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DEVELOPMENT IMPACT OF THE FOOD-FOR-WORK PROGRAM IN BANGLADESH

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PREFACE

The Food-for-Work (FFW) Program in Bangladesh has grown steadily in importance since 1974-75. It has drawn up to 25 percent of food imports in some years and at its current magnitude has the annual capacity to provide more than 100 million days of employment, which translates to at least 17 days of additional employment for every landless worker in Bangladesh in the construction phase alone. A program of this size inevitably must receive a great deal of scrutiny, and in a country with scarce development resources questions are justifiably generated on its effectiveness in meeting both immediate welfare and long-run growth objectives.

This in-depth study has attempted to address questions of both the program's short-run effectiveness and longer run contributions when it is geared to the construction and maintenance of the rural economic infrastructure. The first part of the study, which was completed in 1984, addressed the issues at the construction phase of the program. These included effectiveness in providing the lowest income households with incremental income and employment; management practices that influence target group benefits as well as physical productivity of the schemes; appropriateness and quality of design and implementation of projects; and effects on agricultural productivity during and immediately following these projects. This earlier report concluded that the Food-for-Work Program is successful in distributing at least 70 percent of the foodgrains utilized to target beneficiaries, namely, low-income families in rural areas. It was found that this amount could be increased substantially, if adequate provision is made for the range of project-related costs that have to be incurred before earthwork can begin. Also, some technical and management problems were identified, with possible solutions to improve the effectiveness of completed projects.

This report presents results of the second and final part of this study. The first report dealt with the problems of initiation, appropriateness, design, implementation and maintenance of the FFW projects and suggested measures to overcome these deficiencies. Complementary to the first report, this study focuses on the question that if the projects were well designed, implemented and maintained, what would be the major developmental consequences of the projects? This report documents the nature of direct and indirect benefits that flow from the completed projects as well as the distribution of these benefits within the population. Both the development of rural

infrastructure for facilitating growth of economic activities in rural areas and management of water resources are required for raising agricultural productivity. Construction and maintenance of irrigation and drainage canals, field channels, flood-protection and coastal embankments, roads and bridges are usually expected to be consistent with both relief objectives of the food-for-work programs and developmental objectives.

The consequences for agricultural production and productivity, savings, investment and consumption patterns that can generate multiplier effects; employment and income growth in sectors of the rural economy; and finally, food consumption and nutritional status of various segments of the population, are analyzed in-depth. The results of this analysis underline the favorable long-term potential of well-designed and maintained rural infrastructure projects of the type examined in this report. The results also identify situations where additional investment of resources may be required in order for favourable production and distributional consequences to be realized.

However, the results of the research also underline the importance of a better understanding of the range of the problems in conception, location, design, implementation and maintenance of projects under the Food-for-Work Program in realizing the potential identified from the projects evaluated in this study. This will provide the basis for determining the long-term potential for making such projects feasible within the resources available to Bangladesh.

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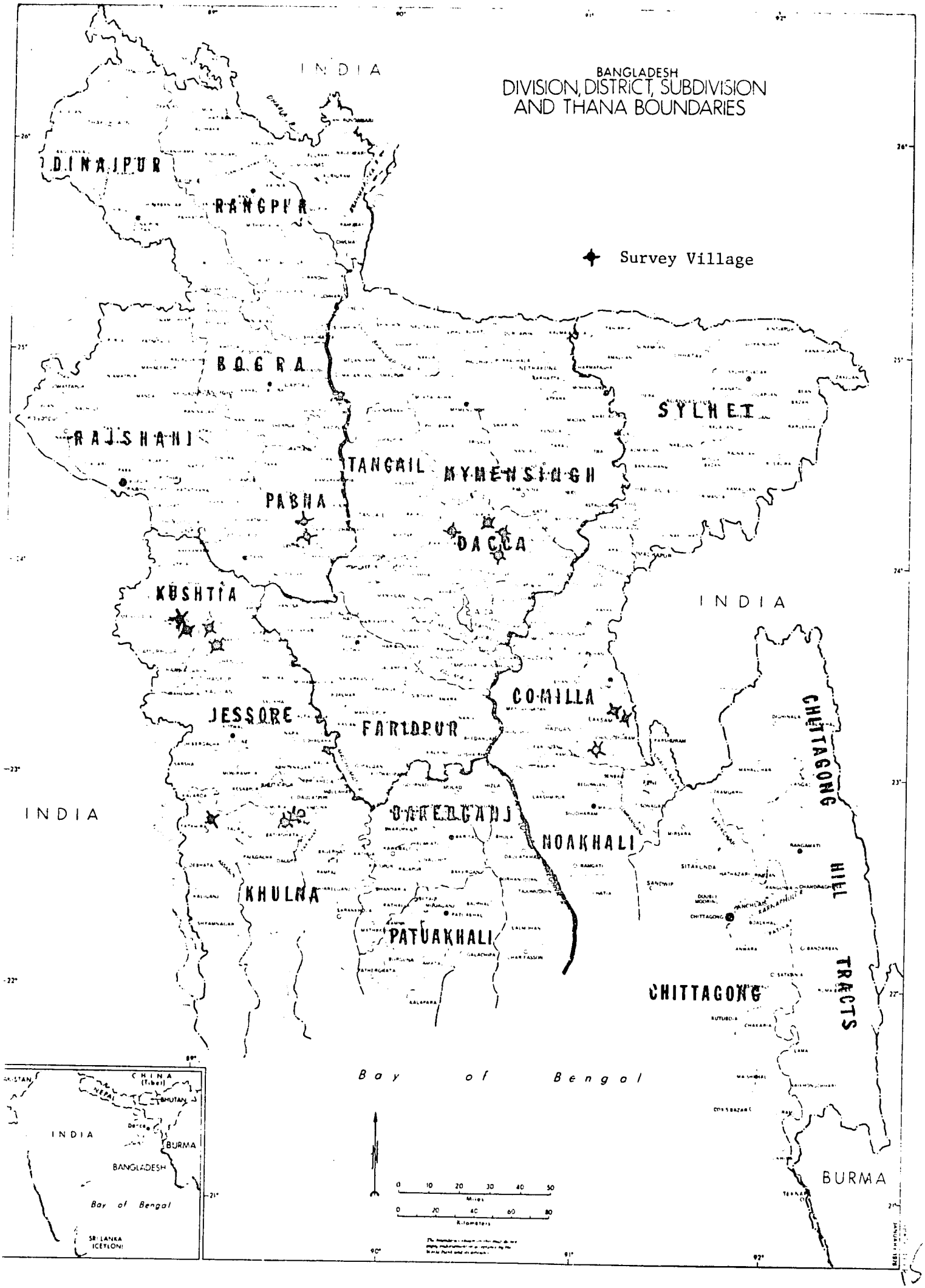
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PATUAKHALI
CHITTAGONG
Bay of Bengal
BURMA
CHINA
(Tibet)
NEPAL
BHUTAN
INDIA
BURMA
BANGLADESH
Bay of Bengal
SRI LANKA
(CEYLON)
Miles
Kilometers

I. INTRODUCTION

Background

Bangladesh has a poor, developing economy in which agriculture is the primary source of income and employment, providing about 47 percent of the gross domestic product and employing 61 percent of the total labor force. Services (trade, transport etc.) are the second most important sector, with about one-fourth of GDP and one-sixth of the total employment in the economy. Manufacturing is small, accounting for a little less than a tenth of GDP and a still smaller share of employment. The characteristics of resource endowment, demographic features, and utilization of resources in Bangladesh have created some of the worst problems of widespread underemployment, poverty, and malnutrition among developing nations. A development strategy for such a delicate economy with such severe low-income and underemployment problems must focus on programs that increase employment and enhance productivity of labor.

Increase in employment and improvement of labor productivity through technological change and capital accumulation in agriculture are vital requirements for raising incomes of rural people. Positive effect of rural infrastructure in capital formation, diffusion of agricultural technology, reduction of costs of marketing between agriculture and nonagricultural sectors, expansion and integration of markets and the resulting specialization in the use of resources, and generation of output and employment renders infrastructural development central in economic development. The role of infrastructures in acceleration of economic growth is particularly strategic when the thrust of a development strategy rests heavily on private sectors in a mixed-economy framework.

Capital construction in the rural economy through mobilization of labor is an important instrument for improving labor productivity and employment. Development of rural roads, marketplaces, irrigation and drainage channels, embankments, and small dams through public initiative was tested by the Comilla Rural Development Academy, and the results indicated that such programs could be both productive and provide assistance for the poor. Thereafter, between 1963 and 1968, expenditure on the program averaged about 8 percent of the public sector's annual development program. Since 1975, food for work (payment of in-kind wages to workers) has become a large part of the rural public works program in Bangladesh (Table A1.1). In recent years it has had the capacity to provide over 17 days of additional employment annually for every landless worker in the country.

Aspects of this program have been evaluated by a number of researchers and institutions. However, none of the previous evaluation studies known to us has been comprehensive enough to cover the effects of the public works program on both production and welfare. This report on the development impact of the Food-for-Work (FFW) Program is the second part of a comprehensive study financed by donors under the auspices of the World Food Program and the Government of Bangladesh.[1] The first part of the study, covering the short-run consumption, employment, and income effects of Bangladesh's FFW Program, its management and technical problems, has already been completed and submitted.

Objectives

The objective of this part of the impact study is to examine and measure the direct and indirect effects of projects between two and three years after completion. The projects evaluated were designed to improve infrastructures that would increase agricultural productivity, such as irrigation and drainage canals, flood protection embankments and coastal embankments. The effects of these land infrastructures were assessed in relation to their interaction with general infrastructures (such as roads, markets, and socioeconomic institutions).[2] Within this general objective, the effects of the projects on agricultural production and income, employment, rural capital formation, and consumption and nutrition were evaluated.

Specifically, the principal objectives of this study are to:

a) measure the direct long-term (2-3 years) impact of the land infrastructures created by the Food-for-Work projects on agricultural production, employment, food consumption and nutrition;

b) measure the extent of indirect impact of the project on rural capital formation under different levels of infrastructure development; and

c) provide a descriptive picture of the process of linkages among different economic activities under varying conditions of infrastructural development.

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[1]This volume includes all technical papers; the summary of these papers was submitted earlier as a separate report to the WFP and the Government of Bangladesh.

[2]For a rigorous definition of general infrastructure, see Chapter 4.

The direct effects of the projects are visible in the localities in terms of higher agricultural production achieved through: a) horizontal expansion of area under crops, depending on the type of project, b) higher cropping intensity, and c) higher crop yields. There is also the possibility of introduction of high-value crops in the project area if the agronomic conditions are favorable.

Again, the increase in crop production and higher cropping intensity may result in more employment in agriculture and non-agriculture (trades, construction, and services). The higher agricultural production and employment will result in higher income to the rural households living in and around the project locations. If the project areas are closely connected with the market centers, the increased production and household income is likely to promote trade and stabilize prices to a greater extent than in less accessible areas. The higher income to poor households in the project area is expected to create increased demand for goods and services for better nutrition and human development. Such newly generated demands will have multiplier effects toward sustained development of the region, depending on the type of goods demanded and their income elasticities of demand and supply response.

Further, projects in infrastructurally developed areas can be better served with modern agricultural inputs at lower prices compared to those in isolated locations. Institutional supports in the form of extension services, provision of credit and repairs of agricultural equipment are also expected to be higher in these developed areas because of easy accessibility by government officials. Rural people from those areas have easy contact with the agencies responsible for supplies and services and can influence their distribution. These inter-area differences between developed and under developed localities may not be pronounced equally for all groups of rural households. The rich and large land owners may benefit more than the poor and landless families because of the variations in resource endowments and ability to respond to market forces.

The brief outline described above indicates the mechanisms by which project areas are expected to be better off compared to their pre-project status or areas without projects. The extent to which these changes actually occurred and how much the project areas, both with and without infrastructures, were relatively better off is examined in this report.

Methodology, Study Design and Definitions

For a correct assessment of the impact of an investment on a project, the ideal approach is the one in which it is possible to net out the project impact from the effects that would have resulted over time without the project. There are autonomous forces which are expected

to generate changes even if the project were not in place. By comparing the benchmark situation with the after-project results, which is the usual approach of project evaluation, it is not possible to correctly measure the project effect. If it is possible to identify a reasonably precise control village and get benchmark information on both the project and control villages at the beginning of a project, and if, after the project reached the production stage, a simultaneous survey on project and control villages is conducted, then it is possible to correctly measure the net impact of the investment made on a project, provided adjustment for dissimilar exogenous factors between control and project, if any, is made. But such an ideal approach is empirically impossible in most cases. Under the FFW program, projects are selected within a short period of time which makes it difficult to select suitable controls and collect benchmark information on the project and control areas for evaluation research. At the time the study was undertaken no benchmark information was available for any of the projects implemented under the FFW program.

So, the design of the present study had to incorporate a comparison of the "project village" with a comparable "control village" in order to measure the net effect of a project on the project village. In view of the weaknesses of the approach--that in reality it is difficult to find a control area similar to the project area in all respects--the method of comparison of mean values was further complemented by application of regression analysis. Using regression analysis, we measured the effects of factors which are not related to projects and then adjusted the project impact for dissimilar endowment of explanatory factors between project and control villages.

This approach is considered as good as, if not superior to, the comparison of benchmark with after-project situations even if benchmark data were available.

Another characteristic of the study-design involved measuring the benefit at the margin that was related specifically to the project. Most of the Food-for-Work projects are part of larger water-development projects under the Bangladesh Water Development Board (BWDB). If particular care was not taken in designing the study, the project effect could incorrectly include the effect of BWDB projects as well. For example, the effect of the field channel project in the G.K. project area includes the effect of earlier investment made by the BWDB on pumps and primary and secondary distribution canals. The early investment was the sunk cost. If the marginal investment on field channels had not been made under the FFW program the project area would not have benefitted at all from the previous investment.

We did not adopt a benefit-cost approach of analysis; the need for such an approach was minimized somewhat by the fact that benefits were measured at the margin. If any interest however arises in looking at the benefit-cost picture of the FFW projects we evaluated, a quick estimate of project costs implicit in foodgrain used and administrative costs involved in project implementation can easily be

made for comparison with project benefits. The primary concern of the study was to measure the long-run developmental impact of FFW programs. This was necessary to mitigate the prevailing general impression that such projects had no production impact, not to speak of a rate of return comparable to other options.

In this study, after selection of a project village, a control village was selected that matched it as closely as possible in terms of ecology, cropping pattern, distance from important centers for agricultural development and general economic activities, such as markets and towns. To capture the effect of the general infrastructure at the same time, four villages were selected for each type of project. These were: project villages with developed general infrastructure[3] and with under-developed general infrastrucutre, and control villages with developed and under-developed infrastructure. This selection was based on a field survey to ensure that the project and control villages were similar in their ecology, cropping patterns, farm structures, and integration with the outside economy.

Five types of FFW projects affecting agriculture and its development were included in our analysis. These were:

1) dual-purpose canals, to be used for irrigation in the dry season and for drainage in the wet season;

2) field channels for irrigation in an area with large surface water irrigation;

3) coastal embankments against intrusion of saline water;

4) river embankments for protection of crops against normal flooding which can occur during middle or late rainy season; and

5) river embankments for protection against flash flooding which occur in early monsoons.

A purposive selection of projects was undertaken in order to select only the better designed and implemented projects, since the badly designed and implemented projects are expected to have no impact, and the in-depth investigation attempted in this study would have meant a wastage of time and resources if those projects were selected. The engineering survey conducted for the first phase of the study showed that about one-third of the projects are well-designed and implemented. The following steps were taken in selecting projects:

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[3]The level of general infrastructure at the village level was determined by access to: markets and towns, financial institutions, networks for supply of modern agricultural inputs, communication and transport facilities.

1) A list of all projects implemented between 1975/76 and 1979/80 was prepared from quarterly progress reports of the World Food Program in Dhaka.

2) Thirty-four Upazilas were selected from this list on the basis of the concentration of projects in the Upazila and geographic location.[4]

3) One field investigator visited each Upazila to investigate the completed projects. On this basis, a list of the better implemented projects in the Upazilas was prepared. These represent the top 30 percent of all projects implemented under the FFW Program.

4) After examining the information collected by the field investigators, a list of 14 Upazilas was prepared. Research fellows from the Bangladesh Institute of Development Studies and the International Food Policy Research Institute visited these sites. Finally, 16 villages representing the nine project and seven control villages were selected for the study.[5] (Table 1.1)

Table 1.1--Selected Villages by Type of Project

Type of Project	Project Village	Control Village
Field Channels	1)Bandabeel, Kushtia 2)Harishpur, Jessore	1)Roakoli, Kushtia 2)Gobrapara, Jessore
Dual Purpose	3)Charkhamair, Dhaka 4)Sayedpur, Dhaka	3)Rajarampur, Dhaka 4)Gobindapur, Dhaka
Coastal Embankment	5)Khejurdanga, Khulna 6)Birhat, Khulna	5)Taliamara, Khulna
River Embankments		
a) Flood protection	7)Patgari, Pabna	6)Rawtora, Pabna
b) Flash flood protection	8)Illashpur, Comilla 9)Khunta, Comilla	7)Chashapara, Comilla

Source: Survey.

[4] An Upazila is a newly organized administrative unit in place of an older unit called Thana which consists of about 150 villages on the average.

[5] A suitable control for coastal embankment could not be found.

Sampling of Households. After selection of all project and control sites, a household census was conducted in those villages to collect information on landholdings and occupational structure of all households. This made it possible to use a stratified sampling procedure to select a representative sample of households from the population. The households were classified into eight groups based on the size of landholding (four groups) and occupation of the head of the household (two groups). A proportionate random sample was drawn from each stratum so as to have 40 households from each village. A total of 640 households covering 16 villages were selected in this way.

Data Collection. Data were collected through structured interviews throughout the calendar year of 1982. Six different sets of questionnaires were administered at different times during the survey period. In the beginning, Questionnaire I was administered to collect detailed statistics on assets and liabilities of all sample households. Questionnaire II, on costs and returns in crop production activity, was administered three times in the year following three crop seasons: Aus, the summer season; Aman, the autumn; and Boro, the winter season. Questionnaire III was completed eight times during the year to collect information on weekly expenditures on food and non-food necessities, as well as employment of family workers and wage earnings. Evaluation of seasonal fluctuations in consumption expenditures, wage rates, and employment was the primary objective of this survey. Expenditure on items such as clothing, household durables, education, health, housing, and acquisition of fixed assets were collected quarterly by administering Questionnaire IV. Questionnaire V, an individual food-consumption survey, together with anthropometric measurements of household members, was conducted covering half the households selected for the study. A description of this subsample is given in Chapter 5. These measurements were made three times during the year. Finally, a special community-level survey (Questionnaire VI) was undertaken to provide an explicit basis for scaling the degree of general infrastructural development. In this survey, the access of study villages to physical (roads, transport facilities), institutional (markets, cooperatives, banks) and social (schools, colleges, hospitals, etc.) infrastructures was measured.

Brief Description of the Project Sites

As has already been mentioned, four major agricultural projects were covered in this survey. The locations, coverage, and costs (in terms of wheat) of these projects are described below.

Field Channels. These are small tertiary irrigation channels through which water reaches the main fields for irrigation. These channels connect the secondary canals that were originally constructed under

the Ganges-Kobadala (G.K.) project, Phase II, in the districts of Kushtia and Jessore. The G.K. is a famous gravity irrigation project built sometime during the sixties. The project sites selected are located in the two districts, namely Kushtia and Jessore. With the construction of new channels and their extensions, new irrigated area is being expanded gradually. These are of different sizes and can irrigate 500-1000 acres of land. These are expected to benefit about 500 families, depending on length of channel, topography of the area, and so on.

To be specific, the selected project at Bandabeel would cover 500 acres of crop land; it cost 391 maunds[6] of wheat in the year 1978-79. The investment cost comes to about Tk 110 per acre. This channel would benefit 500 farm households and is expected to increase production of paddy about 25 thousand maunds a year.

This project village is located within a mile of its Upazila center, Alamdanga. The rural households living there thus have easy access to all the infrastructural facilities available in that Upazila, which is well connected by road with its subdivision and district towns. The farm families living in the project villages are thus expected to be better off than those in remote areas.

The infrastructural facilities generally available in an Upazila are the offices of the development agencies, a rural health complex, secondary and higher secondary schools, and supply centers for fertilizer, pesticides, seeds, diesel, and the like. The development agencies located there are the executive offices of general administration, agriculture, livestock, fisheries, cooperatives, and population. Located in some Upazilas are the Water and Power Development Board and the Rural Electrification Board, which oversee the execution and operation of their development projects. Important wholesale market centers are also located in the Upazilas.[7]

Another project village is located at Harishpur, by our criteria a less accessible area, three miles away from its Upazila, Harinakunda. The communication link between these two places is an earthern road. In this village, there is no market. The rural households there have fewer facilities than are enjoyed by Bandabeel people.

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[6] One maund is equal to 37.4 kg.

[7] According to the recent government policy of decentralization the executive officers stationed there are given greater executive and financial powers. The head of an Upazila, who will now be elected, has now been designated as chairman. All executive officers will assist the chairman in designing and implementing the development programs not yet in operation.

The field channel at Harishpur was constructed in 1978-79 at a cost of 709 maunds of wheat. It was intended to irrigate 1,000 acres of cultivated area. The annual increase in production of paddy attributable to the project would be about 51 thousand maunds. One thousand families are expected to benefit from this project. The investment cost for this project is estimated at Tk 100 per acre.

The control villages corresponding to the project villages Bandabeel and Harishpur are Roakoli and Gobrapara, respectively. Roakoli is about three miles from its Upazila center, Alamdanga. A bitumin paved road connecting Alamdanga with the district headquarters, Chuadanga passes through the village. Gobrapara, on the other hand, is about six miles away from the Upazila Harinakunda and is situated about two miles toward the interior from the motorable road. It has, however, a market at a distance of more than a mile, from which it is cut off by a river.

Dual Purpose Canals. This is a project of re-excavation of Dardaria Khal in the Kapasia Upazila of the Dhaka district. Before the project was undertaken, a huge area was frequently submerged by heavy monsoon rain because of a lack of drainage facilities. Again, in the full monsoon season, this area was also flooded frequently by the river Lakhya. The floods, often two a year, caused extensive damage to crops.

To protect this large block of 10,560 acres, this project was initiated under the Food-for-Work program in 1979-80. It included a plan for full protection of 3,000 acres and partial protection of 7,500 acres. The project had two major components:

1. Re-excavation of the main Dardaria Khal and its branches to avoid the flash floods caused by incessant rain;

2. Construction of a bridge-cum-regulator in the mouth of Dardaria Khal to the Lakhya River and an embankment along the river.

The amount of wheat allocated to this project was only 10,000 maunds. The investment cost comes to about Tk 187 per acre. Annual additional production of paddy from this project was expected to be 600,000 maunds, besides protecting a large area planted in jute. It may be noted that the re-excavation of various brances of the main khal (stream) is still in progress, and the project, for that matter, could not yet benefit the distant blocks.

Within this project area, two villages were selected -- Charkhamair and Sayedpur. Charkhamair, which is situated within a mile of its Upazila center, Kapasia, is considered to be more highly developed infrastructurally because of easy accessibility to Upazila infrastructural facilities. The farm families can enjoy all the facilities available there. The other project village is Sayedpur which is almost 4 miles away from the same Kapasia center. This is considered a less well developed village because the farmers are at

disadvantage. The corresponding control village to Charkhamair is Rajarampur, which is connected to Kapasia Upazila center by paved road, but its own Upazila center is located a long distance away. It has a market near the village. The infrastructurally less developed village selected as control is Gobindapur, which is five miles to the interior from its Upazila, Kaliakair, to which it has neither road nor rail link. The water route is the principal means of reaching it during the five-month monsoon season. The people from this village can hardly avail themselves of the infrastructural facilities developed at its Upazila center. There is also no market or secondary school there. This is, in a sense, a remote village, although there are hundreds of such villages in the country.

River Embankments. In our study, two types of river embankment, which serve two essentially different purposes, were included. The first one was designed to protect land from normal flood water by means of a flood dike along the Boral river from Baghabari ghat to Demra in the Upazila of Shahjadpur, Pabna; the second was constructed along the river Kankri to avoid the flash flood caused by incessant rain of many days' duration. Constructed during the late 1960s, this was rather a repair work under Food-for-Work, which according to the proposal was an improvement. The project was located in the Choddagram Upazila.

The flood dike is a long flood-protection embankment along one bank of the Boral river. Until 1981, only four out of a planned six miles had been completed, at a cost of about 40,000 maunds of wheat. It was initiated in 1976. The completed part was expected to protect 6,000 acres of land. The investment cost for this project was Tk 933 per acre. The annual increase in the production of paddy, as proposed in the scheme, would be 27,000 maunds.

The project village selected within this protected block was Patgari, which is connected by a paved road to two nearby Upazilas, Shahjadpur and Bera, both of which are about five or six miles away. The farm families have easy access to both centers. This village is infrastructurally more developed.[8] The control village is Rawtora, just on the other side of the bank about three miles to the interior from the Upazila center and the Bogra-Dhaka Highway. Rawtora is subject to regular flooding. The people from that village communicate with the Shahjadpur Upazila through an old, destroyed road not usable by either rickshaw or baby taxi (threewheeled taxi).

The selected project villages that benefited from the Kankri river embankment are Illashpur and Khunta. The catchment area of this project is 10,200 acres. The extra production of paddy was

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[8] In the report the terms less or more developed infrastructure are used to mean under-developed or developed infrastructures. However, the difference in development is a matter of degree.

expected to be about 102,000 maunds a year. The embankment was improved in 1974-75 and now needs further reapir. Illashpur is located within a quarter of a mile from the Comilla-Chittagong highway and is well connected with its Upazila center -- Choddagram -- by bus and rickshaw. The distance, however, is about eight miles. This village is taken to be infrastructurally more developed. Khunta, on the other hand, is an interior village almost without any communication link with its Upazila center, Choddagram. It is located about 8 miles to the interior from the Dhaka-Chittagong Highway which is the nearest paved road. It has a market about two miles away. There is an earthen road, not easily traversed during the rainy season, between the market and the Chittagong highway. This village, by our criteria, is infrastructurally less developed. The control village is Chasapara, which is within two furlongs of the Chittagong highway. It is located in the Comilla Kotwali Upazila and has the use of all the infrastructural facilities of the Comilla district headquarters and the Comilla Academy for Rural Development. Chasapara has the most highly developed infrastructures of any of the 16 villages.

Coastal Embankments. This type of embankment is constructed against salt water. The embankments are quite long, and each is intended to protect the whole belt of a region. In selection of the villages that have benefited from coastal embankments, it was necessary to select two embankment locations because there were so few areas suitable for the survey--particularly because there was no well-developed village in the region. In spite of the spread of the locations, it was not possible to select a well-developed control village because almost all areas in the region were protected by coastal embankments. The project areas selected for the study were located at the Baithaghata and Satkhira Upazillas in the Khulna district. These project areas are about 50 miles apart. The embankment projects are:

1. Reconstruction of the embankment from Baithaghata Ferryghat to Ranjiter huls of Sialidanga;

2. Construction of an extension of the embankment in Polder No. 2 from 1 mile to 2.5 miles at Sathkira.

The first embankment, completed in 1980-81 and 4.4 miles long, was expected to protect 500 acres of land. The estimated additional production from the project would be about 5,000 maunds. The village selected there as enjoying the benefit of project was Birhat, and the corresponding control village was Taliamara, where there was no such protection. Crops at Taliamara are subject to damage from salt water. The two villages are neighboring villages, separated by a river. Neither is well developed infrastructurally because of the distance from the Upazila center and the lack of communication facilities. Of these two, Birhat is nearer the center.

The project village endowed with well-developed infrastructures was Khejurdanga, near the Satkhira Upazila, with which it is connected by a paved road that is easily traversed by rickshaw. This village benefits from the new 2.5-mile embankment in Polder No. 2, constructed in 1977 at a cost of 1,200 maunds of wheat.

Socio-economic Characteristics of Households in Projects and Controls

Basic assets of households including landholdings and family size are shown for project and control villages and by degree of general infrastructure development on Tables 1.2 and 1.3 respectively. In the aggregate, differences between project and control villages are statistically insignificant. The average size of owned land is similar to the national average of 1.73 acres.[9] The average size of cultivated holdings is also similar to the national figure of 2.4 acres found by the Pilot Agricultural Census of 1982.[10] Differences between villages with varying levels of general infrastructure development are more pronounced.

Comparison of size-distribution of land ownership in sampled villages with national figures is given in Table 1.4. The proportion of landless and near-landless households is found to be lower in the study areas than for Bangladesh as a whole, and the proportion of small farmers (between 1-2.5 acres) is higher than the national average. The proportions of large landowners and their control over land in the study area, however, are similar to the national average. It is noteworthy that the areas with poorly developed infrastructures have the highest proportions of landless and near-landless (less than 0.5 acres). (Table 1.5.)

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9 Yearbook of Agricultural Statistics of Bangladesh 1979-80, Dhaka, 1980, p. 694.

10 Report on Pilot Agricultural Census, 1982, Dhaka, September, 1983, p. 86.

Table 1.2--General Characteristics of Households in Project and Comparable Villages

Characteristics	Project Village (N=358)	Comparable Village (N=281)	Percent Difference	Statistical Significance
Total owned land (acres)	2.16	2.38	-9.2	NS
Owned cultivated land (acres)	1.72	1.98	-13.1	NS
Cultivated holding	2.22	2.48	-11.7	NS
Proportion of rented land	16.2	14.6	11.0	NS
Total value of non-land assets (TK)	6,151	5,547	10.9	NS
Total value of agricultural fixed assets except land (TK)	3,238	2,867	12.9	NS
Household size (persons)‡	6.55	6.32	3.6	NS
Family size (persons)	6.41	6.11	4.9	NS
Family workers engaged primarily in agriculture	1.41	1.42	-0.7	NS
Landless households as a percent of total households	15.6	15.3	2.0	Not tested

‡ It includes teacher/relations and permanently hired labor residing in the house as a regular member in addition to family members.

* This is based on the actual farm households whose number is 302 and 238 in project and control villages, respectively.

Table 1.3--General Characteristics of Households by Level of Infrastructure

Characteristics	Developed Infrastructure (N = 160)	Medium Developed Infrastructure (N = 199)	Poorly Developed Infrastructure (N = 280)	Percent Difference: Developed vs. Medium Developed		Percent Difference: Developed vs. Poorly Developed	
Total owned land (acres)	2.46	2.42	2.01	1.7	NS	22.4	NS
Owned cultivated land (acres)	2.06	2.00	1.58	3.0	NS	30.4	S
Cultivated holding (acres)	2.37	2.51	2.18	-5.6	NS	8.7	NS
Percent rented land	31.7	14.1	6.7	124.8	S	373.1	S
Total value of non-land assets (TK)	7080	7067	4364	1.8	NS	62.2	S
Total value of agricultural fixed assets except land (TK)	3214	3826	2461	-16.0	NS	30.6	NS
Household size (number)	6.81	6.34	6.31	7.4	NS	7.9	NS
Family size (number)	6.60	6.17	6.16	7.0	NS	7.1	NS
Family workers engaged primarily in agriculture (number)	1.32	1.32	1.54	nil	NS	-14.3	S

Table 1.4--Land Ownership Distribution of the Households in the Survey Areas

Ownership Size (Acre)	Survey Areas Proportion of Total Household	Survey Areas Proportion of Total Area Owned	Bangladesh 1979[1/] % of Household	Bangladesh 1979[1/] % of Total Area
Landless	4.2	nil	15.4	nil
0.01 - 0.50	26.0	2.0	33.3	3.5
0.51 - 1.0	15.3	5.4	11.8	5.3
1.01 - 2.5	24.3	17.6	20.7*	20.9*
2.51 - 5.0	19.6	31.3	11.2‡	24.5‡
5.01 - 7.5	5.8	15.7	3.9	14.7
7.51 - 10.0	2.0	7.8	1.6	8.6
10.0 +	2.8	20.3	2.1	22.5
All groups	100.0 (639)	100.0 (1440 acres)	100.0	100.0

* Includes the ownership category of 1.01 - 2.0 acres.

‡ Includes the ownership category of 2.01 - 5.0 acres.

1/ Statistical Pocketbook of Bangladesh, 1983, p. 208.

Table 1.5--Land Ownership Distribution of Households by Infrastructural Development

Infrastructural Development	Landless*	0-0.49	0.50-2.49	2.50-4.99	5.0 +	Total Number
Developed	14.4	11.3	43.8	20.0	10.6	160
Moderately developed	16.6	8.5	42.2	21.1	11.6	199
Poorly developed	26.4	16.8	30.4	16.8	9.6	280
All areas						
Total number	130	82	239	121	67	639
(%)	(20.3)	(12.8)	(37.4)	(18.9)	(10.5)	(100.0)

* This is defined as those who have no cultivated land but may have homestead. In Bangladesh, such households comprised about 29 percent in 1978.

Occupational Distribution of the Household Heads. Occupation is determined by the time spent instead of the income received. The primary occupation is that to which maximum time is given. In the study areas, people are involved in multifarious occupations. For the sake of elaboration in this analysis the category of agriculture was div,ded into four subcategories--cultivation, sharecropping, wage labor, and other agriculture, which includes fishing, livestock and poultry raising, wood collection, and crop processing. In the nonfarm sectors, the most important occupations are industry, trade, and services.

The majority of heads of households (52 percent) are found to be cultivators--that is, they are primarily engaged in working their own farms. The next most important occupation is wage labor (23 percent), in which most of the landless households are occupied. In total, about 78 percent of the heads of households have indicated agriculture as their primary occupation (see Table 1.6). Services and trades are the two main nonagricultural occupations, in which 7 percent are occupied.

The investigation into the occupational distribution by project and control areas indicates little difference, with the exception of wage labor, the share of which is higher in the project villages. This is to be expected, because the development projects are there and more people can be absorbed there through greater intensity of cropping and cultivation of high yielding varieties (HYV). The differences in occupational distribution are to some extent distinct between developed and poorly developed areas. This is particularly true of other agriculture, none of which has been involved in developed areas because of limited scope there and perhaps less remunerative than nonfarm opportunities. This is evident from the larger share in trades and services--11 percent in developed areas but only 7 percent in poorly developed areas--as shown in Table 1.6. The lower proportion of cultivators in poorly developed areas is attributable to the higher proportion of landless households there, as mentioned earlier--26 percent rather than 14 percent--and these landless households keep themselves occupied as wage labor, irrespective of the levels of wage rates, for the sake of subsistence.

The occupational distribution between less developed and more developed areas is similar, except in two areas, other agricultural and other nonagricultural activities. Other nonfarm occupations include transport, construction work, both skilled and unskilled, and domestic service. More rickshaw operators are found at Charkhamaro and Khejurdanga, for there is no other means of transportation for reaching their Upazilas. It is also of special interest to note that there are a few households at Patgari engaged as construction workers outside the village. The developed villages are all connected by passable roads, so such occupations are fewer there.

Table 1.6--Occupational Distribution of Households, by Project or Control Villages and Infrastructural Development a/

Project or Control Village or Level of Development	Cultivation	Share-cropper	Labor	Other Agriculture	Industry	Trade	Services	Others	Total Number
				(percent)					
Project village	52.1	0.9	24.1	2.1	0.6	6.3	8.6	5.4	336
Control village	51.1	1.5	20.5	2.6	2.2	8.6	7.1	6.3	268
Highly Developed	55.9	1.3	17.8	0	0.7	10.5	10.5	3.3	152
Moderately Well developed	54.2	1.1	20.0	3.2	0.5	5.3	7.4	8.4	190
Poorly developed	47.3	1.1	27.1	3.1	2.3	6.9	6.9	5.3	262
All areas	51.7	1.2	22.5	2.3	1.3	7.3	7.9	5.8	604

a/ Thirty-five cases of dependents--students, children, disabled, and so on--have been excluded.

Level of Education of the Household Heads. In the survey areas, 60 percent of the heads were found to be illiterate, which is lower than the national average. This seems to be attributable to the selection of villages that are somewhat well off, many of them close to the Upazila centers where educational facilities are well developed. This is quite evident from the much lower proportion of illiterate heads of households in the developed and moderately developed areas--46 percent and 58 percent, respectively--than in the poorly developed locations (see Table 1.7). The better educated heads--those that have passed the SSC and above--make up only 8 percent in the study areas. The proportion is again higher in the project villages because incomes are higher in those villages. Such a difference is also to be observed between developed and poorly developed areas.

Table 1.7--Level of Education of Heads of Households, by Project or Control Village and Infrastructural Development

Project or Control Village or Level of Development	Illiterate	Primary	Secondary	SSC	HSC	Total Number of Households
	(Percent)					
Project village	59.4	18.5	12.3	7.3	2.5	357
Control village	59.8	21.0	14.2	3.2	1.8	281
Highly developed	46.3	26.9	16.9	6.3	3.8	160
Moderately well developed	58.1	21.7	10.1	7.1	3.0	198
Poorly developed	68.2	13.9	13.2	3.9	0.7	280
All areas	59.6	19.6	13.2	5.5	2.2	638

APPENDIX TABLE

Table A1.1--Coverage of the Food-for-Work Program, 1975-84

Year	Amount of Food Imports	Public Distribution of Foodgrains	Distribution of Food Through FFW Program	Estimate of Employment Generated by FFW Program
		(1,000 tons)		(million person days)
1975/76	1,445	1,668	209	56
1976/77	795	1,450	223	60
1977/78	1,609	1,997	275	74
1978/79	1,162	1,786	230	62
1979/80	2,826	2,402	227	61
1980/81	1,061	1,526	358	96
1981/82	1,226	2,036	288	77
1982/83	1,841	1,906	379	101
1983/84	2,058	2,052	390	107

Source: Bangladesh Bureau of Statistics, 1984-85 Statistical Pocket Book of Bangladesh, Dhaka, 1985.

II. THE EFFECT ON AGRICULTURAL PRODUCTION AND HOUSEHOLD INCOME

While generating employment for the poor, the Food-For-Work (FFW) Program builds various types of economic infrastructure in rural areas. People are employed for digging or re-excavation of canals for drainage and irrigation, construction and repair of embankments for protection against floods or intrusion of salt water into the coastal areas, and so on. The embankments are often used as roads, facilitating transport in interior areas.

If the infrastructures are properly built, they should have an immediate effect on agricultural production in the area affected by the project. Irrigation canals would facilitate shifting of land from traditional to high-yielding varieties; the water control would make application of chemical fertilizers more effective and less risky; better drainage would reduce the risk of crop failures, increase yields, and induce cultivators to raise more than one crop from the same land in a year; and the effect of embankments built for protection against floods would be similar. Thus, while the immediate objective of the FFW Program is to generate employment during the construction phase, a chain of secondary effects is expected to be set in motion, beginning with the effect of the project on agricultural production.

In the absence of any information on the benchmark situation of the project areas at the time of implementation, we have no choice in making this evaluation but to assess the effect by comparing a sample of households in the project area with a control sample of households outside the project area whose situation was similar to that of households in the project area before the project was undertaken. The information concerning the project group and the control group of households is assumed to give a picture of the situation with the FFW and without the FFW. The details of the selection of the study villages and the drawing of the sample households have been discussed in chapter 1. This chapter is based on the information provided by the cultivators' households.

The accuracy of the findings obtained in this evaluation depends on the similarity of the project and control villages. Since this chapter is concerned with the effect on agricultural production and land is the most important determinant of production that is not supposed to be influenced by the project, the similarity can be judged by comparing the endowment of land in the project and control villages. This is done in Table 2.1, which reports the amount of land owned and cultivated by households in the project group and the

Table 2.1--Endowment of Cultivatable Land in Project and Control Groups, 1982 (Acres per household)

Type of Infrastructure	Land Owned			Cultivated Holdings		
	Project	Control	Difference between Project and Control (Percent)	Project	Control	Difference between Project and Control (Percent)
Drainage-cum-irrigation canal (DIC)	2.22	2.48	-10.5	1.83	2.11	-13.3
Field channel for irrigation (FCI)	3.18	3.54	-10.2	2.46	3.03	-18.8
Coastal embankment (CE)	1.69	1.39	21.6	1.60	1.64	-2.4
Flood-protection embankment (FPE)	1.77	0.97	82.5	1.65	0.82	101.2
Flash-flood-protection embankment (FFPE)	1.73	2.14	-19.2	1.70	1.94	-12.4
All types	2.16	2.38	-9.2	1.87	2.10	-10.9

control group. It will be noted that the control group is in general better endowed with land compared to the project areas. The average size of land ownership and cultivated holdings in the selected project group is about one-tenth lower than that in the control group. At the level of individual projects, the difference is even wider.

The implication of the findings is that simple comparison between project and control of the average values of the variable at the household level will produce misleading results. The results must be adjusted for the differences in land endowments. This has been done by expressing the values of the relevant variables per unit of land while comparing project and control groups.

Data on agricultural production were collected for two calendar years, 1981 and 1982, using two different methods of collecting information. Information for 1981 crop seasons was collected at the plot level by asking the respondent to list all plots of land he cultivated during the year and collecting detailed information on the

characteristics of the plot, crops grown on the plot in the three different crop seasons--aus, aman, and boro--and the yields. In 1982, the interviewers visited the respondent household at the end of each crop season and collected detailed input-output information at the crop level.[1] The information on input use was collected only for 1982. So, the findings of the survey on production are shown for two years but the input-output relations are shown only for 1982.

A descriptive picture is presented below of the effect of the FFW Program on crop production and on various factors that influence it. Since the different types of infrastructure selected for the study do not have similar effects on the variables that influence production, the findings have been presented by type of infrastructure. Next follows the findings on the effect of the FFW Program on distribution of production among various groups of households classified by landholding. Last is a study of the input-output relation using the production function techniques and an assessment of the effect of the FFW Program on returns from various inputs at the margin and the efficiency in the use of the inputs.

A DESCRIPTIVE PROFILE OF THE EFFECT ON CROP PRODUCTION

Crop Production

The findings of the survey on the value of production of all crops per unit of land are reported in Table 2.2. The values have been estimated at constant 1982 prices. The comparison with control group shows the effect of the project to be positive in three out of the five types of infrastructure. The largest positive effect is found in the case of the field channels for irrigation, where the gross value of production in the project group is found to be about 1.5 times as high as that in the control group. For drainage-cum-irrigation canals, the value of production is also significantly higher in the project groups--about 13 percent higher on the average for two years and about a fourth higher for 1981. For coastal-embankment and flood-embankment projects, the average level of production is not much different in the project and control groups. The estimates for 1982 for the coastal embankment projects show production in project groups to be about a fifth greater than that of the control, but the reverse was true in 1981. For flash-flood protection embankment, the estimates of production are significantly lower in the project group for both years, indicating that the

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[1] Experience of the survey indicated that the respondents could provide better information if asked questions at the plot level than at the crop level. At the crop level, there is a tendency to under-report acreage, particularly for minor crops. For large surveys such as this one, however, collecting input-output information at the plot level becomes unmanageable.

Table 2.2--Gross Value of Agricultural Production per Unit of Land, 1981 and 1982 (Tk per acre of cultivated holding)

Type of Infrastructure	Project Group			Control Group			Difference between Project and Control (Percent)
	1981	1982	Average	1981	1982	Average	
Drainage-cum-irrigation canal	4,213	4,443	4,328	3,381	4,256	3,819	13.3
Field channel for irrigation	6,262	6,117	6,190	2,536	2,236	2,386	159.4
Coastal embankment	2,155	3,340	2,748	2,684	2,748	2,716	1.2
Flood embankment	5,920	6,098	6,009	5,352	6,985	6,169	-1.2
Flash-flood embankment	5,580	3,948	4,764	6,437	9,250	7,844	-39.2
All types	4,781	4,788	4,785	3,465	4,060	3,763	27.2

project has had no effect. This is not surprising; it was observed at the time of the survey that the embankment failed to protect the project areas from flood.

For all projects taken together, the average value of production for the two years is found to be about a fourth higher in the project group than in the control group. If the flash-flood-embankment project is excluded, the average value of production in the project group is estimated to be about 50 percent higher than that in the control group.

Since Bangladesh has to import food, agricultural development programs emphasize the growth of cereal production. It will be noted from Table 2.3 that the positive effect of the project on the production of cereal--that is, rice and wheat--is more pronounced than that on crop production in general. For all projects taken together, production of cereals (unhusked) per acre of land is about 30.2 maunds in the project group but only about 21.3 maunds in the control--that is, about two-fifths greater for the project group.[2] If the flash-flood-embankment project is excluded, the difference comes to about 80 percent. The larger effect on cereal production is accounted for mainly by the field channel project. The production of cereals in irrigated villages under this project is about three times

[2] One maund is equivalent to about 37.4 kilograms.

Table 2.3--Production of Cereals per Unit of Land, 1981 and 1982
(Maunds per acre of cultivated land)

Type of Project	Project Villages			Comparable Villages			Project over Comparable Villages (Percent Difference)
	1981	1982	Average	1981	1982	Average	
Drainage-cum-irrigation canal	24.0	24.4	24.2	20.9	21.2	21.1	15.0
Field channel for irrigation	41.3	39.2	40.3	9.1	9.8	9.5	326.5
Coastal embankment	13.1	23.2	18.2	18.2	18.9	18.6	-1.9
Flood embankment	28.2	31.6	29.9	28.9	43.4	36.2	-17.3
Flash-flood embankment	38.4	28.5	33.5	43.8	65.7	54.8	-38.9
All projects	30.3	30.0	30.2	19.2	23.3	21.3	41.8

as great as in the unirrigated villages, while the value of production for all crops is about 1.6 times as great. It appears that with the availability of irrigation facilities, some land is shifted from cereals to other crops.

Factors that Contribute to the Increase in Crop Production

Intensity of Land Use. The extent of the use of owned land for productive purposes and for multiple cropping during a year can be seen in Table 2.4. The intensity of cultivation, defined as the proportion of owned land put into cultivation, is found to be greater in the project group in four out of the five types of infrastructure. For all of them taken together, the intensity of cultivation is found to be about 3 percent greater in the project group than in the control. Although it is difficult to establish a direct link between the FFW Program and the intensity of cultivation, higher intensity might be induced if the infrastructures had a positive effect on profitability of cultivation.

The building of economic infrastructure, however, is expected to have a direct effect on multiple cropping. The availability of irrigation facilities would allow the growing of an additional crop during the dry winter season. Protection from flood may induce

Table 2.4--Pattern of Land Use, by Type of Infrastructure, 1981

Type of Infrastructure	Percent of Total Land Cultivated[a]		Total Cropped Acreage as Percent of Cultivated Land		Irrigated Land as Percent of Cultivated Land	
	Project	Control	Project	Control	Project	Control
Drainage-cum-irrigation canal	93.9	86.2	135	124	28.5	27.0
Field channel for irrigation	88.5	89.1	154	170	46.3	4.9
Coastal embankment	86.3	79.4	100	105	6.4	0.0
Flood embankment	92.5	88.8	190	152	12.6	58.5
Flash-flood embankment	94.3	90.7	178	189	70.3	87.1
All projects	90.9	87.7	157	151	37.1	24.8
All projects, excluding flash-flood embankment	90.1	87.2	140	145	27.9	14.8

[a] Includes area in orchards and bamboo bushes.

Note: The table is based on the information collected at the plot level for 1981. Only the plots owned and cultivated by the respondents have been included, in an effort to dissociate the possible effect of tenancy on cropping intensity and irrigation.

cultivators to grow crops in low-lying land that they would otherwise have kept fallow during the monsoon season, or they might even try a premonsoon crop if early floods are protected.

The findings of the survey on intensity of cropping, defined as the total cropped acreage during a year--the flow of land--as a percentage of total cultivated land--the stock of land--are also reported in Table 2.4. The cropping intensity is found to be higher in the project group for drainage-cum-irrigation canal and flood protection embankment infrastructures, similar for the coastal embankment, and lower for the field channel for irrigation and flash-flood protection embankment. In all of them taken together, the index of cropping intensity is about 6 percentage points higher in the project group than in the control. The higher cropping intensity

in the control group for the field channel area is primarily the result of the growing of low-yielding pulses that have a short maturing period. With the availability of irrigation facilities, crop rotation from local aus to pulses to wheat is replaced by rotation from HYV aus to HYV aman for medium lowlands and rotation from local aus to pulses is replaced by single-crop HYV aman to fallow rotation on high lands, which leads to a reduction in the cropping intensity, while the area under high-value crops increases. If the area under pulses and oilseeds is excluded, the cropping intensity for the field-channel project is estimated to be 144 percent for the project group and only 118 for the control.

Use of Irrigation. The most important factor that influences the productivity of land is access to irrigation facilities. Some of the Food-for-Work projects in fact aim directly at increasing access to irrigation facilities of land in the area of influence of the project. The field-channel project is a case in point. It can be seen from Table 2.4 that for this type of infrastructure, about 46 percent of the land for the project group but only about 5 percent for the control group is irrigated. The drainage project also aimed at increasing irrigation facilities, but the actual use of irrigation in the project group is not found to be significantly different from use by the control group. In one of the control villages, a deep tube well was sunk in 1979 to irrigate part of the land of the village, while in another control village, traditional irrigation, by swing baskets and dhones, is practiced in the extreme low-lying areas during the dry winter season. In the project villages, low lift pumps are fielded to get water from the canal. But extreme variation in topography and drying up of the canal upstream during the driest months act as constraints to further expansion of irrigation in the project areas. It is reported that the existing facilities could irrigate about 53 percent of the land, which means that about 47 percent of the facilities remain unused.

The other three types of infrastructure are not supposed to have any direct effect on irrigation, but they are nonetheless being practiced by the cultivators. It will be seen from Table 2.4 that the Comilla area under the project of flash-flood protection embankment has a very high intensity of irrigation -- about 70 percent for the project group and 90 percent for the control group. In this area, modern irrigation began to spread during the late 1960s under the influence of the integrated rural development model developed in Comilla. Most of the areas were covered by irrigation through tube wells and power pumps by the end of the 1970s. Since a larger proportion of the area in the project villages falls under the depressed basin that the embankment was expected to protect from sudden abnormal flooding, the intensity of irrigation is lower in

the project villages than in the control village.[3] This is a significant reason for the lower level of production in the project group than in the control group for this type of infrastructure, which has nothing to do with the project. Only about 5 percent of the land that could be irrigated with the available facilities remains unirrigated for both project and control groups.

In the case of the flood-embankment project, the control group has a significantly higher intensity of irrigation than the project group. But in this instance, it could be argued that cultivators in project villages could have been induced to practice more irrigation if the project had not been undertaken. With the project, they are assured of a good aman crop during the monsoon season, which the cultivators in the control area are deprived of (see Appendix Table A.2). This has induced cultivators in the control area to go for irrigation so that they can raise at least one crop during the dry season. In the project area, cultivators practice irrigation in the extreme low-lying areas where no crop could be grown during the monsoon season. If they want to expand irrigation on this type of land, they will have to forgo the benefits of the project, because by the time the irrigated crop has been harvested, it is too late to broadcast the deep-water aman paddy that is grown in this area. It is reported by the respondent that about 12 percent of the land that could be irrigated by the existing facilities is not used for growing irrigated crops in the project village, while all of such land is irrigated in the control village.

Allocation of Land to Various Crops. Details of the allocation of land to various crops for the project and control groups are reported in Table A2.1. The most dramatic change in the cropping pattern seems to have taken place following the field channel for irrigation and flood protection embankment projects. For field channel for irrigation, the main crops in the control areas are traditional broadcast aus paddy and the pulses kalai and mung, while in the project areas, the main crops are the HYV aus and HYV aman paddy.[4] It appears that with the availability of irrigation facilities, land is shifted from local to HYV aus and from pulses to HYV aman. In the control areas, about a third of the land is cropped with HYV wheat and sugarcane, which are high-profit crops that could be grown under unirrigated conditions. With the availability of irrigation, some of this land is also shifted to HYV paddy; for the project group, these two crops occupy only about an eighth of the total land.

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[3] It is found from the plot-level data that about 47 percent of the land in the project villages and about 83 percent in the control villages is located at high or medium-high levels.

[4] In the area, aus is sown broadcast beginning in April and is harvested in August. Pulses are sown in September and harvested in November. The aman, which is the monsoon-season crop, is transplanted in July-August and is harvested in December-January.

The major cropping pattern in the area of the flood-protection embankment is in the deep-water broadcast aman paddy, followed by pulses (khesari), which are partly used as fodder. About 88 percent of the land is cropped during the aman season--all of it with the deep-water aman. In contrast, only about a fourth of the total land of the control group is cropped during the aman season, 14 percent with deep-water aman. The remaining land is kept fallow during the monsoon season and is cropped during the winter season with boro paddy, mostly HYVs (with irrigation) and oilseeds (without irrigation). Before the introduction of irrigation, the cultivators had sown deep-water aman and had gotten a good harvest only in seasons with low rainfall and abnormally low flooding.

The effect of the changes in cropping patterns on agricultural production would come mainly through the change in the proportion of land cultivated with HYVs. The finding of the survey on this indicator is reported in Table 2.5. A positive effect is found only in the case of the field-channel project, where land cropped with HYVs is about nine-tenths of the total cultivated land but only about an eighth in the control villages. Two types of infrastructure --drainage and coastal embankment--had no significant effect on the growing of HYVs, while in the other two, the control group has grown more HYVs, which is in fact the effect of the differences in the intensity of irrigation.

Table 2.5--Land Cropped in High-Yielding Varieties, by Type of Projects (Percent of total cultivated land)

Type of Infrastructure	Project Group			Control Group		
	1981	1982	Average	1981	1982	Average
Drainage-cum-irrigation canal	28.5	20.6	24.6	27.7	26.7	27.2
Field channel for irrigation	98.1	83.0	90.6	11.0	14.1	12.6
Coastal embankment	1.4	5.6	3.5	nil	nil	nil
Flood embankment	20.3	18.6	19.5	66.2	83.3	74.8
Flash-flood embankment	111.0	111.5	111.3	129.3	165.7	147.5
All types	59.7	56.0	57.9	33.3	40.7	37.0

For all projects taken together, the amount of land cropped with HYVs is about 21 percent of cultivated land higher in the project group than in the control group. If the flash-flood-protection embankment project is excluded, because it is not supposed to have any effect, direct or indirect, on irrigation, it is estimated that the FFW Program has led to an increase in the proportion of area under HYVs to about 40 percent from about 24 percent in the situation without the project.

Crop Yields

The findings of the survey on crop yields are presented in detail in Table A2.2. Only the salient features of the findings will be discussed here. The effect on crop yield is found to be significantly positive for three types of infrastructure--drainage-cum-irrigation canal, field channel for irrigation, and flood-protection embankment. In the drainage-cum-irrigation canal area, the yield rates are found to be significantly higher in the project group for the principal crops grown in the area, with the exception of HYV boro paddy, for which the yield is not significantly different. The drainage component of this project aims to protect the aman crops; the yield for the project situation is found to be about 50 percent greater for deep-water aman and about a third greater for local transplanted aman than in the situation without the project. For the field channel for irrigation area, the yield is significantly better in the project group for all varieties of paddy and jute and pulses, not significantly better for sugarcane and oilseeds, and significantly lower only for wheat than in the control group. The low yield for wheat for the project group is reported to be the result of excessive moisture in the land. For the flood protection embankment area, also, the yield is significantly higher in the project villages for all the principal crops grown in the area.

The coastal embankment and the flash-flood-protection embankments did not have any positive effect on the yield rates of paddy, which is the only crop grown in these areas.

Since the cereals account for nearly three-fourths of the cropped acreage in the study areas and the prices of the various cereals, including wheat, are not much different, the effect of the project on crop yields, all crops taken together, can be approximated by the yield rates for cereals. The findings of the survey on this variable for both the 1981 and 1982 crop seasons are summarized in Table 2.6. It can be concluded from the table that FFW projects had a significant positive effect on crop yields; the yield rate is about two-fifths higher in the project villages than in the control villages. The main factor in this, however, is the significantly larger proportion of area under high-yielding varieties in the project villages (see Table 2.5). It can be seen from Table 2.6 that for the high-yielding varieties, the difference in yield is only

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Table 2.6--The Effect of the Project on Cereal Yields[a]

Variety and Season	Project Group	Control Group	Percent Difference
Local variety			
1981	16.7	13.2	26.5
1982	20.5	14.7	39.5
Average	18.6	14.0	32.9
High-yielding variety			
1981	35.9	33.6	6.8
1982	42.0	36.0	16.7
Average	39.0	34.8	12.1
All varieties			
1981	24.4	17.6	38.6
1982	28.6	20.2	41.6
Average	26.5	18.9	40.2

[a] Excludes the villages covered by the flash-flood-embankment project.

marginal, although in the local varieties the average yield is about a third higher in the project group than in the control.

Estimates of Crop Damages Caused by Natural Factors. Natural factors affected production in a number of study villages, both in 1981 and 1982. In 1981, a drought in September-October seriously affected aman production except in the low-lying areas under the drainage-cum-irrigation canal and flood protection embankment projects. In 1982, a hailstorm reduced boro yield in the project villages in the flash-flood protection embankment area, which was also affected by a flash flood. The high land in the field channel for irrigation and flash-flood protection embankment areas was again affected in October by a drought that reduced aman yield.

One of the objectives of building economic infrastructure with the FFW Pprogram is to reduce the risk of crop failures from such natural agents as drought and flood. Development of irrigation facilities can protect crops against damage from drought, particularly the HYVs, which are the least drought-resistant crops. Drainage and flood embankments are meant to protect the aman plant, particularly the deep-water aman, from sudden submersion under water.

So it will be interesting to see the extent to which the risk of crop failure was reduced in the project areas.

The respondents were asked to report the loss of production from natural causes as a percentage of the normal production of the various crops grown during 1982. The findings on the weighted average loss of production estimated from the response for the four principal crops are reported in Table 2.7. Nearly a fourth of the production is reported to have been lost from natural causes, and the effect appears to have been similar in both the project and control groups. There are, however, important variations in the effect for different crops and types of project. The extent of loss is significantly lower in the project group for the two crops that are most susceptible to damages by flood and drought, the deep-water aman to flood, and the HYV aman to drought. The HYV boro paddy is grown under irrigated conditions during the dry season and is therefore much less prone to damage from drought and flood. The crop is sometimes damaged by high-velocity winds or hailstorms, however. During the year of survey, this crop was severely affected by hailstorms in two of the project villages under flash-flood protection embankment, while the control village was unaffected, which is the main factor behind the large difference in estimated loss of production for this crop between the project and control villages. If this project is excluded, the estimated loss in boro production is found to be almost the same in the project and control groups, and the average loss of all crops together comes to about 17 percent for the project group, about 22 percent for the control group.

Table 2.7--Estimated Loss of Production Attributable to Natural Factors, 1982 (Percent of normal production)

Crop	Project Villages	Control Villages	All Villages
Deep water aman paddy	17.6	25.4	19.3
Local transplanted aman paddy	41.4	38.9	40.6
HYV aman paddy	21.2 (12.7)	44.9 (42.4)	28.4 (20.7)
HYV boro paddy	37.0 (23.3)	9.8 (18.9)	18.3 (20.0)
All Crops	23.4 (16.7)	23.0 (22.0)	23.2 (18.7)

Note: Figures in parentheses are estimates that exclude the areas under the flash-flood protection embankment.

Use of Major Inputs--Labor and Fertilizer

Apart from the natural factors, other determinants of the crop yield would of course be the differential use of various inputs other than land. The level of input use may in turn be determined by such economic factors as the relative prices of input products and the relative resource endowments--ratios of land to labor and land to capital--in the cultivator household, most of which are independent of the project,[5] as well as by technical factors such as irrigation and drainage facilities that are being directly affected by the FFW projects.

In Table 2.8 the findings of the survey on the use of two major units, human labor and chemical fertilizers, per unit of cultivated land, are reported. It is found that only in the case of FCI, the

Table 2.8--Use of Labor and Fertilizer per Unit of Land, 1982

Type of Infrastructure	Labor		Fertilizer	
	Project	Control	Project	Control
	(days per acre)		(lb. of materials per acre)	
Drainage-cum-irrigation canal	58.2	57.0	74	54
Field channel for irrigation	91.5	60.4	235	59
Coastal embankment	34.8	41.6	24	3
Flood protection embankment	74.0	92.3	73	409
Flash-flood protection embankment	83.1	89.2	401	471
All types	71.3	63.7	185	131

Note: Land was measured in stock terms, so total labor days used in crop production during 1982 was divided by the stock of cultivated land to obtain the estimate of labor used per acre.

[5] The FFW Program may affect the relative input-product prices faced by cultivators by building physical infrastructure such as roads, which would have an effect on markets and costs of transport.

use of both labor and fertilizer is substantially greater in the project group than in the control group. In the case of DIC, labor use is not significantly different but fertilizer use is greater in the project group. But in the case of the embankment projects, the use of both labor and fertilizer is less in the project villages. For all projects taken together, however, the use of both labor and fertilizer is found to be significantly greater in the project villages than in the control villages, implying a positive effect of the FFW projects on the use of both these inputs.

The effect of the development of irrigation facilities, which gives cultivators better access to improved technology, on the use of inputs can be seen from Table 2.9. Labor use per cropped acre is about 90 percent greater in HYVs than in the traditional varieties. Labor use per acre in each of these varieties is almost the same in the project and control villages, but the use of labor per acre for both technologies taken together is greater in the project group because of the larger proportion of land planted in HYVs, which are more labor-intensive. Chemical fertilizers are used in small amounts in local varieties, except in the area affected by the flash-flood protection embankment. But in HYVs, fertilizer is used in substantial amounts. The application, on the average, in the HYVs is about ten times that in the local varieties. Thus, to the extent that the FFW Program facilitates more irrigation and wider adoption of HYVs, it will have a positive effect on the use of chemical fertilizers. During 1982, the use of chemical fertilizers was about two-thirds higher in the project group than in the control.

Table 2.9--Use of Inputs in Cereal Production, by Type of Technology

Input and Technology	All Types of Project			Excluding FFPE		
	Project Villages	Control Villages	Percent Difference	Project Villages	Control Villages	Percent Difference
Labor use (days per cropped acre)						
Local variety	36.0	37.7	-4.5	36.8	37.9	-2.9
High-yielding variety	62.0	60.8	2.0	69.8	70.4	-0.9
All varieties	48.6	47.2	3.0	49.2	46.4	6.0
Fertilizer use (lb./cropped acre)						
Local variety	29	30	-3.4	13	29	-55.2
High-yielding variety	282	220	28.2	246	155	58.7
All varieties	151	112	34.8	101	61	65.6

Relative Prices of Input Products. Relative prices are important economic factors that should influence the use of inputs. The FFW program may not directly influence the prices, but it may do so indirectly if market conditions are imperfect. If a project had a large positive effect on production in an area poorly connected with a well-developed network of road or river transport, local producer prices might be depressed. Similarly, the spread of improved technology will put an upward pressure on the demand for labor, thereby possibly raising wage rates under the condition of an imperfect market. Thus, a project might lead to an unfavorable relative price for cultivators compared to a situation without the project.

Information on prices of different products and inputs prevailing in the villages under study was recorded fortnightly during 1982 while the survey was being conducted. The movement of the average growers' prices for paddy and the wage rate for unskilled agricultural labor for the project and control villages are plotted in Figures 2.1 and 2.2. A large seasonal fluctuation in prices can be noted from the graphs. In the case of paddy, the prices are the lowest during the post-harvest periods--that is, mid November to mid January (aman harvest), and during May-June (boro harvest). The difference between the lowest and the highest prices is about 50 percent. Similar seasonal fluctuations are also noted in the agricultural wage rate. The wage rates are high during the months of December to May and are low during the period July-October. The peak is in May and the trough in October.

Comparing project and control villages, however, no significant differences are found in the prices of paddy but the wage rate is higher in the project villages most of the time. The findings seem to support the notion that the product market is largely integrated with the national economy, so changes in prices in one place are transmitted to other areas through the operation of the normal market forces. The labor market, however, appears to be imperfect because of the difficulties in free movement of labor from one place to another. So the upward pressure in the demand for labor following the FFW Program leads to higher wage rates.

The average 1982 prices for labor and fertilizer in relation to the prices of paddy are shown in Table 2.10. The findings indicated that the FFW Program does not have any impact on the real cost of fertilizer, but it has an adverse impact on the cost of labor.

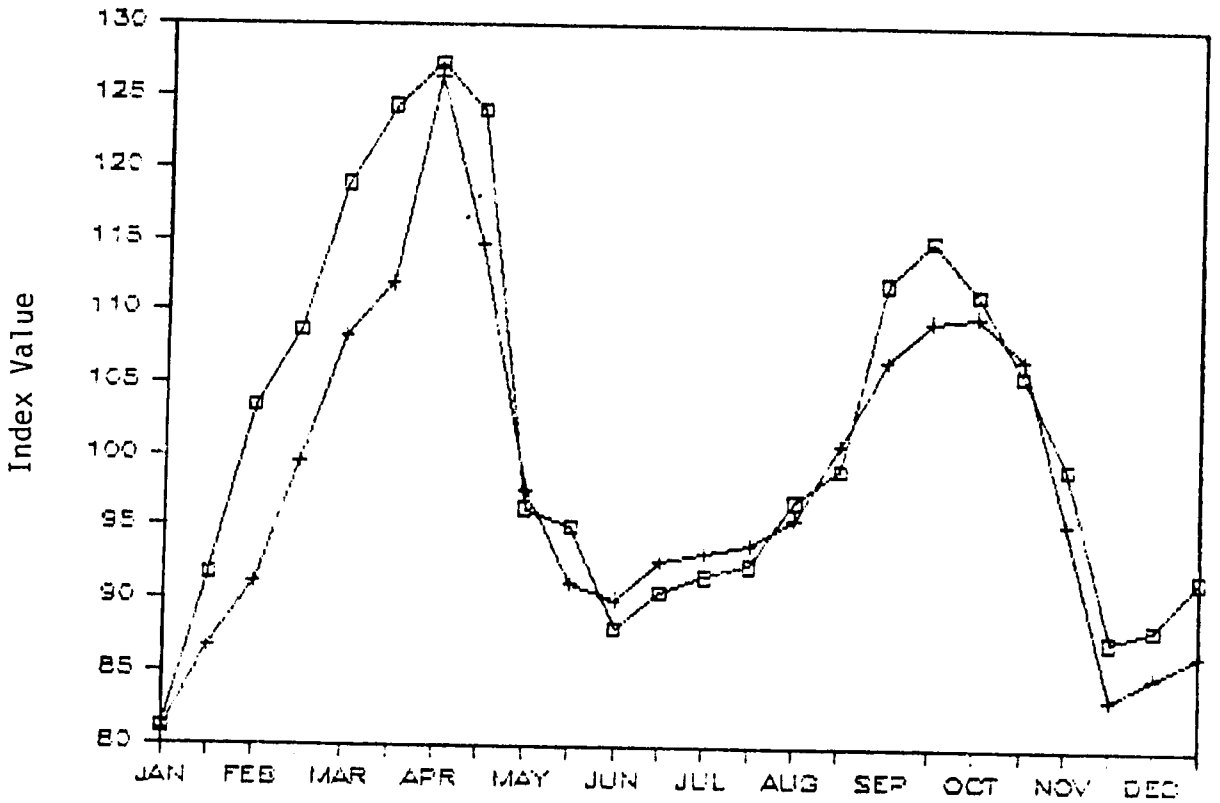
Effects of the Projects--The Results of the Test of Differences in Average Values

The arithmetic mean of the variables that influence production for the project and control groups and the results of the test of difference in the mean values are shown in Table 2.11. In calculation of the means, the sample households under the flash-flood-

Figure 2.1

SEASONAL VARIATION IN PADDY PRICES

Index Value (188.25 = 100)

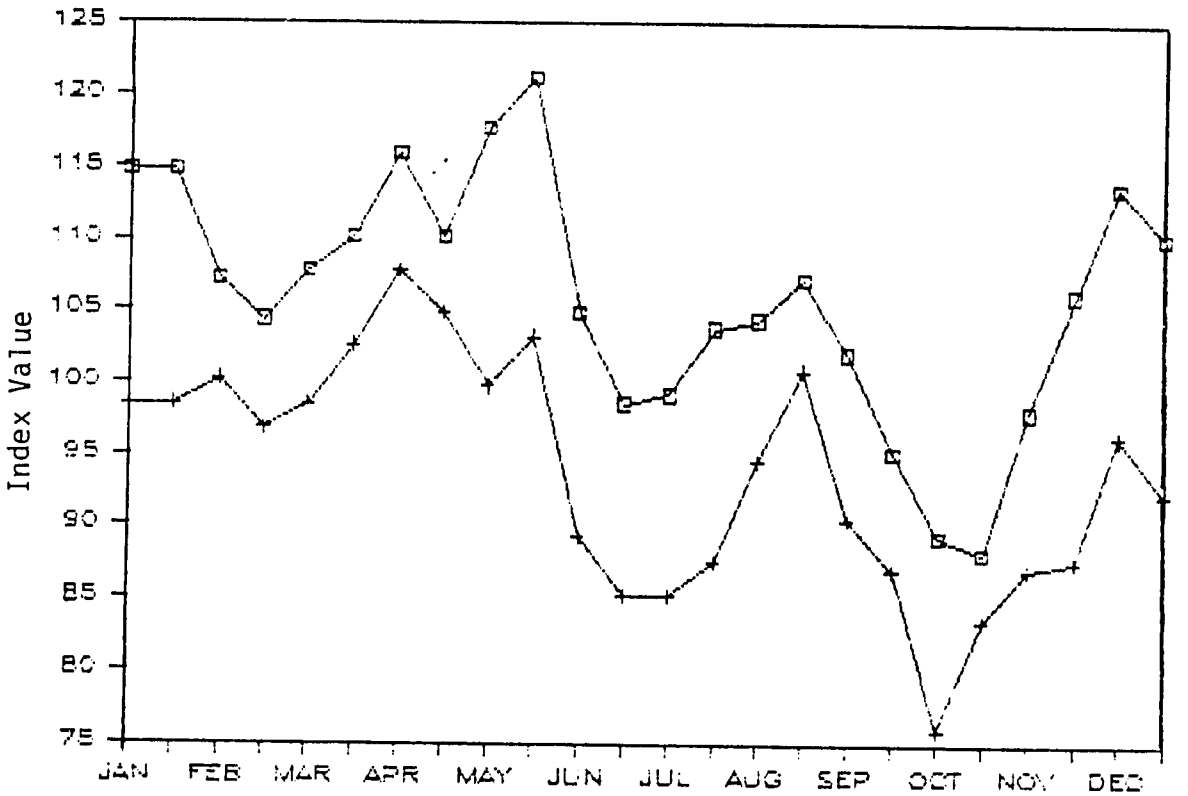


Developed Infrastructure Undeveloped Infrastructure

Figure 2.2

SEASONAL VARIATION IN AGRICULTURAL WAGE RATE

Index Value (17.25 = 100)



Project Villages

Comparable Villages

Table 2.10--The Effects of the FFW Program on Relative Agricultural Prices, 1982

Item	Project Villages	Control Villages	Percent Difference
Absolute prices			
Paddy (Tk per maund)			
Average growers' price	168.0	168.7	-0.4
Harvest price	151.0	149.5	1.0
Fertilizer--urea (Tk per maund)	152.1	150.7	0.9
Wage rate[a] (Tk per day)	17.95	16.03	12.0
Relative prices[b]			
Fertilizer--paddy (kg. of paddy to buy kg. of fertilizer)	1.01	1.01	0.0
Labor--paddy (kg. of paddy to buy one day of labor)	4.45	4.01	11.0

[a] Estimated from farm-level data on the wage rate (cash plus kind) paid to hired laborers in different crops. Bangladesh currency is called Taka (Tk).

[b] The price ratios are worked out in relation to the harvest prices of paddy because the greater portion of the production is sold at those prices.

Table 2.11--The Result of the Test of Differences in Mean Values of Production Variables

Variable	Project Group	Control Group	Percent Difference	Estimated t Values
Percent of area irrigated	38.4	18.8	19.6	4.8[a]
Percent of area under HYV	40.3	23.6	16.7	8.8[a]
Intensity of cropping with major crops (percent)	135	128	7	2.1[a]
Labor use per acre of cultivated land (days)	69.6	62.6	11.2	2.7[a]
Fertilizer use per acre of cultivated land (Tk)	198	142	39.4	2.8[a]
Cereal yield (maunds/ cropped acre)	29.4	23.4	25.6	3.7[a]
Labor use per cropped acre in cereal production (days)	49.3	46.2	6.7	1.1
Fertilizer use per cropped acre in cereal production (lb.)	110	76	45.7	3.0[a]
Cereal production per acre of cultivated land (maunds)	32.1	22.3	43.9	4.9[a]
Gross value of production per acre of cultivated land (Tk)	5,401	4,276	26.3	4.1[a]

[a] The difference is statistically significant at less than 5 percent probability error.

Note: The values are unweighted means at the cultivator level, except for irrigated and HYV areas; those averages have been weighted by the amount of land cultivated.

protection embankment project have been dropped, since for most of the variables, values are lower for the project group than for the control group; this effect should not be attributed to the project.

From the findings it can be seen that the project has a significant effect on the principal variables that affect production. The only exception is the use of labor, for which the effect is found to be positive but not statistically significant. The production effect appears to be more pronounced in cereals than in crop production as a whole. Cereal production is about two-fifths greater than it would have been in the absence of the project; about a fourth is attributable to the increase in yield. The value of production of all crops is about a fourth higher in the project villages, and the difference is statistically significant.

Influence of Varying Physical Infrastructures on the Effects of FFW Program

It can be argued that the effect of economic infrastructures built under the FFW Program may be different depending on the development of physical infrastructures, such as roads and access to markets and financial institutions, in the area of influence of the project. The positive effects of the project are expected to be more pronounced in areas where such facilities have already been developed than in areas that lack them.

One of the variables through which physical infrastructures can influence the effects of the project is the relative prices of the agricultural products and inputs. Proximity to markets and financial institutions and better infrastructures would reduce transaction costs such as transport charges and trade margins and would therefore help producers to realize better prices for their products and lower costs for inputs. The difference between the prices of paddy and two primary inputs, labor and fertilizer, in areas with well-developed infrastructural facilities and the prices in areas where infrastructures are underdeveloped can be seen from Table 2.12. The paddy prices are indeed higher and fertilizer prices lower in areas in which infrastructural facilities are well developed. But the price of labor--the wage rate--is unfavorable to cultivators in areas in which infrastructural facilities are well developed. The price ratio of labor to paddy is about 10 percent higher in developed areas, while the price ratio of fertilizer to paddy is about 10 percent lower in areas in which infrastructural facilities are well developed. The difference in prices is thus expected to have a positive effect on the use of fertilizers but a negative effect on labor. The net effect on production would be difficult to predict a priori.

The findings of the survey on value of production per unit of land with the availability of various types of infrastructures are

Table 2.12--Relative Agricultural Prices under Different Conditions of Physical Infrastructure

Variable	Areas with Well-Developed Infrastructure	Areas with Underdeveloped Infrastructure	Difference (percent)
Absolute prices			
Prices of paddy	170.6 (151.5)	165.4 (149.0)	3.1 (1.7)
Wage rate	18.20	16.18	12.5
Chemical fertilizers	149.1	154.1	-3.3
Relative prices			
Fertilizer--paddy (kg. of paddy to buy kg. of fertilizer)	0.87 (0.98)	0.93 (1.03)	(-6.5) (-4.9)
Labor--paddy (kg. of paddy to buy a day of labor)	4.49	4.06	10.6

Note: Figures in parentheses are prices during the immediate post-harvest periods. such as access to irrigation facilities, are

reported in Table 2.13. It will be noted that the technical factors, such as access to irrigation facilities, are much more important as determinants of production than access to infrastructural facilities. The gross value of production is slightly higher in the areas that have better infrastructural facilities, but this is mainly because a larger proportion of the area is devoted to some cash crops of high value, such as sugarcane. The cereal production per unit of land is lower in developed areas because the proportion of area irrigated, mainly because of government intervention, is larger in areas with less developed infrastructural facilities. The influence of physical infrastructures can be judged more from the difference in yield in individual crop varieties, because it is least affected by the endowments in irrigation facilities. It will be noted from Table 2.13 that the difference in infrastructure does not have any effect on the yield rates of local varieties of cereals, but the yield rate of HYVs is in fact lower in areas with well-developed infrastructural facilities.

The FFW Program has a positive effect on yield rates in both types of area, but the evidence of whether the existence of physical infrastructural facilities adds to the positive effect of the FFW

Table 2.13--The Effects of the FFW Program on Production under Different Conditions of Physical Infrastructure, 1982

Variable	Areas with Well-Developed Infrastructural Facilities			Areas with Under-developed Infrastructural Facilities		
	Project[a]	Control	Both[b]	Project[a]	Control	Both
Gross value of production (Tk per acre)	4,736 (10.8)	4,271	4,588 (7.9)	5,909 (80.2)	3,279	4,252
Percent land irrigated	24.6 (-0.8)	25.4	24.9 (-7.2)	59.6 (43.6)	16.0	32.1
Percent land in HYV	25.9 (-7.5)	33.4	28.4 (-6.7)	62.3 (43.2)	19.1	35.1
Percent area in cash crops	15.1 (1.0)	14.1	14.7 (9.3)	1.5 (-6.2)	7.7	5.4
Yield per acre (maunds)						
Local cereal	19.7 (80.7)	10.9	17.5 (nil)	22.1 (43.5)	15.4	17.6
HYV cereal	39.8 (9.9)	36.2	38.4 (-6.1)	43.5 (21.5)	35.8	40.9
Cropping intensity with cereals	96.2 (12.0)	84.2	92.4 (-12.2)	122.5 (28.5)	94.0	104.6
Paddy production per acre of cropped land (maunds)	24.1 (36.1)	17.7	22.1 (-16.6)	40.4 (119.6)	18.4	26.5

a Figures in parentheses are percent difference between project group and control group.

b Figures in parentheses are percent difference between areas with well-developed infrastructure facilities and areas with underdeveloped infrastructural facilities.

Program is inconclusive. The positive effect is more pronounced in developed areas for local varieties but not for HYVs.

DISTRIBUTION OF PRODUCTION, BY LANDHOLDING STATUS

It is often stated in official documents that a primary objective of the development policy in Bangladesh is growth with equity. Indeed, the FFW Program is undertaken to generate employment during the slack season for the benefit of the rural poor. The study of its short-run effect has shown that the program has succeeded to a large extent in reaching the target group. The analysis in the preceding section has shown that the economic infrastructures built through the program have led to a positive effect on agricultural production. It will be interesting to see how the incremental production is shared by different groups of farmers.

The shares of various landholding groups in total production for 1982 by the project and control groups are shown in Table 2.14. It will be noted that the distribution of production is unequal in both project and control villages. In the project villages, small farms--holding up to 2.5 acres--constitute nearly 63 percent of all farms, but their share of total production was about 29 percent. At the other end, the share of the top 14 percent of the cultivators--those holding more than 5 acres--was about 37 percent of total production. This inequality in the distribution of production, however, emanates primarily from the unequal pattern in the distribution of landholding. Each group's share of production is found to be almost the same as its share of total cultivated land.

Comparing the project and control groups, however, one finds that absolute production per farm is higher in the project villages among each of the landholding groups, but the difference is much less pronounced among the small farms than among the medium-size and large farms. In comparison with the situation without the project, the increase in production is only about 15 percent on small farms, while it is about 46 percent on the medium-size farms and about 36 percent on large farms. As a result, the share of small farms in total production goes down with the project: their share is about 5 percent less in project villages than in the control villages. Thus, while the FFW program has a positive effect on absolute production achieved on small farms, it leads to greater inequality in the distribution of production.

The main factors that contributed to the negative distribution effect are differences in the effect of the FFW Program on the adoption of HYVs and the effect of farm size on crop yields. In the situation without the project there is a strong inverse relation between farm size and adoption of the HYVs. Cereal area cropped with HYVs is 29 percent on small farms but only 22 percent on large farms. Presumably the high pressure of subsistence that follows from the very low level of income may have induced more small farmers than

Table 2.14--Distribution of Agricultural Production, by Farm Size

Landholding Group	Percent of Farms	Percent of Land Cultivated	Cereals: Share of Production	Cereals: Average Production per Farm	All Crops: Share of Production	All Crops: Average Production per Farm
			(percent)	(maunds)	(percent)	(Tk)
Project Group						
Small farms	63.0	29.1	28.9	34.7 (26.6)	28.5	5,860 (15.0)
Medium farms	23.1	32.3	34.7	114.5 (66.7)	34.3	19,240 (46.3)
Large farms	13.9	38.6	36.4	200.2 (65.6)	37.1	34,721 (35.9)
Control Group						
Small farms	64.5	28.5	36.1	27.4	34.2	5,096
Medium farms	22.1	30.4	31.0	68.7	30.2	13,152
Large farms	13.4	41.1	32.9	120.9	35.6	25,557

Note: Small farms are those with holdings of up to 2.5 acres of cultivated land; large farms are those with holdings of more than 5.0 acres.

Figures in parentheses are percentage difference in production between the project and the control group.

large farmers to go for HYVs, despite the fact that the average yield--and therefore profits--is low in the situation without the project and that growing HYVs under limited irrigation facilities entails high risks and low productivity of labor if traditional methods of irrigation such as swing baskets and dhones are to be used--methods that are indeed being practiced in a few control villages.[6] With the increase in irrigation facilities and greater profitability of cultivation following the project, the negative effect on the adoption of HYVs disappears. The proportion of area under HYVs increases only about 6 percent on small farms, while it increases 12 percent on large farms and about 18 percent on medium-size farms.

The findings reported in Table 2.15 also show an inverse relation between size of farm and productivity of land. But this negative effect is more pronounced in the control group than in the project group and with local varieties than with HYVs. The negative effect is usually explained by the differences in the resource positions of the cultivators; the small farms produce more because they are better endowed with labor in relation to capital, and labor is the dominant input in traditional agriculture.

Development of irrigation facilities and better drainage give more scope for the use of modern inputs that require capital, which

Table 2.15--Adoption of HYVs and Crop Yields, by Size of Farm

Size of Holding	Cereal Area under HYV	Yield Rates in Cereals		
		Local Variety	HYV	All Varieties
	(percent)	(maunds/acre)		
Project Villages				
Small farm	35.7	21.2	44.2	29.4
Medium farm	43.8	21.6	40.0	29.6
Large farm	34.0	19.3	42.8	27.3
Control Villages				
Small farm	29.3	17.6	41.4	25.0
Medium farm	25.4	14.4	36.8	20.1
Large farm	21.8	12.5	30.0	16.3

[6] Labor used for irrigating land was 3.6 percent of total labor days used in the project villages, while it was 6.0 percent in the control village. In one of the control villages where HYVs are grown mostly with traditional irrigation, nearly 37 percent of the total labor was used for irrigating land.

scales down the advantages of the labor-using small farms. In the situation without the project, the difference between the productivity of land in cereal cultivation on the small farms and that on the large farms is about 35 percent; with the project the gap narrows to about 7 percent. As a result, average production with the project increases much more on the large farms than on the small farms.

THE EFFECTS OF THE FFW PROGRAM ON EFFICIENCY IN THE USE OF INPUTS: ESTIMATES FROM THE PRODUCTION FUNCTION

Earlier, the effects of the project were assessed by comparing the average values of the variables that influence production in the project and control groups. The approach is partial; the effect on each variable was assessed separately, without dissociating the effects of the other variables.

It is possible, however, to estimate production functions to derive the independent contribution of each of the factors of production while holding the contributions of other factors constant and to compare them with and without the project in order to assess the effects of the project. Production function is also a tool that is used to determine efficiency in the allocation of resources. According to the neoclassic economic theory, allocation of resources is optimum when the marginal product of the resources is equal to their prices. Deviation from this condition means that there is scope for achieving greater efficiency in the use of the inputs through reallocation of the resources. In agriculture, there are certain technical constraints, such as lack of irrigation facilities, that may prevent allocation of inputs in the desired direction. It is often found, for example, that the marginal return from chemical fertilizers is much greater than their costs, implying that additional application of fertilizer would improve allocative efficiency. But application of fertilizer in large amounts often goes with the adoption of HYVs, which is largely dependent on the availability of irrigation facilities. Thus, the FFW Program may lead to a higher level of efficiency in the organization of production by releasing some of the technical constraints.

Information from the survey at the farm level has been used to estimate the Cobb-Douglas production function of the following type for the cereal crops:

$$Y = A L^a N^b F^c, \qquad (1)$$

where

Y = the amount of production of cereals on the farm (maunds),

L = the amount of land cropped with cereals (acres),

N = the number of labor days used in cereal crops, and

F = the amount of chemical fertilizers used in cereals (lb.).

The parameters a, b, and c are values of elasticity of output with regard to the respective inputs. The function was fitted separately for the project and control groups. Again, the sample farms in the flash-flood-embankment project have been excluded from the analysis for the reasons explained earlier. Also, in order to reduce the influence of the natural factors, the cases with average cereal yields of less than ten maunds per acre have been excluded.

Estimation of the parameters posed the usual econometric problems encountered in fitting the agricultural production functions. The explanatory variables are found to be highly correlated.[7] In order to avoid the problem of multicollinearity, the function was fitted in the following modified form:

$$Y = A\, L^{a+b+c}\, (N/L)^{b}\, (F/L)^{c}. \qquad (2)$$

The following estimates of the original and modified form of the production function are obtained from the data for the entire sample:

Original form:

$$\text{Log } Y = 0.90 + \underset{(0.040)}{0.708} \text{ Log } L + \underset{(0.043)}{0.216} \text{ Log } N + \underset{(0.014)}{0.077} \text{ Log } F.$$

$$\bar{R}^2 = 0.88 \quad F = 760$$

Modified form:

$$\text{Log } Y = 0.80 + \underset{(0.021)}{0.673} \text{ Log } L + \underset{(0.040)}{0.190} \text{ Log } N + \underset{(0.014)}{0.096} \text{ Log } F.$$

$$\bar{R}^2 = 0.88 \quad F = 789$$

Figures in parentheses are standard errors of estimate.

The estimated values of the parameters of the modified form are found to be almost the same as those estimated by fitting the unrestricted form, but the standard error for land was substantially reduced, giving greater efficiency of estimate.

Besides land, labor, and fertilizer, a host of other factors, both economic and noneconomic, exclusion of which might introduce specification error into the estimates of the parameters, also

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[7] The data give a correlation coefficient of 0.85 between land and labor, 0.55 between labor and fertilizer, and 0.38 between land and fertilizer.

influence production. The factors worth mentioning are HYV seeds and irrigation, the effect of which might be captured by both labor and fertilizer. But there are problems incorporating all of them into a single equation, because HYV seeds, fertilizer, and irrigation are highly complementary inputs. In order to show their effects, two alternative specifications of the equations have been fitted using land planted in HYVs and irrigation land as separate explanatory variables. The amount of land in HYV has been treated as an additional input in the production function, while irrigation has been used as a shifter variable measured by the proportion of total land irrigated.

Two noneconomic factors that have been included as additional variables influencing production are the proportion of area under tenancy and the educational level of the cultivator.[8] At the theoretical level, there is a controversy over the effect of tenancy on production. The traditional argument is that a sharecropping arrangement, which is the dominant form of tenancy in the area, will provide disincentives to additional application of inputs because the marginal return will have to be shared with the landowner while the additional cost will have to be borne entirely by the tenant. A new school of thought, however, argues that the landowner will stipulate the input of the tenant, so there would be no difference in the use of inputs by a sharecropper and by an owner cultivator.

The education variable is expected to have a positive effect because a literate person would be more receptive to new technology and would be more efficient in the use of modern inputs, such as the application of chemical fertilizers in the right doses and appropriate combinations. But education, in the social setting of the country, can keep a person away from doing manual labor and thus might have a negative influence on production.

The estimated values of the parameters in various specifications of the equation are reported in Table 2.16. The value of adjusted $\bar{R}^2$ shows that the variables included in the equation explain about 93 percent of the variation in production in the project group and about 84 percent in the control group. The statistical significance of the coefficients of land, labor, and fertilizer is high for both areas. But the value of the standard error of the estimates for all three inputs for the project villages is almost half of that for the control villages, which may indicate that the FFW program reduces the risk of production.

The values of the elasticities show that nearly three-fourths of the incremental production is accounted for by land, one-fourth by other inputs. The values of the elasticities are almost the same in the project and control villages, except the elasticity of the use of fertilizer--which may in fact be a proxy for the modern inputs--which

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[8] A dummy variable has been used for education with value 1 if the head of the household had attended secondary school.

Table 2.16--Estimated Parameters of the Production Function in Cereal Cultivation, 1982

Factor of Production	Project Group (N = 190)			Control Group (N = 130)		
	Est.(1)	Est.(2)	Est.(3)	Est.(1)	Est.(2)	Est.(3)
Constant	0.82	0.84	1.23	0.78	0.80	1.29
Elasticity of output with respect to						
Land	0.745 (0.021)	0.778 (0.029)	0.767 (0.021)	0.660 (0.041)	0.696 (0.050)	0.747 (0.041)
Labor	0.145 (0.041)	0.113 (0.046)	0.135 (0.040)	0.200 (0.084)	0.154 (0.089)	0.145 (0.083)
Fertilizer	0.088 (0.013)	0.053 (0.025)	0.081 (0.013)	0.125 (0.034)	0.093 (0.040)	0.122 (0.034)
HYV Land		0.030 (0.023)			0.051 (0.034)	
Coefficients of						
Proportion of area irrigated			0.084 (0.038)			0.294 (0.101)
Proportion of area under tenancy			0.175 (0.071)			0.132 (0.131)
Dummy for educational level			0.713 (0.047)			-0.076 (0.089)
Value of $\bar{R}2$	0.93	0.93	0.93	0.82	0.82	0.84
F Value	773	586	405	198	150	105
Sum of the elasticities	0.98	0.98	0.98	0.99	0.99	1.01

Note: Values in parentheses are standard errors of estimate.

is lower in the situation with the project. The application of fertilizer is low in the situation without the project and the incremental return from additional application therefore remains high. The higher application made possible by the project reduces the incremental return.

That fertilizer may capture the effect of other modern inputs, such as HYV seeds, is indicated by the change of its coefficient in estimate (2), in Table 2.16, where HYV land has been incorporated as an additional factor of production in the model. As a result of the inclusion, the elasticity with respect to the use of fertilizer is reduced from 0.09 to 0.05 for the project villages and from 0.13 to 0.09 for the control villages. It also reduces the coefficient of labor, indicating that the spread of HYVs leads to a higher marginal return on labor. The inclusion of the HYV area, however, increases the standard error of the estimate substantially, indicating the presence of strong multicollinearity between fertilizer and HYVs, so the value of coefficients becomes less reliable.

Inclusion of the proportion of irrigated land as a shifter variable, however, leaves the standard errors of the output elasticities unchanged. The value of the coefficient is found to be statistically significant for both areas, indicating that irrigation leads to a shift in the production function.

The coefficient of tenancy is positive and statistically significant for the project area, contrary to the theoretical expectation. It implies that a tenant achieves greater productivity than an owner-cultivator. This result is also found in some of the earlier investigation of the effect of tenancy on the productivity of land. The coefficient of the dummy variable for education is found to be positive only in the project villages, but the coefficient is not statistically significant.

The sum of the elasticities is almost equal to one for both project and control villages, indicating a constant return to scale in production.

The marginal productivities of the various inputs derived from the estimated parameters in estimate (3) at the mean level of application are reported in Table 2.17. The project group has a higher marginal productivity than the control group to the extent of about 48 percent from land and about 27 percent from labor. The incremental return from the application of fertilizer is, however, lower in the project villages. It can thus be concluded that the economic infrastructures built by the FFW Program have a positive effect on the marginal contribution of both land and labor to production.

The marginal productivities are, however, found to be significantly different from the prices of the input, indicating considerable inefficiency in the use of the inputs. The marginal productivities of land and fertilizer, the scarce resources, are greater than their costs, while the marginal productivity of labor, the abundant resource, is lower than the wage rate in the market. For the control group, the marginal productivity of labor is about 42 percent lower than the wage rate, while for the project group, the difference is 34 percent. The marginal return from fertilizer is about 1.5 times as high as its cost in control villages, while in the

Table 2.17--Estimates of Marginal Productivities of Various Inputs, 1982

Factor of Production	Project Area	Control Area
Marginal Productivities		
Land (maunds)	22.0	14.9
Labor (Tk/day)	11.84	9.34
Fertilizer (Tk/pound)	3.47 (2.27)	5.98 (4.57)
Cost of Inputs		
Rent paid by tenants (maunds)	14.3	10.0
Agricultural wage rate (Tk per day)	17.95	16.03
Fertilizer prices (Tk per pound)	1.82	1.82

Note: The marginal productivities have been estimated at the average values of the variables and elasticities in estimate (3) in Table 2.16. Figures in parentheses are the marginal productivity of fertilizer from estimate (2), which dissociates the contribution of HYV seeds. project villages, the gap narrows

to 25 percent. The findings thus give an indication that with the project, there is a move toward more efficient allocation of resources.

THE EFFECT ON HOUSEHOLD INCOME

Since rural households do not keep records of their activities, it is difficult to estimate income accurately for activities conducted on a self-employed basis. Estimates of income suffer from the usual problems of faulty memory and willful overreporting of costs. There are activities that involve production of fruits and vegetables in kitchen gardens, fishing from nearby creeks and canals, and production of household goods, such as mats, ropes, and nets, which are undertaken irregularly for home consumption. These are expenditure-saving activities, but since rural households do not consider them as income there is a tendency to underreport these activities.

So estimates of rural incomes that use production accounts from data collected by household surveys are usually biased downward.

In this survey, we have been careful to collect information as comprehensive as possible for estimating income. A detailed questionnaire on input and output for crop production activities was administered three times during the year, at the end of each cropping season, in order to reduce the errors attributable to faulty memory. Input-output information on processing, manufacturing, and trading activities was collected through quarterly surveys. The irregular expenditure-saving activities were recorded in the weekly consumption, expenditure, and employment survey, which was administered eight times during the year. Income from these activities for the whole year has been estimated by extrapolating from the estimates for the eight weeks.

The structure of rural incomes obtained from the survey can be seen from Table 2.18. The share of agriculture in total income is estimated at 68 percent for both the project and the control area. Income from crop production, including agricultural wage income, and kitchen gardening constitute about 60 percent of rural income in the project area and about 56 percent in the control area. Noncrop

Table 2.18--Structure of Rural Incomes in Project and Control Areas, 1982

Source of Income	Project group		Control group		Project over Control
	Household Income	Per-cent	Household Income	Per-cent	(Percent)
	(taka/year)		(taka/year)		
Agriculture	13,579	68.7	12,257	68.2	9.7
Crop production	7,432	37.6	5,401	30.0	-8.4
Kitchen gardening	2,367	12.0	2,561	14.2	-7.9
Livestock	1,286	6.6	1,345	7.5	-4.4
Fishing	482	2.4	889	5.0	-45.7
Agricultural wages	2,012	10.2	2,061	11.5	-2.4
Other sources	6,184	31.3	5,723	31.8	8.1
Cottage industry	592	3.0	587	3.3	0.9
Trade	1,465	7.4	1,109	6.2	32.1
Services	3,801	19.2	3,659	20.3	3.9
Nonagricultural wages	326	1.6	368	2.0	-11.4
Total household income	19,763	100.0	17,980	100.0	9.9
Family size	6.46	...	6.02	...	6.6
Income per capita	3,059	...	2,988	...	2.4

agricultural activities and nonfarm activities thus contribute more than two-fifths to total rural incomes.

Total household income is estimated to be about 10 percent greater in the project area than in the control area. The difference in income per capita is less, however--only 2.4 percent--because the households in the project group are larger. Average income per capita is estimated at Tk 3,059 for the project group and Tk 2,988 for the control. Average income per capita for the country as a whole is estimated by the Bangladesh Bureau of Statistics to be Tk 2,826 for the year 1982-83.

The economic infrastructures built through the Food-for-Work Program are likely to have a direct effect on income from agricultural production and a secondary effect on income from industry, trade, construction, and so on generated by increased consumption of nonfarm goods and services and through additional investment. The comparison of the project group with the control group shows that the project has a positive effect on crop production, rural trade, and services but has a negative effect on agricultural wages. One explanation for the negative income effect on agricultural wages may be that since manual labor is considered socially degrading, some of the middle-size farmer, who used to participate in the agricultural labor market when their income was low, withdrew from wage-earning activities when their own production increased because of the project.[9] The increase in cultivation and cropping intensity following development of irrigation and drainage facilities also provides more opportunities for self-employment on the family farm. Total income from crop production and agricultural wages together is about 27 percent greater for the project group than for the control group. Similarly, income from cottage industry and trade is about 21 percent higher for the project group.

Table 2.18 shows that the control group earns significantly more income from noncrop activities, such as kitchen gardening, livestock and poultry raising, and fishing than does the project group. These activities are generally less land-intensive, in which the productivity of labor is low. It appears that at low levels of income, people tend to work more at this type of activity in order to supplement their meager incomes from land; but as the productivity of land increases, leisure is substituted for such low-productive labor. So the effect of FFW on total household income is less than its direct effect on crop production.

Table 2.19 reports the effects on income from crop production, by type of FFW project. As mentioned in the section on methodology, there is no significant difference in household land endowment

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[9] This is supported by labor-use data which show that households owning more than two acres of land in the project area do much less work as agricultural wage laborers than those in the control area (see Chapter 3).

Table 2.19--The Effect of Food-For-Work on Income from Crop Production, by Type of Project

Type of Project	Income from Crop Production per Acre of Land		
	Project Area	Control Area	Difference
	(Tk)		(percent)
Drainage-cum-irrigation canals	3,293	3,001	9.8
Field channel	2,920	1,350	116.3
Coastal embankment	2,285	1,848	23.6
Flood embankment	2,246	2,540	-11.6
Flash-flood embankment	2,478	3,490	-29.0
Average for all projects	2,688	2,368	13.5
Average for projects excluding flash-flood embankment	2,748	2,181	26.0

between the project group and the control group for all projects taken together, but the difference is significant for individual projects. So in assessing the effects at the project level, it is necessary to dissociate the effects of the different land endowments of the project and control groups. This has been done by expressing the value of income per acre of land. The crop production income reported in Table 2.19 includes wage income from this activity. The income effect is found to be positive for drainage-cum-irrigation canals, field channels for irrigation, and coastal-embankment projects, but for the two flood-embankment projects income from crop production is, in fact, greater in the control area. The negative income effect of the flash-flood-protection project, as mentioned earlier, may be the result of both inadequate maintenance of the embankment and problems with selection of the control area. If this project is excluded, crop-production income per acre of land is about 26 percent greater for the project group than for the control group.

Owing to the problem of comparability between the project and the control, a more acceptable method of assessing the effect of FFW on income may be to fit a regression model, relating income to its main determinants and incorporating FFW as a separate explanatory variable. This has also been done by hypothesizing that income from crop production (Y_A) would depend on the amount of land owned by the household (L_O), the amount of land rented (L_R), the number of family workers engaged in agriculture (W), and the value of fixed assets other than land--that is, agricultural implements and draft power (K). Two dummy variables have been used to incorporate the effects

of the economic infrastructures created by the FFW Program (P) and of the general infrastructure--that is, access from the area to roads, markets, service centers, and so on (I). The results are reported in Table 2.20. Two variants of the model have been estimated: 1) excluding the FFW project and infrastructure, and 2) including them. It should be noted that inclusion of the project and infrastructure does not change the value of the coefficients of the other explanatory variables; only the value of the constant term is reduced. This indicates that the FFW project and the existence of general infrastructure shift the income curve upward.

The value of the regression coefficients indicate that one acre of owned land on the margin contributes about Tk 2,500 to household income, and one worker on the margin earns about Tk 1,000 a year in crop-production activity. The marginal contribution of rented land is only about a fifth that of owned land. This is understandable, in view of the exploitative conditions of sharecropping--the tenant must bear the costs of all inputs and give half the gross produce to the landowner. So the tenant earns very little from the rented land beyond what he gets for his labor from self-employment on it. The data do not show any significant relation between crop production and the value of agricultural fixed assets other than land.

Holding all other factors constant, the income of the project group is about Tk 1,912 higher than that of the control group, while total income in the area with well-developed general infrastructure is about Tk 1,130 greater than that in the area with less developed infrastructure. At the mean values of the explanatory variables, estimate (2) in Table 2.20 gives income of Tk 7,372 per household in an area without project or infrastructure. The net contribution of the project is thus estimated to be about 26 percent and that of infrastructure to be 15 percent.

If we include incomes from trade, industry, and services that are likely to be stimulated by the growth of income from crop production activity, the following relationship is obtained:

$$Y = 1{,}319 + \underset{(2.87)}{2{,}120P} + \underset{(3.68)}{2{,}767I} + \underset{(8.39)}{1{,}921L_O} + \underset{(1.72)}{566L_R} + \underset{(3.02)}{1{,}967W}$$

$$+ \underset{(5.26)}{0.205K} + \underset{(0.85)}{723E} \qquad \bar{R}^2 = 0.47 \qquad F = 65.$$

The definitions of the variables are as before, except that K and W include capital and workers employed in nonfarm activities, E is a dummy variable representing education with value 1 for household heads having higher than primary level education, and L_O includes land used for homestead and other purposes, such as ponds and orchards. The figures in parentheses are estimated t values of the regression coefficients.

The coefficient of the capital stock in the total income equation is positive and statistically significant. The value of

Table 2.20--The Effects of Food-For-Work on Income from Crop Production: Regression Estimates

Variable	Unit	Estimate 1	Estimate 2
Constant	Taka per household	3,106	1,494
L_O	Acres	2,511 (14.9)	2,505 (15.0)
L_R	Acres	576 (2.1)	648 (2.4)
W	Persons	970 (3.6)	1,023 (3.8)
K	Taka	0.037 (0.76)	0.028 (0.57)
P	Project=1 Control=0		1,912 (3.18)
I	Developed infrastructure=1 Undeveloped infrastructure=0		1,130 (0.76)
$\bar{R}^2$		0.45	0.47
F		100	70

Note: Values in parentheses are estimated t values.

the coefficient indicates that Tk 100 worth of capital stock earns Tk 21 on the margin, implying a rate of return of 21 percent. The marginal contribution of a worker to total household income is Tk 1,967; the contribution to income from crop production estimated earlier--Tk 1,023--is only about 52 percent of that value.

The coefficient of the project, Dummy P, indicates that household income in the project area is Tk 2,120 greater than in the control area. Recalling that the direct effect of FFW is to increase income from crop production by Tk 1,912, one can conclude from this crude method of analysis that the secondary effect on other sectors generates additional income of Tk 208 per household--that is, about 11 percent of the direct effect. The secondary effect appears to be greater in areas with well-developed infrastructures. Total house-

hold income is greater by Tk 2,767 in the same areas, while income from crop production was greater by only Tk 1,130.

At the mean values of the variables for L_O, L_R, W, and K for the entire sample, the household incomes estimated from the parameters of the equation are reported in Table 2.21 for samples in different types of area.

Table 2.21--The Effects of Project and Infrastructure on Income

Area Characteristics	Annual Income from Crop Production	Annual Income from Crop Production, Trade, Industry, and Services
	(Tk per household)	
Without project or infrastructure	7,372	8,346
With project but without infrastructure	9,284 (26)	10,465 (25)
With project and infrastructure	10,414 (41)	13,233 (59)

Note: Figures in parentheses are percent increase in income compared to the situation without the project.

It appears from the figures that the project increases income about 25 percent in areas that lack infrastructural facilities and about 59 percent in areas in which infrastructures are better developed.

Total income per household in developed areas with the project is higher than that in areas without the project by Tk 4,887, of which Tk 3,042 is attributable to the direct effect on crop production. It thus appears that Tk 1.0 worth of direct effect generates about Tk 0.60 worth of secondary effect in developed areas. In underdeveloped areas the total effect of the project on income is estimated to be Tk 2,119 per household, of which Tk 1,912 is attributable to the direct effect of the project on crop production. An increase of Tk 1.0 in income through direct effect thus generates Tk 0.11 in additional income through secondary effects in the less well-developed areas.

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APPENDIX TABLE

Table A2.1--The Allocation of Land to Various Crops
(Percent of cultivated holding)

Crop	Drainage-cum-Irrigation		Field Channel for Irrigation		Coastal Embankment		Flash Flood Embankment		Flood Embankment	
	Project	Control	Project	Control	Project	Control	Project	Control	Project	Control
Paddy										
Local aus	9.3	19.3	12.9	47.4	...	...	...	...	...	...
HYV aus	1.0	1.0	36.0	*	...	...	...	...	...	...
Mixed aus & aman	1.5	...	5.7	*	...	...	...	...	...	...
Broadcast aman	9.7	18.1	4.7	10.5	...	...	...	...	88.0	13.9
Local T. aman	13.2	16.8	6.1	9.8	97.4	99.2	58.0	46.7	...	9.9
HYV aman	*	...	48.8	...	1.8	...	37.0	44.4	...	8.0
Local boro	28.2	12.8	...	...	...	...	8.3	*	...	...
HYV boro	24.8	24.8	...	...	...	...	68.8	82.4	12.2	55.3
Wheat	*	*	5.2	17.7	...	...	...	...	6.4	3.3
Jute	12.4	8.9	4.1	6.1	...	...	...	...	...	...
Sugarcane	3.7	0.5	7.1	14.0	...	...	...	...	...	...
Oilseeds	12.6	3.8	0.6	6.3	...	...	...	...	3.0	29.9
Pulses	1.4	7.1	9.4	49.2	*	5.8	3.6	10.2	79.2	17.6
Others	17.5	10.4	13.8	9.4	*	*	2.5	5.0	1.0	4.7

APPENDIX TABLE

Table A2.2--Yield Rates of the Principal Crops, 1981
(Maunds per acre of land)

Crop	Drainage-cum-Irrigation			Field Channel for Irrigation			Coastal Embankment		
	Project	Control	Percent Difference	Project	Control	Percent Difference	Project	Control	Percent Difference
Paddy									
Local aus	14.5 (58)	11.2 (69)	29.5	19.9 (59)	14.1 (345)	41.1	...	...	
HYV aus	...	...		31.6 (208)	...		...	...	
Broadcast aman	18.3 (50)	12.2 (72)	50.0	22.4 (29)	8.7 (29)	157.5	...	...	
Local transplanted aman	19.7 (125)	15.0 (56)	31.3	25.2 (44)	11.1 (64)	127.0	14.6 (125)	21.9 (32)	-33.3
HYV aman	...	...		30.9 (300)	26.5 (15)	16.6	...	...	
Local boro	30.7 (117)	26.4 (50)	16.3	...	...		...	...	
HYV boro	44.9 (171)	45.2 (106)	-0.7	...	...		...	...	
Wheat	...	...		12.8 (11)	17.3 (52)	-26.0	...	...	
Jute	18.2 (128)	12.1 (67)	50.4	13.1 (23)	12.3 (50)	6.5	...	...	
Sugarcane	408 (11)	...		542 (14)	575 (20)	-5.7	...	...	
Pulses	7.0 (9)	6.0 (24)	16.7	7.5 (25)	6.4 (122)	17.2	...	...	
Oilseeds	9.4 (87)	3.7 (23)	154.0	53. (5)	5.2 (24)	1.9	...	...	

Note: Figures in parentheses are the number of plots on which the yield estimates are based.

Table A2.2--Yield Rates of the Principal Crops, 1981 (continued)

Crop	Flash Flood Protection Embankment			Flood Protection Embankment		
	Project	Control	Percent Difference	Project	Control	Percent Difference
Paddy						
Local aus	...	...		...	...	
HYV aus	...	...		...	...	
Broadcast aman	...	...		25.5 (166)	21.0 (11)	21.4
Local transplanted aman	16.7 (166)	27.4 (90)	-39.1	...	23.6 (6)	
HYV aman	21.0 (118)	29.9 (95)	-70.2	...	27.1 (5)	
Local boro	...	...		...	...	
HYV boro	32.7 (204)	27.2 (151)	20.2	58.6 (14)	46.8 (28)	25.2
Wheat	...	...		...	...	
Jute	...	...		...	...	
Sugarcane	...	...		...	...	
Pulses	...	...		15.5 (153)	13.5 (10)	14.8
Oilseeds	...	...				

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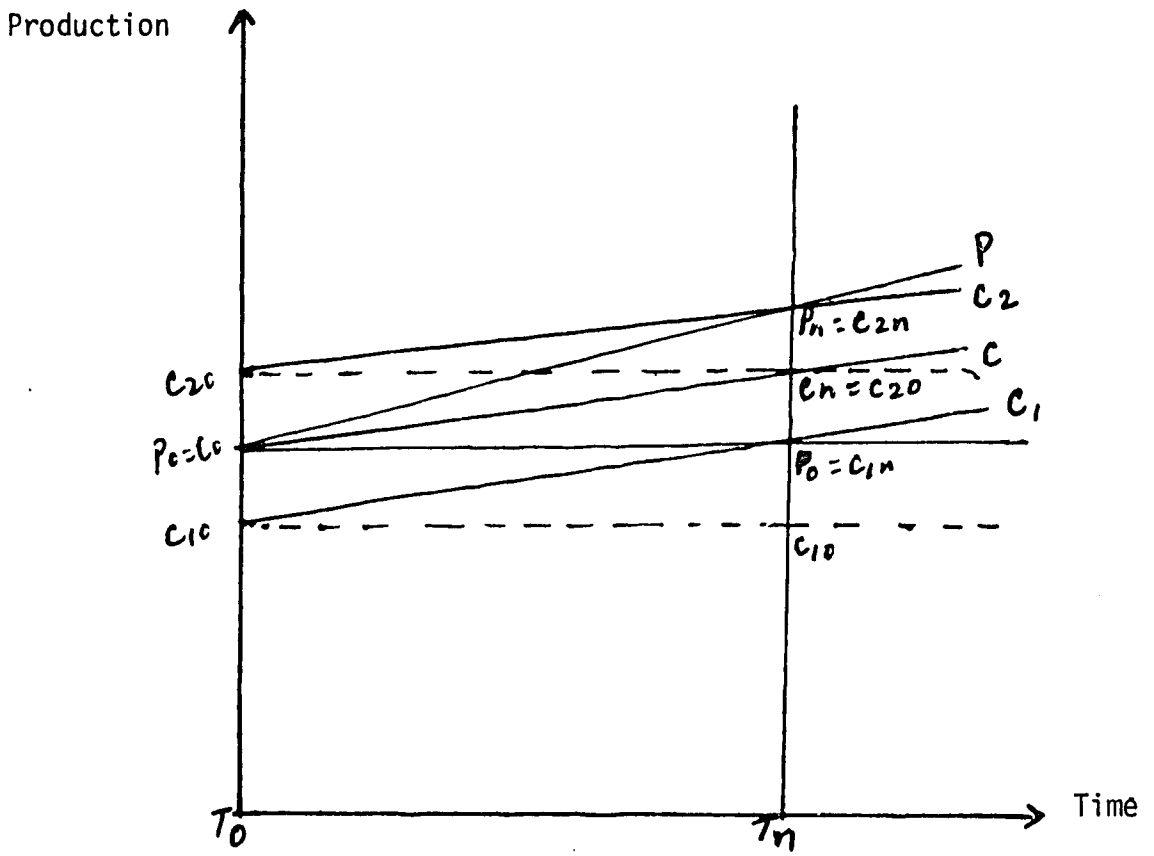
Appendix to Chapter II

Assessing the Effects of the Project: An Analysis Based on Memory Recall

The objective analysis of the effects of the Food-for-Work (FFW) Program carried out in the preceding chapters was based on a comparison, at the time of evaluation, of variable values for a sample project group and a control group. The validity of the results of such a comparison depends critically on the assumption that the project group was similar in all respects to the control group before initiation of the project. In practice, however, it is extremely difficult to find a control group that meets this requirement--often because of lack of knowledge about the preproject situation. There are a host of agroeconomic and socioeconomic factors, as well, that may affect production and income and are difficult to assess without detailed investigation.

The best methodology for evaluating the effects of a project involves selecting project and control areas before implementation of the project, collecting relevant information for both project and control villages through a benchmark survey at the time of implementation, and assessing changes in those variables during the period between benchmark and evaluation points. This is clarified in Figure A.1. The horizontal axis denotes time, the vertical axis the values of the variable against which the effect of the project is to be measured--agricultural production, for example. In this figure, the value of production in the project area; at the benchmark point was Po, which increased to Pn at the time of evaluation of the project, n. It would be incorrect to ascribe the difference in Po-Pn entirely to the project, since certain autonomous changes would surely have taken place in the project area during the period To-Tn even in the absence of the project. In evaluation of the effects of the project, the effects of such autonomous changes need to be dissociated. The control area is selected for this purpose. The curve C, C_1, and C_2 depicts the autonomous changes in the control area in three different situations during this period. The slopes of the three curves are the same, indicating that production would have increased by PoCn even in the absence of the project. The real effect of the project is thus an increase in production of PnCn. The point here seems to be that if a control such as C is selected in which the level of production is exactly the same as that of the project area at the benchmark point, no information for the benchmark period is needed. If such a control as C_2, which was better off

Figure A.1--Measuring the Effects of the Project by Tracing Changes in Project and Control Areas



(C_{20} < Po) at the benchmark point had been selected, the conclusion would have been that the project did not have any effect on production (Pn = C_2n), unless the effect of time on production had been traced out for both the project and the control areas. If that is done the same conclusion is reached--namely, that the project increased production by PnCn, which is equal to the change in the project area (PoPn) minus the change in the control area (C_{20} C_2n). Similarly, if a control such as C_1 had been selected, the wrong conclusion--that the project increased production by Pn C_1n, which is larger than PnCn--would have been reached.

For the projects under evaluation in this study, no benchmark survey was carried out; therefore, no information about the preproject situation, even for the project areas, was available. We had no alternative but to evaluate the effects of the project by comparing the situations in project areas with those in control areas during the period of evaluation. We had spent a considerable amount of time searching for suitable controls, by looking into factors such as average size of landholdings, proportion of landless households, area given over to large farms, level of land, and types of soil. But whether the controls were close approximations of the projects in the preproject situation in all respects was impossible to determine. For coastal embankment projects it was even difficult

to find controls, as almost all coastal areas were covered by the project. Thus even our choice of a particular project for this study was limited. In any event, during the course of this evaluation it became apparent from the data already collected and from discussion with the interviewers that some controls, particularly for the flash-flood-embankment project, were not good choices. The people of the control area were considerably better off than those in the project area long before implementation of the project. This became even clearer when the information on land levels for all plots belonging to the sample households was processed at the start of the survey (see Table A.1).

Table A.1--Distribution of Owned Land, by Land Level

Type of Project	Project group			Control group		
	High	Medium	Low	High	Medium	Low
	(percent of total land)					
Drainage-cum-irrigation canal	31.3	27.9	40.8	42.5	28.3	29.2
Field channel for irrigation	33.1	42.8	24.1	58.4	22.3	19.3
Coastal embankment	22.3	28.2	48.9	41.4	7.2	61.6
Flash-flood protection embankment	17.5	29.6	52.9	15.8	67.5	16.7
Flood protection embankment	31.4	43.1	24.5	31.9	34.3	33.8
All Projects	27.9	34.7	37.4	45.6	29.3	25.1

It can be seen from Table A.1 that in three out of five types of project, the proportion of high land, which is difficult to irrigate, was larger in the control area. Farmers grow low-yielding broadcast aus, pulses, and oilseeds on such land. From this information it would be expected that the average productivity of land would be lower in the control area than in the project area and that a simple comparison of values between project and control would have overestimated the positive effects of these projects. The opposite is true in the case of the flash-flood-embankment project--the difference is even more striking. In this case, about 53 percent of the land held by the sample households in the project villages, but only 16 percent of that in the control villages, was low-lying. Such lowlands are usually single-cropped, either in broadcast aman

or local boro, and the embankment built to protect the land from early flash floods enabled farmers to grow an early high-yielding paddy. In the control village, Chasapara, mid-level land, which could easily be irrigated, constituted about two-thirds of the total area. In fact, under the influence of the Comilla Cooperatives, modern irrigation by means of tube wells had been started quite early in the area. The project area could not avail itself of such facilities to the same extent as the control because of the much larger proportion of low-lying land. Simple comparison of the mean values of project and control variables would thus underestimate the true benefit of this project.

The complications in the methodology of the study having been foreseen, another survey was conducted to collect information on important preproject variables--cropping patterns, crop yields, and investment or disinvestment of principal fixed assets since implementation of the project. Obviously, the problem of memory recall would make this data set less reliable than the data used for the objective analysis. But at least it would indicate directional changes in the project and control areas, which would supplement the objective analysis. Fifty percent of the sample households were also queried at the end of the survey period about changes in their economic condition during the period since implementation of the projects. The findings are reported in this appendix.

The Effect on Agricultural Production

Cropping Intensity. Tables A.2 to A.6 show the changes in cropped area per household and the cropping distribution for different types of project. A summary comparing project and control areas for all types of project is included in Table A.7. It can be seen that the average area of cropped land in the preproject situation was only about 3 percent greater in the project group than in the control group, indicating that the results of our objective analysis of this variable are not too far from reality. The cropped area increased about 4.7 percent above the preproject level in the project area and declined about 2.7 percent in the control area. Assuming that the acreage under cultivation by project and control groups would not normally change during such a short period, one can conclude that the project may have increased cropping intensity about 7.4 percent. The figures for different types of project suggest that the effect on cropping intensity of irrigation-cum-drainage canal, flood-embankment, and flash-flood-embankment projects is positive, but the effect of coastal embankment projects is insignificant, and that of field-channel projects is negative.

Cropping Pattern. It can be seen from Table A.7 that before initiation of the project about two-thirds of the cropped area was cultivated in local paddy in both project and control areas. But the proportion of the area planted in HYV paddy was smaller in the

Table A.2--The Effects of Flood-Embankment Projects on Cropping Patterns

Crop	Project Group		Control Group	
	Before Project	After Project	Before Project	After Project
	(percent)			
Local aus	...	...	4.4	...
Broadcast aman	39.1	36.7	21.0	8.9
Local transplanted aman	4.1	3.8	...	...
HYV aus and boro	...	9.8	34.1	54.9
Wheat	...	...	17.7	12.5
Pulses	40.5	38.0	7.6	7.9
Oilseeds	11.1	10.3	13.1	14.1
Jute	2.2	1.3	2.3	1.2
Cropped land per household (acres)	5.95	6.42	2.29	2.23

Table A.3--The Effects of Flash-Flood-Protection Embankment Projects on Cropping Patterns

Crop	Project Group		Control Group	
	Before Project	After Project	Before Project	After Project
	(percent)			
Local aus	35.4	3.0	...	...
Broadcast aman	1.0	...	...	...
Local T. aman	40.2	19.3	51.5	30.3
HYV aman	12.8	27.9	1.5	19.6
HYV aus and boro	10.5	49.5	47.0	50.1
Chilli	0.2	0.3	...	...
Cropped land per household (acres)	2.66	2.92	4.53	4.01

Table A.4--The Effects of the Field Channel for Irrigation Project on Cropping Patterns

Crop	Project Group		Control Group	
	Before Project	After Project	Before Project	After Project
	(percent)			
Local aus	43.8	15.8	41.8	40.6
Local B. aman	24.2	8.0	12.7	11.6
Local T. aman	2.3	1.1	4.2	5.2
HYV aus and boro	1.6	22.7	...	1.1
HYV aman	1.2	34.5	...	...
Wheat	3.0	3.8	9.4	7.4
Pulses	13.0	3.3	13.0	13.5
Oilseeds	3.3	3.4	6.4	7.4
Jute	8.1	6.7	6.7	6.0
Sugarcane	6.5	4.0	4.9	6.2
Chilli	...	0.4	1.0	1.0
Cropped land per household (acres)	4.32	4.07	4.68	4.50

Table A.5--The Effects of the Coastal Embankment Project on Cropping Patterns

Crop	Project Group		Control Group	
	Before Project	After Project	Before Project	After Project
	(percent)			
Local aus	0.2	0.3	...	...
Local T.aman	88.7	91.7	86.1	93.9
HYV boro and aus	...	4.5	2.8	2.6
Oilseeds	7.6	...	8.3	2.8
Jute	3.5	3.6	...	...
Pulses	...	...	2.8	0.7
Cropped land per household (acres)	2.05	2.00	1.80	1.89

Table A.6--The Effects of the Drainage-cum-Irrigation Canal on Cropping Patterns

Crop	Project Group		Control Group[a]	
	Before Project	After Project	Before Project	After Project
	(percent)			
Local aus	10.6	10.8	33.9	25.2
Broadcast aman	23.3	17.3	1.6	0.5
Local transplanted aman	11.6	11.2	25.0	25.6
Local boro	18.0	16.6	9.6	11.2
HYV aman	1.5	2.3	...	...
HYV aus and boro	8.8	18.7	22.3	31.7
Jute	15.9	10.6	4.1	3.1
Sugarcane	0.9	2.3	...	...
Pulses	2.6	0.8	...	...
Oilseeds	6.0	8.6	3.6	2.5
Chilli	0.9	0.8	...	...
Cropped land per household (acres)	3.21	3.60	2.62	2.62

[a] The information could not be collected for village Rajarampur.

Table A.7--The Effects of FFW Program on Cropping Patterns

	Project Area			Control Area			Effect of Project
	Before Project	After Project	Net Change	Before Project	After Project	Net Change	
	(percent)						
Local paddy	67.5	43.3	24.2	56.7	54.4	-2.3	-
HYV paddy	7.0	36.5	29.5	16.9	20.9	4.0	+
Wheat	0.9	1.0	0.1	6.6	5.0	-1.6	+
Jute	6.5	3.8	-2.7	3.8	3.3	-0.5	-
Sugarcane	2.0	1.5	-0.5	2.3	2.9	0.6	-
Pulses	10.0	8.7	-1.3	7.4	7.4	nil	-
Oilseeds	5.3	4.9	-0.4	5.7	5.7	nil	-
Chilli	0.4	0.3	-0.1	0.5	0.4	-0.1	nil
Total cropped land per household (acres)	3.38	3.54	4.7	3.28	3.19	-2.7	+

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project area--only 7.0 percent--than in the control, where it was 17 percent. Regarding wheat and pulses, which are competing crops, a larger proportion of the control area was planted in wheat, the higher-yielding crop. Thus, a larger proportion of the land in the control area than in the project area was cultivated in higher-yielding crops at the benchmark point. In that respect, comparison between the project and control area during the period of evaluation would underestimate the positive effects of the project to some extent.

The acreage figures in Table A.7 show very little change in allocation of cropped land in the control area since the period of implementation of the project. The area planted in HYV paddy increased by only four points, and this was achieved partly at the expense of local paddy (-2.3 percent) and wheat (-1.6 percent). A substantial change is evident in the project area, however, where the share of cropped land planted in HYV paddy has increased by about 30 percent, mostly at the expense of local paddy (24 percent), jute, and pulses. A comparison of the changes in patterns of land allocation thus indicates a positive project effect--25 percent--on productive use of land. Even in the absence of any change in the yield rates of individual crops, therefore, a crop-allocation effect alone could have contributed to an increase in production.

In a comparison of different types of project (Tables A.2-A.6) it can be seen that crop-allocation patterns in the control area at the benchmark point were similar to those in the project area only in the areas of the field-channel and coastal-embankment projects. Where the other three types of project were undertaken the control area was in fact better off, at least in production of HYV, than the project area. In the flash-flood-embankment project again, about half the land in the control area was cultivated in HYV boro or wheat, whereas in the project area mostly low-yielding pulses (khesari) and oilseeds were grown during the winter season, when HYV boro and wheat are usually grown.

After the benchmark point, a positive effect of the field-channel, drainage-cum-irrigation, and flash-flood-embankment projects on cropping patterns can be observed. In the area affected by the field-channel project, the share of HYV remained almost insignificant in the control area, even at the time of evaluation of the project, while in the project area it had increased from only 4 percent to 57 percent. Near the flash-flood-protection project, the proportion of the area cultivated in HYV increased from 23 to 77 percent in the project area and from 49 percent to 70 percent in the control area. The coastal-embankment project brought very little change in cropping patterns in either the project area or the control area, while in the area served by the flood-protection-embankment project, there was a larger increase in the area cultivated in HYV in the control area than in the project area, facilitated by an increase in irrigation facilities brought about through the use of electrical lowlift pumps.

Crop Yield. Changes in the yield per acre of the principal crops grown in the project and control areas since the implementation of the project are reported in Table A.8. The figures represent normal yields rather than actual yields for the periods of reference. The largest increase was in the yield of broadcast aman in the area of the flood-protection embankment, where the yield increased from about 14 maunds per acre to about 29 maunds. The yield of the alternative crop grown in the control area, HYV aus, is about 150 percent higher than the yield of broadcast aman, even after completion of the project, when the crop is protected from flood. The effect on the yields of the principal crops grown in the drainage-cum-irrigation-canal area is also significantly positive. But the difference in the changes in crop yields is not highly significant in the areas of the field-channel and flash-flood-protection embankment projects. In the area of the coastal embankment, the yield at the benchmark point was reported to be significantly higher in the control area, indicating that the area was presumably less affected by the intrusion of salt water than was the project area. The project group of samples, however, showed about a 21 percent increase in yields above the benchmark level, while the control group showed a decline in yields. Thus, although the yield level was found to be similar--25 maunds an acre--during the period of evaluation, the project appears to have had a significantly positive effect on crop yields in this area.

Table A.8--The Effects of Food-for-Work Projects on Crop Yields

Type of Project	Crop	Control Area			Project Area		
		Before Project	After Project	Percent Change	Before Project	After Project	Percent Change
		(maunds per acre)			(maunds per acre)		
Drainage-cum-irrigation canal	B. aman	20.36	23.83	17	--[a]	--[a]	--[a]
	Local boro	26.06	29.77	14	26.25	26.25	0
	HYV boro	43.25	52.12	21	62.86	53.21	-15
Field channel	Local aus	15.87	13.76	-13	19.39	15.44	-20
	HYV aman	28.50	32.67	15	--[a]	--[a]	--[a]
Coastal embankment	Local T. aman	20.27	24.56	21	32.00	25.43	-21
Flash-flood embankment	Local T. aman	24.91	26.61	7	29.33	31.56	8
	HYV boro	35.00	41.48	19	38.06	42.05	10
Flood embankment	B. aman	14.25	28.80	102	--[a]	--[a]	--[a]
	HYV aus	70.00	70.00	0	64.55	71.67	11

[a] Acreage insignificant.

Gross Value of Production. Table A.9 shows the gross value of crop production at constant 1981-82 prices estimated from the reported information on crop acreage and normal yield. It appears from the figures that at the benchmark point yields in the control area were about 10 percent greater than in the project area, indicating that comparison between project and control during the period of evaluation would underestimate the positive effect of the project on crop production. This discrepancy, however, is largely attributable to the flash-flood-embankment project, where production in the control area was about 125 percent higher at the benchmark point than production in the project area. If this project is excluded, the value of production per household comes to Tk 9,182 in the control area, Tk 9,351 in the project area. Thus, comparison of the mean values of variables excluding this project, as was done in the preceding chapter, would not seriously distort the results.

Table A.9--The Effects of Food-for-Work Projects on Gross Value of Agricultural Production, at Constant 1981-82 Prices

Type of Project	Project Area			Control Area		
	Before Project	After Project	Percent Change	Before Project	After Project	Percent Change
	(taka per household)			(taka per household)		
Drainage-cum-irrigation canal[a]	10,016	15,622	56	6,681	7,789	17
Field channel for irrigation	14,393	18,796	31	10,425	10,749	3
Coastal embankment	5,425	7,082	31	6,024	5,218	-13
Flood-protection embankment	12,609	20,583	63	12,353	14,056	14
Flash-flood-protection embankment	7,956	13,840	74	17,880	18,978	6
All Projects	9,196	14,624	59	10,631	10,761	7

[a] The control area excludes Rajarampur, for which this information could not be collected.

For all projects taken together, the value of crop production in the control area increased about 7 percent during the three-year period, 1979-82, following implementation of the project. In contrast, the rate of increase in the project area was 59 percent.

Thus, during this period the project appears to have had a positive effect of about 52 percent on production. Comparing the figures for the individual projects, it appears that the rate of increase was the highest--68 percent--in the area of the flash-flood-protection embankment project, although after completion of the project the value of production in the project area was about 27 percent less than in the control area. The objective analysis also showed negative or insignificant effects on production for the coastal-embankment and flood-protection-embankment projects. The changes in production in control and project areas shown in Table A.9, however, reveal a significant positive effect on production for these two types of project.

The Effect on Income

The respondents in both the project area and the control area were asked the question, "What has been the change in your economic condition since the period of implementation of the FFW project?" From the distribution of the responses to be seen in Table A.10, it

Table A.10--Responses to the Question "What has been the Change in your Economic Condition since the Period of Implementation of FFW Projects?", by Type of Project

Type of Project	Project Area			Control Area			Value of Chi Square	Level of Significance
	Improved	Unchanged	Deteriorated	Improved	Unchanged	Deteriorated		
	(percent)							
Drainage-cum-irrigation canal	52.5	32.5	15.0	27.8	41.7	30.6	5.32	0.07
Field channel for irrigation	57.5	25.0	17.5	50.0	17.5	32.5	2.54	0.28
Coastal embankment	25.9	27.6	44.4	25.0	25.0	50.0	0.17	0.92
Flash-flood-protection embankment	65.8	10.5	23.7	30.0	45.0	25.0	10.10	0.01
Flood protection embankment	94.7	5.3	0.0	...	60.0	40.0	35.3	0.00
All Projects	57.3	22.0	20.7	30.1	35.3	34.6	22.19	0.00

can be observed that for all projects taken together, the economic conditions of the people in the control area remain almost unchanged, since the respondents are equally divided among response categories--about a third giving each answer. In the project area, however, about four-fifths of the respondents report that their conditions have either improved--57 percent--or remain unchanged--22 percent. This subjective response shows that the FFW Program has a positive effect on income. The Chi-square value for the difference between the responses in the project area and in the control area is found to be highly statistically significant. The largest positive effect is found to be in the flood-protection-embankment area, where 95 percent of the respondents in the project area report that their conditions have improved, while none in the control area report improvement.[1] Respondents reporting improvements in their economic conditions are also in the majority in the project group for the flash-flood-embankment, field-channel, and drainage-cum-irrigation-canal projects, and their proportion is significantly higher than those in the control group reporting improvements. The responses show that in the coastal-embankment area, however, the economic conditions of the people have deteriorated. About 50 percent of the respondents in the control area of this project and 44 percent in the project area report that their economic conditions have deteriorated.

The responses of different landownership groups concerning changes in their economic conditions are shown in Table A.11. It can be seen that respondents who own up to 5.0 acres of land in the control area report deterioration of their economic condition. In the project area, on the other hand, only the conditions of the landless and nearly landless--those who own no more than half an acre--remained unchanged; almost the same proportion reported improvement as reported deterioration. In contrast, the conditions of the larger landholding groups have improved considerably. In the large landowning group 92 percent reported an improvement--none reported deterioration--while 54 percent of the small owners reported improvement and the medium-size owners 72 percent. Thus, under conditions of economic stagnancy, as in the control area, it is only the rich whose economic conditions improve. But under conditions of growth, as in the project area, inequality increases, but absolute conditions in the poorer sections also improve.

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[1] In the objective analysis presented in Chapter 2, it was found that production levels in the control area for this project were higher than those in the project area, which is contrary to this result. The reason might be greater inequality in the distribution of land in the control village and the high cost of production of HYVs, which are grown on a much larger proportion of the land in the control area than in the project area.

Table A.11--Responses to the Question, "What has been the change in your Economic Condition since the Implementation of the Food-for-Work Project?", by Landownership Group

Type of Project	Project Area			Control Area			Value of Chi Square	Level of Significance
	Improved	Unchanged	Deteriorated	Improved	Unchanged	Deteriorated		
	(percent)							
0.5 acre or less (N = 107)	37.6	24.5	35.8	22.2	48.1	29.6	7.96	0.03
0.51-2.0 acres (N = 87)	53.8	26.9	19.2	25.7	37.1	37.1	7.14	0.03
2.01-5.0 acres (N = 81)	72.3	17.0	10.6	38.2	44.1	44.1	12.92	0.02
More than 5 acres (N = 25)	91.7	8.3	...	53.8	23.1	23.1	4.86	0.09

The Effect on Investment

Information was also collected from respondents on the principal expenditures incurred in acquisition of fixed assets since 1979-82, the period of implementation of the project. This information has been used to compile a picture of the level and pattern of investment in the project and control areas which is shown in Table A.12. The figures do not include nonmonetized investment, which we tried to incorporate into the objective analysis of the effects on investment (in Chapter 4). We also collected information on the purchase and sale of land, but we have not included this expenditure in investment because it is a transfer item, since investment by one household on this account basically finances the consumption of others.

The figures reported in Table A.12 are yearly averages of the household's expenditure. Since they are reported at current prices, the average values would be approximately equal to constant 1980 prices, while the income figures, on the other hand, are in 1982 prices. The price index for agricultural products increased about 22.5 percent during the period 1980-82. The income figures reported in Table A.12 have been estimated in constant 1980 prices by using this price deflator.

It can be noted that the rate of investment is estimated at about 13.1 percent for the project area and about 8.2 percent for the control. In monetary terms the investment is about 88 percent

Table A.12--The Effects of Food-for-Work Projects on Investment, 1979-82

(annual household investment, at 1980 prices)

Line of Investment	Project Area Taka	Project Area Percent of Total	Control Area Taka	Control Area Percent of Total	Difference between Project and Control	Level of Significance
Agriculture (excluding acquisition of land)	859	38.1	683	56.8	26	0.21
Other sectors	317	14.1	225	18.7	41	0.19
Education, health, and sanitation	668	29.6	450	37.4	48	0.05
Housing	840	37.2	423	35.2	99	0.001
Disinvestment	(428)	(19.0)	(578)	(48.0)	-22	0.13
Total investment	2,256	100.0	1,203	100.0	88	0.00
Income per household (at 1980 prices)	17,284		14,584		18.5	
Rate of investment	13.1		8.2		4.9	

the control. In monetary terms the investment is about 88 percent greater in the project area, and the difference is highly significant statistically. A social investment, such as expenditure for housing or for education of children, is more income elastic than the productive investment for acquisition of agricultural tools and equipment or for livestock. The investment in the project area is about twice that in the control area, for housing, 41 percent higher for nonagricultural investment, but only 26 percent for acquisition of fixed assets in the agricultural sector. Thus, project-induced growth of investment would generate more linkage effects in other sectors than in the agricultural sector.

III. LABOR MARKET AND EMPLOYMENT EFFECTS

Knowledge of the operation of the rural labor market is necessary for policies that are intended to increase employment and income, particularly for the landless, but little is known about the functioning of the rural labor market in Bangladesh. A few studies, which are based on information collected from one or two villages exist, but the information on employment for the entire year was collected from a one-shot survey, which is likely to have a large margin of error, and the analysis was confined principally to the agricultural sector. A detailed examination of the operation of the rural labor market, based on more reliable information, would therefore be extremely useful to the academic community in general and the development planners in particular.

Since the research investigators who collected field data stayed in the selected study villages for a period of about 14 months, they had an opportunity to observe the pattern of rural employment closely. Also, the coverage of the study areas is such that it may give a representative picture of the Bangladesh economy. The 16 villages selected for the study cover all 4 administrative divisions and the principal ecological zones of the country. And a proportional random sample was drawn for intensive investigation after a complete census of the households in the villages had been taken.

It will be seen from the findings that employment in rural Bangladesh consists primarily of self-employment and that most of the workers are hired on a daily basis, particularly in agriculture. Also, since agriculture depends largely on nature, there is a high degree of seasonality in the demand for labor. Thus, workers change jobs from one day to another, from self-employment to wage employment, and from agriculture to other forms of employment. Under these circumstances, accurate information on employment can be obtained only through a large number of regular surveys covering a short period, so that the respondent can recall what he did during this period. To collect accurate information for the whole year, it would have been ideal to make 52 weekly surveys, which resources at our disposal did not permit. Instead, we collected information for all members of the households who participated in productive work, for each day of the week preceding the day of interview, for 8 weeks scattered throughout the year 1982. The periods were selected on the basis of a priori knowledge of the area so as to represent the normal, busy, and slack periods of employment. The extent of employment for the whole year and its composition was then estimated by extrapolating from the data for these 8 weeks.

PARTICIPATION IN ECONOMIC ACTIVITIES

A worker was defined as a person who was available for work in productive activity during any of the 8 weeks of the survey. The average number of workers estimated from the survey is 1.80 persons per household out of a population of 6.28 persons per household in the entire sample (see Table 3.1). The labor-force participation rate thus comes to about 28.7 percent (a dependency ratio of 3.5 persons per worker) of the total population and 42.7 percent in the active age group (10 years old and over). The 1974 population census of Bangladesh found the participation rate for the country as a whole to be 28.7 percent for the entire population and 44.3 percent in the active age group. The participation rate is abnormally low compared to other developing countries, where about 37.5 percent of the total population participate in economic activities.

Table 3.1--The Extent of Participation in Economic Activities

Variable	Project Group	Control Group	All Groups	Difference between Project Group and Control Group
				(percent)
Number of persons per household	6.41	6.11	6.28	4.9
Number of persons in active age group (10 and over)	4.31	4.10	4.22	---*
Number of workers per household	1.77	1.85	1.80	---*
Working members as percent of total population	27.6	30.3	28.7	2.7
Working members as percent of active population	41.1	45.1	42.7	4.0

* Negligible.

The main factor in the low participation rate is the virtual noninvolvement of women in the labor force. It will be seen from Table 3.2 that only about 7.2 percent of the female population--10.7

Table 3.2--The Extent of Participation in Economic Activities, by Sex

Variable	Project Group	Control Group	All Groups
Worker as percent of total population			
Male	49.5	51.6	50.4
Female	6.8	7.7	7.2
Worker as percent of population in active age group			
Male	72.8	78.3	75.1
Female	9.9	11.3	10.7

percent of the active age group--are in the labor force. About 75 percent of the male population in the age group 10 and over participate in economic activities, a rate similar to the rate of 75.6 percent estimated for other developing countries for 1970.

The participation rate can be taken as a proxy indicator of the supply of labor in the stock sense. It was found in the survey that the socioeconomic position of the household has a strong influence on this variable (see Table 3.3). The participation rate decreases monotonically with an increase in the size of landownership. It is about 30.7 percent for the functionally landless group--households with up to 0.5 acres of land--but only 20.8 percent for households owning more than 7.5 acres of land. The supply of labor declines with the size of ownership very slowly up to holdings of 5.0 acres, then it falls dramatically. It appears that the very poor households supply as many workers as possible to the labor force in order to earn a subsistence income for the family. As soon as the subsistence requirement has been met, they may withdraw some of the working members--the children, for example, so that they can be sent to school.

That the economic position of a household influences the supply of labor is also revealed by the relation of the participation rate to the size of cultivated holding and the form of land tenure. It is found that the participation rate of the owner cultivators is lower than that of the tenants, and that of the large farmers (24.1 percent) is lower than that of the marginal cultivators (30.4 percent) or the landless noncultivators (32.8 percent).

Table 3.3--Labor Force Participation of Various Socioeconomic Groups

Socioeconomic Group	Total Population in the Sample	Number of Workers	Rate of Participation
			(percent)
Landholding group			
Landless noncultivator	667	219	32.8
Marginal farmer (up to 1.0 acre)	1114	339	30.4
Small farmer (1.01-2.50 acres)	885	247	28.9
Medium farmer (2.51-5.00 acres)	906	258	28.4
Large farmer (5.01 or more acres)	474	114	24.1
Tenurial group			
Owner cultivator	2333	655	28.1
Owner cum tenant	1016	303	29.8
Landowning group			
Up to 0.5 acres	1350	415	30.7
0.51-2.00 acres	1186	354	29.8
2.01-5.00 acres	1077	315	29.2
5.01-7.50 acres	235	58	24.7
7.51 or more acres	168	35	20.8

It may be asked whether differences in the rate of participation among socioeconomic groups is a function of the difference in the age structure of the population. If the proportion of population in the active age group is lower in the larger landholding groups, an inverse relation between the participation rate and the size of holding would be expected. The findings of the survey on the age structure of the population, by landholding, are reported in Table 3.4. The age structure is found to be almost the same for the different groups of households. The proportion of population in the most active age group, 16 to 55, is about 43.7 percent for the entire sample; it varies from 44.3 percent for the landless noncultivators to 43.4 percent for the large farmers. The lower rate of participation among large landholders can thus hardly be explained by the difference in the age structure of the population.

Table 3.4--Age Structure of the Population, by Size of Landholding
(Percent of total population)

Age Group	Landless Noncultivators	Marginal Farmers	Small Farmers	Medium-Size Farmers	Large Farmers	All Groups
Up to 5	19.8	20.6	17.5	17.1	17.2	18.6
6-15	29.2	31.6	32.0	30.0	30.6	30.9
16-25	18.8	17.4	18.6	21.0	19.2	18.9
26-55	25.5	25.0	25.5	23.7	24.2	24.8
56 and over	6.6	5.4	6.4	8.2	8.8	6.8

The Effect of the FFW Program on the Rate of Participation

The proportion of the population in the active age that participates in economic activities is found to be about 1.9 percent lower in the project group than in the control group (see Table 3.1). The difference is found to be more pronounced when the rate of participation is estimated separately for the male and female populations. The proportion of males in the active age group that participates in the labor force is about 72.8 percent in the project group, about 78.3 percent in the control group (see Table 3.2). The difference in the participation rate of the female population is 1.4 percent.[1]

The negative effect of the FFW Program on the supply of labor may have originated from its effect on the agricultural production and income of the cultivators. It was pointed out in the preceding chapter that the infrastructures built under the FFW Program have a significant positive effect on agricultural production of all landholding groups. With the increase in income, some of the workers in the project group who had been participating in economic activities because of subsistence pressure appear to withdraw themselves from the labor force. It will be noted from Table 3.5 that there is a significant difference between the project and control groups in the age composition of the workers. The number of workers in the project group is in fact less than in the control group only among

[1] The sex ratio of the population in the active age group differs significantly between the project group and the control group. The male-female ratio is 1.08 in the project group and 1.0 in the control group.

Table 3.5--Age Composition of the Population of Workers

Age Group	Number of Workers per 100 Households		Percent of Total Workers	
	Project Group	Control Group	Project Group	Control Group
Up to 14	10	12	5.6	6.5
15 to 24	46	51	26.0	27.7
25 and over	121	121	68.4	65.8

the children who participate in the labor force under extreme economic pressure, and among the age group 16-25, some of the members of which may attend high schools and colleges if the economic conditions of the household permit. But in the most active age groups, 25 and over, the number of workers is the same in the two groups of households.

EXTENT AND COMPOSITION OF EMPLOYMENT

Occupational Distribution of Workers

Table 3.6 gives a detailed picture, obtained from the survey, of the importance of various occupations. A worker has been included under every occupation in which he was found employed during any of the eight rounds of the survey. Since some workers may often be engaged in more than one occupation, the sum of the number of workers shown under each activity exceeds the total for the sectors. The following points can be observed from the table.

- About two-thirds of the rural workers are employed in agriculture and about half are self-employed on family farms. The hired agricultural laborers are a relatively small group of the rural labor force; they constitute only about a sixth of all rural workers and about a fourth of agricultural workers.

- Nonagricultural activities, such as trading and shopkeeping, construction and transport services, and cottage industry, are important sources of rural employment. Nearly 45 percent of the rural workers are found employed in these activities at some time or other during the year. Employment in cottage industries is highly localized; in only 3 of the 16 villages under study is this found to be an important activity.

Table 3.6 -- Occupational Distribution of Workers, 1982

Occupation	Number of Workers per 100 Households			Percent of Total Workers		
	Project Group	Control Group	All Groups	Project Group	Control Group	All Groups
Agriculture	116	127	121	65.5	68.8	66.9
Cultivating own farm	91	91	92	51.4	49.3	50.8
Agricultural wage laborer	28	30	29	15.8	16.1	15.9
Livestock and poultry raising	31	27	29	17.5	14.5	16.1
Fishing	12	21	16	6.8	11.6	9.0
Non-agriculture	74	90	81	41.8	48.7	45.1
Cottage industry	9	8	8	5.1	4.2	4.6
Trade and shop keeping	17	18	18	9.6	9.8	9.8
Construction and transport service	27	30	28	15.3	16.2	15.6
Salaried service	11	10	11	6.2	5.6	5.9
Other services	5	19	11	2.8	10.4	6.2
Others	21	32	25	11.9	17.2	14.1
Total	177	185	180	100.0	100.0	100.0

Note: The total number of workers employed in various activities would be higher than the total number of workers because some workers are employed in more than one activity.

- A large proportion of workers are engaged in more than one occupation--37 percent of the agricultural workers and 25 percent of the nonagricultural workers. The incidence of multiple occupation, however, is found to be higher within sectors than between sectors. Only about 12 percent of the workers are employed in both agricultural and nonagricultural activities.

Extent of Employment

The extent of employment provided by various rural occupations during the year of survey is shown in Table 3.7. Since the number of hours of work put in during a day may vary across villages and occupations, the duration of employment has been estimated in the number of hours worked during the year and has been converted, for the purpose of comparison, into standard eight-hour man-days. It is found that a worker was employed, on the average, for 284 days during the year. About 63 percent of the employment is generated in the agricultural occupations and 37 percent in other occupations. Thus, in duration of employment also, activities other than agriculture come out as important rural occupations in Bangladesh.

Agriculture provides employment for about 178 days a year, 142 days in crop production and 36 days (20 percent) in noncrop agricultural activities. Of the total employment generated in crop production activities, only a fourth goes to the hired agricultural workers.

Self-employment is the principal form of employment both in agriculture and in other activities. Self-employment is found to constitute about 78 percent of total employment in the agricultural sector and about 51 percent in nonagricultural occupations. About 68 percent of the total employment is generated on own business, and the remaining 32 percent in the market.

Extent of Unemployment

The distribution of workers by the average number of days of employment a week, during the eight weeks of the survey, is shown in Table 3.8. It was found that nearly 76 percent of the workers are engaged in some productive activities all seven days a week, and only about 9 percent remain altogether unemployed during the week. If six days of employment are considered to be full employment, about 19 percent of the workers remain unemployed or underemployed. Some workers, however, reported that they were not available for employment during the week of the survey. If only workers who were available for work during the week of the survey are included, about 74 percent of them were found to be fully employed, about 10 percent altogether unemployed during the week, and 11 percent employed for one to five days. If the duration of employment, measured in

Table 3.7--Number of Days of Employment in Different Occupations during 1982

Occupation	Standard Eight-Hour Man-Days			Percent of Total Employment		
	Project Group	Control Group	All Groups	Project Group	Control Group	All Groups
Agriculture	172	185	178	62.0	63.3	62.7
Cultivating own farm	105	103	104	38.0	35.1	26.7
Agricultural wage laborer	38	37	38	13.7	12.6	13.4
Livestock and poultry raising	21	24	22	765	8.1	7.7
Fishing	8	22	14	2.7	7.4	4.9
Non-agriculture	105	107	106	38.0	36.7	37.3
Cottage industry	7	8	8	2.6	2.8	2.8
Trade and shop keeping	26	24	24	8.9	8.2	8.5
Construction and transport service	31	23	27	11.3	7.8	9.5
Salaried service	16	12	14	5.9	4.1	4.9
Other services	6	16	10	2.1	5.4	3.5
Miscellaneous	20	25	22	7.2	8.4	7.7
Self-employment	181	208	194	65.3	71.4	68.3
Wage employment	96	84	90	34.7	28.6	31.7
Total employment	277	292	284	100.0	100.0	100.0

standard eight-hour days, is related to the number of days a worker was available for employment during 1982, the rate of unemployment is estimated to be 18 percent (see Table 3.9).

Table 3.8--Distribution of Workers, by Number of Days of Employment during a Week

Number of Days of Employment	Percent of All Workers			Percent of Workers Available for Work		
	Project Group	Control Group	All Groups	Project Group	Control Group	All Groups
0	10.8	7.0	9.0	11.9	7.5	9.9
1-2	1.3	1.1	1.2	1.4	1.2	1.3
3-4	3.9	4.5	4.2	4.3	4.8	4.6
5	3.7	5.6	4.6	4.1	6.0	5.0
6	3.7	6.2	4.8	4.1	6.7	5.3
7	76.6	75.6	76.2	74.1	73.9	74.0
Estimated number of days of unemployment during the year	55	46	51	61	49	55

Table 3.9--Estimated Rate of Unemployment during 1982

Item	Project Group	Control Group	Both Groups
Number of days available for work	341	350	345
Number of days employed (8-hour man-days)	277	292	284
Rate of unemployment (percent)	18.8	16.6	17.7

SOCIOECONOMIC FACTORS AFFECTING EXTENT OF EMPLOYMENT

Landholding

It was reported earlier that landholding has a negative effect on the supply of labor measured in stocks--that is, workers. The flow of labor as measured by the number of days of employment in a year is also found to be negatively related to the size of holding (see Table 3.10). A worker belonging to the landless and marginal farmer households works for about 295 days a year, while workers belonging to medium-size and large landholding groups work 269 and 280 days, respectively.

Table 3.10--Duration of Employment, by Size of Landholding (Number of Eight-Hour Days)

Type of Employment	Size of Landholding (Acres)				
	Landless	Up to 1.0	1.01-2.5	2.51-5.0	5.01 or more
Crop production	80 (27.0)	125 (42.7)	165 (59.6)	176 (65.4)	180 (64.3)
Agriculture	128 (43.2)	158 (53.9)	197 (71.1)	213 (79.2)	213 (76.1)
Non-agriculture	168 (56.8)	136 (46.4)	80 (28.9)	56 (20.8)	67 (23.9)
Self-employment	139 (47.0)	155 (52.9)	209 (75.5)	246 (91.4)	263 (93.9)
Hired employment	157 (53.0)	138 (47.1)	68 (24.5)	23 (8.6)	17 (6.10)
Total employment	296 (100.0)	293 (100.0)	277 (100.0)	269 (100.0)	280 (100.0)

Note: Figures in parentheses are percentages of total employment.

Employment generated in the agricultural sector, particularly in crop production, obviously has a strong positive relation to landholding. Crop productivity provides employment for only 80 days for workers in the landless households, most of whom are hired laborers, whereas workers who belong to the large landholding groups are

employed 180 days. Unable to find enough employment from the land, the landless and the small farmers look for jobs in other sectors much more than do the large landholding groups. Annual employment per worker in noncrop activities--fishery, poultry, and livestock raising--is found to be about 48 days for the landless, about 33 days for the large farmers. The negative effect of landholding on nonagricultural employment is found to be more pronounced. The duration of employment in nonagricultural activities is about 2.5 times as high for the landless households as for the large landholders. The share of nonagricultural activities in total employment is about 57 percent for the landless group, which declines rapidly with the increase in the size of holding up to 5.0 acres, but is slightly higher for the largest landholding group, mainly because of the greater importance of trading activity to workers in the household category. Employment in trading gives a U-shaped curve when related to the size of landholding. Annual employment per worker generated in this activity is 30 days for the landless and marginal cultivators, 16 days for the small and medium-size landholding groups, and 35 days for the large landholding group.

Education

Educational background of the worker usually influences the preference for different types of jobs, and also provides the skills required in some of them; it may therefore affect both the demand for and the supply of labor. Table 3.11 relates the amount of employment generated in different sectors to the educational background of the worker. The findings should be interpreted carefully, however, because a high correlation between the educational status of the worker and the size of landholding of the household is expected, and some of the effects of landholding might be captured by the education variable.

Education has a negative influence on employment in crop production and in other agricultural activities. The number of days of employment in agriculture for the illiterate group is about 2.8 times that for workers who had some college education. The duration of agricultural employment is almost the same for the first three educational groups, but this may be the result of the positive effect of landholding outweighing the negative effect of education. The extent of employment generated in nonagricultural activities, however, is found to be positively related to the level of education of the worker. The highly educated are found employed mainly in services and in trading activities, while the illiterate are employed in construction, cottage industries, and miscellaneous occupations such as earthwork and collection of fuel (see Table A3.2).

The total number of days worked is found to be the highest for workers who have no more than primary-level education, and it declines gradually with higher levels of education. The better position of the workers with primary-level education than that of the

Table 3.11--Extent of Employment, by Educational Background of the Worker

Educational Status	Percent of Total Workers	Annual Days of Employment			
		Crop Production	Agriculture	Other Employment	Total Employment
Illiterate	61.0	137	182	98	280
Attended primary schools	18.9	159	189	116	305
Attended secondary schools	11.4	166	189	98	287
With secondary school certificate	5.5	121	133	143	276
With higher secondary certificate and above	3.3	62	66	202	268

illiterate group is presumably because while these two groups do not differ in their attitude toward agricultural work, the former obtain more agricultural employment because of having larger landholdings and also because they are in a better position to find non-agricultural employment, such as petty trade, which requires some education.

Age

A significant difference in the extent and composition of employment is also found among different age groups (see Tables 3.12 and A3.3). As expected, the most productive age group finds employment for the highest number of days (299 a year) and the older age group (55 and over) the lowest. The children work about 14 percent less than the adults. A significantly larger proportion of employment for the child workers is generated in the noncrop agricultural activities, such as livestock raising and fishing--108 days--compared to only 27 days of work generated for the adult workers. The old are self-employed on family farms much more than those in the other age groups and are much less involved in nonagricultural activities, which are carried on mainly by the adults. Much more of the hired work, particularly in agriculture and construction activities, is done by the younger adults than by members of the other age groups.

Table 3.12--Duration of Employment, by Age

Age Group	Number of Days of Employment				
	Crop Production	Agriculture	Other Employment	Hired Work	Total
Children (up to 15)	84 (32.8)	192 (75.0)	64 (25.0)	69 (27.0)	256 (100.0)
Young adults (16-24)	155 (53.4)	189 (65.2)	101 (34.8)	109 (37.6)	290 (100.0)
Adults (25-54)	146 (48.8)	173 (57.9)	126 (42.1)	98 (32.8)	299 (100.0)
The elderly	142 (60.4)	173 (73.6)	62 (26.4)	53 (22.5)	235 (100.0)

Note: Figures in parentheses are percentages of total employment.

Sex

It was reported earlier that a very small proportion of the workers is female, so the difference between workers with regard to sex would not affect the duration and the composition of employment for the entire sample significantly. Nonetheless, it would be interesting to know the background of the female workers and the activities in which they find employment.

The socioeconomic background of both male and female workers is shown in Table 3.13. It will be noted that they come mainly from the poor socioeconomic group--that is, from the landless and nearly landless households, and about 96 percent of them are illiterate. It can thus be concluded that it is sheer subsistence pressure which drives them to join the labor market.

There is a significant difference in the composition of employment among male workers and female workers (see Table 3.14). Very few female workers are employed in agriculture. About 88 percent of their employment, but only 36 percent of that of male workers, is generated in other sectors. Most of the female workers are self-employed; only 18 percent of their employment is generated in wage jobs. Two activities that account for most female employment are cottage industries and services. The female workers also work significantly fewer hours than male workers; annual employment, measured in standard eight-hour days, of female workers is about 40 percent less that that of male workers.

Table 3.13--Socioeconomic Background of the Workers, by Sex
(Percent of Total Workers)

Landholding Group	Male	Female	Level of Education	Male	Female
Landless	18.0	35.7	Illiterate	59.1	95.5
Marginal farmer	28.0	34.8	Primary	19.8	1.8
Small farmer	23.0	19.6	Secondary	12.0	0.9
Medium farmer	21.7	7.2	SSC[a]	5.7	1.1
Large farmer	9.8	2.8	HSC & above[a]	3.5	0.7

[a] SSC means secondary school certificate. HSC means higher school certificate. These are levels in schooling.

Table 3.14 -- Extent and Composition of Employment, by Sex

Sector and Activity	Number of Eight-Hour Days a Year		Percent of Total Employment	
	Male	Female	Male	Female
Agriculture	186	21	64.1	12.0
Self-cultivation	109	10.1	37.5	5.8
Wage labor	39	5.4	13.4	3.1
Livestock	23	5.1	7.9	2.9
Fishing	15	0.0	5.2	0.0
Other sectors	104	153	35.9	88.0
Cottage industry	5	49.5	1.7	28.3
Trade and shopkeeping	25	5.1	8.6	2.9
Construction & transport	29	1.0	10.0	0.6
Salaried service	15	2.0	5.2	1.1
Other services	7	65.6	2.4	37.5
Miscellaneous	22	31.0	7.6	17.7
Self-employment	196	144	67.6	82.3
Wage employment	94	31	32.4	17.7
Total	290	175	100.0	100.0

THE EFFECT OF THE FFW PROGRAM ON EMPLOYMENT

The findings of the survey on the extent and composition of employment for the entire sample in the project and control groups of households were presented in Table 3.7. The direct effect of the FFW Program is expected to fall on crop-production activity, which may induce a second-round increase in employment in such nonagricultural activities as trading, industry, construction, and transport, through the effect of the FFW Program on agricultural production and incomes. It will be noted from Table 3.7 that employment in crop production is slightly greater in the project group than in the control group, implying a positive effect of the FFW Program. Total employment in trading and construction activities is also about 23 percent higher in the project group than in the control. But total employment is significantly higher in the control group, mainly because of the substantial amount of self-employment in such activities as fishing and services, which may not have anything to do with the FFW Program.

It was found in Chapter 2 that the methodology used here gives a negative effect for one of the five types of economic infrastructure built under the FFW Program. It was argued that the negative effect may be attributable to the nonsimilarity of the control group with the project group and the greater effect of adverse natural factors on the project villages than on the control villages during the year of the survey, which has nothing to do with the FFW Program. Thus, while the evidence suggests that this particular project did not have any positive effect on production, it may be wrong to use the data to conclude that it had a negative effect on production. But no effect of this project on employment, positive or negative, should be expected. So, to assess the effect of the FFW Program on employment using the methodology employed here, it would be proper to exclude the sample selected --the flash-flood-protection embankment--for this particular project.

This is done in Table 3.15, which shows the extent of annual employment in different sectors of an average worker, in the project group and the control group, excluding the aforementioned sample. It will be noted that total employment is about 3 percent lower in the project group than in the control group and that the difference is statistically significant. The principal reason is more self-employment in the control group, particularly in noncrop agricultural activities--31 days for the project, 47 days in the control. Wage employment is about 14 percent higher in the project group and the difference is statistically significant. The effect of the project on crop production and on trade, construction, and cottage industry is found to be positive and statistically significant.

It was reported in Table 3.10 that employment in crop production is positively related to the size of landholding. It was also reported that the average landholding in the control group is larger than that in the project group. Thus, the figure given in Table 3.15

Table 3.15 -- The Effect of the FFW Program on Employment

Type of Employment	Number of Standard Man-days Employed during the Year: Project Group	Control Group	Difference between Project Group and Control Group	Estimated t Values
			(percent)	
Self-employment in crop production	102	96	6.3	1.7[a]
Wage employment in crop production	37	39	-5.1	-0.9
Self-employment in agriculture	132	141	-6.4	-1.7[a]
Wage employment in agriculture	38	41	-7.3	-1.3
Self-employment in other sectors	49	61	-19.7	-4.3[b]
Wage employment in other sectors	64	48	33.3	5.3[b]
Agriculture	170	182	-6.6	-3.2[b]
Other sectors	112	108	3.7	1.2
(Trade, industry, construction, and earthwork)	(83)	(68)	(22.1)	(8.6)[b]
Self-employment	181	202	-10.4	-5.5[b]
Wage employment	101	89	13.5	3.5[b]
Total Employment	282	290	-2.8	-2.5*

[a] Statistically significant at less than 10 percent probability error.

[b] Statistically significant at less than 5 percent probability error.

understates the true effect of the FFW Program on employment in crop production because it does not dissociate the negative effect of the difference in size of landholding between the project group and the control group. The difference between employment in crop production in the project group and that in the control group after adjustment for the difference in size of landholding is shown in Table 3.16. The effect on employment in crop production is positive for two of the five types of infrastructure (DCI and FCI); in one (CE), the effect is insignificant, and in two (FPE and FFPE), employment in the project group is in fact less than in the control. For all types of project taken together, employment in the project group is about 17 percent greater than in the control.

Table 3.16--Employment in Crop Production, Adjusted for the Difference in Size of Landholding (Number of days a year per acre of land)

Type of Infrastructure	Self-Employment		Wage Employment[a]		Total Employment	
	Project Group	Control Group	Project Group	Control Group	Project Group	Control Group
Drainage-cum-irrigation canal (DCI)	139	114	25	18	164	132
Field channel for irrigation (FCI)	88	70	35	23	103	93
Coastal embankment (CE)	59	52	18	24	77	76
Flood protection embankment (FPE)	115	130	38	32	153	162
Flash-flood protection embankment (FFPE)	94	108	45	46	139	154
All Types	105	92	33	25	138	117

a This is the employment of hired workers generated on the farm and was estimated from the data on the use of hired labor in various crops. This is estimated from the wage employment generated for family workers estimated from the weekly employment survey presented in earlier tables.

The Impact of Physical Infrastructure in the Employment Effects of the FFW Program

The employment effect of the FFW Program may be expected to vary with the state of development of the physical infrastructure in the project areas. The opportunity for employment, particularly in nonagricultural activities, is expected to be greater in areas that have better transport and communication facilities and better access to markets and financial institutions than in areas that lack these facilities. The extent and composition of employment of the group of sample workers classified by the level of development of infrastructure in the study areas can be seen from Table 3.17. The total number of days worked per worker is indeed found to be significantly greater in areas with better infrastructural development. The positive effect is more pronounced in other sectors than in agriculture and for hired employment than for self-employment. The greatest effect is found to be on hired employment in nonagricultural activities; employment in the well developed areas is 62 percent greater than in the underdeveloped areas.

Table 3.17--The Effects of Physical Infrastructure on Rural Employment

Variable	Areas with Well-Developed Infrastructure	Areas with Underdeveloped Infrastructure	Difference between Well-Developed and Underdeveloped
	(days a year per worker)	(days a year per worker)	(percent)
Self-employment in crop production	102	96	6.2[a]
Wage-employment in crop production	34	42	-19.0[b]
Agricultural activities	180	172	4.4[b]
Self-employment in other sectors	48	60	-18.3[b]
Wage-employment in other sectors	70	43	62.8[b]
Total other sectors	119	103	15.5[b]
Total self-employment	194	188	2.9
Total wage employment	105	87	20.7[b]
Total employment	298	275	8.4[b]

[a] Statistically significant at less than 10 percent probability error.
[b] Statistically significant at less than 5 percent probability error.

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The effect of the FFW Program on employment under different levels of infrastructural development can be seen in Table 3.18. The effect of the project on total employment is found to be negative but more so in areas with less infrastructural development. But the extent of employment generated in both crop production and noncrop activities is found to be greater for the project group than for the control in areas with infrastructural development but not so for areas lacking infrastructural development. Presumably, their income having increased as a result of the FFW Program, the workers tend to substitute low-productive self-employment for leisure, but in areas with infrastructural development and with greater scope for productive nonagricultural employment and more facilities for enjoying the amenities of life, leisure appears to be costlier.

Table 3.18--Employment by Sectors in Project, Control, and Infrastructurally Different Areas (Days a year per worker)

Area and Sector	Project Group	Control Group	Difference between Project Group and Control Group
			(percent)
Areas with well-developed infrastructural facilities			
Crop production	145	134	8.3
Noncrop agriculture	23	63	-73.5
Other sectors	121	104	16.3
Total employment	289	301	-4.0
Areas with underdeveloped infrastructural facilities			
Crop production	141	144	-2.1
Noncrop agriculture	36	30	20.0
Other sectors	85	110	-22.7
Total employment	262	284	-7.3

The independent effects of the FFW Program and the development of physical infrastructure, after adjustment for the effects of the socioeconomic variables, can be seen from Table 3.19, which presents the results of the analysis of variance on extent of employment. Size of holding and education, which contribute positively to income, have a negative effect on the extent of employment, indicating

Table 3.19--The Effects of Various Factors on Employment: The Results of the Analysis of Variance

Variable	Crop Production		Other Activities		Total Employment	
	Effect	F Value	Effect	F Value	Effect	F Value
Landholding	Positive	135.4[a]	Negative	182.6[a]	Negative	7.8[a]
Age	Positive	44.0[a]	Positive	54.0[a]	Positive	71.9[a]
Education	Negative	40.2[a]	Positive	55.8[a]	Negative	15.9[a]
Infrastructure[b]	Positive (4.1%)	2.2	Positive (5.6%)	2.96[c]	Positive (9.3%)	58.0[a]
FFW Program[b]	Positive (4.1%)	2.1	No Effect	0.04	Negative (-3.3%)	30.2[a]

[a] Statistically significant at less than 5 percent error.

[b] Percent differences in average values for the project and control groups after adjustment for the effects of other variables.

[c] Statistically significant at less than 10 percent error.

effect of the FFW Program is positive for employment in crop production, and it increases employment in nonagricultural activities in areas with infrastructural development. After controlling for the effect of other variables, total employment is about 10 percent higher in well-developed areas than in underdeveloped areas.

Impact of FFW Program on Employment for the Landless

Finally, it may be useful to know the effects of the FFW Program on employment of the landless and the land poor. The building of high-quality structures under the FFW Program requires the proper mix of capital and labor, sometimes at a sacrifice of some immediate employment generated during the implementation of the project. Since most of the immediate employment goes to the landless and the land poor, it would be interesting to know whether they would be compensated by the aftereffects of the structure on employment generated for them.

We have classified the workers into two groups on the basis of land ownership, those belonging to households that own up to 2.0 acres of land--the target group--and those that own more--the

nontarget group, and we have estimated the extent of employment separately for these two groups in the project and control areas. The findings are reported in Table 3.20.

Table 3.20--The Effects of the FFW Program on Employment for the Poor

Sector and Type of Employment	Households That Own Up to 2.0 Acres			Households That Own More Than 2.0 Acres		
	Project Group	Control Group	Difference	Project Group	Control Group	Difference
	(Days a year per worker)		(percent)	(Days a year per worker)		(percent)
Agriculture	161	167	-3.6	191	223	-14.3
Self-cultivation on farm	78	72	8.3	158	169	-6.5
Wage employment	54	49	10.2	6	10	-40.0
Livestock	19	16	18.8	24	41	-38.5
Fishing	10	30	-66.7	3	3	0.0
Other Sectors	124	130	-4.6	68	59	15.3
Cottage	6.8	11.9	-42.9	8.2	0.5	large
Trade	25.8	25.7	0.0	22.0	20.1	9.5
Construction and transport	43.6	28.7	51.9	7.1	10.3	-31.1
Salaried service	16.5	15.0	10.0	16.1	5.1	223.5
Other services	6.6	20.7	-68.1	4.2	4.7	-10.6
Others	24.5	27.6	-11.2	10.7	18.1	-40.9
Self-employment	156	187	-16.6	228	256	-10.9
Hired employment	129	110	17.3	31	26	19.2
Total employment	285	297	-4.0	259	282	-8.2

Workers in the target group constitute nearly two-thirds of total workers. The effect of the FFW Program on employment in crop production is positive for the target group, negative for the nontarget group. The target group is employed about 132 days in this activity in the project area, 121 days in the control. In sectors other than agriculture, more employment is generated for the target group in construction activities and transport services, while most additional employment generated in trading activities goes to the nontarget groups. The effect on total employment is, however, found to be negative for the target group but less pronounced than for the nontarget group. To repeat, this may be the effect of higher incomes on substitution of leisure for low-productive self-employment.

SEASONALITY OF EMPLOYMENT

Agricultural activities in Bangladesh depend largely on nature. Most of the land in the country is cropped in paddy under rainfed conditions. About 78 percent of the cropped area in 1982 was in paddy and only about 12.2 percent of that was irrigated. Since the principal agricultural activities, such as transplantation, weeding, and fertilizing, depend on rainfall, which is erratic and seasonally concentrated, agriculture in Bangladesh is characterized by a high seasonal pattern in the demand for labor. This seasonality does not permit maximum use of labor, because at certain times of the year, a worker may remain idle, while at other times, the labor requirement becomes so great that the household may have to hire labor to assist family workers. The casual nature of employment in the labor market is also partly the result of the seasonal pattern of demand. Since the employment survey was carried out in eight rounds covering the calendar year 1982, this study gives an opportunity to measure the extent of seasonality in crop production and its relation to employment in other rural activities.

Crop Production

The variation in employment in crop production for the eight rounds of the survey is reported in Table 3.21. The figures are presented in index form; the number of hours of employment per worker for the week of survey has been expressed as a percent of the average weekly employment hours for all eight weeks. For all study areas together, the coefficient of variation of employment is estimated to be 18 percent. This average figure, however, masks high seasonal fluctuations for different areas under study. This is because the peak season in one area does not always coincide with the peak season in other areas, nor do the slack seasons coincide. This pattern implies that there is scope for reducing underemployment of labor through temporary seasonal migration of workers. In general, February to April and August to November are the slack periods of agricultural employment, while December, January, and May are the peak periods.

The seasonality of agricultural employment in a particular area depends on the cropping pattern. Aman is the principal paddy crop, so the peak period of employment falls in December-January, when aman is harvested and boro paddy is transplanted. With the spread of irrigation facilities, boro becomes an important paddy crop, which accentuates the traditional December-January peak and introduces a new peak during May, when boro paddy is harvested and there are intercultural operations of aus paddy. The peak period of employment in the principal aus growing areas, the area under field channel project, is in August, when aus is harvested and aman is transplanted or weeded, but August is usually a slack period of activity in areas

Table 3.21--Seasonality of Employment in Crop Production Activity, by Area (Index; Average = 100)

Round of Survey	Drainage cum Irrigation Canal	Field Channel for Irrigation	Coastal Embankment	Flood-Protection Embankment	Flash-Flood Protection Embankment	All Areas
(Number of Workers)	(240)	(264)	(105)	(87)	(134)	(834)
Early January	134	110	129	93	125	114
End of February	85	74	99	94	134	90
Early April	95	84	112	105	51	90
End of May	131	116	71	130	165	122
End of July	90	99	99	118	93	102
End of August	77	143	101	16	87	94
End of October	64	61	53	103	14	64
Early December	124	113	136	141	131	124
Mean	100.0	100.0	100.0	100.0	100.0	100.0
Coefficient of variation	24.7	24.6	25.8	35.5	46.1	18.7

such as those under the flood-protection embankment, which are heavily flooded.

Noncrop Activities

Employment in noncrop activities also fluctuates widely across the season, but the extent of variation is less than in crop production. Workers find more employment in noncrop agricultural activities from July through October than in other seasons. The peak period coincides with the monsoon season, when it is easier to find employment in fishing than it is in other seasons. Peak employment in nonagricultural activities is from February through April. This is the main postharvest season, when agricultural households reclive cash from the sale of their produce in the market and purchase nonfood necessities. Thus, the scope of generation of employment in trading is greatest during this period. February through April is also the peak season of construction activities that involve earthwork, such as the implementation of the FFW projects and the manufacture of bricks and tiles, which generate more nonagricultural employment during this period.

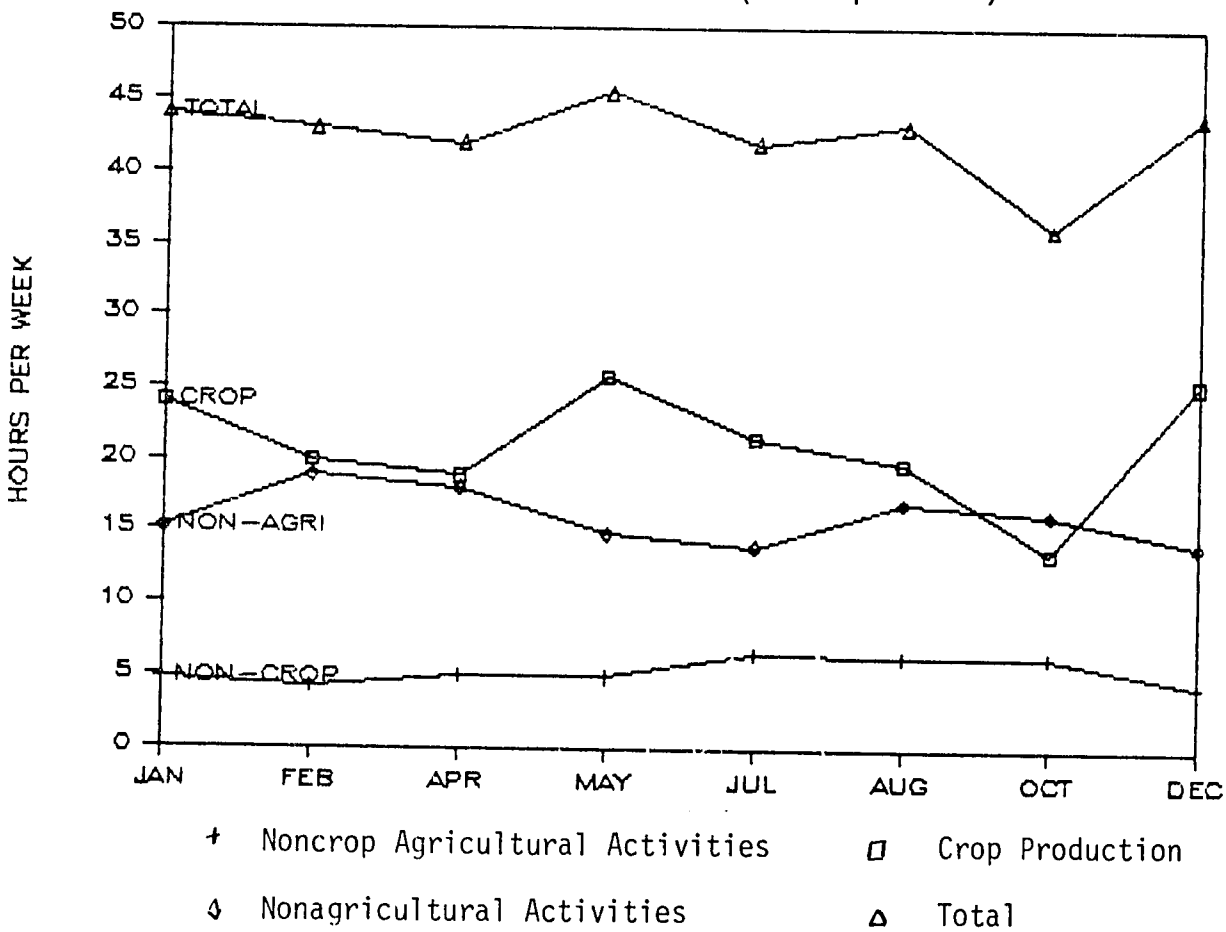
A careful scrutiny of the figures in Table 3.22 reveals an inverse relation between employment in noncrop and nonagricultural activities and employment in crop production across the seasons.

Table 3.22--The Relation Between Seasonality of Employment in Crop and Noncrop Rural Activities (Index; Average = 100)

Season	Crop Production	Noncrop Agriculture	Other Sectors	Agriculture	Total
Early January	114	90	95	109	104
End of February	90	79	118	89	101
Early April	90	94	113	91	99
End of May	122	92	92	116	107
End of July	102	122	87	106	99
End of August	94	120	106	99	102
End of October	64	120	101	75	85
Early December	120	84	88	115	103
Mean	100	100	100	100	100
Coefficient of variation (percent)	18.7	16.5	10.7	13.4	6.2

For the eight observations, the correlation coefficient of employment in crop production works out to be -0.49 for employment in noncrop agricultural activities and -0.57 for employment in nonagricultural activities. Thus, the peak periods of employment in noncrop and nonagricultural activities generally coincide with slack seasons of agricultural employment, which has a smoothing-out effect on the fluctuation in overall rural employment (see Figure 3.1). The coefficient of variation in total employment is only 6.2 percent, whereas it is 19 percent for employment in crop production, 17 percent for noncrop agricultural activities, and 11 percent for nonagricultural activities.

Figure 3.1
RURAL EMPLOYMENT
Seasonal Fluctuations (Hours per Week)



Wage Employment

From the point of view of policymaking, it may be more useful to know the seasonal pattern of wage employment than that of total employment. Lack of wage employment affects the landless and nearly landless much more than the landowners, who can create self-employment with the resources at their disposal. Self-employment for the

landless is often distress employment; they engage themselves in very low-productive activities because they have nothing else to do but cannot afford to remain unemployed. Also, most wage employment is provided by the landless and nearly landless. So policy interventions, such as the FFW Program, which has the aim of augmenting the income of the poor through the generation of employment, could be more effective if they were implemented during slack periods of wage employment. The knowledge of the seasonal pattern of wage employment would thus help proper phasing of this type of work. Proper phasing is also needed to avoid any possible disruptive effects of such programs on the agricultural labor market.

The fluctuation in wage employment is shown in Tables 3.23 and 3.24. The variation in agricultural wage employment is quite large; the seasonal index varies from 60 in October to about 126 in May, when the boro crop is harvested. The peak in nonagricultural wage employment is February through April. This may be in part the effect of employment generated by the FFW Program that is implemented during this period. Because of the additional nonagricultural employment generated, total wage employment also reaches its peak from February through April, which is one of the slack seasons of self-employment. October, however, remains a slack period of both agricultural and nonagricultural wage employment.

Table 3.23--Seasonal Variation in Wage Employment (Index; Average = 100)

Season	Agricultural Wage Employment	Nonagricultural Wage Employment	Total Wage Employment	Self-Employment
Early January	107	83	93	109
End of February	99	133	119	93
Early April	95	130	115	91
End of May	126	95	108	107
End of July	109	73	88	104
End of August	104	104	104	101
End of October	60	94	80	87
Early December	100	88	93	109
Mean	100	100	100	100
Coefficient of variation (percent)	17.5	20.1	12.8	8.1

Table 3.24--Seasonal Pattern of Employment of Landless and Near Landless Households[a]

Season	Crop Production	Noncrop Activities	Total Employment
Early January	112	94	100
End of February	94	109	103
Early April	89	108	101
End of May	130	94	108
End of July	109	97	101
End of August	90	107	100
End of October	56	103	86
Early December	121	89	101
Mean	100	100	100
Coefficient of variation (percent)	21.8	7.0	5.7

[a] Households cultivating up to 1.0 acre of land.

The Effects of the FFW Program on Seasonality

The FFW Program generates wage employment from February through May, which is one of the slack seasons of agricultural activities, particularly in areas in which a small proportion of the land is under the seed-fertilizer-water technology. Its direct contribution to reduction of the seasonal fluctuation in employment therefore cannot be denied. In fact, we have seen that wage employment reaches its peak during February through May because of additional nonagricultural employment generated during this period.

The FFW Program could also indirectly contribute to reducing seasonal fluctuation if it had a positive effect on the spread of irrigation and high-yielding varieties, more labor-intensive crops that are grown mostly from January through June. The figures reported in Table 3.25 show that this may indeed be the case. Employment in crop production from February through April is greater in the project group than in the control. But the coefficient of variation in employment is still as large in the project group as in the control because of a deeper slack in employment in October in the project areas. This may be the effect of shifting of land from some pulses--kalai and mung grown during August through October--and some local varieties of aman paddy harvested early, following the spread of HYV aman.

Table 3.25--The Seasonal Pattern of Employment, in Project and Control Areas

Season	Employment in Crop Production		Total Employment	
	Project Group	Control Group	Project Group	Control Group
Early January	118	111	109	98
End of February	104	84	99	104
Early April	95	86	100	97
End of May	113	136	104	111
End of July	105	101	99	99
End of August	97	79	102	102
End of October	47	82	82	88
Early December	122	121	104	103
Mean	100	100	100	100
Coefficient of variation (percent)	21.9	19.7	7.5	6.3

HIRED LABOR

Size of the Labor Market

The findings reported earlier indicated that rural employment is generated largely in self-employed activities; the labor market is quite small. Only about 32 percent of the labor days worked are hired--22 percent in the agricultural sector, 49 percent in other sectors (see Table 3.26). This is not surprising since the typical holding in agriculture is too small to provide full employment for family workers for most agricultural households, and nonfarm employment is generated partly in response to the lack of employment in the crop-production sector.

Mode of Hiring Labor

Although the labor market is small, about 90 percent of the cultivators are found to be hiring labor at some time or the other during the year (see Table 3.27). The labor-hiring households are a large majority, even among cultivators holding only an acre of land or less. This is the result of the extreme seasonality in the demand

Table 3.26--The Importance of the Market in Generating Employment

Sector	Number of Days of Employment a Year		Hired Employment as Percent of Total Employment
	Self-Employment	Hired Employment	
Agriculture	139 (219)	39 (61)	21.7
Other Sectors	54 (133)	52 (126)	48.8
Total	193	90	31.9

Note: Figures in parentheses are average days of employment for workers primarily engaged in the sectors.

Table 3.27--Importance and Mode of Hired Employment

Size of Holding (Acres)	Percent of Farms Hiring Permanent Workers			Percent of Farms Hiring Casual Workers		
	Project	Control	Both	Project	Control	Both
Up to 1.0	3.4	2.5	3.0	75.9	81.5	78.5
1.01-2.5	6.2	6.3	6.2	92.9	90.6	91.9
2.51-5.0	24.6	20.8	22.8	100.0	93.3	97.3
5.01 or more	47.6	65.4	55.3	100.0	100.0	100.0
All Farms	11.8	14.7	13.1	90.0	89.3	89.7

for agricultural labor; at busy periods labor must be hired to supplement family labor, while during the slack period members of the same household will seek jobs in the labor market. Because of this seasonal variation in the demand and supply, the rural labor market is in general informal in nature, and most workers are hired casually, on a daily basis, according to the need. Very few farm households hire permanent workers on a seasonal basis or by annual contract. It will be noted from Table 3.27 that fewer than a sixth of all cultivators and about half of the large ones hired workers on a permanent basis, while about nine-tenths of them hired workers on a casual basis. A majority of those who employ permanent workers hired only one, primarily to look after the draft animals and to supervise

the casual workers (see Table 3.28). Most of the few marginal and small farmers who keep permanent workers employ child workers, for the most part, to look after the cattle.

Table 3.28--Distribution of Farms, by Number of Permanent Workers Hired

Number of Workers	Project Group	Control Group	Both Groups
None	88.2	85.3	86.9
One	8.2	7.6	8.0
Two	2.5	5.4	3.8
Three	1.1	1.3	1.2
Four	0.0	0.9	0.4

In sectors other than agriculture also, most of the workers are hired on a daily basis except salaried workers such as schoolteachers and local government employees (union parishads). Some of the workers hired in cottage industries and services are paid on a piece-rate basis.

Wage Rate

The permanent farm workers are paid a monthly wage stipulated in the contract at the beginning of the season or the year for which they are contracted, and the wage is renegotiated for the next contract period. In addition, the worker is given free lodging and meals and a minimum of the clothing requirement for the year. The monthly cash wage and the cash equivalent of the wage paid in kind estimated from the survey are reported in Table 3.29. Nearly two-thirds of the total wages are paid in kind.

The casual workers who are paid on a daily basis are also given a portion of their wages in kind, the share varying from area to area. In some villages, the worker is given free meals, in others a certain amount of rice, usually one seer a day. The kind component of the wage is institutionally fixed, but the cash wage varies from day to day, depending on supply and demand in the market.

The wage rate for permanent workers is about a third lower than that paid to casual workers. The difference may be in part the result of the age differences of the two groups of workers and in part of the greater risk of finding casual employment in the labor market. Child workers--up to 14 years of age--account for nearly two-fifths of the permanently hired workers (see Table 3.30) but only about 5 percent of the agricultural hired workers.

Table 3.29--Wage Rates of Agricultural Workers, 1982

Type of Worker	Project Group	Control Group	Both Groups
Permanently hired (Tk per month)			
Cash	125	103	114
Kind	240	238	239
Total	365	341	353
Casual Workers (Tk per day)			
Cash	5.27	3.87	4.51
Kind	12.88	12.16	12.53
Total	17.95	16.03	17.04

Table 3.30--Age Composition of Permanently Hired Work Force, by Size of Farm (Percent of Total Workers)

Size of Holding	Child (up to 15)	Adult (16-54)	Old (55 +)
(Acres)			
Marginal farmer	42.9	57.1	0.0
Small farmer	50.0	50.0	0.0
Medium farmer	42.9	51.4	5.7
Large farmer	32.7	67.3	nil
All farms	38.5	59.6	1.9

The estimated wage rate for various kinds of nonagricultural employment is shown in Table 3.31. Since the number of hours worked varies across occupations, the wage rate is estimated per hour of labor for the purpose of comparison. It will be noted that the wage rate is higher in trading activities and salaried services and lower in cottage industry and miscellaneous nonfarm occupations, such as earth moving and working in brick fields. The agricultural wage rate is higher than the average wage rate in sectors other than agriculture.

Table 3.31--Wage Rates in Nonagricultural Activities

Activity	Project Group	Control Group	Total Sample
		(Tk per hour)	
Cottage industry	1.20	1.84	1.60
Business	2.34	2.02	2.20
Service	2.33	1.98	2.20
Construction and transport	1.88	1.73	1.81
Others	1.59	1.62	1.61
Sectors other than agriculture	1.93	1.78	1.87
Agriculture	2.24	2.00	2.13

Socioeconomic Background of the Hired Workers

It may be interesting to know the socioeconomic background of the hired workers. Tables 3.32 through 3.35 show the distribution of workers according to four socioeconomic variables--landownership, landholding, age, and the educational background of the worker. It will be noted that most hired agricultural workers come from the landless and nearly landless households. Only about 30 percent of the total agricultural workers belong to households who are either landless or cultivate at most an acre of land, but about 75 percent of the hired workers come from this group. In fact, very few of the workers belonging to the group having medium-size and large landholdings participate in the agricultural labor market; the proportion is 5 percent for the medium-size farmers and insignificant for the large farmers. Many more of the hired workers come from among the adults than from among the children and the older age group. It is the younger adults who participate most in the agricultural labor market.

Participation in the agricultural labor market is inversely related with the level of education of the worker. Nearly 95 percent of the hired agricultural workers are either illiterate or have not completed primary school. The workers who participate in the market are about 29 percent illiterate, only 2.7 percent among those who have completed secondary schools, and none among those who have had some college education.

The extent of participation in the nonagricultural labor market gives a U-shaped curve when related to the level of education of the worker. The participation rate is much higher among the illiterate and the best educated group than among those who have had secondary education. Most of the highly educated are employed in salaried services, while the illiterate are employed in cottage industries,

Table 3.32--Distribution of Hired Workers, by Size of Landholding of the Household

Landholding	Agriculture		Other Sectors		Rural	
	Hired Workers	Total Workers	Hired Workers	Total Workers	Hired Workers	Total Workers
(Acres)	(Shares in percent)a					
None	30.3 (52.8)	12.1 (100)	30.6 (47.4)	25.3 (100)	30.4 (46.6)	18.8 (100)
0.01-1.0	46.1 (38.2)	25.6 (100)	41.3 (47.1)	34.3 (100)	43.3 (44.3)	28.3 (100)
1.01-2.5	17.4 (14.3)	25.7 (100)	18.1 (36.0)	19.7 (100)	18.1 (23.0)	22.7 (100)
2.51-5.0	5.9 (4.9)	25.5 (100)	6.9 (19.0)	14.1 (100)	6.3 (8.8)	20.8 (100)
5.01 or more	0.3 (0.5)	11.1 (100)	3.1 (18.9)	6.5 (100)	1.9 (5.7)	9.4 (100)
All Groups	100	100	100	100	100	100

[a] The table should be read as follows: Of the total employment of hired workers in agriculture, 30.3 percent come from the landless group and 46.1 percent from the group owning 0.01-1.0 acres of land. Of all workers in agriculture, 12.1 percent come from the landless group, and of the total workers in this group, 52.8 percent are hired workers and the rest are self-employed.

Table 3.33--Distribution of Hired Workers, by Amount of Land Owned

Land Owned	Agriculture		Other Sectors		Rural	
	Hired Workers	Total Workers	Hired Workers	Total Workers	Hired Workers	Total Workers
(Acres)						
Up to 0.5	64.8 (48.5)	28.3 (100)	55.0 (46.1)	46.8 (100)	59.0 (46.5)	36.7 (100)
0.51-2.0	27.5 (17.6)	33.2 (100)	31.0 (40.5)	30.0 (100)	29.8 (28.2)	30.5 (100)
2.01-5.0	7.5 (5.4)	29.3 (100)	11.2 (24.9)	17.7 (100)	9.5 (11.1)	24.9 (100)
5.01 or more	0.2 (0.3)	9.1 (100)	2.9 (20.0)	5.6 (100)	1.7 (6.1)	7.9 (100)
All groups	100	100	100	100	100	100

Table 3.34--Distribution of Hired Workers, by Age

Age Group	Agriculture		Other Sectors		All Workers	
	Hired Workers	Total Workers	Hired Workers	Total Workers	Hired Workers	Total Workers
Up to 14	4.7 (14.6)	6.8 (100)	2.7 (40.0)	2.8 (100)	3.7 (17.5)	6.1 (100)
15-24	34.1 (27.0)	26.8 (100)	29.8 (48.5)	24.0 (100)	31.7 (34.0)	26.9 (100)
25-54	50.9 (21.6)	50.1 (100)	58.4 (37.0)	61.9 (100)	55.0 (30.7)	51.8 (100)
55 or over	10.3 (13.3)	16.3 (100)	8.9 (30.8)	11.3 (100)	9.6 (18.3)	15.1 (100)
All Groups	100	100	100	100	100	100

Note: Figures in parentheses are the respective shares of the categories of workers in the total number of workers under a particular land-owning group.

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Table 3.35--Distribution of Hired Workers, by Level of Education

Education	Agriculture		Other Sectors		All Workers	
	Hired Workers	Total Workers	Hired Workers	Total Workers	Hired Workers	Total Workers
Illiterate	82.0 (28.7)	60.5 (100)	61.5 (42.1)	57.3 (100)	70.4 (33.4)	61.0 (100)
Primary	13.0 (13.7)	20.2 (100)	16.1 (33.3)	19.0 (100)	14.9 (22.8)	18.9 (100)
Secondary	4.3 (7.2)	12.7 (100)	8.1 (27.2)	11.6 (100)	6.5 (10.7)	11.4 (100)
SSC	0.6 (2.7)	4.6 (100)	7.1 (41.0)	6.8 (100)	4.2 (22.3)	5.5 (100)
HSC +	0.0 0.0	2.0 (100)	7.2 (52.9)	5.3 (100)	4.0 (35.0)	3.3 (100)

Note: SSC stands for Secondary School Certificate; HSC stands for Higher School Certificate.

construction, and earthwork, and so on. Since most of the highly educated belong to the large landholding group, their rate of participation in the market is found higher in nonagricultural sectors than in the agricultural sector.

The Effects of the FFW Program on Wage Employment

In order to assess the effects of the FFW Program on the generation of wage employment, an analysis of variance was made to estimate the independent effect of the project after adjusting for the effects attributable to the aforementioned socioeconomic variables. The summary results are reported in Table 3.36. After adjusting for the effects of the other variables, agricultural wage employment is found to be about 7 percent greater in the project group of households than in the control group. The positive effect is not, however, statistically significant. The effect of the level of physical infrastructure on agricultural employment was negative--that is, it is higher in villages with underdeveloped infrastructural facilities.

Table 3.36--The Effects of Socioeconomic Variables on Wage Employment: The Results of the Analysis of Variance

Variable	Agricultural Wage Employment		Nonagricultural Wage Employment		Total Wage Employment	
	Effect	F Value	Effect	F Value	Effect	F Value
Landholding	Negative	235.4*	Negative	119.7*	Negative	257.7*
Age	Positive	26.2*	Positive	23.8*	Positive	43.1*
Education	Negative	26.3*	Negative[a]	17.5*	Negative[a]	10.4*
Infrastructure[b]	Negative (-3.0)	9.5*	Positive (43.4%)	46.3*	Positive (19.3%)	11.1*
Project[b]	Positive (7.0)	1.6	Positive (23.2%)	15.1*	Positive (16.1%)	16.7*

* Means significant statistically at the 0.95 level of probability.

a Except for the workers who had passed secondary school.

b Figures in parentheses are percent differences in average employment after controlling for the effect of other variables.

The effect of the project on nonagricultural wage employment is found to be positive and of high statistical significance and the positive effect is more pronounced in areas with better infrastructural facilities. Average wage employment, after adjusting for the effects of other variables, is about 35 percent higher among the project group of workers than among the control group and about 19 percent higher in the villages with well-developed infrastructural facilities.

APPENDIX TABLE

Table A3.1--The Extent of Employment in Different Activities, by Educational Status of the Worker (Eight-hour days a year)

Type of Activity	Illiterate	Primary	Secondary	SSC	HSC+
Self-cultivation	86	129	149	118	62
Wage labor	51	30	17	3	nil
Livestock	26	20	18	11	4
Fishing	19	10	5	1	nil
Cottage industry	10	8	3	nil	nil
Trade and shopkeeping	16	32	31	44	81
Transport and construction	31	34	22	10	nil
Salaried services	7	11	14	50	101
Other services	10	7	10	21	16
Others	24	24	19	19	5
Total	280	305	287	276	268

APPENDIX TABLE

Table A3.2--Extent of Employment in Different Activities, by Age of the Workers (Eight-hour days)

Type of Activity	Age Group: Old (55 +)		Child (Up to 15)		Adult Student (16-24)		Most Active Adult (25-54)	
Self-employment in crop production	116	(49.4)	55	(21.5)	105	(36.2)	108	(36.1)
Agricultural wage employment	26	(11.1)	29	(11.3)	50	(17.2)	38	(12.7)
Livestock and poultry raising	18	(7.7)	82	(32.0)	22	(7.6)	14	(4.7)
Fishing	13	(5.5)	26	(10.2)	12	(4.1)	13	(4.3)
Cottage industry	6	(2.6)	4	(1.6)	6	(2.1)	9	(3.0)
Trade and shopkeeping	9	(3.8)	12	(4.7)	18	(6.2)	32	(10.7)
Transport and construction	14	(6.0)	18	(7.0)	37	(12.8)	29	(9.7)
Salaried services	6	(2.6)	5	(2.0)	9	(3.1)	19	(6.4)
Other services	6	(2.6)	4	(1.6)	9	(3.1)	13	(4.3)
Others	20	(8.5)	21	(8.2)	21	(7.2)	23	(7.7)
Total	235	(100.0)	256	(100.0)	290	(100.0)	299	(100.0)

Note: Figures in parentheses are percentages of total employment.

IV. THE EFFECTS ON HOUSEHOLD CAPITAL FORMATION AND CONSUMPTION EXPENDITURES

Food for Work (FFW) projects and, for that matter, other public investments in the rural sector are intended to increase income and employment among the rural population. Whether this increase in income will lead to a sustained growth of rural economy depends on the amount of the incremental income that is saved and invested--that is, the rate of capital formation. Besides investment, publicly pursued price policies in agriculture will bring about greater agricultural production only when a part of the price-induced income is invested in agriculture. Whether farmers in fact do so or whether the investment opportunities do exist for farmers to generate the intended effects of price policies, therefore, depends on the rate and pattern of rural investment. In this chapter, the structure and determinants of investment and consumption behavior of households in the study area will be examined. Analysis of the pattern of consumption becomes relevant because consumption behavior influences savings behavior in a unique way. Marginal propensity to save bears a reciprocal relation to marginal propensity to consume, and savings constitute a principal source of finance for investment.

In examining the rate and the pattern of rural capital formation, particular attention is given to measurement of the effects of FFW projects and general infrastructures. When an FFW project has been completed, thereby creating a common asset for the surrounding farm households, it may impose an additional requirement or demand on individual households for investment in order for them to be able to exploit the potential economic benefit from this common asset. Construction of a small dam to hold water during the winter season, for example, may require farmers to acquire small pumps or indigenous water-lifting devices for irrigation. It may also imply that farmers would have to level their plots, using family labor, before they could use the dam water for irrigation. Thus, land improvement would form a type of investment in land. Besides these new opportunities for investment, increased income generated by projects might enable farmers to undertake some investment activities that they could not afford before because of deficiencies in income or investable resources.

General infrastructures are expected to affect savings and investment behavior of rural households in a number of ways. The presence of such facilities may mean increased opportunity for investment. It may also mean greater profitability of investment both

because access to markets is better and because inputs produced outside rural areas are cheaper. General infrastructures may also increase the aggregate propensity to consume through the demonstration effect of attractive consumer goods available in such areas. This effect of general infrastructures may adversely influence savings behavior in rural households. The implication of this increased consumption among households is expected to have a powerful effect on the demand for consumer goods and therefore on production of them, if supply constraints are not severe. How many of these consumer goods are produced rurally and what proportion are produced in urban-based industries will ultimately determine the shares of rural and urban areas in this induced increase in income and employment. Such dynamic effects of general infrastructures can only be captured through a comprehensive framework of analysis and a carefully designed format of data collection.

Data required for the study were collected from 640 households in 16 villages located in eastern, central, western, and southwestern Bangladesh during 1982. Household expenditures for all purposes, collected weekly and quarterly, were the principal basis of analysis. This information was supplemented by data on household assets at the beginning of the year. Thus, total expenditures were treated as equivalent to gross income. This approach to the estimation of income approximates the permanent annual income of households. Permanent income streams are more relevant to studies on savings and consumption behavior than transitory and relatively unstable annual income estimated from production accounts of households. Household expenditure statistics, moreover, are generally far more reliable than income statistics. Nevertheless, estimates of income, defined as total expenditures minus credit-financed expenditures, were also available and were used in certain analyses. All expenditures can be grouped in three broad categories -- consumption, investment, and taxes. The imputed value of family labor and home-produced goods used in the formation of assets--that is, labor used in land development--was accounted for both as income and as expenditure. Similarly, home-produced goods used for family consumption and payment of taxes were counted both as income and expenditure. This definition of income and expenditure may cause these estimates to look different from similar estimates reported in other chapters of this report. Readers are therefore cautioned to keep this in mind if they wish to make any comparison for the sake of checking consistency.

INCOME, SAVINGS AND INVESTMENT

Because the analysis is based on cross-section information and total expenditure has been adopted as the measure of income, the estimate of investment is also equivalent to the estimate of savings. These two terms, therefore, have similar meaning in the chapter, although savings and investment may not match in some other contexts.

For a valid reflection of rural capital formation, the expenditures for land, livestock, fisheries, and plantation were subject to certain specific modifications. The imputed value of offspring born during the year was part of the investment expenditure on livestock; the other part was the net purchase of livestock. A postive net purchase of livestock among all households partially reflects the fact that Bangladesh is a net importer of cattle from outside--e.g. from India and Nepal, for example, through unofficial trade. Land purchase is not real capital formation at the aggregate level, although at the household level it is as good an investment as a piece of farm equipment. This item is therefore included in gross investment as a separate item and the reader can include it or exclude it to suit any particular purpose. In fisheries, investment expenditures represent the value of improvement or development of fish tanks, fish seedlings, fishing equipment, and so on. On plantations, the imputed value of new plantings and the cost of maintenance of old ones were treated as investment. Plantation in rural Bangladesh typically means a few bunches of trees around a homestead. When a farmer sells one of these trees it could be treated as income rather than as a disinvestment. The concept of net change in an asset is, therefore, not relevant in the case of such a plantation.

Levels of Income

Average levels of income, measured by total household expenditures, are presented in Table 4.1. The difference between gross income and disposable income represents the incidence of direct taxation; the rate of direct taxation in the study villages is only about 0.2 percent of income. Average disposable income per capita is Tk 2,939, which is equivalent to US$118. Average household income in project villages appears to be about 14 percent greater than that in the control villages. Similarly, average household income in villages with well developed infrastructures is about 15 percent greater than the average income in villages in which infrastructures are underdeveloped. The differences in the rates of direct taxation between either control villages and project villages or between infrastructurally well developed and underdeveloped villages do not appear to be statistically significant, although the incidence of direct taxation is slightly higher in infrastructurally well developed villages than in underdeveloped villages.

Levels of Investment

The levels of investment expenditure are presented in Table 4.2. The estimates shown in the table indicate that the average rate of gross investment, measured as a percentage of disposable income, is only 6.06 percent. The corresponding rate of net investment is about 5 percent. The national savings rate, on the other hand, is estimated

Table 4.1--Total Income and Disposable Income in the Study Villages, 1982

Status of Villages	Average Total Income		Average Disposable Income		Rate of Taxation
	Per Household	Per Capita	Per Household	Per Capita	
	(taka)				(percent)
All villages	18,513	2,939	18,473	2,932	0.22
Project villages	19,662	3,025	19,621	3,019	0.21
Control villages	17,131	2,808	17,095	2,803	0.21
Villages with well developed infrastructures	19,758	2,994	19,715	2,987	0.22
Villages with underdeveloped infrastructures	17,208	2,868	17,176	2,863	0.19

Table 4.2--Levels of Investment Expenditures, Sixteen Study Villages, 1982

Status of Villages	Gross Investment per Household	Rate of Gross Investment[a]	Net Investment per Household	Rate of Net Investment[a]	Replacement Investment as Percent of Gross Investment
	(taka)	(percent)	(taka)	(percent)	
All villages	1,119	6.06	905	4.98	19.12
Project villages	1,229	6.26	1,118	5.7	9.03
Control villages	1,016	5.94	680	3.98	33.07
Percent increase (+) or decrease (-) in project over control	20.96[b]	5.39[b]	64.44[c]	43.21	---
Villages with well developed infrastructures	1,095	5.56	892	4.52	18.53
Villages with underdeveloped infrastructures	1,138	6.62	914	5.32	19.68
Percent increase or decrease in developed over underdeveloped	-3.78[b]	-16.01[c]	-2.4	-15.04[c]	---

[a] "Rate of investment" is investment as a percentage of disposable income. "Net investment" is total investment minus replacement expenditures.

[b] Significant at 5 percent.

[c] Significant at 1 percent.

to have been about 4.5 percent in 1982. Such a straightforward comparison, however, could be misleading, even wrong, without a number of clarifications. There is a substantive difference between the household level and the national level in the treatment of what constitutes an investment expenditure. What is an investment expenditure at the household level may simply be a transfer payment at the national level. Thus, the purchase of land by an individual household is an act of investment for that particular household. But it simply represents an equivalent disinvestment by another household selling the land, so at the national level no investment is implied. If an average level of investment is estimated through a cross-sectional study of a large number of households, however, and if special care is taken to eliminate the effects of expenditure of the nature of transfer payments, it is possible to arrive at investment rates at the household level that could be expected to be close to national estimates. In the present study, the size of the sample and the approach to estimation make it somewhat likely that the cross-sectional estimate of investment would be close to the aggregate estimate also.

Returning to the estimates presented in Table 4.2, it can be seen that the average rates of investment differ significantly between villages in which infrastructures are well developed and those in which they are underdeveloped; villages in which infrastructures are underdeveloped are surprisingly allocating a larger proportion of their income to investment than villages in which they are well developed. The difference between project and control villages in the rate of gross investment is modest, but the level of significance for the difference in the rate of net investment is even higher. It appears that the repair and maintenance type of expenditure is proportionately higher in control villages than in project villages. But the overall rate and the rate of net investment are both higher in project villages than in control villages.

A simple comparison of averages would seem to indicate that infrastructures are associated negatively and projects positively with the rate of capital formation. Before examination of this question in a multivariate model, however, some other classifications of investment and socioeconomic categories will be presented as preludes to analysis of determinants of investment rates. Rates of investment by income class, landownership group, and occupational group are presented in Tables 4.3, 4.4, and 4.5, respectively. The figures in Table 4.3 exhibit a short phase of decline, then a span of steadily rising relation between income level and investment rate. A nonlinear income-investment relation is apparent. In Table 4.4, the rates of landownership and investment do appear to bear a less robust but positive relation to one another than is the case between income class and investment rate. Because of a generally positive relation between landownership and income earnings, Table 4.4 is in some respects a reflection of the relation shown in Table 4.3. The estimates in Table 4.5 show the rates of investment in different occupational groups of households. The occupational classifications are

Table 4.3--Gross Investment, by Income Class, Sixteen Study Villages, Bangladesh, 1982

Income Class (taka per household)	Number of Households	Total Income per Household	Gross Investment per Household	Replacement Investment as Percent of Gross Investment
		(taka)		
500 or less	1	3,170	48	1.51
501-1,000	4	9,145	45	0.49
1,001-1,500	50	9,150	88	0.96
1,501-2,000	99	12,004	298	2.48
2,001-2,500	125	14,308	441	3.08
2,501-3,000	94	17,006	772	4.54
3,001-5,000	207	22,581	1,388	6.15
5,001-10,000	55	35,409	5,690	16.06
10,001 or more	4	40,260	23,358	58.01

Table 4.4--Gross Investment Rates, by Landownership Group, Sixteen Study Villages, Bangladesh, 1982

Landownership Group	Number of Households	Average Total Income per Household	Average Gross Investment per Household	Investment as Percent of Income
		(taka)		
Landless	193	11,317	554	4.90
2.0 or less acres	215	15,293	876	5.73
2.0-5.0 acres	163	23,820	1,870	7.85
5.0-7.5 acres	37	30,175	1,896	6.28
More than 7.5 acres	31	44,650	5,986	13.41

Table 4.5--Rate of Investment, by Occupation Group, Sixteen Villages, Bangladesh, 1982

Occupational Group[a]	Number of Households	Average Income per Household	Average Investment per Household	Investment as Percent of Income
		(taka)		
Cultivation	312	22,915	1,614	7.04
Sharecropping	7	16,087	479	2.98
Wage labor	136	19,599	340	3.48
Other agriculture	14	14,205	241	1.70
Industry	8	10,076	753	7.47
Trade	44	19,628	2,559	13.04
Services	48	16,185	773	4.78
Others	35	13,381	234	1.75

[a]The occupational group in which a household was counted was determined by the primary occupation reported by the head of the household.

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based on the primary occupation of the head of the household. Given the fact that a household has more than one earner and a second earning member may have an occupation different from that of the head, the classification does have some ambiguity in representing a particular source of income. Nevertheless, we observe a higher average propensity to invest in households with trade and business (13 percent), agriculture (7 percent), and rural industry (7.4 percent) as the primary occupations of the heads of households. On the face of it, it is difficult to attribute a precise reason for this pattern. But, as subsequent analysis will indicate, the table may be a true reflection of the hypothesis that investment opportunities are an important determinant of the household investment rate.

Determinants of Levels of Investment

The distinction between level and pattern of investment has to be kept in mind from the outset. The level implies the proportion of a given income that is saved and invested. The pattern describes the amount of the available investment fund that is allocated to each type of investment. The relative rate of return on investment is a crucial factor in determination of the pattern of investment, which will be examined in a later section.

We have already alluded to a number of factors, such as income, occupation, and landownership, that explain the investment behavior of rural households. Jorgenson is perhaps the best known of the econonomists who have attempted to theorize relations in investment behavior as well as to estimate them empirically. Most of his work has been limited to investment in manufacturing industries in developed countries, however. The model used by Jorgenson in an empirical study of aggregate investment behavior was an attempt to explain investment by income, capital stock, high-powered money supply, and credit stock. This specification does not include any noneconomic factors and is considered inadequate to explain the investment behavior of rural households in a developing country such as Bangladesh.

To explain the investment behavior of the study households the following model was adopted:

$$(1)\quad INV = a_0 + a_1 DY + a_2 DY^2 + a_3 KT + a_4 KT^2 + a_5 OWNL + a_6 OWNL^2 + a_7 LABR + a_8 EDN + a_9 PROJ + a_{10} INFR + a_{11} CRD ,$$

where INV = gross investment, in taka per capita,

DY = Disposable income, in taka per capita,

KT = Value of capital stock, in taka per capita (excluding land),

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OWNL = Owned land, in decimals per capita,

LABR = Number of working members in the family,

EDN = 1 if head of household has education above 5th grade, otherwise 0,

PROJ = 1 if project village, otherwise 0,

INFR = 1 if infrastructure is well developed, otherwise 0, and

CRD = amount of credit obtained from all sources.

The quadratic terms represent the nonlinearity of the function.

Once the equation has been estimated, the marginal propensity to invest can be calculated as follows:

$$MIS = \frac{dINV}{d\ DY}$$

$$= a_1 + 2a_2DY.$$

The underlying hypotheses for selecting the explanatory variables need further clarification.

It is expected that the relation between investment and income will be positive, for obvious reasons. As income rises, marginal propensity to consume decreases and marginal rate of saving increases. The relation between existing capital stock and new investment is less obvious. If not to anything else, replacement investment bears positive relation to capital stock. The production function could be such, however, that investment cannot be undertaken smoothly and continuously. Ownership of land is a necessary precondition for undertaking new investment in agriculture. The basis for labor -- the proportion of working members in the family -- is that the combination of agriculture, trade, and other activities in the same household is a complex arrangement, in which the availability of extra family labor serves as a positive cause for undertaking new investment.

The primary effect of implementation of an FFW project is an increase in household income. The income variable is therefore likely to pick up that effect, and the project variable is expected to be statistically insignificant. Nevertheless, we include the project variable on the assumption that there are other effects of the project that are not captured by any of the other variables included. Project-induced demand for complementary investments that are required to exploit the project fully fall into this category. There are compelling reasons to include the general infrastructure variable, even though part of its effect is likely to be picked up by the income variable. General infrastructure is expected to have a positive coefficient. The condition of profitability and access to markets and

information are some positive aspects of infrastructurally well developed areas that cannot be represented fully by the income variable. If these specific attributes of general infrastructures influenced consumption more than savings, however, the coefficient of this variable in explaining the level of investment could be negative.

The findings of the model are presented in Table 4.6. A number of significant findings deserve to be taken particular note of. Most nonlinear relations are statistically significant at a probability level of 99 percent. The relation between investment and disposable income is depicted by a curve that first declines with income, then rises from the point a little below the average level of income. The response of investment to changes in disposable income is elastic; the estimate of investment elasticity is 1.50.

The relation between gross investment and capital stock appears to demonstrate that investment tends to increase at a decreasing rate with the increase in capital stock. After a point the relation becomes negative. At mean level, the elasticity of investment in response to variations in capital stock is also small -- 0.21. As the area of land owned increases, the level of investment declines at an accelerated rate. Contrary to the hypothesis that owned land provides an investment opportunity, the relation between the area of land owned and the level of investment appears to be negative. Some clue to this relation will be elaborated when the pattern of investment is examined. The number of working members in the household appears to exert a positive influence, as expected, on the level of investment. Level of education of the head of the household does not appear to have any significant influence on investment.

As expected, the effect of the project is reflected mainly through its income effect. Without the indirect income effect of the project on level of investment, other direct effects are not significantly above or below zero. General infrastructure, however, besides its indirect effect on investment through greater income, has a significant negative influence on the level of investment in rural households. This is a surprising finding, contrary to the original hypothesis but one that opens a way to the learning of new lessons about the relation between general infrastructure and level of rural investment. Part of the answer should be found in the effect of general infrastructure on consumption behaviors. The indications are that a general level of improved infrastructure stimulates a higher propensity to consumption than is present in infrastructurally underdeveloped villages. Lack of opportunities for investment in agriculture, moreover, may have a deleterious affect on investment. These issues will be examimed further in connection with the analyses of investment pattern and consumption behavior.

Let us now try, in the light of the findings of the model, to adjust the effect of projects on total household investment, as shown in Table 4.2. In that table, the average level of investment was

Table 4.6--Regression Coefficients that Relate Level of Investment to Various Explanatory Variables, Rural Households, Bangladesh, 1982

Variable	Coefficient	t-Value	$\bar{R}^2$	Mean Value	Elasticity of Investment[a]
DY	-0.2388	-8.2629	0.67	2910	1.5042
DY^2	0.5894D-04	29.0145	---	---	---
KT	0.0585	3.7025	---	942	0.2114
KT^2	-0.7109D-05	-18.4150	---	---	---
OWNL	-0.7117	-1.0041	---	34.4	-0.2631
$OWNL^2$	-0.0120	-4.2857	---	---	---
LABR	17.3379	2.5752	---	4.2	0.3623
INFR	-47.4972	-1.6046	---	---	---
PROJ	4.4862	0.4868	---	---	---
EDN	-1.0162	-0.1941	---	---	---
CRD	0.0152	0.5625	---	818	---
Constant term	241.5172	---	---	---	---

[a]The elasticity of investment is the percent change in investment brought about by a change of 1 percent in the mean value of one or another of the explanatory variables. The marginal propensity to invest is 0.1246.

found to be about 21 percent higher in project villages than in control villages. Adjusting for the differences between family labor, farm size, and capital endowments in control villages and in project villages, the level of investment in project villages is estimated to be 19 percent higher than that in the control villages. If further adjustment is made for the difference in income levels, however, the project villages do not appear to sustain any increase in the level of investment over control villages.

The foregoing analysis indicates that the principal effect of the FFW projects and infrastructures on total household investment is limited to the income effect of projects. These projects contribute to acceleration of income, and increased income increases the level of investment. The effect of projects on complementary investment, if any, is small.

The other interesting relation is the effect of credit on the level of investment. Credit does not appear to influence the level of household investment in a statistically significant manner, although the direction of the relation is positive. The proportion of credit in the total stream of expenditures is not high. Credit as a proportion of total investment expenditure, however, would be quite high. As shown in Table 4.7, credit represents about 4 to 5 percent of total income (or expenditures).

Table 4.7--Average Levels of Credit Undertaken, 1982

Status of Villages	Credit Amount per Household	Credit as Percent of Total Income
	(taka)	
All villages	825	4.38
Project villages	958	4.87
Control villages	655	3.69
Villages with well developed infrastructures	994	5.03
Villages with underdeveloped infrastructures	657	3.68

PATTERNS OF INVESTMENT IN RURAL HOUSEHOLDS

The pattern of rural investment displays the nature of the investment portfolio and the shares of each individual item in total investment expenditures. This investment pattern for the study households is presented in 4.8 and 4.9. All investment items in these tables are classified under three broad categories: (a) agricultural, (b) nonagricultural, and (c) overhead and long-run investments. The agricultural category includes land development, agricultural equipment and energy--that is, equipment and draft animals, livestock, fisheries, and plantations. The nonagricultural category includes transport, trade and business, and rural industries. The overhead and long-run investment category includes education, land purchases, housing and domestic water supply, and miscellaneous items. The miscellaneous items include, besides some minor items, the mortgaging of land and the recovery of mortgaged land. This detailed classification is provided so that if different investment classifications are sought for various purposes, such computations can easily be performed.

Agriculture accommodates the largest share in the investment portfolio. The average share of agriculture in all villages is about 50 percent. Nonagricultural investment accounts for about 11 percent and the overhead and long-run category accounts for the remaining 39 percent of total gross investment by all households. Agricultural implements and energy, sharing 37 percent; trade and business, sharing 8 percent; and housing, sharing 14 percent, appear to be the top three activities for investment, if the land purchase and miscellaneous items are ignored on the grounds that these do not represent capital formation. Education is traditionally treated as a consumption expenditure in investment analysis. The well-known function of education in the formation of human capital influenced us to include this item as an investment activity. It appears that only about 1-2 percent of gross expenditure is shared by education, implying that only a small proportion of households invest in eduction.

If these broad categories of investment are arranged by project or control villages and by well developed or underdeveloped infrastructures, the picture presented above changes quite a bit (see Tables 4.8 and 4.9).

About 60 percent of total investment in underdeveloped villages is allocated to agriculture, 8 percent to nonagriculture, and about 32 percent to overhead and long-run investment. But in villages with well developed infrastructures the share of agriculture is only about 40 percent, the share of nonagriculture is about 18 percent, and the share of overhead and long-run investments is about 41 percent of total investment. A similar comparison between project and control villages shows that control villages invest a larger share in agriculture than project villages--59 percent and 45 percent,

Table 4.8 -- Pattern of Rural Investment: Sixteen Study Villages in Bangladesh, 1982, by Project and Control

Type of Investment	Average of Project Villages		Average of Control Villages		Average of All Villages	
	Level	Share	Level	Share	Level	Share
	(Taka per Household)	(percent)	(Taka per Household)	(percent)	(Taka per Household)	(percent)
AGRICULTURE						
Land development	78	6.31	138	13.60	100	8.96
Agricultural equipment and energy	422	34.36	397	39.29	416	37.16
Livestock (poultry goats, milk cows)	27	2.19	34	3.30	26	2.31
Fisheries	15	1.23	3	0.29	8	0.75
Plantations	12	0.96	22	2.14	15	1.34
Total	554	45.05	594	58.51	565	50.52
NONAGRICULTURE						
Transport	44	3.59	13	1.23	26	2.31
Business and trade	87	7.10	99	9.77	89	7.96
Rural industries	1	0.08	4	0.39	3	0.30
Total	132	10.78	116	11.39	118	10.56
OVERHEAD AND LONG-RUN INVESTMENT						
Education	22	1.75	10	0.97	16	1.42
Land purchase	170	13.85	53	5.18	118	10.52
Housing and water supplies	170	13.85	135	13.33	155	13.90
Miscellaneous	181	14.72	108	10.61	146	13.06
Total	543	44.17	306	30.09	435	39.00
All Investments	1229	100.00	1016	100.00	1119	100.00

Table 4.9--Pattern of Rural Investment, by Level of Infrastructural Development, Sixteen Villages, Bangladesh, 1982

Type of Investment	Average of Villages with Well-developed Infrastructures		Average of Villages with Under-Developed Infrastructures	
	Level	Share	Level	Share
	(taka per household)	(percent)	(taka per household)	(percent)
AGRICULTURE				
Land Development	93	8.48	108	9.46
Agricultural equipment and energy	307	28.03	513	45.09
Livestock	34	3.07	20	1.74
Fisheries	3	0.24	13	1.18
Plantation	10	0.89	21	1.81
Total	446	40.71	675	59.29
NONAGRICULTURE				
Transport	25	2.26	26	2.30
Business and trade	167	15.27	62	5.43
Rural industries	5	0.48	1	0.07
Total	197	18.01	89	7.79
OVERHEAD AND LONG-RUN INVESTMENT				
Education	16	1.45	15	1.32
Land Purchase	112	10.19	123	10.79
Housing & Water Supply	195	17.77	135	11.90
Miscellaneous	130	11.87	101	8.91
Total	452	41.28	374	32.92
All Investments	1,095	100.00	1,138	100.00

respectively. The share of investment in nonagricultural sectors is almost the same--11 percent in project villages and 12 percent in control. The share of overhead and long-run investments, however, appears to be substantially higher in project villages--44 percent--than in control villages, where it is 30 percent.

Determinants of the Pattern of Investment

What factors determine the allocation of an investable fund among various investment activities? Rural households invest their surplus income primarily in agriculture, business and trade, and house building. To what extent do various factors influence this pattern of allocation of investable resources, and what do infrastructural facilities, including FFW projects have to do with this process?

A multivariate regression analysis was undertaken to relate the shares of a specific group of investment activities in the total investment budget, to a number of explanatory variables hypothesized as important in the relation:

(2) S_i = f(RPFAG, RPFNF, OWNL, LABR, PROJ, INFR, EDN, CRD),

where S_i is the share of a specific category of investment in the investment budget.

Three categories of investment--total agriculture (SINVAG), total nonagriculture (SINVNF), and overhead and long-run (SINVLR)--were selected for estimation of the OLS equation, using the explanatory variables found in equation (2). Appropriate quadratic terms were added to test the hypothesis of nonlinear relations.

Rate of return is a well known determinant of the allocation of investable resources. Rate of return on agriculture (RPFAG) is computed by dividing the net income from agriculture by the value of agricultural capital stock (KT and land). Similarly, rate of return on nonagricultural investment (RPFNF) is computed by dividing the net nonagricultural income of a household by the total nonagricultural capital stock. No rate of return was computed for the category of investment SINVLR (overhead and long-run). Investment in this category is assumed to be influenced by the rate of return of the other two categories.

Dummy variables for general infrastructure (INFR), projects (PROJ), and educational level (EDN) of household heads were adopted. General level of infrastructure influences rate of return positively through prices of inputs and outputs and accessibility to markets. Nevertheless, we include this variable as a means of testing other plausible effects. Where the theoretical basis for assessing general infrastructure is weak, reliance on empiricism is considered a

prerequisite to a fuller understanding of this variable. The rationales for entering variables such as owned land (OWNL), number of working members in the family (LABR), and the amount of credit (CRD) in an investment function concerning rural households were given earlier.

Agricultural Investment

Results that relate the share of agriculture in total investment with postulated explanatory variables are shown in Table 4.10. The effects of FFW projects, educational level of head of household, landownership, and number of working members in the family were statistically significant at levels of 1-10 percent--that is, 90-99 percent level of probability of being correct in the indicated effect. The rate-of-return variable was not statistically significant nor was the rate of return from nonfarm investment significant at any statistically tolerable level.[1] All factors together, however, explain only 13 percent of the variability in the share of agricultural investment, signifying the complex nature of the relations that underlie investment decisions in agriculture.

The insignificant influence of agricultural profitability on agricultural investments, as indicated by the results, should be interpreted cautiously and tentatively. We shall come to this issue after examining the effects of other structural factors. Educational level appears to show a significantly negative effect on the share of agricultural investment. It is consistent with the well-known tendency in rural Bangladesh for educated members of a family to go to nonfarm activity, carrying with them the necessary investable funds. Ownership of land has a significant positive influence on agricultural investment, but the relation is nonlinear. As the area of land owned increases beyond a point found to be about 4.5 acres--any further increase in this variable exerts a negative effect on agricultural investment. The relation between the amount of capital required and the amount of farm land owned is such that for farms consisting of no more than one acre of owned land, capital may remain under used; a pair of bullocks and a plow, for example, may not have enough land to cover. Farms of between one acre and 4.5 acres require increased investment with increased size; this group is generally most productive in Bangladesh. Considerable evidence to this effect is available

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[1]Note that both the rate-of-return variables, RPFAG and RPFNF, are entered into the equation separately rather than as a ratio of the two; a relative rate of return would require a ratio collapsing the two variables into one. The independent entry of these two variables into the equation is based on the assumption that their effects are not symmetrical in influencing the investment pattern.

Table 4.10--Regression Results Relating the Share of Agriculture in Total Investment (SINVAG), with Explanatory Variables

Explanatory Variable	Coefficient	t Value	$\bar{R}^2$
PROJ	-0.0497	-1.7687	0.13
INFR	0.0033	0.1174	---
EDN	-0.0083	-1.6600	---
OWNL	0.0004	5.0000	---
$OWNL^2$	-0.1217D-6	-3.8750	---
RPFAG	-0.0009	-0.2913	---
$RPFAG^2$	0.1978D-5	0.004	---
RPFNF	0.0010	0.934	---
$RPFNF^2$	-0.2229D-5	-0.845	---
LABR	0.01430	2.2170	---
CRD	0.0501	0.8216	---
Constant term	0.2889	---	---

in the literature on the agricultural economy of Bangladesh. Owners of larger farms than 4.5 acres are known to rent out land, cultivate less intensively, and diversify the sources of their income by combining farming with trade and business. The number of family members available for work appears to have a highly significant effect on agricultural investment. This reflects both the nonmonetized investment made possible by family labor and the easier management of monetized investment because the labor supply is flexible and risk-free. The influence of general infrastructure on agricultural investment is not significant, but the direction of the relation is positive.

Total credit obtained by households does not appear to have a significant influence on agricultural investment.

Current Inputs in Agriculture

It is sometimes difficult to draw a line between current cost and investment cost in agriculture in developing countries. Many farmers in Bangladesh, for example, pay water charges to the government that include both running cost and some capital cost. With respect to the costs of fertilizers and pesticides, of course, the scope of such ambiguity between current and capital cost is small. The costs of modern inputs for the sixteen study villages are presented in Tables 4.11 and 4.12.

It will appear from Table 4.12 that the total cost per acre of fertilizer, pesticides, and irrigation, excluding labor cost, expressed as a percentage of disposable income per acre, ranges from about 2.6 percent to 3.2 percent. Expenditure on fertilizer and pesticides is 26.3 percent higher in project villages than in control villages. The same comparison between villages with well-developed and underdeveloped infrastructures indicates that the former group spends about 33 percent more on fertilizers and pesticides than the latter. For irrigation, project villages spent, on the average, about 61 percent more than control villages. Villages with well-developed infrastructures spent about 66 percent more on irrigation than those with underdeveloped infrastructures. FFW projects and general infrastructures appear to have a far more positive effect on the use of modern inputs in agriculture than do investment expenditures.

The pattern of distribution of input cost by income class (see Table 4.12) shows that middle-income households with income per capita ranging from Tk 1,000 to Tk 5,000 spend a larger amount per acre on irrigation than do households whose income is either lower or higher. This correlates with earlier findings on the pattern of investment by landowning groups where middle-sized farmers were observed to have a higher propensity to invest in agriculture. The pattern of expenditures for fertilizer and pesticides does not, however, reveal any such central bulge in the distribution. It shows an increasing association with income class.

Table 4.11--Average Expenditure on Current Inputs in Agriculture

Status of Village	Expenditure on Fertilizer and Pesticides	Expenditure on Irrigation	Total Exp.for Inputs	Total Disposable Income per Acre[a]	Total Cost of Current Inputs as Percent of Income
	(taka per acre)				(percent)
All villages	142.50	114.14	256.64	8,676	2.96
Project village	156.77	136.88	293.65	9,158	3.21
Control village	124.17	84.93	209.10	8,077	2.59
Well-developed infrastructure	165.55	147.07	312.62	9,820	3.18
Under-developed Infrastructure	124.69	88.69	213.38	7,669	2.78

[a]Income per acre is obtained by dividing total disposable income by area of owned land.

Table 4.12--Pattern of Costs of Current Inputs, by Income Class

Income Class	Cost of Fertilizer and Pesticides	Cost of Irrigation
(taka per capita)	(taka per acre)	
Up to Tk. 500	88	90
501 - 750	77	63
751 - 1,000	102	102
1,001 - 1,500	142	123
1,501 - 2,000	136	125
2,001 - 2,500	150	104
2,501 - 3,000	157	127
3,001 - 5,000	154	118
5,001 - 10,000	179	106
10,000 or more		77

Nonagricultural Investment

The results that relate the share of nonagricultural investment to its postulated explanatory factors appear to be the best among the three categories of rural investment (see Table 4.13). All explanatory factors together appear to explain 32 percent of the variability in the shares of nonagricultural investment in the households under study. In a cross-sectional study, such a result would be considered quite satisfactory.

Levels of infrastructure and education and the rate of return on nonagricultural investment appear to exert a significant influence on the share of investment allocated by households to nonagricultural activities. Ownership of land is also found to have a modestly significant influence on nonagricultural investment. The effect of infrastructure is positive and robust, besides having an indirect effect through the rate of return on nonagricultural investment. The educational status of the head of the household appears to have a positive influence in the allocation of an increasing share of investment to nonagricultural activities. Rate of return has a nonlinear relation to the allocation of investment to nonfarm activities, which increases at a decreasing rate with the increase in the rate of return. After a point the allocation to nonfarm activities tend to be negative. This is indicative of the operation of some constraints to the expansion of nonfarm investment. Ownership of land as an explanatory factor bears the opposite relation to the one observed in respect to agricultural investment. Allocation of investable funds to nonfarm activities bears first a negative relation to the extent of land ownership; then, after a point, the relation turns positive. It means that at a lower level of land ownership more of the investment tends to be allocated to agriculture (see Table 4.10); then at a higher level of land ownership the allocation to agriculture declines and allocation to nonagricultural activities increases.

The amount of credit appears to have a significant positive effect on investment in nonagricultural portfolios. It seems that rural households allocate more credit to nonagricultural investment than to agricultural production.

Overhead and Long-Run Investment

Regression results that relate the shares of overhead and long-run investment to explanatory variables are inconclusive. Only 5 percent of the variability in the shares of investable resources to overhead and long-run activity can be explained by the factors shown in Table 4.14.

Table 4.13--Regression Results Relating the Share of Nonagricultural Investment (SINVNF) to Explanatory Variables

Explanatory Variable	Coefficient	t Value	$\bar{R}^2$
PROJ	0.0145	0.772	0.32
INFR	0.0448	2.7152	---
EDN	0.0077	2.6102	---
OWNL	-0.7083D-4	1.4160	---
$OWNL^2$	0.2487D-7	1.0145	---
RPFAG	0.0013	0.7222	---
$RPFAG^2$	-0.6360D-5	1.1545	---
RPFNF	0.0014	2.2222	---
$RPFNF^2$	-0.2416D-5	2.2312	---
LABR	0.0005	0.1316	---
CRD	0.0072	2.9152	---
Constant term	0.0671	---	---

Most of the coefficients are statistically insignificant in the regression analysis. Only the variable "ownership of land," which can also be treated as a proxy for income, appears to exert a significant influence on investment on housing, education, and the purchases of land.

Table 4.14--Regression Results that Relate the Share of Overhead and Long-Run Investment (SINLR) in Total Investment to the Explanatory Variables

Explanatory Variable	Coefficient	t Value	$\bar{R}^{-2}$
OWNL	0.0001	2.0001	0.05
LABR	-0.0105	-1.5789	---
RPFAG	0.0010	1.0000	---
RPFNF	0.0001	0.2564	---
PROJ	0.0095	0.3276	---
INFR	0.0101	0.4153	---
Constant	0.5548	---	---

Table 4.15--Average Values of the Explanatory Variables, by Control or Project Villages and by Well-developed or Underdeveloped Infrastructures

Explanatory Variable	All Villages	Project Villages	Control Villages	Well-developed Infrastructure	Under-developed Infra-structure
RPFNF	3.8889	4.4583	3.1618	3.6767	4.0990
RPFAG	1.8328	2.2364	1.3176	1.5680	2.0952
LABR	4.2528	4.1803	4.3453	4.3016	4.2044
OWNL	216.52	214.26	219.40	200.76	232.13

AN INTEGRATIVE INTERPRETATION OF RESULTS

Investment decisions in rural Bangladesh are conditioned by a complex set of forces that cannot easily be formalized and measured objectively following a traditional framework of analysis. Nevertheless, it appears that the interaction of agricultural and nonagricultural investment opportunities is a significant determinant of the rate of agricultural investment. Nonagricultural opportunities provide a higher rate of return than agriculture (by the definition of "rate of return" used in this study). This is further reinforced by a social norm whereby educated people tend to invest in nonagricultural activities, siphoning investable funds from agriculture to nonagriculture. Large and rich farmers have better opportunities to go into trade and business because of better education, greater access to capital, and a larger supply of family labor. Large and rich households generally have the flexibility in manpower to combine agriculture with nonagricultural activities. Medium-size farm households have limited flexibility to combine agriculture and nonagricultural activities, and they therefore concentrate more intensively on agriculture than any other group. These phenomena are reflected in the nonlinear relation of agricultural and nonagricultural investment to land owned, family size, income, and education.

The technology of production, particularly the preparation of land, planting, weeding, and harvesting, is such that the demand for agricultural investment in this traditional system does not increase or increases only slightly as income increases. New rice technology, of course, enhances both profitability and the demand for new investment in agriculture. But investment opportunities in irrigation are impeded by the lumpiness of the investment,[2] the fragmentation of holdings, and general problems of skill and organization. Where divisible inputs such as fertilizer are involved, farmers do spend on these inputs at an increasing rate, unless constrained by other factors on both the demand side and the supply side.

Opportunities for nonagricultural investment are also limited because of the limited size of the market for such activities. Also, there are constraints to the expansion of nonagricultural activities, as indicated by the nonlinear relation between such investments and their rates of return; at a high level of return even such investments tend to show a declining rate. This would obviously cause an increasing propensity to consume, which will be examined next.

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[2]The term "lumpy" is used in economics to indicate the indivisibility of an input. Fertilizer can be bought in any quantity for effective use; hence it is not lumpy. But you cannot buy half a machine even though the size of your farm is such that you can utilize only half of the capacity of the machine.

The effect of general infrastructures is captured through a number of relations in the analysis. Villages in infrastructurally underdeveloped areas are found to invest about 60 percent on agriculture, while villages having well-developed infrastructures invest 40 percent. The creation and maintenance of land development and agricultural equipment and energy involve substantial labor, particularly family labor. Because the opportunity cost of family labor is lower in underdeveloped villages than in developed villages, the creation of such assets is faster and greater in underdeveloped than in developed villages. On the other hand, the share of nonagricultural investment is larger--18 percent--in developed villages than underdeveloped villages, where it is 8 percent. This finding indicates that nonagricultural investment is substituted for agricultural investment because of infrastructural development. In respect to the use of current inputs--fertilizer and pesticides--and irrigation, however, developed villages show a much larger level of expenditure than do underdeveloped villages. A shift in crop production technique, in the sense of the mix of investment and the use of current inputs, does appear to be made because of the difference in the degree of infrastructural development.

Perhaps the most important effect of infrastructural development on the aggregate level of household investment is its indirect effect on investment by way of the propensity to consume. When investment opportunities are generally limited and attractive consumer goods are plentiful, infrastructural development may be a greater stimulus to consumption than to investment.

The effect of the FFW projects on capital formation at household levels other than the direct creation of community-level assets is moderately high, but this effect is attributed to the income effect of projects through income-investment relations rather than to any complementary and direct effect of projects on household investment. The design and implementation of the projects do not make any explicit provisions for the use of the common assets to become dependent on any significant additional investment from the household. The projects do appear to influence the use of current inputs positively, however. Expenditures for these inputs are substantially larger in project villages than in control villages. The project effect on investment, as opposed to expenditures on current inputs, may also be a reflection of substitution between private and public efforts. The field-channel project is an instance in which the scope of household investment was narrowed by a public undertaking. In the absence of this public undertaking there could have been a larger household investment on irrigation, but the total effect on production would have been much smaller and would have been realized at a slower pace. The fact that farmers in project villages allocate only 6 percent of their investment expenditure to land development while those in control villages allocate 14 percent supports the substitution hypothesis.

HOUSEHOLD CONSUMPTION

Consumption is a mirror image of savings, determining the availability of resources for investment. The behavior of a household in deciding how much of its income is to be consumed currently and how much is to be saved and invested for future consumption will be examined here. The average levels of consumption expenditures in the study villages are shown in Table 4.16.

It can be seen from the table that the average consumption expenditure per capita in the study area was Tk 2,755 in 1982; this is equivalent to US$110.2 at the official rate of exchange. Consumption expenditure per capita was found to be 5.8 percent greater in project villages than in control villages. Similarly, the average per capita consumption expenditure was 5.6 percent greater in villages with well-developed infrastructure than in villages with underdeveloped infrastructure. Average consumption expenditure per household, however, was 14.4 percent greater in project villages than in control villages and 16.1 percent greater in villages with well-developed infrastructures than in infrastructurally underdeveloped villages.

Table 4.16--Average Levels and Rates of Consumption Expenditure, Study Villages, 1982

Status of Villages	Food	Non-Food	Total	Total Consumption as Proportion of Disposable Income	Consumption Expenditure Per Capita
	(taka per household)			(percent)	(taka)
All villages	13,113	4,242	17,355	93.95	2,755
Project village	13,929	4,456	18,385	93.70	2,786
Control village	12,093	3,976	16,069	94.00	2,634
Village with well-developed infrastructure	14,011	4,612	18,623	94.46	2,822
Village with underdeveloped infrastructure	12,174	3,860	16,034	93.35	2,672

Source: Estimated from survey data.

The average rate of total consumption, defined as a proportion of total disposable income, ranged from 93.35 to 94.46 percent among project and infrastructural subgroups. The difference between the average rates of consumption in project villages and control villages was 0.3 points--93.7 in project villages and 94.0 in control villages. The difference between villages with well-developed infrastructure and those with underdeveloped infrastructure was sharp, however (1.1 points)--94.46 in well developed and 93.35 in underdeveloped areas.

Aggregate Consumption Function

Determinants of the rate of total consumption were examined through a multivariate regression model, specified as follows:

TCE = f(DY,LABR,FSZ,OWNL,TENC,EDN,PROJ,INFR)

where TCE = total expenditure per capita of a household,

DY = total disposable income per capita of a household,

LABR = number of working members in the family,

FSZ = family size,

OWNL = owned land of the household,

TENC = proportion of tenanted land,

EDN = a dummy with 1 if head of the household has education at or above the 5th grade, otherwise 0,

PROJ = dummy with 1 for project and 0 for control,

INFR = dummy with 1 for villages with well-developed infrastructures, 0 for those with underdeveloped infrastructures.

A nonlinear term of an explanatory variable in interaction with the income variable was included in the equation for number of cases. The underlying reasons for inclusion of the variables in the model are parallel to the arguments presented earlier in specification of investment functions. The form of the consumption function, however, was based on the modified version of the Working-Leser model.

The estimated results of the model are presented in Table 4.17. The explanatory power of the multivariate analysis seems to be rather high; about 90 percent of the variability in aggregate consumption

expenditures of households is explained by the specified relations. The influence of the income variable is obvious, but the high and statistically significant effect of infrastructure and family size is of special importance. Aggregate marginal propensity to consume is estimated at 0.85, which is roughly (but not exactly) in conformity with the marginal propensity to save (or to invest in the ex-post sense).

The high, positive coefficient of infrastructure shows that, in addition to its effect through income, well-developed infrastructures exert other influences on household consumption behavior such that the propensity to consume tends to be substantially higher in villages with well developed infrastructures than in those with underdeveloped infrastructures. Inclusion of family size as an independent variable, even though the income and expenditure variables were expressed in per capita terms, was done mainly to test the effects of economies or diseconomies of scale of family size on consumption. It appears that the propensity to consume increases with family size, but after a point the tendency declines. The project coefficient is not statistically significant, implying that the project effect should be measured through the coefficients of other variables, notably income, which are positively influenced by the implementation of projects. Given the estimated marginal and average propensities to consume of 0.85 and 0.93, for example, an increase of 11 percent in household income from the execution of FFW projects would imply an increase of about 10 percent in aggregate household consumption. The corollary of this is that household savings should also increase by about 23.5 percent because of the increased income.

Table 4.17--Regression Results that Relate Total Consumption Expenditure to Disposable Income and Other Variables in Households, 1982

Explanatory Variable	Coefficient	t Value	$\bar{R}^{-2}$
DY	6.3635	20.0425	0.895
DY.log DY	-0.5974	-17.7797	---
LABR	-20.5755	- 1.1921	---
DY.log LABR	0.0319	1.40	---
FSZ	44.7458	3.5447	---
Dy. log FSZ	-0.2091	-11.4890	---
OWNL	-0.1569	1.7789	---
DY. log OWNL	0.0479	6.3026	---
TENC	-1.3896	-1.4198	---
DY. Log TEN	-0.0111	-1.0571	---
EDN	4.7377	0.7602	---
PROJ	0.1540	0.1010	---
INFR	118.6717	3.3791	---
Constant term	-1437.199	---	---

Note: The estimated marginal propensity to consume is 0.8515.

Pattern Of Household Consumption

The importance of a detailed analysis of consumption patterns is underscored by the importance of the indirect effect of consumption expenditures of rural households or nonagricultural sectors and overall growth of income and employment in an economy. A number of researchers--Bell, Hazell, Slade, Gibs, Rangarajan--have found that indirect demand linkages of agricultural and rural investment produce a large multiplier effect. For example, Bell, Hazell, and Slade found that for each dollar of income created directly in agriculture by an irrigation project in Malaysia an additional 80 cents of value added was created indirectly in the nonfarm economy. About two-thirds of this multiplier effect was found to be the result of demand linkages --that is, the effect of consumption expenditures of households that received the income initially from the project. The crucial factors in this demand linkage are the average and marginal propensities to consume. The final effect, however, would also depend on what happened on the supply side. If additional resources were forthcoming for investment to meet the demand generated, the effect on growth would be substantial. The supply of additional resources for investment, then, is also a critical issue.

Without providing a full account of the linkage effects involving comprehensive models of macroeconomic analysis, we shall present only those elements, such as propensities to consume, by detailed commodity groups, that represent the crucial parameters in such models. Useful conclusions can perhaps be drawn at first approximation about the probable direction and magnitude of multiplier effects by looking at the patterns of consumption and propensities to consume, which are given here. (Sometime in the future, we plan to develop a macro framework for measuring the full linkage effect.)

A flexibile and nonlinear consumption function was specified so that a good fit is provided to a wide range of commodities through a wide range of income levels. The model follows:

$$(3)\quad S_i = a_o + a_1\,(1/PTCE) + a_2 \log PTCE + a_3X_1 + a_4\,(X_1/PTCE) + a_5FSZ + a_6\,(FSZ/PTCE) + a_7D_1 + a_8D_2\,,$$

where

$S_i = \frac{PCE_i}{PTCE}$, the expenditure share of the ith commodity per capita,

PCE_i = expenditure on the ith commodity per capita,

PTCE = total consumption expenditure per capita,

X_1 = proportion of children in the family,

FSZ = family size

D_1 = dummy variable -- 1 for project, 0 for control,

D_2 = dummy for infrastructure -- 1 for well-developed infrastructure, 0 for underdeveloped infrastructure.

Equation (3) is equivalent to Equation (4) after both sides are multiplied by PTCE:

$$(4) \quad PCE_i = a_0 PTCE + a_1 + a_2 PTCE \log PTCE + a_3 X_1 PTCE + a_4 X_1 + a_5 FSZ\ PTCE + a_6 FSZ + a_7 PTCE\ D_1 + a_8\ PTCE\ D_2\ ;$$

$$MBS = \text{marginal budget share} = \frac{dPCE_i}{dPTCE}$$

$$= a_0\ a_2 \log PTCE + a^2\ PTCE\ (1/PTCE) + a_3 X_1 + a_5 FSZ + a_7 D_1 + a_8 D_2\ ;$$

$$ABS = \text{average budget share} = S_i\ ;$$

$$MBS/ABS = \text{elasticity of expenditure}\ .$$

On the basis of estimation using Equation (3), the results were obtained. The marginal budget shares, average budget shares and elasticity of expenditure, are presented in Table 4.18 for food and in Table 4.19 for nonfood.

It will be seen from the tables that about 77 percent of the total consumption budget is spent on food -- agricultural products -- and 23 percent is spent on services and nonagricultural products. The marginal budget share of food is about 68 percent and the elasticity of food expenditure with respect to total expenditure or income is 0.89. Unlike expenditures for food, expenditures for other products and for services are highly elastic with respect to total expenditure or income. The expenditure elasticities on all nonfood items except fuels range from 1.09 to 3.33. The elasticity of expenditure of all clothes and shoes is 1.72. The demand for clothes produced in cottage industries, however, is less elastic than the demand for clothes produced in mills. Expenditures for imported clothes appear to show the highest elasticity of any type of clothes or shoes. A similar pattern is observed in the case of household durables. Imported durables show

Table 4.18--Food Consumption Behavior of Households in Sixteen Study Villages, 1982

Item of Consumption	Average Budget Share	Marginal Budget Share	Elasticity of Expenditure
1. Total food	0.765	0.677	0.89
2. Cereals	0.505	0.391	0.77
3. Root crops	0.015	0.008	0.49
4. Sugar	0.019	0.027	1.47
5. Spices	0.033	0.028	0.85
6. Tobacco and narcotics	0.030	0.033	1.10
7. Fish and meats	0.063	0.088	1.40
8. Oils and fats	0.025	0.024	0.96
9. Pulses	0.012	0.010	1.23
10. Vegetables	0.032	0.029	0.90
11. Milk	0.014	0.025	1.82
12. Fruits	0.019	0.034	1.81

Table 4.19--Nonfood Consumption Behavior of Households in Sixteen Study Villages, 1982

Item of Consumption	Average Budget Share	Marginal Budget Share	Elasticity of Expenditure
13. Fuels	0.107	0.065	0.61
14. Soaps, washing soda, etc.	0.009	0.020	2.27
15. Clothes and shoes (products of domestic cottage industries)	0.038	0.052	1.38
16. Clothes and shoes (domestic mill products)	0.014	0.031	2.24
17. Clothes and shoes (domestic products 15 + 16)	0.052	0.084	1.62
18. Clothes (foreign products)	0.009	0.020	2.32
19. All clothes and shoes (17 + 18)	0.061	0.104	1.72
20. Household durables (products of domestic cottage industries)	0.004	0.005	1.09
21. Household durables (domestic manufactured)	0.006	0.009	1.71
22. Household durables (imported)	0.001	0.003	2.54
23. All household durables (20 + 21 + 22)	0.011	0.017	1.56
24. Health care	0.018	0.035	1.95
25. Personal services	0.005	0.017	3.33
26. Transport services	0.008	0.013	1.62
27. Social and religious ceremonies	0.014	0.041	2.89

Note: Because of rounding to the nearest decimal point, some results of addition or multiplication may be inexact.

the largest elasticity of expenditure--2.54--and durables produced by domestic cottage industries show the lowest elasticity of expenditure--1.09--among various types of household durables.

Average and marginal propensities to consume are not much different in project villages and control villages, except with respect to some foods other than cereals and items other than food. There are substantial differences between propensities to consume in villages with developed infrastructures and those with underdeveloped infrastructures (see Table 4.20). On account of total food consumption, the average share of the consumption budget in well-developed and underdeveloped villages does not differ significantly. When food consumption is disaggregated, however, both the average and the marginal shares for cereals are significantly higher in underdeveloped villages than in well-developed villages.

The respective average and marginal budget shares for cereals are 47.17 and 35.42 percent in developed villages and 52.24 and 40.78 percent in underdeveloped villages. The difference for noncereal foods is even wider. Budget shares in developed villages, both average and marginal, for noncereal foods are 16-17 percent higher than the corresponding shares in underdeveloped villages. The differences between budget shares in villages with well-developed infrastructures and those with underdeveloped infrastructures for clothes, household durables, health care and personal services, transport, and social and religious services are glaringly high.

Consumers in villages with well-developed infrastructures allocate a significantly higher share of expenditures to these items than their counterparts in villages with underdeveloped infrastructures. The implications of linkage between the demand for noncereal foods, other consumer goods and services, and infrastructural development are obviously profound.

INFRASTRUCTURES IN THE PROCESS OF DEVELOPMENT

Although we started our research to measure the effect of a specific type of infrastructure--land infrastructure developed through food-for-work projects--we were conscious of the potential importance of all other types of general infrastructure in rural development. At the beginning state of the research project, the perception of infrastructure was primarily abstract, and the study design was formulated on the basis of sample villages perceived to be endowed with and without well-developed infrastructures. As the field work progressed, it became clear that villages differed from one another in the degree of infrastructural development rather than in a complete absence or presence of infrastructures. It was therefore necessary to construct some sort of index of infrastructural development. A community-level questionnaire was used in each village to collect information on access to market and towns; access to financial institutions--banks,

Table 4.20--The Difference in Budget Shares between Villages with Well-developed Infrastructures and Those With Underdeveloped Infrastructures

Commodity	Villages with Well-developed Infrastructures		Villages with Underdeveloped Infrastructures		Percent Difference[a]	
	Average Share	Marginal Share	Average Share	Marginal Share	Average	Marginal
Foods and Consumer Goods						
1. Total Food	76.13	67.25	76.96	68.17	-1.08	-1.35
2. Cereals	47.17	35.42	52.24	40.78	-9.71[b]	-13.14[b]
3. Noncereal foods	28.96	31.83	24.72	27.39	17.15[b]	16.21[b]
4. Fuels	10.25	6.50	10.87	6.52	-5.70[c]	-0.30
5. All clothes and shoes	7.48	12.69	5.88	10.10	27.21[b]	25.64[b]
6. All household durables	1.54	2.22	1.07	1.68	30.52[b]	32.14[c]
Services						
7. Health care and personal service	2.37	3.30	2.31	2.60	2.60	26.92[b]
8. Transport	1.00	1.63	0.66	1.07	51.52[b]	52.34[b]
9. Social and religious services	1.62	4.74	1.26	3.69	28.57[b]	28.46[b]

[a]Calculated as follows:

$$\frac{\text{(value in well-developed areas)} - \text{(value in underdeveloped areas)}}{\text{(value in underdeveloped areas)}} \times 100$$

[b]Significant at 95 percent level.

[c]Significant at 99 percent level.

cooperatives, and specialized landing agencies; access to the supply of modern agricultural inputs--fertilizers, seeds, extension services, pumps and tubewells; and access to transport and communication facilities. Each of these broad infrastructural access positions was assessed through a number of formal questions, such as the number of regular and periodic markets near the village, secondary connections of these markets, and the size of the market in buyers, sellers, commodities, transport facilities, roads, and the like. Answers to each question were scaled against a standard ranging from A to D. A represents the best or ideal, B good, C satisfactory and D a poor situation of the particular infrastructural element serving a village. The total number of As, Bs, Cs, and Ds scored by each village were thus determined. This score was used to construct an index by assigning numbers: A = 10, B = 5, C = 2, and D = 1. This procedure of ranking villages by level of infrastructural development corresponds quite closely to the method developed by Sen for ranking countries by level of economic development.[3]

The ranking of the sample villages by level of infrastructural development is shown in Table 4.21.

Table 4.21--Ranking of Villages by the Index Number for Infrastructural Development

Village	Index Number
Chasapara	114
Illaspur	119
Khunta	63
Grobindapur	45
Rajarampur	54
Syedpur	79
Charkhamair	113
Patgari	129
Rowtara	125
Bandabeel	137
Raokoli	113
Harishpur	65
Grobrapara	83
Birhat	62
Taliamara	65
Khejurdanga	108

[3] See Amartya, Sen, Levels of Poverty: Policy and Change, Staff Working Paper No. 401 (Washington, D.C.: World Bank, 1980).

In this report, villages with well-developed infrastructures are those having index numbers 100 and higher, and those with under-developed infrastructures are those whose index numbers are below 100.

Analysis of the interrelation among the various types of infrastructure considered here leads to a number of interesting conclusions. The simple coefficients of correlation among the four categories of infrastructural elements--access to markets, financial institutions, modern agricultural services, and transport and communication facilities--are shown in Table 4.22.

Table 4.22--Coefficients of Correlation between Broad Categories of Rural Infrastructure, Including Projects

	Access to Markets and Towns	Access to Financial Institutions	Access to Modern Agricultural Services	Access to Transport and Communication Facilities
	X_1	X_2	X_3	X_4
X_1	1.00			
X_2	0.36	1.00		
X_3	-0.04	0.07	1.00	
X_4	0.60	0.37	0.26	1.00

The matrix portraying the simple association among the four broad categories of rural infrastructure indicates that the transport and communication category is the leading element. This category bears a high, positive correlation with all other categories. Its positive association with market institutions organized is the highest. The coefficient of correlation decreases, however, from 0.6 to 0.37 to 0.26, with movement from marketing institutions, which are dependent on private trade, to financial institutions, which are dependent both on private and public institutions, and to modern agricultural services, most of which are dependent on public initiative.

The table clearly indicates that publicly provided services, such as the marketing of modern agricultural inputs and services, need not be--and in fact are not--dependent on the leading element of infrastructures, transport and communication. This would not be true if provision of such services were left to private trades in infrastructurally backward areas and countries, at least at the initial stage of diffusion of these inputs.

Commercialization of Rural Economy

The process of rural development necessarily involves a transition from a subsistence to an exchange economy. Without this transition, which is more often gradual rather than abrupt, progress through technological means, specialization in production, trade, and consumption becomes impossible.

How rural infrastructures facilitate the transition can be gauged from some of the evidence presented in this study.

Extent of Monetization in Investment. No previous study is known to have measured the extent of monetized and nonmonetized expenditures in the investment baskets of rural households in Bangladesh. The implication for monetary policies of nonmonetized expenditures in the economy is obvious. But the importance of the extent of monetization in influencing the level and pattern of investment may also be significant. The extent of monetization in the household investment portfolio is shown in Table 4.23. Twenty-five percent of all investment expenditures consist of the formation of nonmonetized assets and involve the use of family labor and home-produced materials. Thus, the leveling of land or the creation of an irrigation dyke using family labor and on-farm materials would constitute a nonmonetized investment. It appears that the extent of monetization is significantly higher in villages with well-developed infrastructures than in underdeveloped villages--a difference of 12 points--and moderately higher--7 points--in project over control villages.

Table 4.23--The Extent of Monetization in the Investment Portfolios of Sixteen Study Villages, Bangladesh, 1982

Item	Total Investment Expenditure	Proportion of Monetized Investment	Proportion of Nonmonetized Investment
	(taka per household)		(percent)
In all villages	1,269	75.0	25.0
In project villages	1,229	77.0	23.0
In control villages	1,316	70.0	30.0
In villages with developed infrastructures	1,095	80.0	20.0
In villages with underdeveloped infrastructures	1,438	68.0	32.0

Monetization in Consumption Expenditure. The extent of monetized and nonmonetized exchange in consumer goods involved in the total expenditure streams of households is shown in Table 4.24. This table, when read in conjunction with similar information on investment expenditure provided earlier, gives a fairly precise picture of the extent of monetization in the rural economy of Bangladesh.

It can be seen that monetized expenditure is about 53 percent of total consumption expenditure in all villages, the remaining 47 percent representing nonmonetized expenditures. The percent of monetization in expenditures for food is about 47 and in other expenditures it is 71 percent. This overall picture does not vary more than 2 or 3 percentage points on account of variations between project and control areas. The picture changes significantly, however, when infrastructural development is considered. The extent of monetization in total consumption expenditures in infrastructurally well-developed villages is 60 percent, whereas in underdeveloped villages it is only 48 percent. The extent of monetization in expenditures for both food and nonfood items is greater in well-developed villages than underdeveloped villages.

Table 4.24--The Extent of Monetization in the Consumption Portfolios of Sixteen Villages, Bangladesh, 1982

Item	Total Consumption Expenditure	Proportion of Monetized Expenditure	Proportion of Nonmonetized Expenditure
	(taka per household)		(percent)
In all villages			
Food	13,266	46.92	53.08
Non-food	4,291	71.24	28.76
Total	17,557	52.87	47.18
In project villages			
Food	13,965	45.97	54.03
Non-food	4,468	70.73	29.27
Total	18,433	51.97	48.03
In control villages			
Food	12,372	48.33	51.67
Non-food	4,068	71.77	28.33
Total	16,440	54.13	45.87
In villages with well-developed infrastructures			
Food	14,041	55.02	44.98
Non-food	4,622	75.67	24.33
Total	18,663	60.01	39.99
In villages with underdeveloped infrastructure			
Food	12,494	41.00	59.00
Non-food	3,961	70.49	29.51
Total	16,455	48.10	51.90

Monetization in Current Production Costs. Monetization of current production costs in agriculture is shown in Table 4.25.

Table 4.25--The Extent of Monetization of Current Agricultural Production Costs in Sixteen Villages, Bangladesh, 1982

Item	Proportion of Monetized Expenditures	Proportion of Non-monetized Expenditures
	(percent)	
All villages	39.50	60.50
Project village	41.40	58.60
Control village	38.20	61.80
Villages with well-developed infrastructures	50.10	49.10
Villages with under-developed infrastructures	31.02	68.98

The average extent of monetization of current production costs of agriculture is about 40 percent in all villages. There is no significant difference between project and control areas on this score. As in the cases of investment and consumption expenditures, however, the extent of monetization is significantly higher in villages with well-developed infrastructures than in underdeveloped villages. About half the current cost of agricultural production in well-developed villages is monetized, whereas only 31 percent is monetized in underdeveloped villages.

Development of Rural Financial Markets

With progressive commercialization in the rural economy, the development of rural financial markets assumes an added importance. The nature of change in the rural credit market, brought about by progress in infrastructural development, is summarized in Table 4.26.

It appears that institutional sources of credit meet only about 7 percent of all the effective demand for credit realized at the household level in the study villages. The remaining part of the actual borrowings is obtained from traditional money lenders and from friends and relatives. The difference in infrastructural development tends to

cause a shift between the shares of money lenders and friends and relatives without any perceptible change in the share of institutional sources in the total supply of credit. All institutional credit in Bangladesh is provided, directly or indirectly, by public arrangement and resources.

Commercial banks, agricultural development banks (which are specialized public banking institutions), and cooperatives are the institutional sources of credit. Even though these institutions are generally located in commercial centers, where there are well-developed infrastructures, their lending practices and terms are very much geared to those who have formal credit-worthiness. It matters very little whether these persons with reliable credit ratings are located in well-developed or underdeveloped areas. Those with credit-worthiness, moreover, are generally from the richer and better-educated households rather than ordinary rural folk. These high-income groups in the rural population are more mobile than others, so lack of information about institutional credit does not pose a serious problem for them, even if they reside in remote, underdeveloped areas. The marginal transaction cost of institutional credit is not likely to be much different whether such groups are found in well-developed or underdeveloped villages. The distribution of institutional credit, therefore, does not give rise to a discriminatory pattern between infrastructurally well-developed regions and those that are underdeveloped.

Table 4.26--Sources of Credit in Study Villages, 1982

Status of Villages	Institutional Source	Money Lenders	Friends and Relatives	All Sources
All villages	7.1	45.8	47.1	100.0
Infrastructurally well-developed	7.1	38.5	54.4	100.0
Infrastructurally underdeveloped	7.2	53.2	39.6	100.0

The money-lending business, on the other hand, involves transactions between wealthy households and poor households in a very personal relationship in which the lenders possess informal but powerful means of enforcing the terms of credit, even if these terms are

bad in the eye of law or are socially unethical. (Note that the payment and acceptance of interest are forbidden under Islamic law, and Bangladesh is predominantly a Moslem society.) The money-lending business as an informal trade is unlikely to thrive in areas in which the literacy rate is high, access to employment is easy, and people are conscious of legal rights and the conditions of law enforcement. These attributes are more closely associated with well-developed than with underdeveloped infrastructures. It is therefore expected that the incidence of money lending will be higher in underdeveloped villages than in those where infrastructures are well developed. The survey results given in Table 4.26 clearly support these propositions.

Friends and relatives are a source of credit that is based on informal, personal relations, but less exploitative and commercial and more cognitive of mutual well-being or sharing than involvements in the money-lending business. Friendship and mutual trust develop among business entrepreneurs and they frequently borrow and lend money among themselves at times when someone's need for extra cash matches someone else's supply of extra cash. This is expected to be more extensive where members of the business community are located closely together--that is, in areas in which infrastructures are well-developed. Borrowing and lending among relatives is a phenomenon expected to prevail in both well-developed and underdeveloped villages. But the average share of the friends-and-relatives category of credit supply is likely to be larger in villages with well-developed infrastructures than in those with underdeveloped infrastructures. The results given in Table 4.26 indicate this to be true.

How the informal credit markets can be transformed into a self-sustained and organized system of financial markets is a question to which most policymakers and development economists seek the answer. It is true that such a transformation occurs with the growth of the economy, an adequate legal framework with dependable enforcement, and a policy environment congenial to the development of entrepreneurship. These are the softwares of the process; the hardwares are provided in infrastructural development.

SUMMARY AND CONCLUSIONS

The main objective of this part of the study was to measure the effects of FFW projects and general infrastructure on the level and pattern of rural expenditures for private investment and for consumption. As this measurement is taken, a structural picture of capital formation in rural households of Bangladesh emerges. Such a study has not been conducted before on such a comprehensive scale.

Average disposable household income in the study area, which comprised 16 villages in various parts of the country, was Tk 2,932 per capita, equivalent to US$118 in 1982. The difference between

gross and disposable income indicated an average rate of direct taxation of only about 0.2 percent of income. There was no significant difference between the rate of direct taxation in project villages and control villages or in infrastructurally well-developed villages and underdeveloped villages. Average income per household in project villages was 14 percent higher than in control villages. Similarly, average household income in villages with well-developed infrastructures was 15 percent higher than that in villages with underdeveloped infrastructures.

The average rate of gross investment--that is, gross investment as a percentage of disposable income--was 6.06 percent. The corresponding rate of net investment was 4.9 percent. Surprisingly, the average rates of investment were significantly higher in villages with underdeveloped infrastructures than in those in which infrastructures were well developed. Project villages were found to have a 21 percent higher rate of gross investment than control villages, and the difference in the rate of net investment was all the more significant. It was clear that the repair-and-maintenance type of investment expenditure was proportionately higher in control villages than in project villages.

The analysis of averages clearly indicates the need for a multivariate framework in assessing the effects of projects and general infrastructures on rates of investment. Preliminary tabular analysis, as a backdrop to multivariate regression analysis, showed a short initial decline, then a steadily increasing relation between household income levels and investment rates. In spite of some ambiguity in the definition of occupational classes, it was observed that households with trade and industries as a primary occupation had the highest average propensity to invest.

A multivariate regression analysis provided quantitative measures of the nonlinear relations involved in explaining the variation in aggregate level of household investment. The relation between investment and disposable income is depicted by a curve that first declines with income, then rises from a point below the average level of income. The marginal propensity to invest at the mean value is about 0.16 and the elasticity of investment with respect to disposable income was estimated at about 1.50.

The relation between gross investment and capital stock appears to demonstrate that investment tends to increase at a decreasing rate with the increase in capital stock. After a point, the relation becomes negative. Contrary to the hypothesis that owned land provides an investment opportunity, the relation between the area of owned land and the level of investment appears to be negative. The number of working members in the household appears to exert a positive influence on investment. The educational level of the head of the household does not show any significant influence on aggregate gross investment.

The effect of FFW projects on investment is reflected mainly through their indirect but positive income effects. The level of investment in project villages would therefore be 19 percent higher than in control villages. This income effect is partly masked by other factors when a simple comparison of averages is made. Apart from this income effect on investment, the projects do not show any influence on complementary investment from households in order to exploit benefits of the projects. General infrastructures, however, besides their indirect but positive effect on investment through greater income, have a significant negative influence on the level of investment in rural households. An explanation for such a surprising result is to be found, as will be shown later, through the analysis of consumption behavior.

The number of working members in the family is found to have a significant positive influence on the level of investment. Credit does not appear to influence the level of household investment in a statistically significant way, although the direction of the relation is positive. Credit represents about 4 to 5 percent of total income.

A pattern of rural investment displays the nature of the investment portfolio and the share of each individual item in the total investment budget. For convenience of discussion, all investment items are classified under three broad categories: agriculture, nonagriculture, and overhead and long-run investment. The share of agriculture, as an average over all villages, is about 50 percent. Nonagriculture accounts for about 11 percent, and the overhead and long-run investments account for the remaining 39 percent of total gross investment. These shares change significantly, however, when they are arranged by project villages and control villages or by villages with well-developed and underdeveloped infrastructures. About 60 percent of total investment in underdeveloped villages is allocated to agriculture, 8 percent to nonagriculture, and the remaining 32 percent to overhead and long-run investments. But in villages with well-developed infrastructures, the share of agriculture is 40 percent, the share of nonagriculture is greater at 18 percent, and the share of overhead and long-run investments is also greater at about 41 percent of total investment. A similar comparison between project and control villages shows that control villages invest a larger share--59 percent--in agriculture than project villages--45 percent. The share of investment in nonagriculture is 11 percent in project villages and 12 percent in control villages. The share of overhead and long-run investments, however, appears to be substantially higher in project villages--44 percent--than in control villages, where it is 30 percent. It was found that only about 1-2 percent of gross investment is allocated to education in study households.

What determines the allocation pattern of an investable fund among various investment activities? A multivariate regression analysis was conducted to test a number of hypotheses concerning

shares of investment, with rates of return on investments in agriculture and nonagriculture, education, number of working members, ownership of land, location, and credit. In explaining the share of investment allocated to agriculture, the rate-of-return variable was found to be of little significant direct influence. Consistent with a general belief that educated members of the household go to nonfarm activities carrying with them the investable funds, the influence of the education variable was found to have a negative effect on investments in agriculture. As the extent of owned land increases beyond about 4.5 acres, it exerts a negative effect on agricultural investment. The numb r of family members available for work appears to have a highly significant effect on the share of investment allocated to agriculture. Food-for-Work projects do appear to have a modest positive influence on the share of investment allocated to agriculture.

Total credit obtained by households does not appear to have a signifcant influence on investment in agriculture.

Even though the project and infrastructural development did not show promise of significant effects on agricultural investment, these community assets exhibited a tremendous influence in project villages on the use of modern agricultural current inputs. Thus, expenditures for fertilizers and pesticides are 26.3 percent greater in project villages than in control villages. The comparison between villages with well-developed infrastructures and those with underdeveloped infrastructures indi-cates that the former group spend about 33 percent more on fertilizers and pesticides than the latter. Project villages spent about 61 percent more for irrigation than did control villages. Villages with well-developed infrastructures spent about 66 percent more on irrigation than did those with underdeveloped infrastructures.

The results that relate the share of investments in nonagriculture to their postulated explanatory factors appear to be the best among the three categories. Levels of infrastructure and education and the rate-of-return factor appear to exert a strongly significant positive influence on the share of investment allocated to nonagricultural investment. The area of land owned is also found to have a moderately significant positive influence on nonagricultural investment. The positive relation between rate of return on agriculture and nonagricultural investment appears to be consistent with the negative relation between area of owned land beyond five acres and investment in agriculture. These two findings support the position that large farms tend to allocate more of their investable funds to sectors other than agriculture.

Results that relate the shares of overhead and long-run investment to various explanatory variables are not conclusive. Income appears to be the dominant factor explaining the relative share of this investment item.

Investment decisions in rural Bangladesh are conditioned by a complex set of forces. It appears that the interaction of agricultural and nonagricultural investment opportunities is a significant determinant of the rate of agricultural investment. Nonagricultural investment opportunities provide a higher rate of return than agriculture (by the definition of rate of return used in this study). This is further reinforced by social norm when educated people tend to undertake nonagricultural activities, siphoning investable funds from agriculture to other sectors. Rich farmers with large farms have better opportunities to go into trade or business because of better education, better access to capital, and larger supplies of family labor. Rich, large households do generally constitute large families, providing flexibility in manpower to combine agriculture with other activities. Medium-size farm households possess limited flexibility in combining agriculture and other activities and therefore concentrate more intensively on agriculture than any other group. These phenomena are reflected in the nonlinear relation of agricultural and nonagricultural investment with owned land, family size, income, and education.

The technology of production, particularly preparation of the land, planting, weeding, and harvesting, is such that the demand for agricultural investment in this traditional system does not increase, or increases only slightly, as income increases. New rice technology, of course, enhances both profitability and the demand for new investment in agriculture. But investment opportunities in irrigation are impeded by the lumpiness of the investment, fragmentation of holdings and general skills, and organizational problems. When divisible inputs such as fertilizers are involved or the problem of lumpiness is mitigated by organizational modification, farmers do spend on these inputs at an increasing rate.

Inhabitants of villages in infrastructurally underdeveloped areas are found to invest more on agriculture than those of infrastructurally well-developed villages, because those in underdeveloped villages must invest more in land development and agricultural equipment and energy. The creation and maintenance of these assets involve substantial labor, particularly family labor. Since the opportunity cost of family labor in underdeveloped villages is lower than in developed villages, the creation of such assets is faster and greater in underdeveloped villages than in well-developed villages. On the other hand, the share of nonagricultural investment is larger in well-developed villages than in underdeveloped villages. This finding indicates that investment in other sectors is substituted for investment in agriculture as infrastructures are developed. Developed villages show a much larger level of expenditure in current inputs and irrigation than do underdeveloped villages. A shift in crop production technique--that is, a change in the mix of investment and the use of current inputs--does appear to come about as the degree of infrastructural development changes.

The effect of the FFW projects on both the formation of capital at the household level and the direct creation of assets at the community level is considerable. This effect, however, is attributed to the income effect of projects, by way of the relation between income and investment, rather than to any complementary, direct effect of projects on household investment. In the design and implementation of the projects no explicit provisions are made to prevent the use of the common assets from becoming dependent on additional investment from the household. The projects do appear to influence the use of fertilizers, pesticides, and irrigation positively, however. Expenditures for these current inputs are substantially larger in project villages than in control villages. The effect of the project on investment, as opposed to its effect on the use of current inputs, may also be a reflection of substitution between private efforts and public efforts. In the field-channel project, for example, the scope of household investment was narrowed by public undertakings in the building of field channels. In the absence of these public undertakings there might have been a larger household investment on irrigation, but the total effect on production would have been much smaller and would have been realized more slowly had there been no public initiative in field channels. The fact that farmers in project villages allocate only 6 percent of investment expenditure to land development while the share of investment by those in control villages is 14 percent supports the substitution hypothesis.

When the opportunities to invest are generally limited, and attractive consumer goods are plentifully available, infrastructural development may encourage consumption more than investment, as an analysis of consumption expenditures shows.

The average rate of total consumption, defined as a proportion of disposable income, ranged from about 93 to 95 percent. The difference between the average rates in project villages and control villages was only 0.3 points--93.7 in project villages and 94.0 in control villages. The difference between the rates in villages with well-developed infrastructures and those with underdeveloped infrastructures, however, was quite sharp--94.46 in developed and 93.35 in underdeveloped areas. A multivariate regression analysis was conducted to measure the effects of the project and the development of infrastructures on the aggregate consumption expenditures of households. The results suggest that, in addition to its effect through income, the development of infrastructures exerts other influences on household consumption behavior; the propensity to consume foods other than cereals and goods other than foods tends to be substantially greater in villages with well-developed infrastructures than in those with underdeveloped infrastructures.

Carrying the analysis to levels of further disaggregation revealed a number of interesting facts. About 77 percent of the total consumption budget is spent on food--that is, agricultural products--

and 23 percent on nonagricultural products. The marginal budget share of food is 68 percent and the elasticity of expenditure for food with respect to total expenditure--or income--is 0.89. Unlike expenditures for food, other consumption expenditures are highly elastic. The average and marginal propensities to consume are not much different in project villages from those in control villages, with a few exceptions. However, there are substantial differences between propensities to consume in villages with well-developed infrastructures from those in villages with underdeveloped infrastructures. The respective average and marginal budget shares for cereals are 47.17 percent and and 35.42 percent in developed villages and 52.24 percent and 40.78 percent in underdeveloped villages. Average and marginal budget shares for noncereal foods are 16-17 percent higher in developed villages than in underdeveloped villages. The differences between budget shares in developed villages and those in underdeveloped villages for clothes, household durables, health care and personal services, transport, and social and religious services are glaringly high. Both average and marginal budget shares for these items in developed villages exceeded those in underdeveloped villages by 25-50 percent.

Rural infrastructure is an important element in the process of rural development. A number of attributes of the transition of the rural economy were examined from the point of view of infrastructural development. The effect of the development of rural infrastructures on the monetization of the rural economy and the development of rural financial markets is reported here.

Twenty-five percent of all investment expenditures consist of the formation of nonmonetized assets involving family labor and materials produced at home. It appears that the extent of monetization of investment expenditure is a significant 12 points greater in infrastructurally well-developed villages than in underdeveloped villages.

In all villages monetized expenditure is about 53 percent of the total consumption expenditure. In villages with well-developed infrastructures, the extent of monetization of consumption is about 60 percent, whereas it is only 48 percent in underdeveloped villages.

The extent of monetization of agricultural production costs in agriculture is 40 percent in developed villages and 31 percent in underdeveloped villages.

The rural credit market appears to be dominated by an informal credit system of money lenders, friends, and relatives as sources of credit; institutional credit constitutes only about 7 percent of all credit. Infrastructural development does not seem to produce much influence on institutional credit. Infrastructural development, however, tends to reduce the incidence of the money-lending business and accelerate informal lending and borrowing among trusted friends in trade and business.

V. THE EFFECTS ON NUTRITIONAL STATUS

It is a well-known fact that the etiology of the nutrition problem in Bangladesh, as in most developing countries, is complex. At the same time nutritional well-being is a desired objective not only of welfare programs but also of long-term development programs. The resultant dilemma is that assessment of nutritional effects is both desirable and confounding. The basic premise supported by all field investigations is that the immediate factors in nutritional status are food intake and disease. Food intake can be influenced by both welfare and development programs by affecting the characteristics of household income and other factors, such as food prices, that are related to demand. Disease can also be influenced in the long run in many ways: environmental changes introduced by the program and changes in the allocation of income and time may be favorable to greater use of health facilities, and an increase in income, if substantial and sustained, can be channeled into investments for improvement of water and sanitation facilities.

Food-for-work programs embody both welfare objectives and development objectives. The phase of these programs aimed primarily at welfare occurs during the construction, when employment is made available to agricultural laborers who would otherwise be unemployed. This takes place along with the provision of a wage good, which prevents increases in demand from causing prices to increase; the seasonal character of the program also prevents an expected short-term rise in prices. This report, however, is primarily concerned with the long-term consequences of the structures constructed in FFW programs.

In the next section all the significant factors involved in producing the nutrition levels in a community will first be delineated. Then an attempt will be made to identify those factors that would likely be influenced by FFW programs in both the short run and the long run. The next section will describe the design of the nutrition analysis and the methods used. This will be followed by results obtained and conclusions reached about the nutrition effects that are indicated.

ANALYTICAL FRAMEWORK

Factors That Influence Nutrition

Even though there is considerable debate on the precise use of various measures such as diet and anthropometry in assessing nutri-

tional status, research during the past decade has considerably enlarged our understanding of the factors underlying malnutrition in developing countries. Thus while the availability of food is an important consideration, it contributes to improved consumption only if households make effective demand for the food that is available. The primary components of effective demand are absolute food prices, relative food prices, and the level of disposable income available to the household. Many characteristics of household income, such as its composition and seasonal distribution--how much of it is permanent, how much transitory, how much is in kind, and how much in cash--and who earns it, which could influence the pattern of its allocation, all contribute to effective demand and thus to the consumption of food by the household and individual members.

As with food intake, both the availability and the effective demand for health services, water supply, and sanitation would influence the impact on disease. For health and sanitation, income and effective cost-related demand are probably the most important factors other than the availability of services and changes in underlying physical conditions, such as changes in water supply and its quality, that may be accompanied by a project completion.

The Effects of FFW on Nutrition-Related Factors

Food-for-work programs such as those conducted by the World Food Programme (WFP) in Bangladesh are geared to the building of economic infrastructures. They are thus expected to contribute to well-being by providing employment in the short run and thereafter by improving the possibilities for agricultural production and its attendant benefits. They can therefore be seen to influence all the conditions that lead to nutritional well-being: the availability of food, the ability to obtain the food that is available, the desire to obtain it, health and sanitation, and probably the distribution of food within the household as well.

The actual improvement that takes place in nutrition is also determined by the distribution of benefits among the population. The more favorable the distribution of benefits toward those households that are nutritionally deprived or whose income is low, the greater the individual effects and the greater the possibility that cumulative effects will be noticeable at the community level.

The Effects on Nutrition after Completion of FFW Projects

As already mentioned, FFW projects influence all the principal factors that affect nutrition--the availability of food, purchasing power, and the ability to allocate additional amounts of income to nutrition and the improvement of health. Both in the short run, moreover--during construction--and in the long run--after completion

of the project--all these effects may be expected in varying degrees, depending on the project and the characteristics of its implementation. The various mechanisms that may be expected to operate after completion of the project will be discussed below.

Increased availability of food. Projects may stimulate increases in food production either directly or indirectly. Direct effects may come from irrigation and flood-protection projects, which may both increase aggregate production and even out seasonal and year-to-year levels of production. Clearly intervening factors such as agricultural services will affect the extent to which the potential growth can be achieved. Projects such as road construction might affect production indirectly, depending on whether there was sufficient potential for marketing production to be realized from access to markets and services that roads would provide. No matter how favorable the effects on the availability of food might be, however, no effects on consumption and nutrition would be realized unless the ability of those who are malnourished to obtain this food were to be enhanced.

The Ability to Obtain Additional Food. Increases in income and reduction in the prices of food or other commodities are the principal determinants of a household's ability to increase consumption. Income may come from additional employment, home production, or self-employment. There are many ways in which increases in income may come about. Land-cultivating households may increase their income from production, laboring households may increase agricultural employment, individuals may increase their self-employment outside agriculture, either by undertaking additional activities stimulated by a project such as road construction or improvement or indirectly in response to demands that arise out of agricultural growth. Clearly the implications are far-reaching. Prices may be influenced by a combination of the changes in both production and demand induced by construction of a project.

Enhancing the ability to obtain additional food is probably the most important thing that can be done to improve nutrition. This is what influences the magnitude of the change in consumption and its distribution within the population. Effects on consumption that are favorable for nutrition are likely to occur only if employment and incomes of the malnourished increase, prices of staples and other items of food to which they allocate relatively large shares of their budgets decline, or both. The seasonal and year-to-year stability of these conditions are especially important if improvements in nutrition are to take place.

The Allocation of Income to Increases in the Consumption of Food. Many factors, which are as yet imprecisely known, influence decisions whether incomes will be allocated to increases in the consumption of food to meet basic needs. Those mentioned most frequently are source

of income and control of income within the household. The argument is that the marginal propensity to allocate increments in income is influenced by whether the increment is in cash or in kind, whether it is transitory or permanent, and whether it was earned by men or by women. The rationale given for these differences is varied and not well substantiated.

The allocation of income to food is also influenced by the household's perception of its nutritional needs. It is acknowledged by now that all societies have perceptions of dietary adequacy that are consistent with a nutritionally balanced and scientifically adequate diet. New scientific discoveries have repeatedly vindicated the superiority of age-old practices for the circumstances in which they prevail. With the exception of diet in disease and circumstances of physiological vulnerability such as weaning and pregnancy, for which medical developments and services may often make traditional practices redundant, indigenous dietary perceptions are generally sound. These perceptions explain the increasing evidence in the literature of economics for the high marginal propensities to consume and the high income elasticities of food consumption by low-income groups.

Distribution of Food within the Household. Generally, when overall household food consumption is low, there is a strong likelihood that food will be maldistributed within the household. Under such circumstances, those who are favored are inevitably those with heavy workloads or those who contribute to household income. Improvement in level and stability of income is usually expected to correct maldistribution within the household. On the other hand, a reduction in wage rates could exacerbate the situation by increasing the energy requirements of the wage earners without increasing their income or by reducing the amount of income generated.

Other factors that may be influenced by infrastructures created by FFW are intrahousehold composition of income and its control, the demand for women's time, whether outside agriculture or in the field, and the range of goods that may be drawn into the area by any of several factors linked to projects.

Changes in the Allocation of Income to Items Other than Food. Allocation of income to items other than food may be positive, neutral, or negative in its nutritional consequences. Nonfood expenditure could be affected by several types of change, including level of income, its composition and control, and the availability and prices of commodities other than food. Expenditures for improvements in water supply and sanitation or the use of health facilities are probably among the most nutritionally positive of nonfood expenditures. Expenditures for housing and clothing can also have positive consequences for health, and other expenditures, such as for education, can ensure even longer-term benefits. Other nonfood expenditures, while improving the perceived quality of life, may

bring few immediate benefits for nutrition. As discussed elsewhere in this report, however, these expenditures may provide the basis for extending the economic benefits of FFW projects to groups beyond those who participate directly in their results.

Intervening Conditions Exogenous to a Project. Several institutional and structural factors can substantially influence the size and distribution of benefits from a completed project. Access to complementary services and infrastructures could influence the types of change that take place, while local institutions may impede or facilitate the effective use of FFW structures. An examination of these conditions and their consequences might influence both the location and the content of future FFW projects. Some of these conditions are explicitly incorporated into the present study, and their implications are relevant to any analysis of the nutritional effects.

Implications for Study of the Nutritional Effects of FFW

Clearly any consideration of the design of a study must be preceded by decisions regarding the nature of the questions that must be addressed. It is apparent from the preceding discussion that nutritional results are influenced by a host of factors that are affected by FFW projects. Three broad sets of alternatives are thus available:

1. Do not attempt to infer any nutritional consequences, and stop at inferences concerning major economic results, mainly agricultural productivity, employment, and linkages between investment and consumption, all of which are being attempted in this study;

2. Attempt to infer nutritional consequences on the basis of observations of the principal economic results; and

3. Draw inferences about nutritional consequences from a combination of actually observed nutrition, its endogenous factor relations, and the economic results inferred earlier.

The main rationale for the first alternative is that there are too many forces or factors unrelated to the project that determine nutrition. This is probably true to some extent for children of weaning age when diarrheal and other diseases may be the primary factors. As discussed earlier, however, these too may be influenced by changes in the allocation of income as a result of the project. The main problem with adopting the first alternative is that effects on nutrition are dismissed from consideration in the effort to determine what projects and associated circumstances produce desirable results.

The second alternative is probably the weakest of all, as there is practically no basis for predicting nutritional consequences from economic results alone. This is because not only is the underlying nutritional situation of the beneficiaries critical in determining the results of a project, but also all the characteristics of control of income within the household and allocation of women's time, which are usually not measured, are crucial determinants of results.

The third alternative, which is the one followed in this study, overcomes the main problems of the first two alternatives. It stresses the processes as much as the possible effects and is therefore an ex-post evaluation with ex-ante content for future projects.

DESIGN OF NUTRITION ANALYSIS AND METHODS USED

Overall design of the nutrition analysis was similar to that of the rest of the study, in that both the type of project and the effects of the surrounding infrastructure were considered in the selection of sites. A subsample of four project sites involving two types of project, both with and without well-developed infrastructures, was selected. Types of project selected were canal irrigation and embankments against flash flooding.[1] All the projects were to have been functionally completed two-three years before the study was undertaken. Another element of the design was the inclusion of nearby "comparable" sites that did not have access to the immediate benefits of the project. All households sampled in the larger study of these four projects and four comparable control sites were included.

The Problem of Cross-Sectional Controls

Since no baseline data existed for the situation that prevailed before the project was begun, extension of the sample beyond that affected by the project in the cross-section was a way of ensuring that events other than the project would be comparable and it would be possible to detect the effects of the project. However carefully the cross-section controls may be selected, it would only be realistic to expect some inherent differences in preproject characteristics of the project and control sample. As far as possible these differences should be corrected in the analysis.

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[1] See the appendix for details of site-selection procedures.

Measurements

The additional information required for the nutrition analysis included:

- anthropometric measurements,
- dietary intakes,
- health status, and
- water supply and sanitation.

This information was obtained in three rounds of the food-consumption and nutrition survey during the year in order to capture the seasonality problem. The three rounds were conducted in April-May, September-October, and January-February to represent average, poor, and good conditions, respectively. This applied generally in the rural areas covered in the nutrition study sample. All the households included in the general economic survey for the four project sites in the nutrition study were surveyed.

Anthropometric measurements--weight and height--of all members of the household less than ten years of age were taken in the first two rounds; all household members were measured in the third round. Age and weaning status, which are necessary for the interpretation of both anthropometric and dietary information, were recorded. Dietary intake of each individual was measured using a one-day weighment method. Both lifetime episodes of serious diseases of each individual member of the household and a six-month history of their duration and severity were recorded.

In addition, data on the availability of food in the household, collected in the consumption expenditure survey that was conducted eight times during the year, and indicators of socioeconomic status from the results of other survey modules were used.

RESULTS

The objective of this analysis is to investigate three sets of questions:

1. What can be said about the underlying or baseline situation in the project sites and in control sites before completion of the project?

2. What is the present situation with respect to the two main immediate determinants of nutritional status, namely, diet and disease, in project sites and control sites as well as the actual nutritional status as reflected by anthropometry?

3. What conclusions can be drawn about possible effects of the project on the nutritional status of different segments of the population by income and landholding status?

Examining the Underlying or Baseline Situation

Since the effects of the project, if any, would have been in evidence no more than two or three years, the characteristics that may not be expected to change during that length of time can be examined to detect any underlying differences in the study populations. Of primary concern is to lay the basis for comparison of the project and control sites at an aggregate level. Of the characteristics measured in the nutrition survey, two sets are identified as changing too slowly to have altered significantly during the past two or three years. These are water supply and the prevalence of stunting, or the percentage of the population whose height is less than the given cut-off line.[2]

Water Supply and Sanitation. Of the main observations that emerged from examining the situation, the first is that protected water supply is substantially more prevalent in the sites not included in the project (see Table 5.1). This is indicated by the presence of a larger number of hand pumps (tube wells) in homesteads in the area not included in the project and could be a mark of its relative affluence throughout a long period. In project sites, however, there appears to be a higher proportion of the population who have temporary (kuccha) toilet facilities than in control sites (see Table 5.2). Though these are unlikely to improve overall water quality significantly, their prevalence might indicate either a higher population density or an effort, whether in the short run--two or three years-or longer, to improve the sanitary conditions through a relatively inexpensive means. In any event, a generally poorer sanitary environment is evident in the project sites, something that is also reflected in the pattern of diarrheal disease, as will be seen later in this chapter.

Prevalence of Stunting. The prevalence of stunting, which is generally defined as the proportion of a population whose height is less than 90 percent of reference height for age, is useful in comparisons of the nutritional status of a population during a longer

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[2] The cut-off line is usually taken as 90 percent of height for age of a reference population. Ninety-five percent of height for age is the lower bound generally found in a reference population. While increasing height may not always be seen as necessary, it is nonetheless a programmed biological response when dietary intakes during the growth years approach adequacy.

Table 5.1--Source of Drinking Water

Source	Project Sites	Control Sites
	(percent)	
Tap or tube well	75.2	92.0
Well	24.8	3.2
Pond or rivers	0.0	4.8
	100.0	100.0

Table 5.2--Toilet Facilities

Type	Project Sites	Control Sites
	(percent)	
Permanent	7.5	5.3
Temporary	52.8	37.8
None	39.7	56.9
	100.0	100.0

period--10 years or more, for example.[3] Even though nutritional improvements during a period of two or three years may increase the average linear growth, the prevalence will not be substantially altered, except for those who may have been just below 90 percent and would cross over with some improvement. At the other extreme, indicating short-run improvements in nutrition is the indicator weight for height. This can be altered even within a period of three to six months with improvements in diet. The prevalence of wasting, or short-run deprivation, is indicated by the proportion of the population whose weight is less than 80 percent of reference weight for height. Table 5.3 shows the prevalence of these indicators among all children between 6 months and 10 years of age for all three rounds of seasonal observations. Since there is a possibility that the seasonality of income, employment, and consumption flows may change as a result of the projects, pooling together the three rounds

[3] This percentage can be used as a cut-off point across all ages up to 10 years, as it was in the Harvard-Iowa standards, which have a stable distribution across these age groups. N.C.H.S. standards, by contrast, show an increasing dispersion with increasing age.

Table 5.3--Distribution of Nutritional Status of Children
(Percent of combined seasonal observations)

Nutritional Status	Project Sites	Control Sites	All Bangladesh (1981-82)[a]
Normal[b]	37.4	34.3	29.0
Wasting (only)[c]	4.4	6.5	6.0
Wasting (all)[d]	13.6	19.0	16.0
Stunting (only)[e]	49.0	46.6	55.0
Stunting (all)	58.2	57.1	65.0
Both Wasting and Stunting[f,d]	9.2	12.5	10.0

[a] Source: Kamaluddin Ahmad and Najmul Hassan, "Nutrition Survey of Rural Bangladesh, 1981-82," ADAB News: 12 (May-June 1984).

[b] Normal: WH $\geq$ 80 and HA $\geq$ 90.
[c] Wasting: WH < 80 and HA $\geq$ 90.
[d] Statistically significant difference between project and control sites at $P_0 < 0.05$.
[e] Stunting: WH $\geq$ 80 and HA < 90.
[f] Wasting and stunting: WH < 80 and HA < 90.

of observations of nutritional status gives the best overall picture in the two areas.

It can be seen that the only indicator that shows the project sites to be worse off is the proportion of stunting. This seems to suggest that during a longer period, the population in the project sites may have been worse off than that of the control sites but were better off during the study period. This is consistent with the observation on the water supply situation examined in the preceding section.

In the wasting and the stunting-cum-wasting measures, the project sites are significantly better off than the control sites. This seems to suggest that for some reason project sites were better able to buffer the seasonal or other swings that may have caused reductions in weight for height. This is confirmed by examining the individual rounds of the survey. It is seen that in Round 2, when in general both diet and disease factors are unfavorable, the same statistically significant result is observed. This is interesting in the light of results that will be presented later, which show a low level of aggregate household consumption in project sites at this time. It may be safe to conclude that the differences in prevalence of wasting are largely a reflection of the situation during the study

period and the three to six months preceding it, since this indicator reflects current consumption.[4]

A Comparison of Findings about Food Consumption with Other Surveys

A comparison of food consumption found in this survey with the National Survey of Bangladesh made in 1981-82 shows roughly comparable results (see Table 5.4). Also, a comparison of cereal consumption in Round 1 with that found in the short-run study made during construction of the project shows substantially greater consumption in the short run for FFW worker households of the smallest landholding groups--the landless and those who hold less than half an acre (see Table 5.5, columns 1 and 3). These surveys, though not strictly comparable, also suggest that:

Table 5.4--Daily Food Consumption per Capita

Food Group	Project Sites	Control Sites	All Bangladesh (1981-82)[a]
		(grams)	
Cereals	503	465	488
Roots	68	68	63
Pulses	7	8	8
Meat	4	5	5
Fish	18	16	23
Leafy vegetables	37	37	20
Other vegetables	136	115	100
Oils and fats	4	4	3
Milk and milk products	25	16	15
Protein	58	54	48
Number of calories	2,167	2,012	1,943

[a] Source: Najmul Hassan and Kamaluddin Ahmad, "Studies on Food and Nutrient Intake by Rural Population of Bangladesh: Comparison Between Intakes of 1962-64, 1975-76 and 1981-82," Ecology of Food and Nutrition 15 (1984): 143-158.

[4] The possible influence of mortality rates on this indicator will be examined later.

Table 5.5--Cereal Consumption during Implementation of Food-for-Work Projects

Landholding Status	Daily Cereal Consumption per Capita (grams)									
	All Cereals, Round 1 (March-April 1982)				Rice and Wheat, Short-Run Survey[a] (April 1982)					
	Project Sites		Control Sites		P_1[b]		P_2[c]		Control Sites	
	Size of Sample	Amount Consumed	Size of Sample	Amount Consumed	Size of Sample	Amount Consumed	Size of Sample	Amount Consumed	Size of Sample	Amount Consumed
	(1)		(2)		(3)		(4)		(5)	
Landless	16	321	26	448	98	449	28	438	97	460
Less than 0.5 acre	15	446	19	401	35	521	13	489	34	536
0.5-1.0 acre	27	527	13	525	17	526	12	500	36	546
1.0-1.5 acres	19	465	25	465	9	516	5	476	24	487
More than 1.5 acres	73	550	68	466	19	463	9	591	24	552

[a] The short-run survey overrepresents the smallholder groups because only households that participated in Food-for-Work projects and comparable households were sampled.

[b] P_1 = Project-site households with FFW employment.

[c] P_2 = Project-site households without FFW employment.

1. Control sites within five miles of FFW projects enjoyed a somewhat favorable effect on consumption during construction of the project, possibly because of a smaller increase in the price of rice than that which usually occurs at this time[5] (compare columns 2 and 5);

2. Members of smallholder groups at project sites, especially those who hold less than an acre of land, who do not participate in FFW consume less than similar households in control sites. This is consistent with the earlier finding that long-term nutritional status seemed to be worse in the project sites than in control sites (compare columns 4 and 5); and

3. Short-run effects on consumption, especially for the landless and nearly landless households--those holding less than half an acre--are more favorable than the long-run benefits to be realized from FFW projects. As will be seen later, however, the seasonality of consumption may also be influenced after projects have been completed (compare columns 1, 3, and 4).

Observations on the Immediate Determinants of Nutritional Status

Dietary intake and disease status are the two direct determinants of nutritional status that were recorded in the nutrition survey. As mentioned earlier, food consumption was measured by a one-day Weighment Method during which individual consumption was recorded. Consumption in each age group has been compared with the recommended allowances shown in Table 5.5 to derive the degree of adequacy. The calculations have been made here for calories only, but figures for protein are expected to show a similar trend, since cereal calories provided about 75 percent of total calories consumed by both groups.

The disease history of children less than three years old was examined, since it is most critical for this age group. Also, the information on lifetime episodes is more likely to be accurate for the lower age groups.

The main findings are that average dietary intakes in the project sites are consistently equal to or higher than consumption levels in the control sites. The incidence of diarrheal disease in children under the age of three, however, is seen to be significantly higher in the project sites. This is consistent with the somewhat poorer water supplies there, as was reported earlier. It should be noted that at this age, children are especially vulnerable to diarrheal disease because of the weaning process. This vulnerability is expected to continue through the preschool years, however, though

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[5] See Raisuddin Ahmed, "Structure and Extent of Marketable Surplus of Rice in Bangladesh," ADAB News 9 (January-February 1982).

to a lesser degree. As a result, the effects of a better diet would not be expected to be reflected strongly in the nutritional status of these age groups.

Levels of Caloric Intake. Individual food intake was recorded for each member of the households in the nutrition survey for all three rounds during the year. In the present analysis of intakes, a subsample of members is selected on the basis of:

1. Age: weaning age groups--that is, children between the ages of six months and three years--are excluded. It can be seen from Table 5.6 on the weaning pattern that 27 percent of the boys and 20 percent of the girls are receiving some breast milk between 30 and 36 months of age. It was also noted that by the 37th month, however, all children were completely weaned from their mothers. Since the measures of food intake do not include breast feeding, adequacy of intake cannot be assessed for this age group.

Table 5.6--Combined Seasonal Observations of Weaning Pattern

Age	Weaning Status[a]							
	Boys				Girls			
	0	1	2	All	0	1	2	All
(months)	(number of observations)							
0-5	1	19	22	42	1	39	28	68
(Percent)	(2.4)	(45.2)	(52.4)	(100)	(1.5)	(57.3)	(41.2)	(100)
6-11	0	10	42	52	3	7	49	59
(Percent)	(0.0)	(19.2)	(80.8)	(100)	(5.1)	(11.9)	(83.0)	(100)
12-17	0	0	54	54	0	2	50	52
(Percent)	(0.0)	(0.0)	(100)	(100)	(0.0)	(3.8)	(96.2)	(100)
18-23	2	0	57	59	6	2	60	68
(Percent)	(3.4)	(0.0)	(96.6)	(100)	(8.8)	(3.0)	(88.2)	(100)
24-29	25	0	41	66	23	0	38	61
(Percent)	(37.9)	(0.0)	(62.1)	(100)	(37.7)	(0.0)	(62.3)	(100)
30-36	52	0	19	71	44	0	11	55
(Percent)	(73.2)	(0.0)	(26.8)	(100)	(80.0)	(0.0)	(20.0)	(100)

[a] Weaning Status: 0 = Completely weaned
1 = Breast milk only
2 = Breast milk plus supplementary food

2. Anthropometric measurement: the food intakes of only those members who were available for anthropometric measurements is analyzed, for two reasons: First, it would help to permit some inference on the relation of diet to the observed anthropometric measurements. Second, if those members of a household who were not available for anthropometric measures despite the close access of the study team to the household were more likely to be absent from the home for relatively long periods, then their presence at meals and consequently the level of consumption recorded for them would be lower. Since there was no provision in the survey for recording food consumed outside the home, there may be a downward bias for these members.

The relation of calorie consumption to calorie requirements is based on comparisons of group consumption with group requirements. The calorie requirements are based on FAO/WHO (1973) recommendations for moderate levels of activity and allow for catch-up growth toward attaining 100 percent of weight for actual height for each age or sex group.

Levels of intake of calories and protein by three age groups from 3-10 years are shown in Table 5.7. In all age groups and all rounds of the survey, boys in the project sites consume more calories and protein than do boys in the control sites. Also, girls in the youngest age group, three to five years, are doing consistently better in the project sites. For the other age groups, the differences are not significant.

Results in the achievement of calorie requirements by those between 3 and 18 years of age are shown in Table 5.8. Boys in all age groups achieve a substantially higher percentage of their calorie requirements in the project sites than in the comparable control sites. Among girls, higher achievements by those between 3 and 5 years of age and by those over 10 are evident in project sites. These differences hold through all three rounds of observations, but are slightly more marked for girls 3-5 years old during the generally depressed second round. Data on consumption by children less than 5 years old do not support the idea of any consumption bias in favor of boys, which does become more evident, however, with the older age groups.

Incidence of Disease. The number of lifetime episodes of various diseases and six-month individual records of the incidence of disease were recorded in the nutrition survey. Considering the vulnerability of children less than 3 years old to disease, its importance for nutritional status at this age and the relative ease of recollection of lifetime episodes for the younger children, the present analysis is focused on that group. It should be expected that the pattern of disease revealed here would also be reflected in the other age groups. The number of episodes is weighted by the child's age to reflect monthly incidence of the disease during the child's lifetime. The results are shown in Table 5.9. It is expected that a further disaggregation of age groups will tend to concentrate the incidence

Table 5.7—Daily Calorie and Protein Intakes of Children Three to Ten Years of Age, by Round

Round and Sex	3-5 Years of Age				5-7 Years of Age				7-10 Years of Age			
	Calorie Intake		Protein Intake		Calorie Intake		Protein Intake		Calorie Intake		Protein Intake	
	Project Group	Control Group	Project Group	Control Group	Project Group	Control Group	Project Group	Control Group	Project Group	Control Group	Project Group	Control Group
			(grams)				(grams)				(grams)	
Round 1												
Boys	1,247	1,044	34.1	31.0	1,552	1,465	45.1	43.3	1,896	1,688	51.0	47.2
Girls	1,338	1,055	34.8	33.3	1,150	1,277	36.3	39.0	1,543	1,453	47.5	43.0
Round 2												
Boys	1,116	1,070	31.1	29.4	1,534	1,198	43.8	33.3	1,727	1,551	47.0	44.5
Girls	1,094	969	30.5	28.3	1,229	1,090	35.6	30.2	1,254	1,333	34.9	38.4
Round 3												
Boys	1,244	1,025	34.0	24.8	1,514	1,428	42.7	38.0	2,016	1,566	52.8	39.1
Girls	1,409	1,090	33.7	28.5	1,235	1,264	31.6	33.3	1,626	1,417	42.2	35.6

Table 5.8--Calorie Intakes of Children Three to Eighteen Years of Age, by Round (percent of calorie requirements met)[a]

Round and Sex	3-5 Years of Age		5-10 Years of Age		10-14 Years of Age		14-18 Years of Age	
	Project Group	Control Group	Project Group	Control Group	Project Group	Control Group	Project Group	Control Group
Round 1[b]								
Boys	103 (33)	86 (38)	115 (70)	106 (93)	...	...	...	...
Girls	111 (23)	87 (35)	93 (71)	92 (68)	...	...	...	...
Round 2[b]								
Boys	92 (35)	89 (36)	109 (76)	94 (89)	...	...	...	...
Girls	91 (26)	80 (33)	83 (77)	81 (70)	...	...	...	...
Round 3								
Boys	103 (35)	85 (37)	120 (84)	101 (97)	130 (68)	108 (68)	130 (55)	125 (58)
Girls	117 (23)	90 (35)	98 (75)	89 (72)	114 (74)	95 (76)	129 (52)	114 (49)

Note: The figure in parentheses in each instance is the number of individuals in the group.

[a] The calorie requirements of all age groups are calculated on the basis of 100 percent of weight for height, using the height of each age and sex group at the time of the survey round and using the FAO/WHO 1973 recommended calorie allowances for a moderate level of activity.

[b] Anthropometric measures for individuals over 10 years were not taken in rounds 1 and 2.

Table 5.9--Episodes of Disease per Year during the First Three Years of Life

Disease Episode and Project or Control Group	Number of Cases	Mean[a]	Standard Deviation	Standard Error	F Value	Two-Tailed Probability	Pooled Variance Estimate		
							T Value	Degrees of Freedom	Two-Tailed Probability
Pneumonia, Measles, Chicken Pox									
Project group	112	0.0408	0.341	0.032	1.07	0.715	0.08	242	0.939
Control group	132	0.0374	0.352	0.031					
Gastric Disorders									
Project group	112	0.3332	1.003	0.095	4.61	0.000	1.90	242	0.058
Control group	32	0.1470	0.467	0.041					

[a] Lifetime episodes divided by age in months, all children $\leq$ 36 months of age at the time of the second round.

of disease in the 1-3 years old but would not alter the pattern of difference observed for the project and control sites. It is seen that while the incidence of the principal infectious diseases, such as pneumonia, measles, and chicken pox, is the same in both project sites and control sites, gastric disorders are twice as common in the project sites.

In the light of this observation, it is worthwhile to examine the possible synergism of disease and nutritional status more fully. There are two possible consequences of disease--the first is its detrimental effect on nutritional status, and the second its contribution to mortality, especially in conjunction with poor nutritional status. Figures on the incidence of disease in the present study indicate that diarrheal disease is on the average about six times more likely to occur than the fevers group. Mortality statistics for different parts of Bangladesh, however, indicate that for children 1-4 years old, the contribution of these two groups of diseases to fatalities is similar.[6] Therefore, though diarrhea occurs more frequently, the fatality rate is much lower than from the fevers group. Thus, while the fatality rate from both groups of diseases will be higher among severely malnourished children, the cumulative effect of diarrhea on the nutritional status of children will be greater. Thus, while it might be argued that if the point prevalence of malnutrition may be lower in a group that has had, for example, an epidemic of measles than that of a similar population that has not, the same argument cannot be made for diarrhea. It can also be calculated that in the present sample, even if diarrheal deaths were <u>twice</u> the national average for Bangladesh, and <u>all</u> of them occurred in the severe malnutrition category of stunting and wasting, it would account for only 0.5 percent difference in point prevalence rates in the project sites.

The higher incidence of gastric disorders in the project sites is consistent with the poorer water supplies there. It is not clear at present whether there may be some inherent location-related or project-related effects, such as a higher water table and concomitant possibilities for contamination, that may have contributed to the higher incidence of gastric disorders. It is likely that the significance of diseases for nutritional status is highest for the weaning age group, 6-36 months of age. The possible effects of projects on water supply need to be investigated further.

<u>Nutritional Status as Shown by Anthropometry</u>. Anthropometric measurements were taken in all three rounds of the nutrition survey for all children 6 months to 10 years of age. In the third round,

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[6] M. Moslehuddin, M. Alauddia, and Ahmedullah Mia, "Causes of Death in Children 0-4 Years Old in Bangladesh," in <u>Infant and Child Mortality in Bangladesh</u>, ed. Barry Edmonston and Radheshyam Bairagi (Dhaka Institute of Statistical Research and Training, University of Dhaka, January 1982).

all members of the household were measured. Two dimensions of the anthropometric measurements are examined--the proportion below a given cut-off point for the various measures and the actual levels of the measures. Three types of anthropometric measurements are commonly used to examine the nature of the nutrition problems. These are weight for height, height for age, and weight for age. Weight for height represents fluctuations of short duration--3 to 6 months--in nutritional status. Height for age or linear growth represents long-term nutritional status and is a cumulative effect throughout the period of growth. It can be increased by improving the diet at any time during the growing years; the possibility for complete catch-up growth, however, decreases with increasing age. The third anthropometric indicator, weight for age, represents a combination of the first two measures since both muscle and skeletal mass contribute to weight.

The proportion of the sample population, 6 months to 10 years old, below the cut-off point for moderate to severe malnutrition of short duration, long duration, and combined short and long duration will be examined. While consistent improvements--or deterioration--during a period of 2 to 3 years could significantly alter the proportion of short-duration malnutrition, it could have only a slight influence in the proportions of long-run malnutrition. Even with improvements in linear growth during a period of 2 to 3 years, only those who had been just below the cut-off point would cross over. Table 5.3 showed the distribution of various types of malnutrition in the project and control sites. The proportion of malnutrition of both short duration and short-cum-long duration was found to be significantly smaller in the project sites. Similarly, the proportion of normal children was significantly higher in the project sites as well.[7] As discussed earlier, however, if the underlying nutrition was similar in both project and control sites, consistent short-run improvements could have led to a slightly greater proportion with normal height for age as well. The proportion of stunting is found to be slightly larger--but statistically significant--in the project sites. This could mean that:

- The underlying nutritional status was poorer in project sites to begin with than in control sites. This was discussed as a likely possibility in an earlier section;

- Or it could be that the time reflected by the short-run indicators--weight for height--was for some reason more than normally favorable for the project sites, even though the long-term trend since completion of the project is negative. The latter is an unlikely situation--an opinion that is supported by an examination of the actual levels of each of the three anthropometric measures.

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[7] Normal indicates the absence of either chronic (low height for age) or acute (low weight for height) malnutrition.

Growth curves for boys and girls in both weight and height are shown in Figures 5.1 through 5.4. Below 3 years of age, the growth curve is slightly poorer for boys but slightly better for girls in the project sites than in the control sites. The differences between the boys in the two locations, however, do not hold consistently across the three rounds, whereas the girls are somewhat better off in the project sites than in the control sites, as shown by statistically significant differences. For 3-18 years old, the pattern by sex is reversed. In the older groups, boys are better off in the project sites than in the control sites, while differences between the girls in the two locations are not significant. An examination of absolute values for the anthropometric indicators shows that in the project sites, differences in nutritional status between boys and girls are lower than in the control sites. In the youngest age groups, girls are significantly worse off than boys in the control sites, while among the older children, the nutritional status of the boys is poorer than that of the girls. An explanation for this apparent dichotomy could be that boys attain better early nutrition for a higher survival rate, and girls achieve a more nearly adequate diet as they grow older.

Nutritional Indicators at the Household Level

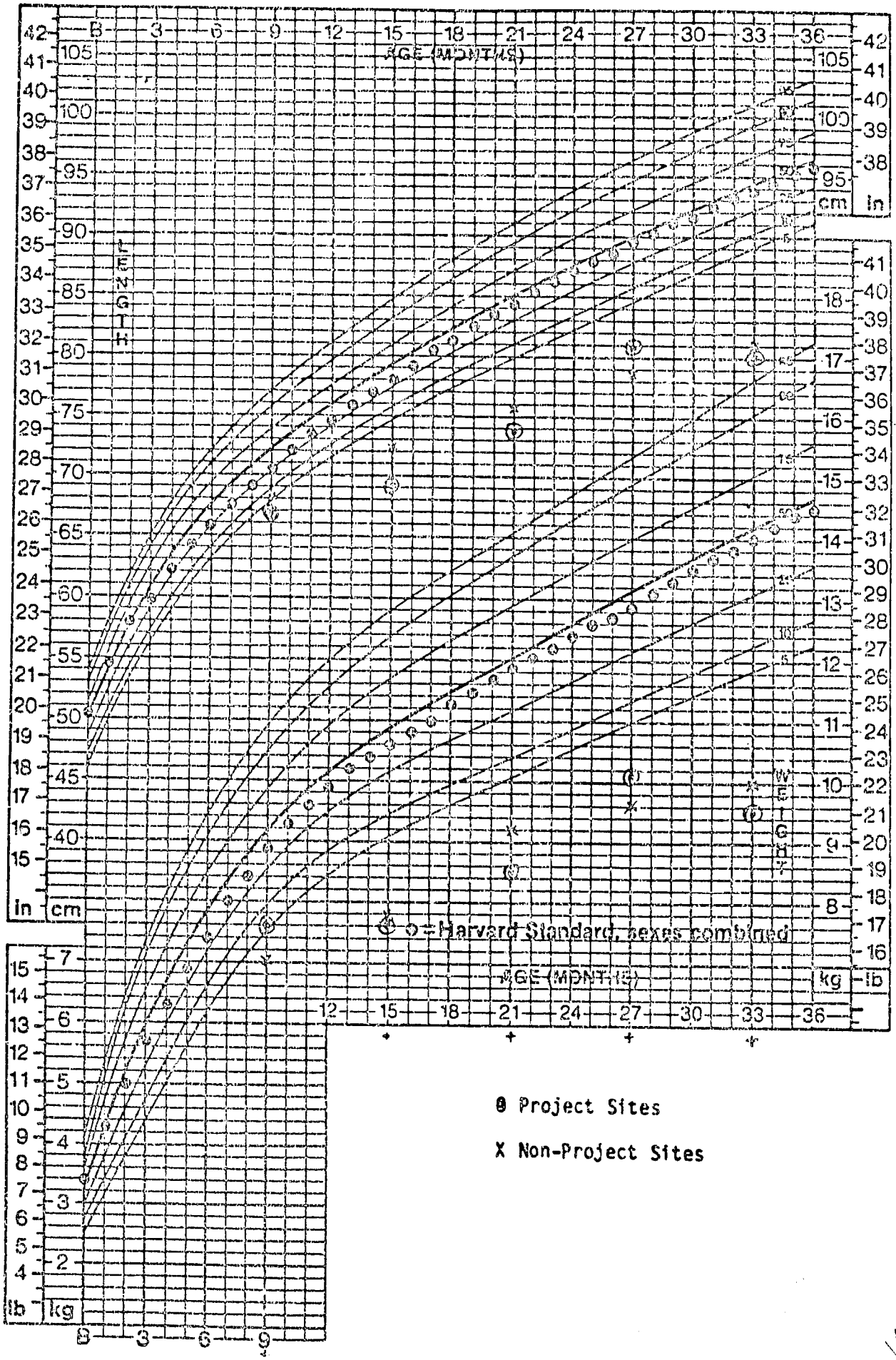
Aggregate Availability of Food. Annual figures for the availability of food are derived from the consumption-expenditure inquiry that was conducted independent of the food-consumption and nutrition survey, eight times during the year. Data for the same subsample of sites and households that were covered in the food-consumption and nutrition survey were selected for this section of the analysis. Annual consumption of food per capita is shown by the total expenditure decile in project and control sites in Table 5.10. It can be seen that overall consumption of cereals and the fish and meat group is significantly greater in the project sites. This pattern also holds for the other deciles. Though aggregate consumption of all other food groups is also greater in the project sample, these differences are not statistically significant.

Seasonal Consumption of Food. The three rounds of the food-consumption survey were intended to reflect good, average, and poor conditions in the seasonal food-consumption cycle. Changes in cropping patterns, yields, and employment patterns, however, may influence the seasonality of consumption over all and for certain segments of the population. Over all the degree of seasonal fluctuation is greater in the project sites (see Table 5.11). Differences between the consumption of most of the principal food items, including cereals, nonleafy vegetables, fish, and milk, by the two groups are more pronounced in Round 3, in which levels of consumption are higher in the project sample. The difference is statistically significant at 5 percent for cereals, total calories, and total protein. Round 3, conducted in December-January, is in the period following the aman harvest, and it appears that this substantially higher consumption

Harvard Standards for Weight and Length, Sexes Combined, Plotted on NCHS Percentiles for Boys—Birth to 36 months

Figure 5.1

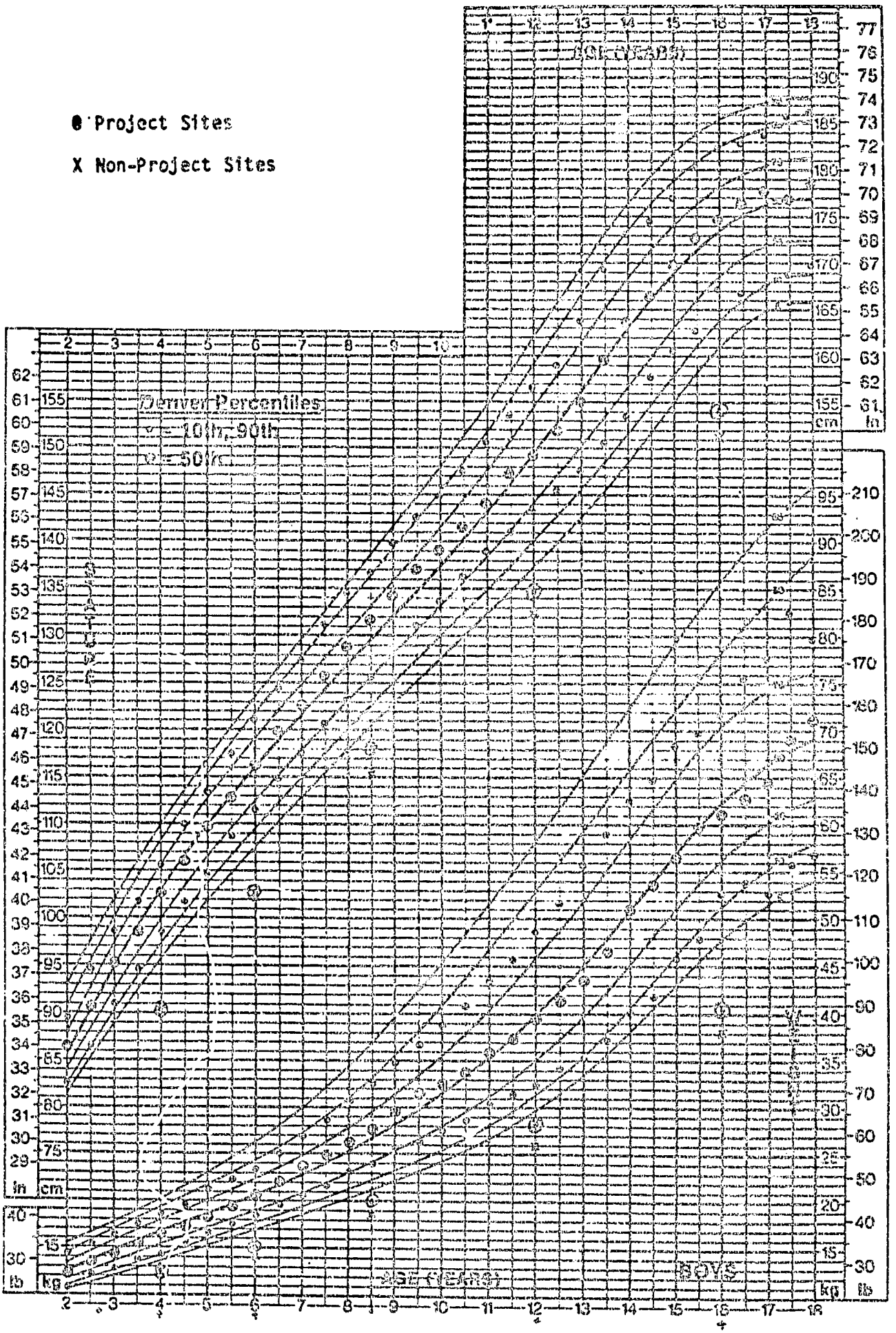
(Round 3)



Denver 10th, 50th, and 90th Percentiles for Weight and Stature of Boys Plotted on NCHS Percentiles for Boys 2 to 18 Years

Figure 5.2

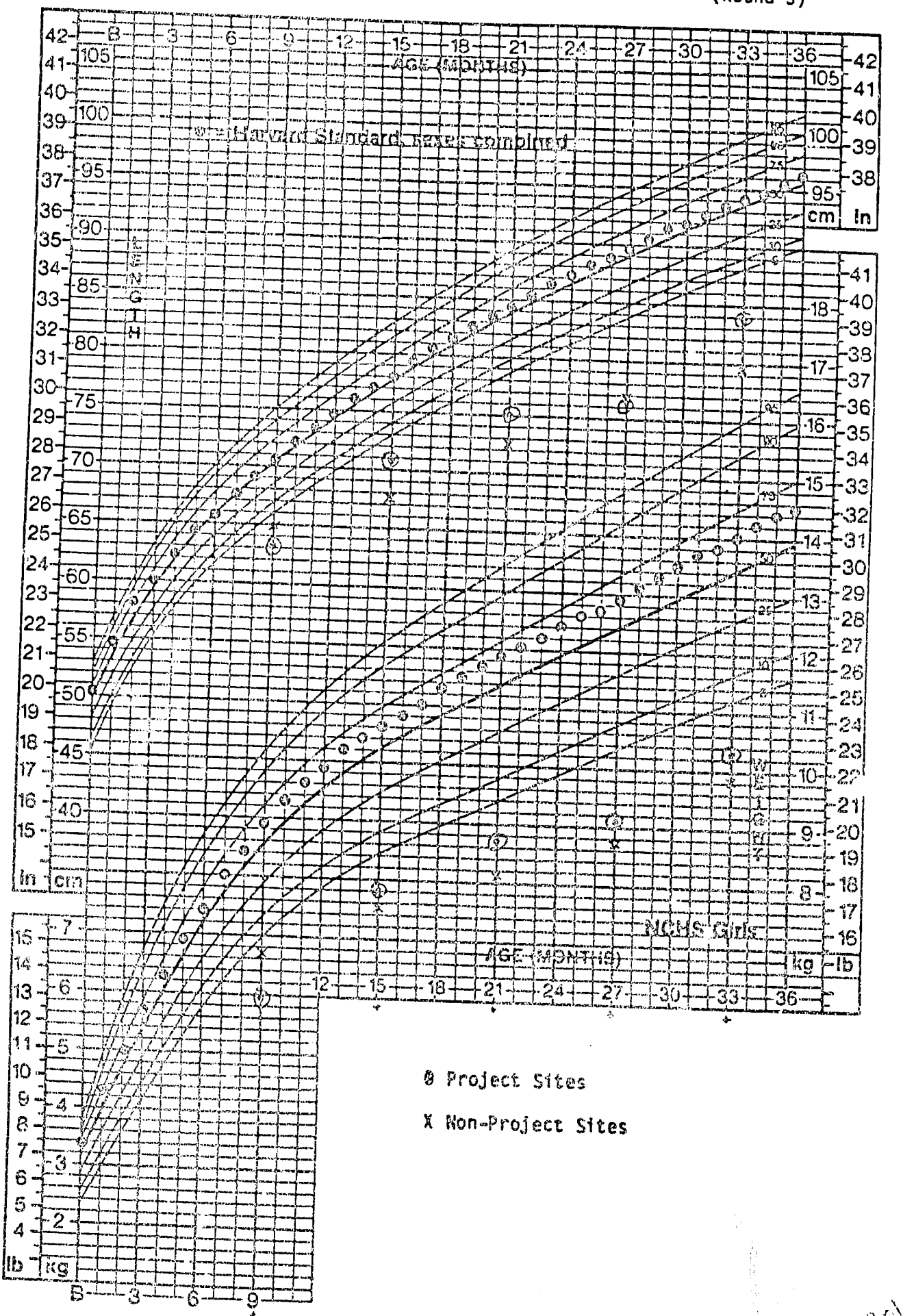
(Round 3)



Harvard Standards for Weight and Length, Sexes Combined, Plotted on NCHS Percentiles for Girls—Birth to 36 Months

Figure 5.3

(Round 3)



Denver 10th, 50th, and 90th Percentiles for Weight and Stature of Girls Plotted on NCHS Percentiles for Girls 2 to 18 Years

Figure 5.4

(Round 3)

● Project Sites

X Non-Project Sites

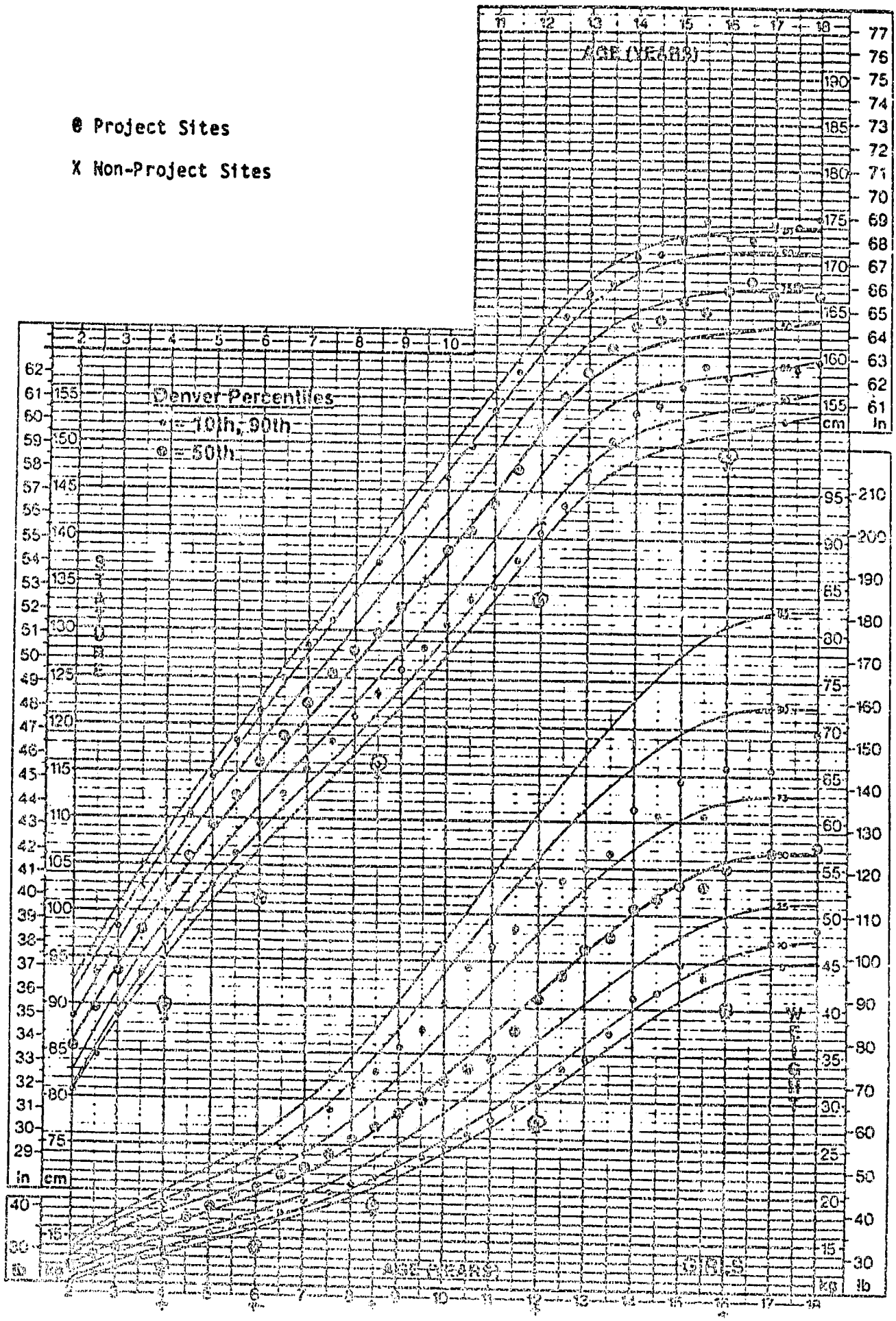


Table 5.10—Annual Consumption per Capita (kilograms)

Deciles	Size of Sample		Cereals		Roots		Sugar		Fish and Meat		Fats		Pulses		Vegetables		Milk	
	Project Group	Control Group	Project Group	Control Group	Project Group	Control Group	Project Group	Control Group	Project Group	Control Group	Project Group	Control Group	Project Group	Control Group	Project Group	Control Group	Project Group	Control Group
I	16	16	137 (34)	138 (121)	132 (62)	231 (357)	32 (25)	37 (38)	46 (30)	25 (19)	14 (5)	8 (2)	9 (11)	13 (15)	457 (191)	361 (174)	25 (31)	3 (6)
II	16	16	183 (21)	150 (17)	193 (49)	142 (38)	42 (17)	37 (39)	63 (31)	48 (24)	23 (3)	11 (2)	29 (17)	15 (9)	388 (178)	406 (63)	34 (49)	6 (22)
III	15	16	187 (24)	159 (21)	246 (61)	138 (51)	64 (44)	43 (28)	79 (27)	59 (19)	23 (8)	14 (5)	27 (17)	38 (47)	455 (144)	356 (133)	35 (39)	49 (68)
IV	16	16	218 (32)	174 (23)	244 (58)	171 (61)	60 (27)	63 (49)	86 (33)	59 (21)	29 (13)	16 (3)	43 (15)	23 (19)	441 (145)	524 (136)	61 (63)	45 (78)
V	16	16	213 (43)	177 (27)	271 (107)	189 (61)	72 (38)	81 (58)	90 (44)	76 (22)	27 (6)	15 (3)	41 (22)	20 (18)	559 (295)	492 (143)	49 (48)	43 (68)
VI	15	16	233 (31)	193 (29)	250 (97)	198 (65)	65 (28)	78 (61)	130 (42)	88 (28)	35 (24)	19 (7)	42 (19)	41 (38)	526 (239)	518 (128)	59 (93)	44 (49)
VII	16	16	268 (55)	222 (46)	271 (60)	240 (80)	104 (64)	67 (59)	152 (59)	119 (29)	34 (9)	24 (7)	41 (27)	33 (24)	609 (245)	534 (145)	92 (103)	141 (134)
VIII	16	15	278 (97)	217 (46)	387 (131)	259 (109)	126 (46)	108 (64)	191 (40)	135 (37)	38 (15)	29 (12)	45 (41)	62 (61)	702 (236)	636 (283)	122 (126)	101 (83)
IX	16	16	289 (66)	250 (55)	384 (148)	284 (74)	125 (51)	128 (85)	230 (91)	167 (92)	52 (30)	34 (13)	61 (29)	58 (52)	666 (261)	704 (314)	135 (125)	134 (131)
X	16	16	367 (103)	291 (114)	402 (131)	312 (132)	184 (155)	133 (79)	288 (70)	269 (147)	59 (23)	50 (37)	93 (65)	55 (63)	911 (309)	803 (350)	233 (214)	177 (174)
All	158	159	237 (84)	197 (75)	278 (127)	214 (143)	88 (75)	79 (66)	136 (90)	104 (90)	33 (20)	22 (18)	43 (36)	36 (42)	572 (264)	526 (242)	89 (118)	74 (109)

Note: Figures in parentheses are standard deviations.

Table 5.11--Seasonal Food Consumption, by Expenditure Decile

Deciles	Size of Sample: Project Group	Size of Sample: Control Group	Annual Expenditure per Capita: Project Group	Annual Expenditure per Capita: Control Group	Round 1 (April-May) Total Calories per Capita Consumed Daily: Project Group	Round 1 Total Calories per Capita Consumed Daily: Control Group	Round 1 Total Protein per Capita Consumed Daily: Project Group	Round 1 Total Protein per Capita Consumed Daily: Control Group	Round 1 Total Cereal per Capita Consumed Daily: Project Group	Round 1 Total Cereal per Capita Consumed Daily: Control Group	Round 2 (September-October) Total Calories per Capita Consumed Daily: Project Group	Round 2 Total Calories per Capita Consumed Daily: Control Group	Round 2 Total Protein per Capita Consumed Daily: Project Group	Round 2 Total Protein per Capita Consumed Daily: Control Group	Round 2 Total Cereal per Capita Consumed Daily: Project Group	Round 2 Total Cereal per Capita Consumed Daily: Control Group	Round 3 (January-February) Total Calories per Capita Consumed Daily: Project Group	Round 3 Total Calories per Capita Consumed Daily: Control Group	Round 3 Total Protein per Capita Consumed Daily: Project Group	Round 3 Total Protein per Capita Consumed Daily: Control Group	Round 3 Total Cereal per Capita Consumed Daily: Project Group	Round 3 Total Cereal per Capita Consumed Daily: Control Group
			(taka)				(grams)		(grams)				(grams)		(grams)				(grams)		(grams)	
I	16	16	1,539	1,128	1,627	1,446	36.2	41.7	335	356	1,233	1,391	33.1	38.4	338	367	1,674	1,329	38.8	34.8	383	351
II	16	16	1,980	1,523	2,341	1,730	78.7	54.6	524	420	1,798	1,826	50.7	54.6	455	440	2,359	1,800	56.1	44.9	529	421
III	15	16	2,193	1,746	1,994	2,037	55.4	63.1	628	463	1,705	1,830	48.0	51.1	406	453	1,989	1,765	50.8	41.6	695	415
IV	16	16	2,426	1,931	1,943	1,872	52.8	56.3	458	438	1,852	1,867	54.1	52.2	443	447	2,330	2,035	53.5	53.0	512	472
V	16	16	2,646	2,087	2,054	1,710	56.3	46.9	460	382	1,942	1,885	55.8	49.0	471	443	2,229	1,714	57.8	38.9	532	393
VI	15	16	2,931	2,349	2,068	2,011	55.7	58.2	471	446	2,025	1,950	56.2	52.3	471	493	2,167	2,060	57.5	55.0	515	473
VII	16	16	3,4[illegible]	2,649	2,223	2,173	61.2	63.1	531	483	2,233	2,055	59.6	57.4	519	435	2,431	2,248	64.4	54.9	561	496
VIII	16	15	3,8[illegible]	3,045	2,373	2,285	66.8	67.8	537	533	2,370	2,273	676.	60.0	537	520	2,986	2,525	73.8	65.1	601	539
IX	16	16	4,373	3,459	2,705	2,418	67.1	67.8	642	551	2,316	2,493	57.6	63.0	564	578	2,303	2,434	52.7	61.7	552	504
X	16	16	5,639	5,432	2,818	2,333	73.7	62.7	630	499	2,661	2,441	70.6	58.9	593	549	2,556	2,344	63.2	58.8	617	563
All	158	159	3,103	2,532	2,192	2,009	60.4	58.1	501	457	2,015	2,000	55.3	53.7	476	474	2,284	2,028	58.6	50.9	531	463

could be partly a result of the increase in acreage planted in aman rice in project sites.

Over all Round 2 represents the most depressed consumption period, even though consumption of grain is up slightly in the control sites. This could be because somewhat more aus rice is cultivated in some of these sites. Levels of food consumption and nutrient intakes by both groups are similar at this time, at least in the aggregate. It will be seen in the next section that low-income groups in the project sites consume significantly less at this time than do those in the control sites.

In Round 1, which coincides roughly with the boro rice or wheat harvest, project sites consume somewhat more of most foods and all nutrients recorded, but the differences are not statistically significant.

Seasonal Food Consumption by Expenditure Decile and Landholding Status

Annual consumption expenditures by the project sample are seen to be greater in the aggregate and by each project decile than in the control group. Calorie consumption in Round 1 is similar in both groups but declines more among the lower deciles of the project sites in Round 2. In Round 3, however, consumption is substantially greater in project sites, both in the aggregate and by all deciles. As noted earlier, the seasonality of consumption is greater in the project sites, and it seems to affect mainly the lowest income groups. It is not clear whether this is the result of an improvement at some times of the year--as in January-February as a result of increased production of aman, leaving consumption during the slack season of September-October largely unaffected, or whether there has been any reduction in the levels of consumption during the slack season. This must be weighed with the observation made earlier of a lower baseline nutritional situation in project areas and in the smaller landholdings in these sites.

A similar comparison based on landholding status shows the landless households in the project sites to be substantially worse off in Rounds 1 and 2 and only slightly better off than the landless in control sites in Round 3 (see Table 5.12). All landholding groups in project sites consumed more in Round 1, and only the smallest landholding group--those holding less than half an acre--together with the landless consume less than those in control sites in Round 2. All landholding groups in project sites show similar or higher levels of consumption in Round 3. In this context, it should be noted, as reported earlier, that while project sites reported increases in cropping intensity and in yields, increasing the gross value of production 25.6 percent above that in control sites, agricultural wage employment appears actually to have declined slightly. Substantial increases in non-agricultural employment have

Table 5.12--Seasonal Food Consumption, by Landholding Status

Size of Landholding	Size of Sample: Project Group	Size of Sample: Control Group	Round 1 (April-May): Total Calories per Capita Consumed Daily: Project Group	Round 1: Total Calories per Capita Consumed Daily: Control Group	Round 1: Total Protein per Capita Consumed Daily (grams): Project Group	Round 1: Total Protein per Capita Consumed Daily (grams): Control Group	Round 1: Total Cereal per Capita Consumed Daily (grams): Project Group	Round 1: Total Cereal per Capita Consumed Daily (grams): Control Group	Round 2 (September-October): Total Calories per Capita Consumed Daily: Project Group	Round 2: Total Calories per Capita Consumed Daily: Control Group	Round 2: Total Protein per Capita Consumed Daily (grams): Project Group	Round 2: Total Protein per Capita Consumed Daily (grams): Control Group	Round 2: Total Cereal per Capita Consumed Daily (grams): Project Group	Round 2: Total Cereal per Capita Consumed Daily (grams): Control Group	Round 3 (January-February): Total Calories per Capita Consumed Daily: Project Group	Round 3: Total Calories per Capita Consumed Daily: Control Group	Round 3: Total Protein per Capita Consumed Daily (grams): Project Group	Round 3: Total Protein per Capita Consumed Daily (grams): Control Group	Round 3: Total Cereal per Capita Consumed Daily (grams): Project Group	Round 3: Total Cereal per Capita Consumed Daily (grams): Control Group
Landless	16	26	1,327	1,891	35.3	59.5	321	443	1,430	2,002	39.8	56.2	352	487	2,184	1,904	51.0	48.6	516	459
Renters	8	6	2,305	1,685	60.1	47.1	520	397	1,862	1,910	54.8	49.3	461	457	2,274	1,707	59.2	36.8	538	385
0.1-< 0.5 acre	15	15	1,935	1,765	54.9	52.2	446	481	1,574	1,839	41.7	52.6	371	430	1,941	1,666	47.1	43.2	428	410
0.5-< 1.0 acre	27	13	2,316	2,153	66.7	63.4	537	525	1,937	1,690	59.8	46.4	464	405	2,206	1,958	59.0	50.4	521	454
1.0-< 1.5 acres	19	25	2,149	2,037	64.8	57.6	465	495	1,982	2,047	53.7	50.7	469	486	1,954	2,096	51.7	53.4	463	475
1.5-< 3.0 acres	34	24	2,271	2,257	60.8	63.6	518	690	2,224	1,950	57.8	53.1	513	460	2,743	2,136	68.8	55.5	608	469
3.0-< 5.0 acres	23	23	2,394	1,827	64.7	49.6	557	523	2,310	2,122	62.0	55.3	546	511	2,455	2,216	63.1	51.0	587	486
5.0 acres or more	16	21	2,624	2,276	68.2	66.8	607	486	2,385	2,231	63.1	60.4	549	507	2,129	2,265	57.3	58.1	499	494

taken place, however, and the seasonal peak of this employment coincides with Round 3 of the consumption survey. Thus, the favorable consumption by the landless in Round 3 may be the result of greater off-farm employment in conjunction with possible price effects of increased production of aman at this time. This points to the importance of improving the linkages of agricultural growth to other sectors for improving the welfare of the landless and marginal landholders. Food-for-work programs are crucial to this effort because they can facilitate not only improvements in agricultural production but can also, for example, facilitate these growth linkages by improving the networks of roads in these areas.

SUMMARY OF FINDINGS

Some of the main conclusions to be drawn from the analysis presented in this chapter are the following:

1. The baseline nutrition situation in the project sites appears to have been slightly worse than in the comparable control sites that were selected. This is based on a greater prevalence of stunting than wasting or stunting-cum-wasting found during the study and the poorer water supplies in the project sites.

2. Current dietary intakes by all age groups examined in the project sites appear to be better than by those in the control sites. This could be the result of changes introduced as a result of the completion of the project. A preliminary examination of the incidence of disease, however, indicates more frequent gastroenteric problems in the project sites, which appears to be a continuation of a longer trend, which may or may not have been influenced significantly by the projects. Further examination of the pattern of investment in water supply and sanitation recently made in the study sites and of investments expected to be made in the long run is necessary if the benefits of the project are to be available consistently.

3. The first two sets of observations have several implications for nutrition,, which are borne out in part by examination of the anthropometric measurements. Of those children for whom diarrheal disease may be more significant than diet--the youngest, especially those of weaning age--the nutritional status may not have improved in project sites sufficiently to make them better than control sites. Dietary improvements are likely to be more significant for the nutritional status of older children, however, than for that of their younger siblings, and for them improvements in diet during the past two or three years in the project sites may even pull their nutritional status above that of children in the control sites.

4. Anthropometric measurements, which were used to assess nutritional status, are only partial indicators and can be influenced

by changes in mortality rates at the same time that nutritional status also influences mortality. This makes unraveling the changes that are taking place quite problematic. Since any changes in nutrition can be expected to have been largely as the result of changes in the diet, however, with the disease factor remaining virtually constant, anthropometric differences should be good indicators of the changes that are taking place.[8] Measures of nutritional status suggest that in general there may have been an equalizing trend in the project sites for differences between boys and girls at various ages. The nutritional status of girls, who are significantly worse off on the whole in the younger (less than five years) age groups, improved in the project sites more than in the control sites. Conversely, among the 10-18 years old, boys are slightly worse off than girls as a whole, and boys in this group improved significantly more in the project sites. If we can accept the earlier observation that the baseline situation was in fact worse in the project sites, then the positive implications of the results are even stronger.

5. Levels of food consumption obtained in this survey are comparable to those obtained in the national survey of 1981-82. A comparison of cereal-consumption figures with those obtained during project implementation in Phase I of the study, however, suggests that short-run gains for small landholders may appear to be greater than long-run improvements, but the latter are available at different times of the year and over a long time period. There is some indication that differences between the baseline situation in project sites and control sites in the short-run study may have been similar to that observed in this survey. A slightly higher consumption among landless and near-landless project participants than that of similar non-participants in project site villages was also observed among the short-run effects.[9]

6. While annual consumption is higher in the project sites, both in the aggregate and for all income or expenditure deciles, there is a more pronounced seasonal fluctuation here than in the control sites. This appears to be attributable to improvements in agricultural productivity made possible during parts of the production cycle and not in others. For the landless and low-income groups, improvements in diet are found to coincide both with better harvests and with more extensive employment outside agriculture.

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[8] Any differential change in mortality would then be only a result of diet-induced nutritional changes, and the only danger would be in a downward dietary trend, while anthropometry may have a slight upward bias because of higher mortality rates.

[9] See also "Characteristics and Short-Run Effects of the WFP-Aided Food-for-Work Programme in Bangladesh," a report to the World Food Programme submitted by BIDS/IFPRI, December 1983.

APPENDIX TO CHAPTER V

EVALUATION OF FOOD-FOR-WORK PROJECT NUTRITIONAL STATUS STUDY; A PRELIMINARY REPORT ON SITE SELECTION[10]

This is part of the long-term Study of the Effects of the Food-for-Work Project. The objective of the study is to trace the changes in nutritional status of households brought about by Food-for-Work through changes in income and cropping patterns by carrying out an investigation of the diets of the households using a twenty-four-hour recall method and of children up to ten years of age by taking their anthropometric measurements as well. The other part of this long-term study is concerned with tracing the development linkages that food-for-work projects create by themselves and in interaction with other rural infrastructural activities. Data for the study would be collected through a comprehensive household survey in four sites, each of which includes four villages--one project village and one control village from an area in which infrastructures are under-developed, and one project village and one control village from an area in which infrastructures are better developed. One site was to be selected from each of the following four types of project: field channels for irrigation, dual-purpose canals, embankments along rivers, and coastal embankment.

The following procedures were adopted for selecting the sites:

1. A list of all projects executed from 1975/76 to 1979/80 was prepared from the files of quarterly progress reports of WFP Dacca.

2. Thirty-four thanas were selected from the above categories on the basis of concentration of food-for-work schemes in the thana and geographical location.

3. The field investigator-supervisor was sent to each of the thanas, where he discussed the completed food-for-work schemes in the thana with subdivision- or thana-level officials of the implementing agency--in most instances the Water Development Board. After they had been briefed about the objectives of the study, the officials were asked to name a few projects among those completed on or before 1979-80 that could be utilized for

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10 Prepared by the Bangladesh Institute of Development Studies, Dacca.

study. They visited the project sites, talked with local people, and selected one project that had sites with variations in infrastructural development and suitable controls. They then administered a community-level questionnaire to four selected villages, two project villages and two control villages. The questionnaire contained information on infrastructural facilities (access to markets, communication links, and access to schools and colleges), cropping patterns, land levels and land quality, irrigation and input-supply facilities, non-agricultural activities, and land tenure.

4. After the information collected by the field investigators had been carefully scrutinized, a short list of 14 thanas was prepared. The research associates then visited the project sites and the selected villages in the short-listed thanas from which information had been collected earlier, and finally 16 sites were selected.

For our study on nutritional status, it was decided to select 8 of those 16 sites--4 project villages and 4 control villages. Information needed for the study was to be collected from the 40 households already selected from each village. After scrutinizing the age distribution of the children of the selected households, we found that our anthropometric study would require many more households for there to be enough children in each age group to carry out a meaningful statistical analysis on the basis of each project and its control village. To double the size of our sample, we therefore selected two villages and their matching control villages for each of two types of project, namely, field channels and embankments along rivers. The reason for selecting these two types of project is that while the former is expected to have an appreciable effect on cropping patterns, income, and employment, the latter is expected to have only a minimal effect on those variables. We shall thus have not only an idea about the extent of variation of effect on nutritional status attributable to different types of project but we shall also have an overall picture of the effects of FFW projects when we focus our attention on project and control areas in general, irrespective of type of project. Again, we have selected one site having a village with underdeveloped infrastructures and one having a village with well-developed infrastructures for each type of project so that we have two project villages with underdeveloped infrastructures and two with well-developed infrastructures and, of course, for each of them a control village as well.

Selecting the sites in this manner enabled us not only to study the effects of FFW projects in general but also to capture the extent of variation, if any, attributable to type of project, and differences attributable to variations in infrastructural development.

Thus, with the aforementioned objectives in mind, we selected the following sites:

Project	Study Village
1. Field channel	1. Bandabeel, U. P. Alamdunga, P. S. Alamdunga, Kustia (PDI)
A. Construction of FC of T 1/10G in Alamdunga	2. Roekuli, U. P. Jihala, P. S. Alamdunga, Kustia (CDI)
B. Construction of FCs in Harishpur, Harinakunda	3. Harishpur, U. P. Joradah, P. S. Harinakunda, Jessore (PLDI)
2. Embankment along rivers	4. Gobrapara, U. P. Doulatpur, P. S. Harinakunda, Jessore (CLDI)
A. Embankment on Kakri River, Choddlong	5. Chasapara, U. P. Chansra, P. S. Kotwali, Comilla (CDI)
B. Embankment on River Boral Sathin, Pabna	6. Illaspur, U. P. Uzirpur, P. S. Chodhogram, Comilla (PDI)
	7. Patgaari, U. P. Pakdumra, P. S. Sathin, Pabua (PLDI)
	8. Rawtora, U. P. Potadia, Shahajadpur, Pabna (CLDI)

Note: PDI = Project village with well-developed infrastructure
PLDI = Project village with underdeveloped infrastructure
CDI = Control village with well-developed infrastructure
CLDI = Control village with underdeveloped infrastructure

VI. SUMMARY OF FINDINGS AND POLICY IMPLICATIONS

Capital construction in rural economy through mobilization of labor is an important instrument for providing relief, generating slack season employment, increasing production and improving labor productivity. Bangladesh has a long and varied experience of organizing rural works programs through public initiative aimed at providing assistance for the poor. Since 1975, food for work (payment of in kind wages to workers) has become a large part of the rural public works program in Bangladesh. In recent years it has used about 400 thousand tons of foodgrains per year which has the annual capacity to provide more than 100 million mandays of employment in the construction phase, equivalent to at least 17 days of additional employment for every landless worker in the country. The importance of a study on the effectiveness of a program of this size in meeting both immediate welfare and development objectives cannot be overemphasized.

Objectives of the Study

This report of the development impact of the Food-for-Work (FFW) Program is the second part of a comprehensive study financed by donors under auspices of the World Food Program and the Government of Bangladesh. The first part of the study addressed the issues at the construction phase of the program -- management practices and inadequacies, appropriateness and quality of design and implementation of the projects, and effectiveness in providing low income households with incremental income and employment during the period of implementation. The report was submitted earlier and the technical papers were published in the special issue of the Bangladesh Development Studies, July-December 1982. The executive summary of the findings is reproduced in the annex to this report. This part of the study addresses the question that if the projects were well designed and implemented what would the major development consequences be? More specifically, it evaluates the impact of such projects after 2-3 years of their completion on agricultural production, income, employment, capital formation, and consumption and nutrition of rural households in general and different socioeconomic groups in particular.

Methodology

In the absence of any benchmark information on the project and the control areas, the study had to measure the effect of a project by comparison of the values of relevant variables of a 'project group' of sample households with those for a comparable 'control group' during the calendar year 1982 when the field survey was implemented. In practice, however, it is extremely difficult to find a control group which is exactly similar to the project before it is implemented. This was also the experience of the study. A simple comparison of arithmetic means may thus give an inaccurate picture of the effect of the project. Recognizing the limitation of the methodology, regression analysis and the analysis of variance were employed in appropriate places to dissociate the effect of autonomously varying resource endowments of the sample households in project and control villages.

An important limitation of the study is its failure to estimate the rate of return from investment in the FFW program. This limitation is inherent in the type of projects financed through FFW -- repair and maintenance of embankments and roads, re-excavation of canals and digging of field channels for getting water from the canals. These are only marginal expenditures added on the large investments (sunk cost) undertaken in the past in order to make them operative or more effective. Thus the estimated benefits of the FFW projects cannot entirely be related to their costs. So the study has to be satisfied with the measurement of benefits. The primary concern was to assess the development impact -- this was necessary to mitigate the general impressions that such projects had no production impact, not to speak of a rate of return comparable to other options.

Five different types of projects were selected for assessing the development impact. These are:

1. DUAL PURPOSE CANALS, to be used for irrigation in the dry season and for drainage in the wet season;

2. FIELD CHANNELS for irrigation for enabling farmers to get water in their fields from canals constructed under large scale irrigation projects;

3. COASTAL EMBANKMENTS for protecting crops from damages caused by intrusion of salt water;

4. RIVER EMBANKMENTS for protection of crops against normal flooding which can occur during middle or late rainy season; and

5. RIVER EMBANKMENTS for protection against pre-monsoon flash flooding which occurs in areas adjacent to the hills in the east and northeastern parts of the country.

No road project was selected because at the time of undertaking this study the sponsor of the study (WFP) did not finance road projects. However, it was found at the time of selection of projects for the study that many embankments are used as road-cum-embankments.

A purposive selection of projects was undertaken so that only the better implemented ones were chosen. The badly designed and implemented projects are expected to have no impact, and the indepth objective analysis attempted in this study would have meant a wastage of time and resources if these projects were selected. Both the engineering survey conducted for the first phase of the study and the reconnaisance survey of the conditions of completed projects at the time of project selection found that about one-third of the projects were relatively better designed and implemented. The details of the selection of five particular projects and 16 villages (nine project and seven control sites) for the study are reported in Chapter 1. The villages are scattered through the four administrative divisions of the country and represent the principal ecological zones.

A census of all households in the selected villages was carried out to serve the sample frame for the study. The households were classified into eight groups based on the size of landholding (four groups) and occupation of the head of the household (two groups). A proportionate random sample was drawn from each stratum so as to have 40 households from each village.

The field work was conducted during September 1981 to January 1983. The selection of project sites, census of study villages, and selection of sample households was completed during September to November 1981, and the data were collected administering five sets of structured questionnaires on the selected households during December 1982 to January 1983. Questionnaire I was administered once to collect detailed information on assets and liabilities of all sample households. Questionnaire II, on costs and returns of crop production activity, was administered three times in the year following three crop seasons, aus, aman, and boro. Questionnaire III was adminsitered eight times during 1982 to collect weekly expenditure on food and non-food items as well as employment of family workers. Evaluation of seasonal fluctuations in consumption expenditure, employment, wage rates, and estimation of employment and income from irregular activities was the primary objective of this survey. Expenditure on items such as clothing, household durables, education, health, housing and acquisition of fixed assets were collected retrospectively for

each quarter of 1982 administering Questionnaire IV. A nutrition survey was conducted three times during the year which included anthropometric and individual food consumption measurements on a subset of 320 out of 640 households in eight of the 16 villages under three types of projects. Finally, a community level survey was undertaken to provide an explicit base for scaling the degree of general infrastructure development. In this survey, the access of the study villages to physical, institutional and social infrastructures was measured.

The data were edited, coded, verified and cleaned at the Bangladesh Institute of Development Studies, Dhaka for storing on computer tapes. The analysis was conducted and the preliminary drafts prepared at International Food Policy Research Institute, Washington, D.C., during October 1984. The preliminary findings were presented to World Food Program, and in a number of seminars in Dhaka attended by policymakers, aid administrators, and researchers in the country.

Effect on Crop Production

The FFW program has had a significant positive effect on agricultural production. The value of production of all crops per unit of land is about one-fourth higher in the project group of sample households compared to the control and the difference is statistically significant. The production effect appears to be more pronounced in cereals than in crop production as a whole, because of the substitution of some non-cereal crops with cereals following irrigation. The level of cereal production is about two-fifths higher than it would have been in the absence of the project.

The most important factor which made higher production in the project group possible is the expanded coverage of irrigation following the implementation of FFW projects. Irrigated area is about 37 percent of cultivated area in the project group compared to 25 percent in the control. Following irrigation there has been a change in cropping pattern from growing of low-valued pulses and oilseeds to high-yielding cereals. Better drainage in the irrigation-cum-drainage canal project and provision of supplementary irrigation in the field channel project has made possible a shift of land from local to HYV aman crop in the monsoon season. Since the high-yielding cereals are more labor- and fertilizer-intensive, the change in cropping pattern has led to an increase in labor and fertilizer use per unit of land. The project group used about 70 days of labor per acre of land compared to 63 days for control -- an increase of 11 percent which is

found to be statistically significant. The positive affect on fertilizer use is more pronounced. The project group used about 100 pounds of materials per acre of cropped land compared to 76 pounds for the control. As a result the productivity of land in the project group was about one-fourth higher than for the control group. The index of multiple cropping was about 7 percent higher in the project group -- the difference is statistically significant.

The effect of the FFW program on crop production is positive for all groups of farmers. The small farmers, however, gained much less compared to the medium and large ones. The value of production on small farms in the project group is about 15 percent higher compared to the control, the corresponding figure for the medium and large farms is 46 and 36 percent respectively.

The comparison of the arithmetic means of the value of crop production per acre of land between the project and control groups showed that three out of the five projects selected for the study had positive effects on production. They are: field channels for irrigation, drainage-cumirrigation canal, and coastal embankment. For flood protection embankment, the value of production for the project group of households is in fact lower than the control. This may partly be due to poor maintenance of the embankment which could not protect the project areas from floods both in 1981 and 1982. It is also partly due to improper selection of control. An analysis of the data about the benchmark conditions for this project, reported by respondents by memory recall, shows that the average value of production per household in the project villages was only about 45 percent of that for the control at the benchmark point; the estimated value at the time of survey is about 73 percent. While the level of production in the project villages was still lower than the control at the time of the study, they have experienced about 74 percent increase in production compared to only 6 percent in the control village from the benchmark point.

Estimation of the production function with farm-level data provides further insights into the effects of Food-for-Work on the efficiency in allocation of inputs and their productivity. The analysis indicates that the marginal productivity is about 48 percent higher for land and 27 percent higher for labor in the project group compared to the control. The marginal productivity of fertilizer is about 42 percent lower in the project group. The marginal productivity of the inputs are however significantly different from their prices. This indicates considerable allocative inefficiency in their use. The marginal productivity of land and fertilizer, the scarce resources, are higher than their costs, while the marginal productivity of labor, the abundant resource, is lower than the market wage rate. For the control group the marginal productivity of labor is 42 percent lower than the wage rate, while for the project group the difference is 34

percent. The marginal return from fertilizers in the control group is about 1.5 times higher than their unit costs, while in the project group the gap narrows down to 25 percent. The findings indicate that the FFW program leads to a movement towards more efficient allocation of resources.

Effect on Household Income

The economic infrastructures built through the FFW program are likely to have direct effect on income from crop production and a secondary effect on income from industry, trade, transport, and construction services, which are stimulated by the increased consumption of nonfarm goods and services, and by additional investment on both farm and nonfarm sectors. The income from crop production and agricultural wage in the project group is about 27 percent higher than the control, and the income from industry and trade is about 21 percent higher. A simple comparison of average household income suggests it is about 10 percent higher for the project group compared to the control. The difference in per capita income is however not significant because of the larger size of households in the project group. The positive effect on total income appears to be less because the control group earns significantly more from such noncrop activities as kitchen gardening, livestock and poultry raising, and fishing, which are generally less land-using activities with low productivity of labor. Presumably, at low levels of income, people tend to be self employed more in these activities in order to supplement their meagre income from land -- with increase in land productivity and incomes, such low productive labor is substituted by leisure.

In order to dissociate the effect of varying factor endowments in the project and control group from the effect of the FFW program, a regression analysis was conducted relating household income to its main determinants and incorporating FFW projects and the presence of well-developed infrastructures as dummy explanatory variables. The regression coefficient of both dummy variables are positive and statistically significant. The estimated equation evaluated at the mean level of the value of the explanatory variables predicts average household income from crop production activity at Tk 7,372 in the absence of both project and infrastructure, Tk 9,284 with project but without infrastructure, and Tk 10,414 with both project and infrastructure.[1] It is therefore concluded from the findings that the

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[1] The result reported here is different from that presented earlier, in the summary report. The discrepancy is due to punching errors found after preparation of the first draft in the case of four households. This needed reprocessing of the data and substantial revision of the draft.

project increases income from crop production by 26 percent, and in the presence of well-developed infrastructural facilities it is increased by another 15 percent. The secondary effect on household income through stimulation of industry, trade and other services appears to be 40 percent of the direct effect on crop production -- 60 percent in areas with well-developed infrastructural facilities and only 11 percent in areas lacking them.

The respondents in both project and control areas were asked the question, "What has been the change in your economic condition since the period of implementation of the FFW project?" This subjective response also shows that the FFW program has a positive impact on income. In the project group about 57 percent reported improvement in income and 21 percent reported deterioration. In the control group only 30 percent reported improvement and 35 percent reported deterioration. The conditions of others were reported unchanged. The responses of different landownership groups show that in the control group economic conditions of households who own up to 5.0 acres of land remained unchanged or deteriorated. In contrast, in the project group the majority of households who own more than 0.5 acres reported an improvement -- 54 percent for the 0.51 - 2.0 acre landownership group, 72 percent for the 2.01 - 5.0 acre group and 92 percent for the above 5.0 acre group. Compared to the control, the income of the landless increased at a higher rate than that of the small farmers; but the highest increase in income was for the large farmers.

Effect on Employment

The labor force participation[2] rate is estimated from the survey at 29 percent of the total population and 43 percent of the population in the active age group (10 years and over). The main factor behind the low participation rate is the marginal involvement of women in income earning activities (11 percent in the active age group).

The labor force participation rate is found lower in the project group (27.6%) than in the control (30.3%). This difference is mainly due to the involvement of children and women in the recorded activities which is found to be lower in the project group. This apparently negative impact of FFW on supply of labor may be taken as a positive development since some of the children who were forced to participate in the labor force due to poverty can go back to school as the household income increases with the project.

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[2] Based on wage employment and directly remunerative self employment.

The average worker was employed for 284 standard days (eight hour) during 1982. About 63 percent of the employment was generated in agricultural occupations and 37 percent in nonagriculture. Agriculture provided employment for 178 days -- 142 days in crop production and 36 days in noncrop activities. If the duration of employment measured in standard eight hour days is related to the number of days a worker was available for employment during 1982, the average time rate of unemployment is estimated at 18 percent.

The effect of the FFW program on employment in crop production activity, which is directly affected by such work, and in construction and cottage industries, which are likely to be stimulated by higher agricultural production and rural incomes, is found to be positive and statistically significant. The number of days of employment in all these activities is about 9 percent higher for the project group of workers than the control -- 6 percent higher in crop production and 22 percent higher in nonfarm activities.

The total number of days of employment in 1982 is, however, found to be three percent lower in the project group than in the control. This is mainly due to higher self-employment of the control group in such low productive activities as fishing, domestic services, collection of fuel, etc. -- 31 days for the project, 47 days for the control. Presumably at higher levels of income people tend to substitute such low productive employment for leisure.

The independent effect of the FFW program and of general infrastructure on employment has been estimated through an analysis of variance so that the effects of the important socioeconomic variables --for example, size of landholding and age and education of the worker --are dissociated from the effects of projects and infrastructure. The effect of FFW is found to be positive for employment in crop production and it increases employment in nonagricultural activities in areas with well-developed infrastructural facilities. After adjustment for the effects of other variables, employment in crop production is found to be about 8 percent higher in areas with infrastructural development and 4 percent in areas lacking them.

In the implementation phase, the FFW program generates wage employment during the February-May period, which is found to be one of the slack seasons for agricultural activities, particularly in areas with a low proportion of land under the HYVs. The FFW thus directly contributes to reduction of seasonal fluctuations in employment. It also generates employment in the long run through spreading of irrigation and diffusion of HYVs, which are more labor intensive and are grown mostly during the January - June period. The survey finds employment in crop production during the February - April period to be higher in the area with completed projects compared to the control. But the coefficient of variation in weekly employment for the eight

weeks of survey is similar in the project and control group because of a larger slack in employment in October in the project areas. This may be due to the reallocation of land in project areas in favor of HYV aman from pulses and early maturing varieties of local aman.

Impact on Food Consumption and Nutrition

The level and pattern of food consumption obtained in the survey are comparable with those obtained from the national nutrition survey of 1982. The cereal consumption per capita per day is about eight percent higher in the project group (503 grams) compared to the control (465 grams). The project appears to have a positive impact on consumption of milk and milk products, vegetables and fish. As a result the nutritional level of the population is higher in the project area -- the per capita daily consumption is 2,167 kilocalorie and 58 grams of protein compared to 2,012 kilocalories and 54 grams of protein in the control area. The national figure for 1981-82 is 1943 kilocalories and 48 grams of protein per capita per day.

While annual consumption is higher in the project sites both in the aggregate and for all income deciles, there is a more pronounced seasonal fluctuation here than in the control. This appears to be attributable to agricultural productivity improvements made possible during some parts of the production cycle and not in others. For the landless and low income groups, seasonal improvements in diets occur mainly in the post-aman and post-boro periods which coincides with better harvests and higher nonagricultural employment at that time.

The anthropometric measurements show that the baseline nutrition situation in the project sites was slightly worse than in the control. The prevalence of stunting in the children (below age 10), defined as the proportion below 90 percent of a reference height for age, is found to be about 49 percent in the project sites compared to 46.6 percent in the control. The prevalence of stunting will not be substantially altered during the 2-3 year period since the projects have been completed.

The short-run nutritional improvements will be reflected in the prevalence of wasting defined as the proportion of population below 80 percent of a reference weight-for-height. The project sites are significantly better off regarding wasting as well as stunting-cum-wasting measures -- the proportion is 13.6 percent in the project sites compared to 19.0 percent in the control. This could be the result of changes introduced due to the project completion. An examination of disease incidents indicates higher gastroenteric problems in the project sites, which appears to be a continuation of a longer trend that may not have been influenced significantly by the FFW program.

An analysis of the expenditure pattern shows that about 77 percent of the total consumption budget is spent on food (i.e. agricultural products) and 23 percent on nonfood (nonagricultural products) items. The nonfood items are highly income-elastic. The average and marginal propensities to consume for various products are not found to be much different between the project and control groups but there are substantial differences between villages with developed and underdeveloped infrastructures. Compared to the sample in the infrastructurally underdeveloped area, the sample in the well-developed area have about 13 percent lower marginal consumption of cereals, but 16 percent higher marginal consumption of noncereal foods, 26 percent for clothing and 32 percent for household durables. This finding indicates that development of infrastructural facilities would stimulate nonfarm activities through higher consumption expenditure of purchased food and nonfood items.

Impact on Capital Formation

The average rate of gross investment is estimated at 6.1 percent of the disposable income for the entire sample. The rate of net investment after deduction of the replacement expenditures for depreciation of capital stock is estimated at only 4.9 percent of income.

The comparison of the mean values for the project and control group shows that the FFW program may have had a positive effect on capital formation. In the project group the gross investment is about 27 percent higher and net investment is about 64 percent higher than in the control and the differences are statistically significant.

A multivariate regression analysis shows that the rate of investment first declines with income and then rises from the point below the average level of income. The marginal propensity to invest at the mean values of income is estimated at 12 percent and the income elasticity of investment at 1.50. The level of investment appears to be negatively relate with the size of land holding and positively related with the number of working members. Educational level of the household head and the amount of credit received do not appear to have any positive influence on the level of investment. The effect of the FFW program on investment is reflected mainly through its indirect but positive income effects. After controlling for the effect of other variables, the effect of the FFW program on the level of investment is estimated at 19 percent.

The development of general infrastructures is found to have a significantly negative effect on the level of investment. This finding is obtained both from the comparison of mean values of variables and from the regression analysis. It results from a proportionately larger investment expenditure in infrastructurally less

developed villages on land development, agricultural equipment, and energy. The level of investment on land development is also found to be higher in the control villages than in the project. Land development involves a substantial amount of labor, particularly family labor. Since the opportunity cost of family labor is lower in underdeveloped areas, more labor is devoted to asset creation in these villages. In the project villages the scope of asset creation through private initiative is narrowed down by the involvement of the government in such activities as provision of subsidized irrigation facilities and digging of field channels. In the absence of such public undertakings some households in the control villages come forward to make such investment, which is reflected in the higher rate of investment for land development in control villages. The private investment, however, takes place at a much slower pace, and it would have a much smaller impact on capital formation and agricultural production had there been no public investment on land infrastructures, which is facilitated by the FFW program.

The expenditure on working capital for agricultural development for greater use of modern agricultural inputs is however higher in the project villages than in the control, and in areas with more developed infrastructural facilities. The group of sample households in areas of infrastructural development spend about 26 percent more on fertilizer and pesticides and 66 percent more on irrigation than the group in less developed areas.

Policy Implications

The evidence presented in the summary and the technical papers clearly indicates that FFW projects, if properly selected, designed, implemented, and maintained, generate a substantial positive impact on all aspects of village economy. Therefore, the FFW program should not be considered only as a vehicle for short-run relief to the poor and underemployed, but as a means for construction of productive long-term rural infrastructures. The program therefore should be strengthened and be well-planned as a mechanism for rural development.

The program in its current form is primarily involved in creating land infrastructures, i.e., irrigation and drainage canals, and flood control and saline protection embankment with the use of mostly manual labor. The impact of these types of infrastructures is greatly strengthened when improved agricultural technology and a more developed level of general infrastructures are simultaneously provided. The role of such general infrastructures such as improved roads and communication facilities, rural electification, developed market places and establishment of financial institutions has been emphasized by the findings of its positive interactive effects with the the

effect of the FFW program. These results logically point to a policy directed at concentrating development of general infrastructure in areas where FFW projects create larger potential for agricultural development. The development of general infrastructures will need more cash investments on material inputs than the development of land infrastructures. Some land infrastructures such as embankment and drainage canals will also need apportunant structures such as culverts, bridges and sluice gates, the absence of which reduces their development impact. Thus, the donors and the government should make an appropriate balance between in-kind food and cash investments in planning the FFW program. A higher priority should be given to the development of better quality rural roads, markets and communication system using food-for-work and other public resources.

It is vital to emphasize that the positive impact of the FFW Program is conditioned by the quality of management, as reflected in design and implementation of the projects. This evaluation concentrated only on the successful projects. The results of the management and engineering reports of this study[3] indicated that about one-third of all projects would meet the same standards of success as the projects that have been studied. A need for improvement in the process of selection, design and implementation of the project is obvious. The issues pertaining to these management problems have been examined in the technical papers on engineering and management aspects of the program. These papers are part of the short-run impact study submitted earlier. On the basis of the recommendations in those papers, the government has already made some changes in the management and implementation of projects. But changes having long-run and structural implications (e.g., local level institutions, technical support on a regular basis for project selection, and design, etc.) have to be implemented gradually.

The central element of the design of rural infrastructural development is the role of an effective local-level organization (local government). The local government has to perform the following critical functions in infrastructural development:

a) selection, design and implementation of projects that meet local needs;

b) routine maintenance of structures created by public resources;

c) generation of local resources for maintenance as well as new asset creation in rural areas.

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3 Bangladesh Development Studies, July-December, 1982.

Maintenance of roads, canals, embankments and other physical facilities is generally neglected because of the absence of effective local-level organizations endowed with the required resources. A dirt road or embankment may continue to be useable if annual maintenance, particularly after the monsoon, is regularly done. Alternatively, capital-intensive hard structures can provide a number of years of useful service without regular repair. In this sense, capital intensity is a temporary substitute for labor-intensive regular maintenance. Even a hard surfaced road may be washed away after 2-3 years if regular maintenance is neglected. For rural infrastructures to continue to be useful, maintenance of these public assets is considered to be a priority. A centralized national-level organization would be quite ineffective for maintenance of rural infrastructures.

If a local organization has to perform the tasks of implementation and maintenance of rural infrastructures effectively, it must possess resources for this purpose. The newly constituted Upazila system provides an institutional solution, but Upazilas do not have access to the required resources. At present only about Tk 5 million, on average, is provided by the national government to an Upazila government for rural development. This is grossly inadequate for the tasks involved in construction and maintenance of all types of rural infrastructures. While a larger share of the central budget has to be allocated to Upazilas for a meaningful decentralization, Upazilas must also develop a program of internal resource generation to supplement the central contributions for construction and maintenance of rural infrastructures. Some arrangement to provide matching funds from the central to the Upazila governments is necessary to induce resource generation at the local level.

The scope for mobilizing additional resources from within the rural sector is wider than it would appear on first glance. Studies indicate that the incidence of direct taxation on the rural sector is only 0.2 to 0.5 percent of income compared to 2.0 to 3.0 percent in the urban sector. The incidence of indirect and concealed taxation also does not appear to be biased against the agricultural sector (see the BIDS study on taxation prepared for the Planning Commission, 1985). The extent of the collection of direct tax on agriculture is less than 60 percent of the assessed amount of tax, which indicates a high rate of default, particularly among richer households. If local governments are associated with these tax collections and promised an incremental share of the collection, the amount of resources thus available to local governments would be quite substantial. In addition, new opportunities could arise to enhance the revenue base of local governments. User-fees on constructed infrastructures (e.g., license fees on trucks, rickshaws, and scooters; water charges on irrigation and drainage beneficiaries; market fees on traders in marketplaces; taxes on rice mills and other mills and factories; real estate taxes; fees on bridges) could be employed to bring revenue to

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local governments. Such an approach to resource generation at the local level would, however, call for: (a) institutionalizing the principles for assessment and collection, (b) developing organizational strength at Upazila levels to perform the task, and (c) installing machinery for regular auditing of local government accounts and procedures.

ANNEX

(From: Characteristics and Short-run Effects of the WFP-Aided Food-for-Work Programme in Bangladesh)

December 1983

Executive Summary

Origins and Terms of Reference

This summary and accompanying documents constitute the third and final report on the management and short-run aspects of an In-Depth Evaluation of WFP-Aided Food-for-Work in Bangladesh which has been in progress for the past three years. A report on the long-run impact will be submitted in 1984. The present report is based on findings from field surveys covering management practices; extent to which food-for-work reaches the target group; employment, income and consumption effects; quality of work; and short-run impact on productivity.

The management, worker and productivity surveys were carried out at 32 project sites, selected by stratified random sample. The household survey was carried out at a subset of 5 project sites where work continued throughout most of the season, plus 5 comparable nonproject sites for control. The engineering survey was carried out at a subset of 17 project sites, with desk review of all 32 projects. Findings are presented from each of the individual surveys, followed by conclusions and recommendations of the evaluation team.

Since its inception following the 1974 famine in Bangladesh, the Food-for-Work Programme (FFW) in its entirety has utilized an average of 280,000 tons of wheat annually, of which WFP has supplied a little over 50 percent. FFW food as a proportion of total cereal imports has varied from about 8 to 34 percent over the past several years, averaging about 18 percent. Thus the size of the programme is such that termination could have a significant adverse impact on food supply availability in the country.

In food-for-work projects, activities are undertaken during the dry season (mid-December through mid-May) which are intended to

contribute to the development of the country's rural infrastructure and the workers are to be paid with wheat.

Under the current plan of operation, 80 percent of WFP's wheat is allocated for canal excavations and construction and rehabilitation of river and coastal embankments under the authority of the Water Development Board (WDB), although the share actually utilized by the Water Board is usually somewhat less. Since 1981/82 -- the year of the field survey -- the remainder of WFP's wheat has been allocated entirely for local initiative schemes, principally rural roads, administered by the Relief and Rehabilitation Division of the Ministry of Food (formerly the Ministry of Relief and Rehabilitation -- MRR).

Extent to Which Food-for-Work Reaches Target Group

The Food-for-Work Programme has achieved considerable success in reaching the target group. Whereas less than 50 percent of the population in the country as a whole belong to the functionally landless category, that is, those with less than half an acre of land, about 50 percent of FFW participants are drawn from completely landless households, and 70 percent belong to the functionally landless category. Ninety percent own less than 2 acres. The per capita income of worker households prior to the work season was less than half the national average and 85 percent of the workers at illiterate. Eighty percent of all workers gave agricultural labour or self-cultivation as their primary occupation. However, 66 percent listed earthwork as their secondary occupation and 85 percent had previous earthwork experience, most of it in Food-for-Work Projects. Migrant workers comprised less than 15 percent of the total number of workers included in our sample. Most workers lived less than a mile from the project sites and nearly all went to their place of work on foot. The fact that such a large proportion lived in the project locality and gave agricultural labour as their primary occupation, indicates that they regard earthwork on Food-for-Work projects as intended, as a source of remunerative employment during a season when demand for agricultural labour is low.

Employment, Income and Consumption Effects

Employment in Food-for-Work represents largely a shift from self-employment in extremely low-productivity activities and to a somewhat smaller extent from other forms of wage employment. When wage employment is not available, landless labourers try to sell their services or engage in petty trade in whatever way they can in order to subsist. When Food-for-Work employment is available, survey results

show that the net income earnings of participant households was 55 percent higher during the six weeks' survey period, compared to what they would have earned during the same period in the absence of FFW. On an annual basis this amounts to about a 10 percent increase.

Households with FFW participants and comparable households in control villages both had relatively high levels of food consumption compared to the national average for their income group and there was no significant difference between the food consumption of FFW participants and that of a control group during the work season. However, participants in Food-for-Work who were heavily involved in the projects, that is, those comprising the top 50 percent in terms of days employed, had a marginally higher level of food consumption. Other uses of the additional income earned through food-for-work could include loan repayment and nonfood consumption. Data was not collected on nonfood consumption, but that collected on loan repayment suggests that additional income was used for this purpose. To the extent that extra earnings were used for loan repayment, the positive consumption effect of FFW was being distributed over time. These preliminary findings reflect less increase in food consumption than is commonly found among low-income groups when their income increases. The basis for these counter-intuitive findings will be further explored in conjunction with analysis of consumption data collected for the long-run impact analyses to be submitted later this year.

For FFW participants compared to non-participants the share of wheat in the consumption basket is higher. This change in the consumption pattern was itself a consequence of the system of payment in kind, coupled with the fact that there was a transaction cost involved in converting wheat into rice or other items. Of all those households receiving wheat, 54 percent sold some amount of wheat; but the total amount of wheat sold was only 14 percent of the total receipt. When wheat was sold, it was sold in 61 percent of cases to meet urgent cash needs; in only about 24 percent of cases was preference for rice reported as the reason.

Management Considerations

The management survey examined five topics: procedures for initiating, designing and selecting projects; procedures for forming project implementation committees; procedures for acquiring land at project site; procedures for supervising and paying labor; and procedures for delivering wheat to the project site.

As noted above, the procedures laid out for initiating and selecting WDB and MRR projects are quite different. For WDB projects technical considerations were expected to dominate, whereas for MRR

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projects a high degree of local participation was expected. In fact, a relatively high degree of participation by local influential people in the planning process was found in both WDB and MRR projects. At half the project sites they felt another project would have been more beneficial. When villagers viewed the project as beneficial, engineers observed that this contributed to a high standard of implementation.

In 1981/82 there were also considerable delays in the approval process, perhaps attributable in part to the general shortage of wheat in the country in that year which may have prevented early start-up work. Since then procedures for review and selectionof project proposals have been streamlined so that Government Orders (GOs) can be issued by December 1 each year.

Two problems which were thought to cause delay after the issuance of GOs were the formation of Project Implementation Committees (PIC) and the acquisition of land for lifting and depositing earth at the project site. While political factors were mentioned as having had a significant influence on formation of PICs at 26 of the 31 sites visited, neither political conflict nor problems of finding technically qualified members appeared to delay formation of PICs at most sites. Land acquisition posed more serious problems however. At 5 WDB sites private land had to be acquired for right-of-way to build a new structure, and in these cases compensation was paid. However, since most other projects involved reconstruction or rehabilitation of an existing structure, compensation was not authorized. Nevertheless, even at these sites land is required for lifting and depositing of earth, sometimes in substantial amounts. Although most local officials reported that the necessary land is given voluntarily, farmers at a quarter of the project sites (5 WDB and 3 MRR) reported that the land to be used for the project is usually planted to crops and often cannot be recovered after the work is complete.

The normal practice is to acquire land as close as possible to the project site, and this may also create technical problems if the quality of the soil being lifted is not appropriate for the type of construction being undertaken. Particularly where flood control embankments are being constructed, acquisition of land lying at a greater distance from the project site could provide construction material of consistent quality for the entire length of the embankment and thus reduce the likelihood of breaches.

Procedures for supervision are much more highly developed with respect to organization of work and payment of wages than with respect to technical quality of labour supervision. Oversight and monitoring functions are carried out by PIOs for MRR projects and SOs for WDB projects. These individuals verify earthwork measurements and report on the quality of work completed, for the most part by personal

checking at the project site, but they are not required nor do they undertake to monitor the quality of the work completed in accordance with standard engineering practice. WFP field officers review project documents and make at least one field visit to as many projects as possible during the course of the work season.

Workers are organized in gangs whose size varies from 6 to 35. They work longer hours and are more productive than provided for in the official estimates of the amount of earthwork which can be moved in a day, but on average they receive less wheat per 1000 cft of earthwork moved than the officially specified rate. The productivity rate reported by various respondents averaged between 105 and 118 cft for a 9-hour day.

The quantity received varied considerably from one project site to another and tends to reflect the local market wage rate, averaging about 4.35 seers per day for WDB projects and about 4.58 seers per day for MRR projects, according to the responses of gang leaders and labour supervisors. Based on an average productivity rate of 105 to 118 cft per day, this amounts to a wage rate of 37 to 42 seers per 1000 cft in WDB projects and 39 to 44 seers in MRR projects. The average rate reported by PIC members was somewhat higher -- 46 to 48 seers for WDB projects and 51-52 seers for MRR projects. Workers however reported receiving lower rates -- on average 40.25 seers in WDB projects versus 46.50 seers in MRR projects. These may be compared to the official rates of 50 seers per cft for MRR roads and embankments, 55 seers per cft for MRR canal excavations and a rate of 42.86 seers for basic earthwork plus varying rates for allied factors such as lead and lift in WDB projects, averaging at least 14 to 15 seers. Since the wage entitlement was thus slightly higher in WDB than in MRR projects and average productivity in both was about the same, this means that similar daily wage rates for both sets of workers resulted in a higher rate of underpayment at WDB projects.

Because of differences in statements by different respondents about wage rates paid, and because of differences in the methods used to estimate the total amount of wage owned in WDB projects, it has not been possible to arrive at a precise estimate of the amount of underpayment to workers. Using the workers' statements about the amount of wage they received and various estimates of the wage entitlement in Water Board projects, the rate of underpayment in WDB projects has been estimated by the study team to be 33 percent. However, the procedure used overestimates somewhat the wage entitlement for allied factors in WDB projects, due to having used Water Board's overestimates of the amount of wheat required, as shown in project proformas. Consequently, this rate of underpayment is somewhat overestimated. Using WDB and WFP estimates of the wage entitlement for allied factors, the rate of underpayment in WDB projects is estimated at 24 to 27 percent. Using PIC member statements the estimated rate of underpayment ranged from 17 to 20 percent using these same procedures.

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None of these estimates can be considered precise, but they indicate the probable range of underpayment in WDB projects. For MRR projects the estimated rate using worker statements was about 10 percent and 2 percent using worker statements and 13-15 percent using PIC statements.

Underpayment of wages and overreporting of work accomplished are the two means by which larger amounts of wheat can be claimed from WFP than are actually received by the intended beneficiaries. Excess claims are made for a variety of reasons, many of them reflecting project-related costs which were not covered by rules and regulations of the FFW programme at the time of the survey. These include: payment of cash to workers in lieu of wheat; and coverage of losses in transit, excess transport costs, replacement of gunny sacks, porterage costs, storage costs at project sites, cost for bailing water from canals, organizational and administrative costs, and extra payments to officials at various stages of the process. While all of these requirements were not reported at one site or another, it has not been possible to quantify the magnitude of each of the various elements, nor the extent to which they are exceptional or characteristic of WFP projects as a whole.

An indication of the total magnitude of the excess claims is given by the figure for non-arrival of wheat at the project site reported by PIC members. They commonly reported that a portion of the wheat for which they took receipt at the local storage depot did not arrive at the project site. This complaint was made by 70 percent of the PIC members interviewed; about half of the Thana officials queried indicated that they had received such complaints. On average, the amount of wheat reported as not arriving at the project site came to about 35 percent for WDB projects and about 18 percent for MRR projects, with the weighted averaging amounting to 29 percent. There was considerable variation in the experiences reported from one project to another. One possible explanation for the larger WDB figure is that a larger portion of wheat claimed is sold to cover cash payments to workers, but it has not been possible to verify this hypothesis from the data available.

Quality of Work and Productivity Impact

For lasting impact, Food-for-Work projects require sound conception, correct design, resources for requisite appurtenant structures, and careful technical supervision during implementation. Out of 17 projects studied in depth, the engineering survey found that the structures were appropriate and the design quality good in the majority of both WDB and MRR projects visited. However, the conformity of execution with design and the quality of work done was less good.

In some cases, the problems were sufficiently serious to prevent development impact from being realized, while in other cases fair or poor quality execution was expected to affect primarily the rate of deterioration and frequency of requirement for repair and rehabilitation. Principal problems observed included scheduling problems for large schemes under WDB; inadequate attention to flow behaviour and historical flood levels at some river embankment sites; inconsistency of soil quality in embankments and road projects; haphazard dumping of excavated material and redundancy of project design.

While working on the technical evaluation, especially during field visits, it was observed that motivation, especially of the members of the PIC and the people receiving the benefit of the project was closely associated with good quality work from an engineering standpoint. However, relatively little supervisory attention was accorded to FFW projects by field engineers.

Resurvey one year later at the 31 sample project sites showed that less than one-half had been completed as specified, based on measurement of project length. Work had continued in 1982/83 at only one-third of these incomplete project sites. Thus at the end of the 1982/83 work season, almost 1/3 of the sample sites were still incomplete vis-a-vis the project design. At some sites, incomplete projects could nevertheless be expected to have some effect on cropping patterns and productivity.

Conclusions and Recommendations

The conclusion of the evaluation team with respect to Food-for-Work in Bangladesh is favourable as regards the Programme's success in distributing at least 70 percent of the wheat utilized to target beneficiaries, namely, low-income families in rural areas. Further, despite continuing technical problems, rural infrastructure is clearly being created which has a positive impact on agricultural productivity and long-run development prospects. Further improvement could be made in the following areas:

1. Project initiation -- more integration of project planning process under Thana Development Committees, more opportunity for local participation in the early stages of project planning and selection, and allocation of some portion of the total WFP resources to maintenance work on an experimental basis; consideration of techniques for allocation of WFP resources, weighting by need, but leaving flexibility for rewarding thanas which use resources efficiently.

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2. Technical scrutiny -- strengthening of capacity for technical monitoring in the WFP office in Dhaka; support for principles decentralization by giving greater decision-making autonomy to thanas and supporting them with technical assistance for project preparation; creation of an independent interdisciplinary monitoring and evaluation team which would perform this function for the appropriate Government Ministries.

3. Project implementation committees -- creation of PICs on a permanent basis and greater provision for representation from among groups supplying workers for FFW projects; use of PICs to disseminate information about project proposals and working conditions.

4. Provision for project-related expense -- adjustment of rates for carrying costs in line with survey results and provision of contingency fund in advance of work season for use by PICs in meeting other project-related costs; provision of additional fund for acquiring land needed for lifting and depositing earth at repair and rehabilitation projects; provision of adequate complementary resources to provide requisite appurtenant structures such as bridges and culverts.

5. Wage payment -- payment of wages on a pro-rata basis twice weekly, based on provision of sufficient wheat advance to cover situations when there is a delay in earthwork measurement or in obtaining wheat from the LSD; consolidation of wage rates for WDB projects; opening of project record books to public scrutiny; stricter monitoring of wheat distribution practices and collection from Local Storage Depots.

Since the time of the surveys upon which the above findings and recommendations were based, WFP and Government have agreed on and begun to implement a number of procedural changes which take the evaluation results into account. Because of the introduction of stricter controls, the findings of the in-depth study as reflected in this document may no longer precisely reflect the current projection situation.