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FINAL REPORT

# 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 favourable 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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# I. INTRODUCTION

1.1 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 unemployment and underemployment, poverty, and malnutrition among developing nations. A development strategy for such a delicate economy with so many short-run problems should judiciously balance long-run goals and short-run policies.

An 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. The importance of rural infrastructure in capital formation, raising agricultural productivity, reducing the costs of marketing between agriculture and the nonagricultural sectors, as well as in expansion and integration of markets and the resulting specialization of resources in output and employment, gives it a place in economic development that cannot be ignored. Furthermore, developing an infrastructure

link agriculture with the rest of the economy and generate a larger than normal multiplier effect on the development of the whole economy is a major objective of development strategy.

1.2 Rural Public Works. 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. In recent years it has had the capacity to provide over 17 days of additional employment 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 evaluation studies known to us has been comprehensive enough to cover the effects of the public works program on both development and welfare. This summary of 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. The first part of the study, a report of the short-run consumption, employment, and income effects of Bangladesh's FFW Program and of its management and technical problems, has already been completed and submitted.

1.3 Objectives. The objective of this part of the impact study is to examine and measure the direct and indirect effects of projects between two to five 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). 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 infrastructures created by the Food-for-Work projects on agricultural production, employment, food consumption and nutrition;

b) provide a descriptive picture of the process of linkages among different economic activities under varying conditions of infrastructural development; and

c) measure the extent of indirect impact of the project (induced by increased income, consumption, and investment) under different levels of infrastructure development.

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 acreage 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 elasticities of demand and supply.

Further, infrastructurally developed project areas can be better served with modern agricultural inputs at reasonable prices compared to isolated locations. Institutional supports in the form of extension services, provision of credit and repairs of agricultural machines 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 less developed localities may not be equally pronounced for all groups of rural households. The

rich and large land owners may benefit more than poor and landless families because of the variations in resource endowments and ability to respond to market forces.

The aspects outlined above indicate the expected 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 occur and how much the non-project control areas, both with and without infrastructures, are relatively worse off is examined in this report.

1.4 Methodology, Study Design and Definitions.

For a correct assessment of the impact of an investment 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 standard 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 are conducted, then it is possible to correctly measure the net impact of the investment made on a project, provided the exogenous factors are both similar. But such an ideal approach is empirically impossible.

The design of the present study incorporated 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. We further complemented this method of comparison by employment 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 changes in these 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 cannot easily be assessed as to whether the measured project impact pertains to the FFW project or to the investment in the G.K. project. Because of the fact that the control villages as well as the project villages were located in the general G.K. project area, the difference in impact was attributable to the field-channel works done through the Food-for-Work Program. This was another advantage of the "control village" approach.

We did not adopt a benefit-cost approach of analysis; the need for such an approach was minimized by the adoption of the measurement of marginal benefits. If any interest arises in looking at the benefit-cost picture of the FFW projects we evaluated, however, a quick estimate of project costs implicit in foodgrain used and some 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 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[1/] and with less developed general infrastrucutre, and control villages with developed and less 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.

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1/ 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.

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:

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 Upazillas were selected from this list on the basis of the concentration of projects in the Upazilla and geographic

location.[1/]

3) One field investigator visited each Upazilla to investigate the completed projects. On this basis, a list of the better implemented projects in the Upazillas 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 Upazillas 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.[2/] (Table 1.1)

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.

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1/ An Upazilla is a newly organized administrative unit at the level of Thana which consists of about 150 villages on the average.

2/ A suitable control for coastal embankment could not be found.

Data Collection

Data were collected through structured interviews throughout the calendar year of 1982. Five 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.

Table 1.1--Selected Villages by Type of Project

| Type of Project | Project Village | Control Village |
|---|---|---|
| Field Channels | Bandabeel, Kushtia<br>Harishpur, Jessore | Roakoli, Kushtia<br>Gobrapara, Jessore |
| Dual Purpose | Charkhamain, Dhaka<br>Sayedpur, Dhaka | Rajarampur, Dhaka<br>Gobindapur, Dhaka |
| Coastal Embankment | Khejurdanga, Khulna<br>Birhat, Khulna | Taliamare, Khulna |
| River Embankments | | |
| a) Flood protection | Patgari, Pabna | Rawtora, Pabna |
| b) Flash flood protection | Illashpur, Comilla<br>Khunta, Comilla | Chashapara, Comilla |

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. A nutrition survey was conducted three times during the year, also in order to capture seasonal fluctuation. This included anthropometric and individual food consumption measurements on a subset of 320 out of the 640 households and covered four project villages and their controls in three of the five project types (field channel, flash flood and normal flood protection embankments). 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 study villages to physical (roads, transport facilities), institutional (markets, cooperatives, banks) and social (schools, colleges, hospitals, etc.) infrastructures was measured.

### 1.5 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.[1/] The average size of cultivated holdings is also similar to the national figure of 2.4

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

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) | 6151 | 5547 | 10.9 | NS |
| Total value of agricultural fixed assets except land (TK) | 3238 | 2867 | 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 |

acres found by the Pilot Agricultural Census of 1982.[1/] 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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1/ Report on Pilot Agricultural Census, 1982, Dhaka, September, 1983, p. 86.

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.

# II. FFW IMPACT ON AGRICULTURAL PRODUCTION AND HOUSEHOLD INCOME

## A. Impact on Agricultural Production

2.1 The findings of the study on the effects of Food-for-Work (FFW) projects on agricultural production are presented in this section. The analysis is confined to the effects of projects on (a) gross value of agricultural production, (b) factors contributing to the change in crop production, and (c) distribution impact of such changes. Data on agricultural production was collected for two calendar years, 1981 and 1982. This was done in order to smooth out the effect of natural calamities that affected crop production rather severely in 1982.

2.2 Gross Value of Crop Production. The association of projects with gross value of crop production (estimated at constant harvest prices of 1982) is shown in Table 2.1. It is seen from the table that for all the projects taken together, the gross value of crop production in the project areas was higher than the gross value in control areas by 27 percent. However, there was a considerable difference among the five types of FFW projects. Field channels for irrigation produced the largest impact; gross value of crop production in the project area with field channels surpassed the figure for control areas by about 160 percent. The weight of this large increase on the average of all projects was therefore a dominant factor.

Table 2.1--Gross Value of Agricultural Production in Project and Control Villages, 1981 and 1982 (in TK per acre of cultivated holding)

| Project Types | Project Area, Average of 1981 and 1982 | Control Area, Average of 1981 and 1982 | Difference of Project over Control (%) |
|---|---|---|---|
| 1. Drainage-cum-irrigation (DCI) | 4328 | 3819 | 13.3 |
| 2. Field channels for irrigation (FC) | 6190 | 2386 | 159.4 |
| 3. Coastal embankment (CE) | 2748 | 2716 | 1.2 |
| 4. Flood protection embankment (FPE) | 6009 | 6169 | -1.2 |
| 5. Flash flood embankment (FFE) | 4764 | 7844 | -39.2 |
| All Types | 4785 | 3763 | 27.2 |
| Projects excl. FFE | 4840 | 3129 | 54.7 |

Source: Computed from survey data.

The drainage-cum-irrigation project also shows a positive contribution to the increase in production, i.e. an increase of 13.3 percent over the control villages. Coastal embankment shows only a marginal positive contribution and the flood embankment project indicates a large negative impact.

Surprisingly, gross value of production in the flash-flood embankment area was lower than the gross value in the control area by 39.2 percent. This negative impact of the flash flood project was primarily attributable to the fact that the embankment suffered a number of cracks due to inadequate maintenance and therefore could not protect crops from flash floods both in 1981 and 1982. The damage to

crops was however more severe in the project area in 1982 than 1981.

Farmers in flood prone areas, unprotected by embankment, search for alternatives to overcome potential flood damages. If opportunities for low-lift or tubewell irrigation are afforded, such farmers tend to switch to winter Boro cropping instead of monsoon Aus or broadcast Aman crops. These are also areas where Boro (HYVs) were grown under traditional irrigation when surface water was available. These compensatory factors were also reflected in the negative effect of projects designed to protect crops from floods. Also, while selecting the project and the control villages under the flash flood protection embankment project, comparable selection criteria could not be strictly adhered to. This is evident from the proportion of area under different topographic situations and the area irrigated. In the control village of Chasapara, 83 percent of total land is high and medium-high land and almost free from flash flood. On the other hand, the project villages have less than 50 percent of land at that high level of topography.

In the coastal embankment area, the actual increase in the gross value of crop production due to the project is marginally higher in project areas than in controls. In the control area without the coastal embankment project, the income from fruits, which are not adversely affected by salinity, e.g. coconuts and betel nuts, was larger than in project areas. This difference in the value of fruits (which is included in Table 2.1) masked the larger increase in gross value of crop production in the project area's total gross value of agricultural production. If we exclude the flash flood project area

from our measurement, on the ground that the project lacked effective maintenance, the increase of the gross value of agricultural production in all other projects over their control areas is about 50 percent. The positive impact of projects on agricultural production has been affected by different factors, namely, land use, crop mix, input use and yields. Therefore, some of these factors are examined in the remaining part of this section.

2.3 Intensity of Land Use and Cropping. The cultivation intensity, defined as the proportion of owned cultivable land put into cultivation, was found to be higher in four project areas, but the overall increase in the cultivation intensity in the project area over the control area was only 3 percent. In the area with the field channel project there was no change in cultivation intensity. The nature of the field channel project precludes such an effect on land use.

The cropping intensity, defined as the total cropped area as a percentage of net cultivated area, was higher by 6 percent in project over control areas, indicating a positive impact. However, this change in cropping intensity was not uniform across all projects. Contrary to expectations, in the field channel project area the cropping intensity was found to be higher in the unirrigated control area than in the irrigated project area. This was mostly due to the use of quick maturing (low-yielding) rainfed crops such as pulses and oilseeds in the control area. As a result of the irrigation, the local Aus-pulses-oilseeds crop rotation changed to high-yielding (HYV) Aus-HYV-Aman rotation which reduced the cropping intensity. Although the index of cropping intensity was lower in the field channel project

area compared to its control, the increased use of high-yielding varieties of crops grown under irrigation enabled the project area to generate a substantially higher gross value of agricultural production.

2.4 Irrigation Coverage. Area under irrigation was found to have increased by 60 percent in the project over control villages. This increase has occurred through both direct and indirect effects of the project construction. The effect is, however, not uniform over all projecs. The largest direct increase was in the field channels project. In the areas protected by flood embankment, the intensity of irrigation is higher in control than project villages. Where surface water is available nearby, such flood-prone areas not covered by flood protection measures tend to shift cropping from the monsoon to the winter season by installing low-lift pumps. In the control villages of the flood embankment type, broadcast (deep-water Aman) was given up in favor of high-yielding Boro by means of low-lift irrigation. This is possible only in those areas where surface water is available to make such a shift possible. In the flash-flood project areas, the defects in the embankment and drainage canal did not produce any direct or indirect impact on irrigation.

2.5 Improved Rice Varieties. In consonance with the irrigation pattern between project and control areas, the proportion of land cropped with HYVs was 21 percent higher in project compared to control villages. This effect resulted overwhelmingly from the field channel project, as reflected in Table 2.2.

Table 2.2--Land Cropped with High-Yielding Varieties: By Types of Project (percent of total cultivated land)

| Project Types | Project Area, Average of 1981 and 1982 | Control Area, Average of 1981 and 1982 |
|---|---|---|
| 1) Drainage-cum-irrigation canal | 24.6 | 27.2 |
| 2) Field channels | 90.6 | 12.6 |
| 3) Coastal embankment | 3.5 | -- |
| 4) Flood embankment | 19.5 | 74.8 |
| 5) Flash flood embankment | 111.3* | 147.5* |
| All Project Types | 57.9 | 37.0 |

Source: Computed from survey data.

* This higher intensity is due to HYVs grown in two cropping seasons during the year.

As explained earlier, the shift in cropping pattern facilitated by low-lift irrigation in control villages without flood embankment projects made it possible for those farmers to allocate a larger proportion of land to HYV rice crops. It would appear that because flood protection projects do not reduce risks without having a good maintenance program, they may in fact preclude the kind of protective investments seen in the control sites. In the coastal embankment project, the project effect on the growing of HYV rice is marginal. Without complete protection from intrusion of saline water or without

breeding of salt-resistant varieties, the growing of HYVs is not possible in these areas.

2.6 Input Use: Labor and Fertilizers. The differences between the project and control villages regarding the use of labor and fertilizers for crop production are presented in Table 2.3.

Table 2.3--Labor and Fertilizer Use per Unit of Cultivated Land

| Project Types | Labor (days/acre) | | | Fertilizer (lbs/acre) | | |
|---|---|---|---|---|---|---|
| | Project | Control | Difference (%) | Project | Control | Difference (%) |
| 1) Drainage-cum-irrigation | 58.2 | 57.0 | +2.1 | 74.0 | 54.0 | +37.0 |
| 2) Field channel for irrigation | 91.5 | 60.4 | +51.5 | 235.0 | 59.0 | +298.3 |
| 3) Coastal embankment | 34.8 | 41.6 | -16.3 | 24.0 | 3.0 | +700.0 |
| 4) Flood protection embankment | 74.0 | 92.3 | -19.8 | 73.0 | 409.0 | -82.2 |
| 5) Flash flood protection | 83.1 | 89.2 | -6.8 | 401.0 | 471.0 | -14.9 |
| All Types | 71.3 | 63.7 | +11.9 | 185.0 | 131.0 | +41.2 |

Source: Computed from survey data.

Overall, the intensity of both labor and fertilizer use was higher in project areas compared to control areas. Per acre use of labor was up by 11.9 percent and use of fertilizer was up by 41.2 percent in the project areas. However, there were wide differences in the percent change of these two inputs among various types of projects. These differences also reflect observations made earlier on cropping

intensity and use of HYVs. Use of labor per acre in the projects designed for irrigation (drainage-cum-irrigation and field channels for irrigation) was substantially higher in project than in control areas. In the other three projects designed for protection against flood and salinity intrusion, the labor use per acre was higher in control than project areas, indicating the need for extra labor inputs in such areas for hedging against these calamities. In regard to use of fertilizers, drainage-cum-irrigation, field channel and coastal embankment project areas showed a significantly higher level of fertilizer use in project areas. In the case of flood protective devices, any increase in the use of fertilizer in the project village is more than swamped offset by improvements due to the increased cropping by low-lift irrigation in control villages, also facilitating a higher HYV coverage there.

2.7 Crop Yields. The net effect of the differential patterns of input-use in the project and control areas is reflected in the impact on crop yields, which is found to be significantly positive in project areas (Table 2.4).

Table 2.4--Impact of Projects on Cereal Yields[1/]

| Crops | Project Area | Control Area | % Difference |
|---|---|---|---|
| Local varieties | 18.6 | 14.0 | +32.9 |
| High-yielding varieties | 39.0 | 34.0 | +14.7 |
| All varieties | 26.5 | 18.9 | +40.2 |

1/ Paddy yields in maunds/acre. 1 maund = 37.3 kg.

Source: Computed from survey data.

## 2.8. Overall Impact of the Projects on Production.

The arithmetic means of the variables which influence production for the project and control groups and the results of the test of difference in the mean values are presented in Table 2.5. In this calculation of the means, the sample households under the flash flood protection embankment project have been dropped, since the project group has lower values than the control for most of the variables. This should not be attributed to the project but to its inadequate maintenance.

One may conclude from the findings in Table 2.5 that the project has a significant impact on the main variables affecting production. The only exception is in the use of labor, on which the impact 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 because of substitution of some non-cereal crops with cereals following irrigation. The cereal production is about two-fifths higher than it would have been in the absence of the project; about one-fourth is due to the increase in yield. The value of production of all crops is about one-fourth higher in the project villages, and the difference is statistically significant.

Table 2.5--The Result of the Test on Differences in Mean Values of Production Variables

| Variables | Project Group | Control Group | Percent Difference | Estimated 't'Values |
|---|---|---|---|---|
| Percent of area irrigated | 38.4 | 18.8 | 19.6 | 4.8* |
| Percent of area under HYV | 40.3 | 23.6 | 16.7 | 8.8* |
| Intensity of cropping with major crops (%) | 135 | 128 | 7 | 2.1* |
| Labor use per acre of cultivated land (days) | 69.6 | 62.6 | 11.2 | 2.7* |
| Fertilizer use per acre of cultivated land (TK) | 198 | 142 | 39.4 | 2.8* |
| Cereal yield (maunds/cropped acre) | 29.4 | 23.4 | 25.6 | 3.7* |
| 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 (lbs.) | 110 | 76 | 45.7 | 3.0* |
| Cereal production per acre of cultivated land (maunds) | 32.1 | 22.3 | 43.9 | 4.9* |
| Gross value of production per acre of cultivated land (TK) | 5,401 | 4,276 | 26.3 | 4.1* |

* Denotes that the difference is statistically significant at less than five percent probability error.

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

2.9 Efficiency in Input Use: Analysis of Production Function. Bringing together all information relating to production and input use through the common framework of a production function provides further insights into the efficiency of input use and its impact on production. This analysis indicated that the marginal productivity was 48 percent higher for land and 27 percent higher for labor in project villages compared to control villages. The marginal product of fertilizers was, however, lower in project than control villages. This low marginal product is a reflection of the higher average level of fertilizer use in the project than in control villages. In general, it was found that the standard errors of all parameter estimates in the project villages were smaller than the standard errors in control villages. From this evidence, it can be concluded that, overall, the FFW Program reduces risk elements in the production of agricultural crops.

2.10 Distribution of Production. The shares of different landholding groups in the total production of 1982 for the project and control groups are shown in Table 2.6. It can be noted that the distribution of production is fairly unequal in both project and control villages. In the project villages, small farms (holdings up to 2.5 acres) constitute nearly 63 percent of all farms but only about 29 percent of the total production. At the other end of the spectrum, the top 14 percent of cultivators (with holdings above 5 acres) have a share of about 37 percent of the total production. This absolute inequality in the distribution of production, however, emanates mostly from unequal patterns in the distribution of landholdings.

Table 2.6 --Distribution of Agricultural Production, by Farm Size

| Landholding Groups | Percent of Farms | Percent of Land Cultivated | Cereals | | All Crops | |
|---|---|---|---|---|---|---|
| | | | Share of Production (percent) | Average Production per Farm (maunds) | Share of Production (percent) | Average Production per Farm (TK) |
| Project villages | | | | | | |
| Small farms | 63.0 | 29.1 | 28.9 | 34.7 (26.6)[a] | 28.5 | 5,860 (15.0) |
| Medium farms | 23.1 | 32.3 | 34.7 | 114.5 (66.7)[a] | 34.3 | 19,240 (46.3) |
| Large farms | 13.9 | 38.6 | 34.6 | 200.2 (65.6)[a] | 37.1 | 34,721 (35.9) |
| Control villages | | | | | | |
| 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 holding up to 2.5 acres of cultivated land, while the large farms are those with holdings of above 5.0 acres.

[a]Figures in the parentheses are group differences between project and control, expressed in percentages.

Comparing project and control groups, one finds that absolute production per farm is higher in the project villages for each of the landholding groups, but the difference is much less pronounced for the small farms compared to the medium and large farms. In the "without project" situation (i.e. the control), the increase in production is only about 15 percent on small farms compared to about 46 and 36 percent, respectively, in the medium and large farms. As a result, the small farms' share in total production decreases with project villages -- it is about 5 percent less in project compared to control villages. Thus, while the relative inequality increases, the Food-for-Work Program has a positive effect on absolute production achieved on small farms.

The main factors which contributed to the adverse distributional effect are: 1) the differential impact of the FFW projects on the adoption of HYVs, and 2) the effect of farm size (relative to labor) on crop yields. In the "without project" situation, there is a strong inverse relationship between farm size and the adoption of HYVs. Cereal area cropped with HYVs is 29 percent on small farms, compared to only 22 percent on large farms. Presumably, the high pressure of subsistence which follows from a very low level of income may have induced small farmers switch to HYVs more than the large farmers despite the fact that the average yield, and hence profits, are low in the control situation, and growing HYVs under limited irrigation facilities entails high risks and low labor productivity if traditional methods of irrigation are used (this is in fact the case in control areas). With the increased facilities for irrigation and relatively risk-free

environment following the construction of projects, however, the negative effect of farm size on the adoption of HYVs disappears to a great extent. The proportion of area under HYVs increases by only 6 percent for small farms, compared to 12 percent for large and about 18 percent for medium farms.

B. Impact on Household Income

2.11 Since rural households do not keep any record of their activities, it is very difficult to accurately estimate income for activities conducted on a self-employed basis. Income estimates suffer from the usual problems of memory-recall and wilful over-reporting of costs. There are activities involving production of fruits and vegetables in kitchen gardens, fishing from nearby creeks and canals, and production of household goods (mats, ropes, nets, etc.) which are undertaken on an irregular basis for home consumption. These are expenditure-saving activities, but since rural households do not consider them as income there is a tendency to under-report these activities. So, estimates of rural incomes using production accounts from data collected by household surveys are usually biased downwards.

In this survey, we have been careful to collect information as comprehensive as possible for estimating income. A detailed questionnaire on input-output for crop production activities has been administered three times during the year, at the end of the each cropping season, in order to reduce the errors due to memory recall. Input-output information on processing, manufacturing and trading activities has been collected through quarterly surveys. The irregular expenditure-saving activities have been 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 2.7. The share of agriculture in total income is estimated at 60 percent for the project area and 63 percent for the control area. Income from crop production, including agricultural wage income, and kitchen gardening constitute about 53 percent of the rural income for the project area and about 51 percent for the control area. Non-crop agricultural and non-farm activities thus contribute almost as much as crop production activities to the total rural incomes.

Total household income is estimated to be about 19 percent higher for the project area compared to the control. The difference in per capita income is lower, however, (10 percent) because of the larger size of households in the project group. The average per capita income is estimated at Tk 3278 for the project group and Tk 2968 for the control. The average per capita income for the country as a whole is estimated by the Bangladesh Bureau of Statistics at Tk 2826 for the year 1982/83.

The economic infrastructures built through the Food-for-Work Program are likely to have a direct impact on income from agricultural production and a secondary impact on income from industry, trade, construction, etc., generated by the increased consumption of non-farm goods and services and through additional investment. The comparison of the project with control group shows that the project has a positive impact on crop production, rural trade and industry,

Table 2.7--Structure of Rural Incomes in Project and Control Areas, 1982

| Sources of Income | Project Area | | Control Area | | Project over Control |
|---|---|---|---|---|---|
| | Household Income (TK/annum) | Per-cent | Household Income (TK/annum) | Per-cent | (percent) |
| Agriculture: | 12,721 | 60.1 | 11,334 | 63.4 | 12.2 |
| Crop production | 7,432 | 35.1 | 5,401 | 30.2 | 37.6 |
| Kitchen gardening | 1,509 | 7.1 | 1,638 | 9.2 | -7.9 |
| Livestock | 1,286 | 6.1 | 1,345 | 7.5 | -4.4 |
| Fishing | 482 | 2.3 | 889 | 5.0 | -45.7 |
| Agricultural wage | 2,012 | 9.5 | 2,061 | 11.5 | -2.4 |
| Non-agriculture: | 8,452 | 39.9 | 6,532 | 36.6 | 29.4 |
| Cottage industry | 2,404 | 11.3 | 587 | 3.3 | 30.9 |
| Trade | 1,921 | 9.1 | 1,109 | 6.2 | 73.2 |
| Services | 3,801 | 18.0 | 4,468 | 25.0 | -14.9 |
| Non-agricultural wage | 326 | 1.5 | 368 | 2.1 | -11.4 |
| Total Household Income | 21,173 | 100.0 | 17,866 | 100.0 | 18.5 |
| Family Size | 6.46 | - | 6.02 | - | 6.6 |
| Per Capita Income | 3,278 | - | 2,968 | - | 10.4 |

but has a negative impact on agricultural wage. One explanation for the negative income effect on agricultural wage may be that since manual labor (for others) is considered socially degrading, some of the middle-sized farmers, who used to participate in the agricultural labor market when their income was low, withdrew from wage-earning activities when their own production increased due to the project.1/ The increase in cultivation and cropping intensity

1/ This is support ed by labor utilization 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 III).

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 wage together is about 27 percent higher for the project group compared to the control. Similarly, income from the cottage industry and trade is about 1.5 times higher for the project group.

It has been illustrated in Table 2.7 that the control group earns significantly more income from non-crop activities such as kitchen gardening, livestock and poultry raising, and fishing than the project group. These are generally less land-intensive activities, with low productivity of labor. It appears that at low levels of income, people tend to work more in this type of activity in order to supplement their meagre income from land; but with the increase in land productivity, such low productive labor is substituted with leisure. So, the effect of FFW on total household income is less than the direct effect on crop production.

Table 2.8 reports the impact on crop production income by type of FFW project. As mentioned in the section on methodology, there is no significant difference in household land endowment between the project and control group as a whole for all projects taken together, but the difference is significant for individual projects. So, in assessing the impact at the project level, it is necessary to dissociate the effects of the varying land endownments of the project and control groups. This has been done by expressing the value of crop production per acre of land. The crop production income reported in Table 2.8 includes wage income from this activity. The income effect is found

Table 2.8--Impact of FFW on Income from Crop Production by Project Type

| Type of Project | Income from Crop Production per Acre of Land | | |
|---|---|---|---|
| | Project Area | Control Area (Taka) | Percent Difference |
| Irrigation-cum-drainage channel | 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 |

to be positive for irrigation-cum-drainage channels, field channels for irrigation, and coastal embankment projects, but for the two flood embankment projects the crop production income is, in fact, higher for the control area. The negative income effect for the flash flood protection project, as mentioned earlier, may be due to inadequate maintenance of the embankment as well as problems with selection of the control area. If this project is excluded, the crop production income per acre of land is about 26 percent higher for the project group compared to the control.

Owing to the problem of comparability between the project and the control, a more acceptable method of assessing the impact of FFW on income may be fitting a regression model, relating income to its main determinants, and incorporating FFW as a separate explanatory

variable. We have also done this by hypothesizing that income from crop production (YA) would depend on the amount of land owned by the household (Lo), the amount of land rented ($L_R$), the number of family workers engaged in agriculture (W), and the value of non-land fixed assets, i.e., agricultural implements and draft power (K). Two dummy variables have been used to incorporate the impact of the economic infrastructures created by the FFW Program (P) and of the general infrastructure, i.e., access of the area to roads, markets, service centres, etc. (I). The results are reported in Table 2.9. 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 the general infrastructure shift the income curve upwards.

The value of the regression coefficients indicate that one acre of owned land on the margin contributes about Tk 2200 to household income, and one worker on the margin earns about Tk 1500 per annum in crop production activity. The marginal contribution of rented land is only about one fourth of that of owned land. This is understandable, in view of the exploitative conditions of sharecropping -- that the tenant has to bear all costs of inputs and share half of the gross produce with the landowner. So the tenant earns very little from the rented land over and above what he gets for his labor from

self-employment on the rented land. Our data do not show any significant relationship between crop production and the value of non-land agricultural fixed assets.

Table 2.9--Impact of FFW on Income from Crop Production: Regression Estimates

| Variables | Unit | Equation 1 | Equation 2 |
|---|---|---|---|
| Constant | (Taka per household) | 2,945 | 668 |
| Lo | (Acres) | 2,146<br>(14.8) | 2,173<br>(15.3) |
| $L_R$ | (Acres) | 577<br>(1.92) | 631<br>(2.12) |
| W | (Persons) | 1,399<br>(4.60) | 1,497<br>(4.94) |
| K | (Taka) | -.007<br>(-.13) | -.018<br>(-.34) |
| P | (Project=1)<br>(Control=0) | | 2,754<br>(3.76) |
| I | (Developed infrastructure = 1) | | 1,150<br>(1.53) |
| $\bar{R}^2$ | | 0.47 | 0.49 |
| F | | 82 | 59 |

Note: Values within parentheses are estimated 't' values.

With all other factors constant, the project group has about Tk 2754 higher income than the control, while the area with developed general infrastructure has about Tk 1150 more income than the area with less developed infrastructure. At the mean values of the explanatory variables, the estimated equation (2) in Table 2.9 gives

an income of Tk 2558 per household in an area without project and infrastructure. The net contribution of the project is thus estimated at about 32 percent and that of infrastructure at 13 percent.

For total household income, the following relationship is obtained:

$$Y = 1346 + \underset{(1.26)}{4472P} + \underset{(0.92)}{3342I} + \underset{(5.91)}{3184Lo} + \underset{(.08)}{120L_R} + \underset{(3.72)}{4144W}$$

$$+ \underset{(2.89)}{0.47K} \quad R^{-2} = 0.18 \quad F = 14$$

The definition of the variables are as before, except that K and W include capital and workers employed in non-farm activities, and Lo includes land used for homestead and other purposes (ponds, orchards, etc.). The figures within brackets 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 the coefficient indicates that Tk 100 worth of capital stock earns Tk 47 on the margin, implying a rate of return of 47 percent. The marginal contribution of a worker to total household income is Tk 4144; the contribution to crop production income estimated before (Tk 1497) is only about 36 percent of that value.

The coefficient of the project, Dummy P, indicates that household income in the project area is Tk 4472 higher than the control. Recalling that the direct effect of FFW is to increase crop production income by Tk 2754, one may conclude that the secondary effect on other sectors generates additional income of Tk 1718 per household, i.e.,

about 62 percent of the direct effect. The secondary effect appears to be higher in areas with developed infrastructures. Total household income is higher by Tk 3342 in the infrastructurally developed area, while the income from crop production was higher only by Tk 1150. Thus, the secondary effect appears to be Tk 2192, about 1.9 times the direct effect. The relationship between the project and the infrastructure dummy with the total household income is, however, considerably weaker than the relationship with the crop production income, as indicated by the estimated 't' values.

At the mean values of the variables for Lo, $L_R$, W and K for the entire sample, the household incomes estimated from the equation parameters are reported in Table 2.10 for samples in different types of areas.

It appears from the figures that the project increases income by about 23 percent in areas lacking infrastructural facilities and by about 39 percent in relatively more (infrastructurally) developed areas.

Table 2.10--Effect of Project and Infrastructure on Income

| Area Characteristics | Crop Production in Income per Annum | Total Income per Annum |
|---|---|---|
| | (Tk per household) | |
| Without project and infrastructure | 8,558 | 19,869 |
| With project but without infrastructure | 11,312 | 24,341 |
| With project and with infrastructure | 12,462 | 27,683 |

## III. LABOR MARKET AND EMPLOYMENT EFFECTS

3.1 Knowledge of the operation of rural labor markets is necessary for policies and programs, such as FFW, which are designed to increase employment and income, particularly for the landless. But very little is known about the functioning of the rural labor market in Bangladesh. Since the investigators of this study remained in the selected villages for a period of 14 months, it provided an opportunity to closely observe the pattern of rural employment. Information on labor use was collected for all working members of the sample households who participated in productive work for each day of the week preceding the interview. This was repeated for eight weeks covering the peak, average and slack seasons of economic activity spread over the year 1982. The extent of employment for the whole year and its composition has been estimated by extrapolating from data for these eight weeks.

3.2 Participation in Economic Activities. The labor force participation rate, as defined in the population census of Bangladesh (10 years and over), is estimated from the survey at 28.7 percent of the total population and 42.7 percent of the population in the active age group. The main factor behind the low participation rate is the marginal involvement of women in productive work. Only 10.7 percent of the females in the active age group is employed in productive work[1/] compared to about 75 percent for the males.

1/ The definition of productive work is biased by field work and directly remunerative self-employment. Since women work largely as unpaid household workers, their activities have largely gone unreported.

The socio-economic position of the household has a strong influence on the extent of its members' participation in productive work. The supply of workers decreases monotonically with increases in the size of land ownership, slowly up to the 5.0 acre level, and then rapidly above 5.0 acres. The participation rate is 30.7 percent for population in households owning up to 0.5 acres of land compared to only 20.8 percent for households owning more than 7.5 acres. This differential rate of participation is not due to the difference in the age structure of the population. Presumably, the very poor households use as many workers as possible to earn a subsistence income for the family; as income levels increase households withdraw some members, such as women and children, since female participation outside the home is not socially acceptable, and the children are sent to school.

3.3 Effect of FFW on Participation Rates. The project households have a lower participation rate than the control. The difference is mainly due to the involvement of children and women in productive activities, which is found to be lower in the project areas. The proportion of males in the age group '10 and over' participating in economic activities is estimated at 72.8 percent for the 'project group' of households compared to 78.3 percent for the 'control group.' For the female population, the rate is 9.9 percent and 11.3 percent respectively in the project and control group. This apparently negative impact of FFW on the 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.

3.4 Occupational Distribution of Workers. About two-thirds of the rural workers are employed in agriculture, one half being self-employed on family farms. Laborers employed on others' farms or businesses constitute only one-sixth of all rural workers, and about one-fourth of agricultural workers. Nearly 45 percent of the rural workers are employed in various non-agricultural rural activities at some time or other during the year. A large proportion of workers are engaged in more than one occupation -- 37 percent among the agricultural workers and 25 percent among the non-agricultural workers. The incidence of multiple occupa tions, however, is higher among activities within sectors than between agriculture and non-agriculture.

3.5 Extent of Employment and Unemployment. The average worker is employed for 284 standard days (eight-hour) during a year. About 63 percent of the employment is generated in agricultural occupations and 37 percent in non-agriculture. Agriculture provides employment for 178 days a year, 142 days in crop production and 36 days in non-crop activities. Only a fourth of the total employment generated in crop production activities goes to hired agricultural workers.

Nearly 76 percent of the workers had some employment for all seven days a week for the eight weeks of survey, and about nine percent remained fully employed during the week. If we include only workers who were available for work during the week of the survey, about 74 percent remain fully employed, 10 percent fully unemployed, and 11 percent employed for one to five days. Thus, if six days of employment is considered as full employment, 21 percent of the workers remain fully or partly unemployed. If we relate the duration of

employment measured in standard eight-hour days to the number of days a worker was available for employment during 1982, the average time rate of unemployment is estimated at 18 percent.

3.6 Socio-economic Factors Affecting Employment. The size of landholding of a worker's family has a negative effect on the extent of employment. The number of days of employment in 1982 is estimated at 296 days for the landless and near-landless, 277 for the small farmers, and 269 days for the medium farmers. It is higher (280 days), however, for the large landholding group mainly because of a larger employment period generated by non-agricultural activities in these households.

Employment generated in crop production activities is obviously positively related to the size of landholding; 80 days for the landless and near landless (mostly hired employment) compared to 180 days for the large landholding group (entirely self-employment). Unable to find enough employment from the land, the landless and small farmers look for non-crop and non-agricultural jobs much more frequently than the large landholding groups. The duration of employment in non-agricultural activities is about 1.5 times higher for the landless households compared to large landholdings; for non-crop agricultural activities it is 45 percent higher. Employment in trading, however, produces a 'U' shaped curve when related to the size of landholding.

The education level of a worker has a negative influence on employment in agriculture -- employment is about 1.8 times greater for the illiterate than the college graduates. The extent of employment generated in non-agricultural activities is, however, found

to be positively related with the level of education of the worker. In the non-farm sector, the highly educated are employed mainly in services and trading activities, while the illiterate are employed more in construction, cottage industries, earthwork and miscellaneous occupations. The total number of days worked is the highest for those who attended only primary schools (higher than the illiterate), but declines gradually with higher levels of education. The relatively better employment situation of workers with primary-level education compared to the illiterate group can be explained by the former getting more agricultural employment due to having a larger landholding; they also have better access to non-agricultural petty trades, which require functional literacy. However, the two groups to not differ much regarding their attitude towards agricultural work.

A significant difference in the extent and composition of employment is also found among different age groups. The adults (25-54 age group) have the highest number of days of employment (299 days per annum) while the older age group (55 and over) has the lowest (235 days). The child worker (up to 15 years), compared to other age groups, has a significantly larger proportion of employment generated by non-crop agricultural activities (livestock and fishing). The younger adult group (16-24) participates more in agriculture, construction, and other hired work.

About 70 percent of the female workers come from 1 acre households and 96 percent of them are illiterate. Thus it is mostly subsistence pressure which drives women to join the labor force. Female workers receive on average 40 percent less employment than males.

About 88 percent of female employment is generated in the non-agricultural sector, primarily in cottage industries and services.

Table 3.1--Impact of FFW Program on Employment

| Type of Employment | Number of Standard Mandays Employed Yearly | | Difference in Project over Control (percent) | Estimated 't' Values |
|---|---|---|---|---|
| | Project Group | Control Group | | |
| Self employment in crop production | 102 | 96 | 6.3 | 1.7* |
| Wage employment in crop production | 37 | 39 | -5.1 | -0.9 |
| Self employment in agriculture | 132 | 141 | -6.4 | -1.7** |
| Wage employment in agriculture | 38 | 41 | -7.3 | -1.3 |
| Self employment in non-agriculture | 49 | 61 | -19.7 | -4.3 |
| Wage employment in non-agriculture | 64 | 48 | 33.3 | 5.3* |
| Agriculture | 170 | 182 | -6.6 | -3.2* |
| Non-agriculture | 112 | 108 | 3.7 | 1.2 |
| (Trade, industry construction & earthwork) | (83) | (68) | (22.1) | (8.6*) |
| Self employment | 181 | 202 | -10.4 | -5.5* |
| Wage employment | 101 | 89 | 13.5 | 3.5* |
| Employment in activities affected by FFW Program | 222 | 203 | 9.4 | Not tested |
| Total employment | 282 | 290 | -2.8 | -2.5 |

Notes: * Denotes that "t" value is statistically significant at less than 5 percent error.
** Significant at less than 10 percent level.

3.7 The Employment Effect of FFW. The total number of days of employment generated for the 'project' and the 'control' group of workers and the statistical significance of the difference is shown in Table 3.1. The project group has three percent less employment compared to the control. But the higher employment for the control group is mainly due to higher self-employment in such low productive jobs as fishing and other self-services which may not be related to FFW. The impact of FFW on employment in crop production, which is directly affected by such work, and in trade 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 workers than the control. It is about six percent higher in crop production and 22 percent higher in non-farm activities. This implies that FFW has a positive impact on employment.

It has been reported earlier that employment in crop production is positively related to the size of landholding, and that the average size of landholding is larger for the control group than the project. A simple comparison of the extent of employment in crop production between the project and control groups would thus understate the true impact of FFW, because it does not dissociate the negative effect of the difference in the size of landholding between the groups. This bias can be corrected by estimating employment in crop production per worker per acre of land and comparing these figures between the project and control groups. When this is done, the employment effect of

FFW is found to be positive for the field channel and the drainage-cum-irrigation canal projects, insignificant for coastal embankment, and negative for flood protection embankment projects. For all types of projects taken together, the 'project' group has about 47 percent higher employment compared to the 'control.'

3.8 The Impact of General Infrastructure. The total number of days worked per laborer is also significantly higher in areas with better access to markets and financial institutions (general infrastructure) compared to areas where these facilities are underdeveloped. The positive impact of the general infrastructural facilities is more pronounced in non-agricultural activities than in agriculture, and for hired employment than for self-employment. Also, the positive effect of FFW on employment in crop production and non-crop activities is found to be higher in areas with developed infrastructural facilities than in areas lacking them. Presumably, with increases in income following the FFW Program, the workers have a tendency to substitute low productive self-employment for leisure, but in areas with developed infrastructural facilities, better opportunities for relatively high productive nonagricultural employment, and more modern amenities, leisure becomes relatively more costly.

The independent effect of the FFW Program and of general infrastructure on employment has been estimated through an analysis of variance such that the effect of the important socio-economic variables are dissociated. The results are presented in Table 3.2. It can be seen that the variables representing the size of landholding, education and FFW project, which are generally positively

associated with income, all have a negative effect on the extent of employment, indicating substitution of work with leisure at higher levels of income. The impact of FFW on employment is positive only for crop production activity in both infrastructurally developed and underdeveloped areas, but it induces more employment in non-agricultural activities only in areas with developed infrastructural facilities.

Table 3.2--Effect of Different Factors on Employment: The Result of the Analysis of Variance

| Variables | Employment in Crop Production | | Employment in Non-agriculture | |
|---|---|---|---|---|
| | Effect | 'F' Value | Effect | 'F' Value |
| Size of Landholding | Positive | 135.4* | Negative | 182.6* |
| Age | Positive | 44.0* | Positive | 54.0* |
| Education | Negative | 40.2* | Positive | 55.8* |
| General Infrastructure a/ | Positive (4.1) | 2.2 | Positive (9.3) | 3.0** |
| Food-for-Work a/ Project | Positive (4.1) | 2.1 | No effect | 0.04 |

Notes:

a/ Figures within parenthesis are percent differences in average values for the two groups (between project and control and between developed and underdeveloped infrastructure) after adjusting for the effect of other variables.

* Denotes that the 'F' value is statistically significant at less than 5 percent error.

** Denotes significant at less than 10 percent level.

3.9 The Effect of FFW on Employment Seasonality. Bangladesh agriculture is characterized by a high seasonal pattern in the demand for labor. The estimates of weekly employment for the eight rounds of the survey give a coefficient of variation of 25 to 46 percent separately for the five areas under study, but 19 percent for all the areas taken together. This is because the peak season and slack seasons in one area do not always coincide with other areas. This pattern of seasonality implies that labor under-employment could be reduced through temporary seasonal migration of workers. Generally, February to April and September to November are the slack periods of agricultural employment, while December, January, May and August are the peak periods.

The findings also show an inverse relationship between employment in non-crop and non-agricultural activities and employment in crop production across the seasons. For the eight observations, the correlation coefficient of employment in crop production works out to to be -0.49 with employment in non-crop agricultural activities and -0.57 with employment in non-agricultural activities. Thus, the peak periods of employment in non-farm activities generally coincide with slack seasons of farm employment, which has a smoothing out effect on the fluctuations in overall rural employment. The coefficient of variation in total employment is only 6.2 percent compared to 19 percent for employment in crop production, 17 percent for non-crop agricultural activities and 11 percent for non-agricultural activities.

From the point of view of policy making, it may be more useful to know the seasonal patterns of wage employment than of total employment,

because: 1) the wage labor is mostly provided by the landless and near-landless and 2) the policy interventions such as FFW aim at augmenting the income of the poor through generation of wage employment. The survey finds the fluctuation in agricultural wage employment to be quite large -- the seasonal index varies from 60 in October to about 126 in May. February-April is also one of the slack periods for wage-employment, but due to the high demand for non-agricultural wage employment, this is one of the peak periods for total wage employment.

The FFW Program generates wage employment during the February-May period, which is one of the slack seasons for agricultural activities, particularly in areas with a low proportion of land under HYVs. Hence it directly contributes to reducing the seasonal fluctuations in employment for the landless and near-landless. The FFW Program also indirectly contributes to reducing seasonal fluctuations 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 for the project group of workers compared to the control group. But the coefficient of variation in employment for the project group is similar to the control 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 from pulses or early maturing varieties of local Aman. This points to the need for a greater emphasis on FFW projects starting in October, as soon as the monsson water recedes.

# IV. IMPACTS ON HOUSEHOLD CAPITAL FORMATION AND CONSUMPTION EXPENDITURES

The main objective of this part of the study was to measure the impact of FFW projects and general infrastructure on the level and pattern of rural private investment and consumption expenditures. In doing so, a structural picture of capital formation in rural households of Bangladesh can be obtained. Such a study has never been conducted on such a comprehensive scale. A summary of the main results of this analysis is presensted below.

4.1 Income and Investment Levels. Average household disposable income in the study area, comprising 16 villages in various parts of the country,was TK 2932 per capita (equivalent to $118) in 1982 (Table 4.1). The difference between gross and disposable income indicated an average rate of direct taxation of only 0.2 percent of income. There was no significant difference in the rate of direct taxation between project and control or infrastructurally developed and underdeveloped villages. Average income per household in project villages was 10 percent higher than control villages. Similarly, average household income in villages with developed infrastructures was 11 percent higher than in villages with underdeveloped infrastructure.

Average rate of gross investment (as a percentage of disposable income) was 6.06 percent (Table 4.2). The corresponding rate of net investment was 4.9 percent. The average rates of investment were significantly higher, surprisingly, in villages with underdeveloped than with developed infrastructures. Comparing project with

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

| Village Type | Average Total Income (TK/Household) | Average Total Income Total Income Per Capita (TK) | Average Disposal Income (TK/Household) | Average Disposal Income Per capita Disposible Income (TK) | Rate of Taxation (percent) |
|---|---|---|---|---|---|
| 1. All Villages | 18513 | 2939 | 18473 | 2932 | 0.22 |
| 2. Project Villages | 19662 | 3025 | 19621 | 3019 | 0.21 |
| 3. Control Villages | 17131 | 2808 | 17095 | 2803 | 0.21 |
| 4. Developed Infra-structure | 19758 | 2994 | 19715 | 2987 | 0.22 |
| 5. Under-Developed Infrastructures | 17208 | 2868 | 17176 | 2863 | 0.19 |

Source: Estimated from survey data.

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

| Types | Gross Investment (TK/Household) | Rate of Gross Investment 1/ (%) | Net Investment (TK/Household) | Rate of Net Investment (%) | Replacement Investment as % of Gross |
|---|---|---|---|---|---|
| 1. All Villages | 1119 | 6.06 | 905 | 4.98 | 19.12 |
| 2. Project Villages | 1229 | 6.26 | 1118 | 5.7 | 9.03 |
| 3. Control Villages | 1016 | 5.94 | 680 | 3.98 | 33.07 |
| 4. Percent increase (+) or decrease (-) in project over control | 20.96* | 5.39* | 64.44** | 43.21 | -- |
| 5. Developed Infrastructure | 1095 | 5.56 | 892 | 4.52 | 18.53 |
| 6. Under-developed Infrastructure | 1138 | 6.62 | 914 | 5.32 | 19.68 |
| 7. Percent increase (+) or decrease in developed over under-developed | -3.78* | -16.01** | -2.4 | -15.04** | -- |

Note: Rate of investment is investment as a percent of disposable income. Net investment is defined as the investment excluding those of "replacement type expenditures."
* Significant at 5% level.
**Significant at 1% level.

Source: Estimated from survey data.

control villages, project villages were found to have a rate of gross investment 21 percent higher, and the difference in the rate of net investment was even more significant. It was clear that repair and maintenance investment expenditures were proportionally higher in control than project villages.

4.2 Determinants of the Level of Investment.

The analysis of averages clearly indicates the need for a multi-variate framework in assessing the effects of projects and general infrastructures on the rates of investment. Preliminary tabular analysis, as a backdrop to multi-variate regression exercises, showed a short initial decline but then a steadily increasing relationship between household income levels and investment rates (Table 4.3). In spite of some ambiguity in the definition of occupational classes, it was observed that households with trade and industries as the primary occupation had the highest average propensity of investment.

A multi-variate regression analysis provided quantitative measures of the non-linear relationships involved in explaining the variation in aggregate level of household investment. The relation between investment and disposable income is depicted by a curve which first declines with income and then rises from a point below the average level of income. The marginal propensity to invest at the mean value is about 0.12, and the elasticity of investment with respect to disposable income was estimated at about 1.50.

The relationship between gross investment and capital stock appears to demonstrate that investment tends to increase at a decreasing rate with increases in capital stock. After a point,

the relationship becomes negative. Contrary to the hypothesis that owned land provides an investment opportunity, the relationship between the size of owned land and the level of investment appears to be

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

| Income Classes (Tk. Per Cap.) | No. of House-Holds | Total Income (Tk. Per House-Hold) | Gross Investment (Tk. Per House-Hold | Rate of Investment (Percent of Income) |
|---|---|---|---|---|
| Up to Taka 500 | 1 | 3170 | 48 | 1.51 |
| 501 - 1000 | 4 | 9145 | 45 | 0.49 |
| 1001 - 1500 | 50 | 9150 | 88 | 0.96 |
| 1501 - 2000 | 99 | 12004 | 298 | 2.48 |
| 2001 - 2500 | 125 | 14308 | 441 | 3.08 |
| 2501 - 3000 | 94 | 17006 | 772 | 4.54 |
| 3001 - 5000 | 207 | 22581 | 1388 | 6.15 |
| 5001 - 10000 | 55 | 35409 | 5690 | 16.06 |
| Above 10,000 | 4 | 40260 | 23358 | 58.01 |

Sources: Estimated from survey data.

negative. The number of working members in the household appears to exert a positive influence on investment. Educational level of the household head does not appear to have any significant influence on aggregate gross investment.

4.3 The use of multiple regression analysis indicates that the effect of FFW projects on investment is reflected mainly through their indirect but positive income effects. This means the projects would have a 19 percent higher level of investment than the control villages. The indirect income effect is partly masked by other factors when a simple comparison of averages is made. However, besides their indirect but positive impact on investment through higher income, general infrastructures have a significant negative influence on the level of investment in rural households. An explanation for such a surprising result can be found, as indicated 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 manner, although the direction of the relation is positive. Credit represents about 4 to 5 percent of total income.

4.4 Pattern of Rural Investment. The pattern of rural investment reflects the nature of the investment portfolio and share of each individual item in the total investment budget (Tables 4.4, 4.5). For convenience of discussion, all investment items are classified under three broad categories: a) agriculture, b) non-agriculture, and c) overhead long-run investment. The average share of agriculture over all villages is about 50 percent of total gross investment. Non-agricultural investment accounts for about 11 percent and overhead long-run investment accounts for the remaining 39 percent. However, these shares change significantly when arranged by project and control

Table 4.4 --Pattern of Rural Investment, Sixteen Study Villages, Bangladesh 1982
(By Project and Control)

| Types of Investment | Level Tk./Household | Share (%) | Level Tk./Household | Share (%) | Level (Tk./Household) | Share (%) |
|---|---|---|---|---|---|---|
| 1. Land Development | 78 | 6.31 | 179 | 13.59 | 114 | 8.96 |
| 2. Agricultural Equipment & Energy | 422 | 34.36 | 517 | 39.29 | 472 | 37.16 |
| 3. Livestock (Poultry Goats, Milk Cows) | 27 | 2.19 | 43 | 3.30 | 29 | 2.31 |
| 4. Fisheries | 15 | 1.23 | 4 | 0.29 | 10 | 0.75 |
| 5. Plantations | 12 | 0.96 | 28 | 2.14 | 17 | 1.34 |
| Total Agriculture (1 + 2 +3 + 4 + 5) | 680 | 45.05 | 770 | 58.51 | 641 | 50.52 |
| 6. Transport | 44 | 3.59 | 16 | 1.23 | 29 | 2.31 |
| 7. Business & Trade | 87 | 7.10 | 129 | 9.77 | 101 | 7.96 |
| 8. Rural Industries | 1 | 0.08 | 5 | 0.39 | 4 | 0.30 |
| Total Non-Agriculture (6 + 7 + 8) | 132 | 10.78 | 150 | 11.39 | 134 | 10.56 |
| 9. Education | 22 | 1.75 | 13 | 0.97 | 18 | 1.42 |
| 10. Land Purchase | 170 | 13.85 | 68 | 5.18 | 134 | 10.52 |
| 11. Housing & Water Supplies | 170 | 13.85 | 176 | 13.33 | 176 | 13.90 |
| 12. Miscellaneous | 181 | 14.72 | 140 | 10.61 | 166 | 13.06 |
| Total Overhead and Long-Run Investment (9 + 10 + 11 + 12) | 543 | 44.17 | 396 | 30.09 | 495 | 39.00 |
| Total | 1229 | 100.00 | 1316 | 100.00 | 1269 | 100.0 |

Table 4.5--Pattern of Rural Investment, Sixteen Villages, Bangladesh, 1982
(By Levels of Infrastructures)

| Items | Average of Villages with Developed Infrastructures | | Average of Villages with Under-Developed Infrastructure | |
|---|---|---|---|---|
| | Level Tk./Household | Share (%) | Level Tk./Household | Share (%) |
| 1. Land Development | 93 | 8.48 | 136 | 9.46 |
| 2. Agricultural Equipment & Energy | 307 | 28.03 | 648 | 45.09 |
| 3. Livestock | 34 | 3.07 | 25 | 1.74 |
| 4. Fisheries | 3 | 0.24 | 17 | 1.18 |
| 5. Plantation | 10 | 0.89 | 25 | 1.81 |
| Total Agriculture (1 + 2 + 3 + 4 + 5) | 446 | 40.71 | 852 | 59.29 |
| 6. Transport | 25 | 2.26 | 33 | 2.30 |
| 7. Business & Trade | 167 | 15.27 | 78 | 5.43 |
| 8. Rural Industries | 5 | 0.48 | 1 | 0.07 |
| Total Non-Agricultural (6 + 7 + 8) | 197 | 18.01 | 112 | 7.79 |
| 9. Education | 16 | 1.45 | 19 | 1.32 |
| 10. Land Purchase | 112 | 10.19 | 155 | 10.79 |
| 11. Housing & Water Supply | 195 | 17.77 | 171 | 11.90 |
| 12. Miscellaneous | 130 | 11.87 | 128 | 8.91 |
| Total Overhead and Long-Run Investment (9 + 10 + 11 + 12) | 452 | 41.28 | 473 | 32.92 |
| Total | 1095 | 100.00 | 1437 | 100.00 |

Source: Estimated from survey data.

villages or by developed and underdeveloped infrastructure. About 60 percent of total investment in underdeveloped villages is allocated to agriculture, 8 percent to non-agriculture, and the remaining 32 percent to the overhead long-run category of investment. But in villages with developed infrastructure, the share of agriculture is only 40 percent, with the share of non-agriculture higher, at 18 percent, and the share of overhead long-run also higher, at about 41 percent of total investment. A similar comparison between project and control villages shows that control villages invest a higher share for agriculture than project villages (59 percent and 45 percent, respectively). For non-agricultural investment the share is 11 percent in project and 12 percent in control. The share of overhead long-run, however, appears to be substantially higher in the project compared to control villages (44 versus 30 percent). Only about one to two percent of gross investment is allocated to education in the study households.

4.5 Determinants of Investment Pattern.

What determines the allocation pattern of an investible fund among various investment activities? A multi-variate regression analysis was conducted to test a number of hypotheses relating shares of investment with rates of return from agriculture and non-agricultural investments, education, number of working members, ownership of land, location (i.e. project or control/developed or under-developed infrastructure), and credit. In explaining the share of investment to agriculture, the rate of return variable was found to be of little direct significant influence. Consistent with a general

belief that educated members in the household will carry their investments to non-farm activities, the education variable was found to have a negative influence on agricultural investment.

As the extent of owned land increases beyond about 4.5 acres, it exerts a negative impact on agricultural investment. The number of family members available for work appears to have a highly significant effect on the share of agricultural investment. Most FFW projects do appear to have a modest positive effect on the share of investment in agriculture. On the other hand, total credit obtained by households does not appear to have a signifcant influence on agricultural investment.

4.6 Even though project infrastructures did show promise in terms of agricultural investment but general infrastructural development did not, these community assets exhibited a tremendous edge in the use of modern agricultural current inputs compared to the control villages. Thus, expenditure on fertilizers and pesticides in project villages is 26.3 percent higher than that in control villages (Table 4.6). A comparison between villages with developed and underdeveloped infrastructures indicates that the former group spends about 33 percent more on fertilizers and pesticides than the latter. Regarding irrigation expenditures, project villages spend about 61 percent more than control villages, while villages with developed infrastructures spend about 66 percent more than those with underdeveloped infrastructures.

Table 4.6--Average Expenditure on Current Inputs in Agriculture

| Types (1) | Exp. on Fert. & Pesticides (TK/Acre) (2) | Exp. on Irrig. (TK/Acre) (3) | Total (2+3) (4) | Total Disposable Income/ Acre a/ (5) | Total Current Input Cost as % of Income (6) |
|---|---|---|---|---|---|
| All Villages | 142.50 | 114.14 | 256.64 | 8676 | 2.96 |
| Project Village | 156.77 | 136.88 | 293.65 | 9158 | 3.21 |
| Control Village | 124.17 | 84.93 | 209.10 | 8077 | 2.59 |
| Developed Infra-structure | 165.55 | 147.07 | 312.62 | 9820 | 3.18 |
| Under-developed Infrastructure | 124.69 | 88.69 | 213.38 | 7669 | 2.78 |

Note: 1/ Income per acre is obtained by dividing total disposable income by owned land.

4.7 The results of multiple regression analysis on the share of non-agricultural investment and the postulated explanatory factors appear to be the most significant among the three categories of investments. Levels of infrastructure and education and the rate of return factor appear to exert a significantly positive influence on the share of investment allocated to non-agriculture. The extent of owned land is also found to have a modestly significant and positive influence on non-agricultural investment. The positive relation between the rate of return from agriculture and non-agricultural investment appears to

be consistent with the negative relation between extent of land owned when more than five acres (i.e., large farms) and agricultural investment. These two results support the position that large farmers tend to allocate more of their investible fund to non-agricultural than agricultural investment.

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

4.9 Investment decisions in rural Bangladesh are conditioned by a complex set of forces. It appears that the interaction of agricultural and non-agricultural investment opportunities plays a significant role in determining the rate of agricultural investment. Non-agricultural opportunities provide a higher rate of return than agriculture (under the definition of rate of return used in the study). This is further reinforced by social norm, where educated people tend to work in non-agricultural activities and thus siphon the investible fund from agriculture to non-agriculture. Large and rich farmers have better opportunities to enter trade and business because of better educational status, access to capital, and larger family labor supply. Large and rich households generally provide flexibility in manpower for combining agricultural with non-agricultural activities. Medium-size farm households possess limited flexibility in this regard and therefore concentrate more intensively on agriculture than any other group. These phenomena are reflected in the non-linear relation of agricultural and non-agricultural investment with owned land, family

size, income and education.

The technology of production, particularly land preparation, planting, weeding and harvesting, is such that demand for agricultural investment in this traditional system either does not increase or increases only slightly as income increases. New rice technology, of course, enhances profitability and 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. Where divisible inputs like fertilizers are involved or the problem of lumpiness is mitigated by organizational modification, farmers do spend on these inputs at an increasing rate.

Villages in infrastructurally underdeveloped areas are found to invest proportionately more on agriculture compared to infrastructurally developed villages (Table 4.5). This results from a proportionately larger investment expenditure in underdeveloped villages on land development, agricultural equipment and energy. The creation and maintenance of these assets involves a substantial amount of labor, particularly family labor. Since the opportunity cost of family labor in underdeveloped villages is lower than in developed villages, such asset creation is faster and larger in underdeveloped than developed villages. On the other hand, the share of non-agricultural investment is larger in developed than underdeveloped villages. Thus, a substitution of non-agricultural investment for agricultural investment due to infra-structural development is indicated. However, with respect to the use of current inputs (fertilizer and pesticides) and

irrigation, developed villages show a very large level of expenditure compared to underdeveloped villages. A shift in technique of crop production, in terms of the mix of investment and current input use, appears to occur due to the difference in the degree of infrastructural development.

The effect of the FFW projects on capital formation at the household level (in addition to direct creation of community-level assets) is high. This impact is also attributable to the income effect of projects (via income-investment relations) rather than any complementary and direct project effect on household investment. The projects' design and implementation do not include any explicit provisions so that the use of the common assets is dependent on additional significant investment from the household. However, the projects do appear to positively influence the use of current inputs (fertilizers, pesticides and irrigation). Expenditures on these current inputs in project villages are substantially larger than those in control villages. The projects' effect on investment (as opposed to current inputs) may also be a reflection of substitution between private and public efforts. The field channel project is an example of this, where the scope of household investment was narrowed by a public undertaking in building field channels. Again, in the absence of this public undertaking there could have been a larger household investment on irrigation, but the total impact on production would have been much smaller and realized at a slower pace, had there been no public initiative in field channels. The fact that farmers in project villages allocate a smaller share of investment expenditure (6 percent) for land develop-

ment compared to a larger share (14 percent) in control villages supports the substitution hypothesis.

4.10 Effect of Consumption on Investment. When the opportunities for investment are generally limited and plenty of attractive consumer goods are available, infrastructural development can encourage consumption over investment. This is demonstrated through analysis of consumption expenditures.

The average rate of total consumption, defined as a proportion of disposable income, ranged from about 93 to 95 percent (Table 4.7). The difference in the average rates between project and control was only 0.3 points (i.e., 93.7 for project versus 94.0 for control). However, the difference between developed and underdeveloped infrastructures was quite sharp (i.e., 94.46 in developed and 93.35 in underdeveloped areas). A multi-variate regression analysis was conducted to measure the impact of project and infrastructures on aggregate consumption expenditures of households. The results suggest that, in addition to its effect through income, developed infrastructures exert other influences on household consumption behavior such that the propensity to consume non-cereal foods and non-foods tends to be substantially higher in villages with developed compared to underdeveloped infrastructures.

Analysis at further disaggregated levels revealed a number of interesting facts. About 77 percent of the total consumption budget is spent on food (i.e., agricultural products) and 23 percent on non-food (i.e., non-agricultural products) (Table 4.7). The marginal

Table 4.7-- Average Levels and Rates of Consumption Expenditure, Study Villages, 1982

| Types | Food | Non-Food (TK/Household) | Total | Total Consumption as a Proportion of Disposal Income (%) | Per Capita Consumption Expenditure (TK) |
|---|---|---|---|---|---|
| 1. All Villages | 13113 | 4242 | 17355 | 93.95 | 2755 |
| 2. Project Village | 13929 | 4456 | 18385 | 93.70 | 2786 |
| 3. Control Villages | 12093 | 3976 | 16069 | 94.0 | 2634 |
| 4. Villages with developed infra-structure | 14011 | 4612 | 18623 | 94.46 | 2822 |
| 5. Villages with under-developed infrastructure | 12174 | 3860 | 16034 | 93.35 | 2672 |

Sources: Estimated from survey data.

budget share of food is 68 percent and the elasticity of food expenditure with respect to total expenditure (or income) is 0.89. On the other hand, non-food expenditures are highly elastic (Table 4.8). The average and marginal propensities of consumption are not much different between project and control villages, with a few exceptions. However, there are substantial differences in propensities of consumption between villages with developed and underdeveloped infrastructures (Table 4.9). The respective average and marginal budget shares for cereals are 47.17 and 35.42 percent in developed compared to 52.24 and 40.78 percent in underdeveloped villages. However, average and marginal budget shares for non-cereal foods are 16 to 17 percent higher in developed than underdeveloped villages. The differences in budget shares between developed and 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 on these items in developed villages exceeded the underdeveloped villages by 25 to 50 percent.

4.11 Infrastructure and Rural Transformation.

Rural infrastructure is an important element of the process of rural development. A number of attributes related to transition in the rural economy were examined in terms of infrastructural development. The impact of rural infrastructure on the monetization of rural economy and development of rural financial markets is reported here.

Twenty-five percent of all investment expenditures consist of non-monetized asset formation involving family labor and home-produced

Table 4.8--Consumption Behavior of Households in Sixteen Study Villages, 1982

| | FOOD | | |
|---|---|---|---|
| Items of Consumption | Average Budget Share | Marginal Budget Share | Expenditure Elasticity |
| 1. Total Food | 0.765 | 0.677 | 0.89 |
| 2. Cereals | 0.505 | 0.391 | 0.77 |
| 3. Rootcrops | 0.015 | 0.008 | 0.49 |
| 4. Sugar | 0.019 | 0.027 | 1.47 |
| 5. Spices | 0.033 | 0.028 | 0.85 |
| 6. Tobacco, etc. | 0.030 | 0.033 | 1.10 |
| 7. Fish & 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 4.8 (continued)--Average Consumption Behavior of Households in Sixteen Study Villages, 1982

| NON-FOOD | | | |
|---|---|---|---|
| Items of Consumption | Average Budget Share | Marginal Budget Share | Expenditure Elasticity |
| 13. Fuels | 0.107 | 0.065 | 0.61 |
| 14. Soaps, Soda, etc. | 0.009 | 0.020 | 2.27 |
| 15. Clothes & Shoes (Domestic, Cottage Industries products) | 0.038 | 0.052 | 1.38 |
| 16. Clothes & Shoes (Domestic Mill Products) | 0.014 | 0.031 | 2.24 |
| 17. Clothes & Shoes (Domestic Products 15 + 16) | 0.052 | 0.084 | 1.62 |
| 18. Clothes (Foreign Products) | 0.009 | 0.020 | 2.32 |
| 19. All Clothes & Shoes (17 + 18) | 0.061 | 0.104 | 1.72 |
| 20. Household Durables (Domestic Cottage Industries Products) | 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 & Religious Ceremonies | 0.014 | 0.041 | 2.89 |

Note: Due to rounding at nearest decimal points, some additive and multiplication conditions may appear to be not fulfilled.

Source: Estimated from survey data.

Table 4.9--Difference in Budget Shares between Villages with Developed and Underdeveloped Infrastructures

| Commodities | Developed | | Under-Developed | | Percent Difference[1/] (%) | |
|---|---|---|---|---|---|---|
| | Average Share | Marginal Share | Average Share | Marginal Share | Average | Marginal |
| 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** | -13.14** |
| 3. Non-cereal Foods | 28.96 | 31.83 | 24.72 | 27.39 | 17.15** | 16.21** |
| 4. Fuels | 10.25 | 6.50 | 10.87 | 6.52 | -5.70* | -0.30 |
| 5. All Clothes & Shoes | 7.48 | 12.69 | 5.88 | 10.10 | 27.21** | 25.64** |
| 6. All Household Durables | 1.54 | 2.22 | 1.07 | 1.68 | 30.52** | 32.14* |
| Services | | | | | | |
| 7. Health Care & Personal Service | 2.37 | 3.30 | 2.31 | 2.60 | 2.60 | 26.92** |
| 8. Transport | 1.00 | 1.63 | 0.66 | 1.07 | 51.52** | 52.34** |
| 9. Social & Religious Services | 1.62 | 4.74 | 1.26 | 3.69 | 28.57** | 28.46** |

Note : 1/ The percent difference is calculated as follows:

$$\frac{\text{(Value in Developed)} - \text{(Value in Underdeveloped)}}{\text{(Value in Underdeveloped)}} \times 100$$

* = Significant at 95 percent level

** = Significant at 99 percent level

materials (Table 4.10). It appears that the extent of monetization in investment expenditure is significantly higher (a difference of 12 points) in infrastructurally developed than underdeveloped villages.

The proportion of monetized expenditure is about 53 percent of the total consumption expenditure in all villages (Table 4.11). However, in villages with developed infrastructure the extent of monetization in consumption is about 60 percent compared to only 48 percent in underdeveloped villages.

The extent of monetization in production costs in agriculture is about 40 percent on average in all villages. It is 50 percent in developed and 31 percent in underdeveloped villages (Table 4.12).

The rural credit market appears to be dominated by an informal credit system (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 have much influence on institutional credit. However, infrastructural development tends to reduce the incidence of traditional money lending and accelerate the informal lending and borrowing among trusted friends in business and trade.

Table 4.10--Extent of Monetization in Investment Portfolio, Sixteen Study Villages, Bangladesh, 1982

| Items | Total Investment Expenditure (Tk./Household) | Proportion of Monetized Investment (%) | Proportion of Non-Monetized Investment (%) |
|---|---|---|---|
| In All Villages | 1269 | 75.0 | 25.0 |
| In project villages | 1229 | 77.0 | 23.0 |
| In control villages | 1316 | 70.0 | 30.0 |
| In villages with developed infrastructure | 1095 | 80.0 | 20.0 |
| In villages with under-developed infrastructure | 1438 | 68.0 | 32.0 |

Source: Estimated from survey data.

Table 4.11--Extent of Monetization in Consumption Portfolio, Sixteen Villages, Bangladesh, 1982

| Items | Total Consumption Expenditure (Tk./Household) | Proportion of Monetized Expenditure (%) | Proportion of Non-Monetized Expenditure (%) |
|---|---|---|---|
| 1) In All Villages | | | |
| Food | 13266 | 46.92 | 53.08 |
| Non-Food | 4291 | 71.24 | 28.76 |
| Total | 17557 | 52.87 | 47.18 |
| 2. In Project Villages | | | |
| Food | 13965 | 45.97 | 54.03 |
| Non-Food | 4468 | 70.73 | 29.27 |
| Total | 18433 | 51.97 | 48.03 |
| 3. In Control Villages | | | |
| Food | 12372 | 48.33 | 51.67 |
| Non-Food | 4068 | 71.77 | 28.33 |
| Total | 16440 | 54.13 | 45.87 |
| 4. In Villages with Developed Infrastructure | | | |
| Food | 14041 | 55.02 | 44.98 |
| Non-Food | 4622 | 75.67 | 24.33 |
| Total | 18663 | 60.01 | 39.99 |
| 5. In Villages with Underdeveloped Infrastructure | | | |
| Food | 12494 | 41.00 | 59.00 |
| Non-Food | 3961 | 70.49 | 29.51 |
| Total | 16455 | 48.10 | 51.90 |

Source: Estimated.

Table 4.12--Extent of Monetization in Current Production Cost of Agriculture, 16 Villages, Bangladesh, 1982

| Items | 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 developed infrastructure | 50.10 | 49.10 |
| Villages with underdeveloped infrastructure | 31.02 | 68.98 |

Source: Estimated.

# V. ANALYSIS OF NUTRITION IMPACT

5.1 Design of Nutrition Analysis. The overall design of the nutrition analysis was similar to the design for the rest of the study in that the effects of both project type and surrounding infrastructure were considered in the selection of sites. A subsample of four sites involving two project types, both with and without developed infrastructure, was selected. The project types selected were canal irrigation and embankments against flash flooding. All the projects were to have been functionally completed (as opposed to structurally) two to three years prior to the study. Another element of the design was inclusion of nearby "comparable" sites without access to the immediate benefits of the project.

Since no baseline data existed for the situation prior to the project, an extension of the sample beyond the project in the cross-section was done to ensure that time-series events other than the project would be comparable and hence project effects would be possible to detect. However carefully the cross-section controls may be selected, intrinsic differences in pre-project characteristics of the sample should realistically be expected. These differences are corrected for as much as possible in the analysis.

5.2 Measurements. The additional information required for the nutrition analysis was obtained in three rounds of the survey yearly, in order to capture the effects of seasonality. They were conducted in April-May, September-October, and January-February to represent average-poor, poor, and average-good conditions, respectively. This

generally applied to the rural areas covered in the nutrition study sample. The survey was conducted for all households included in the general economic survey for the four project sites which were also included in the nutrition study.

Anthropometric measurements -- weight and height -- were taken in the first two rounds on all sample household members less than ten years old, and on all members in the third round. Age records and weaning status, which are necessary to interpret both anthropometric and dietary information, were recorded. Dietary intake was measured by a combination of 24 hour weightment and recall, with individual consumption being recorded. Health status was recorded by individual household member, using both lifetime episodes of major diseases and a six-month history of their duration and severity.

5.3 Results. The objective of this analysis is to investigate the following three questions:

1) What can be said about the underlying or baseline situation in the "project" and "comparable" sites prior to the completion of the projec?
2) What is the present situation with respect to the two main immediate determinants of nutritional status, viz. diet and disease, in the "project" and "comparable" sites, and the actual nutrition status as reflected by anthropometry?
3) What conclusions can be drawn about possible project impacts on the nutrition status of different segments of the population by income and landholding status?

5.4 Examining the Underlying or Baseline Situation.

Since the project effects, if any, would be evident for no more than 2-5 years, the characteristics that may not be expected to change during that space of time can be examined to detect any underlying differences in the study population. Of major concern is determining the basis for comparing "project" and "comparable" sites at the aggregate level. Of the characteristics measured in the nutrition survey, two sets were identified as too static to have altered significantly during the past 2-5 years. These are: 1) water supply and 2) prevalence of stunting, or percent of the population below the given cut-off line for height attainment.[1/]

5.5 Water Supply and Sanitation. The main observation that emerged from examining the situation is that a protected water supply is substantially more prevalent in the "non-project" sites (Table 5.1). This is indicated by the presence of a larger number of hand pumps (tubewells) in homesteads in the non-project area and could be a measure of its relative affluence over a long period of time. In project sites, however, there appears to be a higher proportion of the population with temporary (kuccha) toilet facilities as opposed to the non-project sites (Table 5.2). Though these are unlikely to significantly improve overall water quality, it could indicate either a

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1/This 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 approach adequacy during the growth years.

Table 5.1--Source of Drinking Water

| Source | Project Sites | Non-Project Sites |
|---|---|---|
| | (percent) | |
| Tap or tubewell | 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 | Non-Project Sites |
|---|---|---|
| | (percent) | |
| Permanent | 7.5 | 5.3 |
| Temporary | 52.8 | 37.8 |
| None | 39.7 | 56.9 |
| | 100.0 | 100.0 |

higher population density or a basic attempt to improve the sanitary conditions through relatively inexpensive means. Despite this, however, an overall poorer sanitary environment is evident in the project sites, and this is also reflected in the diarrheal disease pattern discussed later in this chapter.

5.6 Prevalence of Stunting. The prevalence of stunting in a population, which is generally defined as the proportion below 90 percent of a reference height-for-age,[1/] is useful for comparing the nutrition status of a population over longer periods of time (e.g., 10 years or more). Even though nutritional improvements during a 2-3 year period may increase the linear growth on average, the prevalence of stunting will not be substantially altered (except for the population just below 90 percent would could cross over with some improvement). The reference which is useful for indicating relatively shorter-run improvements in nutrition is weight-for-height. Weight-for-height can be altered even within a 3-6 month period, with improvements in dietary adequacy.

Prevalence of wasting, or caloric and other deprivations, in the shorter run is indicated by the proportion of a population below 80 percent of reference weight-for-height. Table 5.3 shows the relative prevalence of these indicators for all children between 6 months and 10 years of age for all three rounds of seasonal observations. Since

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1/This percent can be used as a cut-off point across all ages up to 10 years (as the Harvard-Iowa standards have been used), 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
(Combined Seasonal Observations)

| Nutrition Status | Project Sites | Non-Project Sites | Bangladesh** (1981-82) |
|---|---|---|---|
| | .....Percent of Observations ..... | | |
| Normal[1] | 37.4 | 34.3 | 29.0 |
| Wasting (only)[2] | 4.4 | 6.5 | 6.0 |
| Wasting (all) * | 13.6 | 19.0 | 16.0 |
| Stunting (only)[3] | 49.0 | 46.6 | 55.0 |
| Stunting (all) | 58.2 | 57.1 | 65.0 |
| Both Wasting and Stunting[4] * | 9.2 | 12.5 | 10.0 |
| Total Observations | 100.0 | 100.0 | |

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[1] Normal : WH $\geq$ 80 and HA $\geq$ 90
[2] Wasting : WH < 80 and HA $\geq$ 90
[3] Stunting : WH $\geq$ 80 and HA < 90
[4] Wasting and Stunting : WH < 80 and HA < 90

* Statistically significant difference between project and non-project sites at $P_o$ <0.05.

** Source: Kamaluddin Ahmad and Najmul Hassan, "Nutrition Survey of Rural Bangladesh, 1981-82," ADAB News, May-June 1984, Vol. XII, No. 2.

there is a possibility that the seasonality of income, employment, and consumption flows may change as a result of the projects, the best overall picture can result from pooling together the three rounds of nutritional status observations gives in the two areas.

It can be seen that the only indicator for which the project sites are worse off is the proportion of stunting. This would suggest that over a longer period of time the population in the project sites may have been worse off than in the non-project sites, but they are better off during the study period. This is consistent with the observations made of the water supply situation in the previous section.

Regarding wasting as well as stunting-cum-wasting measures, the project sites are significantly better than the non-project sites. This would suggest that for some reason project sites were better able to buffer the seasonal or other swings that may have resulted in weight-for-height reductions. This is confirmed by examining the individual survey rounds. In Round 2, when both diet and disease factors were generally unfavorable, the same statistically significant result were observed. This is interesting in light of results presented later, indicating a lower aggregate household consumption level 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 current situation during the study period and in the 3-6 preceding months, since this indicator reflects relatively current consumption levels.[1/]

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1/ The possible influence of mortality rates on this indicator is examined later.

## 5.7 Comparison of Food Consumption Results with Other Surveys.

A comparison of the food consumption patterns found in this survey with the National Survey of Bangladesh, 1981-82, shows roughly comparable results (Table 5.4). Also, a comparison of cereal consumption in Round 1 with that found in the short-run study during project construction shows a substantially higher consumption in the short run for FFW worker households of the smallest landholding groups (landless and below 0.5 acres (Table 5.5, Columns 1 and 3). These surveys, though not strictly comparable[1/] also suggest that:

1) non-project sites in the vicinity (5 miles) of FFW projects received a somewhat favorable consumption effect during project construction, possibly due to a lower increase in the rice price than that which usually occurs at this time[2/] (comparing Columns 2 and 5);

2) non-participants in FFW at project sites from smallholder groups (especially those holding less than one acre) have lower consumption patterns than similar households in non-project sites. This is consistent with the earlier indications that longer-term nutritional status appeared to be worse in the project relative to the non-project sites (comparing Columns 4 and 5); and

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1/ The short-run sample consisted only of households willing to work in FFW projects.

2/ See Raisuddin Ahmed "Structure and Extent of Marketable Surplus of Rice in Bangladesh", in ADAB News, Vol. IX, No. 1, January-February 1982.

Table 5.4 -- Food Consumption (Per Capita/Day)

| | Aggregate of 3 Survey Rounds | | 1981-82 |
|---|---|---|---|
| | Project | Non-Project | National Survey[1] |
| Cereals (g) | 503 | 465 | 488 |
| Roots (g) | 68 | 68 | 63 |
| Pulses (g) | 7 | 8 | 8 |
| Meat (g) | 4 | 5 | 5 |
| Fish (g) | 18 | 16 | 23 |
| Vegetables - Leafy (g) | 37 | 37 | 20 |
| Vegetables - Other (g) | 136 | 115 | 100 |
| Oils and Fats (g) | 4 | 4 | 3 |
| Milk and Products (g) | 25 | 16 | 15 |
| Calories | 2167 | 2012 | 1943 |
| Protein (g) | 58 | 54 | 48 |

[1] Source: N. Hassan and K. 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), pp. 143-158.

Table 5.5 -- Comparison with Cereal Consumption During Food-for-Work Implementation

| | Cereal Consumption (grams/cap/day) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (All Cereals) Round 1 (March-April 1982) | | | | (Rice and Wheat) Short-Run Survey (April 1982) | | | | | |
| | Project (1) | | Non-Project (2) | | $P_1$[1] (3) | | $P_2$[2] (4) | | Non-Project (5) | |
| Landless | (16) | 321 | (26) | 448 | (98) | 449 | (28) | 438 | (97) | 460 |
| <.5 | (15) | 446 | (19) | 401 | (35) | 521 | (13) | 489 | (34) | 536 |
| .5 - 1 | (27) | 527 | (13) | 525 | (17) | 526 | (12) | 500 | (36) | 546 |
| 1 - 1.5 | (19) | 465 | (25) | 465 | ( 9) | 516 | ( 5) | 476 | (24) | 487 |
| >1.5 | (73) | 550 | (68) | 466 | (19) | 463 | ( 9) | 591 | (24) | 552 |

[1] $P_1$ = Project site households with FFW employment
[2] $P_2$ = Project site households without FFW employment

(Figures in parentheses are sample sizes. The short-run impacts survey over-represents the smallholder groups as only FFW participants and comparable households were sampled).

3) short-run consumption effects, especially for the landless and near-landless households (less than 0.5 acres) are more favorable than the longer-run benefits from FFW projects. However, as seen later, the seasonality of consumption may also be influenced after projects are completed (comparing Columns 1, 3 and 4).

5.8 Summary of Results. The main conclusions based on analysis of the nutrition survey data are as follows:

1) The baseline nutrition situation in the project sites appears to have been slightly worse than in the comparable non-project sites that were selected. This is based on a higher prevalence of stunting versus wasting or stunting-cum-wasting found during the study and the poorer water supply situation in the project sites.

2) Current dietary intakes (Tables 5.6, 5.7) appear to be better for all age groups examined in the project sites relative to the non-project sites. This could be the result of changes introduced due to the project completion. However, an examination of disease incidence 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 project (Table 5.8). Further analysis is necessary regarding the patterns of investment in water supply and sanitation recently made in the study sites, those expected over the long run if project benefits are consistently available over time, and possible effects of projects on water-related infectious diseases.

Table 5.6 -- Calorie and Protein Intake by Round

| | 3-5 Years | | | | 5-7 Years | | | | 7-10 Years | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Calorie Intake | | Protein Intake | | Calorie Intake | | Protein Intake | | Calorie Intake | | Protein Intake | |
| | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project |
| Round 1 | | | | | | | | | | | | |
| Boys | 1247 | 1044 | 34.1 | 31.0 | 1552 | 1465 | 45.1 | 43.3 | 1896 | 1688 | 51.0 | 47.2 |
| Girls | 1338 | 1055 | 41.9 | 33.3 | 1150 | 1277 | 30.4 | 39.0 | 1543 | 1453 | 47.5 | 43.0 |
| Round 2 | | | | | | | | | | | | |
| Boys | 1116 | 1070 | 31.1 | 29.4 | 1534 | 1198 | 43.8 | 33.3 | 1727 | 1551 | 47.0 | 44.5 |
| Girls | 1094 | 969 | 30.5 | 28.3 | 1229 | 1090 | 35.6 | 30.2 | 1254 | 1333 | 34.9 | 38.4 |
| Round 3 | | | | | | | | | | | | |
| Boys | 1244 | 1025 | 34.0 | 24.8 | 1514 | 1428 | 42.7 | 38.0 | 2016 | 1566 | 52.8 | 39.1 |
| Girls | 1409 | 1090 | 33.7 | 28.5 | 1235 | 1264 | 31.5 | 33.3 | 1626 | 1417 | 42.2 | 35.6 |

Table 5.7 Calorie Requirements[1] Met

| | Percent of Calorie Requirements in Diet | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Age (Years) 3-5 | | 5-10 | | 10-14 | | 14-18 | |
| | Project Sites | Non-Project Sites | Project Sites | Non-Project Sites | Project Sites | Non-Project Sites | Project Sites | Non-Project Sites |
| **Round 1** | | | | | | | | |
| Boys | 103 (33) | 86 (38) | 115 (70) | 106 (93) | - | - | - | - |
| Girls | 111 (23) | 87 (35) | 93 (71) | 92 (68) | - | - | - | - |
| **Round 2** | | | | | | | | |
| 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: Figures in parentheses are number of individuals in the group.

[1] Calorie requirements for all age groups are based on 100 percent of weight for current height using FAO/WHO (1973) recommended allowances for a moderate activity level.

Table 5.8 Disease Episodes per Year for First 3 Years of Life[1]

GROUP 1 - (Project Sites)
GROUP 2 - (Non-Project Sites)

| Variable | | Number of cases | Mean | Standard Deviation | Standard Error | F Value | 2-tail Prob. | Pooled variance estimate T Value | Degrees of Freedom | 2-tail Prob. |
|---|---|---|---|---|---|---|---|---|---|---|
| EPI1 | Pneumonia, Measles, Chicken Pox) | | | | | | | | | |
| | GROUP 1 | 112 | 0.0408 | 0.341 | 0.032 | 1.07 | .715 | 0.08 | 242 | .939 |
| | GROUP 2 | 132 | 0.0374 | 0.352 | 0.031 | | | | | |
| EPI2 | (Gastric Disorders) | | | | | | | | | |
| | GROUP 1 | 112 | 0.3332 | 1.003 | 0.095 | 4.61 | 0.000 | 1.90 | 242 | .058 |
| | GROUP 2 | 132 | 0.1470 | 0.467 | 0.041 | | | | | |

[1]Lifetime episodes/age in months for all children ≤ 36 months of age at the time of the second round.

3) There are several nutritional implications of the first two sets of observations, which are partly borne out by considering the anthropometric measurements. For those children for whom diarrheal disease may play a more important role than diet, i.e. the youngest, especially the weaning age groups, nutritional status may not have sufficiently improved in project sites to make them better than non-project sites. However, for older children dietary improvements are likely to be more significant in terms of nutritional status than for younger siblings; and improvements in diet over the past 2-3 years in the project sites may even pull their nutritional status higher than those in non-project sites.

4) Anthropometric measurements, which were used to assess nutritional status, are only a partial indicator and can be influenced by changes in mortality rates, which in turn are influenced by mortality rates. This makes an understanding of anthropometric changes taking place quite difficult. However, since it is expected that any changes in nutrition were largely a result of changes in the diet, with the disease factor being relatively constant, anthropometric differences should provide a good indication of the changes taking place.[1/]

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1/ Any differential change in mortality would then be considered only a result of diet-induced nutritional changes, and the chance for error would be in a downward dietary trend where anthropometry may have a slight upward bias due to higher mortality.

5) Nutritional status measures suggest that in general there may have been an equalizing trend in the project sites for differences between boys and girls at various ages. Girls were significantly worse off on the whole in the younger age groups, while in the project sites they showed more improvement than boys. Conversely, in the 10-18 year age groups, boys were slightly worse off than girls as a whole, and for these ages boys 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 implications of the results are even more positive.

6) Levels of food consumption obtained in this survey are comparable with those from the national survey of 1981-82. However, a comparison of the cereal consumption figure with those obtained during project implementation suggests that short-run gains for small landholder groups may appear to be greater than the longer-run improvements, but the latter are available at different times of the year and over a long period of time. Moreover there is some indication that the baseline situation of project/control differences 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 over similar non-participants in project site villages was also observed.

7) While annual consumption is higher in the project sites, both in the aggregate and for all income (expenditure) deciles, there is a more pronounced seasonal fluctuation here than in the non-

project sites (Tables 5.9, 5.10). 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 appear to coincide with better harvests and higher non-agricultural employment at that time. Such has been the indication in the project sites.

Table 5.9 -- Annual Consumption in Kg. Per Capita Per Year

| Deciles | (Sample Size) | Cereals | | Roots | | Sugar | | Fish & Meat | | Fats | | Pulses | | Vegetables | | Milk | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project |
| I | (16, 16) | 137 | 138 | 132 | 211 | 32 | 37 | 46 * | 25 | 14 * | 8 | 9 | 13 | 457 | 361 | 25* | 3 |
| | | (34) | (121) | ( 62) | (357) | ( 25) | (38) | (30) | ( 19) | ( 5) | ( 2) | (11) | (15) | (191) | (174) | ( 31) | ( 8) |
| II | (16, 16) | 183* | 150 | 193* | 142 | 42 | 37 | 63 | 48 | 23 * | 11 | 29 * | 15 | 388 | 406 | 34 | 8 |
| | | (21) | ( 17) | ( 49) | ( 38) | ( 17) | (39) | (31) | ( 24) | ( 3) | ( 2) | (17) | ( 9) | (178) | ( 63) | ( 49) | ( 22) |
| III | (15, 16) | 187* | 159 | 246* | 138 | 64 | 43 | 79 * | 59 | 23 * | 14 | 27 | 33 | 456 | 386 | 35 | 49 |
| | | (24) | ( 21) | ( 61) | ( 51) | ( 44) | (28) | (27) | ( 19) | ( 8) | ( 5) | (17) | (47) | (144) | (133) | ( 39) | ( 68) |
| IV | (16, 16) | 218* | 174 | 244 * | 171 | 60 | 63 | 86 * | 59 | 29 * | 16 | 43 * | 23 | 441 | 524 | 61 | 45 |
| | | (22) | ( 23) | ( 56) | ( 61) | ( 27) | (49) | (33) | ( 21) | (13) | ( 3) | (15) | (19) | (145) | (136) | ( 63) | ( 78) |
| V | (16, 16) | 213* | 177 | 271 * | 188 | 72 | 81 | 90 | 76 | 27 * | 16 | 41 * | 20 | 559 | 492 | 49 | 43 |
| | | (43) | ( 27) | (107) | ( 61) | ( 38) | (58) | (44) | ( 22) | ( 6) | ( 3) | (22) | (18) | (295) | (143) | ( 48) | ( 68) |
| VI | (15, 16) | 233 * | 193 | 250 | 198 | 65 | 78 | 130 * | 88 | 35 * | 19 | 42 | 41 | 526 | 518 | 99* | 44 |
| | | (31) | ( 29) | ( 97) | ( 65) | ( 28) | (61) | (42) | ( 28) | (24) | ( 7) | (19) | (38) | (139) | (128) | ( 93) | ( 49) |
| VII | (16, 16) | 268 * | 222 | 271 | 240 | 104 | 87 | 152 * | 119 | 34 * | 24 | 41 | 33 | 609 | 534 | 92 | 141 |
| | | (56) | ( 46) | ( 60) | ( 80) | ( 64) | (59) | (59) | ( 29) | ( 9) | ( 7) | (27) | (24) | (245) | (145) | (103) | (134) |
| VIII | (16, 15) | 278 * | 217 | 387 * | 259 | 126 | 108 | 191 * | 135 | 38 | 29 | 45 | 62 | 702 | 636 | 122 | 101 |
| | | (97) | ( 46) | (131) | (109) | ( 46) | (64) | (40) | ( 37) | (15) | (12) | (41) | (61) | (236) | (283) | (126) | ( 83) |
| IX | (16, 16) | 289 | 250 | 384 * | 284 | 125 | 128 | 230 | 167 | 52 * | 34 | 61 | 58 | 666 | 704 | 135 | 134 |
| | | (66) | ( 55) | (148) | ( 74) | ( 51) | (85) | (91) | ( 92) | (30) | (13) | (29) | (52) | (261) | (314) | (125) | (131) |
| X | (16, 16) | 367 | 291 | 402 | 312 | 184 | 133 | 288 | 269 | 59 | 50 | 93 | 55 | 911 | 803 | 233 | 177 |
| | | (103) | (114) | (131) | (132) | (155) | (79) | (70) | (147) | (23) | (37) | (65) | (63) | (309) | (350) | (214) | (174) |
| ALL | (158, 159) | 237 | 197 | 278 | | 88 | 79 | 136 | 104 | 33 | 22 | 43 | 36 | 572 | 536 | 89 | 74 |
| | | (84) | ( 75) | (127) | | ( 75) | (66) | (90) | ( 90) | (20) | (18) | (36) | (42) | (264) | (242) | (118) | (109) |

Note: Figures in parentheses are SDs. * Statistically significant at $P_u<0.05$.

Table 5.10 -- Seasonal Food Consumption by Expenditure Decile

| Deciles | (Sample Size) | Annual Expenditure TK/Capita | | Round 1 (April-May) Total Calorie Daily Cons./Cap. | | Round 1 Total Protein G/Cap/Day | | Round 1 Cereal Quantity G/Cap/Day | | Round 2 (September-October) Total Calorie Daily Cons./Cap. | | Round 2 Total Protein G/Cap/Day | | Round 2 Cereal Quantity G/Cap/Day | | Round 3 (January-February) Total Calorie Daily Cons./Cap. | | Round 3 Total Protein G/Cap/Day | | Round 3 Cereal Quantity G/Cap/Day | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project | Project | Non-Project |
| I | (16, 16) | 1539 | 1128 | 1427 | 1446 | 36.1 | 41.7 | 335 | 356 | 1233 | 1391 | 33.1 | 38.4 | 288 | 347 | 1674 | 1389 | 38.3 | 34.4 | 383 | 351 |
| II | (16, 16) | 1988 | 1523 | 2341* | 1730 | 78.7* | 54.4 | 524 | 420 | 1798 | 1826 | 50.7 | 54.6 | 455 | 440 | 2259* | 1800 | 58.1* | 44.9 | 539* | 421 |
| III | (15, 16) | 2193 | 1746 | 1994 | 2037 | 55.4 | 63.1 | 428 | 465 | 1705 | 1880 | 48.0 | 51.1 | 406 | 453 | 1989 | 1745 | 50.8 | 41.6 | 495 | 415 |
| IV | (16, 16) | 2426 | 1931 | 1943 | 1872 | 52.9 | 56.3 | 458 | 438 | 1852 | 1867 | 54.1 | 52.2 | 443 | 447 | 2230 | 2005 | 58.5 | 53.0 | 512 | 472 |
| V | (16, 16) | 2646 | 2097 | 2004 | 1710 | 56.3 | 46.9 | 460 | 382 | 1942 | 1886 | 55.6 | 49.0 | 471 | 443 | 2229* | 1714 | 57.8* | 38.9 | 532* | 393 |
| VI | (15, 16) | 2931 | 2349 | 2068 | 2011 | 55.7 | 58.2 | 471 | 446 | 2035 | 1950 | 56.2 | 52.3 | 479 | 483 | 2167 | 2060 | 57.5 | 55.0 | 515 | 473 |
| VII | (16, 16) | 3425 | 2649 | 2223 | 2173 | 61.2 | 53.1 | 531 | 483 | 2233 | 2058 | 59.6 | 57.4 | 519 | 485 | 2431 | 2268 | 64.4 | 54.9 | 561 | 496 |
| VIII | (16, 15) | 3805 | 3045 | 2373 | 2385 | 66.6 | 67.8 | 527 | 533 | 2370 | 2273 | 67.6 | 60.0 | 557 | 520 | 2986 | 2525 | 73.8 | 65.1 | 601 | 539 |
| IX | (16, 16) | 4373 | 3459 | 2705 | 2418 | 67.1 | 67.8 | 642 | 551 | 2316 | 2463 | 57.6 | 63.0 | 544 | 578 | 2363 | 2434 | 62.7 | 61.7 | 552 | 504 |
| X | (16,16) | 5689 | 5432 | 2818 | 2333 | 73.7 | 62.7 | 630 | 499 | 2661 | 2441 | 70.6 | 59.9 | 593 | 549 | 2566 | 2344 | 63.2 | 58.8 | 517 | 563 |
| ALL | (158, 159) | 3103 | 2532 | 2192 | 2009 | 60.4 | 58.1 | 501 | 457 | 2015 | 2000 | 55.3 | 53.7 | 476 | 474 | 2294 | 2028 | 58.6 | 50.9 | 531 | 463 |

* Statistically significant at $P_0<0.05$.

## VI. POLICY IMPLICATIONS OF THE FINDINGS

6.1 The evidence presented in this summary and the technical papers clearly indicates that Food-for-Work projects, if properly selected, designed and implemented, generate a very substantial productive impact on village economies. Therefore, the program should not be considered only as a vehicle for short-run relief to the distressed and under-employed sectors of the rural population, but as means for construction of productive long-term rural infrastructures. The Food-for-Work Program should, therefore, be strengthened as a mechanism for rural development.

6.2 The developmental impact of a moderately well-implemented program (i.e, the program's impact on rural income, agricultural production, employment, household investment, nutrition and general conditions for the growth of rural economy) is in fact quite impressive. Agricultural production was found to have increased by an average of 27 percent and per capita household income by about 10 percent due to direct and indirect effects of the evaluated projects. Total impact on generation of employment, measured in terms of man years, was not significant but productive employment increased rather substantially. This means that more productive employment generated was substituted for very low-productivity employment among rural households. Thus there was a shift in the structure of rural employment. Wage employment increased by about 13 percent while selfemployment declined by about 10 percent. The other important, and perhaps the most important, aspect of this shift was the seasonal distribution of

employment. The program reduced seasonal fluctuations by creating more employment in traditional slack periods.

6.3 The FFW Program is primarily involved in creating land infrastructures (e.g. irrigation, flood control, embankments, etc.). The impact of these types of infrastructures is greatly strengthened when better agricultural technology and a more developed level of general infrastructures are simultaneously provided. The role of general infrastructures (e.g. transport and communication, market places, financial institutions, etc.) assumes particular importance in this regard. The fact that the project areas had an increase in non-agricultural employment of about 33 percent over the control villages is partly a reflection of the interaction between projects (i.e. land infrastructure) and general infrastructures. General infrastructures also contributed to an increased use of modern inputs in agriculture to a phenomenal extent. These results logically point to a policy directed at concentrating development of general infrastructures in areas where agricultural potential is largest. Therefore, such a redirection may be desirable in the context of accelerating growth in production. However, an imbalanced geographical concentration of general infrastructures may conflict with a goal of regional balance in income distribution and economic development.

6.4 Besides their positive impact on agricultural production and non-agricultural local employment, general infrastructures exert a vigorous influence on the demand for non-agricultural products and services among rural households. This holds potential for accelerating overall economic development if production of non-

agricultural products can respond to these demand stimuli. The inter-sectoral implications, along with the findings that general infrastructures generate a healthy trend in the evolution of product and factor markets (e.g. commercialization, financial institutions etc.), are sufficiently strong to support a higher priority to the development of rural roads and communication systems, using food-for-work and other public resources.

6.5 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. We evaluated only the successful ones, and our survey indicates that about one-third of all projects would meet the same standards of success as the projects we examined. 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.

6.6 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.

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, partic-ularly after the monsoon, is regularly done. Alternatively, capital-intensive hard structures can provide a number of years of useful service without regular repaire. 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.

6.7 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 Upazilla system provides an institutional solution, but Upazillas 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 Upazilla 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 Upazillas for a meaningful decentralization, Upazillas 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 Upazilla 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 taxation is also not 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 only around 40 to 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 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 Upazilla levels to perform the task, and (c) installing machinery for regular auditing of local government accounts and procedures.