.5	22.5	160.7	54.9	3620.8	8824.7	16.5	154
BORO	1.5	12.3	42.5	147.4	65.6	6269.4	9677.0	25.8	114
WHEAT	0.8	6.7	13.4	153.0	11.3	2054.4	1734.6	2.4	79
JUTE	1.1	9.1	16.2	170.9	18.4	2765.0	3149.7	9.0	92
POTATO	0.3	2.1	100.6	77.8	26.8	7825.7	2083.1	5.4	33
MASUR DAL	0.7	5.4	6.3	285.2	4.3	1793.6	1219.7	0.2	24
MUNG DAL	0.9	7.1	7.3	280.0	6.5	2052.4	1826.6	0.0	5
OTHER DAL	0.9	6.9	8.4	240.7	7.3	2022.0	1759.1	0.2	13
MUSTARD	0.9	6.8	5.3	359.0	4.5	1894.5	1610.4	0.4	34
SESAME	0.8	6.4	5.7	317.8	4.5	1804.0	1443.2	0.2	11
FRUIT & VEG	0.2	1.7	32.0	120.0	6.8	3840.0	821.0	1.0	3
CHILI	0.2	1.8	8.3	563.3	1.9	4673.9	1044.6	0.1	23
TOTAL	12.5	100.0	21.9	232.7	240.3	3302.5	39282.8	69.1	680

Table 6A

AGRICULTURAL INPUTS (Fertilizer)

Site 1 (1984 CARE ROADS)

CROPS	UREA Cost (Taka)	UREA Amount Used (Maund)	POTASH Cost (Taka)	POTASH Amount Used (Maund)	T.S.P. Cost (Taka)	T.S.P. Amount Used (Maund)	TOTAL COST (Taka)	COST PER ACRE (Taka)	SAMPLE SIZE (N=572)
AUS	168.4	0.9	41.4	0.3	97.6	0.5	307.4	186.3	94
AMAN	332.9	1.7	74.1	0.5	246.7	1.3	653.6	236.0	155
BORO	629.6	3.2	169.0	1.1	508.9	2.6	1307.5	817.2	94
WHEAT	253.5	1.3	68.6	0.4	206.8	1.1	528.9	601.0	60
JUTE	111.6	0.6	34.4	0.2	94.3	0.5	240.4	286.2	82
POTATO	127.3	0.7	41.7	0.3	173.4	0.9	342.4	634.0	20
MASUR DAL	20.8	0.1	2.4	0.0	6.0	0.0	29.2	83.4	18
MUNG DAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
OTHER DAL	106.8	0.5	0.0	0.0	0.0	0.0	106.8	194.1	8
MUSTARD	169.3	0.9	31.3	0.2	143.2	0.7	343.8	491.1	25
SESAME	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
FRUIT & VEG	25.0	0.1	0.0	0.0	47.5	0.2	72.5	402.8	4
CHILI	61.6	0.3	1.4	.0	25.0	0.1	88.0	628.2	9
TOTAL	2006.7	10.3	464.4	3.0	1549.3	8.0	4020.3	350.8	572

PRICES Urea = TK. 194.1 Potash = TK. 154.6 T.S.P. = TK. 193.6

Site 2 (PROPOSED 1987 CARE ROADS)

CROPS	UREA Cost (Taka)	UREA Amount Used (Maund)	POTASH Cost (Taka)	POTASH Amount Used (Maund)	T.S.P. Cost (Taka)	T.S.P. Amount Used (Maund)	TOTAL COST (Taka)	COST PER ACRE (Taka)	SAMPLE SIZE (N=672)
AUS	323.0	1.7	52.3	0.3	189.3	1.0	564.7	319.0	96
AMAN	339.5	1.7	42.7	0.3	174.0	0.9	556.3	228.0	154
BORO	646.7	3.3	129.2	0.8	375.5	1.9	1151.3	747.6	112
WHEAT	245.4	1.3	72.6	0.5	205.6	1.1	523.6	623.3	74
JUTE	203.8	1.0	57.5	0.4	95.3	0.5	356.5	312.8	92
POTATO	200.5	1.0	88.1	0.6	218.2	1.1	506.7	1876.8	34
MASUR DAL	23.4	0.1	21.1	0.1	59.2	0.3	103.6	152.4	25
MUNG DAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
OTHER DAL	8.5	.0	0.0	0.0	8.7	.1	17.3	19.8	13
MUSTARD	220.0	1.1	93.0	0.6	218.4	1.1	531.4	625.1	30
SESAME	40.7	0.2	1.5	.0	1.8	.0	44.0	55.0	11
FRUIT & VEG	33.3	0.2	0.0	0.0	6.0	.0	39.3	187.3	3
CHILI	64.8	0.3	10.0	0.1	25.5	0.1	100.3	455.9	23
TOTAL	2349.6	12.0	567.9	3.6	577.5	8.2	4495.0	431.0	672

PRICES Urea = TK. 195.5 Potash = TK. 157.4 T.S.P. = 193.1

Table 6B

AGRICULTURAL INPUTS (Other)

Site 1 (1984 CARE ROADS)

CROPS	Cost of Chemical Fertilizer (Taka)	Cost of Irrigation (Taka)	Cost of Tilling (Taka)	Cost of Labor (Taka)	Cost of Seeds (Taka)	TOTAL COST (Taka)	COST PER ACRE (Taka)	SAMPLE SIZE (N=572)
AUS	307.4	58.5	899.3	538.7	283.7	2087.6	1265.2	94
AMAN	653.6	430.1	1865.3	1070.7	937.2	4957.0	1789.5	155
BORO	1307.5	1902.8	1542.3	1174.0	498.3	6424.9	4015.6	94
WHEAT	528.9	527.5	705.0	368.2	318.6	2448.2	2782.0	60
JUTE	240.4	167.2	1167.9	794.5	139.0	2509.0	2986.9	82
POTATO	342.4	88.0	1519.0	653.1	930.2	3532.7	6541.9	20
MASUR DAL	29.2	5.6	215.0	108.9	67.6	426.2	1217.8	18
MUNG DAL	0.0	0.0	150.0	75.0	40.0	265.0	490.7	1
OTHER DAL	106.8	0.0	142.8	141.3	143.6	534.4	971.6	8
MUSTARD	343.8	0.0	748.8	179.7	54.8	1327.1	1895.9	25
SESAME	0.0	0.0	280.0	475.0	65.0	820.0	836.7	2
FRUIT & VEG	72.5	415.0	275.0	208.8	93.5	1064.8	5915.3	4
CHILI	88.0	57.8	356.8	48.9	111.8	663.3	4737.6	9
TOTAL	4020.5	3652.4	9867.1	5836.7	3683.4	27060.1	2726.7	572

Site 2 (PROPOSED CARE ROADS)

CROPS	Cost of Chemical Fertilizer (Taka)	Cost of Irrigation (Taka)	Cost of Tilling (Taka)	Cost of Labor (Taka)	Cost of Seeds (Taka)	TOTAL COST (Taka)	COST PER ACRE (Taka)	SAMPLE SIZE (N=672)
AUS	564.7	3.4	1192.5	799.2	399.9	2959.8	1672.2	96
AMAN	556.3	153.2	1590.5	840.7	1336.2	4476.9	1834.8	154
BORO	1151.3	2090.5	1191.4	958.6	582.6	5974.5	3879.5	112
WHEAT	523.6	238.2	895.8	322.4	362.4	2342.5	2788.7	74
JUTE	356.5	53.9	693.4	1054.8	252.0	2410.6	2114.6	92
POTATO	506.7	156.8	669.4	338.8	693.9	2365.6	8761.6	34
MASUR DAL	103.6	0.0	749.2	214.8	80.5	1148.1	1688.4	25
MUNG DAL	0.0	0.0	254.0	100.0	40.6	394.6	443.4	5
OTHER DAL	17.3	3.8	253.1	210.0	80.7	565.0	649.4	13
MUSTARD	531.4	57.3	526.3	237.7	49.8	1402.5	1650.0	30
SESAME	44.0	0.0	837.3	290.9	218.8	1391.0	1738.7	11
FRUIT & VEG	39.3	350.0	342.0	93.3	71.7	896.3	4268.3	3
CHILI	100.3	492.6	135.2	126.5	110.9	965.5	4388.9	23
TOTAL	4495.0	3599.9	11608.5	5587.9	4280.0	27293.0	2759.9	672

Site 2:

Revenue per acre of cropped land

= TK. 3142.6

Total variable cost per acre of cropped land

= TK. 2183.4

Net producer surplus or value added = TK. 959.2

Net incremental producer surplus for Site 1

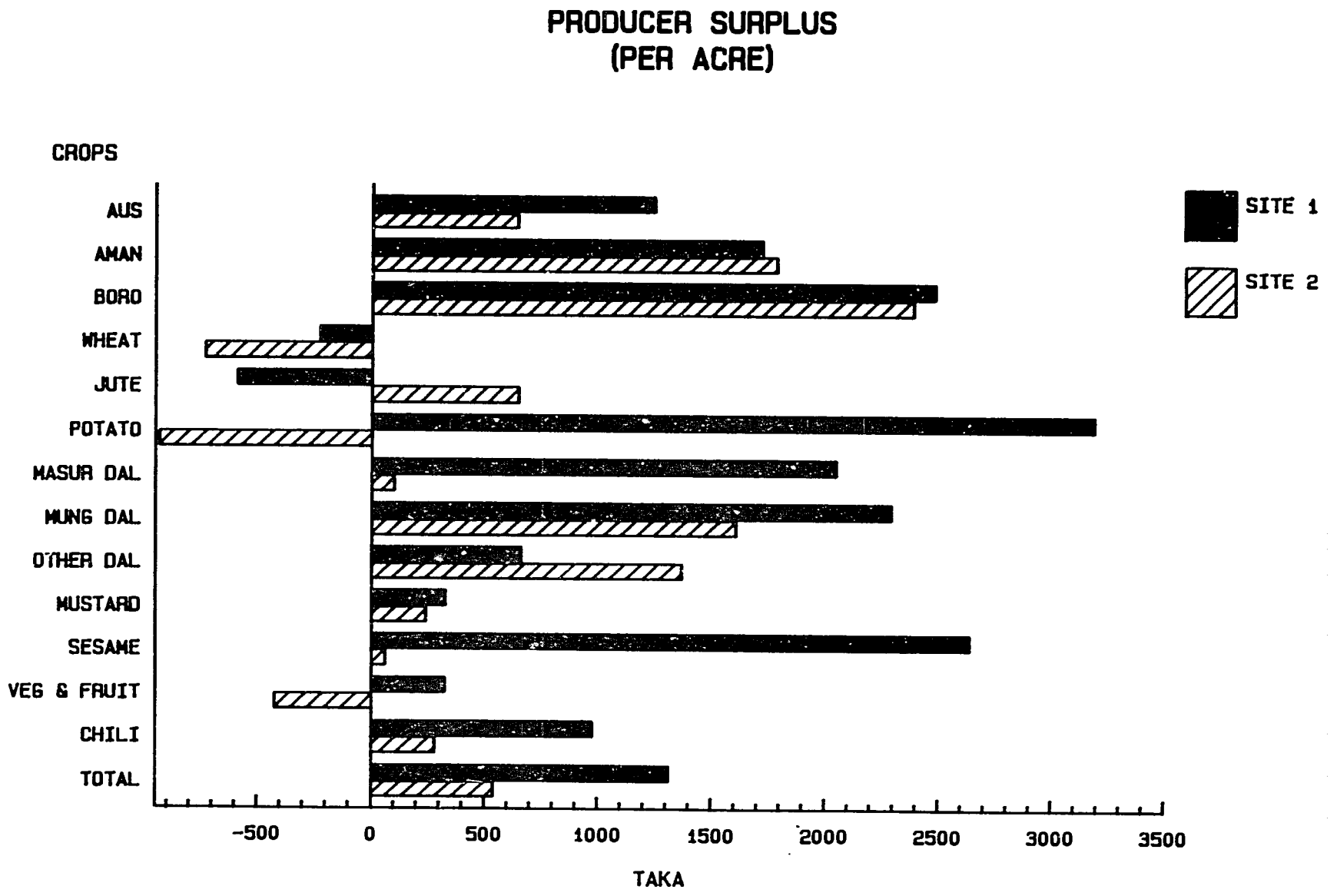
TK. 1464.6 - TK. 959.2 = TK. 505.4 per acre.

Figure 3 displays the net producer surplus per acre for each crop and for both sites. It should be noted, however, that the above amount represents the gains to farmers at Site 1 without taking into consideration fixed costs and other costs not included in our input package. The fixed costs may differ slightly because of differences in land values between the two areas and also land development costs involved in irrigation. Other input costs are unlikely to vary greatly between Site 1 and Site 2 roads.

As Figure 3 shows, Site 1 has a comparative advantage over Site 2 in potatoes, dals, oilseeds, vegetables, fruits and chili peppers, but only 33.9 percent of the land is devoted to these crops in Site 1 as compared to 38.2 percent in Site 2. For jute, Site 2 holds a comparative advantage over Site 1 and proportionately more land is devoted to it. Higher relative advantage in terms of value added in growing other crops at Site 1 may have prompted farmers at Site 1 to stop growing jute. For example, it is relatively more profitable to grow boro paddy than any of these other crops. It should be noted that prices are among the most important variables in agricultural production decisions but they are also guided to a great extent by crop rotation, inherent quality of land and accessibility to complementary inputs.

Considering 6.1 square miles or 3904 acres as the average area of influence for Site 1 roads, and assuming all acres are cultivated land, the total incremental benefit to the farmers within half a mile on each side of the 1984 CARE roads amounts to TK. 1,973,082 or about $60,000 per six-mile road. We stress however that these gains to farmers are computed using cross-sectional data and they do not take into account the cost of building the roads, the cost of maintaining them, the cost of providing various agricultural services for which the farmers did not have to pay, and the effect on consumption and distribution of benefits. Also, we have only considered transport savings that are passed on to the producers in the form of higher producer prices and lower input costs. But the transport sector is normally the initial recepient of the savings and will seek to retain at least a part of these benefits in the form of increased net profits. Since we have not estimated the gains to the transport sector, the net gain to the farmers should perhaps be adjusted upwards to include the net benefits to the transport sector due to the road.

Figure 3


PRODUCER SURPLUS
(PER ACRE)
CROPS
AUS
AMAN
BORO
WHEAT
JUTE
POTATO
MASUR DAL
MUNG DAL
OTHER DAL
MUSTARD
SESAME
VEG & FRUIT
CHILI
TOTAL
SITE 1
SITE 2
-500
0
500
1000
1500
2000
2500
3000
3500
TAKA

Land Values and Tenures. Value of land in unions crossed by the roads in our study, shown in Table 7, has gone up universally since 1983, as reported by more than 90 percent at all respondents in either site. However, the increase at Site 1 (28.5 percent) from 1983 to 1986 at the 1984 CARE roads appears to be greater than the corresponding increase at the proposed 1987 CARE roads. These data come from union statistics representing more than the area of influence in either site, and we are assuming that the value of land at Site 2 in 1983 was similar to that of Site 1. Therefore, we cannot conclude with a high degree of confidence that the reconstruction of roads has led to net increase in the value of land.

One of the negative impacts suggested by our earlier study concerned shifts in land distribution in favor of larger landholders. Our current data show continuing shifts in this direction, but do not show much difference between the project and comparison sites in 1986. The percentage of people owning less than one half acre of land has risen by 17.8 percent between 1983 and 1986 in the areas beside 1984 CARE roads, while the number of people owning more than five acres of land in the unions, through which the Site 1 roads passed, rose by 51.9 percent. Despite these increases, however, land distribution at Site 1 appears to be no different from Site 2 in 1986, suggesting that the shifts may be unrelated to the road reconstruction. When the farmers were asked if they had bought or sold any land in the last two years, 25.9 percent reported affirmatively in Site 1 against 22.7 percent in Site 2. By far the most common negative impact mentioned by the local villagers in informal discussions with the Abt field staff, and also cited by 44 percent of all respondents interviewed, was the loss of land near the road due to the FFW road construction activity itself.

Commercial Activity. Table 8 describes responses to questions concerning commercial activity. The percentage of new businesses (since 1983) among the businessmen we interviewed at Site 1 is 16.7 percent compared to 14.3 percent in three years preceding that. In Site 2 15.3 percent of the businesses were set up in the last three years. When asked if there was an increase in production or sales in the last three years, fewer respondents reported an increase at Site 1 in 1986 than in 1985 and at Site 2. However, in terms of business revenues, Site 1 is almost a fourth larger than the ones in Site 2 (TK. 20,715 and TK. 15,751 respectively).

All respondents were asked specific questions concerning increases in the number of rice and wheat mills, other mills, businesses, and bazars or hats (weekly or bi-weekly markets) in the last 3 years. The percentage of respondents who reported an increase in the number of rice and wheat mills within one half mile of the 1984 CARE roads was greater in 1986 than in 1983, and more than 15 percentage points greater than at the comparison sites in 1986. This subjective assessment is consistent with our objective road observations that show a clear increase in the number of rice mills at Site 1 attributable to the road reconstruction in 1984. There appears to be little change in the number of respondents who reported an increase in the number of hats or bazars and other businesses between 1983 and 1986 beside the 1984 CARE roads. However, once again much fewer persons reported an increase in the number of markets and other businesses near the proposed 1987 CARE roads. In 1986, respondents near the 1984 CARE roads were asked open-ended questions about the most important benefit derived from the improvement of the roads.

Table 7

Land Values and Tenure

		Site 1 (1984 CARE Rds) 1986	Site 1 (1984 CARE Rds) 1983	Site 2 (Prop. CARE Rds) 1986
Local Officials		(N = 24)	(N = 22)	(N = 24)
Reported value of land near the road, in thousand taka per 33 decimal bigha	$\bar{X}$	31.6	24.6	26.5
	Md.	29.8	20.5	20.0
	%△	28.5		
Reported percentage of households in the union owning less than one half acre of land	$\bar{X}$	15.2	12.9	14.0
	Md.	10.5	11.5	14.8
	%△	17.8		
Reported percentage of households in the union owning more than five acres of land	$\bar{X}$	4.1	2.7	4.6
	Md.	2.3	2.0	2.5
	%△	51.9		
Farmers		(N = 168)	(N = 120)	(N = 179)
Percentage who reported having bought or sold land in the past two years	%	25.9	NA	22.7
All Respondents		(N = 302)	(N = 246)	(N = 357)
Percentage who reported an increase over the past three years in the value of land near the road	%	95.4	93.1	91.0
Percentage who cited the loss of land near the road as an important bad effect of the road reconstruction	%	44.0	NA	NA
Percentage who definitely agreed that the road reconstruction led to an increase in the value of land near the road	%	88.9	NA	NA

$\bar{X}$ = mean Md. = median %△ = % change since 1983 NA = Not applicabl

Table 8

Commercial Activity

		Site 1 (1984 CARE Rds) 1986	Site 1 (1984 CARE Rds) 1983	Site 2 (Prop. CARE Rds) 1986
Businessmen		(N = 62)	(N = 41)	(N = 72)
Percentage whose business began in the past three years	%	16.7	14.3	15.3
Percentage who reported an increase over the past three years in production or sales	%	31.7	50.0	43.7
Total revenue per month (in Taka)	$\bar{X}$	20,715	NA	15,751
All Respondents		(N = 302)	(N = 246)	(N = 357)
Percentage who reported an increase over the past three years in the number of rice and wheat mills near the road	%	47.7	41.1	31.9
Percentage who reported an increase over the past three years in the number of other businesses near the road	%	64.9	65.4	51.0
Percentage who reported an increase over the past three years in the number of bazars or hats near the road	%	16.6	17.9	5.3
Percentage who cited increased commercial activity as an important good effect of the road reconstruction	%	18.5	NA	NA
Percentage who definitely agreed that the road reconstruction led to increased employment opportunities near the road	%	60.9	NA	NA

$\bar{X}$ = mean NA = Not applicable/Not asked

About a fourth (18.5 percent) cited increased commercial activities as an important good effect of the road reconstruction. Over 60 percent of the same people were fully convinced that the road reconstruction had led to increased long-term employment opportunities near the road. The average business employed 0.8 permanent and/or 1.1 temporary employees in Site 1 compared to 0.8 and 0.7 employees respectively in Site 2. These data lead us to concluded that the re has been an increase in commercial activity attributable to FFW road projects, but that this increase is evident only in the number of rice mills and wheat mills near the road.

B. Social Impacts

Communication. As in our earlier study, improved communication among villages near the road is cited by respondents as the most important good effect of the road reconstruction, and shows the strongest and most consistent indicators of change since 1983. In 1986, nearly nine out of every 10 respondents (88.4 percent) at Site 1 reported an increase in the quality of communication in the area over the past three years, compared with only half of the respondents at the same site in 1983 (before reconstruction), and at the comparison site in 1986 (see Table 9). More than 90 percent of the 302 respondents at Site 1 cited improved communication as an important good effect of the road reconstruction in 1984, and 85 percent definitely agreed that the road reconstruction led to an increase in the quality of communication among villages near the road. Also, teachers and health workers who were interviewed along Site 1 in 1986 were more likely to mention improved communication as a reason for increases in attendance at primary schools and the use of family planning services over the past three years than those teachers and health workers interviewed at the same site in 1983 or at the comparison sites in 1986. These differences, shown in Table 9, are more pronounced for school attendance (particularly for girls) than for family planning acceptance. Finally, as discussed in Section III and again shown in Table 9, we attribute the 67 percent increase at Site 1 since 1983 in the number of observed access roads feeding into the Site 1 roads to the Food for Work reconstruction activity performed in 1984. Combined with a general increase in observed traffic volume at Site 1 since 1983, these road observations offer further evidence of improved communications. Although increases in the quality of communication among villages near the Food for Work roads are nonquantifiable, this impact is easily apparent and is of major significance since it stimulates change in many other aspects of local socioeconomic conditions such as education and health.

Education. More than any other impact area, there was nearly unanimous agreement among respondents at Site 1 (92.7 percent definitely agreed) that the road reconstruction in 1984 led to increased attendance rates at local primary schools. Shown in Table 10, the data from the followup study pertaining to education fully supports the findings from our 1984 report that link Food for Work road projects to increased attendance at nearby primary schools. Average enrollments at primary schools located within one half mile of 1984 CARE roads increased 13 percent for boys and 11 percent for girls from 1983 to 1986, and these enrollments were 10 percent higher than the corresponding 1986 enrollments reported at the comparison sites. We can compute

Table 9

Communication

		Site 1 1986	Site 1 (1984 CARE Rds) 1983	Site 2 (Prop. CARE Rds) 1986
Teachers		(N = 32)	(N = 33)	(N = 38)
Percentage who cited improved communication as a reason for increased school attendance over the past three years	%(B)	18.8	6.1	5.3
	%(G)	25.0	6.1	2.6
Health Workers		(N = 26)	(N = 30)	(N = 36)
Percentage who cited improved communication as a reason for increased use of family planning services over the past three years	%	26.9	22.5	19.4
All Respondents		(N = 302)	(N = 246)	(N = 357)
Percentage who reported an increase over the past three years in the quality of communications among villages near the road	%	88.4	49.6	50.1
Percentage who cited improved communication as an important good effect of the road reconstruction	%	91.4	NA	NA
Percentage who definitely agreed that the road reconstruction led to increased quality of communications	%	84.8	NA	NA
Road Observations				
Number of access roads feeding feeding into the FFW road	$\bar{X}$	12.5	7.5	10.8
	%	66.7		

%(B) = Percentage for boys; %(G) = Percentage for girls. NA = Not applicable

Table 10

Education

		Site 1 (1984 CARE Rds) 1986	Site 1 (1984 CARE Rds) 1983	Site 2 (Prop. CARE Rds) 1986
Teachers		(N = 32)	(N = 33)	(N = 38)
Reported enrollment at time of interview	$\bar{X}$ (Boys)	184.5	163.1	167.1
	$\bar{X}$ (Girls)	129.8	116.7	120.8
Reported absenteeism in February (dry)	$\bar{X}$ (Boys)	24.9	20.1	23.5
	$\bar{X}$ (Girls)	27.6	18.1	27.9
Reported absenteeism in August (rainy)	$\bar{X}$ (Boys)	31.0	21.6	31.6
	$\bar{X}$ (Girls)	31.1	22.2	36.7
Reported percentage increase over the past three years in daily attendance rates	$\bar{X}$ (Boys)	20.4	12.1	21.4
	$\bar{X}$ (Girls)	25.0	13.4	20.7
Percentage who cited improved transportation or communication as a reason for increased school attendance	% (Boys)	18.8	6.1	5.3
	% (Girls)	17.0	6.1	2.6
All Respondents		(N = 302)	(N = 246)	(N = 357)
Percentage who reported an increase in primary school attendance over the past three years	% (Boys)	95.7	84.1	91.6
	% (Girls)	95.4	84.1	88.5
Percentage who definitely agreed that the road reconstruction led to increased attendance at local primary schools	%	92.7	NA	NA
Road Observations		(N = 16)	(N = 17)	(N = 19)
Number of primary schools within one half mile of the road	$\bar{X}$	7.9	4.6	7.0
	Md.	6.5	3.8	5.9
	%△	71.7		
Percentage of roads with a high school present	%	87.5	75.9	94.8

$\bar{X}$ = mean Md. = median %△ = % Change since 1983 NA = Not applicable

total primary school enrollment in the zone of influence for each road by adding male and female average enrollments and multiplying by the total number of primary schools located within one half mile of the road. For the 1984 CARE roads, total primary school enrollment in the area nearly doubled from an average of 1,287 children in 1983 to 2,483 in 1986. To estimate the proportion of this increase that was brought about by the reconstruction of the roads in 1984 under the Food for Work Program vs. the proportion that reflects general population increase in the area, we need to consider the total enrollments at the comparison sites which, for 1986, averaged 2,015 boys and girls. Assuming that Site 2 enrollments in 1983 were similar to those at Site 1 in 1983, we attribute about one-third of the increase in primary school enrollments at Site 1 from 1983 to 1986 to the road reconstruction in 1984, and two-thirds of the increase to demographic trends unrelated to FFW activity.

Daily absenteeism rates are unexpectedly higher at Site 1 in 1986 than they were in 1983 for both boys and girls and during both the dry months and rainy months. Since absenteeism rates at the Site 2 roads in 1986 are similar to those of Site 1 in 1986 rather than those of Site 1 in 1983, we do not attribute these increases to the road reconstruction. In fact, all other conditions being equal, there are some indications from the data in Table 10 that the improvements made to the Site 1 roads in 1984 may have had a slight positive impact (reduction) on female absenteeism during the rainy season. The percentage of girls who were reported absent in August of 1985 at Site 1 was more than five percentage points lower than the corresponding percentage at Site 2 (31.1 vs. 36.7 percent), whereas absenteeism rates for boys in August (1985) and for both boys and girls in February (1986) were virtually the same at Sites 1 and 2. Finally, although we observed more Site 1 roads with a high school present within one half mile of the road in 1986 than in 1983, we do not link this increase to the road improvements, since all but one of the comparison sites also had a high school nearby at the time of our visit in March and April of 1986. We obtained no information regarding high school enrollments.

Health. Data pertaining to the use of family planning and general health services by the respondents is shown in Table 11. The data support our earlier findings that Food for Work roads in Bangladesh increase access to local health services (through reduced travel time), but do not support our 1984 conclusion that the road reconstruction leads to increased use of family planning services. The reported percentage increase over the past three years in the use of family planning and other local health services was lower at the project sites in 1986 than at either the comparison sites in 1986 or the same project sites in 1983 before reconstruction. On the other hand, the percentage of all respondents who reported a decrease over the past three years in the time it takes to reach the nearest health clinic was much higher at the Site 2 roads in 1986 (54.3 percent) than it was at the same roads in 1983 (30.1 percent) or at the Site 2 roads in 1986 (22 percent). These patterns, taken together, suggest that the increased access to health services at the FFW project sites brought about by the road reconstruction, may actually decrease the use of local health clinics by increasing the use of larger clinics or hospitals located outside of the zone of influence of the Food for Work road. Since it takes less time to reach the nearest health clinic with improved roads, it also takes less time to reach the nearest hospital; hence,

Table 11

Health

		Site 1 (1984 CARE Rds) 1986	Site 1 (1984 CARE Rds) 1983	Site 2 (Prop. CARE Rds) 1986
Health Workers		(N = 26)	(N = 30)	(N = 36)
Reported percentage increase over the past three years in the use of family planning services	$\bar{X}$	23.1	34.1	26.4
	Md.	19.4	25.5	19.8
	%△	-32.3		
Percentage who cited improved transportation or communication as a reason for increased use of family planning services	%	11.5	16.1	13.9
Reported percentage increase over the past three years in the use of health services	$\bar{X}$	18.1	21.7	25.3
	Md.	12.5	19.3	15.3
	%△	-16.6		
Percentage who cited improved transportation or communication as a reason for increased use of health services	%	15.4	22.5	22.2
Farmers		(N = 168)	(N = 120)	(N = 179)
Reported number of visits by health or family planning workers in the last three months	$\bar{X}$	2.4	2.7	1.8
	Md.	2.2	2.5	1.5
	%△	-11.1		
Percentage who reported at least one visit by a health or family planning worker in the last three months	%	65.4	71.3	58.1
All Respondents		(N = 302)	(N = 246)	(N = 357)
Percentage who reported a decrease over the past three years in the time it takes to reach the nearest clinic	%	54.3	30.1	22.0
Percentage who definitely agreed that the road reconstruction has led to increased use of health services	%	49.0	NA	NA

$\bar{X}$ = mean Md. = median %△ = % change since 1983 NA = Not applicable

more villagers may be opting to go the extra distance to receive more extensive health services outside of the one half mile area on either side of the FFW road. This unexpected behavior change would be consistent with the data presented in Table 11, but can only be verified through more in-depth household interviews and visits to larger upazilla health facilities. Finally, health and family planning outreach to families living near Food for Work roads does not appear to be positively influenced by the road reconstruction. Although the percentage of respondents visited and the mean number of visits by health or family planning extension workers in the three months prior to the interview date were higher at Site 1 in 1986 than at Site 2, they were lower than the figures reported at the Site 1 roads before reconstruction. In general, however, it should be noted that health and family planning extension services in Bangladesh continue to reach far more rural households than agricultural extension services. Nearly two-thirds (65 percent) of the farmers interviewed at Site 1 in 1986 reported at least one visit by a health or family planning worker in the first quarter of 1986 compared with 28 percent who reported at least one visit by an agricultural extension agent over the same three month period (see Table 4).

Environment and Other Impacts. Table 12 presents miscellaneous data from the followup study pertaining to annual flooding near the study sites, robbery and theft in the area, and the use of the road by women. According to the respondents living near the 1984 CARE roads, there had been no decrease and perhaps a slight increase in annual flooding near the road from 1980 to 1983. Over the next three-year period, however, respondents at Site 1 roads reported a decrease in annual flooding near the road (from 1983 to 1986). Comparing these response percentages with those for the respondents at Site 2, we note that the decrease in flooding since 1983 appears to be a general trend unrelated to the road reconstruction activities in 1984. Only 43 percent of the respondents at Site 1 definitely agreed that the road reconstruction led to decreased flooding in the area since 1983. Fourteen percent of the respondents at Site 1 definitely agreed that the road reconstruction in 1984 led to increased robbery and theft in the area, while 46 percent definitely disagreed with the same statement.

In our 1984 report, we linked the road reconstruction under the Food for Work Program to an increase in the use of the road by local women. As shown in Table 12, a higher percentage of respondents at Site 1 in 1986 reported an increase over the past three years in the number of women using the road (88.1 percent) than the corresponding percentages at the same sites in 1983 (75.6 percent) or at the comparison sites in 1986 (81.8 percent). A high percentage of the Site 1 respondents (79.5 percent) linked the road reconstruction in 1984 to the increased use of the road by women since 1983. We counted the number of women using the Site 1 and Site 2 roads as part of the hourly traffic surveys conducted in the morning and evenings during our 1983 and 1986 site visits. Although the data suggest a 25 percent reduction in female pedestrian traffic at Site 1 from 1983 to 1986, in fact, this converts to a negligible 1.6 percent increase in the use of the road by local women after considering vehicular traffic and after using Site 3 data to adjust for seasonal effects (as discussed in Section IIIB). Since the road reconstruction is associated with a 15.7 percent increase in the use of the road by local men (including nonpedestrians), the percentage of road users who were female at Site 1 actually decreased from 22.8 percent to 18.7 percent vs.

Table 12

Environment and Other

		Site 1 (1984 CARE Rds) 1986	Site 1 (1984 CARE Rds) 1983	Site 2 (Prop. CARE Rds) 1986
All Respondents		(N = 302)	(N = 246)	(N = 357)
Percentage who reported an increase over the past three years in annual flooding near the road	%	7.6	35.6	18.5
Percentage who reported a decrease over the past three years in annual flooding near the road	%	41.7	21.1	35.9
Percentage who definitely agreed that the road reconstruction has led to decreased annual flooding near the road	%	43.4	NA	NA
Percentage who definitely disagreed that the road reconstruction led to increased robbery and theft near the road	%	46.0	NA	NA
Percentage who reported an increase over the past three years in the number of women using the road	%	88.1	75.6	81.8
Percentage who definitely agreed that the road reconstruction led to increased numbers of women using the road	%	79.5	NA	NA
Road Observations		(N = 16)	(N = 17)	(N = 19)
Number of female pedestrians observed per hour	$\bar{X}$	11.9	16.0	8.3
	Md.	11.2	15.3	8.1
	% $\triangle$	-25.6		
Percentage of pedestrians observed who were female	%	18.7	22.8	20.0

$\bar{X}$ = mean Md. = median % $\triangle$ = % change since 1983 NA = Not applicable

20 percent at Site 2. Therefore, we disagree with the local townspeople that the road reconstruction under Food for Work stimulated an increase in the use of the road by local women, but we note that the improved roads do appear to have stimulated an increase in the use of the road by local men.

C. Effectiveness

In this section, we examine variations in impact among the 1984 CARE roads (Site 1) to test the hypotheses listed in Section IB and validate the findings from the original study regarding key factors associated with positive development impact. We combined data from the personal interview questionnaire with data from the road observations before and after reconstruction to estimate the degree of positive development impact of each road project as follows:

> A score ranging from -28 to +28 was computed following procedures identical to those of the earlier study, using the responses to the 14 items in Section III of the questionnaire. This score reflected the extent to which socioeconomic gains or losses since 1983 were reported at a Site 1 (1984) road, but not at a corresponding Site 2 (proposed 1987) road. If, for example, commercial activity near a 1984 road reportedly increased since 1983, the development impact score for that road would be increased by two, one, or no points depending upon whether or not commercial activity at the comparison site in the same upazilla reportedly decreased, stayed the same, or increased since 1983 according to most respondents. A score of zero for a project site would indicate either that (a) similar changes were reported at the comparison site and no impacts were attributed to the road, or (b) offsetting socioeconomic gains and losses were attributed to the road. A second score ranging from 0 to 20 was computed using staff observations of changes in the socioeconomic environment within one half mile of the reconstructed road from 1983 to 1986. This score reflected the extent to which increases observed at the 1984 roads in the number of new businesses, primary schools, deep tubewells, bi-weekly markets, or health clinics since 1983 were not observed over the same period (1983 to 1986) within one half mile of the corresponding 1980 CARE road (Site 3 in the same upazilla). If, for example, three new rice mills were observed in the zone of influence surrounding a 1984 road, compared to only one new rice mill near the 1980 road in the same upazilla, the development impact score for that 1984 road would be increased by two points.* The subjective (interviewer) and objective (observation) scores were then combined (summed) to form a total estimated development impact score for each Site 1 road.

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*Actual computations adjusted for unequal road lengths within upazillas.

All of the 1984 FFW roads in our sample had positive development impact, using the scoring method described above. Scores ranged from 0.8 to 15.3 with a mean of 6.6 and a standard deviation of 4.5. While this method does not provide a basis for estimating the percentage of roads that had "high" or "low" development impact, it provides a meaningful ranking for analyzing project effectiveness. For purposes of analysis, however, we grouped the 17 Site 1 roads into low, moderate, or high impact categories as shown below:

Upazilla	Site 1 Impact Score	Impact Category
Daulatpur	15.3	High
Sarsha	12.1	High
Narsingi/Araihazar	12.1	High
Gopalpur	11.3	High
Begumganj	9.9	High
Nakla	9.0	High
Nandigram	8.2	Moderate
Brahmanpara	7.9	Moderate
Thakurgaon	5.0	Moderate
Satkhira	4.6	Moderate
Singra	4.1	Moderate
Bhaluka	3.1	Low
Ishwardi	2.8	Low
Dacope	2.8	Low
Khansama	2.7	Low
Matlab	2.0	Low
Pirgacha	0.8	Low
TOTAL N = 17	$\bar{X}$ = 6.6	Std. Dev. = 4.5

Since the Site 1 road in Pirgacha was never reconstructed and the 5,408 maunds of wheat allocated to the project were never used, the low estimated development impact score for this road is consistent with the study hypotheses.

Appurtenant structures. Tables 13A and 13B point to the importance of bridges and culverts in enhancing the positive development impact of rural road projects. As in our 1983 study, we counted the number of gaps on each road that were either unbridged or closed with bamboo bridges and adjusted for the total length of the road. In either categorical or continuous form, an inverse relationshp (r = -.23) appears between estimated positive development impact and the number of unbridged gaps observed per mile of FFW road. Our field teams also noted the extent to which each observed road was passable by cycle-rickshaw, and this variable correlates more strongly (r = .38) with estimated positive development impact. Two-thirds of the Site 1 roads that were passable less than halfway by rickshaw had low development impact scores, whereas nearly all (83 percent) of the Site 1 roads that were fully passable by rickshaw had moderate or high development impact scores.

Table 13

Importance of Appurtenant Structures

13A. Total Estimated Development Impact by Gaps Observed in Road
(Column percentages for Site 1 roads only)

	Number of Gaps Per Mile			
	Low (0)	Medium (<1)	High (>1)	N
TOTAL IMPACT	% (n)	% (n)	% (n)	
Low	17% (1)	50% (3)	40% (2)	6
Moderate	33% (2)	17% (1)	40% (2)	5
High	50% (3)	33% (2)	20% (1)	6
N (sites)	6	6	5	17

Kendall's Tau B = -.23 $p > .10$

13B. Total Estimated Development Impact by Passability of Road
(Column percentages for Site 1 roads only)

	Passability by Rickshaw			
	Completely Impassable	Passable Halfway	Completely Passable	N
TOTAL IMPACT	5 (n)	5 (n)	% (n)	
Low	66% (4)	20% (1)	17% (1)	6
Moderate	17% (1)	40% (2)	33% (2)	5
High	17% (1)	40% (2)	50% (3)	6
N (sites)	6	5	6	17

Kendall's Tau B = .38 $p < .05$

Local maintenance. The importance of FFW road maintenance by local unions is indicated in Table 14, which shows the relationship between total estimated development impact of a road and its overall surface condition (Table 14A) as well as its state of repair over the last 12 months (Table 14B). Roads with excellent or good surface conditions were far more likely to have high positive development impact scores than roads with fair or poor surface conditions ($r = .37$). Also, 50 percent of the 1984 roads that had been maintained within the last year had high positive development impact scores compared with 14 percent of roads that had not been maintained in the same period ($r = .39$). A related observation not shown in Table 14 is that those 1984 roads being maintained under the Women's Maintenance Program (in Araihazar, Nakla, Daulatpur, and Sarsha) were all found to have "high" positive development impact scores. This Canadian-sponsored program administered by CARE offers full-time employment to small numbers of destitute women per union throughout the country for minor road maintenance work. Each union selects the women and the roads to be included in the program and, unlike the Food for Work Program, payments are made directly to the women and are cash payments rather than food allotments. Early indications from this study and from pilot evaluations of the Women's Maintenance Program suggest that this activity is a successful and cost-beneficial (requiring an estimated $150 per mile of maintained road) strategy for improving the rural road system and stimulating local community development.

Since many of the effectiveness variables tend to be intercorrelated, we ran a multiple regression (with the variables in continuous or dichotomous rather than categorical form) to assist us in identifying the most useful predictors of positive development impact. The results, shown in Table 16, indicate that more than one-fourth (27 percent) of the variation in total impact scores among 1984 project sites can be explained by a single predictor variable -- whether or not the road was fully passable by rickshaw at the time of our visit ($F = 4.77$, $p < .05$). The predicted development impact score for a road fully passable by rickshaw was about 50 percent higher than the predicted score for a road only half passable by rickshaw ($Y = 9.2$ vs. $Y = 6.4$) and more than twice as high as the predicted score for a road that was passable less than halfway by rickshaw ($Y = 9.2$ vs. $Y = 3.7$). The significance of other predictor variables such as recent maintenance, unbridged gaps, surface conditions, wheat used per mile, and the presence of electricity or a bank within one half mile of the road, diminished below the 95 percent confidence level after removing the variance in the development impact accounted for by the passability of the road. The implication of this analysis, despite its methodological simplicity and small sample size, is that the positive development impact of FFW roads in Bangladesh is likely to be greatly enhanced by further emphasis on appurtenant structures and local maintenance activities.

Table 14

Importance of Local Maintenance

14A. Total Estimated Development Impact by Overall Road Surface Conditions (Column percentages for Site 1 roads only)

	Surface Rating			N
	Fair or Poor	Good	Excellent	
TOTAL IMPACT	% (n)	% (n)	% (n)	
Low	75% (3)	33% (2)	14% (1)	6
Moderate	25% (1)	17% (1)	43% (3)	5
High	0% (0)	50% (3)	43% (3)	6
N (sites)	4	6	7	17

Kendall's Tau B = .37 $p < .05$

14B. Total Estimated Development Impact by Recent Maintenance Performed (Column percentages for Site 1 roads only)

	Road Maintained in Last Year?		N
	No	Yes	
TOTAL IMPACT	% (n)	% (n)	
Low	43% (3)	30% (3)	6
Moderate	43% (3)	20% (2)	5
High	14% (1)	50% (5)	6
N (sites)	7	10	17

Kendall's Tau B = .39 $p < .05$

Table 15

CORRELATIONS AND STEPWISE MULTIPLE REGRESSION 09:13:35 06/30/86

FILE SITE.1 (CREATION DATE = 06/30/86) CARE ROADS RECONSTRUCTED IN 1984 (N=16)

	TDIMPACT	MAINTAIN	GAPS	PASSHALF	PASSFULL	SANDSOIL	SURFRATE	VEHICLES	ELECLINE	BANK	WHEAT
TDIMPACT	1.00000	0.38889	-0.22838	-0.02679	0.45581	-0.29681	0.37081	0.37126	0.12620	0.21043	0.25246
MAINTAIN	0.38889	1.00000	-0.48024	-0.31334	0.60000	-0.05653	0.29140	0.18971	0.03482	0.20000	0.44565
GAPS	-0.22838	-0.48024	1.00000	0.03310	-0.72838	0.06941	-0.52984	-0.39832	0.12125	0.09376	-0.03580
PASSHALF	-0.02679	-0.31334	0.03310	1.00000	-0.52223	0.04358	0.06917	-0.03086	0.16364	0.24371	0.18922
PASSFULL	0.45581	0.60000	-0.72838	-0.52223	1.00000	-0.14806	0.50332	0.53180	-0.03482	0.06667	-0.04114
SANDSOIL	-0.29681	-0.05653	0.06941	0.04358	-0.14806	1.00000	-0.11446	-0.12445	-0.42598	0.02961	0.41368
SURFRATE	0.37081	0.29140	-0.52984	0.06917	0.50332	-0.11446	1.00000	0.34725	0.09684	0.23842	0.13697
VEHICLES	0.37126	0.18971	-0.39832	-0.03086	0.53180	-0.12445	0.34725	1.00000	0.24524	0.45716	-0.14789
ELECLINE	0.12620	0.03482	0.12125	0.16364	-0.03482	-0.42598	0.09684	0.24524	1.00000	0.31334	-0.35205
BANK	0.21043	0.20000	0.09376	0.24371	0.06667	0.02961	0.23842	0.45716	0.31334	1.00000	0.26007
WHEAT	0.25246	0.44565	-0.03580	0.18922	-0.04114	0.41368	0.13697	-0.14789	-0.35205	0.26007	1.00000

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CORRELATIONS AND STEPWISE MULTIPLE REGRESSION 09:13:35 06/30/86 PAGE 6

FILE SITE.1 (CREATION DATE = 06/30/86) CARE ROADS RECONSTRUCTED IN 1984 (N=16)

* M U L T I P L E   R E G R E S S I O N * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. TDIMPACT TOTAL ESTIMATED DEVELOPMENT IMPACT

VARIABLE(S) ENTERED ON STEP NUMBER 1.. PASSHALF ROAD IS HALF PASSABLE BY RICKSHAW
PASSFULL ROAD IS FULLY PASSABLE BY RICKSHAW

MULTIPLE R	0.51877	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	
R SQUARE	0.26912	REGRESSION	2.	81.12414	40.56207	2.39344
ADJUSTED R SQUARE	0.15668	RESIDUAL	13.	220.31331	16.94718	
STANDARD ERROR	4.11669					

---------------- VARIABLES IN THE EQUATION -----------------

VARIABLE	B	BETA	STD ERROR B	F
PASSHALF	2.720000	0.29046	2.60363	1.091
PASSFULL	5.446666	0.60750	2.49278	4.774
(CONSTANT)	3.720000			

------------ VARIABLES NOT IN THE EQUATION --

VARIABLE	BETA IN	PARTIAL	TOLERANCE	
MAINTAIN	0.18032	0.16874	0.64000	0.352
GAPS	-0.67352	-0.43411	0.30363	2.787
SANDSOIL	-0.22480	-0.25984	0.97651	0.869
SURFRATE	0.07554	0.06816	0.59509	0.056
ELECLINE	0.10294	0.11858	0.96970	0.171
BANK	0.11154	0.12300	0.88889	0.184
WHEAT	0.23185	0.26566	0.95962	0.911

F-LEVEL OR TOLERANCE-LEVEL INSUFFICIENT FOR FURTHER COMPUTATION

V. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

Using longitudinal and cross-sectional data from personal interviews, roadside observations, and union statistics, this study found significant evidence to indicate the following positive development impacts of AID/CARE/BDG Food for Work road projects in Bangladesh:

- Improved maintenance of roads by local unions, with priority given to maintaining roads recently reconstructed under the Food for Work Program;

- Improved communications among villages near the road and between these villages and upazilla headquarters;

- Reduced travel times and transport costs to and from the local market through improved road conditions and increased proximity to bazars, hats, and rickshaw transportation;

- Increased primary school attendance, for both males and females, through improved communication and transportation;

- Increased access to health services, through reduced travel time and increased proximity to local clinics;

- Increased commercial activity, including establishment of new rice mills and markets, and increased monthly business revenues; and

- Improved irrigation, through increased numbers of power pumps, shallow tubewells, and (to a lesser degree) deep tubewells near the road.

Viewed several different ways, the data consistently link the above changes since 1983 to the FFW-supported road reconstruction.

Some evidence was also found to support a potentially negative impact of road reconstruction:

- Decreased use of local health and family planning services, perhaps reflecting increased use of more distant but more comprehensive upazilla health facilities through reduced travel times.

Although attempts were made to draw conclusions on impact related to land value, farm revenue, annual flooding, and shifts in land distribution, the linkages to FFW roads were not clearly established by the methods used in this study.

No evidence, or only marginal evidence, was found to support other hypothesized impacts, including changes in crop mix, use of fertilizer and better seeds, agricultural extension and family planning outreach, primary school absenteeism, road use by women, and robbery and theft near the road.

The following factors were found to be strong predictors of overall development impact, as estimated by a combination of two scoring methods incorporating data from personal interviews with road observations before and after reconstruction under the Food for Work Program:

- Suitability for cycle rickshaws. Roads that were fully passable by rickshaw had estimated total impact scores that were twice as high as those for roads that were not passable by rickshaw;

- Local maintenance. Higher estimated total impact scores were associated with roads that had been maintained within the last year using local funds or under the Women's Maintenance Program; and

- Surface condition. Roads with good or excellent surface ratings had greater estimated development impact than roads with fair or poor surface ratings.

Other factors found to be moderate predictors of overall development impact were:

- Appurtenant structures. Roads with many concrete bridges and culverts had greater estimated development impact than roads with many bamboo bridges and unbridged gaps;

- Soil type. Roads with high percentages of doash soil and low percentages of sandy soil tended to have higher estimates of overall development impact;

- Electrification. Roads with electric lines and/or a bank observed within one half mile tended to have greater estimated development impact; and

- Wheat allocation. Higher estimated total impact scores tended to associate with higher allocations of wheat per mile of road as payment to laborers during the FFW reconstruction activity.

Since many of the predictors of development impact identified above are inter-correlated, only one variable emerged from a stepwise multiple regression analysis as a key predictor of positive development impact: whether or not the road was fully passable by rickshaw two years after its reconstruction under the Food for Work Program. Other factors, such as local maintenance, surface condition, soil type, and the number of unbridged gaps per mile were highly associated with the suitability of the road for cycle rickshaws.

In comparing the above findings and conclusions with those of our 1984 report, the reader will discover a high degree of consistency. The most noteworthy differences are the indications from the follow-up study of increased local maintenance and higher producer surpluses brought about by the Food for Work road reconstruction, and decreased use of union health and family planning services (perhaps due to increased use of upazilla health facilities). Although the most significant predictor of overall development impact in the followup study (whether or not the road is fully passable by rickshaw) was not the same as the most significant predictor from the earlier study (whether or not the road had been recently maintained), the two predictors are highly intercorrelated ($r = .60$) and lead to similar conclusions regarding the critical importance of appurtenant structures and local maintenance for Food for Work roads.

B. Recommendations

For the most part, this study served to validate the findings from our earlier investigation; therefore, the recommendations contained in our 1984 report still stand. Based upon our 1986 field observations and findings, however, we wish to restate our first two recommendations as follows.

1. **Continue to support and expand the AID/CARE/BDG Appurtenant Structures Project,** adding more concrete bridges, culverts, and sluice gates to recently reconstructed Food for Work roads. Since our initial visits to the 18 study upazillas in 1983, USAID and CARE have allocated a proportionately greater share of manpower and funds to the construction of larger (AID) and smaller (CARE) bridges and culverts on CARE-built roads. In our follow-up visits to the 17 Site 1 (1984 FFW) roads and 18 Site 3 (1980 FFW) roads, we observed a total of 103 fewer unbridged gaps, 19 new concrete bridges and 44 new concrete culverts, equating to one new structure per year per six-mile road. This dramatic improvement is largely attributed by upazilla and union officials to the AID/CARE/BDG Appurtenant Structures Project, and the difference was not only observed but also experienced by our field teams who were able to travel the roads with much less difficulty than in 1983. Nevertheless, the local officials we interviewed request proportionately more support for bridges and culverts in 1987 and 1988, and our 1986 observations still show an average of one unbridged gap (including bamboo bridges and unfilled cuts for drainage) per mile for the 1984 CARE roads compared with two per mile for the proposed 1987 roads. The CARE road that we identified in our 1984 report (see page 53) as most deserving of a major new bridge, described in Volume II of this report as Thakurgaon Site 3, remains unbridged and most in need of a major structure among the 53 roads we visited. In many instances during our 1986 field activities, we observed new CARE roads being built parallel to or criss-crossing other little-used CARE roads. Briefly stated in 1986, we observed "too many roads with too few bridges and too little maintenance" in our 18 study upazillas. Therefore, we recommend continued expansion of the Appurtenant Structures Project, particularly in light of its important contribution to the overall development impact of Food for Work roads.

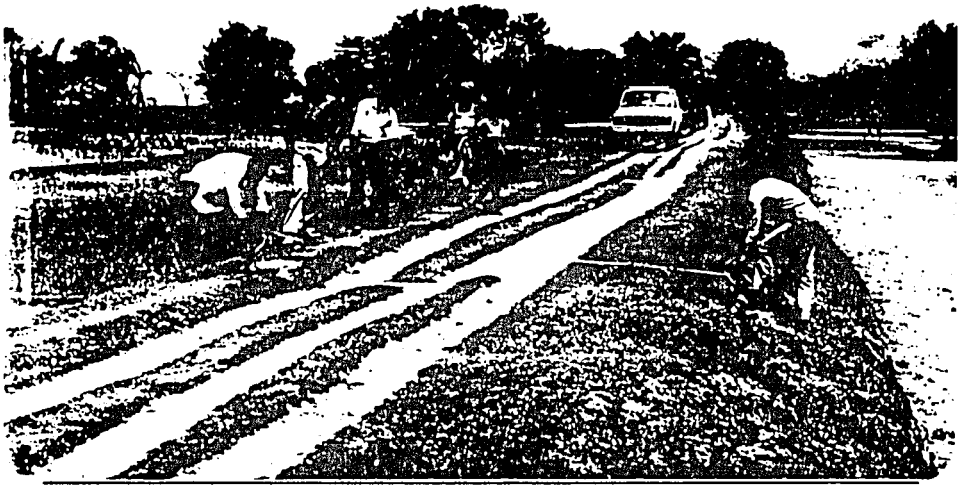
2. **Continue to support and expand the Women's Maintenance Program.** Although our study was not designed to evaluate this nationwide road maintenance program employing destitute women (recently renamed the Rural Maintenance Program), we attribute much of the improved condition of the 1980 CARE roads

and some of the improvement in the 1984 CARE roads to this overlapping program. We observed women at work under the WMP, performing routine road maintenance, during many of our field visits in March and April. Previously, we recommended targetting FFW projects to unions with adequate maintenance funds or where agreement for local maintenance can be obtained in advance. The proliferation of the Women's Maintenance Program to all unions in 1985, together with our new finding that FFW road reconstruction stimulates a commitment to local maintenance, eliminates the need to target projects to unions that can afford to maintain them.

While major repairs requiring contracted labor were needed on many of the reconstructed roads in our study, by far the most common form of road damage observed was surface damage caused by bullock carts, rats, or soil erosion. The surface levelling required to repair this damage can be readily accomplished at low cost and with social benefit to the community under the Women's Maintenance Program. In its current form, the WMP is administered in such a way as to prevent any misappropriation of funds, and the program appears to be highly successful, meeting multiple needs of the community, and fully deserving of continued and expanded support.

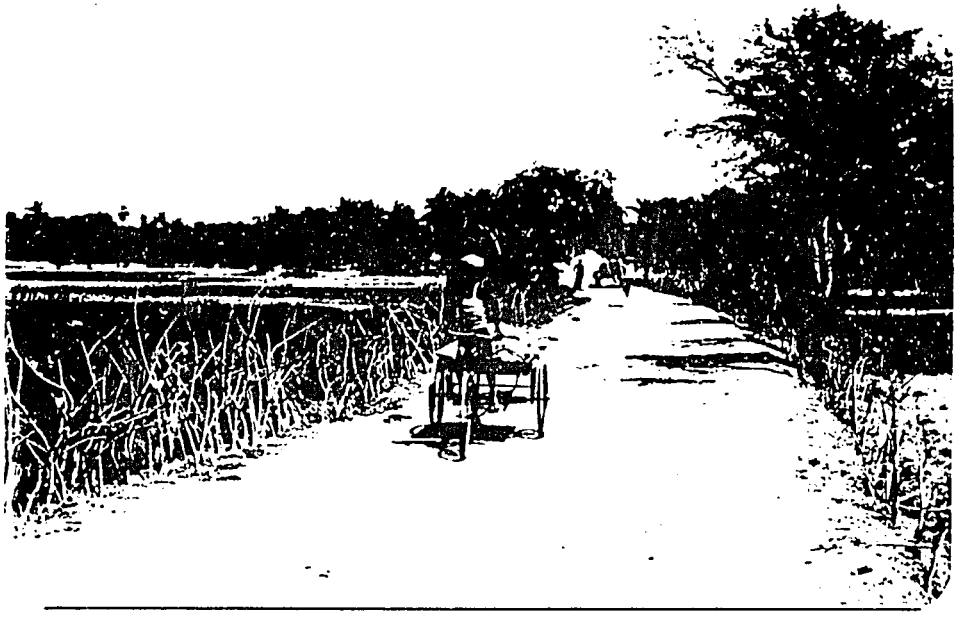
APPENDIX A: PHOTOGRAPHS

BRAHMANPARA UPAZILLA. Boatmen ferry one vehicle at a time across this river linking Brahmanpara Upazilla to Comilla.

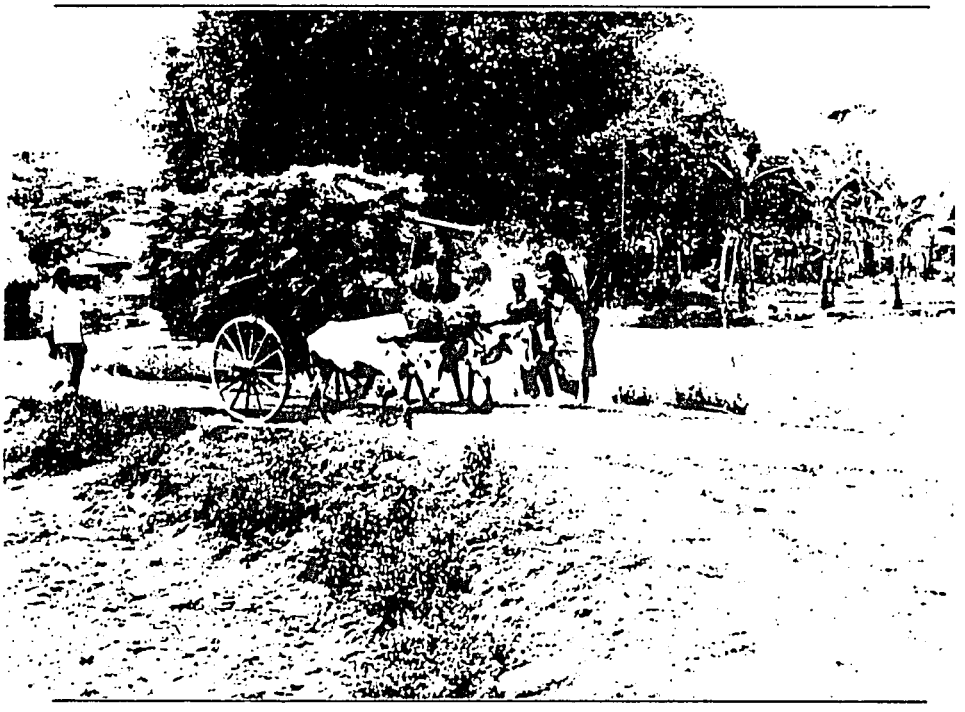


KHANSAMA Site 3. Abt field staff measuring the top width of this Food for Work road constructed in 1982.

DACOPE Site 1. Despite its excellent surface condition, very little traffic was observed along this road cum embankment reconstructed by CARE in 1984.



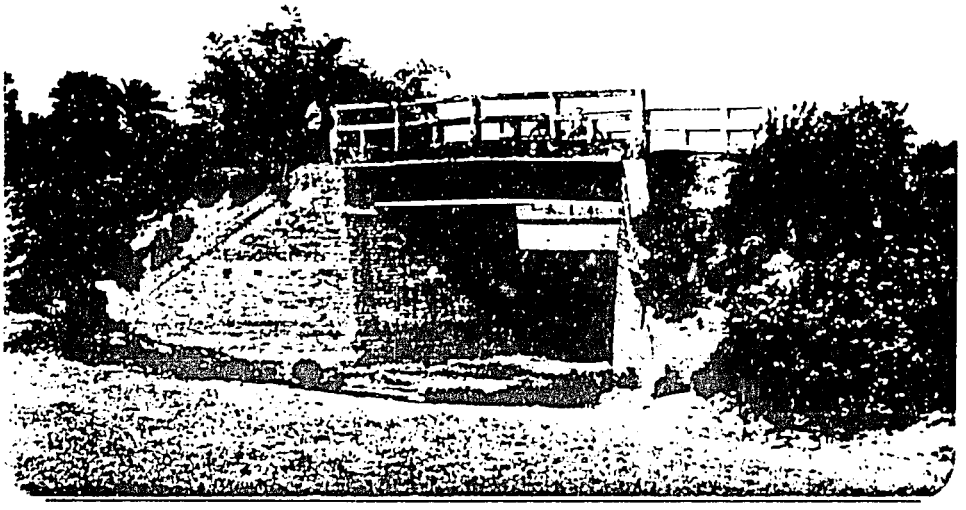
SARSHA Site 1. A flat-bed rickshaw transports sacks of fertilizer along a road reconstructed under the Food for Work Program in 1984.



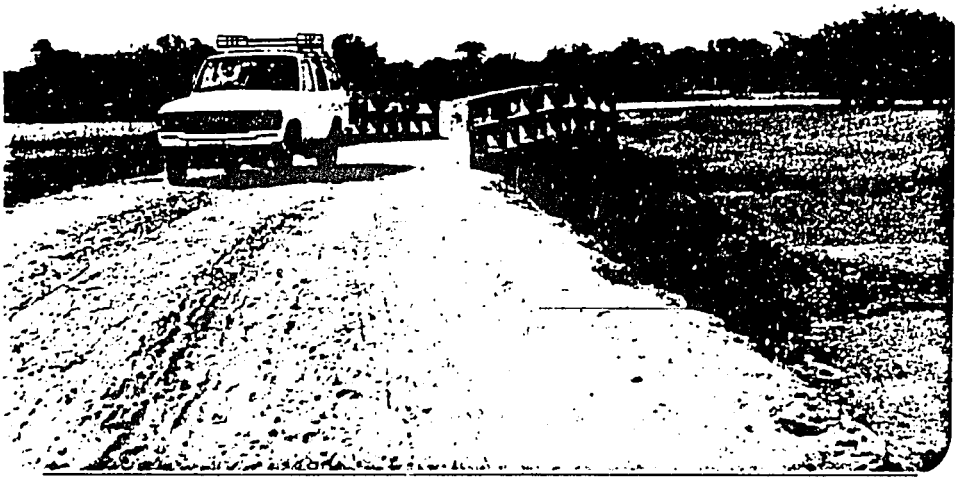
THAKURGAON Site 1. A bullock cart is used to transport wheat along a Food for Work road reconstructed by CARE in 1984.

DACOPE Site 1. Children at one of two new primary schools observed since 1983 along a road reconstructed by CARE in 1984.

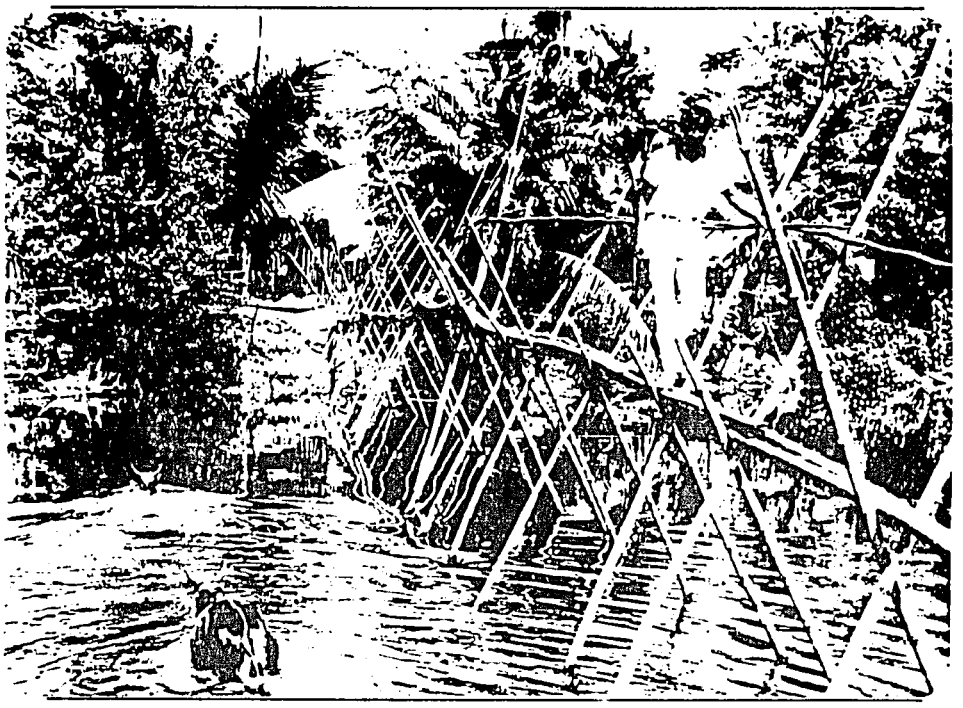
SARSHA Site 2. Thrashing wheat, Bangladesh's principal winter crop, along a road proposed for reconstruction under the Food for Work Project in 1987.



ISHWARDI Site 3. This 24 foot bridge constructed in 1983 remains in excellent condition and stands ready for the monsoon season.

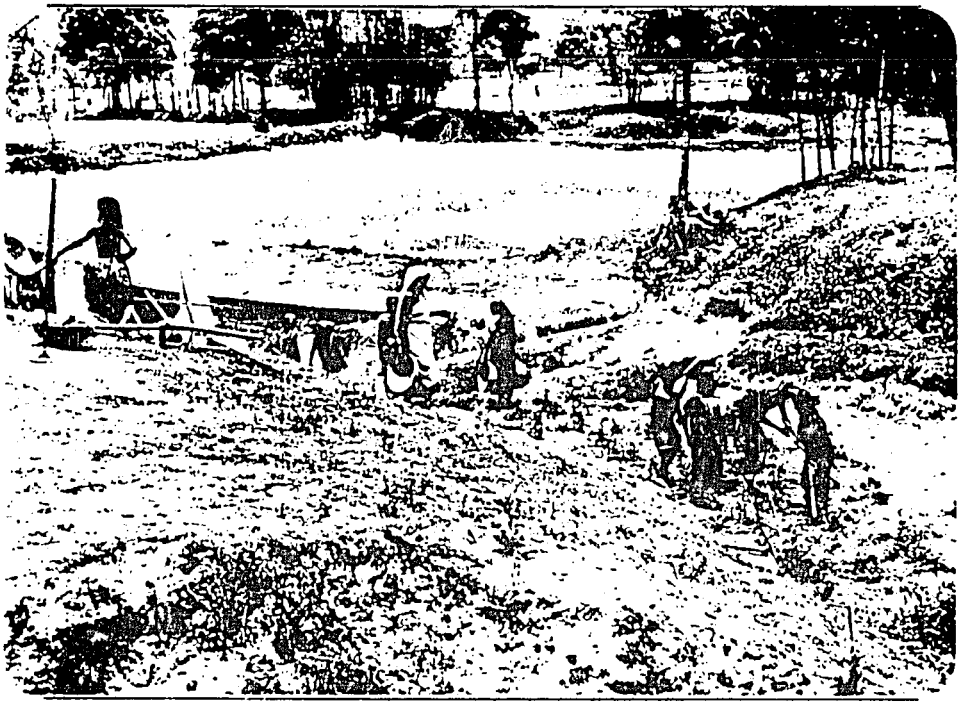


ISHWARDI Site 3. The approaches to this 40 foot USAID-funded bridge had been recently repaired along this 1980 CARE road.

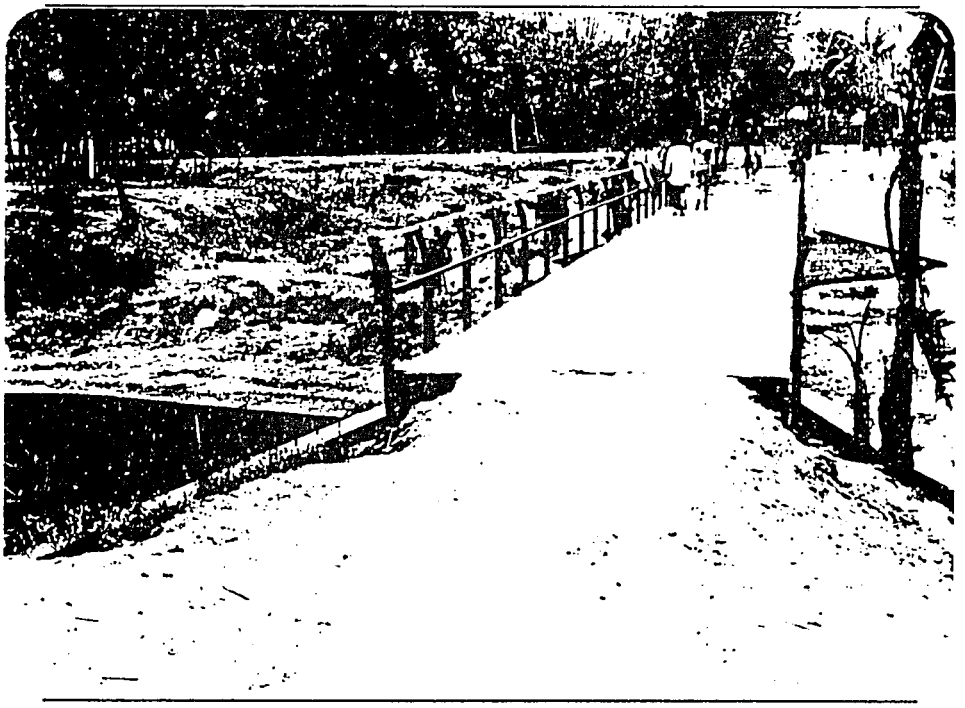


DACOPE Site 2. One of many bamboo bridges found along roads proposed for reconstruction under the Food for Work Program in 1987.

DACOPE Site 1. This cut for drainage should be closed with a sluice gate that allows runoff in one direction during the rainy months.



KHANSAMA Site 3. Women at work under the recently expanded Women's Maintenance Program along a 1982 CARE road.



KHANSAMA Site 3. This bridge, shown in disrepair in our 1984 report, is now fully passable after its approaches were replaced in 1986 as part of the Women's Maintenance Program.

BRAHMANPARA Site 3. Surface damage caused by rats was observed on 30 of the 53 roads included in this study.

APPENDIX B: SURVEY FORMS

ABT ASSOCIATES INC. ROAD CHARACTERISTICS BANGLADESH

Thana No. ____ Name _____ Site No. 1 2 3 Segment No. 1 2 FFW End Date _____ Maunds Alloc _____

SRO No. ____ Name _____ Date _____ Road Type 1 2 Road Length (mi) _____ Maunds Used _____

1. Is the segment completely passable by rickshaw from FFW beginning to ending point?

   Yes ____ No ____

2. Road Quarter 1 3 2 4

   a) Height (top) ____ ____ (ft.)

   b) Width (top) ____ ____ (ft.)

   c) Width (bottom) ____ ____ (ft.)

   d) Surface (rating) ____ ____ (E,G F,P)

3. Is there evidence of recent maintenance performed?

   Yes ____ No ____

   If yes, complete 10a on back.

4. Is there evidence of major repairs needed?

   Yes ____ No ____

   If yes, complete 10b. on back.

5. Number of bridged gaps No.

   a) Culvert (up to 10') ____
   b) Concrete bridge ____
   c) Wooden bridge ____
   d) Bamboo bridge ____
   e) Other (specify) ____

6. Number of unabridged gaps No.

   a) Shallow cut, filled in ____
   b) Shallow cut, not filled in ____
   c) Deep cut, filled in ____
   d) Deep cut, not filled in ____
   e) Under water, shallow ____
   f) Under water, deep ____

7. Is there evidence of road damage caused by: (✓)

   a) Cuts for drainage? ____
   b) Soil erosion? ____
   c) Bullock carts? ____
   d) Rodents? ____

8. Within one-half mile of either side of the road, record the number of: No.

   a) Deep tubewells ____
   b) Hats ____
   c) Primary schools ____
   d) Rice mills ____
   e) Other mills ____
   f) Access roads ____
   g) Other (specify) ____

   _____

   _____

9. Within one-half mile of either side of road, record the presence of: (✓)

   a) Union council office ____
   b) Bank ____
   c) Bazar ____
   d) Post office ____
   e) Health clinic ____
   f) High school ____
   g) Bus stop ____
   h) Railway station ____
   i) Launch ghat ____
   j) Fertilizer shop ____
   k) Electric line ____
   l) Jute or paddy drying on road ____
   n) Other (specify) ____

   _____

   _____

ABT ASSOCIATES INC. ROAD USAGE FORM BANGLADESH

Thana No. Thana Name Site No. 1 2 3 Segment 1 2 Union
RO No. RO Name Road Name Village

	Date Direction Market Day: Yes No			Date Direction Market Day: Yes No		
TRAFFIC TYPE	FIRST COUNT to AM PM	No. 1	No. P	SECOND COUNT to AM PM	No. 1	No. P
Truck/Bus						
Car/Jeep						
Baby Taxi						
Cycle-rickshaw						
Motorcycle						
Bicycle						
Cart						
Pedestrian (M)						
Pedestrian (F)						

1 = not transporting food/produce

P = transporting food/produce

Abt Associates Inc.
Follow-up Study of AID/CARE
Food For Work Roads

QUESTIONNAIRE A: UNION PARISHAD*

Upazilla _____ Site Number _____

Union _____ Village _____

Name of Interviewer _____

Date of Interview _____

Place of Interview

Own residence	1
In the village	2
In the market	3
In the field	4
Other (specify)	5

Time Interview began: _____

Time Interview ended: _____

Introduction

Hello, my name is _____

I would like to talk with you today. I am not a government employee and I am not an employee of CARE. I work for an independent American research firm called Abt Associates Inc. (show letter). They have sent me here to learn about some characteristics of village life near (proposed) Food For Work road projects. I would like to talk with you individually and would like you to answer my questions about the _____ road or the area near that road. What I learn from you may help improve the benefits of future road building projects under the Food For Work program. Even before we start, I want to thank you for helping us.

*NOTE: English translation from Bangla questionnaire. Includes modules for Health Worker(B), Teacher(C), Businessman(D), and Farmer(E) in Section !.

5. Who are involved in project selection? (Circle all that apply.)

Chairman	1
Union Parishad Member	2
PIO	3
Other (specify)	4

6. Who was/will be involved in the technical design of this project? (Probe for upazilla technical assistance.)

_____

_____

7. How was/will the construction of this road supervised? (Probe for number of visits and specific work.)

_____

_____

8. Other than wheat, what contributions are made to this project and by whom? (Probe for contributions by CARE, upazilla, union.)

Contributor	Inputs
_____	_____
_____	_____

9. What is your main occupation?

_____ Code

		1983	1985	Unit
(f)	Bazars or Hats	____	____	Number
(g)	Primary Schools	____	____	Number
(h)	Other Schools	____	____	Number
(i)	Deep Tubewells	____	____	Number
(j)	Power Pumps	____	____	Number
(k)	% of households with electricity	____	____	Percent
(l)	% of population who are literate	____	____	Percent
(m)	Price of land per bigha near the road	____	____	Taka

SECTION 1 (Project and Control Sites)

What is your position at this school?

Head Master	1
Assistant Head Master	2
Teacher	3

2. How long have you held this position or title?

Less than 1 year	1
1 to 3 years	2
3 to 5 years	3
More than 5 years	4

3. How large is this school in terms of:

(a) Number of classes _____

(b) Total number of boys _____

(c) Total number of girls _____

(d) Number of villages served _____

4. During this February, about what percentage of boys were absent on a typical day?

(a) Boys _____%

(b) What percentage of girls _____%

5. During last August, about what percentage of boys have been absent on a typical day?

(a) Boys _____%

(b) What percentage of girls _____%

6.(a) Since 1983, has there been a change in the attendance rate for boys in this school?

Yes	1
No	2
Don't Know	7

6.(b) (If yes) About how much change?

Increased	_____%
Decreased	_____%

6.(c) (If yes) What do you think caused this change? (Probe: Anything else?)

_____

_____

7.(a) Since 1983, has there been a change in the attendance rate for girls in this school?

- Yes
- No
- Don't Know

7.(b) (If yes) About how much change?

Increased _____%

Decreased _____%

7.(c) (If yes) What do you think caused this change? (Probe: Anything else?)

_____

_____

SECTION 1 (Project and Control Sites)

1. What is your position or title?

Shopkeeper	1
Factory or mill owner	2
Business manager but not owner	3
Other _____	

2. How long have you owned or managed this business?

Less than . year	1
1 to 3 years	2
3 to 5 years	3
More than 5 years	4

3.(a) What is your business' principal product?

Product _____

3.(b) What is the unit of measure for that product?

Unit	
Maund	1
Seer	2
Others (specify) _____	3

4. How large is your business in terms of the

(a) Amount of product produced per month? _____

(b) Amount of product sold per month? _____

(c) Number of permanent or full time employees? _____

(d) Number of casual or part time employees? _____

5.(a) During your peak production or sales month last year, how many (unit) of (product) did you produce, process, or sell?

_____Code

5.(b) Is this more or less than your peak month in 1983?

More	
Same	2
Less	3

5.(c) (If more or less) What are the reasons for this change?

_____

Any other reason? _____

6. Does your business use diesel power or electricity?

Neither	0
Diesel Power	1
Electricity	2

SECTION 1 (Project and Control sites)

1. How many bighas of land do you own? _____Bigha

2.(a) How many bighas of land do you

		Now	1983	Unit
(a)	Cultivate yourself	_____	_____	Bigha
(b)	Share crop out	_____	_____	Bigha
(c)	Share crop in	_____	_____	Bigha
(d)	Rent out	_____	_____	Bigha
(e)	Rent	_____	_____	Bigha
(f)	Fallow/use for homestead	_____	_____	Bigha

2.(b) How many decimals makes a bigha in your area? _____ decimals.

3. I would like to ask you some questions concerning the crops that you cultivated since February (Bengali month) 1985.

3.(a) What crops did you grow since February last year?

Aus	_____
Aman	_____
Boro	_____
Wheat	_____
Jute	_____
Potato	_____
Dal (Masur)	_____
Dal (Mug)	_____
Dal (Other)	_____
Mustard Seed	_____
Sesame Seed	_____
Sugar Cane	_____
Fruits & Vegetables	_____
Chili	_____

Others (Specify on Supplemental Crop Form)

3.(b) How many bighas of land were used to grow each of those crops?

Aus _____

Aman _____

Boro _____

Wheat _____

Jute _____

Potato _____

Dal (Masur) _____

Dal (Mug) _____

Dal (Other) _____

Mustard Seed _____

Sesame Seed _____

Sugar Cane _____

Fruits & Vegetables _____

Chili _____

Others (Specify on Supplemental Crop Form)

3.(c) How many maunds of each crop did you produce last season?

Aus _____

Aman _____

Boro _____

Wheat _____

Jute _____

Potato _____

Dal (Masur) _____

Dal (Mug) _____

Dal (Other) _____

Mustard Seed _____

Sesame Seed _____

Sugar Cane _____

Fruits & Vegetables _____

Chili _____

Others (Specify on Supplemental Crop Form)

3.(d) How many maunds of each crop did you sell last season?

Aus _____

Aman _____

Boro _____

Wheat _____

Jute _____

Potato _____

Dal (Masur) _____

Dal (Mug) _____

Dal (Other) _____

Mustard Seed _____

Sesame Seed _____

Sugar Cane _____

Fruits & Vegetables _____

Chili _____

Others (Specify on Supplemental Crop Form) _____

3.(e) What was the selling price in taka per maund for each of the crops?

Aus _____

Aman _____

Boro _____

Wheat _____

Jute _____

Potato _____

Dal (Masur) _____

Dal (Mug) _____

Dal (Other) _____

Mustard Seed _____

Sesame Seed _____

Sugar Cane _____

Fruits & Vegetables _____

Chili _____

Others (Specify on Supplemental Crop Form) _____

4. In order to produce each of the crops mentioned earlier, how much of the following inputs were used and what were their corresponding prices?

Type of Crop

		Quantity Used		Price (in Taka)
(a)	Urea	_____	in mds.	_____
(b)	Potash	_____	in mds.	_____
(c)	T.S.P.	_____	in mds.	_____
(d)	Manure	_____	in mds.	_____
(e)	Seeds	_____	in seers	_____
(f)	Pesticides	_____	in bottles/seers	_____
(g)	Water and Irrigation	_____		_____
(h)	Cost of preparing land (other than labor)			_____
(i)	Cost of labor (all labor)			_____

5. What percentage of the following does the tenant share now and in 1983?

		Now	1983
(a)	Output	%	%
(b)	Seed	%	%
(c)	Fertilizer	%	%
(d)	Cost of Irrigation	%	%
(e)	Pesticides	%	%
(f)	Others (Specify)	%	%

6.(a) Do you sell some of your own crops at the local market?

Yes	1
No	2

6.(b) (If yes) What is the cost of transportation to and from the local market now and in 1983?

	Now	1983
Per maund Taka	_____	_____

7.(a) What was the price of jute in 1985 in the local market?

Per maund _____Taka

7.(b) What was the price of jute in 1983?

Per maund _____Taka

8. How many times in the last three months have you been visited by an agricultural extension agent?

_____Code

9. How many times in the last three months have you or members of your family been visited by a health or family planning worker?

_____Code

10.(a) How much does a bigha of land cost here now?

_____

10.(b) How much did a bigha of land cost here in 1983?

_____

10.(c) Have you sold or purchased any land since 1983?

Yes, Purchased	1
Yes, Sold	2
No	3

10.(d) (If yes) How many bighas of land did you purchase or sell?

SECTION II: (Project and Control Sites)

1.(a) Since this time last year, in other words in the last 12 months, would you say that the condition of the _____ road has deteriorated slightly or not at all, moderately, or severely?

Slightly or not at all	1
Moderately	2
Severely	3
Don't Know	7

1.(b) (If severely) In what way?

_____

2. _____

2.(a) As far as you know, has there been any repair or maintenance work performed on the road since this time last year?

Yes	1
No	2
Don't Know	7

2.(b) (If yes) What repair or maintenance work was done?

1. _____

2. _____

3.(a) In your opinion, is major repair or maintenance work needed on the road?

Yes	1
No	2
Don't Know	7

3.(b) (If yes) What kind of repair or maintenance work is needed?

1. _____

2. _____

SECTION III: (Project and Control Sites)

Now I am going to read a list of characteristics of village life near the _____ road that may or may not have changed in the last few years. For each characteristic I read, please tell me whether you think there has been an increase, decrease, or no change in that characteristic since 1983. If you are not sure or don't know, just tell me so. That is a good answer, too. First of all, how about the value of land near the road. Would you say it has increased, decreased, or stayed pretty much the same since 1983?

		Increased Since 1983	Stayed the Same	Decreased Since 1983	Uncertain or Dont' Know
a)	The value of land near the road?	1	2	3	7
b)	The number of rickshaws using the road?	1	2	3	7
c)	The time it takes to get from here to the local market?	1	2	3	7
d)	The time it takes to get from here to the nearest health clinic?	1	2	3	7
e)	The number of bazars or hats near the road?	1	2	3	7
f)	The number of rice and wheat mills near the road?	1	2	3	7
g)	The number of other mills and businesses near the road?	1	2	3	7
h)	Attendance at primary school by boys?	1	2	3	7
i)	Attendance at primary school by girls?	1	2	3	7
j)	Agricultural production near the road?	1	2	3	7
k)	Annual fishing near the road?	1	2	3	7
l)	Annual flooding near the road?	1	2	3	7
m)	The number of women using the road?	1	2	3	7
n)	The quality of communication between villages here?	1	2	3	7

SECTION IV: (Project Sites Only)

1.(a) What do you think is the most important good effect of the improvements made in the road in 1984 on the people who live near the road?

_____

_____

1.(b) What do you think is the next most important good effect of changes in the road?

_____

_____

2.(a) What do you think is the most important bad effect of the improvements made in the road in 1984 on the people who live near the road?

_____

_____

2.(b) What do you think is the next most important bad effect of the changes in the road?

_____

_____

3. Overall, would you say that the changes and construction work done on the road in 1984 have had all good effects, mostly good effects, no effects, mostly bad effects, or all bad effects on the people who live near the road?

All good effects	1
Mostly good effects	2
No effects	3
Mostly bad effects	4
All bad effects	5
Don't Know	7

4. Now I am going to read you some statements about the _____ road and about the changes made to the road in 1984 under the Food For Work Program. For each statement I read, please tell me whether you would definitely agree, tend to agree, tend to disagree, or definitely disagree with that statement. If you are not sure or don't know, just tell me that you don't know. That is a good answer also. The first statement is _____.

	The improvement of the road . . .	Definitely Agree	Tend to Agree	Tend to Disagree	Definitely Disagree	Dont Know
a)	Has led to increased agricultural production near the road?	1	2	3	4	7
b)	Has increased the communication among villages near the road?	1	2	3	4	7
c)	Has led to increased robbery and theft near the road?	1	2	3	4	7
d)	Has decreased the time it takes to get to the nearest market?	1	2	3	4	7
e)	Did not allow for proper drainage and irrigation	1	2	3	4	7
f)	Has led to an increase in the value of land near the road?	1	2	3	4	7
g)	Has led to more frequent visits by upazilla officials to this area?	1	2	3	4	7
h)	Has led to decrease in the amount of flooding near the road?	1	2	3	4	7
i)	Has led to increased attendance rates at local primary schools?	1	2	3	4	7
j)	Has mostly benefited the large landholders and mills owners?	1	2	3	4	7
k)	Has had fewer benefits each year because of poor maintenance?	1	2	3	4	7
l)	Has led to increased use of the road for drying jute and paddy?	1	2	3	4	7
m)	Has led to increased use of health services by local villagers?	1	2	3	4	7
n)	Has led to increased use of the road by local women?	1	2	3	4	7
o)	Has led to increased use of fertilizer and better seeds by local farmers?	1	2	3	4	7
p)	Has led to decreased agricultural production near the road?	1	2	3	4	7
q)	Has led to increased long-term employment opportunities near the road?	1	2	3	4	7

SECTION V: (Project and Control Sites)

1. What is your age?

10 - 19 years	1
20 - 29 years	2
30 - 39 years	3
40 - 49 years	4
50 - 59 years	5
60 years or more	6

2. What is your religion?

Muslim	1
Hindu	2
Buddhist	3
Christian	4

3. Are you married?

Yes	1
No	2

4.(a) What is the highest level of education that you have completed? _____Code

4.(b) (If none) Can you read and write Bangali?

Yes	1
No	2

Record time interview ended _____

Rate the respondent's cooperativeness:

Very good	1
Good	2
Fair	3
Not good	4

Rate the respondent's reliability:

Very good	1
Good	2
Fair	3
Doubtful	4

THANK RESPONDENT FOR HIS COOPERATION