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BANGLADESH

LAND AND WATER RESOURCES SECTOR STUDY

(in nine volumes)

VOLUME III

SECTOR ECONOMICS

CONTAINING:

Forward
Technical Report No. 3 - The Macroeconomic Framework
Technical Report No. 4 - The Land and Water Sector Sequencing Model
Technical Report No. 5 - The Special Problem of Employment in Agriculture
Technical Report No. 6 - Land Tenancy and Taxation

December 1, 1972

Asia Projects Department

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Note

"The Land and Water Resources Sector Study - Bangladesh" dated December 1, 1972 was prepared between May 1971 and the summer of 1972 under the general supervision of the Bank, by staff members of the Bank, and FAO, with substantial help from consultants. The UNDP and the Bank shared the cost of the consulting services. The study is made available on the understanding that it does not necessarily represent the official position of the Government of Bangladesh or of the Bank.

The study is based mostly on data collected prior to March 1971. Although some of the information contained in the study is out of date, the essence of it is valid and it should be useful to the Government of Bangladesh and to other countries, agencies, and institutions interested in the development of Bangladesh.

BANGLADESH

LAND AND WATER RESOURCES SECTOR STUDY

VOLUME III - SECTOR ECONOMICS

FOREWORD

i. This Volume has two main objectives: (a) to relate the land and water sector to overall economic development in a country where increased employment is an overriding national priority and (b) to suggest optimum sequential investment within the Sector. It presents a framework designed to guide investment decisions for the economy as a whole as well as for the land and water sector.

ii. Studies of the Bangladesh economy as a separate entity are scarce. Thus this Volume attempts to chart a vast and poorly explored territory. Much more work lies ahead. In particular, the economic implications of new trade and transport links with India have yet to be drawn. The response of Bangladesh and India to a deteriorating world market for jute could have an incalculable effect on the economic prospects of the entire region. Trade and aid patterns are still in a state of flux. Although the "needs" of the Bangladesh economy can be quantified in broad terms, there is still no firm basis to estimate the scale of foreign assistance which will, in fact, be forthcoming. For all these reasons, only broad orders of magnitude can be given for key coefficients and variables of the Bangladesh economic equation. By their very nature, the sectoral analyses are somewhat firmer, being based largely on physical and technological factors which have not changed since last year.

iii. Technical Report No. 3 gives insight into the key growth variables of the Bangladesh economy. The macroeconomic foundation for the entire Study is based on a prototype model prepared by Professor Robert Dorfman of Harvard University. The model relates employment and economic growth objectives for seven sectors of the Bangladesh economy. By specifying employment targets and labor productivities at five year intervals this model projects the overall investment-savings gap, per capita income, foreign aid and other sectoral and national income statistics.

iv. The Dorfman model was modified and extended for the purpose of sensitivity analyses. This extension model illustrates the methodology of the report. The data base for the models is fragile since it was difficult to obtain accurate statistics from the past; thus inferences have been drawn from international comparisons.

v. Technical Report No. 4, prepared by Stephen Allison, suggests a framework for systematic comparison of land and water development alternatives based on the division of Bangladesh into 58 land development units. Using the soil and land use data of the Soil Survey, estimates are made of potential land use at future stages of development. Costs and benefits associated with each suggested stage of development are estimated.

vi. Technical Report No. 5, prepared by Professor John Mellor of Cornell University, presents tentative proposals for absorbing a substantial proportion of increments to the labor force in productive activity. The report confirms that intensification of foodgrains production has a key role to play for increasing productive employment opportunities. The report also highlights the urgency of expanding the industrial base so that it may absorb a higher proportion of the labor force as the capacity to expand agricultural employment drops against the constraints of an inelastic land base. Finally, the report touches upon the priority of rural works on employment as well as sector development grounds.

vii. Technical Report No. 6 prepared by R. Zaman presents suggestions for generation of increased resources in the agricultural sector of Bangladesh through land redistribution and reform of the land tax system. Proposals are made for investment of resultant increased resources in a large public works program which would facilitate long term agricultural development projects without necessitating reduction in investment in other sectors.

BANGLADESH - SECTOR STUDY

VOLUME III - SECTOR ECONOMICS

TECHNICAL REPORT NO. 3: THE MACROECONOMIC FRAMEWORK [1/]

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1/ This report was prepared by Richard B. Will (Consultant).

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SUMMARY

i. The purpose of this Report is to give insight into the interactions of key growth variables of the Bangladesh economy. It is based on a prototype model created by Professor Dorfman of Harvard University. By specifying employment targets and labor productivities at five-year intervals from 1973 to 2003, this model projects the overall investment-savings gap, per capita income, foreign aid and other sectoral and national income statistics. The model is designed for situations where increased employment is an overriding national priority.

ii. The Dorfman model divides the economy into seven sectors with separate capital output ratios, depreciation rates and "sectoral equations" giving the sectoral share of total value added as a function of per capita income. The sectoral equations result in allocations of GDP consistent with data of several other similar countries. It does not yield optimized allocation based explicitly on demand. The sectors are Agriculture, Manufacturing, Construction, Utilities, Transportation (including Communications), Trade and Services (including Government).

iii. For sensitivity analyses it proved necessary to modify and extend the basic Dorfman model in two directions -- one with an objective in terms of per capita income growth, and the other assuming a uniform constraint on the availability of foreign aid from 1973 to 2003. In the extension models the labor productivities are only used to calculate the number of jobs. Hence the extensions depend less on the quality of estimates of labor productivities than does the Dorfman model.

iv. The extension model which specifies per capita income growth illustrates the methodology of the Report. The sectoral equations and population determine the sectoral breakout of value added. Employment is found by dividing each sectoral value added by its labor productivity. Direct and indirect taxes, private and government consumption and foreign factor income are determined using estimated functions of population and per capita income. The GNP is calculated as the sum of total value added, indirect taxes and foreign factor income. Capital output ratios provide the level of capital stock in each sector. Investment comprises capital stock growth, depreciation and working capital augmentation. Finally, net foreign aid is total consumption and investment less GNP.

v. The extension models may be driven by the growth of a single sector -- such as agriculture -- through intersectoral linkages. Agricultural growth rates associated with the indicative program of the Land and Water Sector Study were used in Section 4 to project values of per capita income, foreign aid, employment and investment. Sectoral shares of GDP and growth rates of sectoral value added are linked to various average growth rates of agricultural value added in Tables 4-7, and to different per capita income and population growth rates in Tables 8-11.

vi. The results indicate that foreign aid, per capita income and employment are highly sensitive to relatively minor changes in key parameters such as: (a) population growth rate; (b) private marginal

propensity to consume; (c) direct tax rate; (d) indirect tax rate; (e) capital output ratios; and (f) depreciation rates. Each of these six parameters was varied individually in conjunction with per capita income growth rates of 2% and 4% (Section 5B) and annual foreign aid levels of $200 and $500 million (Section 5C) to produce twentyfour tables. For example, Section 5.20 suggests that a decrease in marginal propensity to consume from .84 to .82 can increase per capita income in 2003 by 50%.

vii. The model also illustrates the influence on economic performance of several factors over which policy control may be exercised such as (a) taxation; (b) private savings; (c) population planning; and (d) allocation of investment funds among the sectors of the economy. Since Bangladesh has had extremely low tax rates in comparison with other countries, the development of fair, enforceable and comprehensive direct and indirect tax programs may be a profitable undertaking as the economy and its administrative organizations recover from the 1971 conflict.

viii. The utility of the models depends on the accuracy of the input data, but it is difficult to obtain accurate statistics from the past, and the uncertainty is greatly amplified when projecting relative sectoral magnitudes, capital output ratios, depreciation rates, labor productivities, tax rates and consumption functions up to 30 years in advance. This underscores the need for additional study. Potential topics for further study comprise: the utilization of capital output ratios dependent on growth, replacement of the sectoral equations by an optimizing demand-oriented model, refinement of the private consumption function, development of more appropriate exchange rates in calculations based on cross-national data, low capital inflow simulation including generation of a less capital-demanding time series of capital output ratios and labor productivities, and determination of the likelihood of achieving the optimistic tax rates postulated for 1973.

GLOSSARY

A(i,t)	=	Growth in capital stock in sector i in year t.
B(i,t)	=	New working capital required in sector i in year t.
C(i,t)	=	Average capital output ratio in sector i in year t.
D(i)	=	Depreciation rate in sector i.
DN	=	Population growth rate.
DY	=	Per capita income growth rate.
DT	=	Direct taxes.
E(i,t)	=	Depreciation of capital stock in sector i in year t.
EMP(i,t)	=	Employment in sector i in year t.
F	=	Foreign factor income.
FA(t)	=	Foreign aid in year t.
GC	=	Government consumption.
GDP	=	Gross domestic product.
GNP	=	Gross national product.
GNPF	=	GNP at factor cost.
GNPM	=	GNP at market cost.
I(i,t)	=	Capital formation in sector i in year t.
I(t)	=	Total investment in year t.
IT	=	Indirect taxes less subsidies.
M	=	Private marginal propensity to consume.
N(t)	=	Population in year t.
P(i,t)	=	Productivity in sector i in year t.
PC	=	Private consumption.
pci	=	Per capita income.
PDI	=	Private disposable income.
TC	=	Total consumption
V(i,t)	=	Value added in sector i in year t.
W(i)	=	Working capital output ratio in sector i.
X(i,t)	=	Proportion of GDP in sector i in year t.
X(i, Y(t), N(t))	=	Proportion of GDP in sector i as a function of per capita income and population.
Y(t)	=	Per capita income in year t.
Z(i,t)	=	Sectoral equation in sector i in year t.

BANGLADESH - SECTOR STUDY

VOLUME III - SECTOR ECONOMICS

TECHNICAL REPORT NO. 3: THE MACROECONOMIC FRAMEWORK

I. INTRODUCTION

1.01 The goal of any development strategy is to achieve substantial improvements in per capita income and employment under realistic constraints on the availability of foreign aid 1/ and implementation capacity. The feasibility of alternative development strategies may be evaluated through models which relate key variables (such as per capita income, tax rates, propensity to consume, foreign aid and employment) by means of changing one or more input variables within an acceptable or probable range in order to determine the effect on another variable.

1.02 The macroeconomic sensitivity analyses in this report evolved from a model created by Professor Robert Dorfman of Harvard University with assistance from Drs. Tabors and Alamgir of the Harvard Center for Population Studies. On the basis of specified employment targets and labor productivities at five-year intervals from 1973 to 2003, the model projects the overall investment-savings gap, per capita income and other sectoral and national income statistics. The Dorfman model was designed for application in situations like Bangladesh where the employment problem may be an overriding national priority.

1.03 The basic Dorfman model was modified and extended in two directions --one to cover situations where the macroeconomic objective could be stated in terms of per capita income growth, and the other for application assuming a uniform constraint on the availability of foreign aid from 1973 to 2003. The first approach, Extension 1, specifies a per capita income growth rate rather than employment targets, and foreign aid and jobs are calculated. Similarly, Extension 2 inputs a foreign aid level rather than employment, and determines per capita income and jobs. The basic model and the extensions rely on sectoral equations depending primarily on per capita income to determine the proportion of the GDP which is allocated to each sector.

1.04 A distinction between the basic model and the extensions is that in the extensions the labor productivities are only used to calculate the number of jobs and do not enter any other output statistics. Hence, the relative appropriateness of the basic model and the extensions depends on the quality of the estimates of labor productivities as well as on whether the primary planning objective is in terms of employment, per capita income or foreign aid.

1/ Foreign aid amounts in this report are all net of debt servicing.

II. THE DORFMAN MODEL [1/]

A. Methodology

2.01 Three key elements of the Dorfman model are (i) an employment goal delineated at 5-year intervals from 1973 to 2003; (ii) sectoral equations allocating shares of the GDP to individual sectors; and (iii) time-phased sectoral labor productivities. The economy is divided into seven sectors with no decompositions considered below the sectoral level. Each sector has a time-phased fixed capital output ratio as well as a single depreciation ratio and working capital output ratio. The sectoral breakdown comprises Agriculture, Manufacturing, Construction, Utilities, Transportation (including Communications), Trade and Services (including Government).

2.02 The employment target, which is simply the ratio of jobs to the labor force, is used as follows to determine the required number of jobs. First, population projections delineate the proportion of men and women in various age groups at 5-year periods. Then the labor force is estimated by aggregating specific proportions of each sex-age group. The number of jobs required is the product of the labor force and the percentage employment target.

2.03 For any year, per capita income is determined by an iterative procedure which assures consistency with the job requirement. This is essentially accomplished by choosing a trial level of per capita income and determining the sectoral shares of GDP. The sectoral shares are multiplied by GDP (the product of population and per capita income) to obtain value added in each sector. Then each sectoral value added is divided by the sectoral productivity to produce the number of jobs in that sector.

2.04 If the total number of jobs in all sectors corresponding to the trial per capita income is less (more) than the required quantity derived from the employment target, then the trial per capita income must be adjusted upward (downward). The trial value of per capita income is adjusted iteratively until the difference in the number of jobs implied by the trial per capita income and the required number of jobs is negligible.

2.05 After the per capita income is calculated, then direct taxes, private consumption, government consumption, and foreign factor income may be determined since all are assumed to be known functions of only population and per capita income. Also, with known sectoral value added, capital output ratios may be used to determine required capital stock and working capital levels in each sector. The sectoral investment in any year is then simply the sum of depreciation and the annual increment in capital stock and working capital, and total investment is the sum of sectoral investments. The GNP at market prices is easily determined as the sum of GDP (total value added), foreign factor income and indirect taxes. Finally, foreign aid is found by subtracting the GNP at market prices from the sum of consumption and investment.

1/ A full statement about this model is being prepared by Professor Robert Dorfman, Dr. R. Tabors and Dr. M. Alamgir for publication by the Harvard Center for Population Studies.

2.06 A few caveats should be mentioned. First, the foreign aid calculated is net foreign aid since no debt service burdens have been charged. Second, it is assumed that the values of consumption, taxes, investment, and the sectoral shares can be determined without knowledge of the levels of sectoral imports and exports. This simplification means that in order to run the model it is unnecessary to decompose the aggregated consumption functions by sector, and unnecessary to ascertain imports and exports on either a sectoral or aggregated basis. Thus the model output is not explicitly checked sector by sector for consistency with international demand and internal constraints on transport and trade. Third, for any specified per capita income, the sectoral equations result in sectoral shares which represent the average of similar countries, when they were at that same level. The sectoral equations do not optimize the relative sectoral magnitudes in terms of employment or any other objective. Fourth, the standard cost unit is in terms of 1959-60 dollars.

B. Data Limitations

2.07 The utility of the model depends critically on the accuracy of the basic data. It is difficult to obtain accurate statistics from the past, and the uncertainty is greatly amplified when projecting relative sectoral magnitudes, capital output ratios, depreciation rates, labor productivities, tax rates and consumption functions up to 30 years in advance.

2.08 Like other developing countries, Bangladesh has poor national income and expenditure data, although attempts have been made to improve both the methodology and coverage. Since its establishment in 1950, the Central Statistical Office (C.S.O.) had been the main source of information for all national income data. Initially the data collected were aggregated, and no attempt was made to construct provincial accounts.

2.09 In order to improve the accuracy and coverage of data, the National Income Commission was formed in 1963. In 1964 this group presented a report including the first regional accounts data for the years 1959-60 to 1963-64. In accord with the report recommendations, the C.S.O. revised its estimates of national income accounts for the previous years and also started making available separate regional income accounts. Although some progress was made in determining reliable national and regional income data, expenditure statistics were not developed.

C. Estimation of Coefficients

2.10 This section describes the determination of (i) mathematical expressions for the sectoral equations, direct and indirect taxes, private and government consumption and foreign factor income, and (ii) values for sectoral capital output ratios, depreciation and labor productivities. In the notation below, N = population, Y = per capita income and GDP = gross domestic product = N·Y.

Direct Taxes and Net Indirect Taxes

2.11 In the development process investment expenditures financed by domestic resources usually increase. Although domestic resources available for investment originate from both private and government saving, the government should provide a lead in channeling investment for two reasons. First, a large number of projects need to be undertaken in the public sector either because the investment required is too large compared with the financial capacity of the private sector or because the projects are of such nature that it is socially desirable to exercise public control. Secondly, the government can transform a part of the income of the private sector into investable resource by using fiscal instruments to convert a portion of the private sector income into loans and advances to credit institutions which provide short-, medium- and long-term funds to private investors.

2.12 The performance of Bangladesh in realizing funds through direct and indirect taxes has been extremely poor compared to other developing countries of Asia, Africa and Latin America. In the year 1959-60 the total tax receipt was only 4% of Gross Domestic Product, and the share of direct taxes was only 1%, one of the lowest in the world. Bangladesh should be able to realize a greater proportion of GDP in the form of direct and indirect taxes than it has in the past.

2.13 Figures for GDP at current factor cost, direct and indirect taxes as a fraction of GDP, and per capita GDP of an international cross section of countries are presented in Table 1 for the year 1960. These countries were selected on the basis of their past comparability with Bangladesh. From observation of the data, some correlation between per capita GDP and tax receipts as a proportion of GDP is evident. Although some of the countries at the same level of development (as indicated by the per capita GDP) reveal different proportions of tax receipts, on the average it seems that a higher level of income is associated with a higher proportion of both types of taxes. In some cases, the irregularity in this relationship can be attributed to relative emphasis on direct and indirect taxes of countries at the same per capita GDP level.

2.14 In order to find coefficients of assumed relationships for direct and indirect taxes, least squares regression was applied using international cross-sectional data obtained from Table 1. The results were:

$$IT = (.0835 + .00005\ Y) \cdot GDP$$
$$DT = (.0263 + .00011\ Y) \cdot GDP$$

where IT represents net indirect taxes, DT is direct taxes and Y is the per capita GDP. A few other functional forms were tried by changing the specification of variables and relasing the linearity assumption, but these did not produce as good a fit and thus were abandoned.

Private Consumption

2.15 Several potential linear relationships were examined involving consumption (per capita and total), private disposable income (per capita and total) and population. A 10-year data series for Bangladesh was used, in which both income and consumption were expressed in constant prices to eliminate the effect of price changes. Introduction of the population variable into the consumption function may be appropriate if rate of growth of population is high, but the data did not dictate inclusion of an explicit population variable. The relation chosen was:

$$PC = 144.14 + .84 \cdot PDI$$

where PC is private consumption and PDI represents total private disposable income.

2.16 Only one-way causality was assumed. Thus, for the purpose of predicting private consumption herein, an independent estimate of private disposable income must be available. However, total private disposable income may be influenced by private consumption, and to obtain a more accurate functional relationship, it may be necessary to endogenously determine both variables.

Government Consumption

2.17 It is extremely difficult to estimate the level of government expenditure accurately. However, generally there does appear to be a correlation between per capita government consumption and per capita GDP. The international cross-section data herein correspond to the year 1960 and are primarily taken from two United Nations documents, Yearbook of National Accounts Statistics 1967 and Statistical Yearbook 1962. Extreme observations like Israel and Jordan with very large defense budgets were deleted. Other countries were chosen on the basis of having passed through stages likely to be reached by Bangladesh in the future. Relevant data and presented in Table 2.

2.18 In order to predict the magnitude of government consumption expenditure, the following functional relationships were hypothesized and the parameters estimated by least squares regression:

(1) $GC = N \cdot (K_1 + K_2 \cdot Y)$

(2) $GC = N \quad (K3 + K_4 \cdot Y + K_5 \cdot Y^2)$

where GC is government consumption. The first equation represents a simple linear relationship between per capita government consumption expenditure and per capita GDP, and implies a constant marginal expenditure propensity. The second equation imples that the marginal expenditure in per capita government consumption is a function of the per capita GDP. The regression results using the data in Table 2 revealed that marginal government consumption did depend on the level of per capita GDP; the resulting equation is:

$$GC = N \cdot (5.755 + .0812\ Y + .000065\ Y^2)$$

Net Foreign Factor Income

2.19 The State Bank of Pakistan previously kept detailed information on net factor income from abroad aggregated for the entire country. In the Report of the Advisory Panels for the Fourth Five-Year Plan, the division of invisible receipts and payments between Bangladesh and Pakistan is given but factor income and payments are not identified separately. Since it was not possible to isolate net factor income for Bangladesh the aggregate data in current prices was divided equally between Bangladesh and Pakistan; since the magnitude involved is small, this approximation introduces little error. The best estimate of the net foreign factor income is 0.03% of GDP.

Sectoral Equations

2.20 The seven sectors considered in this analysis (agriculture, manufacturing, construction, utilities, transport, trade and services) account for 100% of GDP, The definitions parallel those in the United Nations Yearbook of National Account Statistics which uses eleven sectors and a category for statistical discrepancy. The principal difference is that the services sector herein includes the U.S. definitions of banking, insurance and real estate, ownership of dwellings, public administration, defense and services. Services and government were combined since the differentiation between them was not consistent: some countries in the data sample included services provided by government in the government sector, while others used the services or utilities sectors.

2.21 One assumption in the use of the sectoral equations is that the growth path of Bangladesh may be estimated by cross national sectoral growth trends of similar countries which have a higher per capita income levels. Another assumption is the dependence of sectoral share of GDP on per capita income. Although this method does not take future technological change and innovation into consideration explicitly, it does allow for implicit inclusion in the sectoral equations of the degree to which similar countries have been able to absorb technology in the past.

2.22 The countries in the data sample were selected on the basis of comparability to projections for Bangladesh and were limited to non-European less developed countries with a population of at least nine million, a per capita income less than $1,000, and a moderate resources base. The sample was further limited by the availability of data for the years 1965 - 1968, which was converted to constant factor cost and averaged, thus providing smoother inputs for the regression analyses. With these constraints, the sample contained

19 countries ranging from $60 (Ethiopia) to $882 (Venezuela) in per capita income, and from 9.14 million (Venezuela) to 505 million (India) in population. All these countries could not be included in all the sectoral analyses due to the non-availability of data (in construction some smaller countries had to be added to the sample) or biases (Venezuela was excluded from certain sectoral analyses due to the biasing effect of its oil resources). Least squares regression techniques were applied to the cross-national data to estimate the relationship in each sector providing the best explanation of variation in the sectoral shares of GDP. The results, with a simplified sectoral equation for construction, appear in Section 3B under "Sectoral Value Added".

Capital Output Ratios and Depreciation Rates

2.23 Both the fixed and working sectoral capital output ratios used herein are actually "average capital output ratios" since they are defined as ratios of sectoral fixed and working capital, respectively, to sectoral value added. To determine the fixed capital output ratios, an estimate for 1973 was obtained by adjusting Bangladesh statistics for a year in the 1960's, and an estimate for 2003 was generally determined by the capital output ratio of one or more target countries in 1960. For example, in agriculture the target was the 1960 level of the median of countries similar to Taiwan. Then a smoothing function was used in conjunction with the productivities to obtain values at five-year intervals between 1973 and 2003. Working capital ratios and depreciation rates were assumed to depend on the sector but to be constant over the 1973 to 2003 period. All these coefficients are given in Table 3.

Productivities

2.24 It was assumed that the best predictor of productivity per job in each sector in Bangladesh would be the experience of similar but moderately more developed countries, rather than past statistics of Bangladesh. Data of seventeen such countries for either 1960 or 1962 were assembled to provide employment, value added and productivity data for each of the seven sectors. Then an estimate of the productivity in 2003 in Bangladesh was obtained by choosing the corresponding adjusted or unadjusted value of a target country in 1960 or 1962, depending on the sector. For example, one-fourth of Taiwan's value was set as the target for the agricultural sector, and South Korea's full value was the goal in manufacturing. Productivity estimates for 1973 were equated to labor productivities calculated from 1963-64 Bangladesh data, and estimates between 1973 and 2003 were obtained by interpolation.

TARGET VALUES FOR PRODUCTIVITIES AND CAPITAL OUTPUT RATIOS

Sector	Target for 2003[1/] Capital Output Ratios	Sectoral Labor Productivities
Agriculture	Median of countries similar to Taiwan	One-fourth of Taiwan
Manufacturing	Median of countries similar to Bangladesh	South Korea
Construction	South Korea	Turkey
Utilities	Taiwan and Korea	Turkey
Transportation	Thailand	Kenya
Trade	1.6 times Taiwan	Top of lower third in sample
Services	Average of Taiwan and South Korea	2% increase annually from 1973

2.25 Since GDP is the product of jobs and average productivity, there is a range of employment which may correspond to any estimate of GDP. If the number of jobs, or equivalently the employment percentage (i.e. jobs per labor force) is multiplied by a constant then the GDP level will be maintained if each sectoral labor productivity is divided by that constant. The Dorfman productivity coefficients correspond to a 95% employment in 1973. Since this level was considered high, it was revised downward to 80% (still considered optimistic) by increasing all Dorfman's estimates of sectoral labor productivities by 18.75%. These revised productivities are given in Table 3. It should be noted that a 95% employment level with the Dorfman productivities yields exactly the same results in all other model output as an 80% employment level with the revised productivities.

1/ Levels of target countries in 1960 are used as the goal for Bangladesh in 2003

III. THE EXTENSION MODELS

A. Overview

3.01 The goal of the extension models is to determine either foreign aid[1]/ requirements or per capita income resulting from specification of several other factors such as tax rates, propensity to consume and population growth. To accomplish this, the basic relation is foreign aid plus GNP equals consumption plus investment. The economy is divided into seven sectors with separate capital output ratios, depreciation rates and "sectoral equations" giving the sectoral share of total value added. Since the sectoral equations result in allocations of GDP consistent with cross-national data, a consistency model results rather than an optimized allocation explicitly based on demand.

3.02 Extension 1, which specifies per capita income, may serve to illustrate the general methodology. The sectoral equations and the population determine the sectoral breakout of value added. Employment can be found by dividing each sectoral value added by its labor productivity. Direct and indirect taxes, private and government consumption and foreign factor income are determined using known functions of population and per capita income. Capital output ratios provide the level of capital stock in each sector. By comparing the capital stock requirements for two years the annual growth can be determined. When capital stock growth is added to depreciation and working capital augmentation, investment can be determined. The GNP is calculated as the sum of total value added, indirect taxes and foreign factor income. Finally, (net) foreign aid equals total consumption and investment less GNP.

3.03 In Extension 2, which specifies foreign aid, the same relationships and coefficients are utilized as if per capita income were specified. But an iteration procedure is required to determine the per capita income time series corresponding to the foreign aid constraint. A one year lag from investment to production is assumed so that an increase (decrease) in foreign aid in any year will affect only investment in that year and will not increase (decrease) per capita income and consumption until the following year. In each year a trial per capita income is selected, and the required capital stock to support that per capita income is determined by means of the sectoral equations. Then the implied level of foreign aid in the previous year needed to attain that capital stock level is ascertained. If the implied level exceeds (is less than) the foreign aid constraint, then the trial per capita income must be adjusted downward (upward). When a balance is attained, the procedure is repeated for the following year.

1/ Foreign aid amounts in this report are net of debt servicing except when indicated otherwise.

B. Determination of Major Indicators

3.04 The relations for GNP, consumption and investment, foreign aid and employment are developed below. Figures and symbols are in millions except for ratios and per capita income; the monetary unit is the dollar; and the index t represents the number of years from 1973.

Population and Per Capita Income

3.05 Population and per capita income are assumed to grow at a constant specifiable annual rate, starting from specified 1973 bases of 74 million population and $70 per capita income. Of course, in the extension in which per capita income is an output, only the 1973 base is input and the time-phased foreign aid level determines the per capita income level. The quantitative expressions to obtain the time phased output as a function of the bases and growth rates are:

N(0) = Population in 1973 = 74
DN = Population growth rate
Y(0) = Per capita income in 1973 = 64
DY = Per capita income growth rate
$N(t) = N(0) \cdot (1+DN)^t$
$Y(t) = Y(0) \cdot (1+DY)^t$

GNP

3.06 First the GNP at factor cost is determined by adding net factor income from abroad to the gross domestic product (population times per capita income). Then the indirect taxes less subsidies are added to the GNP at factor cost to arrive at the GNP at market prices. The corresponding equations are:

N = Population
Y = Per capita income
GDP = Gross domestic product = N·Y
F = Foreign factor income = .0003 · GDP
GNPF = GNP at factor cost = GDP + F
IT = Indirect taxes less subsidies = (.0835 + .00005 Y) ·GDP
GNPM = GNP at market cost = GNPF + IT

Consumption

3.07 Total consumption is obtained by adding private consumption to government consumption. The private consumption is found by subtracting direct taxes from the GNP at factor cost to produce private disposable income, and then assuming that private consumption is a linear function of the private disposable income; the multiplier is a constant marginal propensity to consume. The equations describing this are:

DT = Direct taxes = (.0263 + .00011 Y) ·GDP
PDI = Private disposable income = GNPF - DT
M = Private marginal propensity to consume = .84
PC = Private consumption = 144.14 + M · PDI
GC = Government consumption N · (5.755 + .0812 Y + .000065 Y^2)
TC = Total consumption = PC + GC

Sectoral Value Added

3.08 The relative magnitude of the value added in each of the seven sectors is given by a set of sectoral equations which depend on the time-phased per capita income and population. Since these relative magnitudes do not sum to one, they are adjusted (by dividing each by the sum of the seven) to produce numbers which have the same relative values and whose sum is one. Then, any sectoral value added is found simply by multiplying the appropriate adjusted relative magnitude by the GDP. The series of equations needed to arrive at the sectoral value added is:

Sector	Sectoral equation at time t
Agriculture	$Z(1,t) = 1.335 + \frac{8914}{Y(t) + 108}$
Manufacturing	$Z(2,t) = 6.64 + .0322862 \cdot Y(t)$
Construction	$Z(3,t) = 4.46$
Utilities	$Z(4,t) = 3.029 - \frac{191}{Y(t) + 6}$
Transportation	$Z(5,t) = 5.56 - .0108 \cdot N(t)$
Trade	$Z(6,t) = 14.58 - \frac{67.3}{Y(t) - 50}$
Services	$Z(7,t) = 28.171 - \frac{862}{Y(t) - 6}$

X(i,t) = Proportion of GDP in sector i in year t

$$= \frac{Z(i,t)}{\sum_{j=1}^{7} Z(j,t)}$$

V(i,t) = Value added in sector i in year t

$$= X(i,t) \cdot N(t) \cdot Y(t)$$

Investment

3.09 The investment requirement in any sector is assumed to be the sum of three terms: (i) the growth of capital stock; (ii) the depreciation; and (iii) the growth of working capital. Determination of the capital stock is based on the availability in each sector of an average capital output ratio, defined to be the average amount of fixed capital in that sector required to produce a unit of value added in that sector. The capital stock requirement in a sector in any year is obtained by multiplying the average capital output ratio by the value added.

3.10 If a one-year lag exists between investment and the production of value added, then the amount of growth of capital stock in any year depends on the value added and the average capital output ratio for the following year. In fact, the investment in year t to cover capital stock growth from year t to year t + 1 is found by subtracting the capital stock in year t from the capital stock in year t + 1. The equation to calculate the growth of capital stock follows:

$C(i,t)$ = Average capital output ratio in sector i in year t

$A(i,t)$ = Growth of capital stock in sector i in year t assuming a one-year lag from investment expenditure to productive operation

$= V(i,t+1) \cdot C(i,t+1) - V(i,t) \cdot C(i,t)$

3.11 The depreciation of capital stock is assumed to vary from sector to sector, but to remain at a constant value from 1973 to 2003. It is further assumed that in any year the investment to cover depreciation is the product of the value added, the average capital output ratio and the depreciation rate:

$D(i)$ = Depreciation rate in sector i

$E(i,t)$ = Depreciation of capital stock in sector i in year t
$= V(i,t) \cdot C(i,t) \cdot D(i)$

3.12 The growth in working capital is calculated similarly to growth in capital stock except that the one-year lag is not appropriate, and the working capital output ratio is assumed to maintain the same value from 1973 to 2003. Thus, the investment needed at time t to cover working capital augmentation in each sector is the product of working capital output ratio and the increment in the sectoral value added over the preceding year:

$W(i)$ = Working capital output ratio in sector i

$B(i,t)$ = New working capital required in sector i in year t
$= (V(i,t) - V(i,t-1)) \cdot W(i)$

3.13 The capital output ratios (fixed and working) and depreciation rates for the sectors are given in Table 3. With this data the total investment in any year can be calculated by summing terms as follows:

$I(i,t)$ = Capital formation in sector i in year t
$= A(i,t) + E(i,t) + B(i,t)$
$I(t)$ = Total investment in year t
$= \sum_i I(i,t)$

Foreign Aid

3.14 The investment-savings gap is the excess of resource utilization (comprising both consumption and investment) over the GNP at market prices. Generally the degree of sectoral imports and exports affects the levels of consumption, taxes, investment and sectoral shares of the GDP. However the coefficients for these functions are exogenous to the model. Thus the model output corresponds to the same general level of sectoral imports and exports assumed in the generation of coefficients. However the output does not provide the amount of imports and exports sector by sector, nor even total imports nor total exports. Only the difference between imports and exports may be found, since this difference is equal to the investment-savings gap. Foreign aid (FA) as defined herein is net of i) debt servicing; ii) non-reinvested earned foreign exchange and iii) increments in reserves. Under these conditions foreign aid is equivalent to the investment-savings gap:

Investment-savings gap = TC + I - GNPM
= Imports - Exports
FA = TC + I - GNPM

Employment

3.15 The total number of jobs or employees is uniquely determined with given sectoral productivities, per capita income and population. And the employment rate (defined as jobs per labor force) depends only on per capita income and sectoral productivities since the labor force is assumed to constitute a specified fraction (35%) of the population. The number of employees in each sector is obtained by dividing the calculated sectoral value added by the productivity of an employee in that sector (as presented in Table 3):

$P(i,t)$ = Productivity in sector i in year t
$EMP(i,t)$ = number of employees in sector i in year t

$$= \frac{V(i,t)}{P(i,t)} = \frac{X(i, Y(t), N(t)) \cdot N(t) \cdot Y(t)}{P(i,t)}$$

$$\text{Employment rate} = \frac{EMP(i,t)}{.35 \cdot N(t)} = \frac{Y(t)}{.35} \sum_i \frac{X(i, Y(t), N(t))}{P(i,t)}$$

C. Comparison of Dorfman and Extension Models

3.16 The models are most readily distinguished by specification of the driving element. The Dorfman model specifies an employment target while the two extension models are driven by per capita income growth and an annual foreign aid, respectively. The Dorfman model calculates investment for growth in any year by comparing the capital stock requirements in that year and a previous year, effectively assuming no gestation period involved in capital formation. However, the extension models assume a one-year time lag between investment expenditure and productive capability, so that the investment for growth in any year depends on the capital stock requirements in that year and a succeeding year. This difference causes foreign aid needs in 1973 calculated by Dorfman to be substantially lower than in the extension model since little GDP growth is assumed between 1972 and 1973.

3.17 The extension models utilize a constant annual population growth rate over 1973-2003. In the Dorfman model, three population patterns are considered during 1973-2003 and each involves time-phased annual growth rates based on Revelle-Thomas population series . The mid-low population pattern used as a base by Dorfman has an average growth rate of 3.1% during 1973-1983 and 2.8% during 1973-2003. Average annual population growth rates of 3.0, 2.8, 2.6 and 2.0% are utilized in the sensitivity tests of both extension models.

3.18 The employment target utilized during 1973-2003 by Dorfman was 95%. Although a 70-80% range in 1973 would appear more realistic, the results with 95% are still useful since they can be interpreted as maintaining a constant employment rate, i.e., the same as currently estimated in Bangladesh. Given the population and relative magnitude of sectoral productivities, all other calculations are a function of employment and the productivity only through their product. This means that a 95% employment level with the Dorfman productivities yields exactly the same results as an 80% employment level with the productivities 18.75% higher. By adjusting labor productivities in this way, the extension models were calibrated to an 80% employment level in 1973.

3.19 In the Dorfman model, the average labor force participation rate is determined by breaking down the population by sex and age group and assuming a participation rate for each subgroup. Dorfman's average labor force participation rates increase from .35 in 1973 to about .39 in 2003 for the mid-low population. However, the extension models assume that the labor force remains at 35% of the population.

3.20 The proportion of GDP allocated to the construction sector in the Dorfman model depends on the ratio of gross fixed investment to GDP, whereas in the extensions the construction sectoral equation is simplified to a constant value. Due to this difference, the sectoral equations in the extensions are only in terms of population and per capita income. Accordingly, the iteration procedure in the Dorfman model (needed to achieve consistency of the employment input with the trial per capita income and gross fixed investment) is unnecessary in the extension models.

3.21 The remaining differences are minor. While the extension models start calculations in 1973, the Dorfman model actually begins from a 1969 base and produces slightly different results in 1973 for different inputs. The 1973 population is 74 million in the extension, and 74.2 in the Dorfman model for the mid-low population. The per capita income level in 1973 is assumed to be $64 in the extension models, and is calculated as $64.2 in the Dorfman model for the mid-low population. Finally, the extension models, while based on the Dorfman coefficients have been deliberately geared to obtain inter-relationships among per capita income, foreign aid, population, private marginal propensity to consume, direct and indirect tax rates and capital output and depreciation rates. A graphical comparison appears in Table 13.

IV. THE ROLE OF THE LAND AND WATER SECTOR

Intersectoral Linkages of the Agricultural Program

4.01 The models discussed in Section 3 will be utilized to test the macroeconomic implications of specific agricultural strategies. These models bring the growth history of several countries similar to Bangladesh to bear. The results will have a degree of "built-in" consistency by virtue of (i) utilizing sectoral equations which allocate GDP to sectors consistently with the experience of such countries; and (ii) assuming that several economic indicators such as consumption and taxes will follow pre-established trends.

4.02 The agricultural sector, accounting for over half of the GDP today, will continue to play a dominant role in the economy of Bangladesh for years. Therefore, the proposed program must be balanced or consistent with development demands of other sectors, and with macroeconomic variables such as domestic resource mobilization, foreign exchange availability, institution building and other major constraints. This section seeks to answer the question: How will the proposed agricultural program interact with performance of individual sectors and promote the growth of the whole economy?

4.03 The macroeconomic model can be "driven" by different variables such as per capita income, foreign aid and employment. Here the driving force will be the growth of the agriculture sector time-phased value added. Cropping patterns (in conjunction with implementation constraints on flood control, irrigation, drainage and inputs options) determine agricultural production levels. By converting physical production into value of production, and subtracting the value of purchases by agriculture from other sectors, the agricultural value added component of the GDP results.

4.04 According to the tentative program, agricultural value added would grow by an average rate of 4.6% during 1973-1983 and of 3.5% during 1973-2003. Growth should be greater in the first decade as immediate action is taken to exploit the unutilized land and water potential of the region by existing technological breakthroughs. The calculations are based on population levels of 74.5, 101.0 and 170.3 million in 1973, 1983 and 2003 1/; a constant 35% labor force participation during 1973-2003; a $64 per capita income 2/ and 30% unemployment rate in 1973 3/.

1/ These three population values are from the Revelle-Thomas mid-low population series, which differs slightly in form from those of Section 3 and 5.

2/ A 1959-1960 base is assumed for all prices.

3/ This unemployment rate is 10% higher than the figure used in Section 5. Consequently, the corresponding labor productivities used in this section are one-seventh higher than those in Table 3.

Agricultural Growth, Population, Employment and Per Capita Income Specifications

	1973	1973-1983	1973-2003
Average annual growth rate in agriculture			
Tons		5.1%	4.1%
Value added		4.6%	3.9%
Population (10^6)	74.5		
Population growth rate		3.1%	2.8%
Labor force participation	35%		35%
Unemployment	30%		
Per capita income	$64		

4.05 When time-phased growth rates of agricultural value added are supplied to the model, the following indicators can be readily determined: GDP growth rate, foreign aid (i.e. investment-savings gap), per capita income, employment, investment, sectoral shares of GDP and sectoral growth rates. These will be discussed below.

Intersectoral Consistency

4.06 The indicative land and water resources development program outlined in this Study presupposes that the agricultural program will be part of a balanced overall development strategy giving appropriate weight to other sectors of the economy such as transport, industry and human resources development. To demonstrate this consistency, multi-sectoral growth projections are given in the table below. These results appear plausible in terms of experience in Bangladesh and elsewhere.

OVERALL ECONOMIC AND SECTOR GROWTH VARIATIONS

	1973	1983	2003	10-Year Perspective (1973-1983)	30-Year Perspective (1973-2003)
A. Share of GDP (%)				Average Annual Growth Rate of Value Added (%)	
1. Agriculture	56.2	49.1	42.7	4.6	3.9
2. Manufacturing	9.2	9.7	11.1	6.6	5.6
3. Construction	4.7	4.6	4.7	5.8	4.9
4. Utilities	0.3	1.3	1.6	19.3	12.0
5. Transportation	5.0	4.6	3.9	5.1	4.0
6. Trade	10.3	13.1	14.3	8.9	6.3
7. Services	14.1	17.9	21.7	8.6	6.5
B. Aggregated Amounts				Average Annual Growth Rate (%)	
8. GDP (10^6)	4,768	8,611	20,365	6.0	5.0
9. Population (10^6)	74.5	101.0	170.6	3.1	2.8
10. Per capita income ($)	64.0	85.2	119.4	2.8	2.1
11. Jobs (10^6)	18.3	22.0	29.1		
12. Average productivity ($)	261.	391	700	4.1	5.0
13. Employment	0.70	0.62	0.49		
14. Foreign aid (10^6)	365	356	-111		

4.07 The contribution of the agricultural sector declines from 56% of GDP in 1973 to 49% in 1983 and 43% in 2003, while during 1973-2003 manufacturing increases from 9 to 11%, trade increases from 10 to 14% and government and services increase from 14 to 22%. Per capita income rises from $64.0 in 1973 to $85.2 in 1983 and $119.4 in 2003, an average of 2.1%, while productivity increases by an average of 5% from $261 in 1973 to $700 in 2003. Since productivity rises faster than per capita income, the number of jobs increases more slowly than the population, resulting in a decreasing employment ratio. Net foreign aid falls from $365 million in 1973 to $356 million in 1983, and a surplus appears by the end of the century although with realistic debt service burdens a deficit may result.

4.08 The components of the industrial sector most closely allied with agriculture are chemical inputs, i.e. fertilizer and pesticides. Since the need for fertilizer and pesticides may be met either by imports or domestic production, the tradeoff decision concerning the proper mix of imports and production depends on the results of feasibility studies for the establishment of specific industrial projects. While Bangladesh is likely to have to import much of its chemical inputs requirements in the short run, it has the basic raw material for urea manufacture and should proceed expeditiously with the set-up of a modern industrial complex geared to meet all its agricultural requirements for nitrogen. Pesticides formulation, assembly of small pumps, rigs, well screens and casings are smaller but nevertheless important areas for further industrial development.

4.09 Significant requirements also exist for the processing of agricultural products. In the manufactoring sector, jute is the prime example. Rice, tea, shrimp, lumber, fruit and vegetables also require improved and expanded industrial processing. Further processing of agricultural products and increased farm specialization will stimulate the trade sector by requiring more sophiscated wholesale and retail distribution systems.

4.10 Agriculture will exert a significant demand on the transportation sector as a result of increased trade in agricultural products from areas of relatively high agricultural potential to deficit areas and urban centers. Conveyance of inputs will also place a significant burden on transport with the ten-fold projected increase of fertilizer and pesticides use from 1973 to 2003. In order to operate irrigation, drainage and flood control projects, motor vehicles and vessels will be needed for extension services and maintenance of wells and pumps, apart from the transport requirements imposed by construction of these facilities. Finally, as per capita incomes gradually rise, the rural population will demand more responsive transportation systems for consumer goods requirements.

4.11 Rural electrification will become increasingly justified as greater density of pumps and tubewells in favorable agricultural areas creates more demands on the utilities system; other important power demands will include requirements of the manufacturing sector for processing of agricultural goods and for small industries.

Investment and Resource Mobilization

4.12 The achievement of a balanced development strategy with the outlined agriculture sector development would require investment figures of the order of magnitude given below. Investment to cover growth, depreciation and working capital would grow from $700 million in 1973 to $1.3 billion in 1983 and $2.7 billion by 2003. Although investment climbs rapidly, it grows more slowly than the GDP over the thirty-year period, decreasing from 15% of GDP in 1973 to 13% in 2003. The fraction of total investment in agriculture would climb from 18% in 1973 to 22% in 1983 and 37% in 2003 in spite of agriculture's decreasing share of GDP. This occurs due to the increasing capital output ratio for agriculture. Manufacturing investment remains close to 20% of total investment.

Total Annual Investment Requirements (million)

Sector	1973	1983	2003
Agriculture	127	285	994
Manufacturing	154	279	511
Construction	23	45	101
Utilities	36	79	162
Transportation	57	106	203
Trade	85	102	136
Services	214	378	602
Total	696	1274	2709
Investment as a fraction of GDP	.15	.15	.13

4.13 The investment needs of the tentative program during 1973-1983 will require both foreign assistance and a substantially augmented domestic resources mobilization effort. This will call for greatly improved taxation instruments and a suitable combination of direct and indirect taxation which will maximize savings without creating a negative impact on production incentives. In 1959-1960 revenue from taxation in Bangladesh only amounted to 4% of the GDP. Of this amount direct taxes constituted about 1%, while indirect taxes were 3%.

4.14 Substantial improvement in the development and enforcement of tax programs is necessary. Taxation revenues of the order of 12-13% of GDP should be raised as soon as possible. Since 12% is three times the 1959-60 taxation rate, it is extremely optimistic to assume that such a jump could be accomplished by 1973. Nevertheless, this assumption is made (in calculating foreign aid levels) on the basis of consistency with performance of countries similar to Bangladesh (see Table 1 in Technical Report No. 3).

4.15 The agricultural sector should be able to generate additional savings since it is the largest and least taxed sector. Ways of mobilizing resources within agriculture include the land tax, reduction of input subsidies and increased water charges. All these instruments can be effective in financing non-agricultural development as new agricultural technology takes hold and farm incomes rise. Although subsidization of pesticides and fertilizer increases the value of agricultural production, the subsidy deprives other economic sectors of scarce investment funds. It may be possible to lower the subsidy without decreasing the value of production. The possibility of increasing water charges and taxation on land without affecting production incentives should also be examined.

Employment

4.16 The employment implied by the tentative program can be estimated by dividing sectoral value added by an estimate of productivity per job. Since productivities are extremely difficult to project, the calculated number of jobs can be regarded as little more than an informed guess. The productivities represent an aggregate annual growth of 5%, nearly 3% higher than the per capita income growth rate. Since the productivity growth exceeds the growth in per capita income, the employment rate (jobs per labor force) decreases. In fact, based on this productivity data, the employment rate falls from 70% in 1973 to 62% in 1983 and 49% by 2003. Such a marked decrease highlights the fact that acceptable levels of employment opportunities would require either that (a) agricultural growth be accelerated; (b) a shift occur in the sectoral allocation so as to accelerate the rate at which the non-agricultural share of GDP increases; or (c) the improvements in productivity projected in the calculations do not fully materialize. The last outcome is quite possible since productivities are very difficult to estimate.

Employment and Productivity Statistics

	1973	1983	2003
1. Jobs by sector (million)			
a. Agriculture	13.9	15.1	18.5
b. Manufacturing	1.5	1.7	1.9
c. Construction	.17	.27	.5
d. Utilities	.008	.033	.085
e. Transportation	.27	.36	.5
f. Trade	1.1	1.7	2.1
g. Services	1.5	2.8	5.4
h. Total jobs	18.3	22.0	29.1
2. Population (million)	74.5	101.0	170.6
3. Labor force	26.1	35.3	59.7
4. Employment rate	.70	.62	.49
5. Average Productivity ($)	261	391	700

Model Sensitivity to Agricultural Growth

4.17 Any change in agriculture produces a larger relative change in other sectors through multiple linkage effects. According to the macro-economic model, a thirty-year average agricultural growth rate of 3.9% corresponds to a 5% GDP growth rate and a 2.1% per capita income growth rate. Variations in the growth rates of agricultural value added between 3.5% and 4.9% are consistent with GDP growth rates between 4% and 7%. Thus the elasticity of the GDP growth rate with respect to agricultural growth is greater than one. This leverage effect of agriculture, combined with its size and its potential for job creation, confirms the importance of the agricultural program. Success in agriculture can generate a viable economy. Conversely, failure would spread to other sectors. The relationship between growth rates of agriculture, per capita income and GDP is:

Thirty-Year Average Growth Rate (%)

Table No.	Agriculture	Per Capita Income	GDP	Per Capita Income 1983 $	Per Capita Income 2003 $
4	3.5	1.2	4.0	72.1	91.5
5	3.9	2.1	5.0	78.8	119.4
6	4.5	3.1	6.0	86.8	159.9
7	4.9	4.1	7.0	95.6	213.6

Tables 4, 5, 6 and 7 present the sectoral details corresponding to the four agricultural growth rates.

4.18 The net foreign aid level needed to implement an average 3.9% growth in agricultural value added would be $265 million in 1973 and fall to $213 million in 1983 and $110 by 1993 assuming no changes in coefficients, which is unlikely. In any case, the foreign exchange levels required appear to be within reason, at least through 1993. This level of assistance would be consistent with a 5% GDP growth rate. A surplus appears in 2003 since the level of investment is constrained by the GDP growth rate, or equivalently the per capita income growth rate. This constraint prevents the model from further investment which would maintain or increase employment. Since the per capita income is restrained to grow more slowly than productivity per man, the employment level falls. If the 1973 employment levels were maintained until 2003, then the investment required would be large enough so as to require foreign aid past 2003. The relation between agricultural growth rate, GDP growth rate and net foreign aid requirements is presented below:

Thirty-Year Average Growth Rate (%)		Net Foreign Aid ($ Million)			
Agricultural Value Added	GDP	1973	1983	1993	2003
3.5	4.0	173	125	56	- 43
3.9	5.0	265	213	110	-111
4.5	6.0	365	343	252	- 66
4.9	7.0	466	513	515	193

V. GENERAL SENSITIVITY ANALYSES

5.01 It is useful to determine the sensitivity to both policy and non-policy variables since the results indicate not only the effect of various values of controllable factors but also the effect of making an error in the estimation of any factor. For example, it was found that a relatively small variation in the marginal private propensity to consume may cause a much larger percentage difference in the foreign aid requirement. Output is available both at the sectoral and composite or overall levels.

5.02 The results for the total economy are divided into two parts depending on whether per capita income or foreign aid is treated as an input variable which can be varied. In either case, the results also depend on the values of many other parameters. Six of these parameters (population growth rate, private marginal propensity to consume, direct tax rate, indirect tax rate, capital output ratios and depreciation rates) were selected for additional sensitivity analyses. These parameters are varied individually for fixed per capita income growth rates of 2% and 4% (Section 5B) and for fixed annual foreign aid levels of $200 and $500 million (Section 5C), resulting in twenty four tables, each of which includes output for the values of the parameter given in Table 12. The estimated values of the six parameters are called the "base", and the sensitivity analyses depict the effect of any departure from the base.

A. Sectoral Results

5.03 The effect of different per capita income and population growth rates on the sectoral components are found for combinations of growth rates of population and per capita income presented below:

Table	Population Growth Rate	Per Capita Income Growth Rate	Total Growth Rate
8	.03	.02	.05
9	.03	.03	.06
10	.03	.01	.04
11	.02	.03	.05

5.04 A 3% population growth and a 2% growth in per capita income amounts to a 5% average growth rate for the economy. Table 8, which presents sectoral results for this situation, indicates that agriculture and transportation will have consistently lower than average growth rates while construction starts lower but moves higher than the average by 1983. More specifically, the agricultural sector declines from 56% of GDP in 1973 to 43% in 2003, with an average growth rate of 4.2%; manufacturing increases from 9.2% of GDP to 11.0% in the thirty year period with a growth rate rising from 5.1% in 1973 to 6.0% in 2003. Utilities has the highest sectoral growth rate but starts from the lowest share of GDP. Both trade and services, like utilities, experience declining growth rates but still capture increasing percentages of the GDP since their growth rates never fall below the average growth rate.

Table 9 presents results from a 3% growth in per capita income rather than 2%. In comparison with the above case, the growth rate for agriculture increases by 0.5%, construction and transportation by about 1%; manufacturing, trade and services by an average of about 1.5%; and utilities by an average of about 2%. Thus, with increasing per capita income, agriculture contributes less in relation to its size than the other sectors to overall GDP growth.

5.05 If the per capita income growth rate is only 1%, then from Table 10 the agricultural growth rate will be about 3.6%, still higher than the 3% average annual growth rate experienced from 1964 to 1969. Table 11 gives results for a 2% population growth combined with a 3% growth in per capita income. This results in the same GDP and the same GDP growth rate as the initial case (3% population growth and 2% per capita income growth), but permits some insight into the effects of the tradeoff between population growth and per capita income growth. With this higher per capita income growth rate, the agricultural sector growth rate is reduced by an average of .5%, while the manufacturing, utilities, transportation, trade and services sectors grow slightly faster, and construction is not affected significantly. Also, the annual investment savings gap for the higher per capita income growth rate starts $34 million higher in 1973 (due to the initial investment requirement being affected more by the higher per capita income than by the lower population), but then is even in 1983 (as the lower population outweighs the higher per capita income effect), and produces a $160 million greater surplus by 2003.

B. Foreign Aid as a Function of Key Factors

5.06 In this section the level of foreign aid corresponding to different values of per capita income and six other parameters is calculated at ten year intervals from 1973 to 2003 and rounded to the nearest $ 5 million. When quantities other than per capita income are varied, parametric results will be presented for both 2% and 4% levels of per capita income (pci) growth.

Per Capita Income Growth Rate

5.07 With a 2% growth in per capita income, the time-phased foreign aid requirement would decrease steadily during 1973-2003. The 1973 level of $265 million decreases to self-sufficiency by about the year 2000, and an annual surplus of $65 million is projected for 2003. The steady reduction in the gap indicates that savings generated by previous investments grow faster than investment requirements. If the per capita income growth rate were 1% the foreign aid requirement would be reduced by 70-100 million dollars annually from 1973 to 1993. By 2003, however, the 1% growth rate requires more foreign aid than the 2% rate since with the 2% rate savings from investment prior to 2003 dominates the added investment required for faster growth. A jump to a 3% growth in per capita income would increase the gap by 55-145 million dollars over 1973-2003 over the 2% level, and a 4% per capita income growth rate would require foreign aid in excess of one-quarter billion dollars during 1973-2003, exceeding one-half billion dollars in 1978-1998. Foreign aid levels are from $200-400 million higher with a 4% per capita income growth than with 2%. In fact, at the 4% rate thirty years are required before the foreign aid needed falls to the 1973 level at the 2% rate.

Per capita income growth rate	Foreign Aid Requirement (Millions of Dollars) 1973	1983	1993	2003
.01	165	125	75	10
.02	265	225	135	-65
.03	365	355	280	-10
.04	465	525	550	265

Population Growth

2% Per Capita Income Growth Rate

5.08 If the population growth rate is 2.8% rather than 3%, the amount of annual foreign aid needed is reduced by an average of $25 million, starting at about $10 million in 1973 and growing to $45 million in 2003. At a 2.6% population growth, the annual savings ranges from about $25 million in 1973 to $75 million in 2003. If the annual population growth could be constrained to a 2% level, a trade surplus of over $200 million would result with annual savings over the base growing from $65 million in 1973 to $150 million in 2003. The increase of the increment in the later years is due to the geometric population progression.

Population Growth Rate	Foreign Aid Requirement (Millions of Dollars) 2% pci growth 1973	1983	1993	2003
.030 (base)	265	225	135	-65
.028	255	200	100	-105
.026	240	180	70	-140
.020	200	120	- 5	-215

4% Per Capita Income Growth Rate

5.09 Here a surplus appears by 2003 only for population growth rates of about 2.4% and less.

Population Growth Rate	Foreign Aid Requirement (Millions of Dollars) 4% pci growth 1973	1983	1993	2003
.030 (base)	465	525	550	265
.028	455	490	480	155
.026	440	455	415	55
.020	400	360	240	-185

Propensity to Consume

2% Per Capita Income Growth Rate

5.10 Because of the specific consumption function adopted, the foreign aid requirement in any year is a linear function of the private marginal propensity to consume. Each decrease of .01% in the propensity to consume

permits a reduction of: $45 million in foreign aid in 1973; $75 million in 1983; $120 million in 1993; and $200 million in 2003. The magnitude of the reduction grows rapidly since it is roughly proportional to the GDP. whose rate of increase is 5%. With a .02 reduction in propensity to consume, it is possible to eliminate the necessity for foreign aid by about 1998. Further, if the marginal propensity to consume would decline to .81 by 1983, foreign aid could be eliminated then.

Foreign Aid Requirements (Millions of Dollars)
2% pci growth

Private Marginal Propensity to Consume	1973	1983	1993	2003
.85	310	300	255	135
.84 (base)	265	225	135	-65
.83	220	150	10	-265
.82	175	75	-110	-465

4% Per Capita Income Growth Rate

Foreign Aid Requirements (Millions of Dollars)
4% pci growth

Private Marginal Propensity to Consume	1973	1983	1993	2003
.85	515	615	730	620
.84 (base)	465	525	550	265
.83	420	435	370	-90
.82	375	345	190	-445

Direct Tax Rate

2% Per Capita Income Growth Rate

5.11 The base direct tax rate, defined to be the ratio of direct taxes to GDP, is (.0263 + .00011 Y) where Y is per capita income. Since the private consumption formula is a linear function of direct taxes, the foreign aid requirement is a linear function of direct taxes and of the parameter whose value is .0263 above. Each increment of this parameter by .01 produces a decrease in required foreign aid of about $40 million in 1973, $65 million in 1983, $110 million in 1993 and $175 million in 2003. A .0163 reduction from the base situation would result in a direct tax rate of (.01 + .00011 Y) and foreign aid starting at $330 million and descending to $220 million by 2003. But even this unfortunate situation is better than the direct tax rate of .01 which was estimated in the 1960's. If the direct tax rate were increased to (.04 + .00011 Y) the foreign aid requirement would fall from $210 million in 1973 to nil about 1992, with surplus rising to $300 million in 2003. This signifies annual savings over the base direct tax of between $55 and $240 million during 1973-2003. With a further increase of .01 above the base, required foreign aid would decline from $170 million in 1973 to zero near 1988 and provide a net savings of almost $500 million by 2003. This can be compared with 1960 data from Table 1 for Ecuador (6%), Greece (8%), Kenya (6%), Malaysia (6%), Peru (6.5%) and Uruguay (13%).

Direct Tax Rate: .00011 Y +	Foreign Aid Requirement (Millions of Dollars) 2% pci growth 1973	1983	1993	2003
.01	330	330	310	220
.0263 (base)	265	225	135	- 65
.04	210	135	- 10	-305
.05	170	70	-120	-480

4% Per Capita Income Growth Rate

Direct Tax Rate: .00011 Y +	Foreign Aid Requirement (Millions of Dollars) 4% pci growth 1973	1983	1993	2003
.01	530	655	805	775
.0263 (base)	465	525	550	265
.04	410	420	335	-165
.05	375	340	180	-475

Net Indirect Tax Rate

2% Per Capita Income Growth Rate

5.12 The net indirect tax rate, the ratio of indirect taxes less subsidies to GDP, is (.0835 + .00005 Y) in the base. Foreign aid requirements are a linear function of the net indirect tax rate, and each rate increment of .01 reduces the need for foreign aid by $35 million in 1973, $60 million in 1983, $95 million in 1993 and $155 million in 2003. Any change in the net indirect tax rate has about 20% more effect on the gap than the same change in the direct tax rate because all net indirect taxes add to savings but only 84% of direct taxes constitute added savings. This results since 16% of the amount of the direct tax would have been saved even without the tax, assuming a marginal propensity to consume of .84.

5.13 The indirect tax rate estimated for Bangladesh in the 1960's was about 3%, whereas the base rate varies from 8.7% in 1973 to 8.9% in 2003. If the rate is .0135 lower than the base, or (.07 + .00005 Y), which is twice the recent rate, the foreign aid requirement starts at $330 million in 1973 and only falls to $215 million by 2003. On the other hand, with an increase of .0165 above the base to (.10 + .00005 Y), foreign aid would decline from a moderate peak of $190 million in 1973 to zero about 1990 with a substantial surplus by 2003. In 2003, the net indirect tax rate at this higher level would be less than 11% -- not excessive when measured against other countries listed in Table 1 such as Barbados (13%), China (14%), Honduras (9%), Korea (8%), Morocco (10%), Nigeria (9%) and Vietnam (12%).

Foreign Aid Requirement (Millions of Dollars)
2% pci growth

Net Indirect Tax Rate .00005 Y +	1973	1983	1993	2003
.07	330	330	305	215
.0835 (base)	265	225	135	- 65
.10	190	95	-75	-410

4% Per Capita Income Growth Rate

Foreign Aid Requirement (Millions of Dollars)
4% pci growth

Net Indirect Tax Rate .00005 Y +	1973	1983	1993	2003
.07	530	655	805	770
.0835 (base)	465	525	550	265
.10	390	370	240	-350

Capital Output Ratios

2% Per Capita Income Growth Rate

5.14 The working and fixed capital output ratios in all sectors are changed simultaneously in this analysis by the same percentage to determine the effect on the gap. If the ratios are 80% of the principal estimates, then the aid needed declines from $150 million in 1973 to zero in about 1985 and a surplus of $200 million would result by 1993. At 90%, the maximum aid is $205 million with a $30 million surplus by 1993. For 110% the gap starts at $325 million and never results in a surplus, declining only to $210 in 2003 The gap is a linear function of the ratios, and each 1% error in estimation of all the capital output ratios causes an error in foreign aid calculations of 6, 10, 17 and 28 millions of dollars in 1973, 1983, 1993 and 2003, respectively.

Foreign Aid Requirement (Millions of Dollars)
2% pci growth

Capital output ratios as a percentage of base estimates	1973	1983	1993	2003
80%	150	25	-200	-625
90%	205	125	- 30	-345
100% (base)	265	225	135	- 65
110%	325	325	300	210

4% Per Capita Income Growth Rate

Capital output ratios as a percentage of base estimates	Foreign Aid Requirement (Millions of Dollars) 4% pci growth 1973	1983	1993	2003
80%	310	205	-110	-1045
90%	385	365	220	- 390
100% (base)	465	525	550	265
110%	545	690	880	920

Depreciation Rates

2% Per Capita Income Growth Rate

5.15 All the sectoral depreciation rates are altered by the same percentage to determine the sensitivity of the gap to depreciation. At 80% of the original values, the requirement for foreign aid has a maximum of 220 million in 1973, disappears by 1993, and a $320 million surplus appears in 2003. Each 1% overestimation in the group of depreciation rates causes an overstatement in the gap of $2 million in 1973, $4 million in 1983, $7 million in 1993 and $13 million in 2003.

Depreciation rates as a percentage of base estimates	Foreign Aid Requirement (Millions of Dollars) 2% pci growth 1973	1983	1993	2003
80%	220	140	- 10	-320
90%	240	180	60	-195
100% (base)	265	225	135	- 65
110%	290	265	205	60

4% Per Capita Income Growth Rate

Depreciation rates as a percentage of base estimates	Foreign Aid Requirement (Millions of Dollars) 4% pci growth 1973	1983	1993	2003
80%	420	420	325	-200
90%	440	475	440	35
100% (base)	465	525	550	265
110%	490	580	660	500

C. Per Capita Income as a Function of Key Factors

5.16 In this section the annual per capita income (pci) growth rate is determined as a function of (net) foreign aid for the same parametric variations considered in the preceding section and presented in Table 12. When quantities other than foreign aid are varied, results will be presented for constant annual foreign aid levels of $200 and $500 million. These two levels were chosen for the sensitivity analyses since they achieve essentially the same levels of per capita income by 2003 respectively as the 2% and 4% per capita income growth rates utilized in the preceding section. For example, holding foreign aid at $200 million annually produces a steadily increasing per capita income growth which starts at 1.4% and achieves 2.6% by 2003, yielding a 30-year average growth rate only a trifle under 2%. The table below illustrates these equivalences:

Income and Aid Patterns

	1973	1983	1993	2003
1) $200 million annual foreign aid				
Per capita income ($)	64.0	74.5	90.4	114.5
Pci growth rate (%)	1.4	1.7	2.2	2.6
2) 2% pci growth rate				
Per capita income ($)	64.0	78.0	95.1	115.9
Foreign aid ($ millions)	265.	225.	135.	-65.
3) $500 million annual foreign aid				
Per capita income ($)	64.0	95.9	140.3	208.3
Pci growth rate (%)	4.3	3.9	4.0	4.2
4) 4% pci growth rate				
Per capita income ($)	64.0	94.7	140.2	207.6
Foreign aid ($ millions)	465.	525.	550.	265.

Foreign Aid

5.17 Annual foreign aid of $50 million would be unable to maintain the present per capita income level, while $100 million annual aid would only produce about a 20% improvement by 2003. Aid levels in the $300 to $400 million range yearly would yield average income levels in 2003 125% to 175% higher than at present. Nearly $500 million annually would be required to achieve a $200 per capita income within 30 years.

Annual Foreign Aid (Millions of Dollars)	Per Capita Income (Dollars) 1973	1983	1993	2003
50	64.0	63.4	62.6	57.8
100	64.0	67.1	72.2	78.5
200	64.0	74.5	90.4	114.5
300	64.0	81.8	107.7	147.4
400	64.0	88.9	124.3	178.5
500	64.0	95.9	140.3	208.3

5.18 An advantage of concentrating foreign aid in the early years versus distributing the same amount over a longer period is suggested by the table below, although increased debt service burdens have not been calculated. Spreading $6 billion evenly over 30 years yields a per capita income of $115 in 2003. By distributing the same amount uniformly over 20 years, average income climbs to $134, and a concentration in the first 10 years gives $159 by 2003.

Annual Foreign Aid (Millions of Dollars)	Per Capita Income (Dollars) 1973	1983	1993	2003
$200 during 1973-2002	64.0	74.5	90.4	114.5
$300 during 1973-1992; none thereafter	64.0	81.7	107.4	133.6
$600 during 1973-1982; none thereafter	64.0	102.7	123.3	159.2

Population Growth Rate

$200 Million Annual Aid

5.19 A decrease of .2% in the annual population growth rate would permit a $7 increase in per capita income by 2003. If a rate .4% lower than the base could be maintained, average income would be doubled in 30 years. A 1% decrease would yield a per capita of $158 by 2003, about 50% higher than the base.

Population Growth Rate	Per Capita Income (Dollars) $200 million annual aid 1973	1983	1993	2003
.030 (base)	64.0	74.5	90.4	114.5
.028	64.0	75.7	93.9	122.3
.026	64.0	76.9	97.4	130.5
.020	64.0	80.5	108.9	157.8

$500 Million Annual Aid

Population Growth Rate	Per Capita Income (Dollars) $500 million annual aid 1973	1983	1993	2003
.030 (base)	64.0	95.9	140.3	208.3
.028	64.0	97.4	145.2	220.2
.026	64.0	98.9	150.3	232.7
.020	64.0	103.7	166.6	274.6

Propensity to Consume

$200 Million Annual Aid

5.20 The private marginal propensity to consume significantly affects the average income level when foreign aid is constrained. A reduction of .01 from the .84 base results in a $27 increment in income by 2003, and a .02 decrease leads to a per capita income of $173 within 30 years.

Private Marginal Propensity to Consume	Per Capita Income (Dollars) $200 million annual aid 1973	1983	1993	2003
.85	64.0	70.6	79.1	89.5
.84 (base)	64.0	74.5	90.4	114.5
.83	64.0	78.6	102.5	142.2
.82	64.0	82.8	115.4	172.9

$500 Million Annual Aid

Private Marginal Propensity to Consume	Per Capita Income (Dollars) $500 million annual aid 1973	1983	1993	2003
.85	64.0	91.6	127.7	179.0
.84 (base)	64.0	95.9	140.3	208.3
.83	64.0	100.2	153.7	240.7
.82	64.0	104.7	168.0	276.7

Direct Tax Rate

$200 Million Annual Aid

5.21 An increase in direct taxes of 1.37% of GDP above the base results in a per capita income in 2003 of nearly $150. But a decrease of 1.63% would constrain average income to $80 in 30 years.

Direct Tax Rate = .00011 Y +	Per Capita Income (Dollars) $200 million annual aid 1973	1983	1993	2003
.01	64.0	69.0	74.7	79.8
.0263 (base)	64.0	74.5	90.4	114.5
.04	64.0	79.4	105.0	147.9
.05	64.0	83.1	116.2	175.1

$500 Million Annual Aid

Direct Tax Rate = .00011 Y +	Per Capita Income (Dollars) $500 million annual aid 1973	1983	1993	2003
.01	64.0	89.9	122.6	167.5
.0263 (base)	64.0	95.9	140.3	208.3
.04	64.0	101.1	156.4	247.6
.05	64.0	105.0	169.0	279.6

Net Indirect Tax Rate

$200 Million Annual Aid

5.22 An increase in the indirect tax rate of .0165 over the base would enable per capita income to reach $164 by 2003, $49 higher than the base. On the otherhand a decrease in the tax rate of .0135 would restrict average income to $80 in 2003.

Net Indirect Tax Rate = .00005 Y +	Per Capita Income (Dollars) $200 million annual aid 1973	1983	1993	2003
.07	64.0	69.0	74.9	80.3
.0835 (base)	64.0	74.5	90.4	114.5
.10	64.0	81.6	111.6	163.8

$500 Million Annual Aid

Net Indirect Tax Rate = .00005 Y +	Per Capita Income (Dollars) $500 million annual aid 1973	1983	1993	2003
.07	64.0	90.0	122.9	168.0
.0835 (base)	64.0	95.9	140.3	208.3
.10	64.0	103.4	163.9	266.3

Capital Output Ratios

$200 Million Annual Aid

5.23 Per capita income is highly sensitive to the capital output ratios. A 10% reduction in these ratios permits increases in average income of $5 in 1983, $18 in 1993 and $44 in 2003. The 80% entry below shows that if the ratios have been overestimated by 20%, the per capita income could reach $231 by 2003, over twice the base level.

Capital Output Ratios as a Percentage of Base Estimates	Per Capita Income (Dollars) $200 million annual aid			
	1973	1983	1993	2003
80%	64.0	87.6	134.5	231.3
90%	64.0	80.1	108.0	157.8
100% (base)	64.0	74.5	90.4	114.5
110%	64.0	70.3	78.2	87.0

$500 Million Annual Aid

Capital Output Ratios as a Percentage of Base Estimates	Per Capita Income (Dollars) $500 million annual aid			
	1973	1983	1993	2003
80%	64.0	116.5	209.2	397.6
90%	64.0	104.6	168.0	278.6
100% (base)	64.0	95.9	140.3	208.3
110%	64.0	89.2	120.7	162.9

Depreciation Rates

$200 Million Annual Aid

5.24 A change in the depreciation rates affects average income less than half as much as the same change in capital output ratios. Here a 10% reduction would augment per capita income by $2, $7 and $16, respectively in 1983, 1993 and 2003. A 20% decrease yields a $147 per capita income by 2003.

Depreciation Rates as Percentage of Base Estimates	Per Capita Income (Dollars) $200 million annual aid			
	1973	1983	1993	2003
80%	64.0	79.0	104.0	146.6
90%	64.0	76.7	97.7	130.0
100% (base)	64.0	74.5	90.4	114.5
110%	64.0	72.4	84.1	100.1

$500 Million Annual Aid

Depreciation Rates as Percentages of Base Estimates	Per Capita Income (Dollars) $500 million annual aid			
	1973	1983	1993	2003
80%	64.0	100.7	156.1	248.0
90%	64.0	98.3	148.0	227.4
100% (base)	64.0	95.9	140.3	208.3
110%	64.0	93.5	132.9	190.5

D. Employment as a Function of Key Factors

5.25 The employment rate (defined as the employed fraction of the labor force) depends basically on per capita income, labor productivities and the sectoral equations. Due to the difficulty in defining what constitutes a job, the employment rate is necessarily arbitrary. Accordingly, any single value of this statistic has limited utility. However, its trend is significant in indicating the extent to which the employment situation improves or deteriorates between 1973 and 2003. Such trends are presented below for specified levels of both per capita income growth rates and foreign aid.

Per Capita Income Growth Rate

5.26 When per capita income is specified, the employment rate is insensitive to variations of the base variables (Table 12), and hence only one sensitivity table appears below. For 2% growth in per capita income, the employment rate would fall by about a third during 1973-2003 since average labor productivity increases more rapidly than per capita income. An average per capita income growth rate of nearly 3.5% is needed just to return to the 1973 employment rate by 2003.

Per Capita Income Growth Rate	Employment Rate			
	1973	1983	1993	2003
.01	.80	.61	.51	.42
.02	.80	.66	.60	.54
.03	.80	.72	.71	.70
.04	.80	.78	.83	.89

Foreign Aid

5.27 When foreign aid is specified, per capita income (and hence employment) is a function of population, propensity to consume, tax rates, capital output ratios and depreciation rates, as shown explicitly in Section 5C. Although the employment rates also depend on all these variables, only per capita income and capital output ratios were selected for the sensitivity analyses below.

5.28 At a constant $100 million foreign aid level the employment rate drops to half its 1973 value by 2003. Even $300 million aid annually results in a one-sixth decrease in the employment rate after thirty years. Over $500 million of aid is needed annually during 1973-1983 in order to maintain constant employment in that interval.

Annual Foreign Aid (Millions of Dollars)	Employment Rate			
	1973	1983	1993	2003
50	.80	.57	.43	.31
100	.80	.59	.48	.39
200	.80	.64	.58	.54
300	.80	.69	.67	.67
400	.80	.74	.75	.78
500	.80	.79	.83	.89

Capital Output Ratios

$200 Million Annual Aid

5.29 With fixed foreign aid, lower (higher) capital output ratios produce higher (lower) levels of GDP, per capita income and employment. If all the capital output ratios were 20% lower, the employment rate would decline 10% by 1983 but spurt to nearly full employment shortly after the turn of the century. But at 110% of the base values the 1973 employment rate would be halved by 2003.

Capital Output Ratios as a Percentage of Base Estimates	Employment Rate $200 million annual aid			
	1973	1983	1993	2003
80%	.80	.73	.81	.97
90%	.80	.68	.67	.70
100% (base)	.80	.64	.58	.54
110%	.80	.61	.51	.43

$500 Million Annual Aid

5.30 Low capital output ratios produce employment rates exceeding one in 1993 and 2003. The most plausible explanation of this result is that: (i) the 80% employment rate in 1973 is too high; (ii) annual working time per job will increase through reduction of seasonal unemployment and increased working hours per week; and (iii) the labor force participation rate will increase.

Capital Output Ratios as a Percentage of Base Estimates	Employment Rate $500 million annual aid			
	1973	1983	1993	2003
80%	.80	.93	1.17	1.52
90%	.80	.85	.97	1.13
100% (base)	.80	.79	.83	.89
110%	.80	.75	.73	.72

VI. NEED FOR FURTHER STUDY

6.01 Some extensions and refinements which appear appropriate for future effort are presented below.

Utilization of Capital Output Ratios Dependent on Growth

6.02 The sectoral capital output ratios were calculated assuming target values for the year 2003. However, it would be expected that the faster the economy grows, the sooner the targets will be reached. Thus, to run the model for a wide range of growth rates it may be desirable either (i) to use multiple average capital output ratios dependent on sectoral growth; or (ii) to determine incremental capital output ratios. A simple formula for sectoral investment, I_t, as a function of the sectoral incremental capital output ratio is:

$$I_t = D \cdot K_t + k_t \cdot (V_{t+1} - V_t)$$

where

K_t = capital stock in year t

D = depreciation rate

V_t = value added in year t

k_t = incremental capital output ratio in year t

If a series of V_t and K_t are available then an estimate of the incremental capital output ratio may be obtained from the relation

$$k_t = \frac{K_{t+1} - K_t}{V_{t+1} - V_t}$$

since

$$I_t = K_{t+1} - K_t \cdot (1 - D)$$

Replacement of Sectoral Equations by an Optimizing Demand Oriented Model

6.03 The sectoral equations prescribe the relative magnitudes of the sectors when per capita income is specified. Even though the sectoral equations are based on the aggregated experience of several other countries, they do not necessarily result in a sectoral production allocation for Bangladesh which is either plausible or optimal. Emphasis could be placed on maximization of per capita income or employment explicitly considering demand functions and constraints on resources, foreign aid, trade and infrastructure.

Refinement of Private Consumption Function

6.04 Since the investment-savings gap is apparently more sensitive to the private propensity to consume than to any other parameter, it is especially important to obtain an accurate private consumption function. Forms of regression equations other than those already tried may provide better fits -- for example,

$$PC_t = \alpha_0 + \alpha_1 \cdot PDI_t + \alpha_2 \cdot PC_{t-1}$$

where PC_t and PDI_t are private consumption and private disposable income, respectively, in year t.

Development of a More Appropriate Exchange Rate

6.05 Official exchange rates were used for all countries constituting the cross-national data sample. This probably has a biasing effect on derivation of the sectoral equations and functions for direct taxes, indirect taxes and consumption since it does not necessarily result in comparability of average costs of goods and services among countries. Such comparability may be more closely approached by utilization of free exchange rates or other conversion factors.

Low Capital Inflow Simulation

6.06 In order to reduce the short-term investment-savings gap, a less capital-demanding series of capital output ratios and labor productivities could be generated. Although the long-run effect of an increase in productivity should decrease the investment-savings gap, the short-term effect is to concentrate scarce investment funds on a small number of jobs. For example, according to the coefficients utilized, the capital per job increases by a factor of six in agriculture between 1973 and 2003.

Refinement of Productivity and Capital Output Coefficients

6.07 Since most of the productivity and capital output coefficients for Bangladesh in 2003 were derived somewhat subjectively by setting them equal to values achieved by a more advanced country in 1960, a more analytic methodology for determining their values may be found.

Refinement of Sectoral Equation for Utilities

6.08 In the model, water development projects are apparently assumed to be part of utilities rather than agriculture. This could explain the low capital output ratio and high depreciation rate (9.5%) in agriculture. For the water program to be properly included in the utilities sector it may be necessary to alter the sectoral equation, capital output ratio and depreciation rate for utilities.

TABLE 1

BANGLADESH - SECTOR STUDY

DIRECT AND INDIRECT TAXES FOR SELECTED COUNTRIES (1960)

Country	GDP at 1960 factor cost ($ Millions) 1/	Direct Taxes/GDP	Indirect Taxes/GDP	Per Capita GDP ($) 1/
Barbados	69.9	.0551	.1319	301
Ceylon	1,316.8	.0341	.0659	133
Chile	2,992.9	.1167	.1244	408
China	1,371.8	.0275	.1403	130
Colombia	3,749.1	.0417	.0676	265
Costa Rica	402.2	.0348	.1223	343
Ecuador	787.2	.0615	.1000	183
El Salvador	521.2	.0160	.0890	215
Greece	3,083.3	.0832	.1178	371
Honduras	345.2	.0148	.0949	189
India	28,391.4	.0311	.0703	67
Israel	2,115.6	.1098	.1478	998
Jamaica	604.8	.0533	.0917	375
Kenya	631.7	.0585	.0714	89
Korea	3,483.2	.0265	.0816	139
Malaysia	1,705.9	.0573	.1751	246
Morocco	1,628.5	NA	.1032	140
Nigeria	2,576.1	.0235	.0903	93
Panama	383.4	.0501	.0902	356
Peru	1,925.6	.0646	.0770	189
S. Rhodesia	787.7	.0793	.0633	380
Thailand	2,502.1	.0123	.0889	95
Tunisia	764.3	.0883	.1763	182
Turkey	5,196.5	.0379	.0941	187
Uruquay	1,139.4	.1299	.0807	457
Venezuela	7,330.1	.0810	.0855	1,006
Vietnam	1,353.0	.0109	.1253	97
Zambia	578.7	.1084	.0315	179
Bangladesh 1965-66	3,925.7	NA	.0442	66
Bangladesh 1959-60	3,056.7	.0112	.0294	57

1/ Calculated at official exchange rates.

TABLE 2

BANGLADESH - SECTOR STUDY

GOVERNMENT CONSUMPTION FOR SELECTED COUNTRIES (1960)

	Country	Government Consumption ($ millions)	Gross Domestic Product ($ millions)	Population (Millions)	Per Capita Gross Domestic Product ($)	Per Capita Government Consumption ($)
1.	Barbados	8.6	69.9	0.232	301	37.1
2.	Brazil	1808.3	9389.3	70.967	132	25.5
3.	Ceylon	201.3	1316.8	9.902	133	20.3
4.	Chile	424.5	2992.4	7.340	408	57.8
5.	China (Taiwan)	294.0	1371.8	10.593	130	27.8
6.	Costa Rica	51.1	402.2	1.173	343	43.6
7.	Ecuador	111.0	787.2	4.312	183	25.7
8.	El Salvador	57.2	521.2	2.424	215	23.6
9.	Greece	386.7	3083.3	8.321	371	46.5
10.	Honduras	36.6	345.2	1.830	189	20.0
11.	India	2310.0	28391.4	425.523	67	5.4
12.	Iran	427.7	4133.3	20.352	203	21.0
13.	Ivory Coast	60.8	534.7	3.228	166	18.8
14.	Jamaica	60.5	604.8	1.614	375	37.5
15.	Korea	546.8	3483.2	24.994	139	21.9
16.	Malyasia	260.5	1705.9	6.921	246	37.6
17.	Morocco	241.1	1628.5	11.627	140	20.7
18.	Nigeria	192.9	2576.1	35.106	73	5.5
19.	Panama	46.9	383.4	1.076	356	43.6
20.	Peru	174.1	1925.6	10.162	189	17.1
21.	Philipines	380.1		27.456	146	13.8
22.	Puerto Rico	250.2	1671.8	2.350	711	106.5
23.	South Africa	752.1	6740.9	15.931	423	47.2
24.	Southern Rhodesia	88.5	787.7	2.074	380	42.7
25.	Thailand	261.8	2502.1	26.258	95	10.0
26.	Tunisia	133.6	764.3	4.189	182	31.9
27.	Uruguay	111.3	1129.4	2.494	457	44.6
28.	Venezuela	1100.6	7330.1	7.284	1006	151.1
29.	Vietnam	258.1	1353.0	13.975	97	18.5
30.	Zambia	59.1	578.7	3.235	179	18.3

BANGLADESH - SECTOR STUDY

Sectoral Coefficients

Sector	Fixed Capital Output Ratios/Productivities[1] in Dollars								Depreciation Rate	Working Capital Output Ratio
	1973	1978	1983	1988	1993	1998	2003	2008[2]		
Agriculture	0.25/ 171	0.29/ 203	0.35/ 243	0.41/ 277	0.48/ 316	0.56/ 360	0.66/ 411	0.76/	.095	.104
Manufacturing	3.14/ 264	2.91/ 331	2.7/ 417	2.51/ 525	2.32/ 660	2.16/ 831	2/ 1045	1.84/	.055	.563
Construction	0.25/ 1142	0.258/ 1201	0.266/ 1262	0.274/ 1326	0.282/ 1394	0.291/ 1465	0.3/ 1540	0.309/	.095	1.225
Utilities	7.4/ 1746	7.07/ 1944	6.76/ 2166	6.46/ 2412	6.17/ 2686	5.9/ 2991	5.64/ 3332	5.38/	.025	.097
Transportation	2.38/ 788	2.45/ 870	2.53/ 962	2.61/ 1062	2.7/ 1173	2.78/ 1296	2.87/ 1431	2.96/	.045	.015
Trade	1.44/ 386	1.31/ 469	1.18/ 569	1.07/ 690	0.97/ 838	0.88/ 1039	0.8/ 1235	0.72/	.025	.0005
Services	3.19/ 390	2.95 430	2.73/ 475	2.52/ 523	2.33/ 578	2.16/ 639	2/ 705	1.84/	.025	.01

TABLE 3

1/ In order to calibrate the data to 80% employment in 1973 (rather than 95% used by Dorfman), the above productivities were obtained by multiplying the corresponding Dorfman coefficients by 1.1875 (i.e., .95/.80).

2/ Capital output ratios for 2008 were extrapolated for use in calculating investment requirements in 2003.

SECTORAL RESULTS

Sector	1973		1983		1993		2003	
	Percent of GDP	Growth Rate Pecent	Percent of GDP	Growth Rate Percent	Percent of GDP	Growth Rate Percent	Percent of GDP	Growth Rate Percent
1. Agriculture	56.3	3.3	52.9	3.5	50.3	3.5	48.0	3.6
2. Manufacturing	9.2	4.1	9.3	4.3	9.6	4.4	10.0	4.5
3. Construction	4.7	3.8	4.6	4.0	4.6	4.0	4.7	4.1
4. Utilities	0.3	13.8	0.6	8.7	0.9	7.0	1.1	6.2
5. Transportation	5.0	3.3	4.7	3.3	4.3	3.1	3.9	2.7
6. Trade	10.3	6.4	12.0	5.0	12.9	4.6	13.5	4.4
7. Services	14.1	5.3	15.8	5.1	17.4	4.6	18.9	4.8

8. Population (10^6)	74.5	98.2	129.4	170.6
9. Jobs (10^6)	18.3	18.8	20.9	23.2
10. Employment rate	.70	.54	.46	.39
11. Per Capita Income ($)	64.0	72.1	81.2	91.5
12. GDP ($\$10^6$)	4768	7081	10515	15614
13. Foreign Aid ($\$10^6$)	173	125	57	-43

Population growth rate .028 Per capita income growth rate .012 Total growth rate .04
Sectoral Results Corresponding to 3.5% Average Agricultural Growth during 1973-2003.

TABLE 4

Discounted Gap Reduction Resulting from a Multi-Sectoral Investment

1. In both the Dorfman and extension models, the GNP is not diminished by debt servicing before determination of consumption and savings. This implies that savings must cover debt servicing. Accordingly, this section calculates the present value of all annual savings derived from an incremental multi-sectoral investment (until its residual value is nil) as a function of various discount rates[1/] and two depreciation patterns. Savings depend on incremental capital output ratios, depreciation rates, and consumption and tax rates. The discounted savings less investment is the cumulated reduction in the "discounted (cumulative investment-savings) gap".

2. The calculations are based on the following values: savings per GDP increment = .2, incremental capital output ratio = 1.4 and depreciation rate = .05. Then a $100 increment in GDP the first year corresponds to a $140 investment in year zero and $20 savings in year one. Suppose the incremental investment made in year zero depreciates at annual rate D after year one. No further investment is made, and the capital stock is assumed to contribute to GDP and savings in succeeding years proportionately to its undepreciated value. If R denotes the discount rate, then the present value (in dollars) of the increment in savings from all productive years is:

$$(1) \qquad \frac{20}{1 - D} \sum_{i=i}^{\infty} \left(\frac{1 - D}{1 + R}\right)^{i} = \frac{20}{R + D}$$

3. With annual depreciation, an incremental investment would reduce the discounted gap for interest rates 9% and below. Each $140 increment on investment produces a $260 decrease in undiscounted gap. This explains the sharp declines in the calculated net foreign aid requirements toward the end of the century with 2 and 4% pci growths, compared to the increase necessitated by no pci growth (see Table 13).

IMPACT OF $140 INVESTMENT
(Annual Depreciation)

	Interest Rate R (%)			
	0	5	9	10
Present Value of Savings ($) (Equation (1))	400	200	143	133
Discounted Gap Reduction ($)	260	60	3	-7

1/ Benefits represented by increased consumption accruing from the investment are not included in this analysis.

4. With fractional depreciation a simple expression results for the internal rate of return. If S denotes savings per GDP, then discounted savings per GDP are S/(R+D) and investment per GDP is given by ICOR, the incremental capital output ratio. Equating marginal discounted savings to investment yields:

$$R = \frac{S}{ICOR} - D$$

5. The same type of calculation can be applied to a more favorable depreciation assumption. If investment generates a constant level of output for 1/D years and nothing thereafter (rather than annual depreciation) then the present value of all savings is simply the present value of a unit annuity over 1/D years multiplied by savings in the first year:

$$(2) \qquad 20 \cdot \left[\frac{1 - \left(\frac{1}{1+R} \right)^{1/D}}{R} \right]$$

A reduction in discounted gap occurs for discount rates up to 13%, 4% higher than for the more conservative depreciation assumption. The difference in the discounted gap reduction between the two depreciation assumptions is nil at zero interest.

IMPACT OF $140 INVESTMENT
(One Step Depreciation)

	Interest Rate R (%)				
	0	5	10	13	14
Present Value of Savings ($) (Equation (2))	400	249	170	140.4	132
Discounted Gap Reduction ($)	260	109	30	.4	-8

Computational Solution

The two extension models involve finding either the foreign aid requirement or per capita income as a function of specifications for many other factors such as population growth, relative sectoral growth, direct tax rate and marginal propensity to consume. Both versions utilize the equation:

$FA(t)$ = Foreign aid requirement (or investment-savings gap) in year t

$$= TC(t) + I(t) - GNPM(t),$$

where

$$I(t) = \sum_i \{A(i,t) + E(i,t) + B(i,t)\},$$

and the following dependency relationships:

Term	Dependent on
$TC(t)$	$N(t)$, $Y(t)$
$GNPM(t)$	$N(t)$, $Y(t)$
$A(i,t)$	$N(t+1)$, $Y(t+1)$, $N(t)$, $Y(t)$
$E(i,t)$	$N(t)$, $Y(t)$
$B(i,t)$	$N(t)$, $Y(t)$, $N(t-1)$, $Y(t-1)$
$I(t)$	$N(t+1)$, $Y(t+1)$, $N(t)$, $Y(t)$, $N(t-1)$, $Y(t-1)$
$FA(t)$	$N(t+1)$, $Y(t+1)$, $N(t)$, $Y(t)$, $N(t-1)$, $Y(t-1)$

Descriptions of the two extensions follow. Notation not defined in this appendix is included in the glossary.

A. Determination of foreign aid requirement for specified per capita income. (Extension 1)

The quantities $N(0)$, DN, $Y(0)$, and DY are input; this enables calculation of $N(t)$ and $Y(t)$, $t \geq 0$. Then $FA(t)$ is easily found for any value of t since all terms on the right hand side of the formula for $FA(t)$ have known values.

B. Determination of per capita income for a specified foreign aid pattern. (Extension 2)

The quantities $N(0)$, DN, $Y(0)$ and $FA(t)$, $t \geq 0$ are input; this enables calculation of $N(t)$, $t \geq 0$. Then if the values of $Y(t)$ and $Y(t-1)$ were known, $Y(t+1)$ could be calculated since it would be the only unknown on the right hand side of the equation for $FA(t)$.

Since $Y(0)$ is known, it is possible to determine the sequence $Y(t)$, $t \geq 1$, by starting with $t=0$ to calculate $Y(1)$, then setting $t=1$ to find $Y(2)$ etc. As shown by the dependency relations, the only part of the $FA(t)$ relation involving $Y(t+1)$ is $A(i,t)$. In order to isolate the terms involving $Y(t+1)$ we may define:

$$R(Y(t+1)) = \sum_i (V(i,t+1) \cdot C(i,t+1))$$

$$= Y(t+1) \cdot N(t+1) \cdot \sum_i \left\{ X(i, Y(t+1), N(t+1)) \cdot C(i, t+1) \right\}$$

$$S(Y(t), Y(t-1)) = \sum_i \left\{ E(i,t) + B(i,t) - V(i,t) \cdot C(i,t) \right\}$$

and $$Q(Y(t), Y(t-1)) = FA(t) + GNPM(t) - TC(t) - S(t)$$

Then the desired relation is:

$$R(Y(t+1)) = Q(Y(t), Y(t-1))$$

since

$$I(t) = R(Y(t+1)) + S(Y(t), Y(t-1))$$

Unfortunately an explicit formula for Y(t+1) cannot be obtained from the relation involving R and Q due to the complicated manner in which Y(t+1) appears in the structural equations (X terms) of R(Y(t+1)). Hence the following iterative approximation method may be used to estimate the Y(t) series, where Q(Y(t), Y(t-1)) will be represented by Q(t) and R (Y(t+1)) will be denoted by R(t+1).

1. Initialize at 1973 by setting t = 0
2. Calculate Q(t)
3. Let Y'(t+1) = Y(t). All variables which are a function of Y'(t+1) will be denoted with a prime.

4. Find R'(t+1):

$$U'(t+1) = N(t+1) \cdot \sum_i \left\{ X'(i, Y'(t+1), N(t+1)) \cdot C(i, t+1) \right\}$$

$$R'(t+1) = Y'(t+1) \cdot U'(t+1)$$

5. Determine the error in R'(t+1) as a fraction of the correct value, Q(t):

$$ERR'(t) = \frac{Q(t) - R'(t+1)}{Q(t)}$$

6. Calculate the correction for Y'(t+1):

$$INC'(t) = \frac{ERR'(t)}{U'(t)}$$

7. If the error is large, increment Y'(t+1) by the correction:

   If $|ERR'(t)| \geq .0001$, set Y'(t+1) = Y'(t+1) + INC'(t), and return to Step 4.

8. If the error is small, proceed to estimate Y(t+2):

   If $|ERR'(t)| < .0001$, set Y(t+1) = Y'(t+1) and increment t by 1. If $t \leq 29$ return to Step 2; if t = 30 the procedure terminates since Y(30) has been calculated.

SECTORAL RESULTS

Sector	1973		1983		1993		2003	
	Percent of GDP	Growth Rate Pecent	Percent of GDP	Growth Rate Percent	Percent of GDP	Growth Rate Percent	Percent of GDP	Growth Rate Percent
1. Agriculture	50.3	3.7	50.8	4.0	46.6	4.1	42.7	4.0
2. Manufacturing	9.2	5.0	9.5	5.5	10.2	5.8	11.1	6.0
3. Construction	4.7	4.5	4.6	4.9	4.6	5.1	4.7	5.1
4. Utilities	0.3	22.0	0.8	10.7	1.2	8.3	1.6	7.2
5. Transportation	5.0	4.0	4.7	4.2	4.3	4.1	3.9	3.7
6. Trade	10.3	9.0	12.7	6.0	13.7	5.5	14.3	5.4
7. Services	14.1	7.1	16.9	6.6	19.4	6.2	21.7	6.0

8. Population (10^6)	74.5	98.2	129.4	170.6
9. Jobs (10^6)	18.3	20.2	24.2	29.1
10. Employment rate	.70	.59	.53	.49
11. Per Capita Income ($)	64.0	78.8	97.0	119.4
12. GDP ($\$10^6$)	4768	7736	12552	20365
13. Foreign Aid ($\$10^6$)	265	213	110	-111

Population growth rate .028 Per capita income growth rate .021 Total growth rate .05

Sectoral Results Corresponding to 3.9% Average Agricultural Growth during 1973-2003.

TABLE 5

SECTORAL RESULTS

Sector	1973		1983		1993		2003	
	Percent of GDP	Growth Rate Pecent	Percent of GDP	Growth Rate Percent	Percent of GDP	Growth Rate Percent	Percent of GDP	Growth Rate Percent
1. Agriculture	56.3	4.1	48.7	4.6	42.8	4.6	37.2	4.4
2. Manufacturing	9.2	6.1	9.8	7.0	10.9	7.4	12.7	7.7
3. Construction	4.7	5.3	4.6	6.0	4.7	6.2	4.8	6.3
4. Utilities	.3	31.2	1.0	12.3	1.6	9.4	2.0	8.2
5. Transportation	5.0	4.8	4.7	5.3	4.4	5.2	4.0	4.8
6. Trade	10.3	11.7	13.2	7.1	14.2	6.6	15.0	6.5
7. Services	14.1	9.2	18.1	8.1	21.4	7.5	24.3	7.1

8. Population (10^6)	74.5	98.2	129.4	170.6
9. Jobs (10^6)	18.3	21.9	28.5	37.2
10. Employment rate	.70	.64	.63	.62
11. Per Capita Income ($)	64.0	86.8	117.9	159.9
12. GDP ($\$10^6$)	4768	8528	15253	27282
13. Foreign Aid ($\$10^6$)	365	343	252	-66

Population growth rate .028 Per capita income growth rate .031 Total growth rate .06

Sectoral Results Corresponding to 4.5% Average Agricultural Growth during 1973-2003.

TABLE 6

SECTORAL RESULTS

Sector	1973		1983		1993		2003	
	Percent of GDP	Growth Rate Pecent	Percent of GDP	Growth Rate Percent	Percent of GDP	Growth Rate Percent	Percent of GDP	Growth Rate Percent
1. Agriculture	56.3	4.6	46.7	5.2	39.3	5.0	31.9	4.6
2. Manufacturing	9.2	7.2	10.1	8.6	11.9	9.2	14.9	9.6
3. Construction	4.7	6.1	4.6	7.2	4.7	7.4	4.9	7.3
4. Utilities	0.3	40.3	1.2	13.6	1.9	10.3	2.4	9.0
5. Transportation	5.0	5.6	4.7	6.5	4.4	6.4	4.1	5.9
6. Trade	10.3	14.4	13.6	8.1	14.7	7.7	15.6	7.5
7. Services	14.1	11.3	19.2	9.5	23.2	8.6	26.4	8.1
8. Population (10^6)	74.5		98.2		129.4		170.6	
9. Jobs (10^6)	18.3		23.8		33.5		47.4	
10. Employment rate	.70		.69		.74		.79	
11. Per Capita Income ($)	64.0		95.6		143.0		213.6	
12. GDP ($\$10^6$)	4768		9392		18501		36445	
13. Foreign Aid ($\$10^6$)	466		573		575		193	

Population growth rate .028 Per capita income growth rate .041 Total growth rate .07
Sectoral Results Corresponding to 4.9% Average Agricultural Growth during 1973-2003.

TABLE 7

BANGLADESH - SECTOR STUDY

SECTORAL RESULTS

Sector	1973		1983		1993		2003	
	Percent of GDP	Value Added Growth Rate Percent	Percent of GDP	Value Added Growth Rate Percent	Percent of GDP	Value Added Growth Rate Percent	Percent of GDP	Value Added Growth Rate Percent
1. Agriculture	56.3	3.9	51.0	4.2	47.0	4.2	43.3	4.2
2. Manufacturing	9.2	5.1	9.5	5.6	10.1	5.8	11.0	6.0
3. Construction	4.7	4.6	4.6	5.0	4.6	5.2	4.7	5.2
4. Utilities	.3	21.3	.8	10.7	1.2	8.4	1.5	7.3
5. Transportation	5.0	4.0	4.6	4.3	4.3	4.1	3.8	3.6
6. Trade	10.3	6.9	12.6	6.1	13.6	5.6	14.3	5.5
7. Services	14.1	7.1	16.8	6.7	19.2	6.3	21.4	6.1

8. Population (Millions)	74.0	99.4	133.6	179.6
9. Jobs	24.6	27.5	33.3	40.5
10. Jobs per Population	.33	.28	.25	.22
11. Per Capita Income ($)	64.0	78.0	95.1	115.9
12. GDP ($ Millions)	4736	7759	12710	20822
13. Foreign Aid ($ Millions)	267	224	134	-66

Population growth rate .03 Per capita income growth rate .02 Total growth rate .05

TABLE 8

BANGLADESH - SECTOR STUDY

SECTORAL RESULTS

Sector	1973		1983		1993		2003	
	Percent of GDP	Value Added Growth Rate Percent	Percent of GDP	Value Added Growth Rate Percent	Percent of GDP	Value Added Growth Rate Percent	Percent of GDP	Value Added Growth Rate Percent
1. Agriculture	56.3	4.3	48.9	4.8	43.2	4.7	37.8	4.6
2. Manufacturing	9.2	6.2	9.7	7.1	10.9	7.5	12.5	7.8
3. Construction	4.7	5.4	4.6	6.1	4.7	6.3	4.8	6.4
4. Utilities	0.3	30.5	1.0	12.4	1.5	9.5	2.0	8.3
5. Transportation	5.0	4.9	4.6	5.4	4.3	5.2	3.9	4.7
6. Trade	10.3	11.7	13.1	7.2	14.2	6.7	15.0	6.6
7. Services	14.1	9.2	18.0	8.2	21.3	7.6	24.1	7.2

8. Population (Millions)	74.0	99.4	133.6	179.6
9. Jobs	24.6	29.9	39.3	51.9
10. Jobs per Population	.33	.30	.29	.29
11. Per Capita Income ($)	64.0	86.0	115.6	155.3
12. GDP ($ Millions)	4736	8554	15449	27901
13. Foreign Aid ($ Millions)	367	356	280	-12

Population growth rate .03 Per capita income growth rate .03 Total growth rate .06

TABLE 9

BANGLADESH - SECTOR STUDY

SECTORAL RESULTS

Sector	1973		1983		1993		2003	
	Percent of GDP	Value Added Growth Rate Percent	Percent of GDP	Value Added Growth Rate Percent	Percent of GDP	Value Added Growth Rate Percent	Percent of GDP	Value Added Growth Rate Percent
1. Agriculture	56.3	3.4	53.5	3.6	51.2	3.6	49.3	3.6
2. Manufacturing	9.2	4.1	9.3	4.2	9.5	4.3	9.8	4.4
3. Construction	4.7	3.8	4.7	4.0	4.6	4.0	4.7	4.1
4. Utilities	.3	12.2	.6	8.3	0.8	6.9	1.0	6.2
5. Transportation	5.0	3.3	4.7	3.2	4.3	2.9	3.8	2.4
6. Trade	10.3	6.0	11.8	4.9	12.7	4.6	13.3	4.4
7. Services	14.1	5.1	15.5	5.0	16.9	4.9	18.2	4.8

8. Population (Millions)	74.0	99.4	133.6	179.6
9. Jobs	24.6	25.4	28.2	31.6
10. Jobs per Population	.33	.26	.21	.18
11. Per Capita Income ($)	64.0	70.7	78.1	86.3
12. GDP ($ Millions)	4736	7031	10437	15493
13. Foreign Aid ($ Millions)	166	126	75	10

Population growth rate .03 Per capita income growth rate .01 Total growth rate .04

TABLE 10

BANGLADESH - SECTOR STUDY

SECTORAL RESULTS

Sector	1973		1983		1993		2003	
	Percent of GDP	Value Added Growth Rate Percent	Percent of GDP	Value Added Growth Rate Percent	Percent of GDP	Value Added Growth Rate Percent	Percent of GDP	Value Added Growth Rate Percent
1. Agriculture	56.3	3.3	48.8	3.7	43.0	3.7	37.6	3.6
2. Manufacturing	9.2	5.1	9.7	6.0	10.8	6.4	12.5	6.7
3. Construction	4.7	4.4	4.6	5.1	4.7	5.3	4.8	5.3
4. Utilities	0.3	29.2	1.0	11.3	1.5	8.4	2.0	7.2
5. Transportation	5.0	4.0	4.7	4.6	4.6	4.7	4.4	4.6
6. Trade	10.3	10.6	13.1	6.1	14.2	5.7	14.9	5.5
7. Services	14.1	8.1	18.0	7.1	21.2	6.5	23.9	6.1

8. Population (Millions)	74.0	90.2	110.0	134.0
9. Jobs	24.6	27.1	32.3	38.6
10. Jobs per Population	.33	.30	.29	.28
11. Per Capita Income ($)	64.0	86.0	115.6	155.3
12. GDP ($ Millions)	4736	7759	12710	20822
13. Foreign Aid ($ Millions)	301	224	72	-226

Population growth rate .02 Per capita income growth rate .03 Total growth rate .05

TABLE 11

TABLE 12

BANGLADESH - SECTOR STUDY

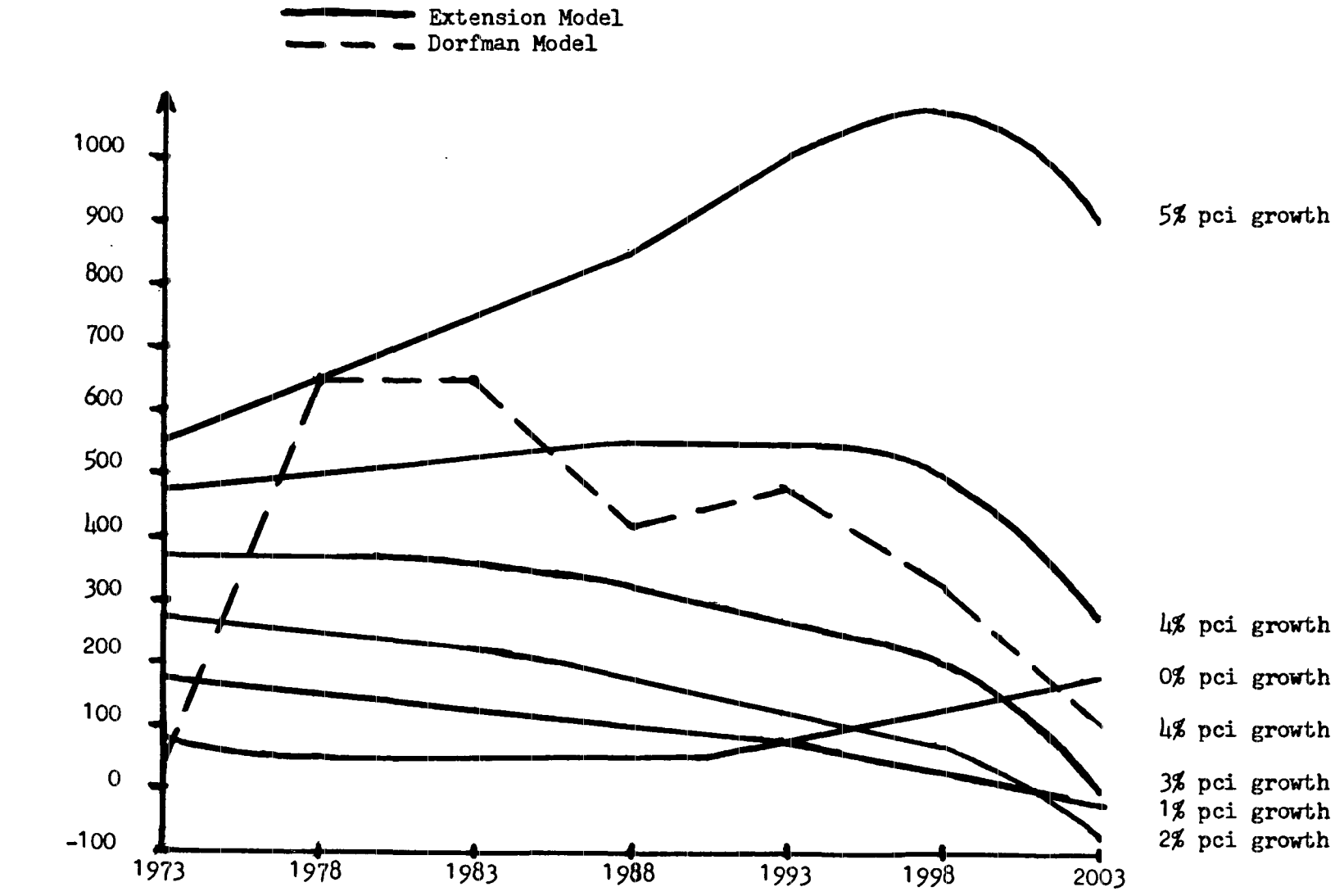
SENSITIVITY ANALYSES OF INTEREST

Input Variable	Fixed Value(s) to Determine Sensitivity to Other Variables	Variations
Principal variables		
1. Per capita income growth rate [1/]	.02; .04	.01; .03
Foreign aid [2/] ($ Millions)	200; 500	50; 100; 300; 500
Base variables		
2. Population growth rate	.03	.028; .026; .020
3. Marginal propensity to consume	.84	.85; .83; .82
4. Direct tax parameter	.0263	.01; .04; .05
5. Indirect tax parameter	.0835	.07; .10
6. Capital output ratios	Given in Table 3	80%, 90% and 110% of base estimates
7. Depreciation rates	Given in Table 3	80%, 90% and 110% of base estimates

1/ In Extension 2, which calculates per capita income, this is not an input variable.

2/ In Extension 1, which calculates foreign aid, this is not input variable.

FOREIGN AID PATTERNS AS A FUNCTION OF PER CAPITA INCOME (pci) GROWTH RATES



Note: Most of the discrepancy between the 4% pci paths of Dorfman and the extension model may be explained by: (i) one-year investment gestation period in extension model versus no lag in Dorfman model; (ii) constant population growth rate in extension model versus a generally declining growth rate in the Dorfman model.

TABLE 13

RESTRICTED

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL DEVELOPMENT ASSOCIATION

BANGLADESH

LAND AND WATER RESOURCES SECTOR STUDY

VOLUME III

SECTOR ECONOMICS

TECHNICAL REPORT NO. 4

THE LAND AND WATER SECTOR SEQUENCING MODEL

December 1, 1972

Asia Projects Department

BANGLADESH - SECTOR STUDY

VOLUME III - SECTOR ECONOMICS

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THE LAND AND WATER SECTOR SEQUENCING MODEL [1/]

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1/ This report was prepared by S.V. Allison

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BANGLADESH - SECTOR STUDY

VOLUME III - SECTOR ECONOMICS

TECHNICAL REPORT NO. 4

THE LAND AND WATER SECTOR SEQUENCING MODEL

SUMMARY AND CONCLUSIONS

i. This technical report presents a framework for systematic and consistent comparison of land and water development alternatives in Bangladesh. The model was initiated as a data processing system designed to minimize manual manipulation of large amounts of data for sensitivity analysis. However, the set of computer programs prepared for this purpose eventually evolved into what is in effect a simulation model of land and water development in Bangladesh.

ii. The analysis is based heavily on the division of Bangladesh into 58 Land Development Units (LDU's) described in Volume II. Using the soil and land use data of the Soil Survey, estimates are made of potential land use at various future stages of development, including: (a) improved inputs (with no irrigation or flood control); (b) inputs plus irrigation (with no flood control); and (c) inputs plus full water control.

iii. Development activities are defined as the steps necessary to move from one stage of development to the next. Costs and benefits associated with each development stage are estimated. The extent of development is limited by physical and institutional constraints. With these estimates, the model allows economic comparison of development activities on a consistent countrywide basis.

iv. In brief, the model maximizes gross value of agricultural production less costs of production less capital and recurrent costs of constructed facilities. The following constraints are imposed: (a) demand for the various agricultural commodities; (b) availability of land and irrigation water; and (c) implementation capacity. In its current formulation, the model is static or single period -- i.e., solved for a particular year. Applied to a series of discrete years (at 10-year intervals), it yields a series of "snapshots" of optimal development patterns. It is designed, however, for future development into a multi-period model to permit fuller investigation of sequencing strategies and constraints.

v. Some important conclusions of this report are that:

(a) It is possible for Bangladesh to reach self-sufficiency in food supplies by 1983 without further technological breakthroughs in development of high yielding rice varieties.

(b) Because of the generally longer gestation and construction times for major flood control projects, and also their

relatively lower economic returns, it would be desirable for dev for development during 1978-83 to emphasize agricultural inputs, low-lift pumps and tubewells. However, after 1983, flood control projects are likely to play an increasingly important role in the drive to increase agricultural productivity.

(c) Unless sites are selected with extreme care or cost can be brought down, tubewells may not be economically attractive in all areas where groundwater is available. There should therefore be continued emphasis on the importance of well site selection as well as on the development of new and lower cost tubewell technology, including effort to develop local drilling capacity.

(d) Development of land and water resources appears most profitable in the Northwest and Southwest Regions. Particular attention will have to be paid to development of transportation, storage, processing and marketing systems in these two regions in order to prevent depression of farm gate prices due to exceeding the capacity of these systems during and after the harvest season.

vi. While a considerable number of simplifying assumptions had to be made to permit construction of this model, the results compare most favorably with those obtained by laborious manual calculation, and a great many alternative development programs can be studied this way in a fraction of the time required for conventional analysis. While a more formal linear programming dynamic appraoch should be included in later applications, the model, even in its present rudimentary state, represents the real situation with sufficient accuracy to be a very useful planning tool.

BANGLADESH - SECTOR STUDY

VOLUME III - SECTOR ECONOMICS

TECHNICAL REPORT NO. 4

THE LAND AND WATER SECTOR SEQUENCING MODEL

I. INTRODUCTION

1.01 The Action Program report published in July 1970 stated, as one of its four primary objectives, that there should be a major effort to develop a more systematic and comprehensive approach to planning land and water development in Bangladesh. This Technical Report is a first step in this direction. It provides an analytical framework or "model" for systematic land and water resources planning for the region.

1.02 The principal targets of development in the land and water sector are to cause sufficient increase in agricultural production to: (a) minimize foodgrain imports; (b) absorb a high proportion of the population into productive rural employment; (c) increase foreign exchange earnings through jute production; and (d) improve dietary standards by increasing protein production. There are substantial possible trade-offs between these objectives. For example, capital can be substituted for labor through mechanization; policies may be devised to emphasize land use shifts from paddy into jute or pulses. The model presented here does not consider fully alternative strategies for factor use, nor does it investigate exhaustively the implications of multiple objectives for land and water development policies. Some of these limitations will be removed through continued work with the Bank's Basic Research Center and Harvard's Center for Population Studies. As a linear programming model becomes fully operational it will be possible to eliminate some of the simpler assumptions. Interaction with the group at Harvard, combined with the project review work performed by Acres under the Interim Work Program, is expected to improve treatment of costs and benefits for individual projects. The basic data, however, cannot be improved significantly until it is possible to return to Bangladesh and work with the Planning Board and operational agencies for an extended period.

1.03 In spite of these shortcomings, the results obtained provide indications of development priorities which accord well with common sense, appear consistent with each other, and make full use of available data. They must, however, be viewed very much as a demonstration of the kind of planning that can and should be done by authorities in Bangladesh.

II. FRAMEWORK

The Model

2.01 The conceptual framework for the model is as follows:

(a) Objectives. To select a set of development activities (for each planning period) which would maximize the net benefits to the economy, subject to identifiable constraints.

(b) Stages of development. For each of the 58 land development units (LDU's) 1/ defined by the Soil Survey of Pakistan (see Vol. II, T.R. No.2), four possible "stages" of development were identified: (a) present (traditional agriculture); (b) improved agriculture only (seeds, fertilizer, pesticides and extension); (c) improved inputs plus irrigation from tubewells (no flood control/drainage); (d) improved inputs plus complete water control (full irrigation and drainage).

(c) Development activities and planning periods. For each LDU certain actions are called for to move from one stage of development to another. The thirty years have been divided into three 10-year planning periods to permit definition of the most favorable pattern of development which could be brought into existence by the end of each decade. Within this framework it is assumed that each activitiy selected for inclusion in the development program will be fully productive by the end of the 10-year period. This means that projects with long gestation periods have to be started very early while those which come to fruition fast can be initiated gradually and with more flexibility.

(d) Development alternatives. For any LDU in the undeveloped state, there exists the possibility (subject to hydrologic constraints) of shifting up to any of the other stages of development, or of doing nothing. For the 58 LDU's in the undeveloped state there are then 58 x 4 = 232 alternative activities. As several of these activities (as defined in light of present knowledge and foreseen technological changes) are mutually exclusive, the number of alternatives diminishes once the development process has started until, at full development, the solution is to "do nothing" for all LDU's. In practice, the flood control and drainage activities tend to have longer gestation periods than inputs package programs, or irrigation development by individual lowlift pumps or tubewells. As a result, the number of activities which can lead to full production in the first 10-year planning period are limited, and it is not until the 1980-1990 period that the contribution from the full range of activities is considered.

1/ While the number of LDU's identified by the Soil Survey is 49, 9 extra subunits have also been delineated and have been used as basic land units for the purposes of the planning model. All are shown in the foldout map which precedes the Annexes to this volume.

(e) The choice between alternatives. Activities are selected in such a way as to maximize net benefits to the economy. The benefits of each activity are defined in terms of increased net annual value per acre of agricultural production due to the move from one state to the next. The costs are in terms of the per acre costs (including capital outlay, operation, maintenance and replacements) of the facilities and services required to make the move possible. The net benefits, which are to be maximized, are the sum of the differences between unit benefits and costs as defined above multiplied by the areas over which each of the chosen activities is to be executed.

(f) Activity levels. For each LDU, data were developed to facilitate comparisons of the average benefits and costs of the various stages of development over the complete LDU. These provide the indications of the relative profitability of initiating the various development activities in a given LDU, but there is no implication that the entire LDU could or should be developed as a complete unit. Certain activities, including the supply of improved inputs will, logically, be applied to a complete administrative unit (probably the thana). Others, particularly flood control, must for physical reasons be applied over areas as large as 50,000 acres or not at all. Irrigation, by contrast, can be brought into an LDU at virtually any degree of intensity. The levels actually selected for the various activities in any particular year will depend on which of the identified constraints proves to be binding in the various LDU's at that point in time. (The operation of these constraints is discussed in detail in Section 7 below.)

2.02 The model can be expressed algebraically as a maximization of the gross value of agricultural production less the costs of production less the costs (capital and recurrent) associated with moving to the higher stage of development, subject to a series of constraints, of which the most important are: (a) demand for the various agricultural commodities; (b) availability of land and irrigation water; and (c) implementation capacity.

2.03 In its current formulation, this is essentially a static or single period model, designed to be solved separately for a particular year. Applied to a series of discrete years (at 10-year intervals, for example), it yields a series of "snapshots" of optimal development patterns in those years, rather than a formal time-sequencing of development activities. It is compatible, however, with future development into a multi-period model to permit fuller investigations of sequencing strategies and constraints.

2.04 As a principal objective of this exercise is to determine the requirements for outside investment in Bangladesh's land and water development program, capital availability has not been introduced explicitly as a constraint. The results of limiting funds have, however, been explored by translating this into its effect on implementation capacity (see Section 8).

Key Assumptions

2.05 A key assumption of the analysis is that benefits and costs can be meaningfully averaged over each LDU. As the basis for the original definition of LDU boundaries was that there should be a certain homogeneity of both agricultural potential and requirements for development, this assumption proves to be a fair one for perhaps 80% of the country. For the remaining 20%, however, sharp differences exist between "good" and "bad" land in an LDU. This condition coincides in most cases with a situation in which the most costly requirements for development (most frequently the flood control/drainage works) are concentrated at one end or in one small part of an LDU. In these circumstances averaging the costs over the entire LDU can distort the apparent merits of development quite severely. Thus, to correct these distortions, smaller units than complete LDU's should be used for analysis. Further work is needed to improve the data base which had to be used for the purpose of this model.

2.06 Other critical assumptions on which the analysis is based fall into three categories:

(a) Those for which there may be sufficient data available in Bangladesh to make extremely detailed studies for limited areas, but for which in an exercise of this sort it is both necessary and acceptable to use less precise country or regional averages. Included in this category are most crop input requirements, including labor, draft power, seed, fertilizers, pesticides and irrigation water.

(b) Those for which precise data could be, but have not been, collected to support detailed studies for limited areas, and for which the best available data was used to arrive at indicative values for each LDU. These include water availability and the costs of certain works required to permit intensified agricultural production, particularly the primary pumping facilities required for two-stage low lift pumping, and the embankments and pumps required for complete water control.

(c) Those which relate to broad policy issues such as agricultural commodity pricing and marketing arrangements.

2.07 The assumptions made in each of these categories are stated explicitly in the sections which follow. Where doubt exists as to the validity of a particular assumption and it is possible that variations would have significance in the overall strategy context, the effects of systematically varying that assumption have been tested to determine the effect on the overall results of the planning exercise. The results of this sensitivity testing are discussed in Section 8 of this Report.

III. DEVELOPMENT ACTIVITIES

Current Inputs

3.01 The various activities proposed to strengthen Agricultural Extension Services and to improve the availability and distribution of current inputs such as seeds, fertilizer and pesticides, are described in detail in Vol. V. For the purpose of the model these activities are handled in two ways: (a) the material costs of the inputs themselves are included as part of the cost of crop production (see Section 5); and (b) the capital and recurrent costs of the facilities and administrative machinery are accounted for separately as the cost to the economy of executing the inputs package programs. The capital facilities required include offices, class rooms, storage buildings and housing for staff. Recurrent costs include salaries, transportation and maintenance of capital facilities. The estimates of both cost components follow this section in Table 1.

Irrigation

3.02 The irrigation facilities considered for the purposes of this exercise are primarily diesel powered tubewells and low-lift centrifugal pumps, some of which are to be assisted by double pumping. It is recognized that there may be opportunities in the future for consideration of conventional barrage diversion projects with gravity canal distribution. However, the experience with this type of development to date in Bangladesh has been so disappointing that they are not considered a practical alternative for the purposes of this model. In the event that a situation develops in which consolidation of scattered holdings, and acquisition of right-of-way for major canal construction become practical propositions, it will be necessary to re-evaluate the irrigation development modes proposed.

3.03 Theoretical computations indicate that 2 cfs should suffice for about 100 acres in most part of the country. The actual area irrigated is, however, a variable which depends heavily on a wide range of physical and social factors. (See Vols. VI and VII). For purposes of cost estimating it has been simply assumed that a low-lift pump would irrigate 50, and a tubewell 60 acres. The cost estimates used in the sector modelling exercise are detailed in Annex 1 and summarized in Table 2.

Drainage

3.04 The term "drainage", as used in this particular Technical Report, connotes water-removal in the broadest sense, including prevention of inundation by increases of 20 feet or more in river levels. The flooding and other drainage related problems of Bangladesh and the solutions which have been explored to date, are discussed in Vol. VIII. In order to have a basis for comparison of this (as opposed to other development activities) as an approach to increasing agricultural production, it was necessary to develop a set of consistent cost estimates for drainage activities in virtually the entire country. The effects of possible error in this

process turn out to be small (see Section 8 below). The details of drainage cost estimates, and the process by which they were built up, appear as Technical Report No. 24 (Vol. XIII).

IV. INPUT-OUTPUT COEFFICIENTS

Introduction

4.01 The main inputs to the agricultural production process are expressed in terms of human labor, draft animal power, seeds, fertilizers, pesticides and water, and accounted for by assigning unit costs to each of these items. Outputs are expressed in terms of crop yields, and accounted for by projections of world prices for each commodity. Detailed farm management or cropping pattern optimization studies require considerable differentiation between the values of these variables from one soil type to another, from one climatic region to the next; and between farms of different sizes operating under different patterns of ownership and resource availability. Information in this degree of detail of this sort is unavailable for the country as a whole. However, the geographical area involved is sufficiently small that the principal cropped areas exhibit considerable similarity in both soils and climate. Average values of input and output variables were therefore selected for each of the major crops and for successive stages of development.

4.02 To some extent, present cropping patterns of each LDU reveal the potential for, and constraints on, development. For instance, where a very high proportion of an LDU is currently planted to broadcast aman, this indicates extensive deep flooding. In such areas, substantial increases in productivity require major drainage and flood control works. Similarly, current large areas in transplanted aman are indicative of widespread shallow flooding, with the promise of major increases in productivity by introduction of improved varieties and fertilization. The differences between average yields of broadcast and transplanted aman rice varieties are considerably greater than the average yield differences between either of these crops resulting from geographical differences within the country. The fractions of the landscape which are adapted to each crop are taken account of in the data base and to a significant degree, it is this which determines regional priorities for development.

Inputs

4.03 The principal on-farm inputs include farm labor, draft animal power, seeds, fertilizer, pesticides and water. The values used are presented in Table 3 at the end of this section. For clarity of presentation and convenience in sensitivity testing these inputs are expressed whenever possible in physical quantities per acre. These are then multiplied by the unit prices shown at the foot of the table.

4.04 For the on-farm labor, a figure of Tks 1.75 per day is used. This is about half the going rate and reflects either the assumption that approximately half the labor is provided by the farm family at no economic cost or, alternatively, that all labor is accounted for at a

shadow price equal to 50% of the financial cost.

4.05 Seeds and pesticide quantities are expressed in monetary units because of the impossibility of using a "standard" product with an "average" unit cost for all crops. With fertilizers this is a more practical proposition, so weight units are used, which facilitates accumulation of quantities used under different cropping patterns and development programs. The unit price assumptions used are presented in Annex 2.

4.06 Irrigation water requirements for the principal crops were estimated on the basis of a Modified Penman approach. (See Vol. VII). The precision of this theoretical method is, however, negated by the very rough estimates which must be made of a long series of other factors determining actual water use. For this reason there is no justification for differentiation between regions. Indicative figures have been taken from the theoretical estimates, and the results used as country-wide averages of the depth of irrigation water required to bring a crop to maturity. To this figure is applied a unit price reflecting only pumping costs -- facility costs having been accounted for elsewhere -- which are directly related to the cropping pattern adopted.

Crop Yields

4.07 The assumed country-wide average yields are averages in both the geographical and temporal sense. Geographically, it has been recognized that both good and bad farmers and good and bad land will be involved. Temporarily, there is allowance for wet years and dry, and in the irrigation only cases, allowance for the fact that there the flood risk remains and there will be years or areas in which the transplanted rice crop will be ruined by floods. Yields are assumed to increase through time and versions of Table 3 applicable to 1993 and 2003 are included in Annex 2.

Commodity Prices

4.08 Prices used are also presented in Table 3. Their basis is discussed in Annex 2, and the effects of sensitivity testing in Section 8. Of particular importance is the price of rice. A figure of Tks 21/md has been used. This is the equivalent of about $100 per long ton F.O.B. Rangoon, which is consistent with recent current Commodities Department projections of world prices for a mix of qualities, about two-thirds Burmese 42% broken and one-third Thai 5% broken.

V. CROPPING PATTERNS

Introduction

5.01 The cropping patterns assumed for each stage of development are, to a very large extent, extrapolations forward from the present land use patterns. The farm management principles on which the project changes are based are described in Annex 3 to this volume. To those individuals who have been involved in cropping pattern optimization exercises, "single-

valued" predictions of what will occur in the future may seem excessively restrictive. For a country which has always grown rice, however, which has a vast and growing demand for this commodity, and which happens to have physical characteristics so appropriate to the cultivation of this crop, it does not require the use of a very elegant predictive model to conclude that for the immediate future the vast bulk of the land will remain devoted to rice production. Changes, if any, will occur at the margin and will be small relative to the whole for the next 10-20 years. Furthermore, it seems probable, both on an intuitive basis, and from the sensitivity testing reported in Section 8, that changes in cropping patterns have surprisingly little effect on the identified sequence of land and water development.

Present Cropping Patterns

5.02 These are presented for all Land Development Units (LDU's) in Annex 3. They stem from nine years of field work on the Soil Survey of Pakistan (see Volume II). Entered into the data processing system by Land Capability Class (LCC), they are manipulated by the fraction of each LCC in a particular LDU and represented in a form showing the fraction of the cropped area of each LDU planted to the various crops.

Inputs Only (or Improved Agriculture)

5.03 The cropping patterns under this heading provide indications of what would be possible in each LDU if it were provided with full agricultural extension staff and complete facilities for supply of current inputs. There is no implication as to when this may happen, or even if it will ever happen, to the complete LDU. It is simply an indication of the potential productivity of the LDU, without any additional irrigation or drainage facilities, but with all constraints to the improvement of rainfed agriculture removed.

Irrigation Only

5.04 Providing irrigation to farmers in Bangladesh implies a considerable increase; not only an increase in output, but also in labor, fertilizer and pesticide input. The risk of reduced yields due to dry periods at the beginning of the aus or the aman season is eliminated, and the cultivation of a complete additional boro crop is made possible in some areas. Flood risks are not, however, reduced and improved cropping is possible only during the winter season on land subject to deep flooding during the monsoon season. As in the Inputs Only case, the cropping patterns presented are indicative of potential and carry no implications as to the actual extent, timing, or economic feasibility of development.

Irrigation and Drainage

5.05 When full drainage (which includes flood control) is attained, flood risks are minimized and full inputs can be used on an increased area. Yields are not generally expected to be a great deal higher, but because of the reduced incidence of losses due to flooding, long-term average yields may be higher. Cropping patterns in some cases reflect a change to higher valued crops and a consequent reduction in rice

production.

Presentation

5.06 Assumed cropping patterns for all LDU's and all stages of development are presented in Annex 3.

VI. THE BASIC DATA PROCESSING SYSTEM

Introduction

6.01 The data discussed in the following sections have been stored in a series of computer accessible disc files which permit them to be manipulated through a set of simple BASIC language programs. This permits tables of the raw data to be obtained in any desired format and also facilitates sensitivity testing. These files and the programs used to create and manipulate theses are described below. Their relationships to one another are shown graphically in the chart which follows. Also shown are the later programs which identify and describe the development programs possible over the next thirty years. The operation of these is discussed in Section 7 of this report.

Input-Output Coefficients

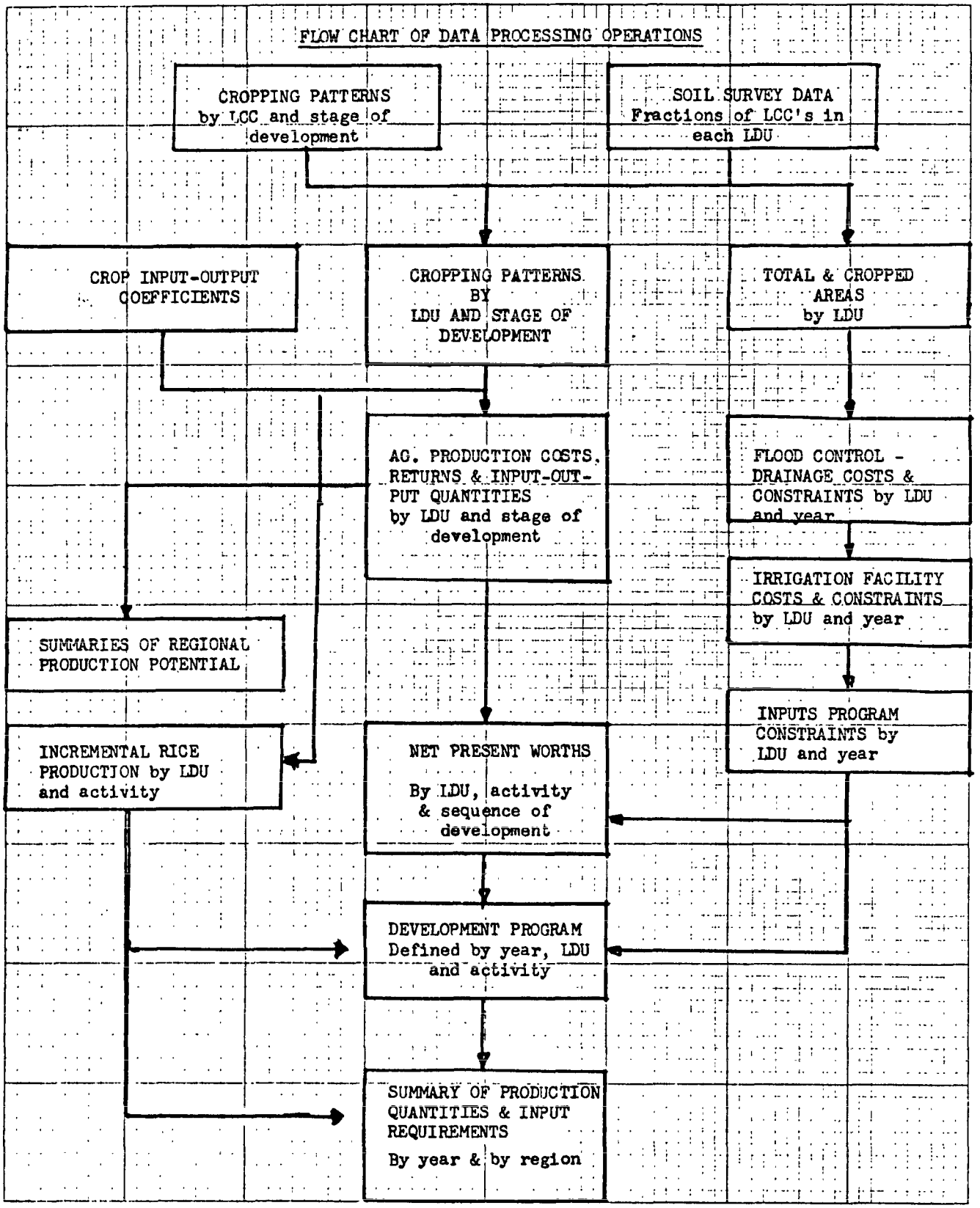
6.02 This program takes, as input data, the crop input-output coefficients for each stage of development described in Section 5. A limited amount of very simple arithmetic is performed: the input quantities multiplied by their unit costs; the production costs accumulated; the yields multiplied by prices; the production costs deducted from gross value of production, and the data printed back in a table (Table 3) which makes explicit the agricultural costs and revenues on which the exercise is based. These results are filed away for use in later computations.

Cropping Patterns by LDU

6.03 The 16 programs in this series -- four for each region -- are essentially duplicates of each other. They take as input data the cropping patterns by Land Capability Class (LCC) described in Section 5, the areas of each LDU and soil survey data giving the fractions of LCC's occurring in each LDU, and then print back the cropping pattern data by LCC (for checking) or by LDU (for use in assessment of the increased agricultural activity possible under each form of development. The cropping patterns, expressed as fractions of the net cropped area, by LDU, are stored for use in later computational steps.

Agricultural Costs and Returns - by LDU

6.04 The 16 programs in this series require no raw input data, but draw on the filed information for input-output coefficients and cropping


FLOW CHART OF DATA PROCESSING OPERATIONS
CROPPING PATTERNS by LCC and stage of development
SOIL SURVEY DATA Fractions of LCC's in each LDU
CROP INPUT-OUTPUT COEFFICIENTS
CROPPING PATTERNS BY LDU AND STAGE OF DEVELOPMENT
TOTAL & CROPPED AREAS by LDU
AG. PRODUCTION COSTS, RETURNS & INPUT-OUTPUT QUANTITIES by LDU and stage of development
FLOOD CONTROL - DRAINAGE COSTS & CONSTRAINTS by LDU and year
IRRIGATION FACILITY COSTS & CONSTRAINTS by LDU and year
SUMMARIES OF REGIONAL PRODUCTION POTENTIAL
INPUTS PROGRAM CONSTRAINTS by LDU and year
INCREMENTAL RICE PRODUCTION by LDU and activity
NET PRESENT WORTHS By LDU, activity & sequence of development
DEVELOPMENT PROGRAM Defined by year, LDU and activity
SUMMARY OF PRODUCTION QUANTITIES & INPUT REQUIREMENTS By year & by region

patterns. These data are then combined to generate tables showing:

(a) the areas planted to each crop,
(b) the resulting production, and
(c) the required inputs

for each LDU and all modes of development. This information may be summarized to show the ultimate possible production by region for each mode of development, or stored for later comparison with the costs of development as required for assignment of development priorities.

Areas

6.05 A single short program draws on the files created by the soil survey and cropping pattern programs to collect into one place the data indicating gross and cropped areas of each LDU, to print this back (Table 4 at the end of this Report) and to place this information in a single file for use in later analysis.

Facility Costs and Constraints

6.06 In addition to the foregoing operations which define the possible benefits of each development activity, a series of programs was written to calculate and place in computer file storage, the estimated costs and assumed constraints on the three major development activities. The first takes, from the file created by the preceding program, the cropped area of each LDU. To this area it applies the judgement of those experienced in the field as to: (i) the maximum possible coverage of inputs package programs, as limited by administrative training and personnel constraints, at 5-year intervals to the year 2003, and (ii) the geographical areas in which this effort should be concentrated for maximum results. The judgements made are printed back in clearly readable form for anyone interested to review, and if in possession of data or better judgement, to suggest alternatives. Table 5 at the end of this Report shows the form of presentation. The costs of inputs package programs -- on a per acre basis -- are assumed to be constant throughout the country, and as detailed in Section 3.

6.07 The second program takes the best available data regarding remaining opportunities for installation of low-lift pumps and tubewells in each LDU. These are due to the physical constraints on land and water development imposed by nature and unchangeable except by acquisition of better topographic or hydrologic data. These numbers are then reduced in a somewhat arbitrary fashion to reflect the facts that past experience in Bangladesh and elsewhere has shown that there are definite administrative constraints which will limit the magnitude of the water development program, country-wide, in any given period. At this point, also, we introduce the "Areas of Concentration" strategy of the agricultural planners which limits development in the early years to specific areas that will yield the greatest incremental rice returns. The numbers of low-lift pumps and tubewells (both assumed to be 2-cusec units) are then converted into areas irrigable at the rate of 50 ac. per pump and 60 ac. per tubewell. The resulting total area is then the maximum incremental irrigated area for each LDU for the particular planning period under consideration. Finally, the estimated capital and recurrent costs of the irrigation facilities are converted into present

values of all costs either at 12% or another discount rate.

6.08 The last program in this series takes the gross area of each LDU and simply reflects a judgement to the effect that under no circumstances would it be physically or administratively feasible to bring more than 250,000 ac. under drainage or flood control in any LDU in any 5-year period. The constraint representation here differs from the irrigation case in which the constraints shown accumulate to what is considered to be a feasible country-wide program. In this case the constraint applies only to a specific LDU and the limitations on a country-wide flood control program are applied elsewhere (see Section 7). The cost estimates in this program are based on manual labor shadow-priced to half its financial cost. Tables 6 to 9 present the results of these operations for irrigation and flood control/ drainage.

Summaries of Potential Production

6.09 The final step in the basic data processing, prior to consideration of costs of, and constraints on, development is to print tables showing production potential by region and stage of development. These are summarized in Table 10.

VII. MODEL OPERATION

Introduction

7.01 The model has been formulated for a computer solution with the intention that a linear programming algorithm would "consider" the available alternatives for each LDU in each year, apply the relevant constraints, and identify an optimal pattern of development (within those constraints) for any given year in the future. The nature of the problem, however, appears to be such that, once the data have been prepared for machine processing, a tentative solution can be identified by a simple procedure which involves computation of the net present worth of each activity, and sequential application of the identified constraints. Both approaches are dependent on the use of the data processing system described in Section 6. Although conceived initially only as a device for processing the data required for the linear programming model, the data processing system evolved to the point at which it is now (in effect) a simulation model of the sectoral development process. The structure and operation of this model is, however, continuing and results will be incorporated in later versions of this volume.

Computation of Present Values

7.02 Benefits. The figures generated in the preceding programs represent annual net agricultural revenues in Tks/ac. at full development. In order to translate these values to present value terms at any given interest rate it is necessary to account for the path by which revenues grow from their previous values to this new level. This is done in the computer program by assuming the following lapse times to attainment of full benefit

values:

Inputs only	5 years
Irrigation Benefits	
- from traditional agriculture (IRRIG-A)	5 years
- from improved agriculture (IRRIG-B)	3 years
Irrigation and Drainage Benefits	
- from traditional agriculture (IR & DRG-A)	9 years
- from improved agriculture (IR & DRG-B)	7 years
- from fully irrigated conditions (IR & DRG-C)	5 years

With each of these lag periods there is associated a set of yearly fractions representing the wellknown sigmoid growth curve. These are illustrated in Fig. 1.a. Using the fractions obtained from curves of this sort, and normal discounting procedures, makes it possible to calculate factors which, when applied to the ultimate annual revenue estimates, yield the present worths of the benefit stream under consideration at the desired interest rate. The factors derived in this way are below:

Present Worth Factors for 25-Year Benefit Streams

Build-up Period (yrs)	Discount Rate (%)						
	6	9	12	15	18	21	24
3	11.4	8.5	6.6	5.2	4.3	3.6	3.1
5	10.6	7.7	5.9	4.6	3.7	3.0	2.5
7	9.8	7.0	5.2	4.0	3.2	2.5	2.1
9	9.0	6.4	4.6	3.5	2.7	2.1	1.7

7.03 Costs. The cost streams are generally more straightforward, only two forms being considered. For inputs only and irrigation, all capital outlay is assumed to take place in the first year. The construction of minor drainage works is also assumed to be completed in one year, and the capital costs treated accordingly. For major drainage and flood control works, however, construction (of 50,000 ac. units) is assumed to be spread out over three years with 30% of the expenditure in the first year, 50% in the second and 20% in the third. Recurrent costs are treated as constant for the full 25 years of the period of comparison.

7.04 Net Present Worths. The data relating to the estimated costs and potential benefits of each activity are taken by the computer and are subtracted from each other to obtain values of incremental net present worth (NPW), expressed in Tks/ac. Tables 11 to 13 (at the end of this Report) show the present and possible net agricultural revenues for each LDU, the costs of attaining these benefits, and the derived incremental NPW's.

Operation of Constraints

7.05 While there are, of course, an almost infinite number of constraints operating on the development process, many of these are impossible to define in quantitative terms while others, though conceptually measurable, would require the construction of a considerably more sophisticated model

than has been possible to date. The assumptions on which the land, water and implementation constraints are based were discussed briefly in Section 6. The manner in which they are caused to operate is illustrated in Fig. 1.b. From these sketches it can be seen how the land, water and implementation constraints are combined to determine the areas brought into each activity in 1983 for the simple case in which the drainage, irrigation and inputs constraints form a steadily increasing series. In fact, and in most cases, particularly in 1993, it would be possible to have more land drained than irrigated. In these circumstances, the irrigation constraint is binding and prevents the development of more land by drainage. Similarly, in the 1973-1983 period, agricultural development strategy limits the inputs package programs to certain highly productive LDU's. In this case the extent of irrigation possibly may, at least theoretically, exceed the availability of inputs and the inputs constraint would be binding. In fact, the implementation constraints which control the distribution (between LDU's) of the tubewells and low-lift pumps judged to constitute a maximum country-wide program were based on the same "areas of concentration" strategy as the inputs package programs so that in no case does a lack of inputs prevent installation of otherwise feasible irrigation facilities.

7.06 An important constraint not mentioned heretofore is that of economic feasibility. The model automatically rejects all development activities of which the estimated costs exceed the estimated benefits -- i.e., there is a cutoff at zero NPW. Twelve per cent was selected for all basic runs and the results of tests performed at other rates are described in Section 8.

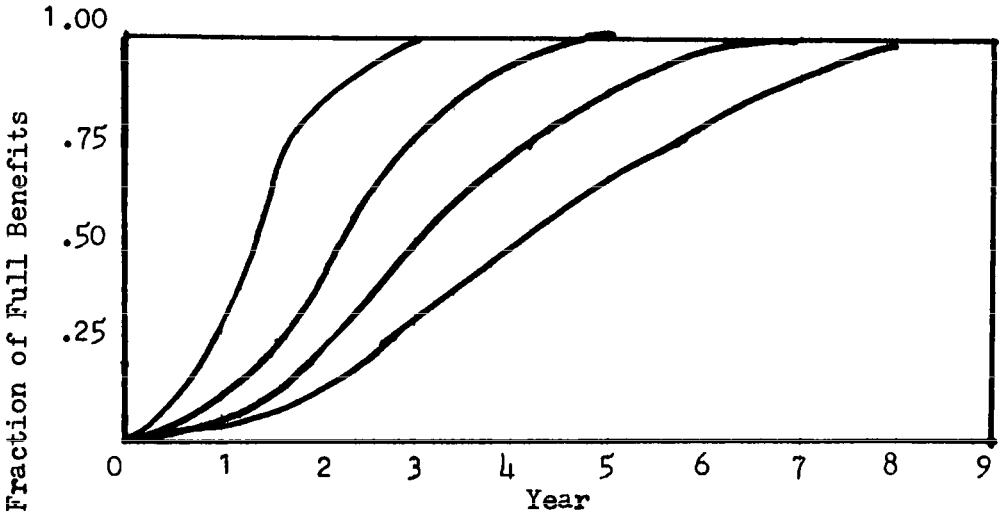


Fig. 1.a GROWTH CURVES TO ATTAINMENT OF FULL BENEFITS

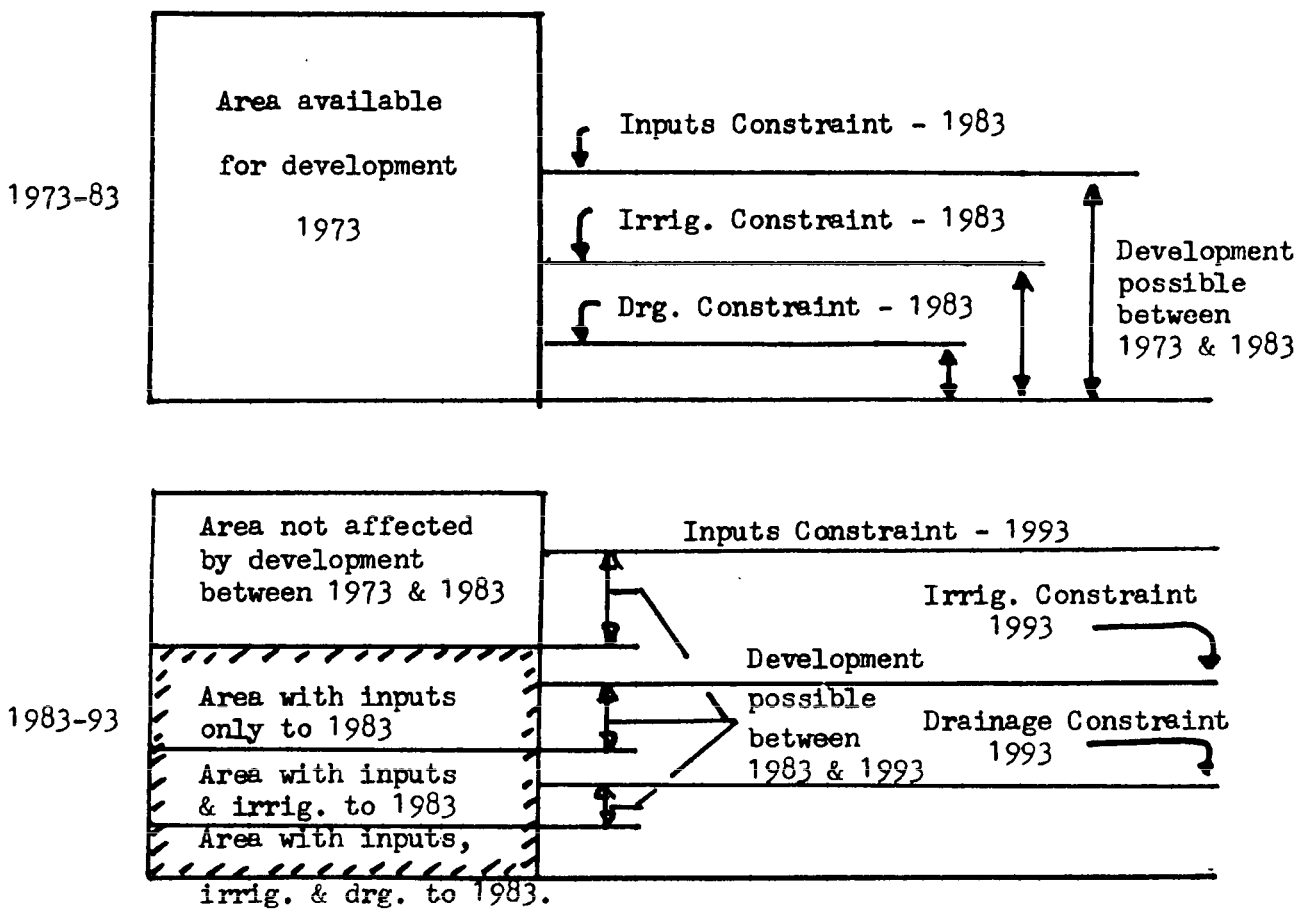


Fig. 1.b OPERATION OF CONSTRAINTS

VIII. RESULTS

Indicated Development Programs

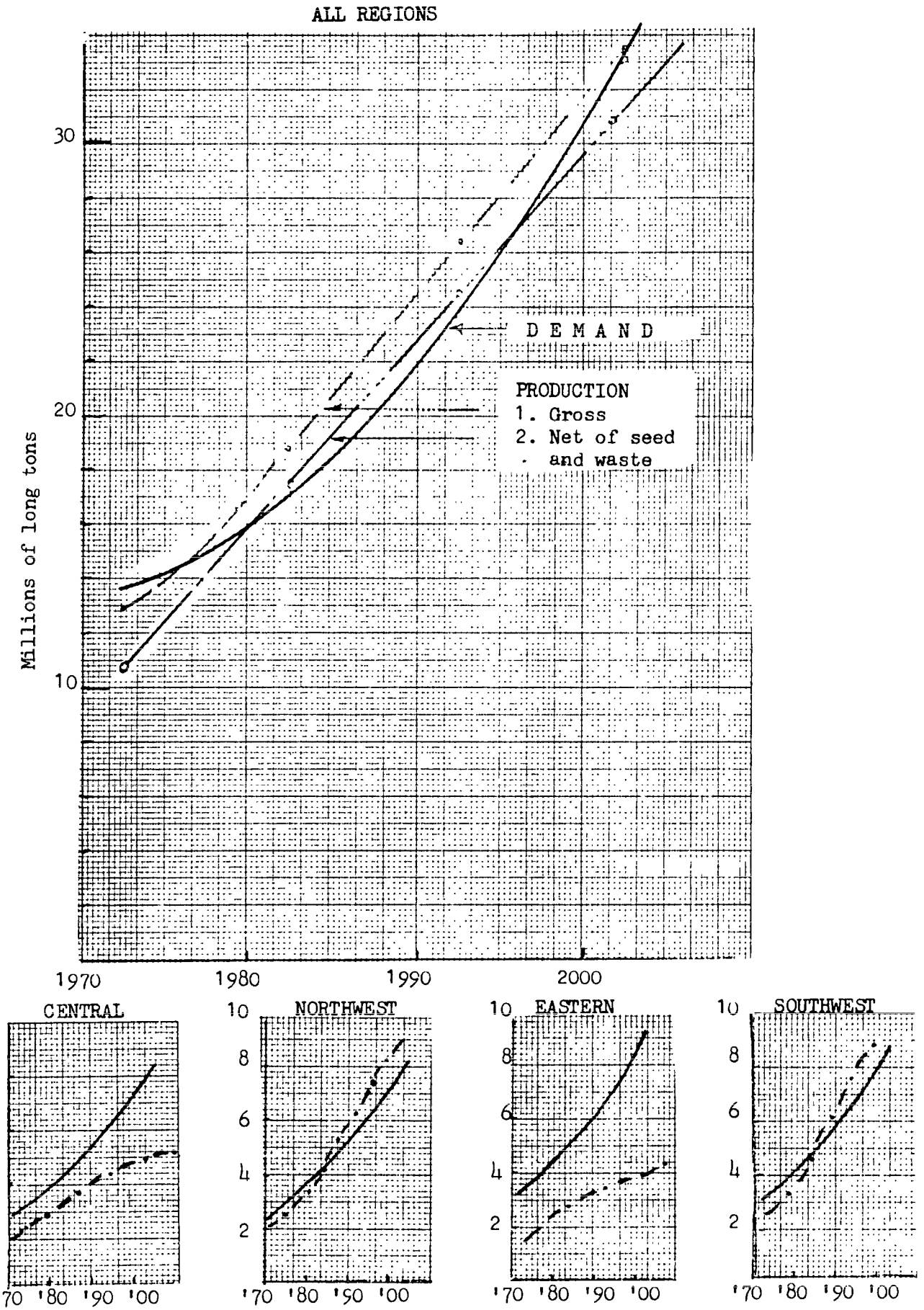
8.01 Implementing the activities possible on all LDU's to the limits dictated by the constraints described in Section 6 leads to the development program shown in Tables 14 to 16. These tables also show the effects of the development program in terms of incremental rice production. Because of the long periods of time required to get major drainage and flood control projects designed, built, and into full production, the program for 1973-1983 consists largely of inputs and irrigation by individual low-lift pumps and tubewells. The primary areas for inputs package programs are those in which it is possible to switch from local to improved varieties of transplanted aman, while the emphasis in water development is on tubewells in the northwest and low-lift pumps in the southwest. Relatively small areas are identified for drainage and flood control, primarily in the Comilla area where the works required do not present major engineering problems and the potential benefits appear to be significant.

8.02 For the period 1983-1993 it becomes necessary to turn, for major increases in agricultural production, to areas in which double pumping of surface water for irrigation is required, and to the major flood control and drainage works. The engineering works involved have not yet been defined in detail, and precise cost estimates cannot therefore be used at the present time. Feasibility studies have been completed for some areas, others are in progress and yet others remain to be initiated in the years ahead. Indications of the feasibility of the major flood control projects appear, however, to be consistent with the most recent work on projects to which considerable analysis has been devoted. The costs of flood protection and drainage in the Dacca Southwest area, for instance, appear to exceed the benefits, discounting at 12%, but this form of development appears economically justified in the Comilla-Noakhali area where embankments would be lower, and some gravity drainage would be possible. Similarly, the cost of tubewell irrigation in certain parts of the central and northwest regions exceed the benefits (and are therefore left out of the 12% cutoff solution) when tubewell cost estimates are based on the high bid prices received in late 1971 for the ADC Tubewell Project. A recent recalculation for that project, which assumed that there would be considerable effort expended to select the best land, yielded a 15% rate of return. Under these circumstances, it is hardly surprising that tubewell irrigation would yield less than 12% when dispersed over some of the less potentially productive LDU's.

Attainment of Targets and Objectives

8.03 Indications are that it will be difficult to eliminate immediately the need for imported foodgrains. Fig. 2 shows projections of demand for foodgrain and the growth of foodgrain production stemming from implementation of the programs defined in Tables 14 to 16, and summarized in Tables 17 to 19.

Fig. 2



FOODGRAIN DEMAND & PRODUCTION

Self-sufficiency would be attained by 1983 and there would be a surplus of perhaps 0.5 million tons in 1993, if meeting the demand projection corresponding to a 1.5% per annum growth in per capita income is taken as the production target.

8.04 Also shown in Fig. 2 is the regional distribution of production. This suggests that only the Northwest region will become fully self-sustaining in foodgrain production, and that strenuous efforts will be required to improve storage facilities, marketing arrangements and transportation outlets for this region. If these steps are not taken, local prices will decline so drastically during harvest seasons, particularly aus, that the incentive to grow the surplus rice on which the rest of the country depends will disappear.

8.05 It is of interest to note that, under the outlined program, production would rise to about two-thirds of the totally unconstrained potential (see para 6.09 and Table 10).

8.06 On-farm employment, under the outlined program, would grow by 47% by 1983, another 9% in 1993, and a final 17% (on a 1970 base) by 2003. This is illustrated in Fig. 3. Expressed in physical terms, the estimate of 3,500 million man-days of employment for 2003 is equivalent to only 100 days of work for each of 351 million people, i.e. about 50% of the available labor force, indicating a very serious employment problem. (For further discussions of employment see Technical Report No. 25).

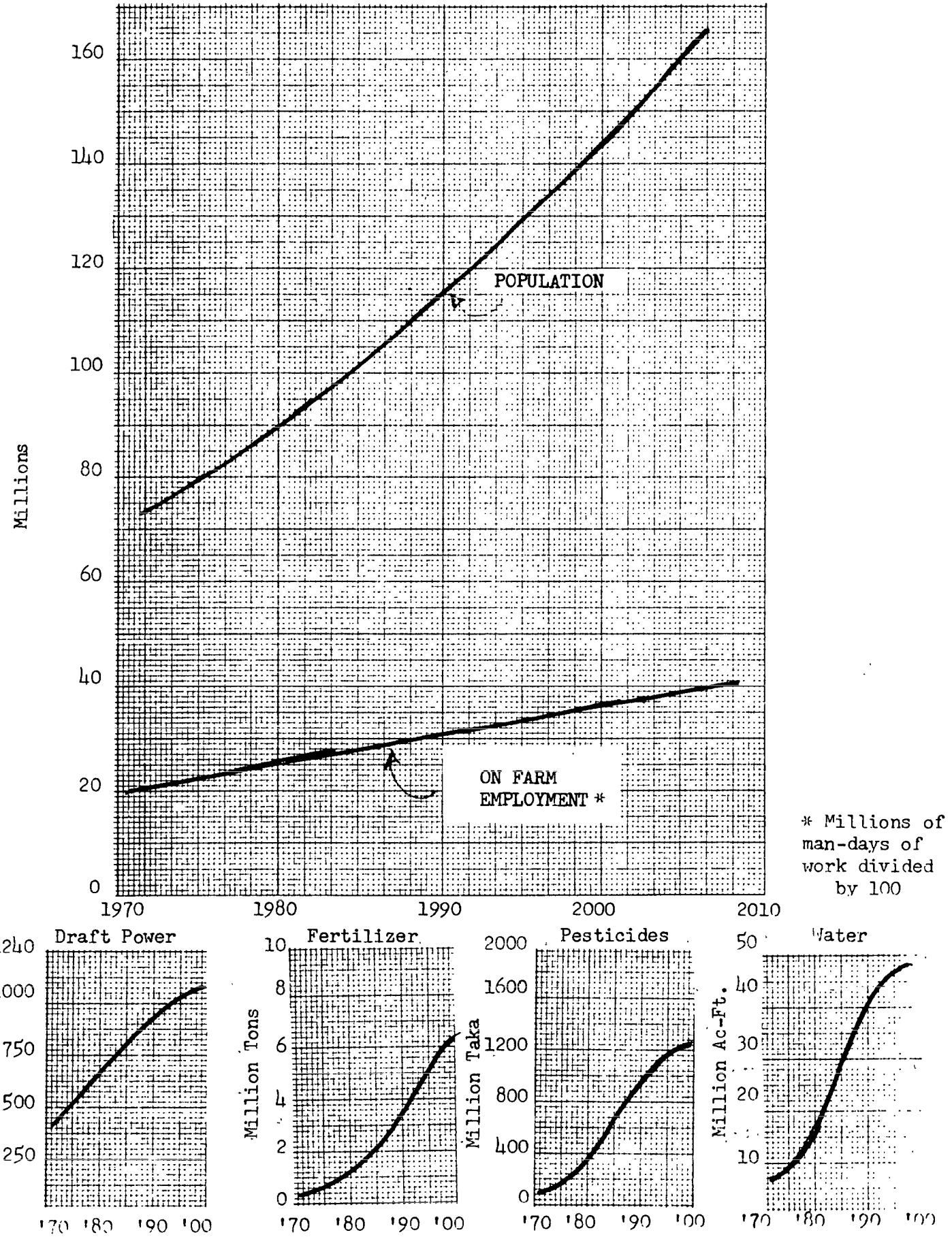
8.07 Nothing is really learned about the degree to which jute production can be maintained or protein production increased from the results of this modelling exercise. The figures shown for these commodities simply reflect judgements made, at the time of cropping pattern definition, to the effect that jute production (as the only major source of foreign exchange) would not be permitted to decrease, and that to the extent possible, protein production would be increased.

Input Requirements

8.08 Illustrated along with employment in Fig. 3 are the patterns by which demand for production inputs would increase if the programs outlined were to be implemented.

8.09 The draft requirement for ploughing and cultivation would increase from about 500 million animal-days in 1973 to 1,090 million animal-days in 2003. This represents an annual increase of less than 1-1/2%, far less dramatic than that of other inputs, but one which will severely tax the draft animal resources of the country (see Technical Report No. 12). This cannot, however, be seriously considered as a binding constraint. If the rest of the development program is being implemented with any degree of success and draft animal availability becomes limiting, a shift towards the use of power tillers or other forms of mechanized cultivation would almost certainly occur.

Fig. 3



FARM LABOUR AND OTHER INPUTS

8.10 During the same period, to attain the projected yields, fertilizer use would have to increase from less than 40 million to about 57 million tons per year. This represents a growth rate of over 9% per year for the 30-year period, while for the period 1973-1983, an annual rate of increase in the vicinity of over 15% would be required. To meet these requirements will take a considerable effort to expand local manufacturing capacity or will necessitate increased imports, with heavy outlays of scarce foreign exchange. The percentage increases are high, however, because the present fertilizer use is so low. Increases in the range indicated are certainly within feasible limits, and have been exceeded by other countries (notably India) at comparable stages of development. The same general comments apply to the projected increase in use of pesticides.

8.11 Water use for irrigation under the program defined in Tables 14 to 16 would increase to 49 million ac. ft. This is a virtually insignificant quantity compared to the total "inflow" of 1,100 million ac. ft. although, as discussed in Technical Report No. 20, stream-flow during March and April may limit surface water withdrawals, and groundwater development must be limited at least until detailed studies of recharge potential indicate that it is safe to proceed to more intensive development than assumed here and discussed in Technical Report No. 20.

Sensitivity Tests

8.12 The sensitivity of the results of this exercise, with respect to variations in a series of the key assumptions and critical cost items, has been tested with the following results:

(a) Yields. The most critical assumption made in the entire study was that per acre rice yields can be increased 150-200% between 1973 and 2003. If the yields shown in Table 3 for 1983 are taken as being applicable to the entire development period, a foodgrain shortfall of 9 million tons would appear, and of 14 million tons in 2003. The reasoning behind the decision to assume steadily increasing yields is given in Annex 2 and Vol. III.

(b) Cutoff interest rate. Discounting all costs and benefits at 6% instead of the 12% on which the basic runs were performed, had surprisingly little effect on the results. This is presumably because the majority of the activities permitted under the identified constraints yield in excess of 12% return. (The entire inputs package program comes into this category.) There appear very few economically marginal activities considered and lowering the interest rate brings in so little additional production that it can be ignored for all practical purposes. In other words, the water availability and physical feasibility constraints become binding in nearly all cases before the requirement of meeting a 12% economic return. Table 32 shows this effect.

(c) Rice price. Using a farm-gate equivalent price of Tks 16/md instead of the Tks 21/md used in the basic solutions leads to a situation in which the costs of irrigation exceed the benefits for more than half the irrigation activities appearing in the basic solution. Table 32 at the end of this report reveals the degree to which the net present worths of some of the irrigation activities are affected by use of the projected world price. The effects on the overall program are to reduce rice production potential by some 2.7 million tons in 2003, and proportionately smaller quantities in 1983 and 1993. The total area under irrigation in 2003 falls 30% from 7.3 to 5.1 million acres, and employment 10% from 3,500 million to 3,150 million man-days. The cost of importing the additional quantity of rice would rise to about $200 million per year, compared to a figure in $40-50 million range, representing the annual foreign exchange cost of the irrigation facilities.

(d) Unit cost of irrigation water. Increasing the cost of pumping an ac. ft. of water (fuel only) 100%, from Tks 15/ac. ft. to Tks 30/ac. ft. leads to a decrease of about 10% on the average in the net returns to the irrigation activities, and has a totally insignificant effect on the overall program.

(e) Price of farm labor. Reducing farm labor costs to zero had a substantial effect on the apparent economic worth of all activities, with net returns increasing 25-30%. This, however, has little effect on the total program because, as described in (a) above, most theoretically possible but economically marginal development activities are excluded in a way which prevents them from being brought back into the solution. Increasing farm labor costs (to the full going rate of Tks 3.50 per day), however, does have a significant impact on the program. Per acre net revenues of crop production appear to drop 20-25%, and net present worths of "inputs only" activities are similarly affected. Irrigation and drainage activities are considerably more sensitive and net present worths become negative in most of the lower potential areas. The overall effect is very similar to that of the decreased rice price and has the same implications.

(f) Efficiency of water use. Examination of the effects of assuming a 50% greater efficiency in the use of irrigation facilities (75 ac. per LLP and 90 ac. per tubewell) reveals simply that water development would appear more attractive economically. Certain marginal projects would remain in the solution instead of dropping out, but the effect on the overall solution is not dramatic. Irrigation constraints were fixed, in the first instance, on the basis of water availability, so that to make water use more efficient simply leads to a reduction in the estimated number of pumping units. The inclusion of the projects which appear marginal under the basic efficiency (inefficiency?) assumption would increase rice production by less than 5% in 2003.

(g) Cost of irrigation and drainage facilities. Increasing the cost estimates for these facilities by 50% had about the same effect as decreasing the price assumed for rice. The less attractive activities drop out and the country is left with a substantially increased requirement for imported foodgrains. Small increases (up to 25%) had no significant effect on the overall program. The irrigation and drainage activities considered appear to fall into three classes:

(i) those which are so attractive from an economical point of view that they can survive quite violent increases in cost or decreases in benefits. (These are mainly the single stage low-lift pump installations.)

(ii) Those which are sufficiently attractive that no minor variation of parameters affects their inclusion in the program, but which drop out following major cost increases or benefit decreases (mainly tubewells and multiple low-lift pumps on areas which are either marginal with respect to productivity, or are already producing at such a high level that only small incremental benefits are possible); and

(iii) those which are so unattractive that no reasonable improvements in efficiency or benefits, or reductions in estimated cost, can bring them into the solution.

Conclusions

8.13 It is concluded that if development proceeds at the rate implied by this program, and the projected yield increases are realized, the country can effectively meet its foodgrain requirements. While Fig. 2 does indicate that some imports will be required, the probable error in the projections of both demand and production exceed the magnitude of the difference between them.

8.14 The polder projects in deeply flooded areas were included for consideration in this exercise but fail to appear in the identified program of development because the estimated incremental costs exceeded the estimated incremental benefits even with the cutoff interest rate reduced to 6%. Further study of these activities is scheduled under the project review to be executed in the months immediately ahead. (A parallel review executed by a number of WAPDA engineers working at Harvard on the UNDP financed Systems Analysis Project came to essentially the same conclusions on these major projects.)

8.15 The most important constraint binding on the solutions presented here is that of potential for irrigation development. With respect to surface water the available data has probably been treated to all the review and analysis they can stand, and it is most unlikely that this constraint can be further relaxed prior to the completion of the major regional studies discussed in Vol. VII. On groundwater, only 4 million acres of the high and dry land potentially irrigable have been included

in the program because of inadequate information on recharge. The effects of releasing this constraint would be to add a further 2.6 million acres under tubewell irrigation. This would be unlikely to occur until 1993-2003 at the earliest, as the assumptions made with respect to possible rates of tubewell construction in the first twenty years are already on the liberal side. The resulting incremental production would be perhaps 3.0-3.5 million tons in 2003.

8.16 Finally, the construction of flood control or drainage facilities for substantial areas subject to very deep flooding (e.g. the Sylhet Basin) were never even considered because there is no defined engineering solution to the drainage of these areas. Also excluded was the possibility of major diversion works with canal systems for distribution of irrigation water (see para 3.02). Both these activities are scheduled for detailed study under the study program outlined in Volume I and there is no firm basis at the present time for including them in a long-range program other than for study.

8.17 The operation of the model as at the end of June 1972 is still subject to minor aberrations, and occasional errors continue to appear in the data base. The correction of these could conceivably lead to a slightly more optimistic forecast of possible production (but could equally well do the opposite). The operation of the linear programming model, with its greater strength and flexibility, may also reveal some possible improvements in a strategy. In sum, however, the unavoidable conclusion appears to be that, except for an increase of emphasis on irrigation and less on flood control in the immediate future, the appropriate strategy for Bangladesh at this point in time is to push every conceivable land and water development activity to the absolute limits of implementation capacity, dropping only those projects which are manifestly uneconomic, and continuing with all reasonable speed to collect and analyze the hydrologic and topographic data necessary for more precise definition of physical opportunities and constraints.

INPUTS PACKAGE PROGRAM

COSTS OF FACILITIES & GOVERNMENT SERVICES

A. EXTENSION (20,000 ac. block)

Year	Estimated Capital Outlay (Tks)	Present Worth (Tks) 6%	9%	12%
1	300,000	300,000	300,000	300,000
2	100,000	94,300	91,700	89,200
3	50,000	44,500	42,100	31,700
4	40,000	33,500	30,900	22,700
	Recurrent Cost (Tks)			
1	70,000	70,000	70,000	70,000
2	91,200	86,000	83,600	81,300
3	98,600	87,500	83,000	70,100
4-25	106,000	987,900	697,500	509,900
PW of all costs		1,703,700	1,398,800	1,023,600
District & Subdivision HQ Admin & Overhead (15%)		255,600	209,800	153,500
Total		1,959,300	1,608,600	1,177,100

B. COOPERATIVES (10,000 ac. block)

Year	Estimated Capital Outlay (Tks)	Present Worth (Tks) 6%	9%	12%
1	222,800	222,800	222,800	222,800
2	121,500	114,000	111,400	108,300
3	32,400	29,700	27,300	25,800
4	28,600	24,000	22,100	18,200
	Recurrent Cost (Tks)			
1	45,000	45,000	45,000	45,000
2	65,000	61,150	59,600	58,000
3	75,000	66,400	63,100	60,000
4-25	85,000	792,200	559,300	408,900
PW of all costs		1,355,250	1,110,600	947,000
District & Subdivision HQ Admin & Overhead (15%)		203,250	166,600	142,000
Total		1,558,500	1,276,200	1,089,000

C. SUMMARY

Present Worth of All Costs

	(Tks 000) 6%	9%	12%	(Tks/Ac) 6%	9%	12%
Extension	1959.3	1608.6	1117.1	97.9	80.4	55.8
Cooperatives	1558.5	1276.2	1089.0	155.8	127.6	108.9
				253.7	208.0	164.7

TABLE 2

SUMMARY OF IRRIGATION FACILITY COSTS

	Tubewells	Low-Lift Pumps	
		Single	Double
1. Capital Costs (Tks)			
Local	30,000	4,500	12,600,000
Foreign	60,000	13,000	17,600,000
Total	90,000	17,500	30,200,000
2. Assumed Service Area (Ac)	60	50	20,000
3. Unit Capital Costs (Tks/Ac)			
Local	500	90	630
Foreign	1,000	260	880
Total	1,500	350	1,510
4. Recurrent Costs (Tks/Ac/Yr)			
Local	42	43	59
Foreign	30	19	67
Total	72	62	126

5. Present Worth of Recurrent Costs (Tks/Ac)	6%	9%	12%	6%	9%	12%	6%	9%	12%
Local	473	412	330	532	422	337	730	500	463
Foreign	338	294	235	359	285	227	706	660	525
Total	811	706	565	891	707	564	1436	1160	988
6. Total Present Worths (Tks/Ac)									
Local	973	912	830	622	512	427	1360	1210	1093
Foreign	1338	1294	1235	619	545	487	1586	1540	1405
Total	2311	2106	2065	1241	1057	914	2946	2750	2498

1/ Based on F.E. at Tks 9.52 = $1.00
2/ Including replacements over 25 years

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

ASSUMED CROP INPUT-OUTPUT COEFFICIENTS 1983

TRADITIONAL CROPS

	CROP	LABOR (MAN) (DAUS)	DRAFT (ANIMAL) (DAUS)	SEED (RS)	FERT (LBS)	PEST (RS)	WATER (A.F)	YIELD (MDS)	PRICE (RS/MD)	G.V.P	PROD. COST (RUPEES PER ACRE)	N.V.P
1	B.AUS I	60	13	20	0	0	0	16	21	336	157	178
2	B.AMAN I	60	13	20	0	0	0	15	21	315	157	157
3	T.AMAN I	70	20	5	56	10	0	23	21	483	207	275
4	M. AUS & AMAN I	70	15	20	0	0	0	21	21	441	180	261
5	BORO I	87	30	5	140	10	3	25	21	525	336	188
6	JUTE I	90	16	5	0	5	0	15	46	690	207	482
7	WHEAT I	50	12	15	0	0	0	8	20	160	132	27
8	GROUNDNUTS I	75	18	13	0	0	0	10	50	500	189	310
9	SUGARCANE I	75	25	180	56	5	0	300	2	600	398	201
10	OTHER RABI	80	15	6	0	0	0	8	100	800	183	616
	IMPROVED CROPS - WITHOUT IRRIGATION											
11	B.AUS II	67	18	25	180	44	0	25	21	525	294	230
12	B.AMAN II	62	15	20	50	20	0	17	21	357	203	153
13	T.AMAN II	93	34	6	280	33	0	36	21	756	384	371
14	MIX A&A II	79	20	25	180	27	0	27	21	567	303	263
15	JUTE II	106	18	5	80	20	0	20	46	920	283	636
16	WHEAT II	60	14	25	100	0	0	12	21	252	200	52
17	GR.NUTS II	90	20	25	150	0	0	14	50	700	285	415
18	S.CANE II	85	35	240	300	33	0	450	2	900	614	285
19	OILSEED II	70	12	3	100	7	0	10	50	500	197	302
	IRRIGATED CROPS -WITHOUT FLOOD RISK CONTROL											
20	B.AUS III	75	20	25	240	60	1	29	21	609	365	243
21	T.AUS III	105	38	6	430	44	3	45	21	945	524	420
22	T.AMAN III	100	37	6	340	48	2	40	21	840	470	369
23	MIX AUS&AMAN III	89	22	25	240	27	2	32	21	672	376	295
24	BORO III	110	40	6	485	44	5	50	21	1050	587	462
25	JUTE III	119	19	5	150	20	1	24	46	1104	348	755
26	WHEAT III	84	20	25	200	0	1	25	21	525	307	218
27	GR.NUTS III	95	21	13	180	0	1	16	50	800	309	490
28	S.CANE III	95	40	240	420	66	2	650	2	1300	749	550
29	OILSEEDS III	80	15	10	205	14	1	20	50	1000	288	711
30	BRASSICAS III	40	12	3	125	7	1	13	50	650	168	481
31	ORCHARDS III	200	25	100	400	24	1	20	100	2000	691	1308
32	RABI VEG.III	120	25	50	300	10	1	15	100	1500	452	1047
	IRRIGATED CROPS -WITH COMPLETE FLOOD CONTROL											
33	B.AUS IV	80	21	25	265	60	1	32	21	672	385	286
34	T.AUS IV	107	39	6	475	44	3	48	21	1008	546	462
35	T.AMAN IV	103	38	6	375	50	2	42	21	882	492	389
36	MIX AUS & AMAN IV	95	23	25	270	27	2	35	21	735	400	334
37	BORO IV	110	40	6	485	44	5	50	21	1050	587	462
38	JUTE IV	123	19	5	220	20	1	26	46	1196	379	816
39	WHEAT IV	84	20	25	200	0	1	25	21	525	307	218
40	GROUNDNUTS IV	100	21	13	180	0	1	16	50	800	318	481
41	SUGARCANE IV	105	45	240	500	66	2	750	2	1500	807	692
42	OILSEEDS IV	80	15	10	205	14	1	20	50	1000	288	711
43	ORCHARDS IV	200	25	100	400	24	1	20	100	2000	691	1308
44	BRASSICAS IV	40	12	3	125	7	1	13	50	650	168	481
45	RABI VEG IV	120	25	100	400	24	1	20	100	2000	551	1448

* ASSUMING FOLLOWING UNIT COSTS:

LABOR	1.75	RS/DAY	DRAFT POWER	2.50	RS/ANIMAL-DAY
FERTILI	0.35	RS/LB	WATER	15.00	RS/A.

TABLE 4

AREAS

LDU	TOTAL AREA (ACRES)	CROPPED AREA (ACRES)
C1	494000.	280063.
C2	201000.	163338.
C3A	696000.	563056.
C3B	266000.	220274.
C3C	312000.	248146.
C3D	137000.	108089.
C4	132000.	105946.
C5	182000.	143592.
C6	191000.	154169.
C7	398000.	319080.
C8A	158000.	124226.
C8B	83000.	66542.
C9	723000.	589505.
C10	142000.	114230.
C11	33000.	25525.
C12	61000.	47017.
C13	1018000.	845784.
C14	36000.	10844.
DACCA	21000.	0.
NW1	212000.	181090.
NW2	858000.	726179.
NW3	1507000.	1218487.
NW4A	480000.	394940.
NW4B	201000.	164710.
NW5	645000.	527799.
NW6	79000.	53690.
NW7	39000.	30030.
NW8A	210000.	184730.
NW8B	34000.	21840.
NW9	941000.	755298.
NW10	359000.	303940.
NW11A	404000.	193830.
NW11B	234000.	144690.
NW12	206000.	174720.
NW13	1458000.	1201198.
NW14	180000.	69160.
E1	304000.	159250.
E2	1181000.	751659.
E3	1219000.	776230.
E4	1411000.	996448.
E5	300000.	199290.
E6	300000.	248430.
E7	269000.	190190.
E8	871000.	649739.
E9	64000.	0.
E10	810000.	640639.
E11A	544000.	382200.
E11B	3644000.	735279.
SW1	280000.	170170.
SW2	242000.	188370.
SW3	2231000.	1849116.
SW4	1599000.	1289467.
SW5	562000.	475930.
SW6	920000.	731639.
SW7	1456000.	1184818.
SW8	317000.	241150.
SW9	238000.	137410.
SW10	1450000.	0.
TOTAL	33551950.	22473100.

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

INPUTS PACKAGE PROGRAMS

ASSUMED MAXIMUM LEVELS OF IMPLEMENTATION

LDU	TOTAL AREA	CROPPED AREA	PROGRAM COVERAGE 1978	1983	1988	1993	1998	2003
			(1000 ACRES)					
C1	494.0	280.1	0.0	0.0	70.0	140.0	210.0	224.1
C2	201.0	163.3	49.0	93.1	122.5	130.7	130.7	130.7
C3A	696.0	563.1	168.9	320.9	422.3	450.4	450.4	450.4
C3B	266.0	220.3	66.1	125.6	165.2	176.2	176.2	176.2
C3C	312.0	248.1	74.4	141.4	186.1	198.5	198.5	198.5
C3D	137.0	108.1	32.4	61.6	81.1	86.5	86.5	86.5
C4	132.0	105.9	31.8	60.4	79.5	84.8	84.8	84.8
C5	182.0	143.6	43.1	81.8	107.7	114.9	114.9	114.9
C6	191.0	154.2	0.0	0.0	38.5	77.1	115.6	123.3
C7	389.0	311.9	0.0	0.0	78.0	155.9	233.9	249.5
C8A	158.0	124.2	0.0	0.0	31.1	62.1	93.2	99.4
C8B	83.0	66.5	0.0	0.0	16.6	33.3	49.9	53.2
C9	723.0	589.5	0.0	0.0	147.4	294.8	442.1	471.6
C10	142.0	114.2	0.0	0.0	28.6	57.1	85.7	91.4
C11	33.0	25.5	0.0	0.0	6.4	12.8	19.1	20.4
C12	61.0	47.0	0.0	0.0	11.8	23.5	35.3	37.6
C13	1018.0	845.8	253.7	482.1	634.3	676.6	676.6	676.6
C14	36.0	10.8	0.0	0.0	2.7	5.4	8.1	8.7
DACCA	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NW1	212.0	181.1	0.0	0.0	45.3	90.5	135.8	144.9
NW2	858.0	726.2	217.9	413.9	544.6	580.9	580.9	580.9
NW3	1507.0	1218.5	365.5	694.5	913.9	974.8	974.8	974.8
NW4A	480.0	394.9	118.5	225.1	296.2	316.0	316.0	316.0
NW4B	201.0	164.7	49.4	93.9	123.5	131.8	131.8	131.8
NW5	645.0	527.8	0.0	0.0	131.9	263.9	395.8	422.2
NW6	79.0	53.7	16.1	30.6	40.3	43.0	43.0	43.0
NW7	39.0	30.0	9.0	17.1	22.5	24.0	24.0	24.0
NW8A	210.0	184.7	0.0	0.0	46.2	92.4	138.5	147.8
NW8B	34.0	21.8	0.0	0.0	5.5	10.9	16.4	17.5
NW9	941.0	755.3	0.0	0.0	188.8	377.6	566.5	604.2
NW10	359.0	303.9	0.0	0.0	76.0	152.0	228.0	243.2
NW11A	404.0	193.8	0.0	0.0	48.5	96.9	145.4	155.1
NW11B	234.0	144.7	0.0	0.0	36.2	72.3	108.5	115.8

NW12	206.0	174.7	52.4	99.6	131.0	139.8	139.8	139.8
NW13	1458.0	1201.2	360.4	684.7	900.9	961.0	961.0	961.0
NW14	180.0	48.2	0.0	0.0	12.1	24.1	36.2	38.6
E1	304.0	259.3	0.0	0.0	64.8	129.7	194.5	207.5
E2	1181.0	960.0	0.0	0.0	240.0	480.0	720.0	768.0
E3	1219.0	998.3	0.0	0.0	249.6	499.1	748.7	798.6
E4	1411.0	997.4	299.2	568.5	748.0	797.9	797.9	797.9
E5	300.0	215.7	64.7	122.9	161.8	172.5	172.5	172.5
E6	300.0	248.4	0.0	0.0	62.1	124.2	186.3	198.7
E7	269.0	190.2	0.0	0.0	47.5	95.1	142.6	152.2
E8	871.0	649.7	0.0	0.0	162.4	324.9	487.3	519.8
E9	64.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E10	810.0	641.5	0.0	0.0	160.4	320.8	481.2	513.2
E11A	544.0	382.2	0.0	0.0	95.5	191.1	286.6	305.8
E11B	3644.0	735.3	0.0	0.0	183.8	367.6	551.5	588.2
SW1	280.0	170.2	0.0	0.0	42.5	85.1	127.6	136.1
SW2	242.0	188.4	56.5	107.4	141.3	150.7	150.7	150.7
SW3	2231.0	1849.1	554.7	1054.0	1386.8	1479.3	1479.3	1479.3
SW4	1599.0	1289.5	0.0	0.0	322.4	644.7	967.1	1031.6
SW5	562.0	475.9	0.0	0.0	119.0	238.0	356.9	380.7
SW6	929.0	731.6	219.5	417.0	548.7	585.3	585.3	585.3
SW7	1456.0	1184.8	355.4	675.3	888.6	947.9	947.9	947.9
SW8	317.0	241.1	72.3	137.5	180.9	192.9	192.9	192.9
SW9	238.0	137.4	0.0	0.0	34.4	68.7	103.1	109.9
SW10	1450.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	33543.0	22993.7	3531.1	6709.0	11633.5	15027.9	17833.8	18394.9

TABLE 6

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

IRRIGATION CONSTRAINTS & COSTS (1983)

	ESTIMATED DEVELOPMENT CONSTRAINTS								NUMBER OF 2-CFS UNIT			AVERAGE
	ULTIMATE				THIS PERIOD				(INCR. OVER 1970/71)			P W
	LLPS (SINGLE)	MULTIPLE PUMPING	TUBE WELLS	TOTAL	LLPS (SINGLE)	MULTIPLE PUMPING	TUBE WELLS	TOTAL	LLPS SINGLE	MULTIPLE PUMPING	TUBE WELLS	COSTS
	(000 ACRES)				(000 ACRES)							(RS/AC)
C1	13.	0.	0.	13.	13.	0.	0.	13.	325.	0.	0.	904.
C2	0.	0.	60.	60.	0.	0.	18.	18.	0.	0.	301.	1500.
C3A	14.	0.	300.	314.	7.	0.	98.	105.	175.	0.	1637.	1442.
C3B	0.	0.	120.	120.	0.	0.	53.	53.	0.	0.	885.	1500.
C3C	0.	0.	148.	148.	0.	0.	53.	53.	0.	0.	885.	1500.
C3D	9.	109.	0.	118.	4.	0.	0.	4.	100.	0.	0.	904.
C4	0.	0.	72.	72.	0.	0.	0.	0.	0.	0.	0.	0.
C5	0.	0.	80.	80.	0.	0.	24.	24.	0.	0.	401.	1500.
C6	10.	0.	72.	82.	7.	0.	0.	7.	175.	0.	0.	904.
C7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
C8A	15.	52.	0.	67.	10.	0.	0.	10.	250.	0.	0.	904.
C8B	3.	61.	0.	64.	2.	0.	0.	2.	50.	0.	0.	904.
C9	80.	40.	0.	120.	50.	0.	0.	50.	1250.	0.	0.	904.
C10	0.	100.	0.	100.	0.	0.	0.	0.	0.	0.	0.	0.
C11	10.	15.	0.	25.	25.	0.	0.	25.	625.	0.	0.	904.
C12	19.	0.	0.	19.	19.	0.	0.	19.	475.	0.	0.	904.
C13	28.	92.	300.	420.	17.	0.	18.	35.	425.	0.	301.	1151.
C14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DACCA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW2	0.	0.	324.	324.	0.	0.	114.	114.	0.	0.	1904.	1500.
NW3	18.	0.	600.	618.	12.	0.	201.	213.	300.	0.	3357.	1970.
NW4A	20.	0.	108.	128.	14.	0.	60.	74.	350.	0.	1002.	1764.
NW4B	0.	0.	60.	60.	0.	0.	18.	18.	0.	0.	301.	2065.
NW5	11.	59.	150.	220.	5.	0.	53.	58.	125.	0.	885.	1426.
NW6	1.	0.	24.	25.	1.	0.	9.	10.	25.	0.	150.	1899.
NW7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW8A	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW8B	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW9	0.	120.	360.	480.	0.	0.	0.	0.	0.	0.	0.	0.
NW10	0.	235.	30.	265.	0.	0.	0.	0.	0.	0.	0.	0.
NW11A	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW11B	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW12	0.	0.	72.	72.	0.	0.	26.	26.	0.	0.	434.	1500.
NW13	0.	0.	480.	480.	0.	0.	138.	138.	0.	0.	2305.	2065.
NW14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E2	56.	0.	0.	56.	26.	0.	0.	26.	650.	0.	0.	904.
E3	196.	0.	0.	196.	144.	0.	0.	144.	3600.	0.	0.	904.
E4	237.	368.	240.	845.	170.	0.	0.	170.	4250.	0.	0.	904.
E5	0.	160.	8.	168.	0.	0.	0.	0.	0.	0.	0.	0.
E6	197.	0.	16.	213.	150.	0.	0.	150.	3750.	0.	0.	904.
E7	6.	0.	0.	6.	4.	0.	0.	4.	100.	0.	0.	904.
E8	13.	240.	0.	253.	5.	0.	0.	5.	125.	0.	0.	904.
E9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E10	0.	75.	0.	75.	0.	75.	0.	75.	0.	1875.	0.	2498.
E11A	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E11B	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW1	7.	0.	0.	7.	5.	0.	0.	5.	125.	0.	0.	904.
SW2	125.	0.	0.	125.	105.	0.	0.	105.	2625.	0.	0.	904.
SW3	10.	160.	376.	546.	5.	55.	174.	234.	125.	1375.	2906.	2167.
SW4	401.	0.	0.	401.	273.	0.	0.	273.	6825.	0.	0.	904.
SW5	401.	100.	0.	501.	137.	100.	0.	237.	3425.	2500.	0.	1285.
SW6	571.	104.	0.	675.	413.	262.	0.	675.	10325.	6550.	0.	1255.
SW7	140.	360.	0.	500.	140.	176.	0.	316.	3500.	4400.	0.	1407.
SW8	53.	0.	0.	53.	40.	0.	0.	40.	1000.	0.	0.	904.
SW9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	2664.	2450.	4000.	9114.	1803.	668.	1057.	3528.	45075.	16700.	17652.	

TABLE 7

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

IRRIGATION CONSTRAINTS & COSTS (1993)

	ESTIMATED DEVELOPMENT CONSTRAINTS								NUMBER OF 2-CFS UNIT (INCR. OVER 1970/71)			AVERAGE P W COSTS (RS/AC)
	ULTIMATE				THIS PERIOD							
	LLPS (SINGLE)	MULTIPLE PUMPING	TUBE WELLS	TOTAL	LLPS (SINGLE)	MULTIPLE PUMPING	TUBE WELLS	TOTAL	LLPS SINGLE	MULTIPLE PUMPING	TUBE WELLS	
	(000 ACRES)				(000 ACRES)							
C1	13.	0.	0.	13.	13.	0.	0.	13.	260.	0.	0.	904.
C2	0.	0.	60.	60.	0.	0.	50.	50.	0.	0.	715.	2065.
C3A	14.	0.	300.	314.	14.	0.	233.	247.	280.	0.	3332.	1975.
C3B	0.	0.	120.	120.	0.	0.	100.	100.	0.	0.	1430.	2065.
C3C	0.	0.	148.	148.	0.	0.	123.	123.	0.	0.	1759.	2065.
C3D	9.	109.	0.	118.	9.	118.	0.	127.	180.	2360.	0.	2385.
C4	0.	0.	72.	72.	0.	0.	66.	66.	0.	0.	944.	2065.
C5	0.	0.	80.	80.	0.	0.	43.	43.	0.	0.	615.	2065.
C6	10.	0.	72.	82.	10.	0.	50.	60.	200.	0.	715.	1811.
C7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
C8A	15.	52.	0.	67.	15.	45.	0.	60.	300.	893.	0.	2097.
C8B	3.	61.	0.	64.	3.	65.	0.	68.	60.	1300.	0.	2428.
C9	80.	40.	0.	120.	80.	40.	0.	120.	1600.	800.	0.	1435.
C10	0.	100.	0.	100.	0.	100.	0.	100.	0.	2000.	0.	2498.
C11	10.	15.	0.	25.	10.	15.	0.	25.	200.	300.	0.	1860.
C12	19.	0.	0.	19.	19.	0.	0.	19.	380.	0.	0.	904.
C13	28.	92.	300.	420.	28.	80.	50.	158.	560.	1600.	715.	2080.
C14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DACCA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW2	0.	0.	324.	324.	0.	0.	270.	270.	0.	0.	3861.	2065.
NW3	18.	0.	600.	618.	18.	0.	500.	518.	360.	0.	7150.	2009.
NW4A	20.	0.	108.	128.	20.	0.	90.	110.	400.	0.	1287.	1790.
NW4B	0.	0.	60.	60.	0.	0.	50.	50.	0.	0.	715.	2065.
NW5	11.	59.	150.	220.	11.	70.	125.	206.	220.	1400.	1787.	1872.
NW6	1.	0.	24.	25.	1.	0.	20.	21.	20.	0.	286.	1988.
NW7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW8A	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW8B	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW9	0.	120.	360.	480.	0.	120.	135.	255.	0.	2400.	1930.	2305.
NW10	0.	235.	30.	265.	0.	235.	0.	235.	0.	4700.	0.	2498.
NW11A	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW11B	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW12	0.	0.	72.	72.	0.	0.	61.	61.	0.	0.	872.	1500.
NW13	0.	0.	480.	480.	0.	0.	380.	380.	0.	0.	5434.	2065.
NW14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E2	56.	0.	0.	56.	56.	0.	0.	56.	1120.	0.	0.	904.
E3	196.	0.	0.	196.	196.	0.	0.	196.	3920.	0.	0.	904.
E4	237.	368.	240.	845.	237.	610.	200.	1047.	4740.	12200.	2860.	2054.
E5	0.	160.	8.	168.	0.	160.	7.	167.	0.	3200.	100.	2485.
E6	197.	0.	16.	213.	197.	0.	13.	210.	3940.	0.	186.	956.
E7	6.	0.	0.	6.	6.	0.	0.	6.	120.	0.	0.	904.
E8	13.	240.	0.	253.	13.	240.	0.	253.	260.	4800.	0.	2416.
E9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E10	0.	75.	0.	75.	0.	75.	0.	75.	0.	1500.	0.	2498.
E11A	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E11B	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW1	7.	0.	0.	7.	7.	0.	0.	7.	140.	0.	0.	904.
SW2	125.	0.	0.	125.	125.	125.	0.	250.	2500.	2500.	0.	1701.
SW3	10.	160.	376.	546.	10.	220.	312.	542.	200.	4400.	4462.	2250.
SW4	401.	0.	0.	401.	401.	100.	0.	501.	8020.	2000.	0.	1222.
SW5	401.	100.	0.	501.	401.	0.	0.	401.	8020.	0.	0.	904.
SW6	571.	104.	0.	675.	571.	675.	0.	1246.	11420.	13500.	0.	1394.
SW7	140.	360.	0.	500.	140.	476.	0.	616.	2800.	9524.	0.	1603.
SW8	53.	0.	0.	53.	53.	0.	0.	53.	1060.	0.	0.	904.
SW9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	2664.	2450.	4000.	9114.	2664.	3569.	2878.	9111.	53280.	71377.	41155.	

TABLE 8

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

IRRIGATION CONSTRAINTS & COSTS (2003)

	ESTIMATED DEVELOPMENT CONSTRAINTS								NUMBER OF 2-CFS UNIT			AVERAGE
	ULTIMATE				THIS PERIOD				(INCR. OVER 1970/71)			P W
	LLPS (SINGLE)	MULTIPLE PUMPING	TUBE WELLS	TOTAL	LLPS (SINGLE)	MULTIPLE PUMPING	TUBE WELLS	TOTAL	LLPS SINGLE	MULTIPLE PUMPING	TUBE WELLS	COSTS
	(000 ACRES)				(000 ACRES)							(RS/AC)
C1	13.	0.	0.	13.	13.	0.	0.	13.	217.	0.	0.	904.
C2	0.	0.	60.	60.	0.	0.	60.	60.	0.	0.	750.	1500.
C3A	14.	49.	300.	363.	14.	49.	300.	363.	233.	817.	3750.	1641.
C3B	0.	0.	120.	120.	0.	0.	120.	120.	0.	0.	1500.	1500.
C3C	0.	52.	148.	200.	0.	52.	148.	200.	0.	867.	1850.	1818.
C3D	9.	58.	0.	67.	9.	58.	0.	67.	150.	967.	0.	2284.
C4	0.	0.	72.	72.	0.	0.	72.	72.	0.	0.	900.	1500.
C5	0.	0.	80.	80.	0.	0.	80.	80.	0.	0.	1000.	1500.
C6	10.	0.	72.	82.	10.	0.	72.	82.	167.	0.	900.	1407.
C7	0.	87.	0.	87.	0.	87.	0.	87.	0.	1450.	0.	2498.
C8A	15.	103.	0.	118.	15.	103.	0.	118.	250.	1717.	0.	2295.
C8B	4.	65.	0.	69.	4.	65.	0.	69.	67.	1083.	0.	2405.
C9	80.	40.	0.	120.	80.	40.	0.	120.	1333.	666.	0.	1435.
C10	0.	100.	0.	100.	0.	100.	0.	100.	0.	1666.	0.	2498.
C11	25.	0.	0.	25.	25.	0.	0.	25.	417.	0.	0.	904.
C12	19.	0.	0.	19.	19.	0.	0.	19.	317.	0.	0.	904.
C13	28.	45.	300.	373.	28.	45.	300.	373.	467.	750.	3750.	1595.
C14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DACCA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW2	0.	0.	324.	324.	0.	0.	324.	324.	0.	0.	4050.	2065.
NW3	18.	116.	600.	734.	18.	116.	600.	734.	300.	1933.	7500.	2115.
NW4A	20.	58.	108.	186.	20.	58.	108.	186.	333.	967.	1350.	2077.
NW4B	0.	0.	60.	60.	0.	0.	60.	60.	0.	0.	750.	2065.
NW5	11.	59.	150.	220.	11.	59.	150.	220.	183.	983.	1875.	1787.
NW6	1.	0.	24.	25.	1.	0.	24.	25.	17.	0.	300.	2003.
NW7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW8A	0.	45.	0.	45.	0.	45.	0.	45.	0.	750.	0.	2498.
NW8B	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW9	0.	120.	360.	480.	0.	120.	360.	480.	0.	2000.	4500.	2198.
NW10	0.	235.	30.	265.	0.	235.	30.	265.	0.	3917.	375.	2460.
NW11A	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW11B	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW12	0.	0.	72.	72.	0.	0.	72.	72.	0.	0.	900.	1500.
NW13	0.	0.	480.	480.	0.	0.	480.	480.	0.	0.	6000.	2065.
NW14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E2	56.	0.	0.	56.	56.	0.	0.	56.	933.	0.	0.	904.
E3	196.	76.	0.	272.	196.	76.	0.	272.	3267.	1267.	0.	1349.
E4	237.	368.	240.	845.	237.	368.	240.	845.	3950.	6133.	3000.	1917.
E5	0.	160.	8.	168.	0.	160.	8.	168.	0.	2666.	100.	2482.
E6	197.	0.	16.	213.	197.	0.	16.	213.	3283.	0.	200.	971.
E7	6.	50.	0.	56.	6.	50.	0.	56.	100.	833.	0.	2327.
E8	13.	240.	0.	253.	13.	240.	0.	253.	217.	4000.	0.	2416.
E9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E10	0.	75.	0.	75.	0.	75.	0.	75.	0.	1250.	0.	2498.
E11A	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E11B	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW1	7.	0.	0.	7.	7.	0.	0.	7.	117.	0.	0.	904.
SW2	125.	0.	0.	125.	125.	0.	0.	125.	2083.	0.	0.	904.
SW3	10.	0.	376.	386.	10.	0.	376.	386.	167.	0.	4700.	2025.
SW4	401.	274.	0.	675.	401.	274.	0.	675.	6683.	4567.	0.	1551.
SW5	157.	100.	0.	257.	157.	100.	0.	257.	2617.	1667.	0.	1524.
SW6	571.	107.	0.	678.	571.	107.	0.	678.	9517.	1783.	0.	1047.
SW7	140.	360.	0.	500.	140.	360.	0.	500.	2333.	6000.	0.	1555.
SW8	53.	0.	0.	53.	53.	0.	0.	53.	883.	0.	0.	904.
SW9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	2436.	3042.	4000.	9478.	2436.	3042.	4000.	9478.	40601.	50699.	50000.	

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

FLOOD CONTROL & DRAINAGE COSTS AND CONSTRAINTS

LDU	PRESENT VALUE OF ALL COSTS (RS/AC)	TOTAL AREA (1000 AC)	IMPLEMENTATION CONSTRAINT YEAR 5	YEAR 10	YEAR 15	YEAR 20	YEAR 25	YEAR 30
			(1000 AC)					
C1	0.0	493	0	0	0	0	0	0
C2	0.0	200	0	0	0	0	0	0
C3A	0.0	695	0	0	0	0	0	0
C3B	0.0	265	0	0	0	0	0	0
C3C	0.0	311	0	0	0	0	0	0
C3D	799.0	136	136	136	136	136	136	136
C4	0.0	131	0	0	0	0	0	0
C5	0.0	181	0	0	0	0	0	0
C6	0.0	190	0	0	0	0	0	0
C7	0.0	388	0	0	0	0	0	0
C8A	799.0	157	157	157	157	157	157	157
C8B	1059.0	82	82	82	82	82	82	82
C9	720.1	722	250	500	722	722	722	722
C10	1059.0	141	141	141	141	141	141	141
C11	1059.0	32	32	32	32	32	32	32
C12	0.0	60	0	0	0	0	0	0
C13	107.7	1017	250	500	750	1000	1017	1017
C14	0.0	35	0	0	0	0	0	0
DACCA	0.0	20	0	0	0	0	0	0
NW1	0.0	211	0	0	0	0	0	0
NW2	0.0	857	0	0	0	0	0	0
NW3	4.8	1506	250	500	750	1000	1250	1500
NW4A	15.2	479	250	479	479	479	479	479
NW4B	0.0	200	0	0	0	0	0	0
NW5	273.9	644	250	500	644	644	644	644
NW6	30.0	78	78	78	78	78	78	78
NW7	0.0	38	0	0	0	0	0	0
NW8A	0.0	209	0	0	0	0	0	0
NW8B	0.0	33	0	0	0	0	0	0
NW9	114.8	940	250	500	750	940	940	940
NW10	773.0	358	250	358	358	358	358	358
NW11A	0.0	403	0	0	0	0	0	0

NW11B	0.0	233	0	0	0	0	0	0
NW12	0.0	205	0	0	0	0	0	0
NW13	0.0	1457	0	0	0	0	0	0
NW14	0.0	179	0	0	0	0	0	0
E1	0.0	303	0	0	0	0	0	0
E2	0.0	1180	0	0	0	0	0	0
E3	0.0	1218	0	0	0	0	0	0
E4	491.7	1410	250	500	750	1000	1250	1410
E5	119.9	299	250	299	299	299	299	299
E6	161.6	299	250	299	299	299	299	299
E7	17.2	268	250	268	268	268	268	268
E8	139.8	870	250	500	750	870	870	870
E9	0.0	63	0	0	0	0	0	0
E10	264.3	809	250	500	750	809	809	809
E11A	0.0	543	0	0	0	0	0	0
E11B	0.0	3643	0	0	0	0	0	0
SW1	0.0	279	0	0	0	0	0	0
SW2	0.0	241	0	0	0	0	0	0
SW3	35.3	2230	250	500	750	1000	1250	1500
SW4	542.6	1598	250	500	750	1000	1250	1500
SW5	0.0	561	0	0	0	0	0	0
SW6	3.4	928	250	500	750	928	928	928
SW7	264.3	1455	250	500	750	1000	1250	1455
SW8	264.3	316	250	316	316	316	316	316
SW9	0.0	237	0	0	0	0	0	0
SW10	0.0	1449	0	0	0	0	0	0

RICE PRODUCTION POTENTIAL[1/]
(Millions of tons)

Region	Present	Yield Levels	With Inputs			With Irrigation Only			With Full Irrigation and Drainage		
Central	2.18	1983	3.27			3.92			5.76		
		1993		3.93			4.71			6.91	
		2003			4.72			5.65			8.29
Northwest	3.28	1983	4.63			9.08			9.87		
		1993		5.56			10.09			11.85	
		2003			6.67			13.08			14.22
East	2.88	1983	3.95			6.10			9.45		
		1993		4.74			7.32			11.34	
		2003			5.32			8.79			13.61
Southwest	2.66	1983	3.69			7.22			10.22		
		1993		4.43			8.66			12.27	
		2003			5.32			10.39			14.72
Total	11.00	1983	15.56			26.32			35.31		
		1993		18.67			31.59			42.37	
		2003			22.40			37.91			50.84

1/ Unconstrained by economic considerations.

TABLE 10

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

RANKING OF DEVELOPMENT ACTIVITIES BY NET PRESENT WORTHS

1983

LDU	PRESENT AV NET REVENUE	STAGE OF DEVELOPMENT	POTENTIAL NET REVENUE	INCR NET REVE	INCR COST	NET P.W.	RANKING BY NET P.W
			(RS/AC)				
C1	3530.	INPUTS	4947.	1418.	270.	1148.	56
		IRRIG-A	6304.	2775.	1174.	1601.	38
		IRRIG-B	6718.	1771.	904.	867.	81
C2	4033.	INPUTS	5029.	996.	270.	726.	95
		IRRIG-A	6147.	2114.	1770.	344.	145
		IRRIG-B	6488.	1460.	1500.	-40.	171
C3A	3533.	INPUTS	4270.	737.	270.	467.	123
		IRRIG-A	5673.	2140.	1712.	428.	130
		IRRIG-B	6101.	1831.	1442.	389.	136
C3B	3973.	INPUTS	5065.	1092.	270.	822.	83
		IRRIG-A	6265.	2292.	1770.	522.	120
		IRRIG-B	6631.	1567.	1500.	67.	161
C3C	4087.	INPUTS	4909.	822.	270.	552.	117
		IRRIG-A	6747.	2660.	1770.	890.	79
		IRRIG-B	7307.	2399.	1500.	899.	78
C3D	3369.	INPUTS	4397.	1028.	270.	758.	90
		IRRIG-A	5265.	1896.	1174.	722.	96
		IRRIG-B	5530.	1133.	904.	229.	152
		IR&DRG-A	7030.	3661.	1973.	1688.	32
		IR&DRG-B	8065.	3668.	1703.	1965.	18
		IR&DRG-C	8919.	3654.	799.	2855.	6
C4	4232.	INPUTS	5155.	923.	270.	653.	107
C5	3860.	INPUTS	4913.	1053.	270.	783.	88
		IRRIG-A	6185.	2324.	1770.	554.	116
		IRRIG-B	6573.	1659.	1500	159.	157
C6	2765.	INPUTS	3405.	641.	270.	371.	140
		IRRIG-A	4605.	1840.	1174.	666.	104
		IRRIG-B	4971.	1566.	904.	662.	106
C7	2767.	INPUTS	3462.	695.	270.	425.	131
C8A	3200.	INPUTS	4407.	1207.	270.	937.	73
		IRRIG-A	4821.	1621.	1174.	447.	128
		IRRIG-B	4947.	540.	904.	-364.	185
		IR&DRG-A	6822.	3621.	1973.	1648.	35
		IR&DRG-B	7845.	3438.	1703.	1735.	28
		IR&DRG-C	8768.	3947.	799.	3148.	3
C8B	3409.	INPUTS	4783.	1374.	270.	1104.	61
		IRRIG-A	5519.	2110.	1174.	936.	74
		IRRIG-B	5744.	960.	904.	56.	165
		IR&DRG-A	7394.	3985.	2233.	1752.	27
		IR&DRG-B	8520.	3737.	1963.	1774.	26
		IR&DRG-C	9435.	3916.	1059.	2857.	5
C9	3581.	INPUTS	4915.	1333.	270.	1063.	63
		IRRIG-A	5297.	1716.	1174.	542.	119
		IRRIG-B	5414.	499.	904.	-405.	186
		IR&DRG-A	7464.	3883.	1894.	1989.	17
		IR&DRG-B	8562.	3647.	1624.	2023.	16
		IR&DRG-C	9558.	4260.	720.	3540.	2
C10	2807.	INPUTS	4199.	1392.	270.	1122.	58

C11	1748.	INPUTS	2042.	283.	270.	13.	169
		IRRIG-A	2383.	635.	1174.	-539.	189
		IRRIG-B	2490.	459.	904.	-445.	187
		IR&DRG-A	4203.	2454.	2233.	221.	153
		IR&DRG-B	4896.	2865.	1963.	902.	77
		IR&DRG-C	5663.	3280.	1059.	2221.	14
C12	3355.	INPUTS	4755.	1400.	270.	1130.	57
		IRRIG-A	5471.	2117.	1174.	943.	72
		IRRIG-B	5690.	935.	904.	31.	167
C13	2676.	INPUTS	4004.	1327.	270.	1057.	65
		IRRIG-A	4666.	1989.	1421.	569.	113
		IRRIG-B	4868.	864.	1151.	-287.	184
		IR&DRG-A	5313.	2637.	1529.	1108.	60
		IR&DRG-B	6058.	2055.	1259.	796.	87
		IR&DRG-C	6483.	1817.	108.	1710.	29
C14	2783.	INPUTS	4342.	1559.	270.	1289.	49
DACCA	0.	INPUTS	0.	0.	270.	-270.	182
NW1	3472.	INPUTS	4736.	1264.	270.	994.	70
NW2	3353.	INPUTS	4203.	851.	270.	581.	112
		IRRIG-A	6656.	3304.	1770.	1534.	40
		IRRIG-B	7405.	3201.	1500.	1701.	30
NW3	3695.	INPUTS	4510.	815.	270.	545.	118
		IRRIG-A	6320.	2625.	2240.	385.	138
		IRRIG-B	6872.	2362.	1970.	392.	134
		IR&DRG-A	7019.	3324.	2245.	1080.	62
		IR&DR -B	7959.	3448.	1975.	1474.	44
		IR&DRG-C	8459.	2139.	5.	2134.	15
NW4A	3792.	INPUTS	4372.	580.	270.	310.	146
		IRRI A	6285.	2493.	2034.	458.	126
		IRRI B	6868.	2496.	1764.	732.	92
		IR&DR -A	6836.	3044.	2050.	995.	69
		IR&DR -B	7696.	3324.	1780.	1545.	39
		IR&DR -C	8127.	1842.	15.	1827.	24
NW4B	3236.	INPUTS	4189.	953.	270.	683.	103
		IRRI A	5962.	2727.	2335.	392.	135
		IRRI B	6504.	2315.	2065.	250.	150
NW5	3449.	INPUTS	3919.	470.	270.	200.	154
		IRRI -A	5334.	1885.	1696.	189.	155
		IRRIG-B	5766.	1847.	1426.	420.	132
		IR&DR -A	6607.	3158.	1970.	1188.	55
		IR&DR -B	7500.	3581.	1700.	1881.	22
		IR&DR C	8161.	2827.	274.	2553.	9
NW6	2609.	INPUTS	3339.	730.	270.	460.	125
		IRRIG A	5489.	2880.	2169.	711.	97
		IRRIG-B	6145.	2806.	1899.	907.	75
		IR&DR -A	5865.	3257.	2199.	1057.	66
		IR&DR -B	6785.	3447.	1929.	1517.	41
		IR&DR -C	7181.	1692.	30.	1662.	34
NW7	1655.	INPUTS	1927.	272.	270.	2.	170
NW8A	1227.	INPUTS	1563.	336.	270.	66.	162
NW8B	888.	INPUTS	1200.	312.	270.	42.	166
NW9	2880.	INPUTS	3738.	858.	270.	588.	111
NW10	2642.	INPUTS	3266.	625.	270.	355.	142
NW11A	1796.	INPUTS	2801.	1005.	270.	735.	91
NW11B	2879.	INPUTS	3739.	861.	270.	591.	110
NW12	2941.	INPUTS	3901.	961.	270.	691.	101
		IRRIG-A	5629.	2588.	1770.	818.	84
		IRRIG-B	6025.	2124.	1500.	624.	108

NW13	2308.	INPUTS	2678.	371.	270.	101.	159
		IRRIG-A	5353.	3045.	2335.	710.	98
		IRRIG-B	6168.	3490.	2065.	1425.	45
NW14	2331.	INPUTS	2554.	224.	270.	-46.	173
E1	2400.	INPUTS	3078.	677.	270.	407.	133
E2	1856.	INPUTS	2184.	329.	270.	59.	164
		IRRIG-A	3491.	1635.	1174.	461.	124
		IRRIG-B	3890.	1706.	904.	802.	86
E3	1440.	INPUTS	2060.	621.	270.	351.	144
		IRRIG-A	2377.	937.	1174.	-237.	180
		IRRIG-B	2474.	414.	904.	-490.	188
E4	3636.	INPUTS	4595.	959.	270.	689.	102
		IRRIG-A	5473.	1836.	1174.	662.	105
		IRRIG-B	5740.	1145.	904.	241.	151
		IR&DRG-A	6505.	2869.	1666.	1203.	52
		IR&DRG-B	7316.	2721.	1396.	1325.	48
		IR&DRG-C	7878.	2406.	492.	1914.	20
E5	4097.	INPUTS	4652.	554.	270.	284.	148
E6	2194.	INPUTS	2913.	719.	270.	449.	127
		IRRIG-A	3444.	1250.	1174.	76.	160
		IRRIG-B	3607.	694.	904.	-210.	179
		IR&DRG-A	5797.	3603.	1336.	2267.	13
		IR&DRG-B	6815.	3902.	1066.	2837.	7
		IR&DRG-C	7844.	4399.	162.	4238.	1
E7	3078.	INPUTS	3777.	699.	270.	429.	129
		IRRIG-A	5235.	2157.	1174.	983.	71
		IRRIG-B	5679.	1902.	904.	998.	68
		IR&DRG-A	5001.	1923.	1191.	732.	93
		IR&DRG-B	5545.	1767.	921.	846.	82
		IR&DRG-C	5639.	404.	17.	387.	137
E8	2154.	INPUTS	2802.	648.	270.	378.	139
		IRRIG-A	4034.	1880.	1174.	706.	99
		IRRIG-B	4410.	1608.	904.	704.	100
		IR&DRG-A	4337.	2183.	1314.	869.	80
		IR&DRG-B	4954.	2152.	1044.	1108.	59
		IR&DRG-C	5235.	1201.	140.	1061.	64
E9	0.	INPUTS	0.	0.	270.	-270.	181
E10	2213.	INPUTS	2548.	335.	270.	65.	163
		IRRIG-A	4430.	2217.	2768.	-551.	190
		IRRIG-B	5004.	2456.	2498.	-42.	172
		IR&DRG-A	4107.	1894.	3032.	-1138.	192
		IR&DRG-B	4642.	2094.	2762.	-668.	191
		IR&DRG-C	4707.	278.	264.	13.	168
E11A	750.	INPUTS	907.	157.	270.	-113.	175
E11B	851.	INPUTS	999.	148.	270.	-122.	176
SW1	3380.	INPUTS	4662.	1283.	270.	1013.	67
		IRRIG-A	6510.	3130.	1174.	1956.	19
		IRRIG-B	7074.	2411.	904.	1507.	42
SW2	3049.	INPUTS	4956.	1907.	270.	1637.	36
		IRRIG-A	6016.	2967.	1174.	1793.	25
		IRRIG-B	6340.	1384.	904.	480.	122

SW3	3094.	INPUTS	4124.	1030.	270.	760.	89
		IRRIG-A	6342.	3248.	2437.	811.	85
		IRRIG-B	7018.	2894.	2167.	727.	94
		IR&DRG-A	6767.	3673.	2472.	1201.	54
		IR&DRG-B	7805.	3681.	2202.	1478.	43
		IR&DRG-C	8251.	1910.	35.	1874.	23
SW4	2546.	INPUTS	4091.	1545.	270.	1275.	50
		IRRIG-A	5054.	2508.	1174.	1334.	47
		IRRIG-B	5348.	1257.	904.	353.	143
		IR&DRG-A	6658.	4112.	1717.	2395.	11
		IR&DRG-B	7820.	3730.	1447.	2283.	12
		IR&DRG-C	8664.	3610.	543.	3068.	4
SW5	1437.	INPUTS	2268.	831.	270.	561.	115
		IRRIG-A	3133.	1696.	1555.	140.	158
		IRRIG-B	3397.	1128.	1285.	-157.	177
SW6	2707.	INPUTS	4676.	1969.	270.	1699.	31
		IRRIG-A	5602.	2895.	1525.	1370.	46
		IRRIG-B	5884.	1208.	1255.	-47.	174
		IR&DRG-A	5506.	2799.	1528.	1271.	51
		IR&DRG-B	6297.	1621.	1258.	363.	141
		IR&DRG-C	6509.	908.	3.	904.	76
SW7	2281.	INPUTS	3065.	784.	270.	514.	121
		IRRIG-A	4574.	2293.	1677.	615.	109
		IRRIG-B	5034.	1969.	1407.	562.	114
		IR&DRG-A	4411.	2130.	1942.	189.	156
		IR&DRG-B	5014.	1949.	1672.	277.	149
		IR&DRG-C	5148.	574.	264.	310.	147
SW8	3264.	IN UTS	5202.	1937.	270.	1667.	33
		IRRIG-A	7129.	3865.	1174.	2691.	8
		IRRIG-B	7718.	2516.	904.	1612.	37
		IR&DR -A	7153.	3889.	1438.	2451.	10
		IR&DR -B	8252.	3051.	1168.	1882.	21
		IR&DRG-C	8595.	1465.	264.	1201.	53
SW9	1201.	IN UTS	1265.	64.	270.	-206.	178
SW10	0.	INPUTS	0.	0.	270.	-270.	183

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

RANKING OF DEVELOPMENT ACTIVITIES BY NET PRESENT WORTHS

1993

LDU	PRESENT AV NET REVENUE	STAGE OF DEVELOPMENT	POTENTIAL NET REVENUE	INCR NET REVE	INCR COST	NET P.W.	RANKING BY NET P.W
			(TK/AC)				
C1	3530.	INPUTS	5743.	2213.	270.	1943.	47
		IRRIG-A	7437.	3907.	1174.	2733.	18
		IRRIG-B	7954.	2211.	904.	1307.	98
C2	4033.	INPUTS	5811.	1779.	270.	1509.	78
		IRRIG-A	7334.	3302.	2335.	967.	126
		IRRIG-B	7799.	1987.	2065.	-78.	195
C3A	3533.	INPUTS	4905.	1372.	270.	1102.	112
		IRRIG-A	6810.	3277.	2272.	1005.	122
		IRRIG-B	7391.	2487.	2002.	484.	158
C3B	3973.	INPUTS	5869.	1896.	270.	1626.	70
		IRRIG-A	7457.	3484.	2335.	1149.	110
		IRRIG-B	7941.	2072.	2065.	7.	190
C3C	4087.	INPUTS	5664.	1577.	270.	1307.	99
		IRRIG-A	8089.	4002.	2335.	1667.	69
		IRRIG-B	8829.	3165.	2065.	1101.	113
C3D	3369.	INPUTS	5068.	1700.	270.	1430.	86
		IRRIG-A	6252.	2883.	2667.	216.	181
		IRRIG-B	6613.	1544.	2397.	-853.	208
		IR&DR -A	7985.	4616.	3466.	1150.	109
		IR&DRG-B	9289.	4221.	3196.	1025.	119
		IR&DRG-C	10216.	3964.	799.	3165.	10
C4	4232.	INPUTS	6002.	1770.	270.	1500.	80
		IRRIG A	7846.	3614.	2335.	1279.	100
		IRRIG-B	8409.	2407.	2065.	342.	172
C5	3860.	INPUTS	5691.	1830.	270.	1560.	74
		IRRIG-A	7347.	3486.	2335.	1151.	108
		IRRIG-B	7852.	2161.	2065.	96.	186
C6	2765.	INPUTS	3885.	1120.	270.	850.	138
		IRRIG-A	5610.	2846.	2148.	697.	147
		IRRIG-B	6137.	2252.	1878.	374.	166
C7	2767.	INPUTS	3996.	1229.	270.	959.	128
C8A	3200.	INPUTS	5096.	1896.	270.	1626.	71
		IRRIG-A	5698.	2498.	2402.	96.	187
		IRRIG-B	5882.	786.	2132.	-1346.	213
		IR&DRG-A	7904.	4703.	3201.	1502.	79
		IR&DRG-B	9233.	4136.	2931.	1205.	106
		IR&DRG-C	10311.	4613.	799.	3814.	3
C8B	3409.	INPUTS	5596.	2187.	270.	1917.	48
		IRRIG-A	6566.	3157.	2705.	451.	160
		IRRIG-B	6862.	1266.	2435.	-1170.	210
		IR&DRG-A	8344.	4935.	3764.	1171.	107
		IR&DRG-B	9739.	4143.	3494.	649.	150
		IR&DRG-C	10707.	4141.	1059.	3082.	13
C9	3581.	INPUTS	5708.	2126.	270.	1856.	55
		IRRIG-A	6219.	2638.	1749.	889.	135
		IRRI -B	6375.	668.	1479.	-811.	207
		IR&DRG-A	8307.	4726.	2469.	2257.	31
		IR&DR -B	9643.	3935.	2199.	1737.	60
		IR&DRG-C	10687.	4468.	720.	3748.	4

C10	2807.	INPUTS	4988.	2181.	270.	1911.	50
		IRRIG-A	5322.	2515.	2768.	-253.	199
		IRRIG-B	5423.	436.	2498.	-2062.	214
		IR&DRG-A	7452.	4646.	3827.	819.	142
		IR&DRG-B	8765.	3778.	3557.	221.	180
		IR&DRG-C	9816.	4494.	1059.	3435.	7
C11	1748.	INPUTS	2183.	435.	270.	165.	182
		IRRIG-A	2698.	950.	2175.	-1225.	211
		IRRIG-B	2856.	673.	1905.	-1232.	212
		IR&DRG-A	5114.	3366.	3234.	132.	183
		IR&DRG-B	6065.	3882.	2964.	919.	133
		IR&DRG-C	7093.	4394.	1059.	3335.	8
C12	3355.	INPUTS	5481.	2127.	270.	1857.	54
		IRRIG-A	6404.	3049.	1174.	1875.	53
		IRRIG-B	6685.	1203.	904.	299.	176
C13	2676.	INPUTS	4653.	1977.	270.	1707.	65
		IRRIG-A	5601.	2925.	2373.	551.	156
		IRRIG-B	5890.	1237.	2103.	-866.	209
		IR&DRG-A	5851.	3175.	2481.	694.	148
		IR&DRG-B	6748.	2095.	2211.	-116.	196
		IR&DRG-C	7098.	1497.	108.	1390.	89
C14	2783.	INPUTS	5144.	2361.	270.	2091.	39
DACCA	0.	INPUTS	0.	0.	270.	-270.	201
NW1	3472.	INPUTS	5594.	2122.	270.	1852.	56
NW2	3353.	INPUTS	4933.	1581.	270.	1311.	96
		IRRIG-A	8171.	4818.	2335.	2483.	24
		IRRIG-B	9159.	4225.	2065.	2160.	36
NW3	3695.	INPUTS	5307.	1612.	270.	1342.	93
		IRRIG-A	7699.	4004.	2296.	1707.	64
		IRRIG-B	8428.	3121.	2026.	1094.	114
		IR&DRG-A	7888.	4193.	2301.	1892.	51
		IR&DRG-B	9073.	3766.	2031.	1735.	61
		IR&DRG-C	9493.	1794.	5.	1789.	58
NW4A	3792.	INPUTS	5055.	1263.	270.	993.	124
		IRRIG-A	7656.	3865.	2132.	1733.	62
		IRRIG-B	8450.	3395.	1862.	1533.	76
		IR&DRG-A	8137.	4346.	2147.	2199.	34
		IR&DRG-B	9366.	4311.	1877.	2433.	25
		IR&DRG-C	9887.	2231.	15.	2215.	33
NW4B	3236.	INPUTS	4971.	1735.	270.	1465.	82
		IRRIG-A	7270.	4034.	2335.	1699.	68
		IRRIG-B	7971.	3000.	2065.	935.	131
NW5	3449.	INPUTS	4587.	1138.	270.	868.	137
		IRRIG-A	6415.	2966.	2097.	869.	136
		IRRIG-B	6972.	2385.	1827.	558.	155
		IR&DRG-A	7526.	4077.	2371.	1706.	66
		IR&DRG-B	8678.	4091.	2101.	1990.	45
		IR&DRG-C	9369.	2954.	274.	2680.	19
NW6	2609.	INPUTS	3941.	1332.	270.	1062.	117
		IRRIG-A	6805.	4197.	2281.	1916.	49
		IRRIG-B	7679.	3739.	2011.	1728.	63
		IR&DRG-A	6461.	3852.	2311.	1541.	75
		IR&DRG-B	7549.	3609.	2041.	1568.	73
		IR&DRG-C	7776.	971.	30.	941.	130
NW7	1655.	INPUTS	2259.	603.	270.	333.	175
NW8A	1227.	INPUTS	1911.	684.	270.	414.	165
NW8B	888.	INPUTS	1494.	605.	270.	335.	173
NW9	2880.	INPUTS	4418.	1538.	270.	1268.	101
		IRRIG-A	6491.	3610.	2647.	1064.	116
		IRRIG-B	7123.	2705.	2277.	428.	163
		IR&DRG-A	6006.	4088.	2663.	1423.	87
		IR&DRG-B	8119.	3701.	2392.	1309.	97
		IR&DRG-C	8616.	2125.	115.	2010.	44

NW10	2642.	INPUTS	3855.	1213.	270.	943.	129
		IRRIG-A	5367.	2725.	2768.	-43.	193
		IRRIG-B	5828.	1973.	2498.	-525.	205
		IR&DRG-A	6936.	4294.	3541.	753.	145
		IR&DRG-B	8149.	4294.	3271.	1023.	120
		IR&DRG-C	8998.	3632.	773.	2858.	16
NW11A	1796.	INPUTS	3304.	1508.	270.	1238.	104
NW11B	2879.	INPUTS	4387.	1509.	270.	1239.	103
NW12	2941.	INPUTS	4532.	1591.	270.	1321.	95
		IRRIG-A	6792.	3851.	1770.	2081.	41
		IRRIG-B	7481.	2949.	1500.	1449.	85
NW13	2308.	INPUTS	2942.	634.	270.	364.	171
		IRRIG-A	6732.	4424.	2335.	2089.	40
		IRRIG-B	7888.	4945.	2065.	2880.	15
NW14	2331.	INPUTS	2725.	394.	270.	124.	184
E1	2400.	INPUTS	3601.	1200.	270.	930.	132
E2	1856.	INPUTS	2572.	716.	270.	446.	161
		IRRIG-A	4293.	2437.	1174.	1263.	102
		IRRIG-B	4818.	2245.	904.	1341.	94
E3	1440.	INPUTS	2450.	1011.	270.	741.	146
		IRRIG-A	2836.	1397.	1174.	223.	178
		IRRIG-B	2954.	504.	904.	-400.	204
E4	3710.	INPUTS	5373.	1663.	270.	1393.	88
		IRRIG-A	6557.	2847.	2355.	492.	157
		IRRIG-B	6918.	1545.	2085.	-540.	206
		IR&DRG-A	7908.	4199.	2847.	1352.	92
		IR&DRG-B	9095.	3722.	2577.	1145.	111
		IR&DRG-C	9869.	3312.	492.	2821.	17
E5	4097.	INPUTS	5364.	1267.	270.	997.	123
		IRRIG-A	8305.	4208.	2751.	1457.	83
		IRRIG-B	9202.	3838.	2481.	1357.	91
		IR&DRG-A	7582.	3485.	2871.	614.	151
		IR&DRG-B	8567.	3203.	2601.	602.	153
		IR&DRG-C	8647.	343.	120.	223.	179
E6	2194.	INPUTS	3430.	1235.	270.	965.	127
		IRRIG-A	4052.	1858.	1249.	609.	152
		IRRIG-B	4242.	813.	979.	-166.	198
		IR&DRG-A	6769.	4575.	1411.	3164.	11
		IR&DRG-B	8062.	4632.	1141.	3491.	6
		IR&DRG-C	9285.	5232.	162.	5071.	1
E7	3078.	INPUTS	4382.	1304.	270.	1034.	118
		IRRIG-A	6518.	3440.	1174.	2266.	30
		IRRIG-B	7170.	2788.	904.	1884.	52
		IR&DRG-A	6047.	2968.	1191.	1777.	59
		IR&DRG-B	6885.	2503.	921.	1582.	72
		IR&DRG-C	6997.	479.	17.	462.	159
E8	2154.	INPUTS	3253.	1099.	270.	829.	140
		IRRIG-A	5098.	2944.	2695.	249.	177
		IRRIG-B	5661.	2407.	2425.	-18.	192
		IR&DRG-A	5355.	3201.	2835.	366.	170
		IR&DRG-B	6260.	3006.	2565.	442.	162
		IR&DRG-C	6614.	1516.	140.	1376.	90
E9	0.	INPUTS	0.	0.	270.	-270.	200
E10	2213.	INPUTS	2849.	637.	270.	367.	168
		IRRIG-A	5351.	3139.	2768.	371.	167
		IRRIG-B	6115.	3265.	2498.	767.	144
		IR&DRG-A	4877.	2665.	3032.	-368.	203
		IR&DRG-B	5630.	2781.	2762.	19.	189
		IR&DRG-C	5716.	364.	264.	100.	185
E11A	750.	INPUTS	1051.	301.	270.	31.	188
E11B	941.	INPUTS	1200.	259.	270.	11.	191

SW1	3380.	INPUTS	5408.	2118.	270.	1848.	57
		IRRIG-A	7691.	4311.	1174.	3137.	12
		IRRIG-B	8360.	2862.	904.	1958.	46
SW2	3060.	INPUTS	5730.	2670.	270.	2400.	26
		IRRIG-A	7326.	4266.	2019.	2247.	32
		IRRIG-B	7813.	2082.	1749.	334.	174
SW3	3111.	INPUTS	4863.	1752.	270.	1482.	81
		IRRIG-A	7732.	4621.	2499.	2122.	37
		IRRIG-B	8608.	3744.	2229.	1516.	77
		IR&DRG-A	8042.	4930.	2534.	2396.	27
		IR&DRG-B	9435.	4572.	2264.	2308.	28
		IR&DRG-C	9954.	2222.	35.	2187.	35
SW4	2551.	INPUTS	4860.	2309.	270.	2039.	43
		IRRIG-A	6141.	3590.	1524.	2066.	42
		IRRIG-B	6531.	1672.	1254.	418.	164
		IR&DRG-A	7837.	5286.	2066.	3220.	9
		IR&DRG-B	9331.	4471.	1796.	2675.	20
		IR&DR -C	10304.	4164.	543.	3621.	5
SW5	1438.	INPUTS	2689.	1251.	270.	981.	125
		IRRIG-A	3833.	2395.	1174.	1221.	105
		IRRIG-B	4182.	1493.	904.	589.	154
SW6	2708.	INPUTS	5253.	2545.	270.	2275.	29
		IRRIG-A	6950.	4242.	1690.	2552.	22
		IRRIG-B	7468.	2215.	1420.	795.	143
		IR&DRG-A	6507.	3799.	1694.	2105.	38
		IR&DRG-B	7580.	2327.	1424.	903.	134
		IR&DRG-C	7773.	822.	3.	819.	141
SW7	2281.	INPUTS	3558.	1277.	270.	1007.	121
		IRRIG-A	5628.	3347.	1891.	1456.	84
		IRRIG-B	6260.	2702.	1621.	1080.	115
		IR&DRG-A	5268.	2986.	2155.	831.	139
		IR&DRG-B	6112.	2553.	1885.	668.	149
		IR&DRG-C	6259.	631.	264.	367.	169
SW8	3264.	INPUTS	6041.	2777.	270.	2507.	23
		IRRIG-A	8741.	5477.	1174.	4303.	2
		IRRIG-B	9565.	3524.	904.	2620.	21
		IR&DRG-A	7666.	4402.	1438.	2964.	14
		IR&DRG-B	8910.	2870.	1168.	1701.	67
		IR&DRG-C	8962.	221.	264.	-43.	194
SW9	1201.	INPUTS	1317.	115.	270.	-155.	197
SW10	0.	INPUTS	0.	0.	270.	-270.	202

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

RANKING OF DEVELOPMENT ACTIVITIES BY NET PRESENT WORTHS

2003

LDU	PRESENT AV NET REVENUE	STAGE OF DEVELOPMENT	POTENTIAL NET REVENUE	INCR NET REVE	INCR COST	NET P.W.	RANKING BY NET P.W
			(RS/AC)				
C1	3530.	INPUTS	6841.	3311.	270.	3041.	48
		IRRIG-A	8878.	5348.	1720.	3628.	27
		IRRIG-B	9499.	2658.	1450.	1208.	158
C2	4033.	INPUTS	7149.	3116.	270.	2846.	62
		IRRIG-A	8972.	4939.	2370.	2569.	79
		IRRIG-B	9528.	2379.	2100.	279.	190
C3A	3533.	INPUTS	5933.	2400.	270.	2130.	104
		IRRIG-A	8291.	4758.	2330.	2428.	89
		IRRIG-B	9010.	3077.	2060.	1017.	165
C3B	3973.	INPUTS	7112.	3139.	270.	2869.	61
		IRRIG-A	9036.	5063.	2370.	2693.	69
		IRRIG-B	9623.	2511.	2100.	411.	184
C3C	4087.	INPUTS	6944.	2857.	270.	2587.	78
		IRRIG-A	9836.	5749.	2370.	3379.	34
		IRRIG-B	10718.	3774.	2100.	1674.	139
C3D	3369.	INPUTS	6012.	2643.	270.	2373.	91
		IRRIG-A	7530.	4161.	2257.	1904.	120
		IRRIG-B	7993.	1981.	1987.	-6.	196
		IR&DRG-A	9429.	6060.	3056.	3004.	52
		IR&DRG-B	11141.	5130.	2786.	2343.	93
		IR&DRG-C	12243.	4713.	799.	3914.	17
C4	4232.	INPUTS	7377.	3144.	270.	2874.	59
		IRRIG-A	9483.	5251.	2370.	2881.	57
		IRRIG-B	10126.	2749.	2100.	649.	174
C5	3860.	INPUTS	6875.	3014.	270.	2744.	66
		IRRIG-A	8852.	4901.	2370.	2621.	74
		IRRIG-B	9455.	2581.	2100.	481.	182
C6	2765.	INPUTS	4656.	1891.	270.	1621.	141
		IRRIG-A	6921.	4156.	2228.	1928.	118
		IRRIG-B	7611.	2956.	1958.	998.	166
C7	2767.	INPUTS	4814.	2047.	270.	1777.	133
C8A	3200.	INPUTS	5984.	2783.	270.	2513.	83
		IRRIG-A	6832.	3632.	2254.	1378.	154
		IRRIG-B	7091.	1108.	1984.	-876.	208
		IR&DRG-A	9366.	6166.	3053.	3113.	43
		IR&DRG-B	11109.	5125.	2783.	2342.	94
		IR&DRG-C	12414.	5581.	799.	4782.	4
C8B	3409.	INPUTS	6643.	3234.	270.	2964.	53
		IRRIG-A	7908.	4409.	2220.	2279.	98
		IRRIG-B	8293.	1660.	1960.	-300.	201
		IR&DRG-A	9785.	6376.	3279.	3097.	46
		IR&DRG-B	11587.	4944.	3009.	1935.	117
		IR&DRG-C	12710.	4802.	1059.	3743.	23
C9	3581.	INPUTS	6721.	3139.	270.	2869.	60
		IRRIG-A	7425.	3843.	1877.	1967.	114
		IRRIG-B	7640.	919.	1607.	-687.	207
		IR&DRG-A	9684.	6102.	2507.	3606.	29
		IR&DRG-B	11408.	4688.	2327.	2361.	92
		IR&DRG-C	12624.	5109.	720.	4479.	6

TABLE 13
Page 2

C10	2807.	INPUTS	5064.	3148.	270.	2888.	56
		IRRIG-A	6479.	3673.	2330.	1343.	156
		IRRIG-B	6636.	671.	2050.	-1379.	211
		IR&DRG-A	8911.	6105.	3379.	2726.	67
		IR&DRG-B	10637.	4672.	3109.	1563.	142
		IR&DRG-C	11905.	5426.	1059.	4367.	10
C11	1748.	INPUTS	2372.	623.	270.	353.	187
		IRRIG-A	3097.	1348.	1720.	-372.	202
		IRRIG-B	3318.	946.	1450.	-504.	206
		IR&DRG-A	6333.	4685.	2779.	1906.	131
		IR&DRG-B	7629.	5298.	2509.	2749.	65
		IR&DRG-C	9012.	5915.	1059.	4856.	3
C12	3355.	INPUTS	6404.	3049.	270.	2779.	64
		IRRIG-A	7504.	4249.	1720.	2529.	82
		IRRIG-B	7970.	1566.	1450.	116.	194
C13	2676.	INPUTS	5622.	2946.	270.	2676.	70
		IRRIG-A	6778.	4102.	2195.	1907.	119
		IRRIG-B	7131.	1509.	1925.	-417.	204
		IR&DRG-A	6808.	4132.	2303.	1829.	125
		IR&DRG-B	7976.	2353.	2033.	320.	188
		IR&DRG-C	8341.	1563.	108.	1455.	149
C14	2783.	INPUTS	368.	3585.	270.	3315.	35
DACCA	0.	INPUTS	0.	0.	270.	-270.	199
NW1	3472.	INPUTS	6906.	3434.	270.	3164.	38
NW2	3353.	INPUTS	6072.	2720.	270.	2450.	86
		IRRIG-A	10059.	6707.	2370.	4337.	11
		IRRIG-B	11276.	5203.	2100.	3103.	45
NW3	3695.	INPUTS	6555.	2860.	270.	2590.	77
		IRRIG-A	9457.	5762.	2342.	3419.	33
		IRRIG-B	10342.	3786.	2072.	1714.	136
		IR&DRG-A	9113.	5423.	2347.	3076.	47
		IR&DRG-B	10650.	4095.	2077.	2018.	108
		IR&DRG-C	11015.	1558.	5.	1553.	143
NW4A	3792.	INPUTS	6228.	2436.	270.	2166.	102
		IRRIG-A	9482.	5690.	2228.	3462.	32
		IRRIG-B	10474.	4246.	1958.	2288.	97
		IR&DRG-A	9679.	5987.	2243.	3744.	26
		IR&DRG-B	11343.	5115.	1973.	3141.	39
		IR&DRG-C	11910.	2429.	15.	2413.	90
NW4B	3236.	INPUTS	6119.	2883.	270.	2613.	75
		IRRIG-A	8907.	5572.	2370.	3302.	36
		IRRIG-B	9758.	3639.	2100.	1539.	145
NW5	3449.	INPUTS	5516.	2067.	270.	1797.	132
		IRRIG-A	7834.	4385.	2304.	2081.	105
		IRRIG-B	8541.	3024.	2034.	991.	168
		IR&DRG-A	8843.	5304.	2579.	2816.	63
		IR&DRG-B	10367.	4850.	2308.	2543.	80
		IR&DRG-C	11140.	3306.	274.	3032.	49
NW6	2609.	INPUTS	4747.	2139.	270.	1869.	123
		IRRIG-A	8411.	5803.	2328.	3475.	31
		IRRIG-B	9529.	4782.	2058.	2724.	68
		IR&DRG-A	7471.	4862.	2358.	2505.	84
		IR&DRG-B	8845.	4098.	2088.	2010.	109
		IR&DRG-C	8977.	566.	30.	536.	178
NW7	1655.	INPUTS	2639.	983.	270.	713.	173
NW8A	1227.	INPUTS	2282.	1055.	270.	785.	172
NW8B	888.	INPUTS	1783.	895.	270.	625.	175
NW9	2880.	INPUTS	5416.	2535.	270.	2265.	99
NW10	2642.	INPUTS	4594.	1952.	270.	1682.	138
		IRRIG-A	6715.	3973.	2351.	1622.	140
		IRRIG-B	7232.	2638.	2081.	557.	177
		IR&DRG-A	8420.	5720.	3124.	2595.	71
		IR&DRG-B	10054.	5460.	2854.	2606.	76
		IR&DRG-C	11103.	4488.	773.	3715.	24

NW11A	1796.	INPUTS	3872.	2076.	270.	1806.	130
		IRRIG-A	4712.	2016.	2320.	696.	176
		IRRIG-B	4968.	1096.	2050.	-954.	210
NW11B	2870.	INPUTS	5153.	2275.	270.	2005.	110
NW12	2941.	INPUTS	5508.	2567.	270.	2297.	96
		IRRIG-A	8415.	5474.	2370.	3104.	44
		IRRIG-B	9301.	3794.	2100.	1694.	137
NW13	2308.	INPUTS	3400.	1101.	270.	831.	171
		IRRIG-A	8548.	6240.	2370.	3870.	18
		IRRIG-B	10116.	6707.	2100.	4607.	5
NW14	2331.	INPUTS	3068.	737.	270.	467.	183
E1	2400.	INPUTS	4481.	2080.	270.	1810.	127
E2	1856.	INPUTS	3119.	1263.	270.	993.	167
		IRRIG-A	5326.	3470.	1720.	1756.	135
		IRRIG-B	5999.	2880.	1450.	1430.	152
E3	1440.	INPUTS	2897.	1457.	270.	1187.	159
		IRRIG-A	3402.	1962.	1878.	84.	195
		IRRIG-B	3555.	658.	1608.	-950.	209
E4	3810.	INPUTS	6403.	2593.	270.	2323.	95
		IRRIG-A	7938.	4127.	2138.	1989.	112
		IRRIG-B	8406.	2002.	1868.	134.	193
		IR&DRG-A	9574.	5764.	2630.	3134.	41
		IR&DRG-B	11203.	4800.	2360.	2440.	87
		IR&DRG-C	12199.	4261.	492.	3770.	21
E5	4097.	INPUTS	6507.	2410.	270.	2140.	103
		IRRIG-A	10093.	5095.	2322.	2674.	25
		IRRIG-B	11186.	4670.	2052.	2628.	73
		IR&DRG-A	9078.	4081.	2441.	2539.	81
		IR&DRG-B	10485.	3978.	2171.	1807.	129
		IR&DRG-C	10605.	512.	120.	392.	185
E6	2194.	INPUTS	4006.	1812.	270.	1542.	144
		IRRIG-A	4836.	2642.	1749.	892.	170
		IRRIG-B	5080.	1083.	1479.	-397.	203
		IR&DRG-A	8338.	6144.	1911.	4233.	12
		IR&DRG-B	10075.	6069.	1641.	4428.	8
		IR&DRG-C	11673.	6838.	162.	6676.	1
E7	3078.	INPUTS	5531.	2452.	270.	2182.	101
		IRRIG-A	8191.	5113.	2237.	2876.	58
		IRRIG-B	9003.	3472.	1967.	1505.	146
		IR&DRG-A	7379.	4300.	2254.	2046.	107
		IR&DRG-B	8594.	3063.	1984.	1079.	162
		IR&DRG-C	8717.	526.	17.	508.	179
E8	2154.	INPUTS	3866.	1712.	270.	1442.	150
		IRRIG-A	6412.	4258.	2274.	1984.	113
		IRRIG-B	7180.	3323.	2004.	1319.	157
		IR&DRG-A	6643.	4480.	2414.	2075.	106
		IR&DRG-B	7011.	4045.	2144.	1901.	121
		IR&DRG-C	8369.	1956.	140.	1816.	126
E9	0.	INPUTS	0.	0.	270.	-270.	198
E10	2213.	INPUTS	3385.	1172.	270.	902.	169
		IRRIG-A	6490.	4278.	2320.	1958.	115
		IRRIG-B	7438.	4053.	2050.	2003.	111
		IR&DRG-A	5818.	3605.	2584.	1021.	163
		IR&DRG-B	6837.	3452.	2314.	1138.	161
		IR&DRG-C	6942.	452.	264.	188.	191
E11A	750.	INPUTS	1317.	566.	270.	296.	189
E11B	1064.	INPUTS	1480.	415.	270.	145.	192
SW1	3380.	INPUTS	6573.	3193.	270.	2923.	54
		IRRIG-A	9104.	5724.	1720.	4004.	15
		IRRIG-B	9876.	3392.	1450.	1942.	124
			[illegible]	[illegible]	270.	[illegible]	[illegible]

SW2	3075.	INPUTS	6851.	3776.	270.	3506.	28
		IRRIG-A	9001.	5026.	1720.	4206.	13
		IRRIG-B	9656.	2805.	1450.	1359.	155
SW3	3135.	INPUTS	5839.	2704.	270.	2434.	88
		IRRIG-A	9342.	6207.	2347.	3859.	19
		IRRIG-B	10410.	4572.	2077.	2494.	85
		IR&DRG-A	9337.	6202.	2383.	3820.	20
		IR&DRG-B	11090.	5251.	2113.	3139.	40
		IR&DRG-C	11623.	2282.	35.	2247.	100
SW4	2557.	INPUTS	5832.	3275.	270.	3005.	51
		IRRIG-A	7445.	4888.	1882.	3006.	50
		IRRIG-B	7937.	2105.	1612.	493.	180
		IR&DRG-A	9356.	6799.	2425.	4374.	9
		IR&DRG-B	11278.	5446.	2155.	3291.	37
		IR&DRG-C	12447.	5002.	543.	4459.	7
SW5	1439.	INPUTS	3206.	1767.	270.	1497.	147
		IRRIG-A	4714.	3274.	1865.	1409.	153
		IRRIG-B	5173.	1967.	1595.	372.	186
SW6	2710.	INPUTS	6106.	3396.	270.	3126.	42
		IRRIG-A	8709.	5999.	1860.	4140.	14
		IRRIG-B	9503.	3397.	1590.	1807.	128
		IR&DRG-A	8078.	5368.	1863.	3505.	30
		IR&DRG-B	9595.	3498.	1593.	1906.	122
		IR&DRG-C	9865.	1156.	3.	1152.	160
SW7	2281.	INPUTS	4492.	2211.	270.	1941.	116
		IRRIG-A	7075.	4794.	2149.	2645.	72
		IRRIG-B	7863.	3371.	1879.	1493.	148
		IR&DRG-A	6469.	4188.	2413.	1775.	134
		IR&DRG-B	7652.	3161.	2143.	1018.	164
		IR&DRG-C	7829.	754.	264.	490.	181
SW8	3264.	INPUTS	7460.	4196.	270.	3926.	16
		IRRIG-A	10794.	7530.	1720.	5810.	2
		IRRIG-B	11812.	4351.	1450.	2901.	55
		IR&DRG-A	8094.	5730.	1984.	3746.	22
		IR&DRG-B	10614.	3153.	1714.	1439.	151
		IR&DRG-C	10558.	-236.	264.	-500.	205
SW9	1201.	INPUTS	1418.	217.	270.	-53.	197
SW10	0.	INPUTS	0.	0.	270.	-270.	200

TABLE 14

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

DEVELOPMENT PROGRAM 1973-1983

RANKING BY N.P.W.	LDU	TOTAL AREA CROPPED (1000 AC)	MODE OF DEVELOPMENT	NPW (RS/AC)	AREA CONSTR. (1000 AC)	INCREMENTAL RICE PRODUCTION (TONS/AC)	(THOUS.TONS)	CUMULATIVE (MILL.TONS)	CUMULATIVE AREAS INPUTS (1000 AC)	IRRIGATION (1000 AC)	IRR&DRG (1000 AC)
2	SW8	241.1	IRRIG-A	4303.	40.0	1.4	57.6	0.1	40.0	40.0	0.0
12	SW1	170.2	IRRIG-A	3137.	5.0	0.2	1.2	0.1	45.0	45.0	0.0
18	C1	280.1	IRRIG-A	2733.	13.0	0.5	6.2	0.1	58.0	58.0	0.0
22	SW6	731.6	IRRIG-A	2552.	378.0	1.8	670.8	0.7	436.0	436.0	0.0
23	SW8	241.1	INPUTS	2507.	97.5	0.5	53.5	0.8	533.5	436.0	0.0
24	NW2	726.2	IRRIG-A	2483.	114.0	1.2	139.2	0.9	647.5	550.0	0.0
26	SW2	188.4	INPUTS	2400.	107.4	0.3	30.8	1.0	754.8	550.0	0.0
30	E7	190.2	IRRIG-A	2266.	4.0	1.6	6.2	1.0	758.8	554.0	0.0
32	SW2	188.4	IRRIG-A	2247.	81.0	0.8	68.1	1.0	839.8	635.0	0.0
37	SW3	1849.1	IRRIG-A	2122.	234.0	0.7	161.0	1.2	1073.8	869.0	0.0
38	SW6	731.6	IR&DRG-A	2105.	297.0	2.0	601.0	1.8	1370.8	1166.0	297.0
40	NW13	1201.2	IRRIG-A	2089.	138.0	1.9	264.1	2.1	1508.8	1304.0	297.0
41	NW12	174.7	IRRIG-A	2081.	26.0	1.3	34.9	2.1	1534.8	1330.0	297.0
42	SW4	1289.5	IRRIG-A	2066.	273.0	0.6	177.0	2.3	1807.8	1603.0	297.0
49	NW6	53.7	IRRIG-A	1916.	10.0	1.1	10.9	2.3	1817.8	1613.0	297.0
53	C12	47.0	IRRIG-A	1875.	19.0	0.4	7.6	2.3	1836.8	1632.0	297.0
62	NW4A	394.9	IRRIG-A	1733.	74.0	1.5	107.4	2.4	1910.8	1706.0	297.0
64	NW3	1218.5	IRRIG-A	1707.	213.0	1.1	242.3	2.6	2123.8	1919.0	297.0
65	C13	845.8	INPUTS	1707.	482.1	0.5	238.2	2.9	2605.9	1919.0	297.0
68	NW4B	164.7	IRRIG-A	1699.	18.0	1.0	17.2	2.9	2623.9	1937.0	297.0
69	C3C	248.1	IRRIG-A	1667.	53.0	0.8	42.7	2.9	2676.9	1990.0	297.0
70	C3B	220.3	INPUTS	1626.	125.6	0.5	63.4	3.0	2802.5	1990.0	297.0
74	C5	143.6	INPUTS	1560.	81.8	0.5	39.5	3.0	2884.3	1990.0	297.0
78	C2	163.3	INPUTS	1509.	93.1	0.6	59.0	3.1	2977.4	1990.0	297.0
80	C4	105.9	INPUTS	1500.	60.4	0.6	37.6	3.1	3037.8	1990.0	297.0
81	SW3	1849.1	INPUTS	1482.	820.0	0.2	203.3	3.3	3857.8	1990.0	297.0
82	NW4B	164.7	INPUTS	1465.	75.9	0.4	31.4	3.4	3933.7	1990.0	297.0
84	SW7	1184.8	IRRIG-A	1456.	675.3	0.5	337.2	3.7	4609.0	1990.0	297.0
86	C3D	108.1	INPUTS	1430.	61.6	0.3	19.5	3.7	4670.7	1990.0	297.0
88	E4	997.4	INPUTS	1393.	568.5	0.3	184.4	3.9	5239.1	1990.0	297.0
92	E4	997.4	IR&DRG-A	1352.	170.0	1.5	253.2	4.2	5409.1	2160.0	467.0
93	NW3	1218.5	INPUTS	1342.	481.5	0.5	244.8	4.4	5890.7	2160.0	467.0
95	NW12	174.7	INPUTS	1321.	73.6	0.3	25.3	4.4	5964.3	2160.0	467.0
96	NW2	726.2	INPUTS	1311.	299.9	0.4	134.9	4.6	6264.2	2160.0	467.0
99	C3C	248.1	INPUTS	1307.	88.4	0.6	52.7	4.6	6352.6	2160.0	467.0
102	E2	960.0	IRRIG-A	1263.	26.0	1.1	28.3	4.7	6378.6	2186.0	467.0
105	SW5	475.9	IRRIG-A	1221.	237.0	0.8	194.0	4.8	6615.6	2423.0	467.0
108	C5	143.6	IRRIG-A	1151.	24.0	0.1	2.8	4.8	6639.6	2447.0	467.0
110	C3B	220.3	IRRIG-A	1149.	53.0	0.3	13.5	4.9	6692.6	2500.0	467.0
122	C3A	563.1	IRRIG-A	1005.	105.0	0.7	78.4	4.9	6797.6	2605.0	467.0
126	C2	163.3	IRRIG-A	967.	18.0	0.4	7.2	4.9	6815.6	2623.0	467.0
135	C9	589.6	IRRIG-A	889.	50.0	0.5	22.8	5.0	6865.6	2673.0	467.0
136	NW5	527.8	IRRIG-A	869.	58.0	0.9	54.0	5.0	6923.6	2731.0	467.0
139	SW7	1184.8	IR&DRG-A	831.	316.0	1.2	367.4	5.4	7239.6	3047.0	783.0
147	C6	154.2	IRRIG-A	687.	7.0	0.8	6.5	5.4	7246.6	3054.0	783.0
152	E6	248.4	IRRIG-A	609.	150.0	0.5	80.4	5.5	7396.6	3204.0	783.0
156	C13	845.8	IRRIG-A	551.	35.0	0.0	1.2	5.5	7431.6	3239.0	783.0
160	C8B	66.5	IRRIG-A	451.	2.0	0.6	1.1	5.5	7433.6	3241.0	783.0
167	E10	641.5	IRRIG-A	371.	75.0	0.9	66.0	5.5	7508.6	3316.0	783.0
177	E8	640.7	IRRIG-A	249.	5.0	1.1	5.5	5.6	7513.6	3321.0	783.0
178	E3	998.3	IRRIG-A	223.	144.0	0.5	60.5	5.6	7657.6	3465.0	783.0
181	C3D	108.1	IRRIG-A	216.	4.0	0.3	1.2	5.6	7661.6	3469.0	783.0
187	C8A	124.2	IRRIG-A	96.	10.0	0.5	5.1	5.6	7671.6	3479.0	783.0

BANGLADESH

DEVELOPMENT PROGRAM 1983-1993

RANKING BY N.P.W.	LDU	TOTAL AREA CROPPED (1000 AC)	MODE OF DEVELOPMENT	NPW (RS/AC)	AREA CONSTR. (1000 AC)	INCREMENTAL RICE PRODUCTION (TONS/AC)	(THOUS.TONS)	CUMULATIVE (MILL.TONS)	CUMULATIVE AREAS INPUTS (1000 AC)	IRRIGATION (1000 AC)	IRR&DR (1000 AC)
3	C8A	124.2	IR&DRG-C	3814.	10.0	1.1	11.3	0.0	0.0	0.0	10.0
4	C9	589.5	IR&DRG-C	3748.	35.4	0.9	33.6	0.0	0.0	0.0	45.4
5	SW4	1289.5	IR&DRG-C	3621.	77.9	1.1	82.1	0.1	0.0	0.0	123.3
9	SW4	1289.5	IR&DRG-A	3220.	77.9	1.7	132.6	0.3	77.9	77.9	201.2
10	C3D	108.1	IR&DRG-C	3165.	4.0	0.9	3.6	0.3	77.9	77.9	205.2
13	C8B	66.5	IR&DRG-C	3082.	2.0	0.9	1.8	0.3	77.9	77.9	207.2
19	NW5	527.8	IR&DRG-C	2680.	58.0	0.5	29.4	0.3	77.9	77.9	265.2
23	SW8	241.1	INPUTS	2507.	55.5	0.5	30.5	0.3	133.3	77.9	265.2
24	NW2	726.2	IRRIG-A	2483.	156.0	1.2	190.5	0.5	289.3	233.9	265.2
27	SW3	1849.1	IR&DRG-A	2396.	254.2	1.4	346.4	0.9	543.6	488.1	519.4
30	E7	190.2	IRRIG-A	2266.	0.1	1.6	0.2	0.9	543.7	488.2	519.4
31	C9	589.5	IR&DRG-A	2257.	35.4	1.4	49.7	0.9	579.1	523.6	554.8
33	NW4A	394.9	IR&DRG-C	2215.	29.6	0.1	3.0	0.9	579.1	523.6	584.5
34	NW4A	394.9	IR&DRG-A	2199.	29.6	1.6	46.1	1.0	608.7	553.3	614.1
38	SW6	731.6	IR&DRG-A	2105.	56.6	2.0	114.6	1.1	665.4	609.9	670.8
39	C14	10.8	INPUTS	2091.	5.4	0.7	3.6	1.1	670.8	609.9	670.8
40	NW13	1201.2	IRRIG-A	2089.	242.0	1.9	463.1	1.5	912.8	851.9	670.8
41	NW12	174.7	IRRIG-A	2081.	35.0	1.3	46.9	1.6	947.8	886.9	670.8
43	SW4	1289.5	INPUTS	2039.	293.9	0.3	84.7	1.7	1241.7	886.9	670.8
47	C1	280.1	INPUTS	1943.	127.0	0.4	47.4	1.7	1368.7	886.9	670.8
48	C8B	66.5	IN UTS	1917.	31.3	0.3	10.3	1.7	1400.0	886.9	670.8
49	NW6	53.7	IRRI -A	1916.	10.7	1.1	11.6	1.7	1410.7	897.6	670.8
50	C10	114.2	INPUTS	1911.	57.1	0.4	23.6	1.8	1467.8	897.6	670 8
51	NW3	1218.5	IR&DR -A	1892.	299.3	1.1	342.0	2.1	1767.1	1196.9	970.1
54	C12	47.0	INPUTS	1857.	4.5	0.2	1.0	2.1	1771.6	1196.9	970.1
55	C9	589.5	INPUTS	1856.	209.3	0.3	55.4	2.2	1980.9	1196.9	970.1
56	NW1	181.1	INPUTS	1852.	90.5	0.5	40.9	2.2	2071.5	1196.9	970.1
57	SW1	170.2	INPUTS	1848.	80.1	0.2	12.2	2.2	2151.5	1196.9	970.1
65	C13	845.8	INPUTS	1707.	159.5	0.5	78.8	2.3	2311.1	1196.9	970 1
66	NW5	527.8	IR&DRG-A	1706.	128.4	1.4	184.7	2.5	2439.5	1325.3	1098.5
68	NW4B	164.7	IRRI -A	1699.	32.0	1.0	30.6	2.5	2471.5	1357.3	1098.5
69	C3C	248.1	IRRI -A	1667.	70.0	0.8	56.4	2.6	2541.5	1427.3	1098.5
71	C8A	124.2	INPUTS	1626.	52.1	0.2	12.7	2.6	2593.6	1427.3	1098.5
74	C5	143.6	IN UTS	1560.	9.0	0.5	4.4	2.6	2602.6	1427.3	1098.5
78	C2	163.3	INPUTS	1509.	19.6	0.6	12.4	2.6	2622.2	1427.3	1098.5
79	C8A	124.2	IR&DR -A	1502.	34.6	1.6	57.0	2.7	2656.8	1461.9	1133.1
80	C4	105.9	INPUTS	1500.	24.4	0.6	15.2	2.7	2681.2	1461.9	1133.1
81	SW3	1849.1	INPUTS	1482.	171.1	0.2	42.4	2.7	2852.2	1461.9	1133.1
82	NW4B	164.7	INPUTS	1465.	5.9	0.4	2.4	2.7	2858.1	1461.9	1133.1
83	E5	215.7	IRRI -A	1457.	130.2	1.1	138.3	2.9	2988.3	1592.1	1133.1
84	SW7	1184.8	IRRIG-A	1456.	146.3	1.5	217.3	3.1	3134.6	1738.4	1133.1
86	C3D	108.1	INPUTS	1430.	20.9	0.3	6.6	3.1	3155.5	1738.4	1133.1
87	NW9	755.3	IR&DRG-A	1423.	227.4	1.3	305.4	3.4	3382.9	1965.8	1360.5
88	E4	997.4	IN UTS	1393.	59.4	0.3	19.3	3.4	3442.2	1965.8	1360.5
89	C13	845.8	IR&DR -C	1390.	35.0	0.4	13.3	3.4	3442.2	1965.8	1395.5
90	E8	649.7	IR&DR -C	1376.	5.0	0.5	2.5	3.4	3442.2	1965.8	1400.5
92	E4	997.4	IR&DR -A	1352.	199.5	1.8	361.8	3.8	3641.7	2165.3	1600.0
95	NW12	174.7	INPUTS	1321.	5.2	0.3	1.8	3.8	3646.9	2165.3	1600.0

96	NW2	726.2	INPUTS	1311.	11.0	0.4	5.0	3.8	3657.9	2165.3	1600.0
100	C4	105.9	IRRIG-A	1279.	21.2	0.6	12.9	3.8	3679.1	2186.5	1600.0
101	NW9	755.3	INPUTS	1268.	150.2	0.4	61.1	3.9	3829.4	2186.5	1600.0
102	E2	960.0	IRRIG-A	1263.	12.2	1.1	13.3	3.9	3841.6	2198.7	1600.0
103	NW11B	144.7	INPUTS	1239.	72.3	0.1	9.2	3.9	3913.9	2198.7	1600.0
104	NW11A	193.8	INPUTS	1238.	96.9	0.1	10.3	3.9	4010.9	2198.7	1600.0
105	SW5	475.9	IRRIG-A	1221.	36.9	0.8	30.2	3.9	4047.7	2235.6	1600.0
107	C8B	66.5	IR&DRG-A	1171.	33.3	1.5	49.2	4.0	4081.0	2268.9	1633.2
108	C5	143.6	IRRIG-A	1151.	19.0	0.6	11.4	4.0	4100.0	2287.9	1633.2
109	C3D	108.1	IR&DRG-A	1150.	21.6	1.5	33.1	4.0	4121.6	2309.5	1654.9
110	C3B	220.3	IRRIG-A	1149.	41.7	0.8	31.7	4.0	4163.3	2351.2	1654.9
111	E4	997.4	IR&DRG-B	1145.	462.1	1.5	688.2	4.7	4163.3	2813.3	2117.0
112	C3A	563.1	INPUTS	1102.	345.4	0.5	161.1	4.9	4508.8	2813.3	2117.0
117	NW6	53.7	INPUTS	1062.	22.3	0.3	5.6	4.9	4531.0	2813.3	2117.0
118	E7	190.2	INPUTS	1034.	91.0	0.7	60.7	5.0	4622.0	2813.3	2117.0
119	C3D	108.1	IR&DRG-B	1025.	71.4	1.2	86.7	5.1	4622.0	2884.7	2188.3
122	C3A	563.1	IRRIG-A	1005.	112.6	0.7	84.1	5.1	4734.6	2997.3	2188.3
123	E5	215.7	INPUTS	997.	42.3	0.5	22.2	5.2	4777.0	2997.3	2188.3
124	NW4A	394.9	INPUTS	993.	212.3	0.6	122.7	5.3	4989.3	2997.3	2188.3
126	C2	163.3	IRRIG-A	967.	32.0	1.0	33.0	5.3	5021.3	3029.3	2188.3
128	C7	311.9	INPUTS	959.	155.9	0.4	68.2	5.4	5177.2	3029.3	2188.3
129	NW10	303.9	INPUTS	943.	152.0	0.3	40.7	5.4	5329.2	3029.3	2188.3
132	E1	259.3	INPUTS	930.	129.7	0.5	70.3	5.5	5458.8	3029.3	2188.3
137	NW5	527.8	INPUTS	868.	77.5	0.3	26.7	5.5	5536.3	3029.3	2188.3
138	C6	154.2	INPUTS	850.	70.1	0.4	28.3	5.5	5606.4	3029.3	2188.3
140	E8	649.7	INPUTS	829.	319.9	0.4	120.9	5.7	5926.3	3029.3	2188.3
141	SW6	731.6	IR&DRG-C	819.	178.1	0.2	44.4	5.7	5926.3	3029.3	2366.5
142	C10	114.2	IR&DRG-A	819.	57.1	1.7	99.7	5.8	5983.4	3086.4	2423.6
145	NW10	303.9	IR&DRG-A	753.	152.0	1.8	280.1	6.1	6135.4	3238.4	2575.5
146	E3	998.3	INPUTS	741.	355.1	0.3	119.6	6.2	6490.5	3238.4	2575.5
147	C6	154.2	IRRIG-A	697.	49.8	0.9	46.0	6.3	6540.3	3288.2	2575.5
148	C13	845.8	IR&DRG-A	694.	95.7	0.9	87.0	6.3	6636.1	3384.0	2671.3
150	C8B	66.5	IR&DRG-B	649.	16.8	1.1	19.4	6.4	6636.1	3400.8	2688.1
161	E2	960.0	INPUTS	446.	441.8	0.4	160.4	6.5	7077.9	3400.8	2688.1
162	E8	649.7	IR&DRG-B	442.	188.7	1.2	231.2	6.8	70 7.9	3589.5	2876.8
165	NW8A	184.7	INPUTS	414.	92.4	0.2	23.1	6.8	7170.2	3589.5	2876.8
168	E10	641.5	INPUTS	367.	245.8	0.3	70.5	6.8	7416.0	3589.5	2876.8
171	NW13	1201.2	INPUTS	364.	581.0	0.2	142.7	7.0	7996.9	3589.5	2876.8
172	C4	105.9	IRRI B	342.	44.8	0.0	0.7	7.0	7996.9	3634.3	2876.8
173	NW8B	21.8	INPUTS	335.	10.9	0.2	2.5	7.0	8007.9	3634.3	2876.8
174	SW2	188.4	IRRI B	334.	100.6	0.8	84.6	7.1	8007.9	3734.9	2876.8
175	NW7	30.0	INPUTS	333.	24.0	0.2	4.8	7.1	8031.9	3734.9	2876.8
180	C10	114.2	IR&DR B	221.	19.9	1.3	26.5	7.1	8031.9	3754.8	2896.7
182	C11	25.5	IN UTS	165.	12.8	0.1	0.8	7.1	8044.7	3754.8	2896.7
183	C11	25.5	IR&DR A	132.	12.8	1.5	19.2	7.1	8057.4	3767.5	2909.5
184	NW14	48.2	INPUTS	124.	24.1	0.2	4.8	7.1	8081.5	3767.5	2909.5
188	E11A	382.2	IN UTS	31.	191.1	0.2	29.3	7.2	8272.6	3767.5	2909.5

BANGLADESH

DEVELOPMENT PROGRAM 1993-2003

RANKING BY N.P.W.	LDU	TOTAL AREA CROPPED (1000 AC)	MODE OF DEVELOPMENT	NPW (RS/AC)	AREA CONSTR. (1000 AC)	INCREMENTAL RICE PRODUCTION (TONS/AC)	(THOUS.TONS)	CUMULATIVE (MILL.TONS)	CUMULATIVE AREAS INPUTS (1000 AC)	IRRIGATION (1000 AC)	IRR&DRG (1000 AC)
1	E6	248.4	IR&DRG-C	6676.	60.0	1.7	99.8	0.1	0.0	0.0	60.0
2	SW8	241.1	IRRIG-A	5810.	10.0	1.8	18.4	0.1	10.0	10.0	60.0
6	C9	589.5	IR&DRG-C	4479.	6.6	1.2	7.6	0.1	10.0	10.0	66.6
7	SW4	1289.5	IR&DRG-C	4459.	112.1	1.3	141.7	0.3	10.0	10.0	178.7
9	SW4	1289.5	IR&DRG-A	4374.	112.1	2.1	236.1	0.5	122.1	122.1	290.8
12	E6	248.4	IR&DRG-A	4233.	60.0	2.3	140.9	0.6	182.1	182.1	350.8
15	SW1	170.2	IRRIG-A	4004.	1.0	0.3	0.3	0.6	183.1	183.1	350.8
25	E5	215.7	IRRIG-A	3674.	36.8	1.4	51.2	0.7	219.9	219.9	350.8
26	NW4A	394.9	IR&DRG-A	3644.	4.4	2.0	8.7	0.7	224.3	224.3	355.2
29	C9	589.5	IR&DRG-A	3506.	6.6	1.8	11.6	0.7	230.9	230.9	361.8
31	NW6	53.7	IRRIG-A	3475.	0.3	1.4	0.4	0.7	231.2	231.2	361.8
33	NW3	1218.5	IRRIG-A	3419.	3.7	1.5	5.5	0.7	234.9	234.9	361.8
35	C14	10.8	INPUTS	3315.	3.3	0.9	2.9	0.7	238.1	234.9	361.8
38	NW1	181.1	INPUTS	3164.	54.3	0.7	35.4	0.8	292.4	234.9	361.8
43	C8A	124.2	IR&DRG-A	3113.	27.5	2.1	56.4	0.8	319.9	262.3	389.2
48	C1	280.1	INPUTS	3041.	84.0	0.5	44.2	0.9	403.9	262.3	389.2
51	SW4	1289.5	INPUTS	3005.	274.7	0.4	112.0	1.0	678.6	262.3	389.2
54	SW1	170.2	INPUTS	2923.	50.1	0.2	11.1	1.0	728.7	262.3	389.2
58	E7	190.2	IRRIG-A	2876.	24.9	2.0	49.8	1.0	753.6	287.2	389.2
60	C9	589.5	INPUTS	2869.	170.3	0.4	63.1	1.1	923.9	287.2	389.2
64	C12	47.0	INPUTS	2779.	14.1	0.3	4.5	1.1	938.0	287.2	389.2
65	C11	25.5	IR&DRG-B	2749.	12.2	1.8	22.4	1.1	938.0	299.5	401.5
76	NW10	303.9	IR&DRG-B	2606.	43.0	1.9	81.3	1.2	938.0	342.5	444.5
94	C8A	124.2	IR&DRG-B	2342.	45.9	1.7	78.6	1.3	938.0	388.4	490.4
99	NW9	755.3	INPUTS	2265.	226.6	0.6	133.5	1.4	1164.6	388.4	490.4
101	E7	190.2	INPUTS	2182.	32.2	1.0	31.0	1.4	1196.7	388.4	490.4
107	E7	190.2	IR&DRG-A	2046.	0.0	2.2	0.0	1.4	1196.7	388.4	490.4
110	NW11B	144.7	INPUTS	2005.	43.4	0.2	8.9	1.5	1240.1	388.4	490.4
118	C6	154.2	IRRIG-A	1928.	3.2	1.2	3.8	1.5	1243.3	391.6	490.4
127	E1	259.3	INPUTS	1810.	77.8	0.8	60.0	1.5	1321.1	391.6	490.4
130	NW11A	193.8	INPUTS	1806.	58.1	0.2	10.5	1.5	1379.2	391.6	490.4
132	NW5	527.8	INPUTS	1797.	158.3	0.5	80.4	1.6	1537.6	391.6	490.4
133	C7	311.9	INPUTS	1777.	93.6	0.6	57.5	1.7	1631.1	391.6	490.4
135	E2	960.0	IRRIG-A	1750.	5.8	1.4	7.9	1.7	1636.9	397.3	490.4
147	SW5	475.9	INPUTS	1497.	106.9	0.3	37.0	1.7	1743.8	397.3	490.4
150	E8	649.7	INPUTS	1442.	194.9	0.5	104.0	1.8	1938.7	397.3	490.4
159	E3	998.3	INPUTS	1187.	299.5	0.5	139.0	2.0	2238.2	397.3	490.4
167	E2	960.0	INPUTS	993.	282.2	0.5	149.2	2.1	2520.4	397.3	490.4
169	E10	641.5	INPUTS	902.	192.5	0.4	80.3	2.2	2712.9	397.3	490.4
172	NW8A	184.7	INPUTS	785.	55.4	0.4	20.2	2.2	2768.3	397.3	490.4
175	NW8B	21.8	INPUTS	625.	6.6	0.3	2.2	2.2	2774.9	397.3	490.4
176	NW11A	193.8	IRRIG-A	596.	38.8	0.3	10.7	2.2	2813.6	436.1	490.4
183	NW14	48.2	INPUTS	467.	14.5	0.3	4.2	2.2	2828.1	436.1	490.4
189	E11A	382.2	INPUTS	296.	114.7	0.2	25.4	2.2	2942.8	436.1	490.4
192	E11B	735.3	INPUTS	145.	588.2	0.1	55.0	2.3	3531.0	436.1	490.4
195	E3	998.3	IRRIG-A	84.	122.0	0.6	76.6	2.4	3653.0	558.1	490.4

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

ALL REGIONS

CROP	1973		1983 PRODUCTION AREAS OF CONCENTRATION					GROSS VALUE OF	PERCENT
	PRODUCTION (TONS)	VALUE OF PRODUCTION (MILLION RS)	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PRODUCTION (MILLION RS)	INCREASE 1973-1983
			(TONS)						
RICE	11296150.	9542.	10218710.	3343141.	3448995.	1576862.	18587700.	15701.	64.5
JUTE	1446074.	1813.	1262004.	475245.	271217.	25124.	2033589.	2549.	40.6
WHEAT	86310.	49.	80235.	54598.	107851.	8165.	250849.	144.	190.6
GROUNDNUTS	3628.	5.	2077.	50052.	28577.	1010.	81717.	111.	2152.4
SUGARCANE	4235260.	231.	3647248.	1318750.	992398.	17833.	5976228.	326.	41.1
RABI CROPS	674789.	1379.	590044.	2104852.	478025.	73813.	3246733.	7163.	381.1
ORCHARDS	52834.	144.	42554.	146491.	2166.	2439.	193649.	528.	266.5
TOTAL		13162.						25993.	97.5
TOTAL AC (THOU)	22994.		15322.	4193.	2696.	783.	22994.		

	INPUTS						PERCENT
	1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	INCREASE 1973-1983
	(MILLIONS)						
LABOR - MAN DAYS	2029.	1829.	546.	444.	167.	2987.	47.
DRAFT-ANIMAL DAYS	496.	451.	151.	139.	56.	797.	61.
SEED-RS	395.	355.	113.	54.	19.	541.	37.
FERTILIZER-LBS	876.	824.	1239.	1469.	619.	4150.	374.
PESTICIDE-RS	132.	117.	181.	164.	78.	540.	309.
WATER-AC.FT	7.	7.	1.	12.	4.	25.	279.

*PRODUCTION ASSUMED TO INCREASE AT 3.5% PER ANNUM

TABLE 17

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

ALL REGIONS

CROP	1973		1993 PRODUCTION					GROSS VALUE OF	PERCENT
			AREAS OF CONCENTRATION						
	PRODUCTION	VALUE OF PRODUCTION	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PRODUCTION	INCREASE
	(TONS)	(MILLION RS)	(TONS)					(MILLION RS)	1973-1993
RICE	11296150.	9542.	4080490.	7259200.	6606985.	7879513.	25826180.	21815.	128.6
JUTE	1446074.	1813.	476017.	901066.	492981.	434916.	2304979.	2889.	59.4
WHEAT	86310.	49.	33277.	107957.	222905.	255634.	619772.	355.	618.1
GROUNDNUTS	3628.	5.	457.	69618.	52911.	80423.	203410.	277.	5506.6
SUGARCANE	4235260.	231.	1488957.	2342442.	1998260.	2039710.	7869369.	429.	85.8
RABI CROPS	674789.	1379.	249768.	3723531.	836746.	849415.	5659460.	12806.	738.7
ORCHARDS	63401.	173.	35642.	392581.	3176.	23880.	455279.	1241.	618.1
TOTAL		13191.						38571.	192.4
TOTAL AC (THOU)	22994.		7049.	8129.	4123.	3692.	22994.		

INPUTS

	1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PERCENT INCREASE
	(MILLIONS)						1973-1993
LABOR - MAN DAYS	2031.	552.	1032.	749.	841.	3173.	56.
DRAFT-ANIMAL DAYS	496.	135.	295.	242.	281.	953.	92.
SEED-RS	395.	111.	192.	87.	88.	477.	21.
FERTILIZER-LBS	879.	254.	3021.	3007.	3598.	9880.	1024.
PESTICIDE-RS	132.	34.	341.	302.	358.	1035.	682.
WATER-AC.FT	7.	3.	4.	19.	20.	45.	591.

*PRODUCTION ASSUMED TO INCREASE AT 1.5% PER ANNUM

TABLE 18

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

ALL REGIONS

CROP	1973		2003 PRODUCTION AREAS OF CONCENTRATION					GROSS VALUE OF	PERCENT
	PRODUCTION (TONS)	VALUE OF PRODUCTION (MILLION RS)	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PRODUCTION (MILLION RS)	INCREASE 1973-2003
			(TONS)						
RICE	11296150.	9542.	2452210.	11012860.	8034528.	10686370.	32185950.	27187.	184.9
JUTE	1446074.	1813.	318093.	1277265.	556248.	552517.	2704121.	3389.	87.0
WHEAT	86310.	49.	22504.	163139.	256498.	315799.	757940.	434.	778.2
GROUNDNUTS	3628.	5.	477.	91661.	66081.	116884.	275102.	375.	7482.7
SUGARCANE	4235260.	231.	1107126.	3255785.	2292722.	2513391.	9169024.	500.	116.5
RABI CROPS	674789.	1379.	151034.	5237506.	977698.	1227968.	7594205.	17761.	1025.4
ORCHARDS	76609.	209.	13840.	775987.	3584.	29292.	822703.	2242.	973.9
TOTAL		13227.						49646.	275.3
TOTAL AC (THOU)	22994.		3396.	11213.	4201.	4183.	22994.		

	INPUTS						PERCENT
	1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	INCREASE 1973-2003
	(MILLIONS)						
LABOR - MAN DAYS	2033.	286.	1381.	813.	1041.	3521.	73.
DRAFT-ANIMAL DAYS	497.	69.	408.	268.	343.	1088.	119.
SEED-RS	395.	58.	247.	87.	98.	490.	24.
FERTILIZER-LBS	883.	117.	4791.	3706.	5056.	13670.	1448.
PESTICIDE-RS	133.	18.	466.	336.	444.	1265.	853.
WATER-AC.FT	7.	1.	6.	19.	22.	49.	647.

*PRODUCTION ASSUMED TO INCREASE AT 1.5% PER ANNUM

TABLE 19

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

CENTRAL

CROP	1973		1983 PRODUCTION					GROSS VALUE OF	PERCENT
			AREAS OF CONCENTRATION						
	PRODUCTION (TONS)	VALUE OF PRODUCTION (MILLION RS)	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PRODUCTION (MILLION RS)	INCREASE 1973-1983
			(TONS)						
RICE	2246611.	1898.	2038942.	1068485.	496107.	0.	3603534.	3044.	60.4
JUTE	508419.	637.	455997.	215282.	93719.	0.	764998.	959.	50.5
WHEAT	7718.	4.	5978.	11046.	67380.	0.	84404.	48.	993.6
GROUNDNUTS	3628.	5.	2077.	3796.	3250.	0.	9123.	12.	151.5
SUGARCANE	545750.	30.	455085.	307471.	41525.	0.	804081.	44.	47.3
RABI CROPS	132439.	271.	136189.	140051.	96819.	0.	373060.	763.	181.7
ORCHARDS	0.	0.	0.	0.	182.	0.	182.	0.	0.0
TOTAL		2845.						4870.	71.2
TOTAL AC (THOU)	4122.		2736.	993.	393.	0.	4122.		

	INPUTS						PERCENT
	1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	INCREASE 1973-1983
	(MILLIONS)						
LABOR - MAN DAYS	434.	397.	156.	71.	0.	624.	44.
DRAFT-ANIMAL DAYS	103.	95.	43.	21.	0.	158.	54.
SEED-RS	76.	69.	27.	8.	0.	104.	36.
FERTILIZER-LBS	160.	149.	441.	254.	0.	844.	429.
PESTICIDE-RS	26.	23.	51.	24.	0.	98.	275.
WATER-AC.FT	1.	1.	0.	2.	0.	3.	149.

*PRODUCTION ASSUMED TO INCREASE AT 3.5% PER ANNUM

TABLE 20

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

NORTHWEST

CRO	1973		1983 PRODUCTION					GROSS VALUE OF	PERCENT
			AREAS OF CONCENTRATION						
	PRODUCTION (TONS)	VALUE OF PRODUCTION (MILLION RS)	OUTSIDE*	INPUTS	IRRIGATION	IRR & DR	TOTAL	PRODUCTION (MILLION RS)	INCREASE 1973-1983
			(TONS)						
RICE	3373809.	2850.	3440900.	973192.	1249164.	0.	5663256.	4784.	67.9
JUTE	421096.	528.	399070.	137245.	85709.	0.	622024.	780.	47.7
WHEAT	36697.	21.	41083.	37677.	38040.	0.	116800.	67.	218.3
GROUNDNUTS	0.	0.	0.	44632.	23960.	0.	68592.	93.	0.0
SUGARCANE	2294461.	125.	2057085.	583063.	731912.	0.	3372058.	184.	47.0
RABI CROPS	209019.	427.	212355.	948958.	95102.	0.	1256415.	2569.	501.1
ORCHARDS	0.	0.	0.	640.	0.	0.	640.	2.	0.0
TOTAL		3951.						8477.	114.6
TOTAL AC (THOU)	6325.		4743.	931.	651.	0.	6325.		

	INPUTS						PERCENT
	1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DR	TOTAL	INCREASE 1973-1983
	(MILLIONS)						
LABOR - MAN DAYS	605.	612.	145.	136.	0.	893.	48.
DRAFT-ANIMAL DAYS	147.	149.	42.	45.	0.	236.	60.
SEED-RS	131.	129.	35.	18.	0.	182.	38.
FERTILIZER-LBS	230.	237.	447.	570.	0.	1254.	444.
PESTICIDE-RS	41.	42.	52.	58.	0.	152.	268.
WATER-AC. T	1.	1.	0.	3.	0.	4.	689.

*PRODUCTION ASSUMED TO INCREASE AT 3.5% PER ANNUM

TABLE 21

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

EASTERN

CROP	1973 PRODUCTION (TONS)	1973 VALUE OF PRODUCTION (MILLION RS)	1983 PRODUCTION --AREAS OF CONCENTRATION (TONS) OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	GROSS VALUE OF PRODUCTION (MILLION RS)	PERCENT INCREASE 1973-1983
RICE	2969414.	2508.	3336794.	480132.	457626.	396759.	4671311.	3946.	57.3
JUTE	136615.	171.	103574.	67206.	10796.	23223.	204798.	257.	49.9
WHEAT	5250.	3.	5101.	0.	0.	9798.	14900.	9.	183.8
GROUNDNUTS	0.	0.	0.	0.	0.	633.	633.	1.	0.0
SUGARCANE	320611.	17.	353091.	90565.	11283.	6148.	461087.	25.	43.8
RABI CROPS	105160.	215.	84498.	135311.	44095.	37708.	301611.	782.	186.8
ORCHARDS	48893.	133.	41862.	14620.	0.	4372.	60854.	166.	24.5
TOTAL		3048.						5019.	64.7
TOTAL AC (THOU)	6278.		5136.	568.	404.	170.	6278.		

	INPUTS 1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PERCENT INCREASE 1973-1983
	(MILLIONS)						
LABOR - MAN DAYS	478.	516.	77.	48.	42.	683.	43.
DRAFT-ANIMAL DAYS	124.	138.	20.	16.	14.	188.	52.
SEED-RS	84.	87.	17.	4.	3.	111.	32.
FERTILIZER-LBS	312.	372.	221.	176.	179.	948.	204.
PESTICIDE-RS	35.	41.	24.	16.	17.	98.	184.
WATER-AC.FT	4.	5.	0.	1.	1.	8.	93.

*PRODUCTION ASSUMED TO INCREASE AT 3.5% PER ANNUM

TABLE 22

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

SOUTHWEST

CROP	1973 PRODUCTION (TONS)	1973 VALUE OF PRODUCTION (MILLION RS)	1983 PRODUCTION AREAS OF CONCENTRATION OUTSIDE* (TONS)	INPUTS (TONS)	IRRIGATION (TONS)	IRR & DRG (TONS)	TOTAL (TONS)	GROSS VALUE OF PRODUCTION (MILLION RS)	PERCENT INCREASE 1973-1983
RICE	2706327.	2286.	1402077.	1424639.	1900377.	1483828.	6210923.	5246.	129.5
JUTE	379948.	476.	303363.	150561.	103595.	3834.	561353.	704.	47.7
WHEAT	36646.	21.	28072.	24075.	24002.	0.	76149.	44.	107.8
GROUNDNUTS	0.	0.	0.	12349.	6725.	567.	19641.	27.	0.0
SUGARCANE	1074444.	59.	781999.	608639.	436693.	15252.	1842581.	100.	71.5
RABI CROPS	228170.	466.	157002.	1285812.	331024.	42710.	1816548.	4176.	696.1
ORCHARDS	14508.	40.	9203.	158539.	2417.	130.	170289.	464.	1073.8
TOTAL		3348.						10297.	207.6
TOTAL AC (THOU)	6268.		2707.	1700.	1248.	613.	6268.		

	INPUTS 1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PERCENT INCREASE 1973-1983
			(MILLIONS)				
LABOR - MAN DAYS	514.	306.	218.	213.	131.	868.	69.
DRAFT-ANIMAL DAYS	122.	69.	62.	68.	47.	246.	102.
SEED-RS	103.	70.	39.	24.	13.	147.	43.
FERTILIZER-LBS	177.	69.	657.	867.	601.	2194.	1138.
PESTICIDE-RS	30.	12.	72.	84.	69.	237.	680.
WATER-AC. T	1.	0.	1.	6.	3.	10.	1294.

*PRODUCTION ASSUMED TO INCREASE AT 3.5% PER ANNUM

TABLE 23

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

CENTRAL

CROP	1973		1993 PRODUCTION AREAS OF CONCENTRATION					GROSS VALUE OF	PERCENT
	PRODUCTION (TONS)	VALUE OF PRODUCTION (MILLION RS)	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PRODUCTION (MILLION RS)	INCREASE 1973-1993
			(TONS)						
RICE	2246611.	1898.	523882.	2027552.	1139458.	886214.	4577107.	3866.	103.7
JUTE	508419.	637.	123473.	400719.	206475.	97443.	828110.	1038.	62.9
WHEAT	7718.	4.	1137.	14946.	134991.	31198.	182271.	104.	2261.7
GROUNDNUTS	3628.	5.	457.	5144.	1753.	26279.	33634.	46.	827.0
SUGARCANE	545750.	30.	79683.	547173.	75473.	382029.	1084358.	59.	98.7
RABI CROPS	132439.	271.	48970.	328455.	182397.	140806.	700629.	1433.	429.0
ORCHARDS	0.	0.	0.	0.	148.	467.	614.	2.	0.0
TOTAL		2845.						6547.	130.1
TOTAL AC (THOU)	4122.		795.	2033.	809.	485.	4122.		

INPUTS

	1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PERCENT INCREASE 1973-1993
	(MILLIONS)						
LABOR - MAN DAYS	434.	80.	300.	153.	107.	640.	48.
DRAFT-ANIMAL DAYS	103.	18.	83.	46.	34.	182.	76.
SEED-RS	76.	14.	51.	16.	12.	92.	21.
FERTILIZER-LBS	160.	25.	833.	570.	433.	1862.	1066.
PESTICIDE-RS	26.	4.	93.	55.	42.	194.	640.
WATER-AC.FT	1.	0.	1.	3.	2.	7.	442.

*PRODUCTION ASSUMED TO INCREASE AT 1.5% PER ANNUM

TABLE 24

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

NORTHWEST

CROP	1973		1993 PRODUCTION					GROSS VALUE OF	PERCENT
			AREAS OF CONCENTRATION						
	PRODUCTION (TONS)	VALUE OF PRODUCTION (MILLION RS)	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PRODUCTION (MILLION RS)	INCREASE 1973-1993
			(TONS)						
RICE	3373809.	2850.	1230580.	2155225.	2450305.	1773093.	7609204.	6427.	125.5
JUTE	421096.	528.	158080.	240017.	130011.	141775.	669883.	840.	59.1
WHEAT	36697.	21.	16057.	59675.	63445.	152588.	291765.	167.	695.1
GROUNDNUTS	0.	0.	0.	50395.	42822.	41936.	135152.	184.	0.0
SUGARCANE	2294461.	125.	886903.	898611.	1290757.	1105222.	4181492.	228.	82.2
RABI CROPS	209019.	427.	85653.	1998598.	158982.	256616.	2499848.	5375.	1096.0
ORCHARDS	0.	0.	0.	97695.	0.	0.	97695.	266.	0.0
TOTAL		3951.						13221.	234.6
TOTAL AC (THOU)	6325.		1802.	2393.	1205.	924.	6325.		

INPUTS

	1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PERCENT INCREASE 1973-1993
	(MILLIONS)						
LABOR - MAN DAYS	605.	169.	304.	257.	212.	941.	56.
DRAFT-ANIMAL DAYS	147.	41.	88.	87.	69.	284.	93.
SEED-RS	131.	38.	64.	32.	28.	162.	23.
FERTILIZER-LBS	230.	61.	891.	1098.	873.	2922.	1169.
PESTICIDE-RS	41.	11.	104.	112.	84.	310.	651.
WATER-AC.FT	1.	0.	1.	7.	5.	12.	2204.

*PRODUCTION ASSUMED TO INCREASE AT 1.5% PER ANNUM

TABLE 25

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

EASTERN

CROP	1973		1993 PRODUCTION					GROSS VALUE OF	PERCENT
			AREAS OF CONCENTRATION						
	PRODUCTION (TONS)	VALUE OF PRODUCTION (MILLION RS)	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PRODUCTION (MILLION RS)	INCREASE 1973-1993
			(TONS)						
RICE	2969414.	2508.	1606187.	1490961.	810374.	2360954.	6268477.	5295.	111.1
JUTE	136615.	171.	32190.	39339.	38590.	117264.	227383.	285.	66.4
WHEAT	5250.	3.	1380.	0.	0.	51849.	53229.	30.	913.9
GROUNDNUTS	0.	0.	0.	0.	0.	3095.	3095.	4.	0.0
SUGARCANE	320611.	17.	126334.	160111.	153677.	41722.	481844.	26.	50.3
RABI CROPS	105160.	215.	34935.	52878.	103239.	195079.	386131.	944.	267.2
ORCHARDS	48893.	133.	31147.	4264.	0.	21385.	56796.	155.	16.2
TOTAL		3048.						6585.	116.0
TOTAL AC (THOU)	6278.		2918.	1707.	628.	1025.	6278.		

INPUTS

	1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PERCENT INCREASE 1973-1993
	(MILLIONS)						
LABOR - MAN DAYS	478.	185.	166.	89.	241.	682.	42.
DRAFT-ANIMAL DAYS	124.	50.	52.	29.	82.	213.	71.
SEED-RS	84.	31.	26.	9.	19.	65.	1.
FERTILIZER-LBS	312.	143.	532.	335.	1051.	2062.	561.
PESTICIDE-RS	35.	15.	59.	31.	100.	205.	494.
WATER-AC.FT	4.	2.	2.	2.	6.	12.	208.

*PRODUCTION ASSUMED TO INCREASE AT 1.5% PER ANNUM

TABLE 26

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

SOUTHWEST

CROP	1973		1993 PRODUCTION					GROSS VALUE OF	PERCENT
			AREAS OF CONCENTRATION						
	PRODUCTION (TONS)	VALUE OF PRODUCTION (MILLION RS)	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PRODUCTION (MILLION RS)	INCREASE 1973-1993
			(TONS)						
RICE	2706327.	2286.	719847.	1585463.	2206850.	2859252.	7371413.	6227.	172.4
JUTE	379948.	476.	162276.	220992.	117905.	78434.	579607.	726.	52.5
WHEAT	36646.	21.	14702.	33337.	24469.	19998.	92506.	53.	152.4
GROUNDNUTS	0.	0.	0.	14080.	8335.	9114.	31529.	43.	0.0
SUGARCANE	1074444.	59.	396038.	736558.	478357.	510740.	2121691.	116.	97.5
RABI CROPS	228170.	466.	80210.	1343610.	392128.	256914.	2072862.	5054.	808.5
ORCHARDS	14508.	40.	4495.	290623.	3028.	2028.	300174.	818.	1969.1
TOTAL		3348.						12219.	265.0
TOTAL AC (THOU)	6268.		1535.	1996.	1480.	1258.	6268.		

INPUTS

	1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PERCENT INCREASE 1973-1993
	(MILLIONS)						
LABOR - MAN DAYS	514.	119.	261.	250.	280.	910.	77.
DRAFT-ANIMAL DAYS	122.	26.	72.	80.	97.	274.	125.
SEED-RS	103.	28.	50.	31.	29.	139.	34.
FERTILIZER-LBS	177.	24.	765.	1004.	1241.	3034.	1612.
PESTICIDE-RS	30.	4.	85.	105.	132.	326.	971.
WATER-AC.FT	1.	0.	1.	6.	7.	13.	1875.

*PRODUCTION ASSUMED TO INCREASE AT 1.5% PER ANNUM

TABLE 27

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

CENTRAL

CROP	1973		2003 PRODUCTION AREAS OF CONCENTRATION					GROSS VALUE OF	PERCENT
	PRODUCTION (TONS)	VALUE OF PRODUCTION (MILLION RS)	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PRODUCTION (MILLION RS)	INCREASE 1973-2003
			(TONS)						
RICE	2246611.	1898.	313257.	2689618.	1354770.	1299672.	5657317.	4779.	151.8
JUTE	508419.	637.	70901.	535330.	236718.	129473.	972423.	1219.	91.3
WHEAT	7718.	4.	875.	18826.	155514.	40386.	215601.	123.	2693.6
GROUNDNUTS	3628.	5.	477.	6132.	2123.	35626.	44357.	60.	1122.6
SUGARCANE	545750.	30.	57733.	692768.	84989.	488396.	1323886.	72.	142.6
RABI CROPS	132439.	271.	23995.	496600.	217640.	207107.	945342.	1934.	613.8
ORCHARDS	0.	0.	0.	0.	178.	564.	742.	2.	0.0
TOTAL		2845.						8187.	187.8
TOTAL AC (THOU)	4122.		392.	2340.	805.	584.	4122.		

INPUTS

	1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PERCENT INCREASE 1973-2003
	(MILLIONS)						
LABOR - MAN DAYS	434.	40.	360.	164.	143.	706.	63.
DRAFT-ANIMAL DAYS	103.	9.	102.	50.	45.	206.	99.
SEED-RS	76.	7.	58.	15.	14.	94.	23.
FERTILIZER-LBS	160.	13.	1158.	692.	664.	2528.	1483.
PESTICIDE-RS	26.	2.	113.	60.	56.	231.	781.
WATER-AC.FT	1.	0.	1.	3.	3.	8.	488.

*PRODUCTION ASSUMED TO INCREASE AT 1.5% PER ANNUM

TABLE 28

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

NORTHWEST

CROP	1973		2003 PRODUCTION					GROSS VALUE OF	PERCENT
			AREAS OF CONCENTRATION						
	PRODUCTION (TONS)	VALUE OF PRODUCTION (MILLION RS)	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PRODUCTION (MILLION RS)	INCREASE 1973-2003
			(TONS)						
RICE	3373809.	2850.	970566.	3088348.	2961885.	2251084.	9271885.	7832.	174.8
JUTE	421096.	528.	122424.	348119.	150898.	162242.	783684.	982.	86.1
WHEAT	36697.	21.	9704.	94942.	78286.	181507.	364440.	209.	893.1
GROUNDNUTS	0.	0.	0.	67364.	54712.	51525.	173601.	237.	0.0
SUGARCANE	2294461.	125.	666938.	1279344.	1510000.	1244421.	4700703.	256.	104.9
RABI CROPS	209019.	427.	55643.	2909482.	208298.	322844.	3496267.	7631.	1572.7
ORCHARDS	0.	0.	0.	178462.	0.	0.	178462.	486.	0.0
TOTAL		3951.						17147.	334.0
TOTAL AC (THOU)	6325.		1138.	2961.	1255.	972.	6325.		

INPUTS

	1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PERCENT INCREASE 1973-2003
	(MILLIONS)						
LABOR - MAN DAYS	605.	110.	389.	278.	243.	1021.	69.
DRAFT-ANIMAL DAYS	147.	27.	117.	96.	78.	317.	115.
SEED-RS	131.	24.	81.	33.	29.	166.	26.
FERTILIZER-LBS	230.	44.	1363.	1349.	1144.	3899.	1593.
PESTICIDE-RS	41.	8.	135.	124.	97.	365.	783.
WATER-AC.FT	1.	0.	1.	7.	5.	13.	2304.

*PRODUCTION ASSUMED TO INCREASE AT 1.5% PER ANNUM

TABLE 29

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

EASTERN

CROP	1973		2003 PRODUCTION					GROSS VALUE OF	PERCENT
			AREAS OF CONCENTRATION						
	PRODUCTION (TONS)	VALUE OF PRODUCTION (MILLION RS)	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PRODUCTION (MILLION RS)	INCREASE 1973-2003
			(TONS)						
RICE	2969414.	2508.	612812.	3034351.	1215592.	3163790.	8026546.	6780.	170.3
JUTE	136615.	171.	11592.	62901.	52210.	137304.	264006.	331.	93.2
WHEAT	5250.	3.	492.	0.	0.	60491.	60983.	35.	1061.6
GROUNDNUTS	0.	0.	0.	0.	0.	11594.	11594.	16.	0.0
SUGARCANE	320611.	17.	52856.	276434.	233325.	49584.	612198.	33.	90.9
RABI CROPS	105160.	215.	12788.	96647.	131254.	267591.	508279.	1208.	383.3
ORCHARDS	59079.	161.	8763.	27621.	0.	25841.	62225.	170.	5.3
TOTAL		3076.						8403.	173.2
TOTAL AC (THOU)	6278.		886.	3468.	778.	1145.	6278.		

INPUTS

	1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PERCENT INCREASE 1973-2003
	(MILLIONS)						
LABOR - MAN DAYS	480.	59.	303.	119.	290.	771.	61.
DRAFT-ANIMAL DAYS	124.	16.	98.	40.	98.	251.	102.
SEED-RS	84.	10.	47.	10.	21.	88.	5.
FERTILIZER-LBS	315.	41.	1159.	513.	1448.	3162.	904.
PESTICIDE-RS	35.	5.	109.	43.	123.	280.	706.
WATER-AC.FT	4.	0.	3.	3.	7.	14.	247.

*PRODUCTION ASSUMED TO INCREASE AT 1.5% PER ANNUM

TABLE 30

BANGLADESH

LAND WATER DEVELOPMENT SECTOR STUDIES

SUMMARY OF AGRICULTURAL PRODUCTION

SOUTHWEST

CROP	1973		2003 PRODUCTION					GROSS VALUE OF	PERCENT
			AREAS OF CONCENTRATION						
	PRODUCTION (TONS)	VALUE OF PRODUCTION (MILLION RS)	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	PRODUCTION (MILLION RS)	INCREASE 1973-2003
			(TONS)						
RICE	2706327.	2286.	555584.	2200549.	2502282.	3971818.	9230234.	7797.	241.1
JUTE	379948.	476.	113177.	330917.	116422.	123497.	684013.	857.	80.0
WHEAT	36646.	21.	11433.	49371.	22698.	33414.	116917.	67.	219.0
GROUNDNUTS	0.	0.	0.	18165.	9246.	18140.	45551.	62.	0.0
SUGARCANE	1074444.	59.	329600.	1007250.	464412.	730993.	2532255.	138.	135.7
RABI CROPS	228170.	466.	58608.	1734783.	420506.	430428.	2644325.	6988.	1058.9
ORCHARDS	17530.	48.	5077.	569904.	3405.	2888.	581274.	1584.	3215.9
TOTAL		3356.						15909.	374.1
TOTAL AC (THOU)	6268.		980.	2444.	1363.	1482.	6268.		

	INPUTS					PERCENT
	1973	OUTSIDE*	INPUTS	IRRIGATION	IRR & DRG	TOTAL	INCREASE 1973-2003
	(MILLIONS)						
LABOR - MAN DAYS	515.	76.	329.	253.	365.	1023.	99.
DRAFT-ANIMAL DAYS	122.	17.	92.	82.	123.	315.	159.
SEED-RS	103.	18.	62.	29.	35.	142.	38.
FERTILIZER-LBS	178.	19.	1110.	1152.	1800.	4081.	2193.
PESTICIDE-RS	31.	3.	109.	109.	168.	389.	1176.
WATER-AC.FT	1.	0.	1.	6.	8.	14.	2017.

*PRODUCTION ASSUMED TO INCREASE AT 1.5% PER ANNUM

TABLE 31

RESULTS OF SENSITIVITY TESTING
NET PRESENT WORTHS(Tks/Ac)

ACTIVITY LDU	'EXPECTED'	LABOR COST ZERO	LABOR COST Tks 3.50/DAY	RICE Tks 16/MD	TUBEWELL COSTS UP 50%	DRAINAGE COST UP 50%	DISCOUNTED AT AT 6%
INPUTS							
SW8	2,658	3,376	1,940	1,994	2,658	2,658	3,839
SW4	1,919	2,424	1,414	1,668	1,919	1,919	2,768
E11B	117	186	49	52	117	117	154
NW1	1,478	1,996	960	1,088	1,478	1,478	2,122
NW6	1,033	1,409	657	821	1,033	1,033	1,478
C9	1,744	2,089	1,399	1,577	1,744	1,744	1,527
C4	994	1,374	613	505	994	994	1,416
IRRIGATION A							
SW6	1,371	2,548	193	NEG	1,371	1,371	2,479
E5	1,372	2,228	456	NEG	1,372	1,372	2,836
NW2	1,302	2,376	228	332	367	1,302	2,725
NW13	952	2,227	NEG	NEG	17	952	
C12	1,430	2,043	817	1,168	1,430	1,430	2,217
C5	415	1,097	NEG	24	NEG	415	1,395
IRRIGATION & DRAINAGE							
SW4	1,722	2,641	NEG	NEG	1,722	NEG	2,834
E4	603	1,070	NEG	NEG	202	NEG	1,765
NW3	1,070	1,973	167	NEG	NEG	1,068	2,324
C8A	739	1,816	NEG	NEG	739	312	1,837
C11	47	701	NEG	NEG	47	NEG	577

TABLE 32

INTRODUCTION

1. This annex is intended to present the sources of, and make explicit, the basic assumptions underlying, the estimates of cost of irrigation facilities used in the development sequencing model.

2. The purpose of these estimates is to permit assessment of the relative priorities for irrigation development of the various land development units. For this purpose the necessary precision of the cost estimates is dictated by the way in which they are to be used. As the principal use is for benefit/cost comparisons in which the error of the benefit estimates may be in excess of 77% of the expected value (see calculations below), there is clearly no point in attempting to develop highly precise cost estimates.

Precision of Benefit Estimates

Estimated average yield (after development; 2 crops/yr) = 60 ± 15% = 60 ± 9 mds/acre
Estimated price = 20 ± 15% = 60 ± 3 Tks/md
Estimated production cost =600 ± 15% =600 ± 90 Tks/acre

Expected benefit = 60 x 20 - 600 = 600 Tks/acre
Lowest likely = 51 x 17 - 690 = 177 Tks/acre
Highest likely = 69 x 23 - 510 =1077 Tks/acre

- but the "truth" could be anywhere in this range.

3. The second use for these cost estimates is to permit assignment of priority to areas in which irrigation is possible at low cost. This necessity does not arise for single low-lift pumps (LLP's) or tubewells as they can be assumed to cost the same, for planning purposes, wherever they are located. Where double pumping is required, however, costs will vary with a wide range of hydrologic and topographic factors. Here generalizations are dangerous, but, in the absence of very detailed topographic maps and hydrologic data, unavoidable. An improved degree of precision in the cost estimates for this case would be most desirable but is, in the present circumstances, unobtainable. The effects of this problem can, however, be minimized by basing estimates on the best available data - then using sensitivity analysis (on the final results of the sequencing exercise) to determine the effect of the low level of precision in the values used.

4. The final use of these estimates is to permit comparisons between the costs of increasing agricultural production by irrigation - and those of doing so by flood protection and drainage measures. In this case it seems from the available figures that, to the extent surface water is available, LLP's (with only single stage pumping) will be the lease costly alternative. Where the choice is between tubewells, two-stage low-lift pumping or drainage facilities (particularly for areas subject only to shallow flooding) the solution is not nearly as clear. Under these circumstances, however, there is no merit in making the irrigation cost estimates more precise than the drainage cost estimates which, like double pumping for LLP's, require extremely detailed hydrologic and topographic data for precise estimation.

5. It is concluded that highly precise estimates of the costs of irrigation facilities are either unnecessary, because they are required for comparison with other unavoidably rough estimates, or unobtainable, because precise estimates would require large quantities of highly detailed topographic and hydrologic data which is unlikely to exist on a country -wide basis for many years.

6. In spite of the foregoing disclaimers there are really only two ways of providing irrigation under serious consideration for the short run in Bangladesh, tubewells and low-lift pumps. Both of these have relatively well-defined hardware requirements, and their capital and operating costs can be estimated with some confidence.

Tubewells

7. For tubewells, although we believe that wells can and should be installed at lower cost, using indigenous drilling methods, we have used, for the purposes of this exercise, the cost estimates from the ADC 3000-well tubewell project. Although the bids recently received for this project were almost double the appraisal estimate, comparisons between these bids and well drilling contracts recently negotiated in Bangladesh indicated:

a) that the new bids appeared to include allowance for price inflation at the rate of about 15% p.a. to the middle of the construction period 1973-74; and

b) that the foreign contractors had further added about 20% of the project costs to cover the present risk situation.

For these reasons the new bids do not provide a basis for changing our estimates of the cost of tubewell construction which, to be consistent with all other estimates, must be expressed in 1970 prices.

Capital Costs of Tubewell Construction

8. In the appraisal report on the ADC tubewell project estimated capital costs, for a 2-cusec diesel powered installation, with deepwell turbine pump and fiberglass downwell components, is given as Tks 48,000 -- the foreign exchange component Tks 24,000 at Tks 4.76= US$1.00.

9. ADC's administration and engineering costs, for the 3000-well project, were estimated at about Tks 15.0 million, with a foreign exchange component of Tks 6.0 million. For a single well this amounts to Tks 5,000 with Tks 2,000 in foreign exchange.

10. Combining the above costs, allowing for contingencies, and rounding off the resulting figures, leads to the following summary of capital costs:

	Local	Foreign	Total
	---------- Tks ----------		
Complete tubewell, including pump and engine, pumphouse and discharge box	24,000	24,000	48,000
Administration and engineering	3,000	3,000	6,000
	27,000	27,000	54,000
Contingencies	3,000	3,000	6,000
Total	30,000	30,000	60,000

Operation, Maintenance and Replacement (O.M. & R.) Costs

11. The fuel costs of operating tubewells (and low-lift pumps) are included, for the purpose of this exercise, with crop production costs as they depend on the specific crops grown. Other O. M. & R. costs for each well include:

	Local	Foreign	Total
	--------- Tks ---------		
Mechanics & operators' time and overhead	2,300	-	2,300
Replacements: 3 new engines in 25 years (6000 x 3/25)	80	640	720
2 new pumps (5500 x 2/25)	180	260	440
	2,560	900	3,460

12. Assuming a service area of 60 acres leads to the per acre costs shown in Table 1 (attached), in which the foregoing foreign exchange figures are appropriately shadow priced.

Low-Lift Pumps

13. There is little doubt about the cost of a single pump. While WAPDA's Chandpur and Coastal Embankment consultants (Leedshill-deLeuw) have done a considerable amount of work towards the design of a lower cost pump, which would operate more efficiently under local conditions, the percentage reduction in cost will be insignificant relative to the cost differences between low-lift pumps and tubewells, and also to the magnitude of errors in the other figures with which these costs will be compared.

14. The basic cost of a single installation in 1970 (Ref.Dacca SW -- draft appraisal report) is Tks 11,000 which includes the pump, engine, trolley, several lengths of pipe, spares, contingencies and an allowance for the infrastructure required to keep a low-lift pump in the field (transport, tools, workshop, offices, etc.). This breaks down as follows:

	Local	Foreign	Total
	---------- Tks ----------		
Pump unit, complete with engine, trolley, pipe, etc.	1,500	5,300	6,800
Infrastructure	2,100	600	2,700
	3,600	5,900	9,500
Contingencies	900	600	1,500
Total	4,500	6,500	11,000

Operation and Maintenance Costs

15. Apart from fuel costs (to be included in crop production costs), annual operation and maintenance costs for each low-lift pump include:

	Local	Foreign	Total
	---------- Tks ----------		
Mechanics & operators' time and ADC overhead	1,800	-	1,800
Spare parts	-	200	200
Replacements: 4 replacements in 25 years of pumps and engines	360	520	880
Total	2,160	720	2,880

16. Assuming a service area of 50 acres then leads to the unit costs summarized in Table 1.

Double Pumping

17. There are at least two possible ways in which secondary pumping to a low-lift pump installation may occur:

a) by pumping through another very similar installation, over a channel plug at the bottom of a long natural drainage channel, i.e., one 2-cusec diesel powered pump feeding another, or perhaps a larger pump feeding several 2-cusec installations;

b) by a relatively major pumping station, properly engineering and constructed, feeding a whole series of standard low-lift pumps.

18. The costs in the first case would be approximately double the costs of a single stage pumping installation. There might be some savings, based on the fact that a single operator could take care of both pumps, and it is possible that the first or lower pump would be working against a lower head. Off-setting costs, however, include the annual construction of the plug at the bottom of the drainage way, and a certain amount of channel excavation. It may, therefore, be assumed that double pumping with small diesel powered pump units will simply double the cost of low-lift pumping.

19. The basis for estimates of secondary pumping through larger electrically powered pump station installations is shown below. From the Dacca-Southwest appraisal report, these estimates are based on a service area of 20,000 ac.

	Local	Foreign	Total
	(Tks million)		
Primary pump plant			
Civil-Structural	4.6	1.2	5.8
Electrical & Mechanical	0.2	1.9	2.1
Transmission & Substation	0.8	1.1	1.9
Primary Channels & Sluices	1.8	0.3	2.1
Secondary Pump Plant	0.3	0.2	0.5
	7.7	4.7	12.4
Contingencies - 15%	1.2	0.7	1.9
Eng. & Supervision - 15%	1.3	0.8	2.1
WAPDA Admin. & Overhead	0.4	-	0.4
Land Acquisition	0.2	-	0.2
Low-lift Pumps incl.cont.	1.8	2.6	4.4
Total	12.6	8.8	21.4

20. Again excluding fuel - operation, maintenance and replacement costs for 20,000 ac are estimated as follows:

	Local	Foreign	Total
	(Tks million)		
Operation & Maintenance:			
- Primary pumps	0.09	.01	.10
- Secondary pumps	0.04	.01	.05
- Low-lift pumps	0.72	.08	.80
Replacement:			
- Transmission lines & substation	0.01	.04	.05
- Primary & Secondary pumps	0.01	.04	.05
- Low-lift pumps	0.08	.26	.34
Dredging	0.04	.13	.17
Primary channels & sluices	0.04	.01	.05
	1.03	0.58	1.61
Admin. & Overhead (15%)	.15	.09	.24
Total	1.18	0.67	1.85

21. The per acre costs of this operation are reflected in Table 1.

Fuel Costs

22. Once a tubewell or LLP is installed, the capital expenditure has been incurred, ADC or WAPDA are committed to the recurring cost of maintenance and repair, more or less independently of the degree to which the installation is used. Wate, however, will not be pumped unless crops are grown, and the quantity pumped (and fuel used) will depend directly on the cropping pattern. For this reason, it was decided to include fuel, but no other irrigation costs, with the per acre costs of production, differentiated by crop. For this purpose the water requirements for each crop are computed in terms of acre-feet pumped. (See Vol.). In the following paragraphs, the cost of pumping this quantity of water is discussed.

Low-lift Pumps

23. The cost of pumping (from either a tubewell or LLP) depends on the rate of pumping, the efficiency of the pump and motor, the fuel use characteristics of the motor, and the cost of fuel.

24. It is assumed that the average rate of pumping is 2-cusecs. At this rate the combined efficiencies of pump and motor, the average lift of 15 ft., and the fuel use characteristics of the diesel engines commonly employed in

Bangladesh, join to cause consumption of fuel at an average rate of 0.625 Imp. gallons/hr. The economic cost of fuel is approximately Tks 1.70 per Imp. Gal. (See Chandpur Project Appraisal Report, Annex 14). In one hour a 2-cusec pump produces 2-ac in or 1/6 of an ac ft. of water. On this basis it takes Tks 1.0625 worth of fuel to produce 1/6 of an ac ft. of water, i.e., Tks 6.5/ac.ft.

Tubewells

25. The factors which affect tubewell operating costs are precisely the same as those that affect low-lift pumps. The principal and only important differences is the pumping lift. Province-wide average rates of drawdown for 2-cusec wells are in the order of 15 ft/cusec -- so that total drawdown may be expected to average about 30 feet. Static lifts vary from 0 to 20 feet from place to place, and from month to month, with an average of about 10 ft. This leads to a total lift of 30 + 10 = 40 ft., or 2.6 times the average lift for a LLP. On the other hand, deepwell turbine pumps are generally more efficient than centrifugals, and the fixed nature of the tubewell diesel motors probably means that they will be maintained better and, therefore, operate more efficiently on the average than low-lift pump motors. On this basis, the cost of water pumped from a tubewell has been taken to be Tks 15 per ac ft.

Single Unit Cost of Irrigation Water

26. For the purposes of the development sequencing model it was most desirable to have a single unit cost per ac ft. for water included in the crop production costs, rather than differentiating between tubewell and low-lift pumps as the source of water. It was, therefore, decided to use the cost of pumping from tubewells as presented above. This would be correct for the tubewell areas, and close to correct where double pumping is required for low-lift pumps, but would over-estimate costs for single stage low-lift pumping by about Tks 8.0 per ac ft. The possible effects of an over-estimate of this magnitude are discussed below.

27. None of the cropping patterns prepared by the agronomists for use in the development sequencing models have average annual pumping requirements in excess of 2.5 ac/ft/ac. Thus, if the unit cost of water is over-estimated by Tks 8 per ac ft the result will be a Tks 20 per ac over-estimate of the costs of crop production on that acre. The order of magnitude of annual crop production costs on irrigated land is about Tks 600 per acre -- and the precision of this estimate is probably plus or minus Tks 150. Under these circumstances, there can be no practical objection to using the tubewell pumping cost of Tks 15 per ac ft for all sources of irrigation water.

Electric vs Diesel Power

28. Although it can be shown theoretically that the costs of electric powered tubewells would be lower than diesel powered wells, this alternative has not been considered or used in the present study for a variety of reasons.

29. This question received considered attention at the time of the Thakurgaon Project Appraisal (Green Cover Report dated April 19,1971). It was found then that, under the particular circumstances of the power system in Bangladesh, and assuming equal reliability, diesel powered wells were somewhat less costly than electric wells. The comparison was, however, found to be extremely sensitive to a series of assumptions regarding reliability, hours of operations, and the growth of the power system in the future. None of these could be resolved objectively then or now and, for the purposes of the present study, resolution is not essential. If electricity turns out, in the long run, to be less costly, a lot of wells will be electrified, but the reduction in cost is unlikely to be sufficient to affect the priority of, for instance, tubewells vis-a-vis low-lift pumps. If, on the other hand, diesel proves to be less costly in the long run, new wells will continue to be installed with diesel powered pumps. In the short run there is no contest, because the rural distribution system is very limited, and to extend it simply for the purpose of electrifying scattered wells would be prohibitively costly.

SUMMARY OF IRRIGATION FACILITY COSTS

	Tubewells	Low-lift Pumps	
		Single	Double
1. Capital Costs (Tks)			
Local	30,000	4,500	12,600,000
Foreign 1/	60,000	13,000	17,600,000
Total	90,000	17,500	30,200,000
2. Assumed Service Area (Ac)	60	50	20,000
3. Unit Capital Costs (Tks/Ac)			
Local	500	90	630
Foreign	1,000	260	880
Total	1,500	350	1,510
4. Recurrent Costs 2/ (Tks/Ac/Yr)			
Local	42	43	59
Foreign	30	19	67
Total	72	72	126

5. Present Worth of Recurrent Costs (Tks/Ac)	6%	9%	12%	6%	9%	12%	6%	9%	12%
Local	473	412	330	532	422	337	730	580	463
Foreign	338	294	235	359	285	227	706	660	525
Total	812	707	565	891	707	564	1436	1240	988
6. Total Present Worths (Tks/Ac)									
Local	972	912	830	622	512	427	1360	1210	1093
Foreign	1338	1294	1235	619	545	487	1586	1540	1405
Total	2311	2106	2065	1241	1057	904	2946	2750	2498

1/ Based on foreign exchange at Tks 9.52= US$1.00
2/ Including replacements over 25 years

CROP INPUT-OUTPUT COEFFICIENTS[2/]

A. PRODUCTION LABOR INPUTS

1. Sources of Information and their Limitations

1.01 One of the difficult problems in budgeting rice production is the estimation of labor inputs. The importance of a reliable estimate of labor use is indicated by the fact that - as one major input, labor accounts for two-thirds the total cost of production in Bangladesh. The problem is compounded by a scarcity of data. For the purposes of the Sector Study, available farm management survey information was reviewed in detail, especially with regard to labor absorption obtained at varying stages of development. The results of this review follow.

The Gumai Bil Survey Data

1.02 Gumai Bil represents a special situation, even for the Chittagong area. The Bil is a basin of 100% rice when under cultivation, thus differing from nearby areas where more diversified production is encountered. The lowest portion of the basin is composed of soils of heavier clay content than the remainder, requiring more work for an equal amount of improved production. Some of the farms producing only desi boro have it on soils in the bottom of the basin, where more plowing and laddering is called for in land preparation. By contrast, farms growing both desi and IRRI-8 give more attention to land preparation for IRRI-8. In such other operations, as irrigating, transplanting, topdressing, spraying and weeding, more attention is also given the IRRI than the desi. Harvest and threshing labor depend on yield.

1.03 Two special considerations are responsible for what may be considered a relatively high labor input in the Bil in the year of the survey. Both irrigation and the IRRI-8 variety were innovations. Effective extension work generated enthusiasm. Near failure in midseason, followed by the discovery that urea provided a remedy, rejuvenated enthusiasm to salvage the crop. This may have resulted in the application of more labor than would be considered "normal" after adoption of the innovations would have become standard practice.

1.04 The second special consideration was that such a contiguous body of rice as the Bil ripening over a period of four to six weeks constituted a mammoth feeding ground for birds, against which efforts at protection were directed in a primitive manner on a large scale. The longer standing time of IRRI-8 accounted for more attention than that received by the desi boro. Men as well as boys were available for this work. Severe enumerative treatment in all individual cases to reduce this figure to a true man-labor component applicable to the farmer's own paddy field allowed a remainder of near 100 hours per acre of IRRI-8, or one-sixth of the pre-harvest man time, adjudged to be rational by persons knowledgeable of the area and the season.

2/ This Annex includes contributions by F.L.Underwood, G.C.Hufbauer, and A. Seager.

1.05 Despite the logic that increased yields from fertilization would take increased amounts of labor, the Gumai Bil data provided little reliable support for such a relationship, except with the IRRI-8 variety. With desi boro, only on the larger acreages were increased yields associated with increased labor, and that labor increase was associated with a marked decrease in acreage per farm. On small and medium-sized acreages, yield increases from about 24 to about 36 maunds per acre were associated with reduced hours of labor per acre.

1.06 With IRRI-8 plantings, however, yield increases from about 38 maunds to 75 or 80 maunds per acre were associated with increased hours of labor on both small and medium-sized acreages. This was partly due to additional harvesting and threshing. The difference between this and the desi boro may also have been associated with the fact that the IRRI yield was more responsive to fertilizer applications, which caused some of the desi plantings that received additional attention to remain in the lower yield groups. With both varieties and at all yield levels, tremendous reductions in labor input rates were associated with increased acreage reflecting the depressing impact of fragmentation on labor productivity.

The Mymensingh Area Survey

1.07 In one study of irrigated desi boro in Mymensingh District, labor hours averaged 643 per acre, producing a yield of 18.4 maunds of paddy (S.M. Masud: Farm Costs and Returns in the Production of Boro Paddy Under Low-Lift Pump Irrigation. Unpublished thesis, Bangladesh Agricultural University, December 1967). This may be compared with 463 hours per acre on desi boro in the Gumai Bil, producing a yield of 19.3 maunds. The average acreage per farm was 0.74 in the Mymensingh over the Bil were in land preparation, manuring, irrigating, and transplanting. Whereas plowing was done four times in Mymensingh as against six to seven in the Bil, additional operations of breaking clods by hand and three times puddling added 24 and 46 hours respectively, and application of 39 maunds of manure against only 8 in the Bil used 32 hours per acre as compared to only 3 or 4 in the Bil. Irrigation used 3 times as much labor, and transplanting 1-1/2 times as much in Mymensingh as in Gumai Bil.

1.08 If the yield of IRRI-8 in Mymensingh should be assumed at three times that of desi boro, and labor inputs assumed to bear similar ratio to desi boro as in Gumai Bil, it might be expected that IRRI would use somewhere in the neighborhood of 1,100 to 1,200 man-hours per acre in Mymensingh. This would assume some speeding up of land preparation and transplanting over the first year's experience, but also that low-lift pump irrigation still would require more time than the cross-dam system possible in the Bil. Early indications were that IRRI-8 yields of 2-1/2 times the desi, or about 46 maunds per acre, would be more realistic than the 3 times observed farther South. Comparative data collected by the Bangladesh Agricultural University on IRRI-8 and desi boro production under irrigation in Mymensingh were not available.

The Comilla Data

1.09 Farm costs and returns survey data reported in the Comilla area on IRRI-8 boro paddy production averaged only 68.8 man-days per acre in 1967 and 75.6 in 1969. The earlier figure was comparable with the desi boro in Gumai Bil and well below that for desi in Kalyanpur village of Mymensingh the same year. Neither was close to any other available data for IRRI-8. Major categories that appeared to be relatively low were land preparation, production of seedlings and transplanting, and the operations required for irrigation. The 0.9 day of tractor power per acre used on these farms would tend to reduce the man time of land preparation, and the number of times the field was gone over to prepare it for transplanting, if known, would have helped to explain the total time spent for the purpose. The work of growing and uprooting seedlings was not reported separately but presumably was combined with transplanting under the heading of "sowing". It is common experience that the more detailed the operations enumerated, in terms of the individual tasks performed by the farmer, the more complete is the final answer obtained. The list of operations reported in the Comilla data was comparatively brief, and detailed operations appeared to have been lumped together. Applications of these data for projection purposes probably should regard the figures as minimal for the yields obtained.

1.10 As in other source data, the acreage of paddy per farm was related inversely to the rates of labor input per acre. A preliminary analysis of the data reported for 1969 showed that about one-third more labor was used per acre on farms growing less than 0.25 acre than on those growing 0.5 acre or more. This was true in practically all categories of work and the same tendency was reflected in the number of bullock days per acre. Yields were comparable between the small and medium-sized acreage groups, but averaged slightly less on the farms growing 0.5 acre or more. The size factor has shown itself to be an important consideration, and Comilla District has been notorious in all data compilations for its small size of holdings and high degree of fragmentation of the farming land area.

2. Labor Input Estimates

2.01 In estimating probable labor inputs for the Study, the Gumai Bil data has been used with adjustment in two important respects. In the first place, the totals included harvesting and threshing labor, whose variation depended more on the quantity of material handled than on the acreage from which it was gathered. Average harvesting and threshing hours for the average yield of 63.6 maunds per acre amounted to 5.4 per maund of IRRI-8 paddy threshed, but where the labor could be determined for different levels of yield without recourse to the original data, the labor per maund of difference in yield averaged 3.2 hours. The corresponding figures for the desi boro were 8.1 and 7.5 respectively, being higher owing to the relatively large amounts of straw handled. On this basis, it was possible to reconstruct a total for harvesting and threshing and deduct it from the grand total to obtain the preharvest labor input per acre.

2.02 The second factor was the variation due to differences in acreage of paddy grown per farm. With labor of producing seedlings omitted, and with harvesting and threshing labor deducted as estimated above, the amount of labor for growing the IRRI-8 crop in the field varied from 1,019 to 414 man-hours (127 to 52 days) per acre at the different acreages observed.

2.03 For purposes of representative composite estimation for a state of advanced development, the basic data taken were typical of approximately the average acreage per farm, or in a range of 0.55 to 0.75 acre. Such acreages would have consisted of seven or eight separate parcels of land, or an average of eight to ten plots per acre.

2.04 Estimates prepared for five major rice crops proposed - two broadcast and three transplanted - varied from 67 man-days per acre for broadcast aman to 115 days for IRRI boro. It was assumed that land preparation for aman would be less than for aus or boro, owing to differences in soil moisture conditions. Work of making banks and ditches and applying irrigation water was assumed to be less in late spring and summer than in the dry season. Weeding of boro and broadcast aus was assumed to be more than for the other crops. A small component was included for incorporation of organic matter in land preparation for boro and aus. Where many basketloads of cowdung, leaves, or other similar materials are carried to the field from the homestead and worked into the soil, as appears to be the tendency in some areas, the labor allotted for manuring would be inadequate. Applications of actual cowdung depend on the animals kept and the amount of the material used for fuel by the household. Relatively small farms having bullocks generally had a higher ratio of cowdung to crop acres than did the larger farms.

2.05 The term fertilizing refers to the use of triple superphosphate and muriate of potash at the time of land preparation, whereas top-dressing referred to the application of urea on the growing crop. Harvesting and threshing labor estimates were derived from the scales prepared from the Gumai Bil data, varied according to expected yield, except for an increment to allow for drying broadcast aus sheaves for threshing and for drying the shelled paddy sufficiently for safe keeping.

2.06 Although the figures are intended to be representative of a large number of farms, they might not apply to any specific one. The represent what might be expected on a farm growing two-thirds to four-fifths of an acre of the IRRI boro by common practices, for example. If the acreage per farm be reduced one-half, the man-hours probably should be increased one-half, except that threshing would depend on yield. Conversely, if the acreage be doubled, the corresponding man-hours should be reduced one-fourth, sliding off to no general reduction above two acres per farm. Furthermore, the figures were intended to represent the current land situation managed by current methods. Consolidation of fragments would alter the results. They would not apply equally well in areas of large farms and those of small farms, as in Dinajpur and Comilla for example. Introduction of mechanical power in land preparation or in threshing would reduce the man-day consumption. The best farms probably would achieve better results than these

figures suggest, and poorer farms not do so well. Under a situation of proposed development, the figures should represent the probable rather than the ideal.

2.07 These considerations led to the following average figures for labor inputs:

Expected Labor Requirements of Rice

	Irrigation?	Yield (m/a)	Man-days	Animal-days
Broadcast aus	No	20	66	13 1/
" "	Yes	30	82	13 1/
T. aus	Yes	40	104	35
T. aman	No	30	87	33
Mixed aus/aman	Yes	30	90	22
Boro	Yes	50	110	36

1/ Hand threshing, no animal-days involved.

3. Wheat

3.01 The nature of this crop demands less exacting land preparation and less frequent irrigation than is the case for broadcast rice. On the other hand, threshing and winnowing will take longer. Consequently, the following figures are assumed for an approximate yield of 25 maunds:

Labor Requirements, Irrigated Wheat

	Pre-harvest	Post-harvest	Total
Hand labor	48	12	60
Animal labor	15	5	20

4. Jute

4.01 Like all crops with a small seed, land preparation is critical. Under improved conditions the assumption is that the moisture content of the soil is under control: the work is done in the dry season, therefore the land can be made just friable enough for easy tillage. Total pre-harvest animal labor requirements will be 15 days.

4.02 Hand-labor requirements, prior to harvest, are lower than with rice, because weeding is easier. The figure adopted is 54 days, allowing for the 4 man-days saved on plowing.

4.03 Harvesting, including carting jute to the buyer for a 25 maund per acre crop, is estimated to require 64 man-days for cutting, retting and stripping, and 2 man-days plus 2 animal-days for taking the produce to market.

Labor Requirements of Jute

	Pre-harvest	Harvest	Total
Hand labor	54	64	120
Animal labor	16	2	18

5. Kharif Groundnuts

5.01 Land preparation is relatively easy. Much of the weeding can, with a little training and adaptability, be done by animals. No allowance is made for irrigation as the crop is assumed to grow in the rainy season.

5.02 Harvesting is entirely a hand operation with the spreading varieties that are grown. The yield assumed is about 16 maunds of shelled nuts.

Labor Requirements of Groundnuts

	Pre-harvest	Post-harvest	Total
Hand labor	30	45	95
Animal labor	21	-	21

6. Sugarcane

6.01 Under improved conditions, sugarcane is to be regarded as a two-year crop and its labor requirements will be evaluated accordingly.

6.02 Land preparation will take about as much animal time as for broadcast rice. After-cultivation between the rows, 4 times, will take 8 days. Hand labor for planting, fertilizing, weeding and irrigation is assumed to take 40 days.

6.03 Cutting and stripping the cane and taking ti to the edge of the field to be picked up for transport to the mill, will take an estimated 45 man-days per acre for a 900 maund crop. Transport to the factory, assuming a median distance of 5 miles from the farm, and including waiting time will take 1 day per load of 25 maunds, i.e. 20 man- and animal-days per acre.

6.04 To grow a ratoon crop involves the same harvest time but considerably less pre-harvest labor: some 25 man-days planting time will be saved at the cost of no more than 5 extra days spent on clearing and tidying up after harvest. Also, no land preparation is necessary. Therefore, the average animal labor requirements of sugarcane, assuming one plant and one ratoon crop, are as follows:

Labor Requirements of Sugarcane

	Pre-harvest	Harvest	Total
Hand labor	36	64	101
Animal labor	20	25	45

7. Pulses

7.01 Pulse crops for the purposes of these calculations are assumed to be catchcrops, receiving the minimum of land preparation and being largely utilized in situ by tethered animals on the field for grazing. Some, of course, are grown for seed.

7.02 Average labor requirements are estimated as follows:

Labor Requirements of Pulses and Catchcrops

	Pre-harvest	Harvest	Total
Hand labor	10	10	20
Animal labor	6	1	7

8. Oilseeds

8.01 The expected oilseeds will be winter groundnuts and Brassicas: mustard and rape. Winter groundnuts have the same labor requirements as the summer variety, except that the equivalent of four man-days must be added to allow for irrigation. The average labor requirements for the group are assumed to be as follows:

Labor Requirements of Oilseeds

	Pre-harvest	Harvest	Total
Hand labor	34	36	70
Animal labor	20	-	20

9. Orchards

9.01 Orchard crops include mangoes, bananas, lichis, coconuts, betel palms and sugar palms. It is impossible to average the groups; the following approximation will serve.

Labor Requirements of Orchards

	Pre-harvest	Harvest	Total
Hand labor	120	80	200
Animal labor	20	-	20

10. Rabi Vegetables

10.01 This is another highly miscellaneous group that includes tomatoes, potatoes, and mostly the European kind of vegetables. The following suggestion is put forward:

Labor Requirements of Rabi Vegetables

	Pre-harvest	Harvest	Total
Hand labor	70	50	120
Animal labor	32	-	32

B. OTHER CROP PRODUCTION INPUTS

11. Seeds

11.01 The following are the commonly recommended seed rates for the crops under consideration:

Seed Rates for the Principal Crops

All broadcast rice	80 lbs.
All transplanted rice	20 lbs.
Jute	4 lbs.
Wheat	80 lbs.
Groundnuts	20 lbs.
Sugarcane	600 lbs.
Pulses	10 lbs.
Oilseeds (Brassicas)	3 lbs.
Orchards	50 saplings
Rabi vegetables	20 lbs.

11.02 It is impossible to put a unit value on all seeds. Generally, planting material for crops, where the planting material and the desired output is the same (rice, wheat, sugarcane) - the seed price is about 20% above market price. Jute seed is worth about Tks 1.50 to Tks 2.0 per lb. A tree sapling is worth about Tks 10.0; some 200 are required per acre and will last for 20 years, i.e. "seed" costs are Tks 100 per acre per annum. For vegetables, the seed or planting material costs may amount to Tks 50.0 per acre. For this reason it was considered the most meaningful to use notquantities of seeds but their costs per acre.

12. Fertilizers

12.01 Fertilizer prices (without subsidies) are based on the following:

(a) Urea. A study conducted by the Industrial Projects Department (February 1971) concluded that, assuming the prevailing price and excise duty

on natural gas, a urea manufacturing project can be viable if the ex-factory price is US$75. They believe, however, that gas prices and duties are too high and recommend their reduction. This recommendation would bring the ex-factory price of urea to US$68 per ton. With shadow pricing this is about Tks 650 per ton.

(b) Phosphates. Two kinds of phosphatic fertilizers have proved to be useful in Bangladesh: triple superphosphate (TSP) on the Gangetic soils, roughly west of the Brahmaputra, and hyperphosphate on the rest of the country. The estimated proportions required are about half of each. The FOB prices are approximately US$65 for TSP and US$35 for hyperphosphate, to which US$15 freight must be added. Therefore, the average price of phosphatic fertilizers, delivered in Chittagong, will be taken as US$65. With shadow pricing this is Tks 620 per ton.

(c) Potash. Muriate of potash, the cheapest (and most suitable) potassic fertilizer available, costs US$59 C&F Chittagong. This, at shadow pricing is equal to Tks 475 per ton.

12.02 The distribution costs of a ton of fertilizer, including the bagging of imported supplies, is estimated at Tks 130 per ton, all costs being incurred in takas. Including this, the final cost of fertilizers to the economy is as shown in the following table:

Economic Costs of Fertilizers at Farmers' Point of Purchase

Urea	Tks 780
Phosphates	750
Potash	605

12.03 Assumed fertilizer doses at the different expected yield levels are given in the table below. The figures are subject to refinement as more precise information becomes available.

RECOMMENDED FERTILIZER DOSES FOR VARIOUS CROPS

Crop	Yield (m/acre)	Urea	Phosphates (lbs per acre	Potash	Total	Cost without subsidy (Tks/a)
Rice	20	60	30	-	90	31
	25	120	60	45	225	71
	30	140	70	55	265	84
	35	170	85	65	310	101
	40	200	100	75	375	119
	45	230	115	85	430	136
	50	260	130	95	485	154
	55	290	145	105	540	178
	60	320	160	115	595	196
	65	350	175	125	650	214
	70	380	190	135	705	232
	75	410	205	145	760	251
Wheat	8	-	-	-	-	-
	12	100	-	-	100	35
	25	130	50	20	210	64
	30	150	60	30	240	80
	36	170	75	40	285	95
Jute	15	-	-	-	-	-
	22	50	25	50	130	36
	25	80	40	80	200	58
	30	100	50	100	250	79
	35	120	70	130	310	100
Sugarcane	400	150	80	70	300	94
	600	200	100	90	390	127
	900	300	170	130	600	175
	1,100	330	200	160	690	225
	1,300	370	220	200	790	256
Brassicas and Oilseeds	13	75	50	-	125	43
	20	100	75	35	210	69
	25	120	80	40	240	79
	30	150	100	50	300	99
Groundnuts	14	50	100	-	150	51
	20	50	120	30	200	66
	25	60	130	40	230	75
Orchards	-	133	133	133	400	127
Rabi vegetables	-	100	100	100	300	95

13. Pesticides

13.01 The following table sets out the pesticide program for the crops grown:

Recommended pesticide treatment for various crops

Crop		Pesticide	Cost (Tks/acre)
Rice:	boro	1/40 lb sevin 85 SP	0.50
	t. aus	2 x 1 lb sumithion	26.60
		1/2 x 10 lb diazinon 14 G	16.60
			43.70
	t. aman	2 x 1/40 lb sevin 85 SP	1.00
		1 1/2 x 10 lb diazinon 14 G	49.80
			50.80
	mixed aus/aman	2 x 1 lb sumithion	26.60
	b. IR aus	2 x 1 lb sumithion	26.60
		1 x 10 lb diazinon 14 G	33.20
			59.80
	b. aman	2 x 1 lb sumithion	26.60
Oilseeds		1 lb x 1/2 metasystox	4.00
		1/2 x 10 lb thimet 10 G	10.50
			14.50
Jute		1 lb sevin 85 SP	20.00
Sugarcane		2 x 10 lb diazinon 14 G	66.40
Orchards		6 x 1 lb malathion 57 EC	24.50
Vegetables		2 x 1 lb malathion 57 EC	9.50

13.02 In computing costs of treatment, only the cost of the chemical was considered. The cost of routine ground application of pesticides is part of the labor costs involved in growing the crops concerned. Aerial spray costs are not counted; they are considered to be part of the overall national cost of epidemics prevention.

13.03 The following basic C&F prices were assumed:

Sevin	US$0.05 per treatment	Tks 0.50
Diazinon 14 G (formulated in Bangladesh)	US$3.50 " "	Tks 33.20
Sumithion	US$1.40 " "	Tks 13.30
Metasystox	US$0.84 " "	Tks 8.0
Thimet 10 G (formulated in Bangladesh)	US$2.20 " "	Tks 21.0
Malathion 57 EC	US$0.50 " "	Tks 4.75

C. CROP YIELDS

14. Present Yields

Rice

14.01 Information on yields in available, seemingly in great detail, from the statistical section of the Agricultural Directorate. The official statistics recognized only three rice crops until 1969/70, when a fourth was separately recorded. In fact, there are five rice crops today and even small areas, in Barisal and the Chittagong Hill Tracts, of a sixth.

14.02 The crops recognized are boro, aus (meaning broadcast aus) and aman. Until 1969/70 the broadcast, deepwater aman, and the transplanted aman, transplanted in areas that do not flood deeper than about 3 ft have been recorded together, although their respective areas were known at least by 1960 (Haroun-er-Rashid).

14.03 There is a relatively small area of transplanted aus, traditionally grown in the Chittagong Hill Tracts and Barisal, admittedly not deserving a separate entry. In the future, under irrigated conditions, transplanted aus will become an increasingly important crop.

14.04 Mixed broadcast aus and aman is grown on an estimated 3 million acres and is not recorded separately. It occupies areas that flood deeply after about early July, so that there is a sporting chance for the aus to mature before the waters rise high enough to swamp it.

14.05 The following table lists areas and production of the summer-planted rice crops. The division into four classes instead of two until 1969 and three thereafter is somewhat arbitrary: it has been based on the best available estimates of agriculturists with extensive local experience.

14.06 The same consensus is that the available figures for broadcast and transplanted aman tended grossly to over-estimate the yield of the broadcast and under-estimate the yield of the transplanted portion, although the sum total is consistent with previous records. Thus, the final figures accepted are as shown below:

Official and Adjusted Rice Area and Yield Figures

	Official Figures			Subdivision into all Classes		
	Area (m acres)	Yield (m/acre) (paddy)	Production (m tons)	Area (m acres)	Yield (m/acre) (paddy)	Production (m tons)
b. aus alone) b. aus with) b. aman)	8.4	14.2	4.4	(5.4 (3.0	16 11	3.18 1.22
b. aman with) b. aus) b. aman alone)	5.15	17.15	3.2	(3.0 (2.15	10 15	1.10 1.19
t. aman	9.66	20.07	7.1	9.66	23	8.12
Total	23.21		14.7	20.21 1/		14.81

1/ Not allowing for double counting of mixed area.

14.07 Unfortunately, the figures available for boro rice cannot be resolved so easily. The official figures speak of 580,000 acres of IRRI ("foreign") boro and 1.6 m of local boro yielding, respectively, 1.29 m and 1.57 m tons of paddy. This implies an IRRI paddy yield of 60.5 maunds per acre, which is clearly a mistake: experimental yields in Los Banos, in the International Rice Research Institute are of this order.

14.08 Similarly, the local boro yield suggested is 26.6 maunds, a figure that cannot be substantiated by any past record except the equally inflated 1968-69 figure. Consequently, the figures for production have been adjusted as shown in the following table:

Reported and Assumed Actual Boro Yields

	Official Statistics			Adjusted Figures	
	Area (m acres)	Yield (m acres)	Output (m tons) (paddy)	Yield (m acres)	Output (m tons) (paddy)
:al boro	1.6	26.6	1.57	25	1.48
:I boro	0.58	60.5	1.29	40	0.85
Tosal	2.18		2.86		2.33

Sugarcane

09 The official yield estimates are very doubtful. The figure 'anced is 515 maunds per acre for 1969-70, compared to the Bangladesh 'rage of 414 maunds. The Bangladesh data is unacceptable for the .lowing reasons:

a) According to most observers with knowledge of both wings, West Pakistani yields are higher than in Bangladesh.

b) Haroun-er-Rashid reports that all independent surveys by the nning Commission showed a yield of about 200 maunds against official figures, the same years, of the order of 500 maunds; this is corroborated by all land use surveys carried out by WAPDA since 1965.

c) The sugarmill farms at Thakurgaon report 200,250 and 485 maunds, pectively, from their three farms; the 485 maund yield is being attained er heavy applications of press mud.

d) The Darsana Sugar Mill farm, the oldest in the country, reports maunds; from its collecting area, which has been under their quite ensive extension efforts since before World War II, 350 maunds.

e) Professor J. N. Efferson, quoting USDA survey figures, gives sugar production as 100,000 tons and gur production as 350,000 tons. uming a recovery rate of 7% and 10% respectively, this implies a yield on ,000 acres of 337 maunds as an average for the country.

10 In view of the foregoing, it was considered advisable to use a sent yield level of about 300 maunds per acre.

Orchards and Rabi Vegetables

11 The yields for these crops is, necessarily, a fictitious figure, ablished on the basis of producing a reasonable gross production value when tiplied by a (also fictitious) price figure.

15. Near Future Yields (1983)

15.01 Yields attainable in ten years are assessed on estimates by research workers and such field performance that is already available, as for instance, for IRRI transplanted aman. They assume fertilizer and pest control inputs at the level given and that land preparation and other cultural practices will not form a limiting factor.

15.02 The four future benchmarks are inputs only or inputs along with surface drainage (i.e. drainage without pumping), irrigation only and irrigation plus complete drainage, as possible within a polder.

15.03 The yield levels for inputs and surface drainage are assumed to be identical: the benefits of drainage are deemed to come from an extended area of high-output crops and crop rotations that it would make possible and not from increasing the yield of the crop that can be grown.

15.04 In case ofthe other two development alternatives, it is assumed that in the irrigation case, in a favorable year the actual yields will be the figure for the irrigation and drainage case, but that a risk of flood damage exists. It was deemed best to express this as a lower yield expectation with irrigation only. However, the farmer's reaction to risk is to some extent unknown. His investment may come below the statistically arrived at figure. Only a scheme of crop insurance and enlightened extension work can amend this; in the ultimate development of each alternative, this is assumed.

15.05 Special comments are required on the projected sugarcane yield. In this case, no varietal breakthrough comparable to rice and, to a lesser extent, wheat is envisaged, yet a three-fold increase is expected under the irrigation and drainage case. It is confidently expected that the forecast yield can be achieved once sugarcane can be planted earlier -- made possible by irrigation -- and relocated onto suitable well-drained land where through lack of irrigation, it cannot be grown today.

16. Longer Term Yields (1993 and 2003)

16.01 Three sets of yield figures were developed. From this follows that it was also necessary to develop three sets of figures for all other inputs. The principles were the following:

a) Yields. It was assumed that the gap between yields possible under carefully controlled conditions and what is realistic to accept, under presently obtaining farming standards, will narrow with time. The first set, estimating expected yields by year 10, represents the biggest increase from the present situation, largely because it contains the wholesale introduction of new varieties and new technologies even for crops where no new varieties are involved. Subsequent periods assume a compound rise in yields of 20% per ten years, as no major varietal breakthrough or dramatic developments of technology are envisaged.

b) Manual Labor. The increase in man-days per acre continues with the assumption that there will be no need to cut out any minor operation that is now being performed simply because there is no alternative employment; on the contrary, somewhat more time will be spent on growing and harvesting the enhanced crop. It must be noted, however, that should the need arise, many man-days could be spared for other non-agricultural tasks.

c) Draft Power. No major changes in the present system of cultivation is envisaged. No allowance is being made for a large-scale introduction of better tillage implements that would reduce time taken for land preparation, nor has a significant degree of mechanization been envisaged. These assumptions may well be unrealistic. A concentrated effort may well be required to bring either or both developments about.

e) Fertilizers. Fertilizer dosages have been increased in the approximate ratio of expected increased plant food removals.

f) Pesticides. Only small increases have been made, as the anticipated pest control program, the already fairly generous allowances for chemicals, and the standby aerial protection plan would give near-complete protection against all foreseeable eventualities.

D. PRICES

17. Rice

17.01 The procedure in estimating rice prices is to begin with the present and prospective international prices of comparable quality rice, expressed in dollars on a CIF import basis. The argument here is that imports, not exports, are and will remain the relevant trading alternative in rice.

17.02 The international prices are converted to domestic prices using the foreign exchange rate of US$1 = Tks 9.5. The domestic price for cleaned rice is then converted to a paddy price by taking account of processing and weight loss. There is no seasonal dimension in the prices because storage costs (the counterpart of seasonality) depend on cropping patterns, which must be solved as part of the overall model.

17.03 As a basis for future world prices we have taken a 1:2 mix of two qualities: Burmese 40% broken and Thai 2% broken. This leads to a weighted average of US$100 per ton FOB.or US$110 per ton CIF Chittagong or Chalna. At Tks9.52=$1.00 this converts to a landed price of Tks 38.4/md of clean rice. This is equivalent to Tks 25/md for paddy which after deducting Tks 4 for milling and transportation leads to a farm gate price of Tks 21/md.

18. Jute

18.01 Although historically jute prices have been subject to wide fluctuations, prices have been stable since 1965:

	1965	1966	1967	1968	1969	1970	Six Year Average
Average FOB export price per ton	$256	$267	$281	$244	$264	$261	$262

Sources: IFS, July 1971 (figures are converted from the short ton quotations). Fluctuations have remained within 10% of the six year average price. One important reason for this stability is that synthetics have made increasing inroads on jute markets, thereby raising the cross-elasticity of substitution and dampening the impact of output variations on jute prices.

18.02 The impact of synthetics is stressed by Repetto, not only in explaining past prices, but also in constructing a future jute policy. 1/ Based on his own analysis and the FAO study 2/, he foresees a decline of 25% in the price of synthetic end products which are competitive with jute goods by 1975. Jute processing costs make up approximately 50% of the cost of jute goods exported from Pakistan. The other 50% is raw jute. Thus, if jute goods maintain their competitive position vis-a-vis synthetic goods, and if the prospective price decline is entirely passed back to raw jute, a decline of some 50% in raw jute prices will be necessary. Repetto contends that some of the decline might be absorbed by a reduction in excessive processing margins in the Bangladesh jute industry. Processing margins might well be squeezed in Bangladesh, but it is more questionable whether the same thing would (or could) happen in other processing countries, at least on a long term basis. It is therefore assumed that the entire burden will eventually fall on raw jute prices, but that, in the short run, part of the drop will be absorbed by lower processing margins. Specifically, it is assumed that there will be a 35% fall in raw jute prices by 1975, and an additional 15% decline by 1980.

	FOB Export Price per Ton; Constant 1970 Dollars	Domestic Price per Maund at $1=Tks 9.5
1970	$260	91
1975	$170	59
1980	$130	46

18.03 In order to export raw jute, it must be transported to Chalna or Chittagong and baled. The baling process involves compression and packaging. Part of the jute is lost in low value cuttings. In addition some jute sticks

1/ R. Repetto "Report to the Special Projects Division of the I.B.R.D. on the Economics of Jute Supply in East Pakistan," Draft version, December 26, 1970.

2/ Food and Agricultural Organization of the United Nations, "Impact of Synthetics on Jute and Allied Fibres," Commodity Bulletin Series No.46, Rome 1969.

are produced as a by-product of jute. These adjustments are summarized below:

Yield of exportable jute as a fraction of raw jute produced	0.7
Value of cutting per maund	Tks 11
Yield of jute sticks as a fraction of raw jute produced	1.6
Value of jute sticks per maund	Tks 2
Cost of baling (all assumed to be capital cost, which is an exaggeration) at Tks 30 per 5 maund bale	Tks 6

These adjustments result in the following valuations of jute at the farm gate:

	1970	1975	1980
FOB export price per maund	Tks 91	Tks 59	Tks 46
Subtract: baling charge per maund	6	6	6
Equals: export price less baling charge	Tks 85	Tks 53	Tks 40
Multiplied by yield of export jute per unit of raw jute (0.7)	59	37	28
Add: jute cuttings per maund of raw jute (0.3 maunds)	3	3	3
Add: jute sticks per maund of raw jute	3	3	3
Equals: farm gate value of jute	Tks 65	Tks 43	Tks 34

18.04 The prices indicated are somewhat higher than customarily quoted, despite the anticipated drop in world jute prices. The reason, of course, is that foreign exchange is valued more realistically here than the customary figures. If jute is given the higher price (relative to rice) indicated by these figures, the implication is that more jute should be grown, despite adverse world price trends. This rather obvious point has been made by several observers.

19. Wheat

19.01 The 1970 FOB price of wheat exported from Australia was $55 per ton 1/ It is anticipated that this price will continue for the foreseeable future. Transport costs are at least $15 per ton, in part because of the limits on vessel size in Chittagong and Chalna 2/. There are no important non-labor

1/ IFS, July 1971, Note: 36.7 bushels = 1 long ton, for wheat.

2/ The current transport charge is about $20 per ton from the Gulf of Mexico, using American ships. It would be somewhat less from Australia using other flag vessels.

processing costs for wheat. Hence the resulting domestic price, based on international CIF import conditions, is Tks 24 per maund ($1 = Tks 9.5). This compares with the 1969/70 controlled Dacca price of about Tks 20 per maund 1/.

20. Sugarcane

20.01 Australia is the nearest source of cheap international sugar for Bangladesh. Australian unit value export prices have been as follows:

	1965	1966	1967	1968	1969	1970	1965-70 av.
Cents per lb.	3.91	3.37	2.98	2.85	3.95	4.67	3.62

Source: IFS, July 1971

20.02 Bangladesh will probably be able to purchase sugar from Australia for about 4.0¢ per lb on average until 1974/75, and the carrying charges to Chittagong or Chalna will be about 0.5¢ per lb.

20.03 In 1974/75, three important sugar acts are scheduled to expire: the Commonwealth Preference Agreement, the U.S. Sugar Act, and the International Sugar Agreement. With the expiration of these acts, it seems likely that generally higher prices will be negotiated for sugar shipped to protected markets. However, this need not mean higher prices in the smaller volume free market. Specifically, if England joins the Common Market, Australia may find the outlets for her sugar reduced, and there could even be a decline in Australian sugar prices. Under the circumstances, it is assumed that the relevant CIF import price for sugar delivered to Bangladesh remains through 1980 at 4.5¢ per lb.

20.04 In order to translate this price into a social price for cane, some estimates need to be made of milling costs and extraction rates. The following profile of milling costs is based on the OECD Manual and some dated information from Bangladesh.

Assumed size of mill (24 hour crushing capacity)	1,500 tons
Recovery percentage (based on 1954-1957 and 1960/61 experience in East Pakistan)	8%
Number of 24 hour (3 shift) days of operation per year (based on experience of Pakistan)	120 days
Implied annual production of refined sugar	14,400 tons

1/ GSO, Monthly Statistical Bulletin, April 1971.

FOB cost of equipment		$ 3,400,000
Sea freight charges[a]		300,000
CIF cost of equipment		$ 3,700,000
CIF equipment cost translated to Tk at the rate of $1 = Tk 9.5	Tk	35,120,000
Design, erection, etc. of the plant[b]		8,370,000
Total Cost of Plant	Tk	43,490,000
Annual capital charge at 11%	Tk	4,780,000
Annual depreciation assuming 40 year life		1,080,000
Annual maintenance at 2% of capital cost		870,000
Annual Costs of Plant[c]	Tk	6,730,000
Processing costs per maund of refined sugar	Tk	17

Sources: OECD Development Centre, Manual of Industry Project Analysis in Developing Countries: Annex to Volume I, Industrial Profiles, Paris 1968. Government of Pakistan, National Planning Board, Sugar Industry of Pakistan, March 1958. A.A. Anwar and M. A. Khan, A Survey of the Sugar Industry of West Pakistan, Boards of Economic Inquiry, Lahore and Peshawar, 1965.

Notes: (a) Estimated.
(b) Based on a dollar design and erection cost of $880,000.
(c) Excluding minor amounts of purchased inputs such as fuel oil, lime, sulphur. Also, all labor is valued at zero wage and thus excluded.

20.05 It should be noted that most sugar consumed in Bangladesh is eaten in the form or gur. This is partly because the heavy taxes applied to refined sugar are not levied on gur. In any event, no international market exists for gur, so the value of cane must be based on the refined sugar price. On this assumption the following results emerge:

CIF import price per maund of refined	Tk 35
Milling costs per maund of refined	Tk 17
Value of cane per maund of cane, assuming 8% recovery	Tk 1.44

21. Groundnuts

21.01 The price of groundnuts mainly depends on the general price structure for all vegetable oils. According to a Bank memorandum, the outlook for vegetable oil prices is a decline from their 1970 levels. The resulting projects for groundnut oil and shelled groundnuts follows:

	Dollars per Ton, CIF European Ports							
	1965	1966	1967	1968	1969	1970	Average 1965-70	Projected 1975
Groundnut oil	323	297	287	271	331	278	315	270-280
Shelled groundnuts(a)	210	164	158	169	210	233	191	165(b)

Source: IBRD memo

Notes: (a) Ex Nigeria
(b) Based on oil outlook

21.02 It is assumed that increased groundnut production in Bangladesh will be consumed locally (in the form of oil and oilcake, the latter for animal or human consumption). However, to avoid both the costing of a processing plant 1/ and the valuation of oilcake, we use European CIF international price of shelled groundnuts to value farm output. On this basis, the present and prospective prices, with $1 = Tks 9.5 per maund of shelled groundnuts are:

	1970	1975	1980
Shelled groundnuts (a)	Tks 81	Tks 58	Tks 43
Unshelled groundnuts	53	38	28

Notes: (a) Based on OECD breakdown of weight of unshelled groundnuts as follows: oil, 25%; oilcake, 40%; shells and waste, 35%. (Industrial Profiles, p. 37)

22. Oilseeds and Brassicas

22.01 As used in the sector model, the term "oilseeds" refers to rapeseed and mustardseed planted in the autumn, whereas brassicas refers to the same crops planted late in the year. The difference is one of yield, not crop. The international price of rapeseed and mustardseed is about $170 per ton. The Commodities Division of the Economics Department looks for a drop of about 8% in rapeseed oil prices by 1975. On the basis of these figures, we assume the following prices per maund of oilseeds or brassicas:

	1970	1975	1980
Oilseeds and Brassicas	Tks 60	Tks 50	Tks 43

1/ There is adequate data for costing a plant in the OECD Manual.

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

ASSUMED CROP INPUT-OUTPUT COEFFICIENTS 1983

TRADITIONAL CROPS

	CROP	LABOR (MAN) (DAUS)	DRAFT (ANIMAL) (DAUS)	SEED (RS)	FERT (LBS)	PEST (RS)	WATER (A.F)	YIELD (MDS)	PRICE (RS/MD)	G.V.P	PROD. COST (RUPEES PER ACRE)	N.V.P
1	B.AUS I	60	13	20	0	0	0	16	21	336	157	178
2	B.AMAN I	60	13	20	0	0	0	15	21	315	157	157
3	T.AMAN I	70	20	5	56	10	0	23	21	483	207	275
4	M. AUS & AMAN I	70	15	20	0	0	0	21	21	441	180	261
5	BORO I	87	30	5	140	10	3	25	21	525	336	188
6	JUTE I	90	16	5	0	5	0	15	46	690	207	482
7	WHEAT I	50	12	15	0	0	0	8	20	160	132	27
8	GROUNDNUTS I	75	18	13	0	0	0	10	50	500	189	310
9	SUGARCANE I	75	25	180	56	5	0	300	2	600	398	201
10	OTHER RABI	80	15	6	0	0	0	8	100	800	183	616

IMPROVED CROPS - WITHOUT IRRIGATION

11	B.AUS II	67	18	25	180	44	0	25	21	525	294	230
12	B.AMAN II	62	15	20	50	20	0	17	21	357	203	153
13	T.AMAN II	93	34	6	280	33	0	36	21	756	384	371
14	MIX A&A II	79	20	25	180	27	0	27	21	567	303	263
15	JUTE II	106	18	5	80	20	0	20	46	920	283	636
16	WHEAT II	60	14	25	100	0	0	12	21	252	200	52
17	GR.NUTS II	90	20	25	150	0	0	14	50	700	285	415
18	S.CANE II	85	35	240	300	33	0	450	2	900	614	285
19	OILSEED II	70	12	3	100	7	0	10	50	500	197	302

IRRIGATED CROPS -WITHOUT FLOOD RISK CONTROL

20	B.AUS III	75	20	25	240	60	1	29	21	609	365	243
21	T.AUS III	105	38	6	430	44	3	45	21	945	524	420
22	T.AMAN III	100	37	6	340	48	2	40	21	840	470	369
23	MIX AUS&AMAN III	89	22	25	240	27	2	32	21	672	376	295
24	BORO III	110	40	6	485	44	5	50	21	1050	587	462
25	JUTE III	119	19	5	150	20	1	24	46	1104	348	755
26	WHEAT III	84	20	25	200	0	1	25	21	525	307	218
27	GR.NUTS III	95	21	13	180	0	1	16	50	800	309	490
28	S.CANE III	95	40	240	420	66	2	650	2	1300	749	550
29	OILSEEDS III	80	15	10	205	14	1	20	50	1000	288	711
30	BRASSICAS III	40	12	3	125	7	1	13	50	650	168	481
31	ORCHARDS III	200	25	100	400	24	1	20	100	2000	691	1308
32	RABI VEG.III	120	25	50	300	10	1	15	100	1500	452	1047

IRRIGATED CROPS -WITH COMPLETE FLOOD CONTROL

33	B.AUS IV	80	21	25	265	60	1	32	21	672	385	286
34	T.AUS IV	107	39	6	475	44	3	48	21	1008	546	462
35	T.AMAN IV	103	38	6	375	50	2	42	21	882	492	389
36	MIX AUS & AMAN IV	95	23	25	270	27	2	35	21	735	400	334
37	BORO IV	110	40	6	485	44	5	50	21	1050	587	462
38	JUTE IV	123	19	5	220	20	1	26	46	1196	379	816
39	WHEAT IV	84	20	25	200	0	1	25	21	525	307	218
40	GROUNDNUTS IV	100	21	13	180	0	1	16	50	800	318	481
41	SUGARCANE IV	105	45	240	500	66	2	750	2	1500	807	692
42	OILSEEDS IV	80	15	10	205	14	1	20	50	1000	288	711
43	ORCHARDS IV	200	25	100	400	24	1	20	100	2000	691	1308
44	BRASSICAS IV	40	12	3	125	7	1	13	50	650	168	481
45	RABI VEG IV	120	25	100	400	24	1	20	100	2000	551	1448

* ASSUMING FOLLOWING UNIT COSTS:

LABOR	1.75	RS/DAY	DRAFT POWER	2.50	RS/ANIMAL-DAY
FERTILI	0.35	RS/LB	WATER	15.00	RS/A.

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

ASSUMED CROP INPUT-OUTPUT COEFFICIENTS 1993

TRADITIONAL CROPS

	CROP	LABOR (MAN) (DAUS)	DRAFT (ANIMAL) (DAUS)	SEED (RS)	FERT (LBS)	PEST (RS)	WATER (A.F)	YIELD (MDS)	PRICE (RS/MD)	G.V.P	PROD. COST (RUPEES PER ACRE)	N.V.P
1	B.AUS I	60	13	20	0	0	0	16	21	336	157	178
2	B.AMAN I	60	13	20	0	0	0	15	21	315	157	157
3	T.AMAN I	70	20	5	56	10	0	23	21	483	207	275
4	M. AUS & AMAN I	70	15	20	0	0	0	21	21	441	180	261
5	BORO I	87	30	5	140	10	3	25	21	525	336	188
6	JUTE I	90	16	5	0	5	0	15	46	690	207	482
7	WHEAT I	50	12	15	0	0	0	8	20	160	132	27
8	GROUNDNUTS I	75	18	13	0	0	0	10	50	500	189	310
9	SUGARCANE I	75	25	180	56	5	0	300	2	600	398	201
10	OTHER RABI	80	15	6	0	0	0	8	100	800	183	616
	IMPROVED CROPS - WITHOUT IRRIGATION											
11	B.AUS II	76	22	25	265	49	0	30	21	630	354	275
12	B.AMAN II	65	15	21	90	22	0	20	21	420	225	194
13	T. AMAN II	104	37	6	410	36	0	43	21	903	460	443
14	MIX AUS & AMAN II	85	22	25	270	30	0	32	21	672	353	318
15	JUTE II	116	19	5	180	22	0	24	46	1104	340	763
16	WHEAT II	69	15	25	130	0	0	16	21	336	228	107
17	GR. NUTS II	95	21	13	175	0	0	17	50	850	293	557
18	S. CANE II	90	38	240	350	40	0	550	2	1100	655	445
19	OILSEEDS II	71	13	10	125	8	0	12	50	600	218	381
	IRRIGATED CROPS -WITHOUT FLOOD RISK CONTROL											
20	B. AUS III	82	25	25	310	66	1	35	21	735	420	314
21	T.AUS III	112	40	6	535	49	3	54	21	1134	583	550
22	T.AMAN III	108	40	6	475	53	2	48	21	1008	544	463
23	MIX AUS & AMAN III	97	24	25	365	30	2	38	21	798	442	355
24	BORO III	115	43	6	595	49	5	60	21	1260	647	613
25	JUTE III	123	20	5	200	22	1	26	46	1196	377	818
26	WHEAT III	86	21	25	240	0	1	30	21	630	327	303
27	GROUNDNUTS III	100	22	13	195	0	1	19	50	950	326	623
28	SUGARCANE III	103	40	240	550	73	2	800	2	1600	815	784
29	OILSEEDS III	80	16	10	230	16	1	24	50	1200	301	898
30	BRASSICAS III	42	13	3	130	8	1	15	50	750	177	572
31	ORCHARDS III	230	26	100	450	30	1	24	100	2400	770	1630
32	RABI VEG III	130	27	50	300	14	1	18	100	1800	479	1321
	IRRIGATED CROPS -WITH COMPLETE FLOOD CONTROL											
33	B. AUS IV	83	26	25	365	66	1	38	21	798	444	354
34	T. AUS IV	113	42	6	585	49	3	57	21	1197	607	589
35	T. AMAN IV	109	41	6	485	55	2	50	21	1050	554	496
36	MIX AUS & AMAN IV	99	25	25	380	30	2	42	21	882	453	428
37	BORO IV	115	43	6	595	49	5	60	21	1260	647	613
38	JUTE IV	128	20	5	230	22	1	28	46	1288	396	891
39	WHEAT IV	86	21	25	240	0	1	30	21	630	327	303
40	GROUNDNUTS IV	100	22	13	195	0	1	19	50	950	326	623
41	SUGARCANE IV	110	50	240	600	73	2	900	2	1800	870	929
42	OILSEEDS IV	80	16	10	230	16	1	24	50	1200	301	898
43	BRASSICAS IV	42	13	3	130	8	1	15	50	750	177	572
44	ORCHARDS IV	230	26	100	450	30	1	24	100	2400	770	1630
45	RABI VEG IV	130	27	50	300	14	1	18	100	1800	479	1321

* ASSUMING FOLLOWING UNIT COSTS:

LABOR	1.75	RS/DAY	DRAFT POWER	2.50	RS/ANIMAL-DAY
FERTILI	0.35	RS/LB	WATER	15.00	RS/A.F

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

ASSUMED CROP INPUT-OUTPUT COEFFICIENTS 2003

TRADITIONAL CROPS

	CROP	LABOR (MAN) (DAUS)	DRAFT (ANIMAL) (DAUS)	SEED (RS)	FERT (LBS)	PEST (RS)	WATER (A.F)	YIELD (MDS)	PRICE (RS/MD)	G.V.P	PROD. COST (RUPEES PER ACRE)	N.V.P
1	B.AUS I	60	13	20	0	0	0	16	21	336	157	178
2	B.AMAN I	60	13	20	0	0	0	15	21	315	157	157
3	T.AMAN I	70	20	5	56	10	0	23	21	483	207	275
4	M. AUS & AMAN I	70	15	20	0	0	0	21	21	441	180	261
5	BORO I	87	30	5	140	10	3	25	21	525	336	188
6	JUTE I	90	16	5	0	5	0	15	46	690	207	482
7	WHEAT I	50	12	15	0	0	0	8	20	160	132	27
8	GROUNDNUTS I	75	18	13	0	0	0	10	50	500	189	310
9	SUGARCANE I	75	25	180	56	5	0	300	2	600	398	201
10	OTHER RABI	80	15	6	0	0	0	8	100	800	183	616
	IMPROVED CROPS - WITHOUT IRRIGATION											
11	B.AUS II	80	25	25	320	54	0	36	21	756	393	362
12	B.AMAN II	68	17	21	220	25	0	24	21	504	284	219
13	T.AMAN II	109	40	6	490	36	0	52	21	1092	504	587
14	MIX AUS & AMAN II	94	25	25	370	33	0	38	21	798	414	383
15	JUTE II	125	20	5	230	25	0	28	46	1288	379	908
16	WHEAT II	72	16	25	150	0	0	20	21	420	243	176
17	GR. NUTS II	97	22	13	200	0	0	20	50	1000	307	692
18	S.CANE II	91	40	240	450	44	0	650	2	1300	700	599
19	OILSEED II	72	14	10	120	9	0	14	50	700	222	478
	IRRIGATED CROPS -WITHOUT FLOOD RISK CONTROL											
20	B AUS III	90	30	25	380	72	1	42	21	882	477	404
21	T AUS III	117	44	6	650	54	3	65	21	1365	647	717
22	T.AMAN III	112	42	6	575	58	2	57	21	1197	596	600
23	MIX AUS & AMAN III	106	30	25	430	33	2	45	21	945	499	446
24	BORO III	120	47	6	720	54	5	72	21	1512	714	797
25	JUTE III	134	21	5	250	25	1	30	46	1380	419	960
26	WHEAT III	88	22	25	285	0	1	35	21	735	348	386
27	GROUNDNUTS III	110	23	13	220	0	1	23	50	1150	355	795
28	SUGARCANE III	110	50	240	600	80	2	900	2	1800	877	922
29	OILSEEDS III	107	17	10	290	18	1	29	50	1450	374	1075
30	BRASSICAS III	43	14	3	190	9	1	18	50	900	203	696
31	ORCHARDS III	250	27	100	500	34	1	29	100	2900	829	2071
32	RABI VEG III	140	28	50	400	18	1	21	100	2100	538	1562
	IRRIGATED CROPS -WITH COMPLETE FLOOD CONTROL											
33	B.AUS IV	95	31	25	430	71	1	45	21	945	505	439
34	T.AUS IV	118	45	6	700	54	3	68	21	1428	669	759
35	T.AMAN IV	114	43	6	595	60	2	60	21	1260	611	648
36	MIX AUS & AMAN IV	112	31	25	485	33	2	50	21	1050	531	518
37	BORO IV	120	47	6	720	54	5	72	21	1512	714	797
38	JUTE IV	145	22	5	460	25	1	31	46	1426	514	911
39	WHEAT IV	88	22	25	285	0	1	35	21	735	348	386
40	GROUNDNUTS IV	110	23	13	220	0	1	23	50	1150	355	795
41	SUGARCANE IV	116	52	240	650	80	2	1000	1	1000	910	89
42	OILSEEDS IV	114	17	10	290	18	1	29	50	1450	386	1063
43	BRASSICAS IV	43	14	3	190	9	1	18	50	900	203	696
44	ORCHARDS IV	250	27	100	500	34	1	29	100	2900	829	2071
45	RABI VEG IV	140	28	50	400	18	1	21	100	2100	538	1562

* ASSUMING FOLLOWING UNIT COSTS:

LABOR	1.75	RS/DAY	DRAFT POWER	2.50	RS/ANIMAL-DAY
FERTILI	0.35	RS/LB	WATER	15.00	RS/A.F

CROPPING PATTERNS [1/]

1. Land Capability

1.01 Fundamental to the Sector Study has been an analysis of the land capability data provided by the Soil Survey Project of Pakistan. The country has been divided into four regions -- NW, C, E, and SW -- whose boundaries are formed by the major rivers Brahmaputra-Jamuna, Ganges and Meghna and by the western boundary of the deeply flooded Sylhet basin. These regions have been subdivided into a total of 49 Land Development Units (LDUs). Some of the LDUs are subdivided to provide a total of 58 units and sub-units. Each LDU represents a natural subregion with distinctive physiographic, hydrological and soil characteristics. Since land use and land capability in Bangladesh are strongly determined by these physical characteristics, each LDU thus provides a distinctive combination of development opportunities and physical constraints. The LDUs are shown on Map 7 and described in Volume II, Technical Report No. 2.

1.02 The land capability classification used is illustrated on Summary Map 6 of Vol. II and on the large scale Analytical Map III - Hydrology, which is described in Vol. II. Briefly, there are five capability classes (I to V), each subdivided into two major subclasses (D indicating land above normal flood level; W indicating land subject to flooding) and with a total of eight subclasses indicating limitations imposed by such factors as low moisture holding capacity, wetness (for dryland crop production), erosion hazard, salinity, toxicity and hazard of flood damage. For purposes of the Sector Study, it has been necessary to indicate four further kinds of subdivision: whether the soils are rapidly permeable (r) or slowly permeable (s); shallowly flooded (MH) or deeply flooded (ML); occurring only in particular LDUs, indicated by N(North) or S(South); and whether adjoining surface water is fresh (f) or saline (s) in the dry season. The tables in Vol. II, Technical Reports 1 and 2 show the proportions of each land capability subclass and appropriate subdivisions within each LDU within each region.

1.03 For each land capability subclass and subdivision, data on present land use have been obtained from reports of the Soil Survey Project. Because of the complexity of land use in Bangladesh, some generalization has been necessary and only the major kinds of crop rotation have been shown. Projections for future land use have been made: for use of basic inputs only (improved seed, fertilizers, pesticides); inputs plus irrigation; irrigation plus drainage; and, for two regions, drainage only. In making these projections, four basic assumptions have been made:

(a) that the jute acreage will remain constant;
(b) that the sugarcane acreage will remain constant;
(c) that rice production will be maximized; and
(d) that oilseeds production (including groundnuts) will be maximized.

1/ This Annex includes contributions by H. Brammer and A. Seager.

1.04 Land use in Bangladesh is largely determined by land levels in relation to flooding and by soil permeability (and associated moisture storage capacity). Future land use with inputs only and with irrigation will be governed by the same determinants. With drainage, land levels in relation to flooding are no longer a constraint, but permeability remains important. These land capability considerations dictate, to a significant degree, the cropping potential of all LDUs under future (developed) conditions.

2. Development Alternatives

2.01 Four development alternatives are being considered: the application of improved farming techniques, irrigation whenever necessary, irrigation coupled with drainage in the appropriate season, and drainage only, without major structures. As far as the farmer is concerned, irrigation means that he can grow a good winter crop that will yield him a gross return of between Tks 500 to Tks 1,000 per acre, whereas before, on the same land, no more than about Tks 250, and usually even less than Tks 150, has been produced in the winter.

2.02 The foregoing do not apply to areas where irrigated boro rice is currently grown. Such irrigation is assumed to be continued, but not expended, in the "inputs only" case.

2.03 The introduction of irrigation implies a considerable increase not only in the level of farm outputs, but also in the labor, tillage, fertilizer and pesticide inputs.

2.04 Drainage, coupled with irrigation, implies in most cases that the full measure of inputs and production attributable to irrigating land not subject to flooding, can be applied to an increasing area. Also, it means the virtual elimination of risks due to flooding, thereby not necessarily increasing the yields per acre in a good, flood-free year, but preventing the reduction of yields, or even complete crop failure due to prolonged inundation.

2.05 Drainage without irrigation means that, in the summer, crops that otherwise do not tolerate being deeply flooded, can be grown: broadcast aus and/or transplanted aman instead of a mixed aus/aman or a broadcast aman crop. There may well be some intensification of winter cropping (and better yields) due to the fact that there is earlier access to the land at the end of the rainy season. Although not reflected in the assumed yield figures, there is also a significant lowering of the flood risk factor, encouraging the farmer to invest in inputs the more readily.

2.06 On a few rare occasions drainage means that production and inputs decrease somewhat when compared to the undrained but irrigated case. This is likely to occur on relatively small portions of individual holdings.

3. Crops Grown

3.01 The principal crops under consideration are rice, jute, wheat, brassicas and groundnuts. Others are classed as "rabi vegetables" or orchards: the former include potatoes, tomatoes, onions, garlic and the usual temperate climate vegetables (cabbage family, carrots, etc.) as well as tobacco.

"Orchards" cover plantations of mangoes, bananas, lichis, betel palm, sugar palm, betel leaves, etc.

Crop Calendars

3.02 The histograms in Fig. 1 give the optimum growing periods of the major crops. The left hand line connects the two dates representing the extremes in planting times that would not affect crop yields. Earlier or later plantings, within reasonable limits, would bring reduced benefits either by lowering yields or increasing the times when the crop is at risk or just consumes water needlessly. One crop, designated in the computer sheets as "brassicas", is not indicated. They incorporate a concept unknown in Bangladesh at present, but well known and practised in India and in Pakistan.

3.03 It is assumed on Indian and Pakistani evidence that mustard and rape, given suitable moisture conditions brought about either by residual moisture or irrigation, can be planted as late as December and a worthwhile if reduced crop obtained, provided aphid infestations can be kept down. The yield will be lower than when planted between the times indicated on the diagram, but in view of the continuing scarcity of vegetable oils in the country, it is likely still to be remunerative. The expected price for the crop is about Tks 50 per maund, in view not only of the likely supply situation, but because of the wellknown preference of the Bengali for the pungent Brassica oils.

3.04 Another crop likely to gain ground in the future, time permitting in the different rotations, is winter groundnuts. They are to be planted as indicated in the diagrams for brassicas, but are likely to be ready for harvest about a month or so later.

3.05 Jute, potentially Bangladesh's most important foreign exchange earner, is unique in that its growing season is perhaps the most elastic: once tall enough for a worthwhile crop to be obtained, any incremental growth must be weighed against potential losses incurred by the next crop due to delayed planting. It will therefore be noted that the growing time assumed for jute is somewhat variable.

PRODUCTION CONSTRAINTS

4. Farm Power and Labor Demand Peaks

4.01 The farming calendar. Figures 2a, b, c and d give samples in the form of contiguous diagrams made up of the components illustrated in Fig. 1, how the farmer's time will be spent in any one field. The samples chosen are the cropping sequences where time is restricted. The other sequences that are used expect to grow only two crops per annum, which is normally not difficult. The diagrams clearly show that three crops per annum are, in our present state of agronomic knowledge, virtually impossible: the b. aus-groundnut-brassicas sequence, the only three crops per annum one that is even remotely possible, requires a degree of managerial skill that may only be available if the land capability class for which it is applicable occupies only a small part of the farm. In all other sequences the time between one harvest and the planting of the next crop is limited. There is, in every instance, enough time to prepare the land, but only if the work animals are strong enough to work day after day for eight hours during these periods, and not only on alternate days. This presupposes one or both the following factors:

i) animals of a breed stronger than the ones used today; and
ii) animals much better fed than today and therefore having greater endurance.

The Bank's livestock report envisages extension activities that would teach farmers the feeding of urea and molasses to supplement rice straw. This is considered essential to the success of improved agriculture; the introduction of a stronger breed of animals is of little value without the foregoing, but of great potential benefit with it.

4.02 Ability to cope with tillage operations. For several land preparation tasks envisaged in future situations, especially in the improved agriculture case, where no water is available to soften the land, ploughing and consequently the very growing of the next crop, depends on the strength of the animal and the implement. Thus, while a team with not enough stamina can, conceivable (if not practically) be substituted by two teams, even this wasteful solution does not meet the criterion of being able to handle difficult land. Thus, the extra feeding, and gradual breed improvement of working animals is a prerequisite to any crop husbandry improvement.

Threshing, Drying, Storage

4.03 It is common experience in all developing countries that no farmer will seriously devote himself to the operations necessary to plant a crop unless he knows that the previous one is safe. This feeling is of no importance between the harvesting and threshing of the aman crop: by then, the rains have ceased. However, it is emphatically not the case when the aus crop is harvested; the risk between harvesting the boro rice or the wheat and its threshing is only slightly less severe.

4.04 Therefore, the success of any system including crops that must be safeguarded before another planting season begins depends on facilities being available to ensure this safety: drying facilities, good and cheap storage and possibly even some form of mechanical threshing, even if only with a foot-pedal machine.

5. Research Required

5.01 The agricultural planning presented relies, to an overwhelming extent, on technologies known today, although, in the main, not practised on a farm scale. That is to say, little more than intensive extension efforts, and availability of the necessary inputs, is required. However, research inevitably goes on, even if it were unreasonable to expect another breakthrough like the one that took the yield of boro paddy from 20 to 50 maunds per acre and that of aus from 11 to 25 or 30. Rather, development is more likely to reduce the growing season of rice varieties either outright, or by making ratooning, non-photosensitive and cold-resistant varieties available.

5.02 Less revolutionary expectations would be a really high-yielding floating rice, the appearance of a more heat-tolerant wheat variety than those currently available or the substitution of barley for wheat at a higher yield level. Further, intensive research efforts on pulses may pay dividends, produce much better yields than can reasonably be envisaged now and cause their substitution for oilseeds. This would bring about a vast dietary improvement and would substantially alter development concepts.

5.03 One conclusion, however, is inescapable. Higher yields, be they due to varieties, farming systems, fertilization, pest control or a combination of all, demand much better care in the field than the present yield levels and also a carefully controlled environment. This means not only more level and better laid-out fields, but also irrigation supplies when needed and the control of inundations, whether caused by river flooding or rainfall. Therefore, there is a very definite limit beyond which irrigated agriculture cannot go and long before this limit is reached, benefits from farming environment control will be more rewarding than from new varieties and more intensive inputs of fertilizers and pesticides.

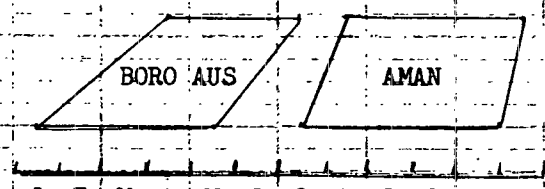
5.04 Therefore, an active and very practical extension service is as important an input as any one of the other means of production. Their training in the farmer's business, be it crop production, animal husbandry or crop storage, must be properly oriented and vastly intensified.

POSSIBLE CHANGES IN CROP ROTATIONS WITH IRRIGATION AND DRAINAGE BY LAND TYPES

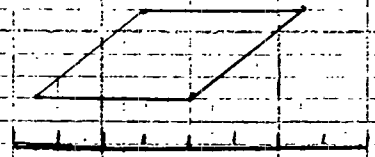
Crop rotations on permeable land			LAND TYPE	Crop rotations on impermeable land		
Present	Irrigation	Irrigation + drainage		Present	Irrigation	Irrigation + drainage
1.a) B aus + rabi b) B aus 2.a) Mesta + rabi b) Mesta 3. Sugarcane	1. B aus + rabi 2. Jute + rabi 3. Sugarcane	Same	Highland (above flood level, or rain water ponded within field bunds)	1. T aman 2. B aus + t aman	Boro + t aman	Same
1. B aus + rabi 2. Jute + rabi 3. B aus + t aman 4. T aman*	Same	1. B aus + rabi 2. Jute + rabi 3. Sugarcane	Medium high-land (1-3 ft flooding)	1. T aman 2. B aus + t aman	1. Boro + t aman + rabi 2. T aus + t aman	Same
1. Mixed aus and deepwater aman + rabi 2. Mixed aus and deepwater aman 3. Jute + rabi	1. Mixed aus and deepwater aman + rabi 2. Jute + rabi	1. B aus + rabi 2. Jute + rabi 3. Sugar-cane	Medium low-land (3-6 ft flooding) ridges and basic margins	1. Mixed aus and deep-water aman 2. Deepwater aman	Boro	1. Boro + t aman + rabi 2. T aus + t aman
1. Deepwater aman 2. Boro (permanently wet land)	1. Boro (except where flash flood hazard)	1. Boro + t aman 2. Boro (in sump areas)	Lowland (6 ft flooding) and medium lowland basin centers	1. Deepwater aman 2. Boro (existing irrigation or permanently wet) 3. Grassland 4. Rabi fodder) 5. B aus	Boro (except where flash flood hazard)	(1. Boro + t aman (2. Boro (in sump areas)

* With high water table.

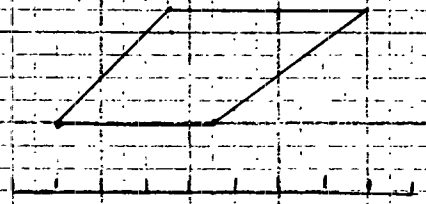
1. BORO/T AUS AMAN



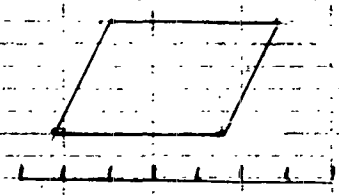
2. IMPROVED BROADCAST AUS/AMAN



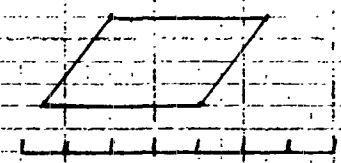
3. JUTE FOR FIBRE



4. POTATOES

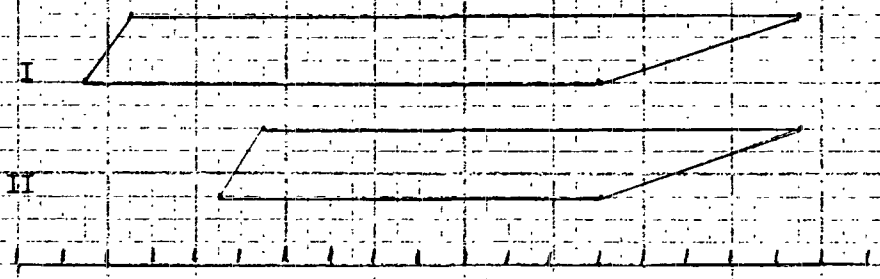


5. PULSES

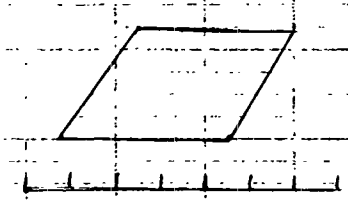


6. WHEAT

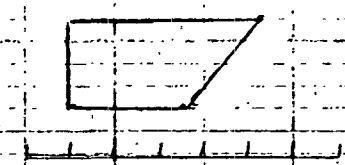
7. SUGARCANE



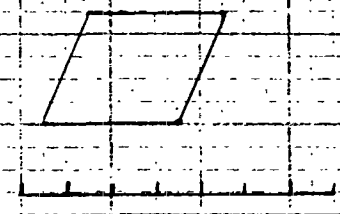
8. GROUNDNUTS



9. VETCHES (KESHARI)



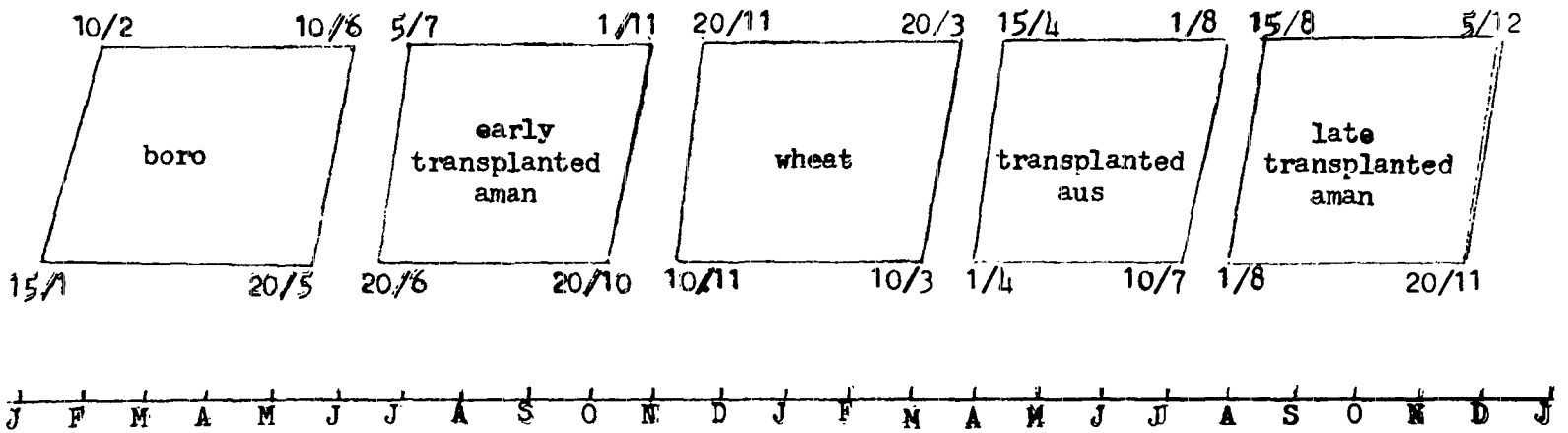
10. BRASSICA OILSEEDS (RAPE AND MUSTARD)



GROWTH PERIODS OF PRINCIPAL CROPS

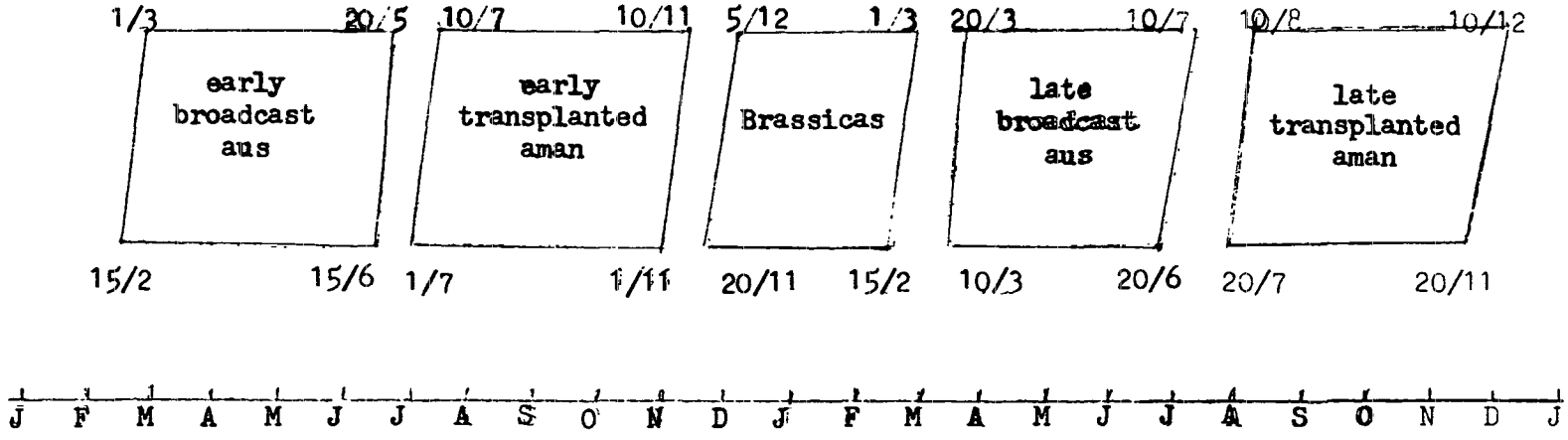
CROPPING PATTERNS AND CALENDAR OF OPERATIONS

Boro - early transplanted aman -
Wheat - transplanted aus -
Late transplanted aman



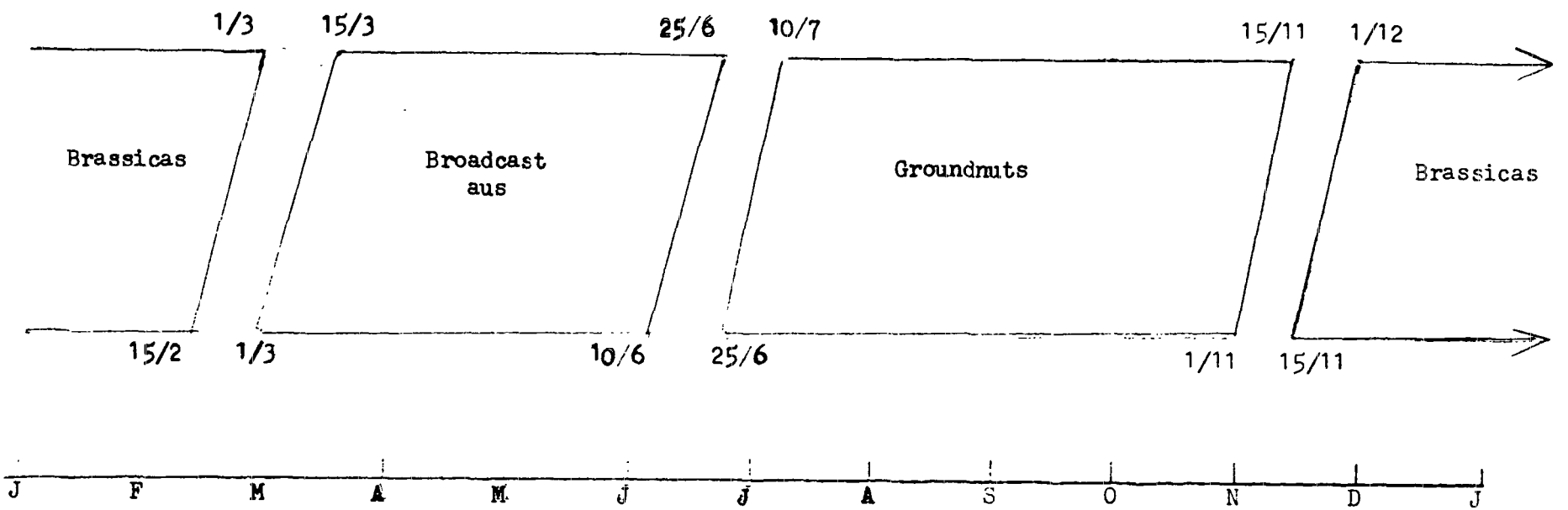
CROPPING PATTERNS AND CALENDAR OF OPERATIONS

Early Broadcast Aus - Early Transplanted Aman
Brassicas - Late Broadcast Aus - Late
Transplanted Aman



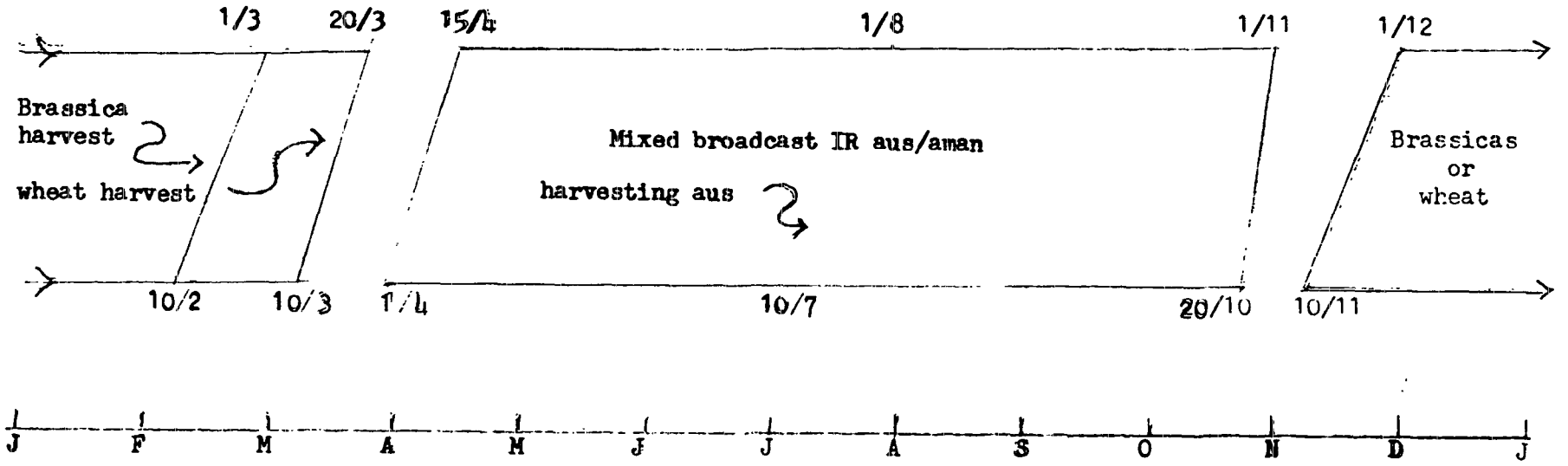
CROPPING PATTERNS AND CALENDAR OF OPERATIONS

Broadcast Aus - Groundnuts - Brassicas



CROPPING PATTERNS AND CALENDAR OF OPERATIONS

Mixed Broadcast IR Aus/Aman
Wheat or Brassicas



BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

PRESENT CROPPING PATTERNS

LDU	C R O P S										I - %
	L.AUS	B.AMAN	T.AMAN	MIX A&A	BORO	JUTE	WHEAT	GR.NUT	SUGAR	O.RABI	
C1	31.8	3.2	24.3	41.2	1.4	18.9	0.1	0.0	0.1	19.8	182.3
C2	58.3	2.0	86.6	0.4	6.7	31.0	0.0	0.1	1.3	0.7	190.6
C3A	37.5	13.7	65.7	3.1	11.6	24.6	0.9	0.0	2.5	4.7	172.5
C3B	38.6	8.9	57.7	15.0	6.6	29.5	0.8	0.1	1.3	11.4	187.5
C3C	53.3	5.3	86.5	0.0	4.3	31.0	1.0	0.0	2.9	2.9	193.0
C3D	16.9	22.4	25.9	23.9	12.2	23.7	0.5	0.0	0.5	15.3	166.1
C4	56.5	0.6	77.2	0.6	0.8	34.0	1.3	0.1	3.8	8.5	191.5
C5	43.8	4.7	54.1	15.2	4.0	27.4	0.6	0.2	1.9	12.4	183.2
C6	27.9	22.0	53.8	0.1	22.0	15.4	0.2	0.0	0.8	0.6	144.4
C7	24.7	20.1	48.1	1.2	27.6	15.0	0.6	0.0	1.7	2.5	146.0
C8A	4.2	26.8	7.3	33.3	12.0	22.1	0.3	0.0	0.3	20.0	160.3
C8B	9.8	15.9	10.8	32.6	11.0	23.2	1.1	0.0	0.3	23.7	161.6
C9	4.8	12.7	6.7	43.9	10.9	25.5	0.1	0.0	0.1	24.9	173.9
C10	0.0	16.5	0.0	31.8	34.2	17.5	0.0	0.0	0.0	16.5	148.3
C11	0.7	18.8	0.0	7.8	68.9	3.8	0.0	0.0	0.0	4.0	111.8
C12	18.2	16.1	8.5	42.3	2.7	19.0	0.0	0.0	0.0	23.0	172.2
C13	41.6	13.3	33.1	3.9	6.7	16.9	1.2	1.0	0.9	7.6	131.8
C14	72.6	0.0	30.2	0.0	0.0	15.6	0.0	3.0	0.0	9.6	131.1
DAC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

CROPPING PATTERN POSSIBLE WITH IMPROVED INPUTS ONLY

LDU	C R O P S															I-%
	L.AUS	IR.AUS	L.B.AMAN	L. BORO	L.T.AMAN	T.I.AMAN	MIX A&A	I.BORO	JUTE	R.NUTS	S.CANE	OILSEEDS	BRASSICAS	RABI	WHE	
C1	16.2	15.6	3.2	1.3	0.0	24.3	41.2	0.1	18.9	0.0	0.2	29.7	43.8	0.0	0.0	218.7
C2	0.0	58.3	2.0	6.7	0.7	85.9	0.4	0.0	30.9	0.1	1.5	3.1	0.5	0.0	0.2	276.6
C3A	0.0	37.5	13.7	7.8	7.0	58.7	3.1	3.9	24.4	0.0	2.7	2.4	4.4	0.0	0.1	224.5
C3B	0.1	38.5	8.9	4.2	0.3	57.4	15.0	2.4	29.3	0.1	1.5	9.7	20.4	0.0	0.2	245.6
C3C	0.0	53.3	5.3	4.1	3.2	83.3	0.0	0.3	30.8	0.0	3.1	0.0	0.0	0.0	0.0	266.6
C3D	0.0	16.9	22.4	8.8	0.2	25.7	23.9	3.4	23.6	0.0	0.6	13.0	30.9	0.1	0.1	195.2
C4	0.0	56.4	0.6	0.7	0.1	77.1	0.6	0.1	33.8	0.1	4.1	15.5	0.8	0.0	0.1	267.4
C5	5.6	38.2	4.7	3.5	3.3	50.7	15.2	0.5	27.2	0.2	2.0	18.9	17.4	0.0	0.5	239.5
C6	0.3	27.6	22.0	10.5	11.6	42.2	0.1	11.5	15.4	0.0	0.8	0.6	0.1	0.0	0.0	184.8
C7	0.1	24.6	20.1	9.1	9.7	38.4	1.2	18.5	14.9	0.0	1.8	0.7	1.5	0.0	0.0	178.9
C8A	0.0	4.3	27.0	6.7	0.4	7.0	33.6	5.4	22.2	0.0	0.4	18.1	43.9	0.0	0.0	176.1
C8B	0.0	9.8	15.9	1.2	2.2	8.6	32.6	9.8	23.2	0.0	0.3	27.5	43.0	1.1	1.1	184.9
C9	1.3	3.5	12.7	7.8	0.0	6.7	43.9	3.0	25.5	0.0	0.2	25.5	51.0	0.0	0.0	187.8
C10	0.0	0.0	16.5	2.1	0.0	0.0	31.8	32.2	17.5	0.0	0.0	17.0	35.5	0.0	0.0	152.4
C11	0.7	0.0	18.8	65.9	0.0	0.0	7.8	3.0	3.8	0.0	0.0	4.5	9.2	0.0	0.0	113.8
C12	16.6	1.6	16.1	1.7	5.2	3.3	42.3	1.0	19.0	0.0	0.0	29.6	52.5	0.0	0.0	192.1
C13	0.0	48.1	15.4	7.3	7.9	30.4	4.5	0.4	19.6	1.2	1.0	31.0	5.9	1.4	3.7	211.6
C14	0.0	81.8	0.0	0.0	3.8	30.3	0.0	0.0	17.5	3.4	0.0	59.7	0.0	0.0	6.7	243.4
DAC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

CROPPING PATTERN POSSIBLE WITH IRRIGATION

LDU	C R O P S																	I-%
	L.AUS	I.AUS	T.AUS	B.AMAN	L.T.AMAN	T.I.AMAN	M.A&A	L.BORO	I.BORO	JUTE	WHEAT	GR.NUTS	S.CANE	OILSE	BRASS	ORCH	RABI	
C1	16.2	7.7	4.5	0.0	0.0	20.2	40.9	1.4	10.4	18.8	3.6	0.0	0.0	37.1	40.6	0.0	0.0	242.6
C2	0.0	5.2	0.0	0.0	0.0	74.6	0.5	6.6	56.3	30.9	8.5	0.7	0.3	6.8	1.2	0.0	0.1	192.8
C3A	0.0	14.0	2.9	0.0	0.0	38.5	2.9	6.6	49.0	24.4	14.5	0.2	0.1	16.6	8.9	0.0	0.0	181.8
C3B	0.1	11.2	4.2	0.0	0.0	45.7	14.3	4.2	36.5	29.3	16.2	0.5	0.2	19.2	14.0	0.0	0.0	210.2
C3C	0.0	14.7	8.8	0.0	0.0	56.2	0.0	3.5	42.2	30.8	16.4	0.0	0.0	26.2	7.8	0.0	0.0	206.6
C3D	0.0	6.3	3.8	0.0	0.0	20.4	20.9	13.3	33.6	22.1	16.2	0.3	0.0	18.0	15.1	0.0	0.0	190.9
C4	0.0	32.8	0.1	0.0	0.0	45.7	0.6	0.7	30.1	33.8	26.2	0.3	1.9	23.9	11.0	0.0	0.0	211.6
C5	4.4	19.9	1.9	0.0	1.3	35.6	15.3	3.3	26.7	27.2	17.7	1.5	1.0	23.3	18.5	0.1	0.1	215.0
C6	0.3	3.4	2.1	0.0	0.0	34.8	0.1	9.3	69.6	15.1	4.7	0.0	0.1	6.9	1.2	0.0	0.0	147.8
C7	0.1	8.6	2.3	0.0	0.0	26.4	1.1	7.7	65.3	14.8	8.1	0.0	0.0	10.4	5.6	0.0	0.0	151.5
C8A	0.0	3.9	0.4	1.6	0.3	4.9	30.9	10.7	30.8	20.7	20.9	0.2	0.0	14.9	18.6	0.0	0.0	189.8
C8B	0.0	16.8	0.0	0.0	0.0	8.6	30.2	1.2	28.1	23.2	16.6	3.8	0.5	20.8	23.6	0.0	0.5	205.3
C9	1.3	5.7	0.0	0.0	0.0	5.8	36.4	8.2	23.0	25.4	22.4	0.0	0.0	18.0	23.7	0.0	0.0	206.3
C10	0.0	0.0	0.0	0.0	0.0	0.0	25.1	3.5	54.4	17.0	19.5	0.0	0.0	9.1	13.5	0.0	0.0	167.2
C11	0.7	0.0	0.0	0.0	0.0	0.0	7.9	65.9	21.6	3.8	4.9	0.0	0.0	2.8	4.8	0.0	0.0	120.4
C12	13.8	6.1	0.0	0.0	2.8	6.1	48.0	4.1	9.8	18.2	15.6	0.0	0.0	24.5	37.0	0.0	0.0	234.1
C13	0.0	24.7	0.0	2.3	4.0	22.7	4.0	10.0	25.8	15.7	13.8	10.2	2.6	11.4	12.3	0.4	1.2	170.4
C14	0.0	45.6	1.1	0.0	3.4	25.6	0.0	0.0	16.2	15.6	16.6	17.9	6.3	18.1	17.9	1.2	1.8	199.4
DAC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

CROPPING PATTERN POSSIBLE WITH IRRIGATION AND DRAINAGE

LDU	C R O P S																	I.C.
	L.AUS	B.I.	T.I.A	B.AMAN	L.T.AMAN	T.I.AMAN	M.A&A	L.BORO	I.BORO	JUTE	WHEAT	GR.NUTS	S.CANE	OILSE	BRASS	OTCH	VEG	
C1	16.2	7.0	8.2	0.0	0.0	27.6	32.5	0.0	15.2	18.8	3.7	6.1	2.1	37.9	38.9	0.0	2.0	252.7
C2	0.0	5.2	0.1	0.0	0.0	79.6	0.0	0.0	63.2	30.9	7.5	0.8	0.3	7.8	0.9	0.0	0.1	197.2
C3A	0.0	14.4	4.0	0.0	0.0	69.1	0.0	0.0	55.4	24.4	10.5	5.4	1.7	16.9	9.8	0.0	1.4	216.6
C3B	0.1	13.5	11.5	0.0	0.0	72.9	0.1	0.0	43.1	29.3	6.7	6.6	2.2	25.9	10.6	0.0	1.8	229.1
C3C	0.0	18.0	5.8	0.0	0.0	59.4	0.0	0.0	42.8	30.8	13.2	8.3	2.6	22.0	13.1	0.0	2.4	223.6
C3D	0.0	9.6	15.4	0.0	0.0	78.8	0.0	0.0	50.9	22.1	3.5	6.5	2.1	29.4	8.8	0.0	2.0	233.2
C4	0.0	31.2	0.4	0.0	0.0	43.6	0.1	0.0	30.9	33.8	22.7	5.6	3.5	23.5	12.1	0.0	1.3	215.7
C5	4.4	20.2	5.0	0.0	1.3	48.5	6.6	0.0	33.4	27.2	12.8	6.6	2.9	26.1	16.2	0.1	1.7	225.2
C6	0.3	4.3	1.4	0.0	0.0	88.7	0.0	0.0	78.2	15.1	4.0	1.7	0.6	6.1	2.5	0.0	0.5	204.6
C7	0.1	9.1	2.0	0.0	0.0	81.0	0.3	0.0	72.4	14.8	6.0	3.7	1.2	9.4	7.1	0.0	1.0	210.8
C8A	0.0	7.3	17.6	0.0	0.3	80.8	0.0	0.0	50.2	20.7	3.3	4.5	1.8	33.8	5.9	0.0	1.4	230.9
C8B	0.0	14.7	18.9	0.0	0.0	71.1	0.0	0.0	40.5	23.2	6.3	10.1	2.7	37.7	10.1	0.0	2.7	243.4
C9	1.3	9.5	17.1	0.0	0.0	67.7	2.7	0.0	41.1	25.4	4.5	8.5	2.9	36.3	11.9	0.0	2.8	240.1
C10	0.0	6.0	10.6	0.0	0.0	83.5	0.0	0.0	64.4	17.0	3.2	5.5	2.0	23.0	5.5	0.0	1.8	226.7
C11	0.7	1.4	2.2	0.0	0.0	53.0	1.4	0.0	90.0	3.8	1.0	0.7	0.5	6.1	2.1	0.0	0.2	165.6
C12	13.8	8.3	8.1	0.0	2.	41.7	22.8	0.0	26.8	18.2	4.6	1.8	2.1	35.8	24.6	0.0	0.6	238.8
C13	0.0	25.2	1.8	0..	4.0	43.7	0.0	0.0	37.2	15.7	11.0	10.5	2.8	14.3	10.5	0.4	1.3	184.2
C14	0.0	46.1	0.7	0.0	3.4	24.8	0.0	0.0	15.8	15.6	16.5	18.4	6.4	17.6	18.4	1.2	2.0	199.8
DAC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

PRESENT CROPPING PATTERNS

LDU	C R O P S										I - %
	B.AUS.	B.AMAN	T.AMAN	MIX A&A	BORO	JUTE	WHEAT	GR.NUTS	S.CANE	O.RABI	
NW1	43.5	0.0	63.9	0.0	0.0	20.9	3.5	0.0	7.9	11.9	175.4
NW2	52.6	0.0	64.6	0.0	0.0	14.8	1.0	0.0	5.2	12.3	165.9
NW3	66..	1.4	58.6	0.0	0.3	18.4	1.3	0.0	5.3	14.6	182.7
NW4A	64.0	3.3	77.7	0.0	0.6	19.4	0.2	0.0	2.6	8.5	184.0
NW4B	47.9	7.9	47.9	0.7	1.9	16.0	4.5	0.0	7.3	14.0	170.5
NW5	30.9	23.8	28.2	17.4	4.2	15.3	6.8	0.0	1.3	22.7	172.0
NW6	35.2	8.1	37.6	0.0	4.1	9.5	3.2	0.0	6.3	14.2	137.3
NW7	9.7	38.8	23.6	0.0	10.3	2.7	0.6	0.0	0.9	5.5	94.9
NW8A	2.3	46.6	2.8	2.6	19.6	1.6	0.6	0.0	0.1	3.4	82.1
NW8B	0.0	48.3	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	68.3
NW9	34.3	15.1	42.9	4.5	6.3	14.0	2.9	0.0	4.2	10.6	152.0
NW10	9.9	35.7	10.8	21.5	9.2	8.8	5.7	0.0	0.4	18.9	143.5
NW11A	6.6	50.0	0.0	16.5	0.0	0.0	0.0	0.0	3.3	14.6	117.5
NW11B	29.7	41.5	0.0	14.2	0.0	4.5	0.0	0.0	4.3	29.8	150.8
NW12	23.7	0.4	73.8	0.0	0.1	14.3	2.7	0.0	6.1	7.8	147.1
NW13	11.5	3.5	89.0	0.2	1.8	3.2	0.4	0.0	0.2	0.7	111.4
NW14	12.8	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	112.8

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

CROPPIN PATTERN POSSIBLE WITH IMPROVED INPUTS ONLY

LDU	C R O P S															
	L.AUS	I.AUS	B.AMAN	L.T.AMAN	T.I.AMAN	M.A&A	BORO	JUTE	WHEAT	GR.NUT	S.CANE	OILSEEDS	BRASSICAS	ORCHARDS	VEG	
NW1	0.0	43.5	0.0	2.5	61.4	0.0	0.0	20.9	9.7	4.2	7.9	13.0	18.8	0.7	0.7	199.2
NW2	0.0	52.6	0.0	10.0	54.6	0.0	0.0	14.8	7.5	7.9	5.2	11.6	3.0	1.2	1.2	179.7
NW3	0.6	66.1	1.4	2.3	56.3	0.0	0.3	18.4	6.6	8.3	5.3	12.6	2.8	0.8	0.8	193.2
NW4A	0.0	64.0	3.3	6.7	70.9	0.0	0.6	19.4	2.3	1.3	2.6	2.3	0.6	0.0	0.0	179.1
NW4B	0.0	47.9	7.9	3.0	44.9	0.7	1.9	16.0	7.5	7.6	7.3	14.0	7.8	1.3	1.3	184.3
NW5	0.1	30.8	23.8	2.7	25.6	17.4	4.2	15.3	8.9	0.6	1.3	9.7	22.3	0.1	0.1	182.8
NW6	0.0	35.2	8.1	20.3	17.3	0.0	4.1	9.5	5.6	9.7	6.3	16.4	3.4	1.6	1.6	151.7
NW7	0.0	9.7	38.8	17.6	6.1	0.0	10.3	2.7	2.1	1.8	0.9	7.3	0.0	0.3	0.3	99.7
NW8A	0.0	2.3	46.6	0.9	1.9	2.6	19.6	1.6	1.4	0.0	0.1	1.2	3.3	0.0	0.0	84.1
NW8B	0.0	0.0	48.3	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.3
NW9	0.1	34.2	15.1	1.5	41.4	4.5	6.3	14.0	4.6	3.3	4.2	6.4	12.8	0.6	0.6	162.6
NW10	0.0	9.9	35.7	0.1	10.6	21.5	9.2	8.8	6.5	0.0	0.4	2.2	33.3	0.0	0.0	160.5
NW11A	6.6	0.0	50.0	0.0	0.0	16.5	0.0	0.0	0.0	0.0	3.3	6.6	49.6	0.0	0.0	155.9
NW11B	18.9	10.8	41.5	0.0	0.0	14.2	0.0	4.5	0.0	1.0	4.3	33.1	42.5	0.3	0.3	193.9
NW12	0.0	23.7	0.4	20.6	53.2	0.0	0.1	14.3	5.8	3.1	6.1	10.7	15.1	0.0	0.0	165.3
NW13	2.6	8.9	3.5	49.5	39.6	0.2	1.8	3.2	0.5	0.0	0.2	3.0	1.1	0.0	0.0	114.8
NW14	5.7	7.2	0.0	64.2	35.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	112.8

FILED BY LDU IN NW14

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

CROPPING PATTERN POSSIBLE WITH IRRIGATION

LDU	C R O P S																	I=s
	L.AUS	I.AUS	T.AUS	B.AMAN	L.T.AMAN	T.I.AMAN	M.A&A	L.BORO	I.BORO	JUTE	WHEAT	GR.NUTS	S.CANE	OILSE	BRASS	ORCH	RABI	
NW1	0.0	59.4	3.3	0.0	0.5	64.5	0.0	0.0	8.1	20.7	10.5	4.7	8.2	15.5	21.5	0.0	0.8	234.2
NW2	0.0	28.5	9.6	0.0	0.1	68.6	0.0	0.0	41.4	14.8	7.6	8.7	5.6	22.0	12.3	0.0	1.6	232.1
NW3	0.0	28.1	2.5	0.0	0.4	66.7	0.0	0.3	45.5	17.9	7.2	8.9	5.6	11.1	11.2	0.0	2.1	218.9
NW4A	0.0	4.5	4.3	0.0	0.0	88.6	0.0	0.8	68.5	19.2	1.4	1.3	2.6	7.0	2.2	0.0	0.4	206.0
NW4B	0.0	41.9	1.7	0.0	0.0	50.8	0.9	0.3	31.7	16.0	9.7	10.2	7.3	12.2	20.4	0.0	1.3	219.7
NW5	0.4	12.5	0.7	1.2	0.0	34.1	18.8	1.7	47.7	14.8	7.3	0.8	1.3	8.1	25.2	0.0	0.1	196.4
NW6	0.0	33.3	2.0	0.0	0.0	38.8	0.0	0.0	48.8	9.5	10.0	12.9	6.3	13.1	12.9	0.0	1.6	201.9
NW7	0.0	9.1	0.0	0.0	0.0	24.2	0.0	6.1	81.2	2.7	4.2	2.4	0.9	4.2	2.4	0.0	0.3	139.7
NW8A	0.0	2.4	0.0	0.0	0.0	2.9	3.3	6.4	86.2	1.6	1.3	0.0	0.1	1.3	3.9	0.0	0.0	112.8
NW8B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
NW9	0.0	20.9	3.1	0.0	0.0	46.3	4.6	0.0	53.0	14.0	4.9	4.1	4.3	9.5	10.8	0.0	0.5	189.2
NW10	0.0	4.6	0.4	0.0	0.0	11.8	21.8	0.0	64.1	8.8	4.3	0.0	0.4	5.0	22.1	0.0	0.0	165.6
NW11A	19.9	0.0	0.0	43.4	0.0	0.0	16.5	0.0	8.5	0.0	6.6	6.6	3.3	6.6	43.0	0.0	0.0	177.6
NW11B	36.8	10.9	0.0	22.6	0.0	0.0	14.2	0.0	6.6	4.5	22.6	6.8	4.4	22.6	37.9	0.0	0.1	213.1
NW12	0.0	35.5	0.0	0.0	0.0	76.1	0.0	0.0	44.1	14.3	6.6	3.2	6.1	6.6	3.2	0.0	1.0	208.7
NW13	0.0	2.3	0.0	0.0	0.0	91.3	0.2	0.0	94.1	3.2	0.6	0.0	0.2	0.6	0.3	0.0	0.0	193.6
NW14	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	200.0

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

CROPPING PATTERN POSSIBLE WITH IRRIGATION AND DRAINAGE

LDU	C R O P S																	I
	L.AUS	I.AUS	T.AUS	B.AMAN	L.T.AMAN	T.I.AMAN	M.AGA	L.BORO	I.BORO	JUTE	WHEAT	GR.NUTS	S.CANE	OILSE	BRASS	ORCH	VEGE	
NW1	0.0	55.2	4.5	0.0	0.0	19.5	0.0	0.0	7.5	20.7	28.1	11.6	11.8	33.4	14.6	0.0	2.2	233.0
NW2	0.0	27.8	19.6	0.0	0.0	63.2	0.0	0.0	33.3	14.8	14.0	9.9	4.5	34.8	11.3	0.0	1.9	243.9
NW3	0.0	27.5	16.1	0.0	0.0	62.6	0.0	0.0	33.2	17.9	21.4	10.1	5.2	28.2	10.2	0.0	2.3	245.3
NW4A	0.0	4.5	23.0	0.0	0.0	92.1	0.0	0.0	51.8	19.2	19.3	1.5	1.5	26.5	1.5	0.0	0.4	244.3
NW4B	0.0	40.6	9.6	0.0	0.0	41.9	0.0	0.0	24.7	16.0	21.1	13.0	8.9	27.0	16.0	0.0	2.1	238.6
NW5	0.4	18.9	12.5	0.6	0.0	68.2	0.3	0.0	49.2	14.8	12.1	7.7	3.4	25.6	8.5	0.0	1.3	230.7
NW6	0.0	32.6	4.0	0.0	0.0	43.7	0.0	0.0	47.3	9.5	13.9	13.3	6.5	17.1	13.3	0.0	1.9	216.3
NW7	0 0	8 5	5.5	0.0	0.0	68.2	0.0	0.0	81.8	2.7	3.0	3.9	1.5	9.1	3.9	0.0	0.6	191.8
NW8A	0.0	5.1	0.4	0.0	0.0	68.8	0.0	0.0	92.1	1.6	1.9	2.1	0.8	2.4	2.4	0.0	0.3	179.5
NW8B	0.0	0.0	0 0	0.0	0.0	60.4	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0.0	160.4
NW9	0.0	20.3	12.4	0.0	0.0	61.0	0.0	0.0	49.1	14.0	14.9	5.2	4.0	24.7	6.4	0.0	0.8	220.9
NW10	0.0	5.1	17.7	0.0	0.0	77.3	0.0	0.0	67.5	8.8	4.4	1.9	0.9	25.0	1.9	0.0	0.4	212.7
NW11A	19.9	0.0	0.0	43.4	0.0	0.0	16.5	0.0	8.5	0.0	6.6	6.6	3.3	6.6	43.0	0.0	0.0	177.6
NW11B	36.8	11.7	0.0	22.6	0.0	0.0	14.2	0.0	6.6	4.5	23.0	6.8	4.4	23.0	37.9	0.0	0.1	214.5
NW12	0.0	34.2	20.6	0.0	0.0	46.4	0.0	0.0	23.4	14.3	19.1	6.4	7.4	42.0	6.4	0.0	1.7	236.7
NW13	0.0	2.1	20.6	0.0	0.0	95.5	0.0	0.0	73.7	3.2	1.2	0.5	0.4	24.0	0.5	0.0	0.1	222.7
NW14	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	200.0

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

PRESENT CROPPING PATTERNS

LDU	C R O P S											I - %
	B.AUS.	B.AMAN	T.AMAN	MIX A&A	BORO	JUTE	WHEAT	GR.NUTS	S.CANE	O.RABI	ORCHARD	
E1	36.3	5.8	56.4	0.0	30.9	0.0	0.0	0.0	1.5	2.8	0.0	136.6
E2	24.1	38.2	24.1	0.0	23.0	1.1	0.0	0.0	0.0	3.2	0.0	113.7
E3	0.0	21.2	0.0	0.0	76.1	1.6	0.0	0.0	0.0	0.0	0.0	98.9
E4	21.5	5.2	21.9	50.4	5.3	13.4	0.7	0.0	0.8	18.3	2.9	192.4
E5	51.5	1.7	65.3	14.8	7.5	18.3	3.0	0.0	3.2	16.6	0.0	203.0
E6	4.8	53.5	4.8	28.0	7.2	6.5	0.0	0.0	0.0	9.3	0.0	142.1
E7	60.3	3.3	92.0	0.0	0.4	0.8	0.1	0.0	1.6	3.2	0.0	165.1
E8	14.9	13.4	52.0	4.9	22.4	1.8	0.2	0.0	0.4	3.2	0.0	119.2
E9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E10	19.5	3.5	70.5	5.4	0.6	3.0	0.4	0.0	0.4	2.9	0.0	112.5
E11A	15.0	1.4	20.8	0.0	0.7	0.0	0.0	0.0	0.5	1.2	0.0	40.8
E11B	10.3	0.0	7.2	0.0	0.0	0.0	0.0	0.0	0.0	3.9	3.6	25.0

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

CROPPING PATTERN POSSIBLE WITH IMPROVED INPUTS ONLY

LDU	C R O P S															
	L.AUS	IR.AUS	T.I.AUS	B.AMAN	L.AMAN	I.AMAN	M.A&A	L.BORO	I.BORO	JUTE	S.CANE	OILSEEDS	BRASSICAS	ORCHARDS	VEG	
E1	0.0	36.3	0.0	5.8	0.0	56.4	0.0	15.4	15.4	0.0	1.5	0.0	0.0	0.0	1.5	135.4
E2	0.0	24.1	0.0	38.2	0.0	24.1	0.0	9.8	13.3	1.1	0.0	1.1	0.0	0.0	0.0	111.6
E3	0.0	0.0	0.0	21.2	0.0	0.0	0.0	40.0	36.1	1.6	0.0	1.6	0.0	0.0	0.0	100.4
E4	0.9	20.6	0.0	5.2	8.6	13.3	50.4	0.0	5.3	13.4	0.8	7.8	33.5	2.9	2.9	217.6
E5	4.5	46.9	0.0	1.7	7.6	57.7	14.8	3.1	4.3	18.3	3.2	3.0	13.5	0.0	0.0	200.0
E6	0.0	4.0	0.0	53.5	4.5	0.4	28.0	0.4	6.8	6.5	0.0	5.6	27.4	0.0	0.0	165.8
E7	0.0	60.3	0.0	3.3	0.0	92.0	0.0	0.0	0.4	0.8	1.6	0.1	0.0	0.0	1.5	163.3
E8	3.4	11.5	0.0	13.4	28.5	23.5	4.9	0.0	22.4	1.8	0.4	0.0	0.0	0.0	3.5	119.3
E9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E10	2.7	16.0	0.0	3.5	28.7	41.8	5.4	0.1	0.6	3.0	0.4	0.8	3.6	0.0	0.0	113.6
E11A	1.5	13.5	0.0	1.4	0.0	20.8	0.0	0.4	0.3	0.0	0.5	0.0	0.0	0.0	0.5	40.1
E11B	1.7	8.2	0.0	0.0	0.0	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	3.6	24.1

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

CROPPING PATTERN POSSIBLE WITH IRRIGATION

LDU	C R O P S																	
	L.AUS	I.AUS	T.AUS	B.AMA.	L.T.AMAN	T.I.AMAN	M.A&A	L.BORO	I.BORO	JUTE	WHEAT	GR.NUTS	S.CANE	OILSE	BRASS	ORCH	RABI	
E1	0.0	28.7	0.0	0.0	0.0	56.6	0.0	19.3	48.8	0.0	0.0	0.0	1.5	0.0	0.0	0.0	1.5	159.4
E2	0.0	5.4	0.0	0.0	0.0	36.7	0.0	31.6	62.9	0.1	0.0	0.0	0.0	0.1	2.9	0.0	0.0	139.7
E3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.2	49.2	1.6	0.0	0.0	0.0	1.6	0.0	0.0	0.0	101.6
E4	0.0	11.4	3.5	0.0	8.6	14.0	25.8	3.0	41.5	11.2	0.0	0.0	0.8	14.6	25.8	2.9	2.9	193.4
E5	0.0	5.1	14.6	0.0	7.6	60.7	10.4	4.2	43.5	18.1	0.0	0.0	3.2	32.8	10.4	0.0	0.0	227.5
E6	0.0	4.8	0.0	14.3	4.5	0.4	16.2	22.5	37.6	4.6	0.0	0.0	0.0	4.6	23.7	0.0	0.0	149.3
E7	0.0	28.2	0.6	0.0	0.0	92.1	0.0	1.9	66.0	0.7	0.0	0.0	1.6	1.4	0.0	0.0	1.5	197.3
E8	0.0	3.5	7.2	0.0	0.0	23.8	0.0	0.0	85.3	1.2	0.0	0.0	0.4	8.4	0.0	0.0	0.2	130.9
E9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E10	0.0	9.9	19.1	3.5	28.7	42.2	2.8	0.1	24.5	2.8	0.0	0.0	0.4	21.9	2.8	0.0	0.0	162.2
E11A	1.5	10.9	0.0	0.0	0.0	21.1	0.0	1.1	11.8	0.0	0.0	0.0	0.5	0.0	0.7	0.0	0.5	49.2
E11B	1.7	10.8	0.0	0.0	0.0	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2	3.6	3.6	34.0

FILED BY LDU IN E5

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

CROPPING PATTERN POSSIBLE WITH IRRIGATION AND DRAINAGE

LDU	C R O P S																	I-%
	L.AUS	B.I.A	T.I.A	B.AMAN	L.T.AMAN	T.I.AMAN	M.A&A	L.BORO	I.BORO	JUTE	WHEAT	GR.NUTS	S.CANE	OILSE	BRASS	ORCH	VE	
E1	0.0	28.7	0.0	0.0	0.0	75.9	0.0	0.0	68.1	0.0	0.0	0.0	1.5	0.0	0.0	0.0	1.5	178.7
E2	0.0	5.1	0.0	0.0	0.0	81.5	0.0	0.0	94.5	0.1	0.6	2.4	0.3	1.9	2.4	0.0	0.3	189.7
E3	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150.0
E4	0.0	4.1	27.3	0.0	0.0	92.8	0.0	0.0	52.3	13.3	5.2	0.5	0.1	22.6	0.5	2.9	3.0	225.0
E5	0.0	2.3	32.5	0.0	0.0	93.4	0.0	0.0	45.8	18.3	22.6	0.7	0.2	10.6	0.7	0.0	0.1	227.7
E6	0.0	15.6	12.8	0.0	0.0	83.0	0.0	0.0	66.1	5.5	0.0	7.7	0.1	20.7	7.7	0.0	0.1	219.3
E7	0.0	28.2	1.1	0.0	0.0	96.1	0.0	0.0	67.6	0.7	1.1	0.0	1.5	0.0	0.0	0.0	1.5	200.7
E8	0.0	3.5	7.9	0.0	0.0	63.7	0.0	0.0	84.2	1.8	1.8	0.0	0.2	6.1	0.0	0.0	0.2	169.9
E9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E10	0.0	9.1	22.6	3.5	27.9	50.4	0.0	0.0	24.8	3.0	3.0	0.0	0.0	19.7	0.0	0.0	0.0	164.0
E11A	1.5	10.9	0.0	0.0	0.0	21.8	0.0	0.0	12.9	0.0	0.0	0.3	0.6	0.3	0.3	0.0	0.6	50.3
E11B	1.7	10.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	0.4	3.2	3.2	3.6	3.9	30.4

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BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

PRESENT CROPPING PATTERNS

LDU	C R O P S											I - %
	B.AUS.	B.AMAN	T.AMAN	MIX A&A	BORO	JUTE	WHEAT	GR.NUTS	S.CANE	O.RABI	ORCHARD	
SW1	29.9	4.7	0.0	13.4	0.0	29.5	0.0	0.0	1.5	31.2	0.0	128.1
SW2	35.1	8.7	48.4	2.4	2.3	10.2	0.0	0.0	0.6	18.6	0.4	130.8
SW3	48.3	11.8	15.2	6.9	2.7	19.0	4.5	0.0	3.8	19.0	0.7	150.2
SW4	22.5	38.4	1.8	12.7	5.1	17.2	3.2	0.0	1.7	14.4	0.2	134.9
SW5	12.7	35.3	1.8	15.7	7.1	5.8	0.2	0.0	0.2	2.9	0.0	98.0
SW6	16.2	2.1	88.5	0.3	5.0	1.3	0.0	0.0	0.1	8.6	0.0	122.8
SW7	9.6	0.0	90.2	0.0	2.6	0.0	0.0	0.0	0.0	3.5	0.0	105.9
SW8	56.1	0.0	76.4	0.0	0.0	4.5	0.0	0.0	0.0	13.9	0.0	150.9
SW9	0.5	0.0	55.0	0.0	0.3	0.0	0.0	0.0	0.0	0.2	0.0	55.9
SW10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

FILED BY LDU IN SW10

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

CROPPING PATTERN POSSIBLE WITH IMPROVED INPUTS ONLY

LDU	C R O P S															
	L.AUS	I.AUS	B.AMAN	L.T.AMAN	T.I.AMAN	M.A&A	BORO	JUTE	WHEAT	GR.NUT	S.CANE	OILSEEDS	BRASSICAS	ORCHARDS	VEG	I
SW1	0.0	29.9	2.1	0.0	0.0	16.0	0.0	29.5	0.0	0.2	1.5	61.8	32.5	0.0	0.0	192.6
SW2	0.0	35.1	1.1	26.7	21.7	10.0	2.3	10.2	0.0	1.5	0.6	19.1	63.1	0.4	0.0	203.0
SW3	0.0	48.3	3.6	14.9	0.2	15.2	2.7	19.0	5.0	2.2	3.8	53.1	9.7	0.7	0.0	201.2
SW4	0.0	22.5	10.3	1.4	0.4	40.8	5.1	17.2	3.5	0.7	1.7	35.1	32.5	0.2	0.0	215.5
SW5	0.0	12.7	19.3	1.4	0.4	31.7	7.1	5.8	0.2	0.1	0.2	5.4	18.6	0.0	0.0	135.1
SW6	0.0	16.2	0.1	68.2	20.2	2.4	5.0	1.3	0.0	0.2	0.1	1.7	69.7	0.0	0.0	187.6
SW7	0.0	9.6	0.0	0.0	90.2	0.0	2.6	0.0	0.0	0.0	0.0	0.0	11.7	0.0	0.0	114.1
SW8	0.0	56.1	0.0	4.0	72.5	0.0	0.0	4.5	0.0	0.0	0.0	4.5	61.3	0.0	0.0	202.9
SW9	0.0	0.5	0.0	43.7	11.3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.7
SW10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

FILED BY LDU IN SW14

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

CROPPING PATTERN POSSIBLE WITH IRRIGATION

LDU	C R O P S																	I = ?
	L.AUS	I.AUS	T.AUS	B.AMAN	L.T.AMAN	T.I.AMAN	M.A&A	L.BORO	I.BORO	JUTE	WHEAT	GR.NUTS	S.CANE	OILSE	BRASS	ORCH	RABI	
SW1	0.0	15.5	0.0	0.0	0.0	0.0	30.5	0.0	2.1	29.5	0.0	1.6	1.5	61.8	30.6	0.0	0.0	206.5
SW2	0.0	14.1	4.6	0.0	0.0	49.4	20.3	0.0	43.6	9.8	0.0	1.5	0.6	23.5	28.2	0.4	0.2	217.8
SW3	0.0	38.0	6.3	0.0	0.2	17.8	5.9	0.8	25.6	18.6	5.0	2.2	3.8	53.8	6.4	0.7	1.8	200.3
SW4	0.0	21.2	0.6	0.0	0.0	1.7	20.0	0.2	39.7	14.4	3.5	0.8	1.7	32.7	16.4	0.2	0.4	177.0
SW5	0.0	1.4	0.6	0.0	0.0	1.6	16.5	20.2	55.4	4.2	0.2	0.1	0.2	5.7	8.6	0.0	0.1	131.6
SW6	0.0	0.7	14.4	0.0	12.8	77.2	6.4	0.0	77.1	1.3	0.0	0.2	0.1	5.0	6.6	0.0	0.0	208.4
SW7	0.0	97.4	0.0	0.0	0.0	99.4	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	13.4	0.0	0.0	212.7
SW8	0.0	35.1	26.2	0.0	4.0	87.5	0.0	0.0	26.2	4.5	0.0	0.0	0.0	30.8	35.1	0.0	0.0	249.4
SW9	0.0	12.3	0.0	0.0	43.7	12.6	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.9
SW10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

BANGLADESH

LAND & WATER DEVELOPMENT SECTOR STUDY

CROPPING PATTERN POSSIBLE WITH IRRIGATION AND DRAINAGE

LDU	C R O P S																	I< '
	L.AUS	I.AUS	T.AUS	B.AMAN	L.T.AMAN	T.I.AMAN	M.A&A	L.BORO	I.BORO	JUTE	WHEAT	GR.NUTS	S.CANE	OILSE	BRASS	ORCH	RABI	
SW1	0.0	13.3	0.0	0.0	0.0	0.0	30.5	0.0	2.1	29.5	0.0	0.2	1.5	61.8	30.6	0.0	0.0	202.9
SW2	0.0	18.5	8.1	0.0	0.0	62.3	12.2	0.0	43.1	9.8	0.0	2.6	0.9	27.3	25.0	0.4	0.4	224.8
SW3	0.0	24.8	19.2	0.0	0.0	61.7	0.1	0.0	32.1	18.6	5.0	2.3	4.5	53.5	2.4	0.7	1.8	235.9
SW4	0.0	13.7	25.8	0.0	0.0	75.3	1.3	0.0	41.4	14.4	3.5	3.8	2.0	46.4	5.6	0.2	0.8	239.3
SW5	0.0	1.4	24.8	0.0	0.0	93.3	0.0	0.0	69.4	4.2	0.2	0.1	0.2	29.3	0.7	0.0	0.1	224.2
SW6	0.0	6.0	4.0	0.0	0.0	98.4	0.0	0.0	88.6	1.3	0.0	0.3	0.2	5.5	5.7	0.0	0.0	210.2
SW7	0.0	87.7	6.1	0.0	0.0	100.0	0.0	0.0	6.1	0.0	0.0	0.0	0.0	6.1	1.1	0.0	0.0	207.2
SW8	0.0	33.6	24.9	0.0	4.0	59.3	0.0	0.0	24.9	4.5	0.0	10.6	4.1	41.5	20.0	0.0	1.5	237.2
SW9	0.0	12.6	0.0	0.0	43.7	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.9
SW10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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BANGLADESH

LAND AND WATER RESOURCES SECTOR STUDY

VOLUME III

SECTOR ECONOMICS

TECHNICAL REPORT NO. 5

THE SPECIAL PROBLEM OF EMPLOYMENT IN AGRICULTURE

December 1, 1972

Asia Projects Department

BANGLADESH - SECTOR STUDY

VOLUME III - SECTOR ECONOMICS

TECHNICAL REPORT NO. 5

THE SPECIAL PROBLEM OF EMPLOYMENT IN AGRICULTURE [1/]

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1/ This report was prepared by J. Mellor of Cornell University.

BANGLADESH

LAND AND WATER RESOURCES STUDY

TECHNICAL REPORT NO. 5

THE SPECIAL PROBLEM OF EMPLOYMENT IN AGRICULTURE

SUMMARY AND CONCLUSIONS

i. This paper examines a set of possibilities for increased productive employment in Bangladesh. These possibilities are indicated in a simplified framework to facilitate analysis of policy requirements and implications. To become operational, they must be developed in more detail and subjected to further test of consistency between employment levels, the supply of consumer goods and the supply of capital.

ii. A significant absorption of productive labor in agriculture requires a more intensive agriculture, including high yielding varieties, double cropping, input distribution, improved water control as well as a significant infrastructure of agricultural education and research.

iii. Overall indications are that (both in agricultural sector and non-agricultural sector) about 621,000 jobs could be expected to be created each year over the next ten years amounting to a 10-year total of 6,210,000 jobs. On the basis of the sensitivity of macro-economic interactions, this increment in actual employment would imply an annual per capita income growth rate of about 3.5% implying a 5% annual growth rate in the agricultural sector. Yet, assuming that the estimated increase in the labor force over the same period is about 8,500,000, unemployment would total 2,290,000 over the next 10 years, that is about 27% on the average for the whole period, yet declining from about 33% in 1973 to 20% or about in 1983.

iv. The capacity to expand public works employment at the pace implied by these estimates is, however, likely to drop after a few years of rapid growth. The capacity to expand employment in connection with increased foodgrain production would also be likely to begin to decline as the supply of land suitable to such intensification is exhausted. In the meantime, it is urgent to expand the industrial sector so as to make it able to absorb an increasingly high proportion of annual increments to the labor force.

vi. The intensification of foodgrain production through high yielding varieties, modern inputs and controlled water supply, is at the center of a high employment policy in the agricultural sector as well as in the national economy at large. Intensification of foodgrains production is not only required to meet an increasing demand for foods, nor merely a potential source of increased employment, but the income generated from the activity plays a major role in providing demand for growth of non-foodgrains agriculture as well as the economic return to investment in public works program. It may also play a role in providing demand for labor intensive consumer goods produced in the non-agricultural sector.

BANGLADESH - SECTOR STUDY

LAND AND WATER RESOURCES STUDY

TECHNICAL REPORT NO. 6

THE SPECIAL PROBLEM OF EMPLOYMENT IN AGRICULTURE

I. INTRODUCTION

1.01 **Bangladesh has a rapid labor force growth and a high density of population at a development stage in which the growth rate of per capita income is very low and the bulk of the labor force is in the agricultural sector. It is this special combination of circumstances which provides one of most difficult and intractable problems for providing levels of employment and breadth of income distribution.**

1.02 There are three separate but interacting elements to the employment problem: (1) the supply of labor which is to be absorbed; (2) the supply of jobs for absorbing that labor; and, (3) the supply of consumer goods to back the wages paid for added employment. The first element, the supply of labor, defines the magnitude of the employment problem. The second and third elements, the supply of jobs and the supply of consumer goods, define the means for solving the problem. Recent emphasis on employment per se has diverted attention from the underlying objectives of increasing the income and consumption of low income people. A broader approach requires that increased employment be accompanied by increased supply of food and other goods consumed by the poor.

1.03 In Bangladesh the magnitude of the employment and income problem is particularly large because of rapid population growth and inadequate general education. Solution is difficult because of the slow growth in the small stock of capital available to make jobs, the limited land base in agriculture for productively absorbing **incremental labor, and the bottlenecks to expanding agricultural production rapidly enough to provide the basic consumer goods demanded by low income people.**

1.04 The nature of the Bangladesh employment problem has been complicated by the disruptions arising from the civil war and large movements of refugees. However, the implications of recent developments can only be understood in the context of underlying employment relationships. Thus, data and analysis will be presented on a pre-independence basis.

II. SUPPLY OF LABOR

2.01 The supply of labor for development projects is a function of labor force growth and the use and productivity of the existing stock of labor. Labor force growth is difficult to define and measure in large part because of uncertainties concerning participation rates. Even more

controversy exists with respect to the productivity and employment of the existing labor force. These controversies are unlikely to be fully resolved without more experience. Thus, policies with respect to labor utilization must be kept flexible and pragmatic.

Labor Force Growth

2.02 Labor force growth reflects the birth and death rates of previous decades and changes in labor participation rates. The labor force is estimated to be growing at a rate close to 3.2% per year or about (Table 1). For the period 1973-78, this represents an average annual addition to the labor force of about over 835,000 persons. This estimate, consistent with past experience, assumes for 1973 that all males between the ages of 15 and 64 are members of the labor force (slightly less than 50% of all males) and 11% of all females are members of the labor force (for an overall labor force participation rate of about 30%). For the period 1978-83, with the same underlying assumptions, the average annual additions to the labor force will average about 860,000 persons.

2.03 Under the economic conditions of Bangladesh, it is likely that the bulk of the employed female and child labor force represents distress laboring forced by extreme poverty. Under such circumstances an effective employment program for adult male workers, particularly on a stable, year-round basis, may well cause a decline in work force participation by females. The same is likely for young children. Thus, low but plausible figures for growth in labor force, consistent with a high employment program, would include addition of only males between the ages of 15 and 64. For 1973-1978, the expected average annual addition of such persons is about 630,000 male workers per year. For the period 1978-83, the expected average is about 610,000 male workers per year.

The Stock of Surplus Labor

2.04 Utilization of the annual additions to the labor force at current average levels of employment and productivity of course provides no basis for increase in average levels of consumption of the laboring classes. If less employment or lower productivity employment is provided, the already low living levels will decline further. Improvement in the welfare of the laboring classes occurs if demand for labor increases more rapidly than the labor force grows, thereby drawing down the stock of surplus rural labor or inducing increased labor productivity and higher wage rates.

2.05 If there is a stock of involuntarily unemployed rural labor, expanding employment opportunities faster than labor force growth works easily and directly to the advantage of the laboring classes. They receive more employment and a proportionate increase in their incomes. At the same time increased production is encouraged by ample supply of labor at constant real wages. If however, there is not surplus labor, then increased demand for labor will increase wage rates and induce increased investment in labor-saving capital or institutional reorganization of agriculture.

2.06 The more inelastic the supply of labor, the more wage rates and production costs will rise, and the more necessary will be planning for the physical and financial requirements of increased labor productivity. This provides a complex development problem in which error can be costly. Failure to foresee a labor shortage and to plan accordingly may impede application of production and income increasing innovation. Planning for labor shortage that does not occur may result in sunk costs in labor saving capital goods which are then used to increase unemployment with consequent lower growth in income and increased inequity in its distribution.

2.07 Unfortunately, measurement of the quantity of surplus labor is complex, with conflicting evidence and opinions. Bangladesh has the characteristics of the classic labor surplus economy. By generally conservative estimating procedures, Robinson estimates on the basis of cross-sectional studies of labor productivity, that all the additions to the rural labor force from 1951 to 1961 were redundant with the then current organization and capital investment.[1/] The bulk of further additions to the rural labor force since 1961 would, by the same logic, be redundant, raising the redundant portion to about one-third. It is reasonable to think that modest investment in institutional organization and capital would free an even larger proportion of the labor force. The impression of large labor surplus is further strengthened by labor budgets which compare the total amount of labor time needed to perform the agricultural tasks under existing technological conditions with the actual supply of rural labor.

2.08 However, such calculations often do not differentiate seasonal labor requirement fluctuations or the effect of habit and social custom on the availability of labor for particular tasks. Indeed, many observers of the Asian scene, including Gunnar Myrdal, argue that there is at most a very small redundant labor supply.[2/] The prime support for this position is the observation that at seasonal peaks in labor demand there seems to be over-full employment, drawing in many temporary members of the total force

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1/ W. C. Robinson, "Disguised Unemployment Once Again: East Pakistan 1951-61," Journal of Farm Economics.

2/ Mydral Gunnar, Asian Drama, Part 5, Pantheon, New York, 1968.

from the ranks of women and children. Complex systems of income and labor sharing, including social custom with respect to tasks various people will perform reinforce the tendency to seasonal labor scarcity. For India, statistical study of the marginal productivity of labor consistently shows it to be positive and comparable to the wage rate.[1/] If additions to the rural labor force since 1951 had been redundant one would expect to find the real wage rate declining. Bose suggests that real wages of rural laborers have fluctuated substantially but have not shown any trend either up or down.[2/] The fluctuations appear to be largely correlated with weather induced changes in foodgrains production and prices.

2.09 Substantial evidence of seasonal labor scarcity is found in Habibullah's detailed survey of Sabilpur village in Noakhali district.[3/] Noakhali district has nearly twice the population density per square mile of Bangladesh as a whole and Sabilpur village at 3324 persons per square mile had over twice the population density of Noakhali district. The village is rural, all but 12 of the male adults were engaged in agriculture, and the village is isolated, 18 miles from the nearest railroad and with no all-weather road. The population of the village had only grown by 8% from 1951 to 1961, the year of the survey. Forty percent of the families in the village had less than half an acre of land. Thus, the village has the classic characteristics of a labor surplus situation. Nevertheless, for an eight week period from April to June less than 10% of the labor force was unemployed; for two weeks there were no laborers without employment and a considerable number were working in excess of an eight hour day (Appendix 3). During this seasonal peak the total labor force increased by nearly 7% over its average size during the rest of the year, largely due to the temporary return of people to the village from urban jobs.

2.10 However, the very fact of the high seasonal peak requirement suggests many days of unemployment during the year. For the village as a whole over 25% of the man-days available for work are unemployed. This is after correction for illness, social occasions and non-farm work. For the lower income 50% of the population, employment in agriculture is found in only 5 months out of 12. In the off-season for agriculture, work is performed at very low productivity and returns in various supplementary activities. The poverty of the lower income half of the population is a function of few days of work and the low productivity of the work obtained.

2.11 Habibullah's data supports Myrdal's assessment and illustrate three major points about the rural labor supply. (1) There is full employment at seasonal peaks. (2) There is potential for migration, both inter-

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1/ Hopper, W. David, "Allocational Efficiency in Traditional Indian Agriculture," Journal of Farm Economics, Vol. XLVII, No. 3, August 1965; and Mellor, John W., "The Use and Productivity of Farm Family Labor in Early Stages of Agricultural Development," Journal of Farm Economics, Vol. XLV, No. 3, August 1963.

2/ Bose, S. R., "Trend of Real Income of the Rural Poor in East Pakistan; 1949-66," Pakistan Development Review, Autumn, 1968.

3/ Habibullah, M., Pattern of Agricultural Unemployment, Bureau of Economic Research, Dacca University, 1962.

regional and urban to rural to meet seasonal peaks. (3) The seasonality of agricultural labor requirements results in relatively few days of employment per year for many members of the labor force except for very low productivity counter-seasonal jobs.

2.12 The most socially distressing form of unemployment in Bangladesh is seasonal unemployment of the laboring classes. Although difficult to document, there is probably also substantial disguised unemployment among the wealthier rural classes. This unemployment arises from social custom and economic decisions which are a product of the economic and physical environment. The existence of such disguised unemployment is important to labor policy because a change in production conditions might bring that labor on the market for additional productive effort or in displacement of existing employment of lower income persons.

2.13 In Bangladesh the land owning classes are large in number, with modest-sized holdings. Their distinguishing feature is their use of time largely in supervisory tasks much of which would not be necessary if land were held in smaller holdings not requiring hired labor. About 20% of rural families are on holdings of over 5 acres. These holdings comprise nearly 60% of the total cultivated area (Appendices 4.1 and 4.2). The owners of this land typically have a much greater income than that of the landless laboring class and on such farms hired labor typically comprises a large proportion of the total labor input. The owners of these larger farms are busy people, but largely in supervising, marketing, and non-farm activities.

2.14 As wage rates rise and as the seasonality of employment declines, the land owning classes may increase their personal labor input. Introduction of machinery is likely to increase the attractiveness of performing work directly and providing less time to supervise others. As wages rise and as mechanization occurs the benefits to the laboring class may be decreased because of shift of relatively idle richer farmers into more farm work. Similarly, labor budget data which show constant labor requirements with increased intensity and mechanization may hide a displacement of lower income hired laborers by higher income peasant operators. Thus, we must raise the question as to who obtains increases in employment, the rural peasant elite, or the rural laborers, as well as how much employment is created.

2.15 Thus, underemployed labor is likely to be of two types, each of which has certain costs incident to its utilization. In the case of the labor of the higher income land owning classes there is danger that it may be mobilized, particularly in combination with increased mechanization, and displace lower income laborers. In the case of seasonally unemployed labor it may be utilized at low marginal cost in the slack seasons, but will require more cost if it is to be used for other purposes in the peak seasons. However, the fact of seasonally full employment should not divert attention from the basic fact that laboring classes are extremely poor and work at very low productivity. The importance of increased employment is not diminished by seasonality of employment. However, its achievement is made more complex.

2.16 The economic implications of the difference between a completely redundant labor force and the actuality of seasonally full employment are, in practice, very small. It is likely that the cost of freeing a substantial quantity of the labor force is very low, even in terms of average annual incomes in Bangladesh and thus the labor supply is in economic terms quite elastic. In the case of Habibullah's case study of Sabilpur, it appears that 20% of the labor force could be released for the full year by a 40% reduction in labor requirements during a two month seasonal peak period, plus an approximate 10% reduction in a one week subsidiary peak. Experience in other parts of the world suggests that investment or reorganization to facilitate such changes occur with only small increases in real wages. Twenty percent of the 1970 rural labor force represents about 3.7 million persons, equal to nearly 4 years of net additions to the labor force. To absorb this number over 20 years would require an addition of 185 thousand jobs per year in addition to those required to absorb net additions to the labor force. Thus, it is likely to be a long time before rising labor costs due to labor scarcity impede increased production.

2.17 In this context it should be recognized that while in a situation of expanding employment opportunities it is desirable that labor be released from current agricultural jobs with small investment in reducing short seasonal peaks in labor requirements. This same situation can represent extreme hardship for the laboring classes if employment is not expanding. Mechanization of a short peak of labor requirements, by removing a small amount of employment may remove the bulk of total yearly income for a substantial group of people.

Implications

2.18 The following implications emerge:

(a) The annual growth in the Bangladesh labor force is large and, as will be seen in the next section, will be difficult to absorb through growth in employment opportunities. Since there would be creation of only 6,000,000 jobs or about over the next ten years, or about 600,000 a year in comparison to a 8,500,000 people increase in the size of the total labor force over the same period. Thus, for a long time to come, it will probably not be possible to reduce the existing aggregate level of rural employment.

(b) However, if increased labor demand is regionally centralized, and particularly if it falls largely in the agricultural sector, substantial regional imbalances between growth in labor demand and supply may occur. The extent to which such imbalance persists depends on (i) the degree of regional concentration of increased employment opportunities; (ii) the ease of migration among regions for the particular jobs available; (iii) the extent to which increased employment opportunities conflict with potentials to reduce peak labor requirements by modified cropping patterns or mechanization.

(c) Some attempt to provide a broad regional dispersion of employment-oriented development efforts should be made. However, for rural development, physical potentials may dictate some regional concentration of employment effects. It should be recognized that for the next few decades labor shortages in an intensive development area are the product of regional imbalances in labor supply demand relationships and not an overall shortage of labor. Because of the wide range of means of dealing with such imbalances and the complexity of the relationship it will be difficult to pre-plan the means of dealing with them. As a result market reaction to changes in relative inter-and intra-regional factor and product prices may be the best means of inducing the necessary adjustments.

(d) Insofar as labor saving reorganization and investment is planned, it should concentrate on seasonal peaks and have minimal spill-over into periods of seasonal slack. The danger is great that planned efforts at capital intensive mechanization will be misplaced. Because of this, preplanned mechanization in accompaniment with an agricultural intensification program should be approached with caution and as a last resort.

BANGLADESH

THE EMPLOYMENT PROBLEM

Projected Population[1/] and Labor Force[2/] by Sex, 1973-1983

Sex	1973			1978			1983		
	Total Population	Labor Force	Labor Force as % of Total [3/]	Total Population	Labor Force	Labor Force as % of Total	Total Population	Labor Force	Labor Force as % of Total
Both	75,397	22,845	30.30	86,872	27,017	31.10	99,372	31,302	31.5
Male	38,687	18,807	48.61	44,582	21,943	49.19	51,258	24,982	48.7
Female	36,710	4,038	11.00	42,290	5,074	12.00	48,614	6,320	13.0

1/ Population Projected by IBRD, Economics Department.
2/ Male labor from projected estimates for males between 15 and 64 of age. For female labor past trends in female participation in labor have been used.
3/ G. M. Farooq, "Labor Force Participation Rates in Pakistan: 1901-1961, "Pakistan Development Review, Vol. VIII, Spring 1968, No. 1.

III. THE SUPPLY OF JOBS

3.01 Rapid expansion of productive employment in Bangladesh requires vigorous policy efforts in each major employment absorption sector. These are: (1) the agricultural sector; (2) the non-agricultural sector; (3) public works programs. Each of these has a substantial potential to provide employment and requires appropriate policies if the targets are to be met. All are interelated so that failure in one will reduce potentials for success in the others.

3.02 In this report, employment targets are set for each sector at a level which appears to tax fully the capacity of the sector to provide employment while, to some extent, improving productivity. The excercise illustrates the extremes difficulty of matching labor force growth with employment growth and the need for a major concurrent effort on several fronts.

Agricultural Employment

3.03 It is clear from the data on labor productivity in traditional agriculture that any absorption of labor in that sector will be at low and diminishing if not zero returns and associated with declining per capita incomes. Fortunately, modernization of agriculture may substantially increase the absorption of labor at levels of productivity which allow rising incomes. The efficacy of such an approach to labor absorption is reinforced by the condition of the Bangladesh economy. The shortage of food in Bangladesh reinforces the need for increased production; the abundant labor supply emphasizes the desirability of labor intensive agricultural development; and, the backwardness of Bangladesh agriculture, particularly with respect to irrigation and double cropping, increases the potential for labor using modernization.

3.04 The high yielding rice varieties are highly variable in their labor requirements. At one extreme we have data from the Gumai Bil area suggesting a doubling of labor requirements in the growing of the high yielding IR-8 rice.[1/] That, however, accompanied a near tripling of yields. A more normal objective might be a roughly 60% increase in yields and an increase in labor requirements roughly half as great. Assuming that high yielding varieties are limited to rice and that rice provides 80% of the employment on a farm, then acceptance of a high yielding variety of these characteristics would increase per farm labor requirements by one-quarter. This would provide employment for several years' growth in the labor supply. The question is how quickly acreage can be transferred to such high yielding varieties. Realization of the full yield and employment potential of the high yielding varieties requires well controlled water supplies. Thus the key to rates of growth of output and employment is how rapidly the area with well controlled water supplies may be enlarged.

1/ Masud, Sharif M. and F. L. Underwood, Gumai Bil: Boro Paddy Profits and Losses: 1967-68 Season, Agricultural University, Mymensingh, F. M. Research Report No. 5, April 1970.

3.05 If we see the increased labor requirement of high yielding varieties and increased double cropping as part of an intensive irrigation package we define a massive potential within agriculture for increasing employment and production. With a shift from single cropping to double cropping, a 60% increase in yields, and 30% increase in labor use per cropped acre, as above, per acre production would increase 3.2 times and employment 2.6 times. This may be too high an employment multiplier to assume for the purpose of aggregate estimates of employment potential for a massive increase in irrigation. Local labor supply demand imbalances, choice of somewhat less intensive cropping patterns, more days of labor by landowning classes and other factors may all reduce this potential. Thus the target is arbitrarily reduced by 20%. With these assumptions, addition of 85,000 acres per year to the area intensively irrigated would absorb about 122,000 laborers or nearly one-fifth of all the current annual increment to the male labor force.1/ Addition of 250,000 acres per year would absorb nearly all the annual additions to the labor force. However, these are large acreages. Eighty five thousand acres is equal to about 0.5% of the total net rice acreage in Bangladesh. The foodgrains employment target suggested here is 243,000 laborers per year achieved by transferring 170,000 acres per year to double cropped rice cultivation. This is equal to about one percent of total net rice area. Addition of 170,000 acres per

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1/ Assumed: 19 million agricultural laborers in 1970 (Appendix 7, Assumption III); 0.5% of the labor on 0.5% of the land equals 95,000 laborers, then through intensification increase the employment level 1.6 times, equals 152,000. This assumes a level of employment per worker equivalent to the current average of about 160 man days per year. We reduce that by 20% to provide employment for 122 thousand man equivalents. Since it is presumably the seasonal peak which is reduced, this might well provide more days of employment and of income per worker than the current average. The same estimate can be derived from many different alternative sets of assumptions. For example, the employment increase here is 1.3 times, that is 1.6 reduced by 20%. If one assumed an increase in double cropping percent of 0.7, e.g., from the current average of about 144% to 245% and the other assumptions the same, without the twenty percent reduction, the employment increase would be the same. Alternatively one could assume the base employment figure 20% lower and the other assumptions as above. The assumptions we have made, make the system somewhat more sensitive to changes in the double cropping percent than in the percent yield increase. The change in double cropping percentage depends on the specific acreage irrigated. Some areas already have a high double cropping percentage. Some have a potential for triple cropping. The current national cropping intensity is about 150%. In many areas of higher elevation the cropping intensity is much lower than that prior to irrigation and then has a potential to go to much higher than a 200% cropping intensity. For example, cases in North Bengal with intensive irrigation grow five crops in two years for a cropping intensity of 250%.

170,000 acres per year would require the equivalent of about 2,800 tubewells or low-lift pumps earth with the capacity to irrigate 60 acres. The total annual additions to irrigation in Bangladesh averaged about 98,000 acres per year over the past decade, but this includes a high proportion of area only extensively irrigated and with inadequate water control for a high level of labor absorption.

3.06 It is the highly flexible, assured irrigation systems which provide the greatest long-run employment potential. These are not necessarily the ones which provide the greatest short-run employment in public works. Thus, in choosing irrigation systems for their employment impact the longer run potential for continuous steady employment through the system which is more capital intensive in construction must be compared with ones with less capital intensity in construction but which provide less potential for long-run absorption of labor in operation.

3.07 Developing a large employment potential in agriculture also assumes a well-developed infrastructure of fertilizer and other input supply, including a highly developed transport, communication and power system, educational services to cultivators and, most important, a research system designed to provide the crop varieties and practices suited to accepting the full potentials for intensification of agriculture. This too is generally lacking in Bangladesh. It is clear that once again the poor past record of development of infrastructure of transport, communications, and research systems make it difficult to provide employment in agriculture. It is particularly unlikely that the existing research system is adequate to provide the flow of suitable crop varieties and practicies needed to match the rapid increase in intensive farming suggested here. A high employment program must give particular attention to provision of a productive experiment station system in Bangladesh and the full set of supporting infrastructure elements.

3.08 Even at best a high employment program for agriculture is likely to be highly regionalized. For example, North Bengal may well give not only the best response to tubewell investment but also to rural public works built in support of a large increase in agricultural production and incomes. This could easily develop a local labor shortage which would impede further intensification of agriculture and encourage farm mechanization. The solution to such a problem of regional imbalance in labor supply and demand probably requires special efforts to spread intensive irrigation as widely as physical conditions allow, to facilitate labor migration which already is a current practice, and to search for other means to increase employment.

3.09 The target suggested for foodgrains production is a high one not only from the point of view of irrigation and production infrastructure, but also from the point of view of labor absorption. Insofar as current

periods of peak labor requirements are increased by double cropping and use of high yielding varieties, the labor absorption potential will be reduced by reorganization, capital investment or less intensive production. Substitution of labor from households of the wealthier rural people for that of the poorer rural people may further diminish employment potentials for the poor. In view of this, there is need for attention to diffusion of intensification over broad geographic areas, search for means of spreading labor requirements seasonally through choice of cropping combination, and minimizing the extent to which efforts to reduce labor requirement's seasonal peaks also reduce labor requirements at other seasons as well. In achieving this delicate balance of forces it is important to differentiate applications of power and machinery which facilitate intensification and increase labor use from those which reduce the total level of employment.

3.10 The employment targets for foodgrains production includes also an estimate for spread of high yielding varieties without additional irrigation. There is a major potential for such spread. If we assume a 30% increase in yields, 15% increase in labor requirements and transfer of about 425 thousand acres per year (about 2.5% of total net cropped area) from traditional to high yield varieties the added employment provided would be about 57 thousand persons per year or a 25% addition to the estimate for intensive irrigation. The residual supporter of the additions to the labor force not encompassed in these employment targets would be the increase on traditional acreage.

3.11 A high employment policy will also increase incomes and hence the demand for non-foodgrain agricultural commodities which in turn jointly provide a substantial potential for increasing employment. Livestock products and fruits and vegetables offer particularly important potential for increased labor use. However, the early stage of development of the Bangladesh economy poses severe difficulties in meeting this potential for expanding employment and production. The non-foodgrain commodities have more difficult input, financing and marketing problems than foodgrains and there is a small base of current production because of small demand tracing from low incomes.

3.12 In practice the employment program specified here would probably result in faster growth in demand for these income elastic commodities and hence a greater potential for increase in employment in this sector than specified. However, as is the case for modernization and intensification of the foodgrain sector, there must be considerable investment in institutions and capital if the employment and production potential is to be met. These needs range from the normal research and education functions for improving the technology of production, to special credit and marketing facilities.

Non-agricultural Employment

3.13 The rate of labor absorption in the non-agricultural sector has been particularly slow in Bangladesh. During the period 1951-61 the rate of growth of the total labor force was 3.1% per year, while the non-agricultural labor force grew at only 1.7% per year (Appendix 6). As a result of this unusual circumstance the proportion of the population in agriculture gradually increased. There is probably no clearer sign of economic retrogression than a rising proportion of the population in agriculture. If that same downward trend in the proportion of the labor force absorbed in the non-agricultural sector were to continue for the period 1970-75, then that sector would absorb less than 520,000 laborers in the five year period or less than 105,000 per year (Appendix 9, assumption III). This is only 13.5% of the annual addition of 770,000 to the male labor force.

3.14 If we take a high figure for rate of growth of non-agricultural employment of 5.5% per year (which would reduce the proportion of the population in agriculture by one percentage point in five years), then the non-agricultural sector would absorb about 190,000 persons per year between 1970 and 1975 and some 230,000 per year between 1975 and 1980.1/ For 1970-75 this is about 70% more than provided by projection of the past trend and represents absorption of 22% of the annual additions to the male labor force.

3.15 It seems unlikely that a rate of growth in non-agricultural employment of 5.5% can be achieved in the next five years without a major effort. Projections of growth in non-agricultural employment in low income countries are of course too pessimistic when based on past growth rates in the context of low employment policies. The Taiwan economy has achieved rates of growth of non-agricultural employment well above 6% in recent years. India, in the early 1960's achieved over a 5% rate of growth of non-agricultural employment and was beginning to show potential for further acceleration of that rate. However, both Taiwan and India attained these rates only after a substantial period of economic growth. As a result, a wide range of industries has been developed, and a large infrastructure of transportation, power and managerial skills had been provided. In this sense Bangladesh has not yet commenced economic development and will have initial difficulty in attaining a high rate of growth of non-agricultural employment.

3.16 A rapid rate of growth of non-agricultural employment in Bangladesh is most likely to be achieved if a favorable environment is created for production of manufactured consumer goods, such as textiles, light electronics, and plastic articles, which are in substantial demand by lower and middle income consumers. Production of such goods can be performed in small to medium scale firms, which operate with relatively low amount of capital per worker and tap widely for capital and entre-

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1/ Assumes base of 3.1 million (Appendix 9, assumption III) growth at compound rate of 5.5% and dividing the total addition by 5 gives the average annual addition for the period 1950-75; and similarly for 1975-80.

preneurship. It is here that a crucial interaction develops between employment policy in the non-agricultural sector and rapid, yield increasing technological change in foodgrains production. It is the latter which provides not only the food for a growing urban labor force and thereby provides stable wages and labor costs but also the growing demand for the industrial output which is necessary to profitable operation and high rates of expansion. The ability to productively absorb labor in the non-agricultural sector is further limited by the unusually small initial size of the non-agricultural sector. A very rapid growth rate for a small sector still makes very few jobs.

3.17 In the long run, labor absorption must occur largely in the non-agricultural sector. To prepare for that, Bangladesh must give highest priority to developing an industrial structure oriented towards export commodities and goods for domestic use which have low capital labor ratios. This requires attention to stimulating demand and providing an infrastructure of credit, communications and power and assuring adequate supplies of production inputs.

Rural Public Works

3.18 Increased intensification of agriculture through new technologies will increase returns to public works including roads, land leveling and rural electrification. According to expenditure figures on rural public works provided by Thomas[1/] and estimates of likely wage rates, the total man year equivalents employed in the public works program during its peak around 1964 would have been approximately 250,000. We assume resumption of public works of that magnitude while the capacity of the non-agricultural sector is being developed for longer run ability to absorp the bulk of growth in the labor force.

1/ Thomas, John W., Rural Public Works and East Pakistan Development, Economic Development Report No. 112, Development Advisory Service, Center for International Affairs, Harvard University, Cambridge, September, 1968. Table 7.

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BANGLADESH

LAND AND WATER RESOURCES SECTOR STUDY

VOLUME III

SECTOR ECONOMICS

TECHNICAL REPORT NO. 6

LAND TENANCY AND TAXATION

December 1, 1972

Asia Projects Department

BANGLADESH - SECTOR STUDY

VOLUME III - SECTOR ECONOMICS

TECHNICAL REPORT NO. 6

LAND TENANCY AND TAXATION[1/]

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APPENDICES

1. Size and Distribution of Farms by Tenure (68 tables)

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1/ This report was prepared by R. Zaman.

BANGLADESH - SECTOR STUDY

VOLUME III - SECTOR ECONOMICS

TECHNICAL REPORT No. 6

LAND TENANCY AND TAXATION

SUMMARY AND CONCLUSIONS

i. Agriculture, comprising 60% of the GNP, has been the predominant economic sector in Bangladesh, yet in recent years its contribution to total tax revenue has been relatively very small (around 11%). Two main factors contributed to this state of affairs. First, the existing land revenue system has been highly inefficient and antiquated and has not been geared to meet requirements for agricultural development. Second, the past land tenancy legislations failed to prevent concentration of land holdings in relatively few hands, creating widespread rural inequalities in the distribution of income. As a result, a vocal demand for economic and social justice has been growing in rural Bangladesh. It is in light of these developments that this study was made, to examine (1) some of the causes and consequences of the present land tenure system, (2) the size distribution of land and the present land revenue system, and (3) to suggest some measures for their improvement.

ii. This study proposes three major plans for reform, two based on direct redistribution of land and one based on land revenue collection. The first plan for redistribution of land calls for (a) fixing the ceiling limit of holdings to 7.5 acres per family, (b) redistribution of the expropriated land among farms with average holdings below 2.5 acres at approximate market prices, but through subsidized credit, and (c) utilization of the sale proceeds of expropriated land to operate a Public Works Program which would help the landless and displaced laborers. It may be argued, however, that this plan could not be implemented as it involves too many farmers whose interests would be at stake and thus, they would take every recourse to evade the reform.

iii. The second plan for redistribution of land calls for (1) fixing the ceiling limit of holdings to 12.5 acres per family, (2) redistribution of the expropriated land among farms with average holdings below 2.5 acres at prices lower than the market values, (3) in addition to redistribution, imposition of progressive rates of land revenues for farm sizes over 1.00 or 2.50 acres, (4) use of sale proceeds of expropriated land in operating a Public Works Program which would help the landless and displaced laborers, and (5) utilization of additional revenues resulting from progressive taxation in providing concessional credit facilities to small farmers for purchases of modern inputs.

iv. As an alternative to direct land redistribution a progressive land tax measure has been proposed which is likely to discourage large land holdings and thus, will indirectly reduce inequalities in the possession of land. The plan will increase many fold the total net revenue from its present level and thus, will enable the state to operate a sizeable Public Works Program, and to increase investment in long term agricultural development projects without any concommitant reduction in investment in other sectors.

v. Because agriculture is the predominant sector of the Bangladesh economy, any significant improvement in the overall economy will be determined by the success of the State in generating more resources from that sector. In achieving this objective, the State will have to enforce, sooner or later, some land redistribution policies and major reform in the land revenue system similar to the one suggested in this study.

BANGLADESH - SECTOR STUDY

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TECHNICAL REPORT No. 6

LAND TENANCY AND TAXATION

I. INTRODUCTION

1.01 Ever since the British East India Company became the master of Bengal (now Bangladesh and West Bengal State in India) in 1756, problems related to land reforms and revenue collection have been the most vexing issue to the administrators there. The Permanent Settlement of 1793 introduced by Lord Cornwallis 1/ aimed at simplifying the revenue administration by making the zamindars (landlords) responsible for revenue collection. The "Haptam" regulation of 1799 which gave the zamindars wide and arbitrary powers over the tenants soon created general unrest and riots in Bengal and ultimately forced the British to enact the Rent Act of 1859 and the Tenancy Act of 1885 to define the occupancy rights of tenants. The latter act was amended in 1928 and then again in 1938. None of these acts which aimed at defining the rights of the tenants vis-a-vis the zamindars and the powers and obligations of the zamindars regarding revenue collection and payments to state, proved to be satisfactory to the British Government. Consequently, the British Parliament sent a commission in 1940, known as the Bengal Land Revenue Commission of 1940 or simply the Floud Commission, named after Sir Francis Floud, Chairman of the Commission, to recommend measures for improvement and modifications of the then land revenue system and to consider seriously the proposal for abolishing the zamindari system in its entirety. The Floud Commission recommended the abolition of the Permanent Settlement and visualized a new direction for revenue collection in Bengal by suggesting that "the policy should be to aim at bringing the actual cultivators into the position of tenants holding directly under government." 2/ The Floud Commission was followed by the Bengal Administrative Enquiry Committee, 1944-45 (or known as the Rowlands Committee, named after Sir Archibald Rowlands, Chairman) but their recommendations as well as those by the Floud Commission were not implemented until the subcontinent achieved its independence from the British in 1947, and Pakistan and India were established.

1/ For details, see Bengal, Agriculture and Industries Department, "Report of the Land Revenue Commission," Bengal, (Floud Commission), Alipore: 1940; see also Asian Studies Center, Occasional Paper No. 2, Michigan State University, August, 1966.

2/ See Report of the Land Revenue Commission, Bengal, op. cit., p. 42.

1.02 The East Bengal State Acquisition and Tenancy Act of 1951 abolished the zamindari system and the state acquired all rent receiving interests down to the cultivator of the soil. The cultivators were confirmed as proprietors and were liable to pay revenues directly to the vernment. The cultivators were prohibited from creating further rent receivers. However, not until April 1956 was any satisfactory measure taken to implement the act. 1/ The present land tenancy system in Bangladesh owes its origin to the East Bengal State Acquisition and Tenancy Act referred to above and to its subsequent amendments suggested by the Land Revenue Commission of 1958. 2/ The ceiling limit for possession of land was fixed at 125 acres in 1961 and "the limits of subsistence and economic holdings were fixed at 3 and 8 acres respectively and their partition forbidden." 3/ The latter provision, however, was dropped in 1964.

1.03 Fragmentation of holdings has been considered a serious problem in Bangladesh and as such, prevention of it was one of the important objectives of the Tenancy Act of 1950 and the subsequent amendments suggested by the Land Revenue Commission. The data presented in the tables in this study show that the land reforms of the past were not successful in achieving this goal. Similarly, every land reform legislation in the past had provisions for improving or modernizing the revenue administration for efficiency, yet hardly any appreciable changes were noticed in collecting land revenue with relatively lower costs. In recent years, increasing proportions of land revenue collected were being used by the Revenue Department for meeting its expenses (from about 42% in 1961-62 to 57% in 1968-69), while the importance of land revenue in the total revenue receipts continued to decline (from about 23% in 1961-62 to 10% in 1968-69). 4/ As late as July 1970, attention of the state was drawn to this issue by an Advisory Panel of Economists for the Fourth Five Year Plan (1970-75).

> "The problem of taxing agricultural incomes needs special attention. In order to increase the marginal rate of saving in a developing country through taxation, appropriate ways must be found to siphon off a substantial portion of additional income in the agriculture sector pari passu with the growth of this sector. This is unavoidable in view of the large quantitative weight of the agricultural sector in the total national product. The Planning Commission has shown appropriate awareness of this problem, but has not given specific proposals to meet it. The problem is particularly complex because it calls for a major politico-economic decision as to the desirable extent

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1/ See Government of Pakistan, Planning Commission, The Second Five Year Plan (1960-65), June 1960, including revised estimates, November 1961, p. 189.

2/ Ibid., p. 189.

3/ See Government of Pakistan, Planning Commission, The Third Five Year Plan (1965-70), May 1965, p. 425.

4/ Estimated from data presented in Government of East Pakistan, Planning Department, Economic Survey of East Pakistan, 1969-70 and from Central Statistical Office, sources.

> of restraining consumption in the agricultural sector, and involves furthermore, an examination of the whole institutional set-up in agriculture, for example, the nature of the land tenure system, the size of holdings, the nature of financial institutions and so on..." 1/

1.04 The emergence of East Pakistan as the independent nation of Bangladesh in December 1971 gave an impetus to the popular demand in the country for an effective land reform policy and for improvement in land revenue collection and administration. This was the result of the 1970 election of the Awami League which won on a political manifesto which contained, among other things, a promise for reforms in land tenancy and agricultural taxation. In light of new developments in Bangladesh, detailed examination of the present system of land tenancy, and the size and structure of land holdings becomes more meaningful as useful guidelines for reform may emerge in such an analysis.

II. PRESENT SIZE AND DISTRIBUTION OF FARMS BY TENANCY - SOME IMPLICATIONS

2.01 Farms in Bangladesh can be classified into three major groups, the most important being the owner-operated farms where farmers have proprietary rights of the land they cultivate. For the country as a whole, this group represents 54% of the total land area and 61% of the total farms (see Appendix 1, Table 1). The next most important group consists of farms where the farmers own part of their cultivated land and rent the rest on a sharecropping basis. This group is generally referred to as the owner cum sharecropped farms or simply owner-sharecropped farms. The land area under their command (including rented land) represents 45% of the total cultivated area and 38% of the total farms. However, if one separates the land area they rent under sharecropping (16% of total cultivated area) from the area under their command, one finds that 83% of the total cultivated land in Bangladesh is owned by the farm operators (54% under owner-operated farms and 29% under owner-sharecropped farms). Pure tenants represent only 2% of all farms and 1% of total farm area. When the country is divided into four regions or divisions and each region divided into smaller administrative units called districts, one can find considerable variations in the number and area of farms under the first two important tenancy systems (see Appendix 1, Table 2 through 22 and Summary, Table I). Land area under owner-operated farms as a percentage of total farms varies from a low of 37% in Rajshahi District to a high of 95% in Chittagong Hill Tracts. Sharecropped area varies from 1% of total farm area in Chittagong Hill Tracts to 24% of total farm area in Dinajpur District. The number of pure tenants and farm areas under them are more or less uniformly small and do not show

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1/ Government of Pakistan, Planning Commission, The Reports of the Advisory Panels for the Fourth Five Year Plan 1970-75, Volume 1, July 1970; East Pakistan's Economists Report, pp. 52 and 53.

much variation from district to district, the only exception being Dinajpur District where pure tenants represent 8% of total farms and 5% of total farm area.

2.02 The average size of a farm in Bangladesh is about 3.53 acres, varying from an average of 1.84 acres in Comilla District to 5.80 acres in Kushtia District (see Appendix 1, Table 67 and Summary, Table II). In general, the districts in northwestern Bangladesh have a higher average size of farm, probably because these districts are relatively sparsely populated and the soil is relatively sandier, requiring larger tracts of land to produce a given quantity of food. Because of the sandy nature of the soil, double cropping is almost impossible without irrigation facilities. The data in Appendix 1, Table 67 show that there is hardly any significant variation in average farm sizes under specific size categories up to 25 acres in the different regions and districts of Bangladesh. Average farm size in size category of 25 acres and above varies from 31.60 acres in Chittagong Hill Tracts to 138.36 acres in Chittagong District, the latter figure exceeding the ceiling limit of 125 acres enacted by the state in 1961. Regionally, Chittagong Division has the smallest average size of farm and relatively larger inequalities in the distribution of land holdings (see Appendix 1, Table 67 and 68, also Summary, Table II).

2.03 Some of the characteristics of the present land distribution system shown in Appendix 1, Tables 1 through 22 and in Tables 67 and 68 are summarized in Summary Tables I and II and presented below for recapitulation:

(i) Approximately 24.3% of all farms are under 1 acre size holding, commanding only 3.2% of all farm land;

(ii) Approximately 51.6% of all farms are under 2.5 acres, commanding only 16.3% of all farm land, i.e., more than half of all the farms in Bangladesh are below "subsistence" holdings of 3 acres as defined by the Land Revenue Commission of 1958; 1/

(iii) Farms with holdings between 2.50 and 7.50 acres comprise 37.7% of the total farms, commanding 45.7% of all farm land;

(iv) Farms with holdings between 7.50 acres and 12.49 acres represent 7.2% of all farms and command 19.1% of all farm land. Farms with holdings over 12.50 acres represent 3.5% of all farms and command 18.9% of farm land. Thus, 10.7% of farms (4 + 5) commanded over 38% of farm land. The crux of the problem lies not in what percentages of farms are under what size distributions, but what size farms command what proportion of total farm land in Bangladesh. Any move towards achieving rural income

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1/ See footnote 3.

Summary, Table I

Bangladesh: Some Principal Indicators About Land Tenancy System

Indicators	Owner-Operated Farms	Owner-Sharecropped Farms			Tenants
		Total	Land Owned	Land Sharecropped	
Percent of total land area	54	45	29	16	1
Percent of total number of farms	61	38	- [a]	- [a]	2
Regional percentage variations in land area (minimum to maximum)	37-95	4-62	4-40	1-24	0-5

[a] Percent of farms is the same as total for owner-sharecropped farms.

Source: Estimated from Table 1 through 22.

Summary, Table II

Bangladesh: Some Average Characteristics of Farm Sizes[1]

Characteristics	Bangladesh	Chittagong Division	Dacca Division	Khulna Division	Rajshahi Division
1. Average size of farms (in acres)	3.53	2.61	3.25	4.08	4.45
2. Percent of farms under 2.50 acres	51.6 (16.3)	68.2 (25.9)	53.3 (19.1)	44.0 (11.8)	37.9 (10.9)
3. Percent of farms between 2.50 and 7.50 acres	37.7 (45.7)	25.7 (40.8)	37.9 (49.2)	42.0 (45.6)	46.8 (45.9)
4. Percent of farms between 7.50 and 12.49 acres	7.2 (19.1)	4.0 (14.5)	6.1 (17.6)	9.5 (21.8)	10.1 (21.4)
5. Percent of farms over 12.50 acres	3.5 (18.9)	2.1 (18.9)	2.6 (14.1)	4.6 (20.8)	5.2 (21.7)

[1] Figures in parenthesis refer to percentages of land area under the command of respective farm size categories.

Source: Estimated from Table 67 and 68.

equalities will meet with failure unless this disparity is removed either through land reform which calls for redistribution of land from the large to the small farms, or through a progressive land taxation policy, or a combination of both;

(v) All categories of farms, whether small, medium or large, either give or rent land on a sharecropping basis. The system does not appear to be confined to any particular region.

III. SHARECROPPING AND OWNER-FARMING IN BANGLADESH - A COMPARATIVE REVIEW

3.01 In an attempt to analyze the causes of the widespread practice of sharecropping in Bangladesh and to examine the relative efficiencies of sharecroppers and owner-operators, this author conducted a farm survey in 1970-71 in three areas of Bangladesh, namely Phulpur Thana in Mymensingh District, Thakurgaon Tubewell Project area in Dinajpur District and in the Dacca-Narayanganj-Demra Project area. Each survey area included irrigated farms where new varieties of rice and modernization practices were introduced and farms with no irrigation water where traditional farming techniques were in use. The findings of that survey have been presented elsewhere. 1/ Here, only some of the relevant results will be reproduced.

3.02 The results of the survey show that although the size of families is not significantly different between owner-cultivators and sharecroppers (i.e., owner-sharecropped farms according to our definition in this study), in the survey areas, the size of land holdings owned by them is considerably different. Sharecroppers own approximately half the quantity of land owned by owner-cultivators with approximately the same size of families. As a result, the sharecroppers rented land to make an efficient use of their surplus labor (alternative rural employment opportunities being very limited and uncertain) and their fixed resources such as draft animals, and farm equipment. Some of the land owners rented their land by means of sharecropping because, due to capital rationing and managerial bottlenecks, they could not cultivate their land as intensively as was potentially profitable. Moreover, since the cropping pattern has been relatively fixed and so also the factor proportions, the landowners had an incentive to shift uncertainty to sharecroppers by leasing land to them as the sharecroppers were presumably unable to reduce the marginal product of land to any appreciable extent by varying the amounts of other inputs. In such a situation, there existed an incentive to lease land on a sharecropping basis which was profitable to both parties. The system of sharecropping provides enough flexibility in the rural communities to ensure that those who cannot properly utilize their land for cultivation can always rent to fellow farmers.

1/ M. Raquibuz Zaman, "Sharecropping and Economic Efficiency in Bangladesh," a forthcoming publication of the Bangladesh Institute of Development Economics.

3.03 Sharecropping was found to be an acceptable institution in the rural areas, but problems existed in the survey areas, as well as in Comilla Project area, where data were also collected, concerning the proportion of crop sharing between the sharecroppers and the landowners. In areas where there was tremendous pressure on land, the landowners exacted more than 50% of the crop without contributing anything to meet costs of production. In general, the sharecropping lease in practice was of the traditional type, i.e., 50-50 share of crops between the two parties and no sharing of costs by the landowners. A new relationship between the landowners and sharecroppers with respect to cost sharing has been emerging with the introduction of irrigation and High Yielding Varieties (HYV) of rice and other crops. Landowners have begun to share costs of purchased inputs in the irrigated areas (and to some extent in unirrigated areas, see Appendix 2, Tables 2 and 4) of Phulpur, Thakurgaon, DND and Comilla Project Areas (see Appendix 2, Tables 7 and 8). If costs are shared between the owners and sharecroppers in the same proportion as revenue, then there should be no disincentive from the sharecropping system. Methods of land rental collection by landowners varied from place to place. Where the sharecropper farmed the land of an absentee landowner, the sharecropper husked the paddy in his courtyard and carried the rental, often less than the correct amount, to the landowner's residence. Where the landowners were also practising farming in the village, the rental share was either divided in the field before harvest, or the entire yield was taken to the landowner's house for husking and from there, the sharecropper picked up his portion of the crops. Sharecroppers operating lands of nonfarmers in the village generally paid rental after husking and weighing the paddy at their homes. Considerable scope existed in the latter case as well as in the first to cheat landowners and pay less than the agreed-upon rental. It is interesting to note that some sharecroppers admitted, although reluctantly, that they often commit "mistakes" in paying the agreed-upon shares to landowners.

3.04 With respect to relative efficiencies of production of sharecroppers and owner-operators, no clear picture emerged from the survey data, although in general, yield per acre was slightly higher on the owner-operated land. This is probably because owner-operated lands were generally of better quality as farmers did not rent their best land to others. Yet in both the irrigated and unirrigated areas of Thakurgaon, yield per acre of some crops (see Appendix 2, Tables 5 and 6) in the sharecropped farms were found to be higher, probably due to surplus family laborers of the sharecroppers who consequently, could provide better care for the rented land.

3.05 The institution of sharecropping has not hindred the modernization of farm practices or the introduction of purchased inputs in the irrigated areas. It, however, affects the ability of farmers to use modern inputs adequately as it denies them an access to institutionalized credit facilities. This is also true for pure tenant farmers who have no access

Summary, Table III

Bangladesh: Owner-Sharecropped Farms - Some Average Characteristics

	Bangladesh	Chittagong Division	Dacca Division	Khulna Division	Rajshahi Division
1. Average land area owned	2.73	2.21	2.57	3.27	2.81
2. Average land area rented on sharecropping	1.53	1.01	1.16	1.98	1.90
3. Farm Sizes Below 2.50 Acres					
a) Average land area owned	0.87	0.92	0.92	0.86	0.72
b) Average land rented	0.63	0.40	0.59	0.77	0.87
Subtotal	1.50	1.31	1.51	1.63	1.59
	(42)	(31)	(39)	(47)	(55)
4. Farm Sizes Between 2.50 and 7.50 Acres					
a) Average land area owned	2.63	2.77	2.81	2.67	2.57
b) Average land rented	1.68	1.36	1.39	1.84	1.96
Subtotal	4.31	4.13	4.20	4.51	4.53
	(39)	(33)	(33)	(41)	(43)
5. Farm Sizes Between 7.50 and 12.49 Acres					
a) Average land area owned	6.41	6.27	7.04	6.16	6.16
b) Average land rented	2.97	3.00	2.22	3.19	3.22
Subtotal	9.38	9.27	9.26	9.35	9.38
	(32)	(32)	(24)	(34)	(34)
5. Farm Sizes Over 12.50 Acres					
a) Average land area owned	13.37	13.40	14.60	12.75	13.39
b) Average land rented	4.64	4.90	3.20	5.54	4.42
Subtotal	18.01	18.30	17.80	18.29	17.81
	(26)	(27)	(18)	(30)	(25)

Note: Figures in parenthesis refer to land area rented as percentage of total area farmed. Notice these percentages do not vary much between size groups for any particular division.

Source: Estimated from Tables 1 through 5.

to credit institutions. 1/ Credit institutions offer loans to farmers against their land as security. As the sharecropper does not own the sharecropped land, he has no acceptable assets to offer as collateral. In cases where there is a good cooperation between the landowner and the sharecropper and where the landowner himself is a practising farmer in the village, the latter can take the credit facilities against his land from the banks or cooperative societies and share these (credits are generally in kind, e.g., fertilizer, seed, etc.) with his tenants. However, this is not widely practised as yet.

3.06 One of the conclusions that emerged from the survey results was that giving proprietary rights to sharecroppers (for that matter to pure tenants) would not solve the problem of rural equity as it involves all size categories of farmers who either rent land or give land on a share-cropping basis (see Summary, Table IV). Secondly, although granting proprietary rights to sharecroppers would mean that they would have access to institutionalized credit facilities, it would be preferable to reform the credit institutions themselves in a way in which they are able to provide credits to sharecroppers and tenants. For example, the credit institutions may be asked to provide loans to such farmers against crops in rented land as securities, while the state provides some sort of crop insurance facilities to them. The persistence of the institution of share-cropping and tenancy will help to maintain the present flexibility of land use in the rural areas and thereby ensure fuller utilization of land (although not necessarily better utilization).

IV. REDISTRIBUTION OF LAND - SOME IMPLICATIONS

4.01 It was pointed out earlier that only 10.7% of farms operated over 38% of land in Bangladesh and approximately 51.6% of the total farms cultivated only 16.3% of the total farm land. In the first group of farms each owned land holdings over 7.50 acres while the latter group consisted of farms below 2.50 acres. One can build a case for redistribution of land from the first group of farmers to the latter one, both on economic and social grounds. Similarly, a case for redistribution of land from farm sizes above 12.50 acres to the farm sizes below 2.50 acres can also be argued on socio-economic grounds. It may be pointed out here that only 3.5% of all farms fall in the holding size category of above 12.50 acres but command 18.9% of farm land. Which of these two alternative policies would be more desirable for Bangladesh would depend on their relative merits and demerits, and the extent to which either of these can be successfully implemented.

1/ Unlike sharecroppers, the pure tenants rent land on a per acre fixed cash basis and as such, do not have any disincentive problems. Any quantity produced in excess of what is needed to pay the rent belongs to them whereas in the case of sharecroppers, no matter what is produced, 50% or so is given to landowners. See Bishop and Toussaint, Introduction to Agricultural Economic Analysis, John Wiley and Sons, Inc., New York, 1966 for an excellent review of different types of tenancy systems and the relative incentives or disincentives they provide to farmers.

4.02 The total number of farms with holding sizes over 7.50 acres is 656 thousand and the land area that can be expropriated from them approximately 3.3 million acres (their total holding being 8.3 million acres). The main argument for expropriating land from this group of farms is that a holding of 7.50 acres provides a decent income for a relatively large family, while a holding size below 2.50 acres does not even provide a subsistence income to an average size family in Bangladesh. 1/ Justice therefore, demands that land should be redistributed from those with holding sizes over 7.50 acres to those below 2.50 acres. This can be looked at as a wealth tax for farms over 7.50 acres, the rate of wealth tax would vary according to the amount of excess land over 7.50 acres. For example, if a farmer owned 10 acres, then expropriation of 2.50 acres would represent a 25% tax on his wealth. Suppose, for a moment, that a land redistribution of this sort can be implemented. If so, the effects of this will be: (1) to raise the average per farm holding of farms below 2.50 acres from the present level of 1.11 acres to 2.17 acres (see Appendix 1, Tables 67 and 68; for regional and district level variations see Appendix 1, Tables 23 through 44). Thus, the aggregate farm income of these people will be increased considerably; (2) it will increase the demand for basic consumer goods since their propensity to consume incremental income will be relatively high. 2/ This in turn will encourage the growth of the domestic industries; 3/ (3) displacement of large holdings does not necessarily reduce investments in the economy to an extent that it offsets the gains from the increased consumption effects on the economy generated indirectly by redistribution of land. This is because it is believed that the large farms very often either indulge in conspicuous consumption and speculation in the market for land or in hoarding. It is more likely that redistribution will cause a change in their consumption pattern, result in less hoarding and increase their consumption of desirable goods, (4) it will displace some of the 646 thousand permanent hired laborers employed by the large farms, 4/ depriving their assured source of income. A sizeable number of these displaced laborers might possibly get employment from the small farms whose need for labor would increase after redistribution of land. It is quite likely, however, that during the seasonal peaks all of the displaced laborers would have employment. A redistribution policy which only gives additional land to farms below 2.50 acres and does not make any provision for landless laborers

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1/ This is based on considered judgements of different groups of people in Bangladesh. The Third Five Year Plan of Pakistan mentions some such land holdings as economic and subsistence holdings.

2/ See Nurul Islam, Studies in Consumer Demand, Oxford University Press, Vol. 1 and 2, 1965 and 1966.

3/ See John W. Mellor and Uma J. Lele, "Growth Linkages of the New Foodgrain Technologies," Cornell University-USAID Income Distribution Research Project, Occasional Paper No. 50, Cornell University, Ithaca, New York, December 1971.

4/ Data obtained from the Census of Agriculture. See sources of data in Appendix 1, Table 1 for full reference.

and those laborers who are likely to lose employment, at least for a part of the year, cannot achieve its economic justice objective. Therefore, the redistribution policy has to be carried out in conjunction with other related policies.

4.03 The state should not distribute the land among small farms as free gifts. It should, instead, sell the expropriated land among small farms through some market mechanism and use the sale proceeds to create employment opportunities for the landless laborers. To accomplish this, the state must place the land on the market, at a price somewhat lower than the market price, to sell to farmers whose size holdings fall below 2.50 acres with a provision that each farmer's total owned land should not exceed the ceiling of 2.50 acres. It is assumed here that 2.50 acres are enough to ensure a subsistence living for a farm family. The money for buying the expropriated land should be financed through the national cooperative societies who would extend loans to these farmers at concessional rates payable in instalments extended over time. Assuming that the average price of an acre of land is about Tks 1,560, the state can accumulate a gross revenue of Tks 5,148 million from the sale proceeds of the expropriated land which would be paid to the state in six equal instalments of Tks 260 per acre, the amount of each payment being equivalent to yearly gross rental value of an acre, and the money thus received (Tks 850 million) can be utilized to finance a Public Works Program to help the rural poor 1/ (mainly landless laborers, some of whom might have lost jobs because of redistribution of land).

4.04 With respect to feasibility of implementation, a land redistribution policy which calls for expropriation of land 2/ from holding sizes above 12.50 acres seems more appropriate than the one discussed above. It includes only a few rich farmers in each village, totalling 214,000 farms in the entire country. Since they previously controlled the village power structure during the long Pakistani rule, they have fallen into disfavour, both with the state and with the general public. Any attempt to expropriate their land above 12.50 acre holdings will be welcomed by the villagers, and they would help to ensure that the rich farmers could not evade the plan. It should be pointed out here that the redistribution plan should be carried out through the village Panchayets with frequent supervision from the state.

4.05 The above alternative plan calls for expropriating 1.4 million acres for redistribution among the small farms raising their average holding size from 1.11 acres to 1.57 acres (again for regional and district

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1/ In 1963-64, when the Public Works Program reached its peak in former East Pakistan, the amount spent on the Program was Rs 200 million. Thus, the sale proceeds from the expropriated land can be used to financed such a Public Works Program for a few years while in the process the economy would grow and absorb the displaced and landless laborers in other sectors.

2/ See page 14 where it is compared to wealth tax.

level variations, see Appendix 1, Tables 45 through 66). The sale proceeds of this land will yield to the state Tks 2,184 million (at the rate of Tks 1,560 an acre) over a period of six years or a yearly sum of 364 million (at Tks 260 per acre, equivalent to yearly gross rental value). This should then be utilized to operate a large Public Works Program to help the landless laborers and some of the 352 thousand laborers employed by rich farmers who will be displaced because of redistribution of land. The economic gains to small farms will not be significant unless accompanied by some reform in agricultural taxation of land revenue. Reforms in agricultural taxation will enable the state to generate additional revenue which can be used to provide concessional credit facilities to the small farms while at the same time, transfer resources from the relatively richer farms (farms with holding sizes immediately below 12.50 acres) which are not affected by land redistribution. The state can achieve this by levying progressive rates of land revenue for larger farm sizes. It may, for example, abolish land revenue for farm sizes either below 1.0 acre or 2.50 acres and then fix land revenue rates at graduated scales for larger farm sizes in the following manner (see Summary Table IV). If the state decides to tax all farm sizes above 1 acre, the total yearly gross revenue would be Tks 512.4 million (about 3.4 times the present gross revenue). Alternatively, if it abolishes revenue for farm sizes below 2.50 acres, the total gross revenue would be Tks 476.4 million. The yearly additional gross revenue from these two alternative plans would be 362.4 million and Tks 326.4 million respectively. Either of the additional amounts can be used to help the poor farms to increase their aggregate income and thereby the aggregate income of the economy, while the sale proceeds of expropriated land can be used to create jobs and income for the landless laborers in the rural areas.

V. LAND REFORM THROUGH CHANGES IN AGRICULTURAL TAXATION POLICIES

5.01 The present land revenue system does not take into consideration the size of farm or quality of farm land in estimating land revenue payable per acre. The revenue is in terms of a fixed rate per acre and has not been periodically revised upwards in conformity with the rising trend in agricultural prices.

5.02 Although agriculture has been contributing about 60% to the GNP, the contribution of land revenue (which is the only direct tax on agriculture) to total revenue receipts has been approximately 11%. With the increasing investments in irrigation, better seeds and fertilizer, rural electrification and soil conservation, the need for much enhanced contribution from the agriculture sector through land revenue or some other such tax will be felt. 1/ Yet over the years, net land revenue (gross revenue--

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1/ For an excellent set of arguments in favor of raising land revenue in India, see T. M. Joshi, N. Anjandiah and S. V. Bhende, Studies in the Taxation of Agricultural Land and Income in India, Asia Publishing House, London, 1968, Chapter 7.

Summary, Table IV

Implications of Redistribution of Land Over
12.50 Acres in Conjunction with Progressive Rates
of Land Revenue on the Gross Revenue Earnings of the State

Source of Revenue	Rate/Acre (takas)	Total (million takas)
Sale proceeds of expropriated land (total)	1560.00	2184.00
1. Yearly total instalments by the buyers of new land	260.00	364.00
2. Total revenue from farm sizes between 1.0 and 2.49 acres	5.20 (2.0)	36.00
3. Total revenue from farm sizes between 2.50 and 4.99 acres	15.08 (5.8)	101.00
4. Total revenue from farm sizes between 5.00 and 7.49 acres	30.16 (11.6)	125.80
5. Total revenue from farm sizes between 7.50 and 12.50 acres	59.80 (23.0)	249.60
Subtotal 1 (excluding items 1 and 2)		476.40
Subtotal 2 (excluding item 1)		512.40
Total/Year		876.40

Note: Numbers placed in parenthesis are the percent of gross rental per acre.

Source: For estimation procedures, see text.

cost of collection) has increased only very slightly. 1/

5.03 One way to redress the poor performance of agriculture in development finance through land revenue or taxation is to fix land revenue at progressive rates so that it can also work as a proxy for agricultural income tax. If the proposed redistribution of land through a land reform (i.e., the plan related to sizes above 12.50 acres) is not carried out, then a progressive land revenue system should take its place. The state, in such a case, could abolish land revenue for farm sizes either below 1 acre or below 2.50 acres. Such an act would reduce gross revenue by 13 and 16.3% respectively depending on what is acted upon, as land areas under such holdings represent those percentages of total. Assuming that cost of collection of revenue per farm is the same in a region irrespective of farm size (i.e., there is no connection between defaults and farm size) it can be argued that cost of collection will be reduced by 27.3 and 51.6% respectively by this reform and thus, will yield a much larger net land revenue than is collected now. 2/ Second, the state could increase the per acre land revenue of farm sizes over 2.50 acres at progressive rates from that of the present fixed flat rate. Periodically, (say every five years), the state could estimate the approximate average gross income per acre (alternatively, yearly rental which is normally half of gross income) for some representative areas and determine for a period not exceeding five years (i.e., a normal economic plan period) land revenue rates for different farm sizes in the manner shown in Table V.

5.04 These rates are considerably higher than what the farmers now pay as land revenue, yet they are significantly lower than the rate of taxes urban dwellers of similar income categories pay. This proposed plan for reform in land revenue has the following effects. First, it enhances total land revenue to a great extent from a present level of over Tks 150 million to Tks 964.4 million (see Summary Table V) while reducing the cost of collection of revenue significantly. Second, it discourages acquiring large land holdings by farms as the rate of taxation increases with rise in sizes and thus, indirectly leads towards reduced inequalities in the form of possession of land. In this way, it can partly accomplish a major aim of any land reform legislation. Third, bringing larger revenues from the agriculture sector enables the state to operate a sizeable Public Works Program and to increase investment in long term agricultural development projects without any concommitant reduction in investments in other sectors. If the state delegates power of collection of land revenue to the local Panchayet councils who are used for collection of local taxes and maintainance of land records, assuming only supervisory and auditing roles, it can further reduce the cost of collection and minimize tax default rates. Moreover, the success in implementing this plan will be greatly

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1/ See Government of East Pakistan, Department of Finance, Budgets of the Government of East Pakistan, various years, quoted in Pakistan Economic Survey, 1969-70.

2/ At present, no data are available on cost of collection of land revenue by farm sizes and as such, the estimates presented above are to be used only as approximations.

Summary, Table V

Bangladesh: Land Revenue Rates and Receipts
by Farm Sizes Under the Proposed Plan for Reform

Source of Revenue	Rate/Acre (takas)	Total (million takas)
1. Farm sizes between 1.00 and 2.49 acres	5.20 (2.0)	14.60
2. Farm sizes between 2.50 and 4.99 acres	15.00 (5.8)	101.00
3. Farm sizes between 5.00 and 7.49 acres	30.00 (11.6)	125.80
4. Farm sizes between 7.50 and 12.49 acres	60.00 (23.0)	249.60
5. Farm sizes between 12.50 and 24.99 acres	100.00 (38.4)	306.60
6. Farm sizes over 25.00 acres	160.00 (61.6)	166.80
Total Gross Revenue		964.40

Note: Numbers placed in parenthesis are percent of gross rental per acre.

Source: Acreage under each farm size is estimated from the Agricultural Census data. For estimation procedure of the revenue receipts, see text.

facilitated if the state channels its development expenditures related to agriculture through the Panchayets as this will enable the farmers to judge for themselves how their tax money is utilized for their own long term benefits. The additional land revenue earned by the state under the new plan can also be utilized to provide special facilities to small farms, to sharecroppers and to tenants. The money can be used for either giving concessional credits for purchased inputs such as better seeds, fertilizer and insecticides or can be used for subsidizing any of these or other inputs to such farms and to provide some insurance facilities for their crops.

5.05 Because agriculture is the predominant sector of the Bangladesh economy, any significant improvement in the overall economy will be determined by the success of the state in generating more resources from that sector. In Achieving this objective, the state will have to enforce, sooner or later, some land redistribution policies and a major reform in the land revenue system similar to the one suggested in this study.

BANGLADESH

SIZE AND DISTRIBUTION OF FARMS BY TENURE

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	Size of Farms in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-Total	2.50 - 4.99	5.00 - 7.49	Sub-Total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-Total
Total Area	21,726	704	2,826	3,530	5,735	4,193	9,928	4,159	3,066	1,043	8,268
Total No. of Farms	6,139	1,492	1,677	3,169	1,615	698	2,313	442	188	26	656
Owner Operated Farms (O)											
a. total area	11,654	568	1,664	2,232	2,656	1,983	4,639	2,197	1,832	756	4,783
b. total no. of farms	3,731	1,271	1,015	2,286	754	330	1,084	233	111	18	362
c. O area as % of total	54	81	59	63	46	47	47	53	60	72	58
d. no. of O farms as % of total	61	85	61	72	47	47	47	53	59	69	55
e. size per farm (acres)	3.12	0.45	1.64	0.98	3.52	6.01	4.28	9.43	16.50	41.89	13.21
Owner-Sharecropped Farms (OS)											
a. total area	9,830	123	1,106	1,229	2,982	2,166	5,148	1,940	1,226	287	3,453
b. total no. of farms	2,308	194	628	822	833	361	1,194	207	76	8	291
c. land owned	6,303	71	642	713	1,773	1,368	3,141	1,326	905	218	2,449
d. land sharecropped	3,527	52	464	516	1,209	798	2,007	614	321	69	1,004
e. land owned per farm	2.73	0.37	1.02	0.87	2.13	3.79	2.63	6.41	11.91	27.25	8.42
f. land sharecropped/farm	1.53	0.27	0.74	0.63	1.45	2.21	1.68	2.97	4.22	8.63	3.45
g. S land as % of OS land	36	42	42	42	41	37	39	32	26	24	29
h. S land as % of total	16	8	16	15	21	19	20	14	11	7	13
i. OS land as % of total	45	17	39	35	52	52	52	46	39	27	41
j. OS farms as % of total farms	38	13	37	26	52	52	52	47	40	31	44
Tenant Farms (T)											
a. total area	242	13	56	69	97	44	141	22	8	2	32
b. total no. of farms	100	27	34	61	28	8	36	2	1	-	3
c. T area as % of total	1	2	2	2	2	1	1	1	1	1	1
d. T farms as % of total farms	2	2	2	2	2	1	1	-	-	-	-
e. size per farm (acres)	2.42	0.48	1.65	1.13	3.46	5.50	3.92	11.00	8.00	-	10.67

Note: - means less than one thousand or insignificant

Source: Data estimated from Government of Pakistan, Ministry of Food and Agriculture, Agricultural Census Organization, 1960 Pakistan Census of Agriculture, Vol. 1, Final Report - East Pakistan, October 1962, Tables 5 and 9.

APPENDIX 1
Table 1

NORTHWEST BANGLADESH (RAJSHAHI DIVISION):
SIZE AND DISTRIBUTION OF FARMS BY TENURE
('000)

	Size of Farms in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-Total	2.50 - 4.99	5.00 - 7.49	Sub-Total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-Total
Total Area	6,692	99	633	732	1,690	1,382	3,072	1,435	1,113	339	2,887
Total No. of Farms	1,503	201	368	569	473	231	704	152	68	10	230
Owner Operated Farms (O)											
a. total area	3,308	73	311	384	675	620	1,225	729	653	244	1,626
b. total no. of farms	763	158	187	345	190	103	293	77	40	7	124
c. O area as % of total	49	74	49	52	40	45	40	51	59	72	56
d. no. of O farms as % of total	51	79	51	61	40	45	42	51	59	70	54
e. size per farm (acres)	4.34	0.46	1.66	1.11	3.55	6.02	4.18	9.47	16.33	34.86	13.11
Owner-Sharecropped Farms (OS)											
a. total area	3,249	21	292	313	955	737	1,762	694	457	95	1,246
b. total no. of farms	690	33	163	196	266	123	389	74	28	3	105
c. land owned	1,941	7	135	142	498	432	1,000	456	336	79	871
d. land sharecropped	1,308	14	157	171	457	305	762	238	121	16	375
e. land owned per farm	2.81	0.21	0.83	0.72	1.87	3.51	2.57	6.16	12.00	26.33	8.30
f. land sharecropped per farm	1.90	0.42	0.96	0.87	1.72	2.48	1.96	3.22	4.32	5.33	3.57
g. S land as % of OS land	40	67	54	55	48	41	43	34	26	17	30
h. S land as % of total	20	14	25	23	27	22	25	17	11	5	13
i. OS land as % of total	49	21	46	43	57	53	57	48	41	28	43
j. OS farms as % of total farms	46	16	44	34	56	53	55	49	42	30	46
Tenant Farms (T)											
a. total area	135	5	30	35	60	25	85	12	3	-	15
b. total no. of farms	51	9	18	27	17	4	21	1	-	-	-
c. T area as % of total	2	5	5	5	3	2	3	1	-	-	1
d. T farms as % of total farms	3	4	5	5	4	2	3	1	-	-	-
e. size per farm (acres)	2.65	0.56	1.67	1.30	3.53	6.25	4.05	12.00	-	-	-

See Table 1 for source and an explanatory note.

APPENDIX 1
Table 2

SOUTHWEST BANGLADESH (KHULNA DIVISION):
SIZE AND DISTRIBUTION OF FARMS BY TENURE
('000)

	Size of Farms in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-Total	2.50 - 4.99	5.00 - 7.49	Sub-Total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-Total
Total Area	4,956	116	470	586	1,206	1,052	2,258	1,079	800	234	2,113
Total No. of Farms	1,214	257	277	534	335	175	510	115	49	7	171
Owner Operated Farms (O)											
a. total area	2,334	102	294	396	513	421	934	485	401	118	1,004
b. total no. of farms	709	234	180	414	146	70	216	51	24	4	79
c. O area as % of total	47	88	63	68	43	40	41	45	50	50	48
d. no. of O farms as % of total farms	58	91	65	78	44	40	42	45	50	57	46
e. size/farm (acres)	3.29	0.44	1.63	0.96	3.51	6.01	4.32	9.51	16.71	29.50	12.71
Owner-Sharecropped Farms (OS)											
a. total area	2,577	12	168	180	677	620	1,297	589	396	116	1,101
b. total no. of farms	491	19	92	111	185	103	288	63	25	3	91
c. land owned	1,606	5	90	95	389	378	767	388	278	79	745
d. land sharecropped	971	7	78	85	288	242	530	201	118	37	356
e. land owned/farm	3.27	0.26	0.98	0.86	2.10	3.67	2.67	6.16	11.12	26.33	8.19
f. land sharecropped/farm	1.98	0.37	0.85	0.77	1.56	2.35	1.84	3.19	4.72	12.33	3.91
g. S land as % of OS land	38	58	46	47	43	39	41	34	30	32	32
h. S land as % of total	20	5	17	15	24	23	24	19	15	16	17
i. OS land as % of total	52	11	35	30	56	59	58	55	50	50	52
j. OS farms as % of total farms	41	7	33	21	55	59	56	55	50	43	54
Tenant Farms (T)											
a. total area	45	2	8	10	16	11	27	5	3	-	8
b. total no. of farms	15	3	5	8	4	2	6	-	-	-	-
c. T area as % of total	1	1	2	2	1	1	1	-	-	-	-
d. T farms as % of total farms	1	1	2	1	1	1	1	-	-	-	-
e. size/farm (acre)	3.00	0.67	1.60	1.25	4.00	5.50	4.50	-	-	-	-

See Table 1 for source and an explanatory note.

APPENDIX 1
Table 4

CENTRAL BANGLADESH (DACCA DIVISION):
SIZE AND DISTRIBUTION OF FARMS BY TENURE
('000)

	Size of Farms in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-Total	2.50 - 4.99	5.00 - 7.49	Sub-Total	7.50 - 12.99	12.50 - 24.99	25.00 & Over	Sub-Total
Total Area	5,830	207	907	1,114	1,742	1,125	2,867	1,028	658	163	1,849
Total No. of Farms	1,794	421	536	957	493	187	680	110	41	5	156
Owner Operated Farms (O)											
a. total area	3,088	160	491	651	776	537	1,313	572	434	118	1,124
b. total no. of farms	1,045	345	299	644	220	89	309	61	27	3	91
c. O area as % of total	53	77	54	58	44	48	46	56	66	72	61
d. no. of O farms as % of total farms	58	82	56	67	45	48	45	55	66	60	58
e. size/farm (acres)	2.96	0.46	1.64	1.01	3.53	6.03	4.25	9.38	16.07	39.33	21.35
Owner-Sharecropped Farms (OS)											
a. total area	2,700	42	403	445	951	583	1,537	454	223	44	721
b. total no. of farms	725	66	229	295	269	97	366	49	14	1	64
c. land owned	1,860	23	249	272	617	408	1,028	345	183	36	564
d. land sharecropped	840	19	154	173	334	175	509	109	40	8	157
e. land owned/farm	2.57	0.35	1.09	0.92	2.29	4.21	2.81	7.04	13.07	36.00	8.81
f. land sharecropped/farm	1.16	0.29	0.67	0.59	1.24	1.80	1.39	2.22	2.86	8.00	2.45
g. S land as % of OS land	31	45	38	39	35	30	33	24	18	18	22
h. S land as % of total	14	10	17	16	20	16	18	10	6	5	9
i. OS land as % of total	46	21	44	40	55	52	54	44	34	28	39
j. OS farms as % of total farms	41	16	43	31	54	52	54	45	34	40	42
Tenant Farms (T)											
a. total area	42	5	13	18	15	5	17	2	1	1	4
b. total no. of farms	24	10	8	18	5	1	6	-	-	-	-
c. T area as % of total	1	2	2	2	1	-	-	-	-	-	-
d. T farms as % of total farms	1	2	1	2	1	-	1	-	-	-	-
e. size/farm (acre)	3.00	0.50	1.63	1.00	3.00	5.00	2.83	-	-	-	-

See Table 1 for source and an explanatory note.

EASTERN BANGLADESH (CHITTAGONG DIVISION): SIZE AND DISTRIBUTION OF FARMS BY TENURE

('000)

	Size of Farms in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-Total	2.50 - 4.99	5.00 - 7.49	Sub-Total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-Total
Total Area	4,249	282	817	1,099	1,097	635	1,732	617	495	306	1,418
Total No. of Farms	1,628	614	496	1,110	313	105	418	65	30	4	99
Owner Operated Farms (O)											
a. total area	2,928	234	568	802	692	406	1,098	411	343	274	1,028
b. total no. of farms	1,215	533	349	882	198	67	265	43	21	3	67
c. O area as % of total	69	83	69	73	63	64	63	67	69	90	72
d. no. of O farms as % of total farms	74	87	70	79	63	64	63	67	69	75	68
e. size/farm (acres)	2.41	0.44	1.63	0.91	3.49	6.06	4.14	9.56	16.33	91.33	15.34
Owner-Sharecropped Farms (OS)											
a. total area	1,300	46	244	290	399	226	625	204	151	32	387
b. total no. of farms	403	76	144	220	113	38	151	22	9	1	32
c. land owned	891	34	169	203	269	150	419	138	110	24	272
d. land sharecropped	409	12	75	87	130	76	206	66	41	8	115
e. land owned/farm	2.21	0.45	1.17	0.92	2.38	3.95	2.77	6.27	12.22	24.00	8.50
f. land sharecropped/farm	1.01	0.16	0.52	0.40	1.15	2.00	1.36	3.00	4.56	8.00	3.59
g. S land as % of OS land	31	26	31	30	33	34	33	32	27	25	30
h. S land as % of total	10	4	9	8	12	12	12	10	8	3	8
i. OS land as % of total	31	17	31	27	37	36	37	33	31	10	28
j. OS farms as % of total farms	25	12	29	20	36	36	36	33	31	25	32
Tenant Farms (T)											
a. total area	21	2	5	7	6	3	9	2	1	-	3
b. total no. of farms	10	4	3	7	2	-	2	-	-	-	-
c. T areas as % of total	-	-	-	-	-	-	-	-	-	-	-
d. T farms as % of total farms	1	1	1	1	1	-	1	-	-	-	-
e. size/farm (acre)	2.10	0.50	1.67	1.00	3.00	-	4.50	-	-	-	-

See Table 1 for source and an explanatory note.

DINAJPUR DISTRICT:
SIZE AND DISTRIBUTION OF FARMS BY TENURE
('000)

	Size of Farms in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	1,225.4	5.8	65.2	70.9	277.2	279.5	556.6	286.7	240.1	70.9	597.8
Total Number of Farms	221.1	12.1	37.3	49.4	77.3	46.9	124.2	30.5	14.9	2.1	47.5
Owner Operated Farms (O)											
a. Total Area	612.1	3.6	22.8	26.4	86.8	117.8	204.6	153.9	163.0	64.1	380.9
b. Total No. of Farms	93.4	7.9	13.7	21.6	24.0	19.7	43.7	16.2	9.9	1.9	28.1
c. O Area as % of Farms	50	62	35	37	31	42	37	54	68	90	64
d. No. of Farms as % of Total	42	66	37	44	31	42	35	53	67	89	59
e. Size/Farm (acres)	6.55	0.45	1.67	1.22	3.61	5.98	4.68	9.48	16.37	34.27	13.58
Owner-Sharecropped Farms (OS)											
a. Total Area	555.9	1.5	33.3	34.7	164.6	148.3	312.9	126.7	74.7	6.9	208.3
b. Total No. of Farms	110.2	2.6	18.3	20.8	45.8	24.9	70.7	13.6	4.8	0.2	18.7
c. Land Owned	257.0	-	5.9	5.9	56.8	69.5	126.3	73.1	47.2	4.6	124.8
d. Land Sharecropped	298.8	1.5	27.3	28.8	107.8	78.8	186.6	53.7	27.5	2.3	83.5
e. Land Owned/Farm	2.33	0.0	0.33	0.29	1.24	2.79	1.79	5.37	9.82	19.07	6.69
f. Land Sharecropped/Farm	2.71	0.57	1.49	1.38	2.36	3.16	2.64	3.94	5.73	9.63	4.48
g. S Land as % of OS Land	54	100	82	83	66	53	60	42	37	34	40
h. S Land as % of Total	24	26	42	41	39	28	34	19	11	3	14
i. OS Land as % of Total	45	25	51	49	59	53	56	44	31	10	35
j. OS Farms as % of Total Farms	50	21	49	42	59	53	57	45	32	11	39
Tenant Farms (T)											
a. Total Area	57.5	0.7	9.1	9.8	25.8	13.3	39.1	6.1	2.4	-	8.5
b. Total No. of Farms	17.5	1.5	5.4	6.9	7.5	2.3	9.8	0.7	0.2	-	0.8
c. T Area as % of Total	5	12	14	14	9	5	7	2	1	-	1
d. T Farms as % of Total Farms	8	12	14	14	10	5	8	2	1	-	2

See Table 1 for source and an explanatory note.

RANGPUR DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE

('000)

	Size of Farms in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	1,992.9	34.2	246.4	280.6	584.0	398.3	982.3	381.3	261.1	87.7	730.1
Total Number of Farms	497.0	61.0	143.7	204.8	165.9	66.9	232.9	40.7	16.1	2.6	59.4
Owner-Operated Farms (O)											
a. Total Area	1,213.8	25.1	127.9	152.9	285.1	237.4	522.5	261.7	204.3	72.4	538.3
b. Total No. of Farms	286.5	47.3	76.5	123.8	80.6	39.8	120.4	27.7	12.5	2.2	42.4
c. O Area as % of Total	61	73	52	55	49	60	53	69	78	83	74
d. No. of Farms as % of Total Farms	58	77	53	60	48	59	52	68	78	84	71
e. Size/Farm (acres)	4.24	0.53	1.67	1.24	3.54	5.97	4.34	9.45	16.33	33.67	12.71
Owner-Sharecropped Farms (OS)											
a. Total Area	735.1	7.4	105.9	113.3	278.5	154.8	433.3	116.6	56.6	15.3	188.5
b. Total No. of Farms	192.4	10.8	59.6	70.4	79.2	26.2	105.3	12.7	3.6	.4	16.7
c. Land Owned	451.0	2.2	46.5	48.8	154.9	100.3	255.2	85.6	47.5	14.0	147.0
d. Land Sharecropped	284.1	5.2	59.3	64.5	123.6	54.5	178.1	31.0	9.1	1.3	41.4
e. Land Owned/Farm	2.34	0.21	0.78	0.69	1.96	3.84	2.42	6.75	13.14	35.10	8.82
f. Land Sharecropped/Farm	1.48	0.48	1.00	0.92	1.56	2.08	1.69	2.45	2.53	3.14	2.48
g. S land as % of OS land	39	70	56	57	44	35	41	27	16	8	22
i. OS land as % of Total	14	15	24	23	21	14	18	8	4	1	6
j. OS land as % of Total	37	22	43	40	48	39	44	30	22	17	26
k. OS Farms as % of Total Farms	39	18	41	34	48	39	45	31	22	16	28
Tenant Farms (T)											
a. Total Area	44.1	1.6	12.7	14.3	20.4	6.1	26.5	3.0	0.3	-	3.3
b. Total No. of Farms	18.1	2.9	7.6	10.6	6.1	1.1	7.2	0.3	0.02	-	0.4
c. T Area as % of Total	2	5	5	5	3	1	3	1	0	0	0
d. T Farms as % of Total Farms	3	5	5	5	4	2	3	1	0	0	0

See Table 1 for source and an explanatory note.

PABNA DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE

('000)

	Size of Farms in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.49 - 24.99	25.00 & Over	Sub-total
Total Area	875.7	21.2	90.9	112.1	214.7	173.9	388.7	182.8	144.6	47.5	374.8
Total Number of Farms	223.9	51.9	53.6	105.5	59.8	28.9	88.8	19.4	8.9	1.4	29.6
Owner-Operated Farms (O)											
a. Total Area	355.9	17.3	45.2	62.5	70.6	56.9	127.5	72.3	67.9	25.7	165.9
b. Total No. of Farms	115.7	45.5	28.2	73.7	20.1	9.5	29.8	7.6	4.1	0.8	12.5
c. O Area as % of Total	41	82	50	56	33	33	33	40	47	54	44
d. No. of Farms as % of Total Farms	52	88	53	70	33	33	34	39	46	53	42
e. Size/Farm (acre)	3.08	0.38	1.60	0.85	3.52	5.98	4.28	9.50	16.56	34.28	13.32
Owner-Sharecropped Farms (OS)											
a. Total Area	516.5	3.6	44.7	48.3	142.9	116.5	259.5	110.4	76.6	21.7	208.7
b. Total No. of Farms	106.3	5.6	24.8	30.4	39.4	19.4	58.8	11.7	4.7	0.7	17.1
c. Land Owned	348.5	2.0	26.5	28.5	86.8	75.2	161.9	78.7	61.0	18.2	157.9
d. Land Sharecropped	167.9	1.6	18.2	19.8	56.2	41.3	97.5	31.6	15.6	3.5	50.7
e. Land Owned/Farm	3.28	0.37	1.07	0.94	2.20	3.88	2.76	6.71	12.87	27.63	9.22
f. Land Sharecropped/Farm	1.58	0.28	0.73	0.65	1.43	2.13	1.66	2.69	3.28	5.31	2.96
g. S land as % of OS Land	33	43	41	41	39	35	38	29	20	16	24
h. S land as % of Total	19	7	20	18	26	24	25	17	11	7	14
i. OS land as % of Total	59	17	49	43	66	67	67	60	53	46	56
j. OS Farms as % of Total Farms	47	11	46	29	66	67	66	61	54	47	58
Tenant Farms (T)											
a. Total Area	3.3	0.3	1.0	1.3	1.2	0.5	1.7	0.08	0.2	-	0.2
b. Total No. of Farms	1.9	0.9	0.6	1.5	0.4	0.09	0.4	0.01	0.01	-	0.02
c. T Area as % of Total	0	1	1	1	1	0	0	0	0	0	0
d. T Farms as % of Total Farms	1	2	1	1	1	0	1	0	0	0	0

See Table 1 for source and an explanatory note.

MYMENSINGH DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY LAND TENURE

('000)

	Size of Farms in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.49 - 24.99	25.00 & Over	Sub-total
Total Area	3,219.1	91.2	456.3	547.5	958.6	632.9	1,591.6	596.1	392.4	91.5	1,080.0
Total Number of Farms	931.9	197.6	266.4	463.9	271.6	105.6	377.2	63.8	24.3	2.7	90.7
Owner-Operated Farms (O)											
a. Total Area	1,677.4	67.8	218.6	286.4	408.4	307.2	715.7	338.8	264.9	71.8	675.4
b. Total No. of Farms	512.6	160.1	131.9	291.9	115.1	51.0	166.2	36.1	16.3	2.1	54.5
c. O Area as % of Total	52	74	48	52	43	49	45	57	68	78	63
d. No. of Farms as % of Total Farms	55	81	50	62	42	48	44	57	67	78	60
e. Size/Farm (acres)	3.27	0.42	1.66	0.98	3.55	6.02	4.31	9.39	16.25	34.50	12.40
Owner-Sharecropped Farms (OS)											
a. Total Area	1,519.7	21.3	230.8	252.1	541.2	323.2	864.5	256.4	127.4	19.4	403.2
b. Total No. of Farms	407.3	33.0	130.3	163.3	153.7	54.2	207.9	27.6	7.9	0.6	36.1
c. Land Owned	1,044.8	10.9	137.4	148.3	347.8	228.9	576.8	199.3	105.1	15.3	319.7
d. Land Sharecropped	474.9	10.4	93.4	103.8	193.4	94.3	287.7	57.1	22.3	4.1	83.4
e. Land Owned/Farm	2.57	0.33	1.06	0.91	2.26	4.23	2.77	7.21	13.24	26.43	8.85
f. Land Sharecropped/Farm	1.17	0.32	0.72	0.64	1.26	1.74	1.38	2.07	2.81	6.98	2.31
g. S land as % of OS Land	31	49	40	41	36	29	33	22	17	21	21
h. S land as % of Total	15	11	20	19	20	15	18	10	6	4	8
i. OS land as % of Total	47	23	51	46	56	51	54	43	32	21	37
j. OS Farms as % of Total Farms	44	17	49	35	57	51	55	43	33	22	40
Tenant Farms (T)											
a. Total Area	21.9	2.0	6.9	8.9	8.9	2.5	11.5	0.9	0.1	0.4	1.5
b. Total No. of Farms	12.1	4.6	4.2	8.8	2.7	0.4	3.2	0.1	0.01	0.01	0.1
c. T Area as % of Total	1	2	1	2	1	0	1	0	0	0	0
d. T Farms as % of Total Farms	1	2	1	2	1	0	0	0	0	0	0

See Table 1 for source and an explanatory note.

SYLHET DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE
('000)

	Size of Farm in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	1,623.4	46.8	180.7	227.5	360.2	262.3	622.5	306.2	297.5	169.8	773.4
Total Number of Farms	402.6	97.7	108.1	205.8	100.6	43.4	143.9	32.1	17.9	2.8	52.9
Owner-Operated Farms (O)											
a. Total Area	1,147.6	40.8	128.5	169.2	227.1	168.8	395.9	211.8	217.7	152.9	582.4
b. Total No. of Farms	295.3	87.9	78.5	166.4	63.6	27.9	91.4	22.0	13.1	2.3	37.4
c. O Area as % of Total	71	87	71	74	63	64	64	69	73	90	75
d. No. of Farms as % of Total	73	90	72	73	63	64	64	69	73	81	71
e. Size/Farm (acres)	3.89	0.46	1.64	1.02	3.57	6.06	4.33	9.62	16.64	66.80	15.57
Owner-Sharecropped Farms (OS)											
a. Total Area	468.6	5.5	49.4	54.9	130.3	92.9	223.2	94.2	79.5	16.8	190.5
b. Total No. of Farms	103.6	8.7	27.9	36.6	36.2	15.4	51.6	10.0	4.9	0.5	15.4
c. Land Owned	324.1	2.9	28.7	31.7	83.7	63.6	147.3	68.6	62.4	14.2	145.1
d. Land Sharecropped	144.5	2.5	20.7	23.2	46.7	29.3	75.9	25.5	17.2	2.7	45.4
e. Land Owned/Farm	3.13	0.34	1.03	0.87	2.31	4.13	2.86	6.85	12.78	26.21	9.40
f. Land Sharecropped/Farm	1.40	0.29	0.74	0.63	1.29	1.90	1.47	2.55	3.52	4.96	2.94
g. S Land as % of OS Land	31	46	42	42	36	32	34	27	22	16	24
h. S Land as % of Total	9	3	11	10	13	11	12	8	6	2	6
i. OS Land as % of Total	29	12	27	24	36	35	36	31	27	10	25
j. OS Farms as % of Total Farms	26	9	26	18	36	36	36	31	27	19	29
Tenant Farms (T)											
a. Total Area	7.3	0.6	2.8	3.4	2.8	0.6	3.4	0.2	0.3	-	0.5
b. Total No. of Farms	3.7	1.0	1.8	2.8	0.8	0.1	0.9	0.02	0.02	-	0.04
c. T Area as % of Total	0	1	2	2	1	0	1	0	0	0	0
d. T Farms as % of Total Farms	0	1	2	1	1	0	1	0	0	0	0

See Table 1 for source and an explanatory note.

NOAKHALI DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE

('000)

	Size of Farm in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	661.2	70.9	161.4	232.4	168.7	90.7	259.4	79.7	64.4	25.4	169.5
Total Number of Farms	324.7	146.6	100.8	247.4	48.9	15.3	64.3	8.6	3.9	0.6	13.1
Owner-Operated Farms (O)											
a. Total Area	410.3	57.6	110.1	167.8	100.8	50.4	151.2	42.4	33.4	15.6	91.4
b. Total No. of Farms	238.4	123.8	69.5	193.3	29.6	8.5	38.2	4.6	1.9	0.4	6.9
c. O Area as % of Total	62	81	68	72	60	55	58	53	52	61	54
d. No. Farms as % of Total	73	84	59	78	60	56	59	54	51	56	53
e. Size/Farm (acres)	1.72	0.47	1.58	0.87	3.40	5.90	3.96	9.23	16.85	44.57	13.19
Owner-Sharecropped Farms (OS)											
a. Total Area	243.4	12.8	50.3	63.1	66.7	38.9	105.6	35.4	30.2	9.2	74.7
b. Total No. of Farms	83.1	21.1	30.7	51.8	19.0	6.5	25.5	3.8	1.9	0.3	5.9
c. Land Owned	156.8	9.7	37.5	47.2	46.0	21.8	67.8	19.1	17.1	5,6	41.8
d. Land Sharecropped	86.6	3.1	12.8	15.9	20.7	17.1	37.8	16.3	13.1	3.6	32.9
e. Land Owned/Farm	1.89	0.46	1.22	0.91	2.42	3.37	2.66	5.08	9.16	22.32	7.11
f. Land Sharecropped/Farm	1.04	0.15	0.42	0.31	1.09	2.65	1.48	4.34	6.98	14.31	5.60
g. S Land as % of OS land	36	24	26	25	31	44	36	46	43	39	44
h. S land as % of Total	13	4	8	7	12	19	15	20	20	14	19
i. OS Land as % of Total	37	18	31	27	39	43	41	45	47	36	44
j. OS Farms as % of Total Farms	26	14	30	21	39	42	40	44	48	40	45
Tenant Farms (T)											
a. Total Area	7.5	0.6	0.9	1.5	1.2	1.5	2.6	1.8	0.9	0.6	3.3
b. Total No. of Farms	3.2	1.7	0.6	2.3	0.4	0.3	0.6	0.2	0.05	0.02	0.3
c. T Area as % of Total	1	1	1	1	1	2	1	2	1	2	2
d. T Farms as % of Total Farms	1	1	1	1	1	2	1	2	1	3	2

See Table 1 for source and an explanatory note.

CHITTAGONG DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE

('000)

	Size of Farm in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	699.9	39.5	124.8	164.3	179.6	99.3	278.9	89.0	68.2	99.6	256.8
Total No. of Farms	265.6	108.9	74.6	183.5	51.3	16.5	67.8	9.5	4.2	0.7	14.4
Owner-Operated Farms (O)											
a. Total Area	381.1	31.1	60.5	91.6	72.6	44.6	117.2	41.4	36.6	94.3	172.3
b. Total No. of Farms	166.5	94.0	37.2	131.3	20.7	7.4	28.1	4.4	2.2	0.5	7.2
c. O Area as % of Total	54	79	48	56	41	45	42	47	54	95	67
d. No. Farms as % of Total	63	86	50	72	40	45	41	47	53	75	50
e. Size/Farm (acres)	2.29	0.33	1.62	0.70	3.51	6.05	4.18	9.39	16.34	17.46	23.96
Owner-Sharecropped Farms (OS)											
a. Total Area	314.3	8.1	63.2	71.3	104.8	54.0	158.8	47.4	31.4	5.3	84.2
b. Total No. of Farms	96.9	14.1	36.7	50.8	30.0	8.9	39.0	5.0	1.9	0.2	7.2
c. Land Owned	181.1	5.2	36.6	41.8	56.3	29.9	86.2	27.9	21.7	3.6	53.1
d. Land Sharecropped	133.2	2.9	26.6	29.5	48.5	24.1	72.7	19.5	9.8	1.8	31.1
e. Land Owned/Farm	1.87	0.37	1.00	0.82	1.87	3.33	2.21	5.55	11.01	19.76	7.41
f. Land Sharecropped/Farm	1.37	0.21	0.72	0.58	1.62	2.69	1.86	3.89	4.95	9.94	4.33
g. S Land as % of OS Land	42	36	42	41	46	45	46	41	31	33	37
h. S Land as % of Total	19	7	21	18	27	24	26	22	14	2	12
i. OS Land as % of Total	45	21	51	43	58	54	57	53	46	5	33
j. OS Farms as % of Total Farms	36	13	49	28	59	54	58	53	47	25	50
Tenant Farms (T)											
a. Total Area	4.6	0.2	1.2	1.4	2.2	0.6	2.8	0.2	0.1	0	0.3
b. Total No. of Farms	2.1	0.7	0.7	1.4	0.6	0.1	0.7	0.02	0.01	0	0.03
c. T Area as % of Total	1	1	1	1	1	1	1	0	0	0	0
d. T Farms as % of Total Farms	1	1	1	1	1	1	1	0	0	0	0

See Table 1 for source and an explanatory note.

FARIDPUR DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE

('000)

	Size of Farm in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	1,261.8	51.3	197.7	249.1	371.3	250.9	622.3	219.0	134.3	37.1	390.5
Total No. of Farms	398.4	99.3	119.2	218.5	105.0	41.9	146.9	23.6	8.3	1.0	32.9
Owner-Operated Farms (O)											
a. Total Area	660.9	41.4	121.1	162.5	168.6	111.2	279.7	111.4	84.9	22.3	218.7
b. Total No. of Farms	242.6	83.0	75.0	158.1	48.3	18.6	66.8	11.9	5.2	0.6	17.7
c. O Area as % of Total	52	81	61	65	45	44	45	51	63	60	56
d. No. of Farms as % of Total Farms	61	84	63	63	46	44	45	51	62	62	54
e. Size/Farm (acres)	2.72	0.50	1.61	1.03	3.49	5.98	4.19	9.35	16.47	34.89	12.34
Owner-Sharecropped Farms (OS)											
a. Total Area	591.1	8.7	73.7	82.4	199.4	138.7	338.2	106.8	49.2	14.5	170.6
b. Total No. of Farms	149.9	13.4	42.4	55.7	55.8	23.2	78.9	11.6	3.1	0.4	15.1
c. Land Owned	395.1	4.2	43.9	48.1	124.8	91.8	216.6	77.3	40.5	14.1	130.4
d. Land Sharecropped	196.0	4.5	29.8	34.3	74.7	46.9	121.5	29.5	8.8	1.9	40.2
e. Land Owned/Farm	2.64	0.31	1.04	0.86	2.24	3.97	2.74	6.66	12.88	36.22	8.61
f. Land Sharecropped/Farm	1.31	0.34	0.70	0.62	1.34	2.03	1.52	2.54	2.80	4.84	2.65
g. S Land as % of OS land	33	52	40	42	37	34	36	28	18	13	24
h. S Land as % of Total	16	8	15	14	20	19	20	13	7	5	10
i. OS Land as % of Total	47	17	37	33	54	55	54	49	37	39	44
j. OS Farms as % of Total Farms	38	13	35	26	53	55	54	49	38	38	46
Tenant Farms (T)											
a. Total Area	9.8	1.2	3.0	4.3	3.3	1.1	4.4	0.7	0.1	0.3	1.1
b. Total No. of Farms	5.9	2.9	1.9	4.7	0.9	0.2	1.1	0.07	0.01	0.01	0.09
c. T Area as % of Land	1	2	3	2	2	2	1	1	0	1	0
d. T Farms as % of Total Farms	1	3	2	2	1	0	1	0	0	1	0

See Table 1 for source and an explanatory note.

JESSORE DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE

('000)

	Size of Farm in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	1,354.8	21.8	98.7	120.5	357.4	357.7	715.1	318.0	171.8	29.5	519.3
Total Number of Farms	306.5	48.6	55.8	104.3	97.6	59.1	156.7	33.9	10.6	0.9	45.5
Owner-Operated Farms (O)											
a. Total Area	675.4	19.2	55.3	74.6	143.1	149.9	293.1	169.7	113.9	24.2	307.7
b. Total No. of Farms	166.5	44.4	32.5	76.9	39.5	24.6	64.1	17.9	6.9	0.8	25.5
c. O Area as % of Total	50	88	56	62	40	42	41	53	66	82	59
d. No. Farms as % of Total Farms	54	91	58	74	41	41	41	53	65	82	56
e. Size/Farm (acres)	4.06	0.43	1.70	0.97	3.62	6.09	4.57	9.50	16.50	31.81	12.06
Owner-Sharecropped Farms (OS)											
a. Total Area	670.9	2.3	41.9	44.2	210.6	205.3	415.9	147.9	57.6	5.3	210.8
b. Total No. of Farms	136.9	3.5	22.5	25.9	56.9	34.1	91.1	16.0	3.7	0.2	19.9
c. Land Owned	426.9	0.9	20.7	21.6	118.1	130.2	248.3	106.3	45.9	4.7	156.9
d. Land Sharecropped	244.0	1.3	21.2	22.6	92.4	75.2	167.6	41.5	11.7	0.6	53.9
e. Land Owned/Farm	3.12	0.26	0.92	0.83	2.07	3.82	2.73	6.64	12.35	27.72	7.89
f. Land Sharecropped/Farm	1.78	0.38	0.94	0.87	1.62	2.20	1.84	2.59	3.14	3.71	2.70
g. S Land as % of OS Land	36	60	51	51	44	37	40	28	20	12	26
h. S Land as % of Total	18	6	22	19	26	21	23	13	7	2	10
i. OS Land as % of Total	49	10	42	37	59	57	58	47	34	18	41
j. OS Farms as % of Total Farms	45	7	40	25	58	58	58	47	35	18	44
Tenant Farms (T)											
a. Total Area	8.6	0.3	1.5	1.7	3.7	2.4	6.1	0.4	0.3	0	0.7
b. Total No. of Farms	3.0	0.6	0.9	1.5	1.1	0.4	1.5	0.05	0.02	0	0.07
c. T Area as % of Land	1	1	2	1	1	1	1	0	0	0	0
d. T Farms as % of Total Farms	1	1	2	1	1	1	1	0	0	0	0

See Table 1 for source and an explanatory note.

APPENDIX 1
Table 14

KHULNA DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE

('000)

	Size of Farm in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	4,955.7	115.7	469.7	585.4	1,205.7	1,051.9	2,257.6	1,078.5	799.9	234.2	2,112.6
Total Number of Farms	1,214.3	257.0	276.6	533.6	335.5	174.9	510.4	114.6	48.9	6.7	170.2
Owner-Operated Farms (O)											
a. Total Area	2,333.5	101.8	293.9	395.7	513.0	420.7	933.7	484.9	401.4	117.7	1,004.1
b. Total No. of Farms	708.6	234.3	179.5	413.8	145.8	69.9	215.7	51.2	24.3	3.6	79.1
c. O Area as % of Total	47	88	62	68	43	40	41	45	50	50	48
d. No. of Farms as % of Total	58	91	65	78	44	40	42	45	50	54	46
e. Size/Farm (acres)	3.29	0.43	1.64	0.96	3.52	6.02	4.33	9.47	16.55	32.62	12.70
Owner-Sharecropped Farms (OS)											
a. Total Area	2,577.4	12.3	167.9	180.2	677.1	620.3	1,297.3	588.2	395.5	116.1	1,099.9
b. Total No. of Farms	490.6	19.3	92.4	111.7	185.3	104.2	288.4	62.8	24.5	3.1	90.4
c. Land Owned	1,606.4	12.7	90.2	102.9	388.7	378.7	767.4	386.8	277.0	79.3	743.1
d. Land Sharecropped	970.9	6.6	77.7	84.3	288.4	241.6	529.9	201.4	118.5	36.8	356.7
e. Land Owned/Farm	3.27	0.66	0.98	0.92	2.10	3.67	2.66	6.16	11.30	25.57	8.22
f. Land Sharecropped/Farm	1.98	0.34	0.84	0.75	1.56	2.34	1.84	3.21	4.83	11.89	3.95
g. S land as % of OS Land	38	53	46	47	43	39	41	34	30	32	32
h. S Land as % of Total	20	6	17	14	24	23	23	19	15	16	17
i. OS Land as % of Total	52	11	36	31	56	59	57	55	49	50	52
j. OS Farms as % of Total Farms	41	8	33	21	55	59	57	55	50	46	53
Tenant Farms (T)											
a. Total Area	44.8	1.6	7.9	9.5	15.6	10.9	26.6	5.3	3.0	0.3	8.7
b. Total No. of Farms	15.2	3.4	4.7	8.1	4.5	1.9	6.3	0.6	0.2	0.01	0.8
c. T Area as % of Land	1	1	2	2	1	1	1	0	0	0	0
d. T Farms as % of Total Farms	1	1	2	2	1	1	1	0	0	0	0

See Table 1 for source and an explanatory note.

RAJSHAHI DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE

('000)

	Size of Farm in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	1,847.0	24.6	127.9	152.5	386.1	377.9	764.0	440.6	384.0	105.9	930.5
Total No. of Farms	366.4	52.1	73.9	125.9	105.6	62.2	167.9	46.4	23.0	3.3	72.7
Owner-Operated Farms (O)											
a. Total Area	683.6	18.1	60.5	78.6	120.3	118.9	239.3	150.4	158.2	57.1	365.7
b. Total No. of Farms	157.6	41.3	36.3	77.6	33.6	19.5	53.1	15.8	9.3	1.7	26.9
c. O Area as % of Total	37	74	47	52	31	31	31	34	41	54	39
d. O Farms as % of Total Farms	43	79	49	62	32	31	32	34	41	53	37
e. Size/Farm (acres)	4.34	0.44	1.67	1.01	3.58	6.10	4.50	9.52	16.94	32.81	13.60
Owner-Sharecropped Farms (OS)											
a. Total Area	1,146.5	5.9	64.9	70.8	258.7	255.3	514.0	287.6	225.2	48.9	561.7
b. Total No. of Farms	203.0	9.3	36.2	45.4	70.0	42.1	112.1	30.3	13.6	1.5	45.5
c. Land Owned	688.3	2.1	31.8	33.9	133.1	144.9	277.9	177.8	160.6	39.9	378.4
d. Land Sharecropped	458.2	3.7	33.1	36.9	125.6	110.5	236.1	109.8	64.6	8.8	183.3
e. Land Owned/Farm	3.39	0.23	0.88	0.75	1.90	3.44	2.48	5.86	11.79	25.97	8.32
f. Land Sharecropped/Farm	2.26	0.40	0.92	0.81	1.79	2.62	2.11	3.62	4.74	5.74	4.03
g. S Land as % of OS Land	40	64	51	52	49	43	46	38	29	18	33
h. S Land as % of Total	25	15	26	24	33	29	31	25	17	8	20
i. OS Land as % of Total	62	24	51	46	67	68	67	65	59	46	60
j. OS Farms as % of Total Farms	55	18	49	36	66	68	67	65	59	47	63
Tenant Farms (T)											
a. Total Area	16.9	0.6	2.4	3.1	7.1	3.6	10.7	2.5	0.6	0	3.1
b. Total No. of Farms	5.8	1.5	1.4	2.9	1.9	0.6	2.6	0.3	0.04	0	0.3
c. T Area as % of Total	1	3	2	2	2	1	1	1	0	0	0
d. T Farms as % of Total Farms	2	3	2	2	2	1	2	1	0	0	0

See Table 1 for source and an explanatory note.

BOGRA DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE

('000)

	Size of Farm in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	750.6	13.1	102.8	115.9	228.1	151.9	380.1	144.1	83.4	27.2	254.6
Total Number of Farms	194.9	23.7	59.7	83.5	64.9	25.5	90.4	15.3	5.1	0.7	21.1
Owner-Operated Farms (O)											
a. Total Area	439.5	8.7	54.9	63.6	112.1	88.5	200.6	90.5	59.8	24.9	175.2
b. Total No. of Farms	109.6	16.5	32.7	49.2	31.8	14.8	46.6	9.5	3.7	0.7	13.9
c. O Area as % of Total	58	66	54	55	49	58	53	63	72	92	69
d. O Farms as % of Total Farms	56	70	55	59	49	58	52	63	72	90	66
e. Size/Farm (acres)	4.01	0.53	1.68	1.29	3.53	5.98	4.31	9.49	16.20	37.80	12.62
Owner-Sharecropped Farms (OS)											
a. Total Area	297.9	3.1	43.2	46.3	110.9	61.9	172.9	52.9	23.6	2.2	78.7
b. Total No. of Farms	78.1	4.6	24.3	28.9	31.6	10.5	42.0	5.7	1.5	0.07	7.2
c. Land Owned	199.0	1.1	23.	24.8	69.4	42.2	111.7	41.3	19.5	1.8	62.5
d. Land Sharecropped	98.9	1.9	19.5	21.5	41.6	19.7	61.3	11.7	4.1	0.4	16.2
e. Land Owned/Farm	2.55	0.24	0.98	0.86	2.20	4.03	2.66	7.30	13.42	25.71	8.72
f. Land Sharecropped/Farm	1.27	0.43	0.80	0.74	1.32	1.88	1.46	2.07	2.85	5.83	2.26
g. S Land as % of OS Land	33	65	45	46	37	32	35	22	18	18	21
h. S Land as % of Total	13	15	19	19	18	13	16	8	5	2	6
i. OS Land as % of Total	40	23	42	40	49	41	46	37	28	8	31
j. OS Farms as % of Total Farms	40	19	40	35	49	41	47	37	28	10	34
Tenant Farms (T)											
a. Total Area	13.1	1.4	4.6	5.9	5.0	1.5	6.5	0.6	0	0	0.6
b. Total No. of Farms	7.3	2.6	2.8	5.4	1.5	0.3	1.8	0.07	0	0	0.07
c. T Area as % of Total	2	10	4	5	2	1	2	0	0	0	0
d. T Farms as % of Total Farms	4	11	5	7	2	1	2	0	0	0	0

See Table 1 for source and an explanatory note.

KUSHTIA DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE

('000)

	Size of Farm in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	618.4	4.8	28.3	33.1	118.6	140.2	258.8	153.9	137.9	34.8	326.6
Total Number of Farms	106.7	9.3	16.3	25.6	32.1	23.3	55.4	16.3	8.4	1.0	25.7
Owner-Operated Farms (O)											
a. Total Area	241.1	3.6	15.2	18.9	33.4	39.7	73.1	57.3	66.3	25.6	149.2
b. Total No. of Farms	43.2	7.4	9.2	16.5	9.4	6.6	15.9	5.9	3.9	0.8	10.7
c. O Area as % of Total	39	77	53	57	28	28	28	37	48	73	46
d. O Farms as % of Total Farms	40	79	56	64	29	28	29	37	48	74	42
e. Size/Farm (acres)	5.58	0.50	1.65	1.14	3.55	6.04	4.58	9.58	16.66	33.22	13.90
Owner-Sharecropped Farms (OS)											
a. Total Area	372.6	0.9	12.4	13.3	82.9	99.4	182.4	96.3	71.3	9.2	176.9
b. Total No. of Farms	61.8	1.6	6.7	8.3	22.0	16.6	38.6	10.3	4.4	0.3	14.9
c. Land Owned	241.6	0.3	5.1	5.4	44.1	60.5	104.5	66.2	57.8	7.6	131.6
d. Land Sharecropped	130.9	0.6	7.3	7.9	38.9	38.9	77.9	30.1	13.5	1.7	45.2
e. Land Owned/Farm	3.91	0.19	0.77	0.66	2.00	3.65	2.71	6.45	13.22	28.09	8.83
f. Land Sharecropped/Farm	2.12	0.39	1.09	0.95	1.77	2.35	2.02	2.93	3.09	6.11	3.03
g. S Land as % of OS Land	35	67	59	59	47	39	43	31	19	18	26
h. S Land as % of Total	21	13	26	24	33	28	30	20	10	5	14
i. OS Land as % of Total	60	20	44	40	70	71	70	63	52	27	54
j. OS Farms as % of Total Farms	58	17	41	32	69	71	70	63	52	26	58
Tenant Farms (T)											
a. Total Area	4.8	0.2	0.7	0.9	2.2	1.1	3.3	0.3	0.3	0	0.6
b. Total Number of Farms	1.7	0.3	0.5	0.8	0.6	0.2	0.8	0.03	0.02	0	0.5
c. T Area as % of Total	1	4	3	3	2	1	1	0	0	0	0
d. T Farms as % of Total Farms	2	4	3	3	2	1	2	0	0	0	0

See Table 1 for source and an explanatory note.

BARISAL DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE

('000)

	Size of Farm in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	1,836.5	59.0	232.4	291.4	460.9	324.5	785.4	350.7	289.9	119.0	759.7
Total Number of Farms	507.7	126.2	138.7	264.9	130.4	54.2	184.6	37.4	17.7	3.3	58.3
Owner-Operated Farms (O)											
a. Total Area	882.7	51.7	154.3	206.0	215.9	136.2	352.0	147.8	130.0	46.8	324.7
b. Total No. of Farms	319.5	114.4	94.9	209.3	62.3	22.9	85.2	15.7	7.8	1.4	24.9
c. O Area as % of Total	48	88	66	71	47	42	45	42	45	39	43
d. O Farms as % of Total Farms	63	91	68	79	48	42	46	42	44	43	43
e. Size/Farm (acres)	2.76	0.45	1.63	0.98	3.46	5.96	4.13	9.39	16.67	33.19	13.01
Owner-Sharecropped Farms (OS)											
a. Total Area	930.2	6.4	74.1	80.5	238.3	182.5	420.8	198.9	158.1	71.9	428.9
b. Total No. of Farms	180.7	9.9	41.4	51.4	66.2	30.3	96.5	21.2	9.8	1.8	32.8
c. Land Owned	603.3	3.4	46.0	49.4	151.5	117.7	269.2	131.8	106.7	46.2	284.7
d. Land Sharecropped	326.9	2.9	28.1	31.1	86.8	64.8	151.5	67.1	51.4	25.8	144.3
e. Land Owned/Farm	3.34	0.34	1.11	0.96	2.29	3.88	2.79	6.22	10.94	25.22	8.68
f. Land Sharecropped/Farm	1.81	0.30	0.68	0.61	1.31	2.14	1.57	3.17	5.27	14.08	4.40
g. S Land as % of OS Land	35	46	38	39	36	36	36	34	33	36	34
h. S Land as % of Total	18	5	12	11	19	20	19	19	18	22	19
i. OS Land as % of Total	51	11	32	28	52	56	54	57	54	60	56
j. OS Farms as % of Total Farms	36	8	30	19	51	56	52	57	55	56	56
Tenant Farms (T)											
a. Total Area	23.6	0.9	3.9	4.9	6.8	5.9	12.6	3.9	1.9	0.3	6.1
b. Total Number of Farms	7.6	1.8	2.4	4.2	1.9	0.9	2.9	0.4	0.1	0.01	0.5
c. T Area as % of Total	1	2	2	2	1	2	2	1	1	0	1
d. T Farms as % of Total Farms	1	1	2	2	1	2	2	1	1	0	1

See Table 1 for source and an explanatory note.

DACCA DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE
('000)

	Size of Farm in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	1,348.8	64.3	252.8	317.1	412.2	240.8	652.9	212.8	131.1	34.8	378.7
Total Number of Farms	463.2	124.1	150.7	274.8	116.7	39.9	156.6	22.8	8.1	0.9	31.9
Owner-Operated Farms (O)											
a. Total Area	749.4	50.4	151.0	201.4	199.2	118.5	317.7	121.5	84.4	24.4	230.2
b. Total No. of Farms	289.5	102.1	92.2	194.3	56.8	19.6	76.4	12.9	5.2	0.7	18.8
c. O Area as % of Total	55	78	60	64	48	49	49	57	64	70	61
d. O Farms as % of Total Farms	63	82	61	71	49	49	49	57	64	71	59
e. Size/Farm (acres)	2.59	0.49	1.64	1.04	3.51	6.04	4.16	9.39	16.22	35.84	12.23
Owner-Sharecropped Farms (OS)											
a. Total Area	589.2	12.5	98.5	110.9	210.0	120.7	330.7	90.7	46.4	10.4	147.5
b. Total No. of Farms	167.8	19.3	56.4	75.7	59.1	20.1	79.2	9.8	2.9	0.3	12.9
c. Land Owned	420.3	7.9	67.6	75.5	144.3	86.6	230.9	67.9	37.3	8.6	113.8
d. Land Sharecropped	168.9	4.5	30.9	35.4	65.8	34.1	99.9	22.8	9.1	1.8	33.7
e. Land Owned/Farm	2.50	0.41	1.20	1.00	2.44	4.32	2.92	6.96	12.86	30.60	8.80
f. Land Sharecropped/Farm	1.01	0.24	0.55	0.47	1.11	1.70	1.26	2.33	3.14	6.54	2.61
g. S Land as % of OS Land	29	36	31	32	31	28	30	25	20	18	23
h. S Land as % of Total	13	7	12	11	16	14	15	11	7	5	9
i. OS Land as % of Total	44	19	39	35	51	50	51	43	35	30	39
j. OS Farms as % of Total Farms	36	16	38	28	50	50	51	43	36	29	41
Tenant Farms (T)											
a. Total Area	10.2	1.4	3.3	4.7	2.9	1.5	4.5	0.6	0.4	0	0.9
b. Total No. of Farms	5.9	2.6	2.1	4.7	0.8	0.3	1.1	0.07	0.02	0	0.09
c. T Area as % of Total	1	3	1	1	1	1	0	0	1	0	0
d. T Farms as % of Total Farms	1	2	1	2	1	1	0	0	0	0	0

APPENDIX 1
Table 20

See Table 1 for source and an explanatory note.

COMILLA DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE
('000)

	Size of Farm in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	1,091.6	121.9	323.7	445.7	343.1	148.9	492.1	108.6	40.0	5.3	153.9
Total Number of Farms	592.9	256.0	198.3	454.4	99.3	24.8	124.1	11.7	2.5	0.1	14.4
Owner-Operated Farms (O)											
a. Total Area	825.6	101.5	243.4	344.9	248.5	110.7	359.2	85.0	31.9	4.6	121.6
b. Total No. of Farms	474.1	222.7	149.8	372.5	71.9	18.4	90.4	9.1	2.0	0.1	11.3
c. O Area as % of Total	76	83	75	77	72	74	73	78	80	88	79
d. O Farms as % of Total Farms	80	87	76	82	73	74	73	78	80	86	78
e. Size/Farm (acres)	1.74	0.46	1.63	0.93	3.45	6.02	3.97	9.31	15.88	38.72	10.80
Owner-Sharecropped Farms (OS)											
a. Total Area	265.2	20.2	79.9	100.1	94.5	38.3	132.8	23.6	8.1	0.6	32.3
b. Total No. of Farms	117.7	32.5	48.4	80.8	27.3	6.4	33.7	2.6	0.5	0.02	3.1
c. Land Owned	223.3	16.4	64.9	81.3	80.8	33.2	114.1	20.4	6.9	0.6	27.3
d. Land Sharecropped	41.9	3.8	15.0	18.8	13.6	5.1	18.7	3.2	1.2	0.005	4.4
e. Land Owned/Farm	1.90	0.50	1.34	1.01	2.96	5.18	3.38	7.88	13.77	31.30	8.78
f. Land Sharecropped/Farm	0.36	0.12	0.31	0.23	0.50	0.79	0.56	1.22	2.41	0.25	1.40
g. S Land as % of OS Land	16	19	19	19	14	13	14	13	15	1	14
h. S Land as % of Total	4	3	5	4	4	3	4	3	3	1	3
i. OS Land as % of Total	24	17	25	22	28	26	27	22	20	12	21
j. OS Farms as % of Total Farms	20	13	24	18	27	26	27	22	20	14	22
Tenant Farms (T)											
a. Total Area	0.8	0.3	0.3	0.7	0.09	0	0.09	0	0	0	0
b. Total Number of Farms	1.1	0.8	0.2	1.1	0.03	0	0.03	0	0	0	0
c. T Area as % of Total	0	0	0	0	0	0	0	0	0	0	0
d. T Farms as % of Total Farms	0	0	0	0	0	0	0	0	0	0	0

See Table 1 for source and an explanatory note.

CHITTAGONG HILLS TRACT DISTRICT: SIZE AND DISTRIBUTION OF FARMS BY TENURE

('000)

	Size of Farms in Acres										
	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Total Area	172.6	3.1	25.9	29.0	45.1	33.5	78.6	33.5	25.1	6.3	64.9
Total Number of Farms	42.4	4.6	14.5	19.0	12.6	5.5	18.1	3.6	1.5	0.2	5.3
Owner-Operated Farms (O)											
a. Total Area	163.2	3.1	25.3	28.4	42.7	31.6	74.4	30.7	23.7	6.0	60.4
b. Total No. of Farms	40.7	4.5	14.2	18.7	11.9	5.2	17.1	3.3	1.4	0.2	4.9
c. O Area as % of Total	95	99	98	98	95	94	95	91	94	96	93
d. O Farms as % of Total Farms	96	99	98	98	95	94	95	92	94	95	93
e. Size/Farm (acres)	4.01	0.67	1.79	1.52	3.59	6.09	4.35	9.25	16.78	31.77	12.28
Owner-Sharecropped Farms (O)											
a. Total Area	8.9	0.009	0.5	0.5	2.3	1.8	4.1	2.6	1.5	0.3	4.4
b. Total No. of Farms	1.5	0.01	0.3	0.3	0.6	0.3	0.9	0.3	0.09	0.01	0.4
c. Land Owned	6.4	0	0.1	0.1	1.8	1.3	3.1	1.6	1.3	0.3	3.2
d. Land Sharecropped	2.5	0.01	0.3	0.3	0.5	0.5	1.0	1.0	0.1	0	1.1
e. Land Owned/Farm	4.17	0.00	0.51	0.48	2.83	4.47	3.35	5.99	14.97	28.40	8.78
f. Land Sharecropped/Farm	1.62	1.00	1.34	1.33	0.88	1.64	1.12	3.74	1.37	0.00	3.06
g. S Land as % of OS Land	28	100	72	73	24	27	25	38	8	0	26
h. S Land as % of Total	1	0	1	1	1	1	1	3	0	0	2
i. OS Land as % of Total	5	0	2	2	5	5	5	8	6	4	7
j. OS Farms as % of Total Farms	4	0	2	1	5	5	5	7	6	5	7
Tenant Farms (T)											
a. Total Area	0.5	0.008	0.1	0.1	0.08	0.1	0.2	0.2	0	0	0.2
b. Total No. of Farms	0.2	0.02	0.07	0.09	0.02	0.02	0.04	0.02	0	0	0.02
c. T Area as % of Total	0	0	1	0	0	0	0	1	0	0	0
d. T Farms as % of Total Farms	0	0	0	0	0	0	0	1	0	0	0

APPENDIX 1
Table 22

See Table 1 for source and an explanatory note.

APPENDIX 1
Table 23

BANGLADESH: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	21,726	6,139	100.0	100.0	3.54
Under 2.5	6,878	3,169	31.7	51.6	2.17
2.50 - 4.99	5,735	1,615	26.4	26.3	3.55
5.00 - 7.49	4,193	698	19.3	11.4	6.01
Subtotal (2.50 - 7.49)	9,928	2,313	45.7	37.7	4.92
7.50	4,920	656	22.7	10.7	7.50

Source: Estimated from Table 1

NORTHWEST BANGLADESH (RAJSHAHI DIVISION): SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	6,692	1,503	100.0	100.0	4.45
Under 2.50	1,894	569	28.3	37.9	3.33
2.50 - 4.99	1,690	473	25.3	31.5	3.57
5.00 - 7.49	1,382	231	20.7	15.4	5.98
Subtotal (2.50 - 7.49)	3,072	704	46.0	46.9	4.36
7.50	1,725	230	25.8	15.3	7.50

Source: Estimated from Table 2

APPENDIX 1
Table 24

SOUTHWEST BANGLADESH (KHULNA DIVISION):
SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	4,956	1,214	100.0	100.0	4.08
Under 2.50	1,416	534	28.6	44.0	2.65
2.50 - 4.99	1,206	335	24.3	27.6	3.60
5.00 - 7.49	1,052	175	21.2	14.4	6.01
Subtotal (2.50 - 7.49)	2,258	510	45.6	42.0	4.43
7.50	1,283	171	25.9	14.1	7.50

Source: Estimated from Table 3

CENTRAL BANGLADESH (DACCA DIVISION):
SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	5,830	1,794	100.0	100.0	3.25
Under 2.50	1,793	957	30.8	53.3	1.87
2.50 - 4.99	1,742	493	29.9	27.5	3.53
5.00 - 7.49	1,125	187	19.3	10.4	6.02
Subtotal (2.50 - 7.49)	2,867	680	49.2	37.9	4.22
7.50	1,170	156	20.1	8.7	7.50

Source: Estimated from Table 4

EASTERN BANGLADESH (CHITTAGONG DIVISION):
SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	4,249	1,628	100.0	100.0	2.61
Under 2.50	1,774	1,110	41.8	68.2	1.60
2.50 - 4.99	1,097	313	25.8	19.2	3.51
5.00 - 7.49	635	105	14.9	6.5	6.05
Subtotal (2.50 - 7.49)	1,732	418	40.7	25.7	4.14
7.50	743	99	17.5	6.1	7.50

Source: Estimated from Table 5

APPENDIX 1
Table 28

DINAJPUR DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,225.4	221.1	100.0	100.0	5.54
Under 2.5	315.1	49.4	25.7	22.3	6.38[1/]
2.50 - 4.99	277.2	77.3	22.6	35.0	3.59
5.00 - 7.49	279.5	46.9	22.8	21.2	5.96
Subtotal (2.50 - 7.49)	556.6	124.2	45.4	56.2	4.48
7.50	356.3	47.5	29.0	21.5	7.50

1/ If the land from large farms is redistributed among the small farms, their per farm holdings exceed 6.38 acres. As a result, in this district it should be redistributed among all farms below 7.5 acres.

Source: Estimated from Table 6.

RANGPUR DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,992.9	497.0	100.0	100.0	4.01
Under 2.5	565.2	204.8	28.4	41.2	2.76
2.50 - 4.99	584.0	165.9	29.3	33.4	3.52
5.00 - 7.49	398.3	66.9	20.0	13.5	5.95
Subtotal (2.50 - 7.49)	982.3	232.9	49.3	46.9	4.22
7.50	445.5	59.4	22.4	12.0	7.50

Source: Estimated from Table 7

PABNA DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	875.7	223.9	100.0	100.0	3.91
Under 2.50	264.9	105.5	30.3	47.1	2.51
2.50 - 4.99	214.7	59.8	24.5	26.7	3.59
5.00 - 7.49	173.9	28.9	19.9	12.9	6.02
Subtotal (2.50 - 7.49)	388.7	88.8	44.4	39.7	4.38
7.50	222.0	29.6	25.3	13.2	7.50

Source: Estimated from Table 8

APPENDIX 1
Table 31

MYMENSINGH DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	3,219.1	931.9	100.0	100.0	3.45
Under 2.50	947.2	463.9	29.4	49.8	2.04
2.50 - 4.99	958.6	271.6	29.8	29.1	3.53
5.00 - 7.49	632.9	105.6	19.7	11.3	5.99
Subtotal (2.50 - 7.49)	1,591.6	377.2	49.4	40.5	4.22
7.50	680.3	90.7	21.1	9.7	7.50

Source: Estimated from Table 9

SYLHET DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,623.4	402.6	100.0	100.0	4.03
Under 2.50	604.1	205.8	37.2	51.1	2.94
2.50 - 4.99	360.2	100.6	22.2	25.0	3.58
5.00 - 7.49	262.3	43.4	16.2	10.8	6.04
Subtotal (2.50 - 7.49)	622.5	143.9	38.3	35.7	4.33
7.50	396.8	52.9	24.4	13.1	7.50

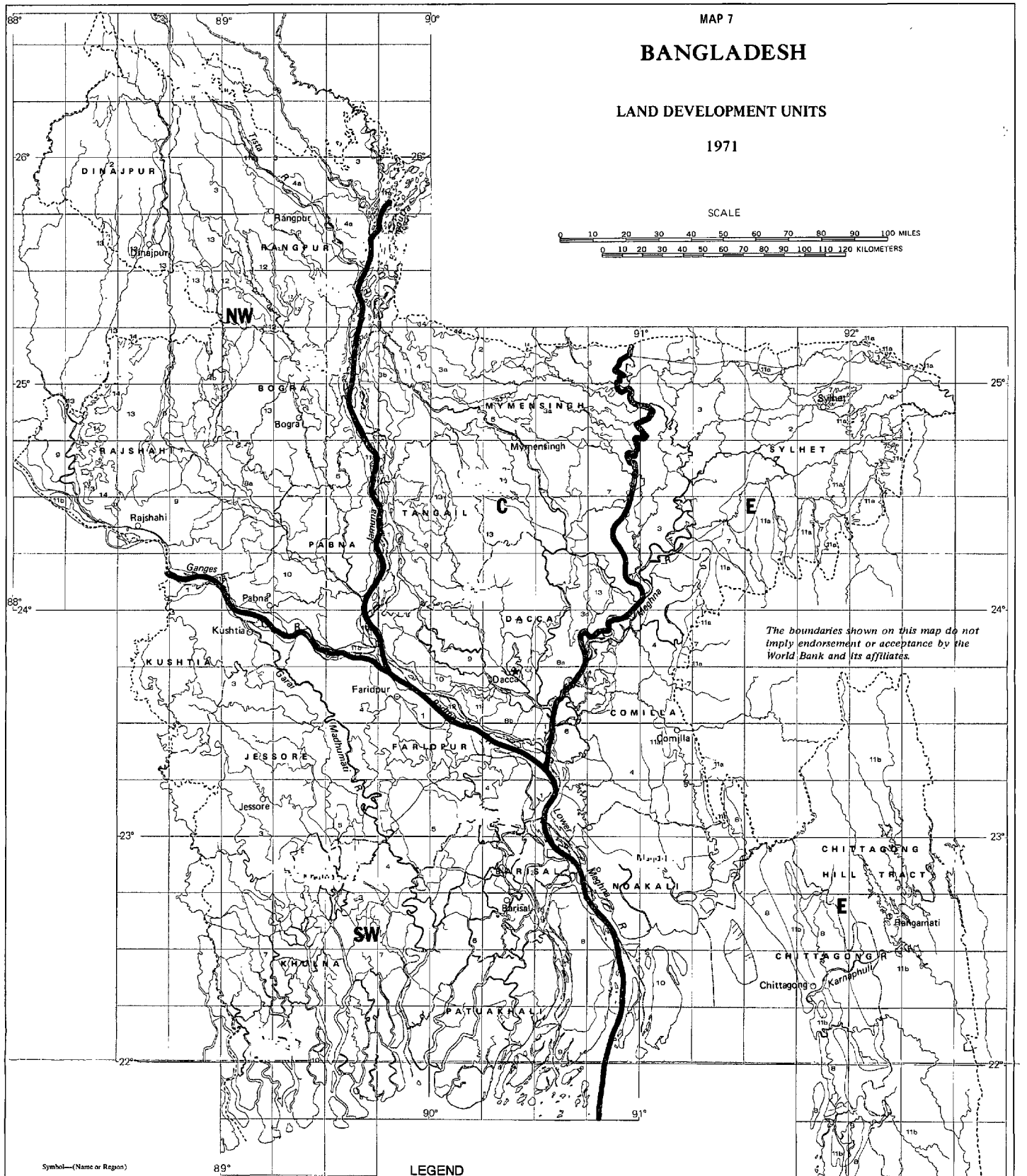
Source: Estimated from Table 10

MAP 7

BANGLADESH

LAND DEVELOPMENT UNITS

1971



Symbol—(Name or Region)

LEGEND

NW (Northwest Region)

1 Northern part of old Himalayan piedmont plain
2 Southern part of old Himalayan piedmont plain
3 Northern part of Tista floodplain
4 Northern Floodplain
  a Southern part of Tista floodplain
  b Little Jamuna floodplain
5 Karatoya-Bangali floodplain
6 Middle Atrai floodplain
7 Lower Atrai floodplain
8 Basin or Floodplain
  a Lower Atrai Basin
  b Lower Purnabhaba floodplain
9 Lower Mahananda and high part of Ganges floodplain
10 Low part of Ganges floodplain
11 Active Floodplains
  a Active floodplains of the Brahmaputra, Tista, Dharla, Dudhkumar and Gangadhar rivers
  b. Active Ganges floodplain
12 North-eastern Barind tract
13 Level Barind tract
14 Dissected Barind tract

C (Central Region)

1 Active Brahmaputra-Jamuna floodplain
2 North Mymensingh piedmont plain
3 High parts of old Brahmaputra floodplain
  a North Mymensingh
  b West Mymensingh
  c South Mymensingh
  d North-east Dacca
4 High old Brahmaputra ridges
5 Old Brahmaputra floodplain complex
6 North Mymensingh piedmont basins
7 Low parts of old Brahmaputra floodplain
8 Dacca Southeast
  a North of Dhaleswari river
  b South of Dhaleswari river
9 Southern part of Jamuna floodplain and part of old Brahmaputra floodplain
10 Old Ganges floodplain
11 Arial bil
12 Active Ganges floodplain
13 Madhupur tract
14 Northern hills

SW (Southwest Region)

1 Active Ganges floodplain
2 Mehendiganj area
3 Ganges-Kobadak Project Area (except tidal floodplain area)
4 Southeastern Ganges floodplain
5 Gopalganj-Khulna peat basins
6 Non-saline Ganges tidal floodplain
7 Saline Ganges tidal floodplain
8 Bhola (except extreme south)
9 South Bhola and off-shore islands outside the Coastal Embankment Project Area
10 Khulna Sunderbans

E (Eastern Region)

1 Northern piedmont plain
2 Eastern Surma-Kushiyara floodplain
3 Sylhet basin
4 Low parts of Meghna estuarine floodplain
5 High Meghna estuarine floodplain and Comilla basin
6 Middle Meghna floodplain
7 Eastern piedmont plain
8 Chittagong coastal plain and offshore islands
9 Chakaria Sunderbans
10 Young lower Meghna estuarine floodplain
11 Northern and eastern hill areas
  a. Sylhet, Mymensingh and Comilla
  b Chittagong and Chittagong Hill Tracts

= Regional Boundaries
= Unit Boundaries
6 = Unit Numbers

IBRD 3872

NOAKHALI DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	661.2	324.7	100.0	100.0	2.04
Under 2.50	303.6	247.4	45.9	76.2	1.23
2.50 - 4.99	168.7	48.9	25.5	15.1	3.45
5.00 - 7.49	90.7	15.3	13.7	4.7	5.93
Subtotal (2.50 - 7.49)	259.4	64.3	39.2	19.8	4.03
7.50	98.3	13.1	14.9	4.0	7.50

Source: Estimated from Table 11

APPENDIX 1
Table 34

CHITTAGONG DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	699.9	265.6	100.0	100.0	2.64
Under 2.50	313.1	183.5	44.7	69.1	1.71
2.50 - 4.99	179.6	51.3	25.7	19.3	3.50
4.50 - 7.49	99.3	16.5	14.2	6.2	6.02
Subtotal (2.50 - 7.49)	278.9	67.8	39.8	25.5	4.11
7.50	108.0	14.4	15.4	5.4	7.50

Source: Estimated from Table 12

APPENDIX 1
Table 35

FARIDPUR DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,261.8	298.4	100.0	100.0	3.17
Under 2.50	392.8	218.5	31.1	54.8	1.80
2.50 - 4.99	371.3	105.0	29.4	26.4	3.54
4.50 - 7.49	250.9	41.9	19.9	10.5	5.99
Subtotal (2.50 - 7.49)	622.3	146.9	49.3	36.9	4.24
7.50	246.8	32.9	19.6	8.3	7.50

Source: Estimated from Table 13

APPENDIX 1
Table 36

JESSORE DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,354.8	306.5	100.0	100.0	4.42
Under 2.50	298.5	104.3	22.0	34.0	2.86
2.50 - 4.99	357.4	97.6	26.4	31.8	3.66
5.00 - 7.49	357.7	59.1	26.4	19.3	6.05
Subtotal (2.50 - 7.49)	715.1	156.7	52.8	51.1	4.56
7.50	341.3	45.5	25.2	14.8	7.50

Source: Estimated from Table 14

KHULNA DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	4,955.7	1,214.3	100.0	100.0	4.08
Under 2.50	1,421.5	533.6	28.7	43.9	2.66
2.50 - 4.99	1,205.7	335.5	24.3	27.6	3.59
5.00 - 7.49	1,051.9	174.9	21.1	14.4	6.01
Subtotal (2.50 - 7.49)	2,257.6	510.4	45.6	42.0	4.42
7.50	1,276.5	170.2	25.8	14.0	7.50

Source: Estimated from Table 15

RAJSHAHI DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,847.0	366.4	100.0	100.0	5.04
Under 2.50	537.7	125.9	29.1	34.4	4.27[1]
2.50 - 4.99	386.1	105.6	20.9	28.8	3.66
5.00 - 7.49	377.9	62.2	20.5	17.0	6.08
Subtotal (2.50 - 7.49)	764.0	167.9	41.4	45.8	4.55
7.50	545.3	72.7	29.5	19.8	7.50

[1] Since per farm holdings exceed 2.50 acres after land redistribution, it is only fair that land should be redistributed among farms below and above 2.50 acres.

Source: Estimated from Table 16.

BOGRA DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 rms as % of otal Farms	Size/Farm
Total	750.6	194.9	100.0	100.0	3.86
Under 2.50	212.2	83.5	28.3	42.8	2.54
2.50 - 4.99	228.1	64.9	30.4	33.3	3.52
5.00 - 7.49	151.9	25.5	20.2	13.1	5.96
Subtotal (2.50 - 7.49)	380.1	90.4	50.6	46.4	4.21
7.50	158.3	21.1	21.1	10.8	7.50

Source: Estimated from Table 17

APPENDIX 1
Table 39

KUSHTIA DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	618.4	106.7	100.0	100.0	5.80
Under 2.50	166.9	25.6	27.0	24.0	6.52[1/]
2.50 - 4.99	118.6	32.1	19.2	30.1	3.70
5.00 - 7.49	140.2	23.3	22.7	21.8	6.02
Subtotal (2.50 - 7.49)	258.8	55.4	41.8	51.9	4.67
7.50	192.8	25.7	31.2	24.1	7.50

1/ See footnote 1 of Table 37.

Source: Estimated from Table 18.

APPENDIX 1
Table 40

BARISAL DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,836.5	507.7	100.0	100.0	3.62
Under 2.50	613.8	264.9	33.4	52.2	2.32
2.50 - 4.99	460.9	130.4	25.1	25.7	3.53
5.00 - 7.49	324.5	54.2	17.7	10.7	5.99
Subtotal (2.50 - 7.49)	785.4	184.6	42.8	36.4	4.25
7.50	437.3	58.3	23.8	11.5	7.50

Source: Estimated from Table 19

APPENDIX 1
Table 41

DACCA DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,348.8	463.2	100.0	100.0	2.91
Under 2.50	456.5	274.8	33.8	59.3	1.66
2.50 - 4.99	412.2	116.7	30.6	25.2	3.53
5.00 - 7.49	240.8	39.9	17.9	8.6	6.04
Subtotal (2.50 - 7.49)	652.9	156.6	48.4	33.8	4.17
7.50	239.3	31.9	17.7	6.9	7.50

Source: Estimated from Table 20

APPENDIX 1
Table 42

APPENDIX 1
Table 43

COMILLA DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,091.6	592.9	100.0	100.0	1.84
Under 2.50	491.6	454.4	45.0	76.6	1.08
2.50 - 4.99	343.1	99.3	31.4	16.7	3.46
5.00 - 7.49	148.9	24.8	13.6	4.2	6.00
Subtotal (2.50 - 7.49)	492.1	124.1	45.1	20.9	3.97
7.50	108.0	14.4	9.9	2.4	7.50

Source: Estimated from Table 21

APPENDIX 1
Table 44

CHITTAGONG HILL TRACTS DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	172.6	42.4	100.0	100.0	4.07
Under 2.50	54.1	19.0	31.3	44.8	2.85
2.50 - 4.99	45.1	12.6	26.1	29.7	3.58
5.00 - 7.49	33.5	5.5	19.4	13.0	6.09
Subtotal (2.50 - 7.49)	78.6	18.1	45.5	42.7	4.34
7.50	39.8	5.3	23.1	12.5	7.50

Source: Estimated from Table 22

BANGLADESH: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	21,726	6,139	100.0	100.0	3.54
Under 2.50	4,964	3,169	22.9	51.6	1.57
2.50 - 4.99	5,735	1,615	26.4	26.3	3.55
5.00 - 7.49	4,193	698	19.3	11.4	6.01
Subtotal (2.50 - 7.49)	9,928	2,313	45.7	37.7	4.92
7.50 - 12.49	4,159	442	19.4	7.2	9.41
12.50	2,675	214	12.3	3.5	12.50

Source: Estimated from Table 1

NORTHWEST BANGLADESH (RAJSHAHI DIVISION): SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	6,692	1,503	100.0	100.0	4.45
Under 2.50	1,209	569	18.1	37.9	2.12
2.50 - 4.99	1,690	473	25.3	31.5	3.57
5.00 - 7.49	1,382	231	20.7	15.4	5.98
Subtotal (2.50 - 7.49)	3,072	704	46.0	46.9	4.36
7.50 - 12.49	1,434	152	21.4	10.1	9.43
12.50	975	78	14.6	5.2	12.50

Source: Estimated from Table 2.

SOUTHWEST BANGLADESH (KHULNA DIVISION): SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	4,956	1,214	100.0	100.0	4.08
Under 2.50	998	534	20.1	44.0	1.87
2.50 - 4.99	1,206	335	24.3	27.6	3.60
5.00 - 7.49	1,052	175	21.2	14.4	6.01
Subtotal (2.50 - 7.49)	2,258	510	45.6	42.0	4.43
7.50 - 12.49	1,079	115	21.8	9.5	9.38
12.50	700	56	14.1	4.6	12.50

Source: Estimated from Table 3

APPENDIX 1
Table 47

CENTRAL BANGLADESH (DACCA DIVISION): SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	5,830	1,794	100.0	100.0	3.25
Under 2.50	1,360	957	23.3	53.3	1.42
2.50 - 4.99	1,742	493	29.9	27.5	3.53
5.00 - 7.49	1,125	187	19.3	10.4	6.02
Subtotal (2.50 - 7.49)	2,867	680	49.2	37.9	4.22
7.50 - 12.49	1,028	110	17.6	6.1	9.35
12.50	575	46	9.9	2.6	12.50

Source: Estimated from Table 4.

EASTERN BANGLADESH (CHITTAGONG DIVISION): SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	4,249	1,628	100.0	100.0	2.61
Under 2.50	1,475	1,110	34.7	68.2	1.33
2.50 - 4.99	1,097	313	25.8	19.2	3.51
5.00 - 7.49	635	105	14.9	6.5	6.05
Subtotal (2.50 - 7.49)	1,732	418	40.7	25.7	4.14
7.50 - 12.49	617	65	14.5	4.0	9.49
12.50	425	34	10.0	2.1	12.50

Source: Estimated from Table 5

APPENDIX 1
Table 50

DINJAPUR DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,225.4	221.1	100.0	100.0	5.54
Under 2.50	170.6	49.4	13.9	22.3	3.45
2.50 - 4.99	277.2	77.3	22.6	35.0	3.59
5.00 - 7.49	279.5	46.9	22.8	21.2	5.96
Subtotal (2.50 - 7.49)	556.6	124.2	45.4	56.2	4.48
7.50 - 12.49	286.7	30.5	23.4	13.8	9.40
12.50	211.3	16.9	17.2	7.8	12.50

Source: Estimated from Table 6

RANGPUR DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,992.9	497.0	100.0	100.0	4.01
Under 2.50	395.6	204.8	19.9	41.2	1.93
2.50 - 4.99	584.0	165.9	29.3	33.4	3.52
5.00 - 7.49	398.3	66.9	20.0	13.5	5.95
Subtotal (2.50 - 7.49)	982.3	232.9	49.3	46.9	4.22
7.50 - 12.49	381.3	40.7	19.1	8.2	9.37
12.50	233.8	18.7	11.7	3.8	12.50

Source: Estimated from Table 7

PABNA DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	875.7	223.9	100.0	100.0	3.91
Under 2.50	175.4	105.5	20.0	47.1	1.66
2.50 - 4.99	214.7	59.8	24.5	26.7	3.59
5.00 - 7.49	173.9	28.9	19.9	12.9	6.02
Subtotal (2.50 - 7.49)	388.7	88.8	44.4	39.7	4.38
7.50 - 12.49	182.8	19.4	20.9	8.7	9.42
12.50	128.8	10.3	14.7	4.6	12.50

Source: Estimated from Table 8

MYMENSINGH DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	3,219.1	931.9	100.0	100.0	3.45
Under 2.50	693.9	463.9	21.6	49.8	1.50
2.50 - 4.99	958.6	271.6	29.8	29.1	3.53
5.00 - 7.49	632.9	105.6	19.7	11.3	5.99
Subtotal (2.50 - 7.49)	1,591.6	377.2	49.4	40.5	4.22
7.50 - 12.49	596.1	63.8	18.5	6.9	9.34
12.50	337.5	27.0	10.5	2.9	12.50

Source: Estimated from Table 9.

APPENDIX 1
Table 54

SYLHET DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,623.4	402.6	100.0	100.0	4.03
Under 2.50	436.0	205.8	26.9	51.1	2.12
2.50 - 4.99	360.2	100.6	22.2	25.0	3.58
5.00 - 7.49	262.3	43.4	16.2	10.8	6.04
Subtotal (2.50 - 7.49)	622.5	143.9	38.3	35.7	4.33
7.50 - 12.49	306.2	32.1	18.9	8.0	9.54
12.50	258.8	20.7	16.0	5.1	12.50

Source: Estimated from Table 10

APPENDIX 1
Table 55

NOAKHALI DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	661.2	324.7	100.0	100.0	2.04
Under 2.50	265.9	247.4	40.2	76.2	1.07
2.50 - 4.99	168.7	48.9	25.5	15.1	3.45
5.00 - 7.49	90.7	15.3	13.7	4.7	5.93
Subtotal (2.50 - 7.49)	259.4	64.3	39.2	19.8	4.03
7.50 - 12.49	76.7	8.6	11.6	2.7	8.92
12.50	56.3	4.5	8.5	1.4	12.50

Source: Estimated from Table 11

APPENDIX 1
Table 56

CHITTAGONG DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	699.9	265.6	100.0	100.0	2.64
Under 2.50	270.8	183.5	38.7	69.1	1.48
2.50 - 4.99	179.6	51.3	25.7	19.3	3.50
4.50 - 7.49	99.3	16.5	14.2	6.2	6.02
Subtotal (2.50 - 7.49)	278.9	67.8	39.8	25.5	4.11
7.50 - 12.49	89.0	9.5	12.7	3.6	9.37
12.50	61.3	4.9	8.8	1.8	12.50

Source: Estimated from Table 12

APPENDIX 1
Table 57

FARIDPUR DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,261.8	398.4	100.0	100.0	3.17
Under 2.50	304.2	218.5	24.1	54.8	1.39
2.50 - 4.99	371.3	105.0	29.4	26.4	3.54
4.50 - 7.49	250.9	41.9	19.9	10.5	5.99
Subtotal (2.50 - 7.49)	622.3	146.9	49.3	36.9	4.24
7.50 - 12.49	219.0	23.6	17.4	5.9	9.28
12.50	116.3	9.3	9.2	2.3	12.50

Source: Estimated from Table 13.

APPENDIX 1
Table 58

JESSORE DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,354.8	306.5	100.0	100.0	4.42
Under 2.50	178.0	104.3	13.1	34.0	1.71
2.50 - 4.99	357.4	97.6	26.4	31.8	3.66
5.00 - 7.49	357.7	59.1	26.4	19.3	6.05
Subtotal (2.50 - 7.49)	715.1	156.7	52.8	51.1	4.56
7.50 - 12.49	318.0	33.9	23.5	11.1	9.38
12.50	143.8	11.5	10.6	3.8	12.50

Source: Estimated from Table 14.

KHULNA DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	4,955.7	1,214.3	100.0	100.0	4.08
Under 2.50	924.5	533.6	18.7	43.9	1.73
2.50 - 4.99	1,205.7	335.5	24.3	27.6	3.59
5.00 - 7.49	1,051.9	174.9	21.1	14.4	6.01
Subtotal (2.50 - 7.49)	2,257.6	510.4	45.6	42.0	4.42
7.50 - 12.49	1,078.5	114.6	21.8	9.4	9.41
12.50	695.0	55.6	14.0	4.6	12.50

Source: Estimated from Table 15

APPENDIX 1
Table 60

RAJSHAHI DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,847.0	366.4	100.0	100.0	5.04
Under 2.50	313.6	125.9	17.0	34.4	2.49
2.50 - 4.99	386.1	105.6	20.9	28.8	3.66
5.00 - 7.49	377.9	62.2	20.5	17.0	6.08
Subtotal (2.50 - 7.49)	764.0	167.9	41.4	45.8	4.55
7.50 - 12.49	440.6	46.4	23.9	12.7	9.50
12.50	328.8	26.3	17.8	7.2	12.50

Source: Estimated from Table 16

BOGRA DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	750.6	194.9	100.0	100.0	3.86
Under 2.50	153.9	83.5	20.5	42.8	1.84
2.50 - 4.99	228.1	64.9	30.4	33.3	3.52
5.00 - 7.49	151.9	25.5	20.2	13.1	5.96
Subtotal (2.50 - 7.49)	380.1	90.4	50.6	46.4	4.21
7.50 - 12.49	144.1	15.3	19.2	7.9	9.42
12.50	72.5	5.8	9.7	3.0	12.50

Source: Estimated from Table 17

APPENDIX 1
Table 62

KUSHTIA DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	618.4	106.7	100.0	100.0	5.80
Under 2.50	88.3	25.6	14.3	24.0	3.45
2.50 - 4.99	118.6	32.1	19.2	30.1	3.70
5.00 - 7.49	140.2	23.3	22.7	21.8	6.02
Subtotal (2.50 - 7.49)	258.8	55.4	41.8	51.9	4.67
7.50 - 12.49	153.9	16.3	24.9	15.3	9.44
12.50	117.5	9.4	19.0	8.8	12.50

Source: Estimated from Table 18

APPENDIX 1
Table 63

BARISAL DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,836.5	507.7	100.0	100.0	3.62
Under 2.50	437.8	264.9	23.8	52.2	1.65
2.50 - 4.99	460.9	130.4	25.1	25.7	3.53
4.50 - 7.49	324.5	54.2	17.7	10.7	5.99
Subtotal (2.50 - 7.49)	785.4	184.6	42.8	36.4	4.25
7.50 - 12.49	350.7	37.4	19.1	7.4	9.38
12.50	262.5	21.0	14.3	4.1	12.50

Source: Estimated from Table 19

DACCA DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,348.8	463.2	100.0	100.0	2.91
Under 2.50	370.5	274.8	27.5	59.3	1.35
2.50 - 4.99	412.2	116.7	30.6	25.2	3.53
5.00 - 7.49	240.8	39.9	17.9	8.6	6.04
Subtotal (2.50 - 7.49)	652.9	156.6	48.4	33.8	4.17
7.50 - 12.49	212.8	22.8	15.8	4.9	9.33
12.50	112.5	9.0	8.3	1.9	12.50

Source: Estimated from Table 20.

APPENDIX 1
Table 64

COMILLA DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND
('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	1,091.6	592.9	100.0	100.0	1.84
Under 2.50	458.5	454.4	42.0	76.6	1.01
2.50 - 4.99	343.1	99.3	31.4	16.7	3.46
4.50 - 7.49	148.9	24.8	13.6	4.2	6.00
Subtotal (2.50 - 7.49)	492.1	124.1	45.1	20.9	3.97
7.50 - 12.49	108.6	11.7	10.0	2.0	9.28
12.50	32.5	2.6	3.0	0.4	12.50

Source: Estimated from Table 21.

CHITTAGONG HILL TRACTS DISTRICT: SIZE OF FARMS UNDER REDISTRIBUTION OF LAND ('000)

Farm Size (in acres)	Total Area	Total Number of Farms	0 Area as % of Total	Number of 0 Farms as % of Total Farms	Size/Farm
Total	172.6	42.4	100.0	100.0	4.07
Under 2.50	39.1	19.0	22.7	44.8	2.06
2.50 - 4.99	45.1	12.6	26.1	29.7	3.58
5.00 - 7.49	33.5	5.5	19.4	13.0	6.09
Subtotal (2.50 - 7.49)	78.6	18.1	45.5	42.7	4.34
7.50 - 12.49	33.5	3.6	19.4	8.5	9.31
12.50	21.3	1.7	12.3	4.0	12.50

Source: Estimated from Table 22

BANGLADESH: AVERAGE SIZE OF FARMS IN ACRES
('000)

Area	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Bangladesh	3.53	0.47	1.69	1.11	3.55	6.01	4.29	9.41	16.31	40.11	12.60
Regions											
Rajshahi Division	4.45	0.49	1.72	1.29	3.57	5.98	4.36	9.44	16.37	33.90	12.55
Khulna Division	4.08	0.45	1.70	1.10	3.60	6.01	4.43	9.38	16.33	33.43	12.36
Dacca Division	3.25	0.49	1.69	1.16	3.53	6.02	4.22	9.35	16.05	32.60	11.86
Chittagong Division	2.61	0.46	1.65	0.99	3.50	6.05	4.14	9.49	16.50	76.50	14.32
Districts											
Dinajpur	5.54	0.48	1.75	1.44	3.83	5.95	4.48	9.40	16.10	33.63	12.58
Rangpur	4.01	0.56	1.71	1.37	3.52	5.95	4.22	9.37	16.18	34.39	12.30
Pabna	3.91	0.41	1.70	1.06	3.59	6.00	4.38	9.44	16.34	33.65	12.66
Mymensingh	3.45	0.46	1.71	1.18	3.53	5.99	4.22	9.34	16.18	34.28	11.91
Sylhet	4.03	0.48	1.67	1.11	3.58	6.05	4.32	9.55	16.54	60.00	14.63
Noakhali	2.04	0.48	1.60	0.94	3.44	5.94	4.04	9.32	16.51	40.95	12.97
Chittagong	2.64	0.36	1.67	0.90	3.50	6.03	4.12	9.42	16.16	138.36	17.85
Faridpur	3.17	0.52	1.66	1.14	3.54	5.99	4.24	9.28	16.16	35.68	11.85
Jessore	4.42	0.45	1.77	1.15	3.66	6.05	4.56	9.37	16.14	31.74	11.41
Khulna	4.08	0.45	1.70	1.10	3.59	6.01	4.42	9.41	16.34	34.85	12.41
Rajshahi	5.04	0.47	1.73	1.21	3.66	6.07	4.55	9.50	16.70	32.29	12.80
Bogra	3.85	0.55	1.72	1.39	3.52	5.95	4.20	9.44	16.22	37.20	12.05
Kushtia	5.80	0.51	1.74	1.29	3.70	6.01	4.67	9.45	16.47	33.47	12.71
Barisal	3.62	0.47	1.68	1.10	3.53	5.99	4.26	9.38	16.42	36.62	13.04
Dacca	2.91	0.51	1.68	1.15	3.53	6.03	4.17	9.35	16.15	36.22	11.89
Comilla	1.84	0.48	1.63	0.98	3.45	6.01	3.96	9.27	15.94	37.69	10.71
Chittagong Hill Tracts	4.07	0.67	1.79	1.52	3.59	6.09	4.35	9.29	16.75	31.60	12.24

Source: Estimated from data presented in Tables 1 through 22.

BANGLADESH: PERCENTAGE DISTRIBUTION OF FARMS BY SIZE
('000)

Area	Total	Under 1.00	1.00 - 2.49	Sub-total	2.50 - 4.99	5.00 - 7.49	Sub-total	7.50 - 12.49	12.50 - 24.99	25.00 & Over	Sub-total
Bangladesh	100	24.3	27.3	51.6	26.3	11.4	37.7	7.2	3.1	0.4	10.7
Regions											
Rajshahi Division	100	13.4	24.5	37.9	31.5	15.4	46.8	10.1	4.5	0.7	15.3
Khulna Division	100	21.2	22.8	44.0	27.6	14.4	42.0	9.5	4.0	0.6	14.1
Dacca Division	100	23.5	29.9	53.3	17.9	10.4	37.9	6.1	2.3	0.3	8.7
Chittagong Division	100	37.7	30.5	68.2	19.2	6.5	25.7	4.0	1.8	0.3	6.1
Districts											
Dinajpur	100	5.5	16.9	22.3	32.7	21.2	56.2	13.8	6.7	1.0	21.5
Rangpur	100	12.3	28.9	41.2	33.4	13.5	46.9	8.2	3.3	0.5	12.0
Pabna	100	23.2	24.0	47.1	26.7	13.0	39.7	8.7	4.0	0.6	13.2
Mymensingh	100	21.2	28.6	49.8	29.1	11.3	40.5	6.9	2.6	0.3	9.7
Sylhet	100	24.3	26.9	51.1	25.0	10.8	35.8	8.0	4.5	0.7	13.1
Noakhali	100	45.2	31.0	76.2	15.1	4.7	19.8	2.6	1.2	0.2	4.0
Chittagong	100	41.0	28.1	69.1	19.3	6.2	25.5	3.6	1.6	0.3	5.4
Faridpur	100	24.9	29.9	54.9	26.4	10.5	36.9	5.9	2.1	0.3	8.3
Jessore	100	15.8	18.2	34.0	31.8	19.3	51.1	11.1	3.5	0.3	14.8
Khulna	100	21.2	22.8	44.0	27.6	14.4	42.0	9.4	4.0	0.5	14.0
Rajshahi	100	14.2	20.2	34.4	28.8	17.0	45.8	12.7	6.3	0.9	19.8
Bogra	100	12.2	30.6	42.8	33.3	13.1	46.4	7.8	2.6	0.4	10.8
Kushtia	100	8.7	15.3	24.0	30.0	21.9	51.9	15.3	7.9	1.0	24.1
Barisal	100	24.9	27.3	52.2	25.7	10.7	36.4	7.4	3.5	0.6	11.5
Dacca	100	26.8	32.5	59.3	25.2	8.6	33.8	4.9	1.8	0.2	6.9
Comilla	100	43.2	33.5	76.7	16.8	4.2	21.0	2.0	0.4	-	2.4
Chittagong Hill Tracts	100	10.8	34.1	44.9	29.6	13.0	42.6	8.5	3.5	0.5	12.5

Source: Estimated from data presented in Table 1 through 22.

APPENDIX 1
Table 68

ACREAGE, YIELD AND USE OF FERTILIZER BY OWNER AND SHARECROPPED FARMS IN UNIRRIGATED AREAS OF PHULPUR

Crop	Variety	Number of Farmers		Average Area Under Crops (Acres)		Average Yield Per Acre (mds.)		Number of Farmers Using Fertilizer		Use of Fertilizer Per Acre by Those Who Applied (Seers)	
		Owner Operator	Share-cropped	Owner Operator	Share-cropped	Owner Operator	Share-cropped	Owner Operator	Share-cropped	Owner Operator	Share-cropped
Aus	T.V.	37	30	1.07	1.02	12.38	7.42	7	5	55.55	22.34
Aus	I.T.V.	7	-	0.60	-	12.72	-	3	-	77.93	-
Aus	B.C.	-	7	-	0.29	-	6.03	-	-	-	-
Aman	T.V.	45	51	1.59	1.10	16.83	14.02	9	9	20.42	14.21
Aman	I.T.V.	11	13	0.77	0.76	17.11	23.27	1	6	79.17	26.95
Aman	B.C.	-	18	-	0.76	-	9.26	-	-	-	-
Boro	T.V.	11	12	0.56	0.62	25.49	20.32	4	7	64.35	28.63
Jute	T.V.	-	23	-	0.41	-	12.02	-	5	-	18.99
TOTAL		111	154					(22%) of total	(21%) of total		

T.V. = Traditional Variety
I.T.V.= Improved Traditional Variety
IRRI = International Rice Research Institute's Variety
B.C. = Broadcast

Source: Farm Survey of the Owner and Sharecropped Farm in East Pakistan (Conducted for this study)

APPENDIX 2
Table 1

SHARING OF FERTILIZER COSTS IN SHARECROPPED LAND IN THE UNIRRIGATED AREA OF PHULPUR

Crop	Variety	Total No. of Share-cropped Farmers	Number of Farmers Using Fertilizer	Distribution of Cost of Fertilizer (No. of Cases)		
				Share-cropper	Land-owner	Shared By Both
Aus	T.V.	30	5	3	-	2
Aus	I.T.V.	-	-	-	-	-
Aus	B.C.	7	-	-	-	-
Aman	T.V.	51	9	6	2	1
Aman	I.T.V.	13	6	5	-	1
Aman	B.C.	18	-	-	-	-
Boro	T.V.	12	7	4	1	2
Boro	IRRI	-	-	-	-	-
Jute	T.V.	23	5	2	1	2
TOTAL		154	32	20	4	8

T.V. = Traditional Variety
I.T.V. = Improved Traditional Variety
B.C. = Broadcast
IRRI = International Rice Research Institute's Variety.

Source: Farm Survey of the Owner and Sharecropped in East Pakistan (Conducted for this Study).

ACREAGE, YIELD AND USE OF FERTILIZER BY OWNER AND SHARECROPPED FARMS IN UNIRRIGATED AREAS OF PHULPUR

Crop	Variety	Number of Farmers		Average Area Under Crops (Acres)		Average Yield Per Acre (mds.)		Number of Farmers Using Fertilizer		Use of Fertilizer Per Acre by Those Who Applied (Seers)	
		Owner Operator	Share-cropped	Owner Operator	Share-cropped	Owner Operator	Share-cropped	Owner Operator	Share-cropped	Owner Operator	Share-cropped
Aus	IRRI	8	8	0.52	0.68	48.82	33.02	8	8	135.42	115.93
Boro	T.V.	26	33	0.99	0.89	30.75	23.98	26	33	112.45	64.84
Boro	IRRI	15	13	0.72	0.86	38.52	27.53	15	13	259.33	105.66
TOTAL		49	54					49	54		

IRRI = International Rice Research Institute's Variety

T.V. = Traditional Variety

Source: Farm Survey of the Owner and Sharecropped Farm in East Pakistan (Conducted for this study).

APPENDIX 2
Table 3

APPENDIX 2
Table 4

SHARING OF FERTILIZER AND IRRIGATION COSTS IN SHARECROPPED LAND IN THE IRRIGATED AREA OF PHULPUR

Crop	Variety	Total No. of Share-cropped Farmers	Number of Farmers Using the Fertilizer	Distribution of Cost of Fertilizer (No. of Cases)			Distribution of Cost of Irrigation Water (No. of cases)		
				Share-cropped	Land-owner	Shared By Both	Share-cropped	Land-owner	Shared By Both
Aus	IRRI	8	8	6	-	2	2	3	3
Boro	T.V.	33	33	17	3	13	4	12	17
Boro	IRRI	13	13	4	1	8	-	3	10
TOTAL		54	54	27	4	23	6	18	30

T.V. = Traditional Variety

IRRI = International Rice Research Institute's Variety

Source: Farm Survey of the Owner and Sharecropped Farms in East Pakistan (Conducted for this study).

ACREAGE, YIELD AND USE OF FERTILIZER BY OWNER AND SHARECROPPED FARMS IN UNIRRIGATED AREAS OF THAKURGAON

Crop	Variety	Number of Farmers		Average Area Under Crops (Acres)		Average Yield Per Acre (mds.)		Number of Farmers Using Fertilizer		Use of Fertilizer Per Acre by Those Who Applied (Seers)	
		Owner Operator	Share-cropped	Owner Operator	Share-cropped	Owner Operator	Share-cropped	Owner Operator	Share-cropped	Owner Operator	Share-cropped
Aus	T.V.	23	17	0.76	0.67	12.54	13.56	9	4	34.53	24.25
Aman	T.V.	26	24	1.30	1.31	17.30	13.17	5	4	22.00	26.25
Jute	T.V.	20	12	0.43	0.38	8.53	9.33	3	2	30.67	18.25
Sugar-cane	T.V.	17	12	0.73	0.59	226.65	226.11	7	6	40.95	46.45
Oil Seeds	T.V.	18	6	0.44	0.29	3.05	3.11	7	4	34.57	27.50
TOTAL		104	71					(30%) of total	(28%) of total		

T.V. = Traditional Variety.

Source: Farm Survey of the Owner and Sharecropped in East Pakistan (Conducted for this study).

APPENDIX 2
Table 5

ACREAGE, YIELD AND USE OF FERTILIZER BY OWNER AND SHARECROPPED FARMS IN IRRIGATED AREAS OF THAKURGAON

Crop	Variety	Number of Farmers		Average Area Under Crops (Acres)		Average Yield Per Acre (mds.)		Number of Farmers Using Fertilizer		Use of Fertilizer Per Acre by Those Who Applied (Seers)	
		Owner Operator	Share-cropped	Owner Operator	Share-cropped	Owner Operator	Share-cropped	Owner Operator	Share-cropped	Owner Operator	Share-cropped
Aus	T.V.	7	10	0.86	0.88	11.83	14.50	2	3	25.00	37.27
Aus	IRRI	5	6	0.65	0.60	22.00	12.68	5	5	58.00	67.00
Aman	T.V.	15	18	1.35	1.22	16.44	14.24	5	6	32.27	31.49
Jute	T.V.	9	8	0.63	0.33	7.74	6.29	6	2	30.00	20.00
Sugar-cane	T.V.	10	6	0.56	0.47	272.34	267.67	6	3	40.65	62.41
Oil Seeds	T.V.	6	4	0.52	0.57	3.12	3.73	2	3	78.00	24.02
TOTAL		52	52					26	22		

T.V. = Traditional Variety
IRRI = International Rice Research Institute's Variety.

Source: Farm Survey of the Owner and Sharecropped Farms in East Pakistan (Conducted for this study).

APPENDIX 2
Table 6

SHARING OF FERTILIZER COSTS IN SHARECROPPED LAND IN THE UNIRRIGATED AREA OF THAKURGAON

Crop	Variety	Total No. of Share-cropped Farmers	Number of Farmers Using Fertilizer	Distribution of Cost of Fertilizer (No. of Cases)		
				Share-cropper	Land-owner	Shared By Both
Aus	T.V.	17	4	1	-	3
Aus	IRRI	-	-	-	-	-
Aman	T.V.	24	4	1	2	1
Jute	T.V.	12	2	2	-	-
Sugar-cane	T.V.	12	6	1	1	3
Oil Seeds	T.V.	6	4	1	1	2
TOTAL		71	20	6	4	9

T.V. = Traditional Variety

IRRI = International Rice Research Institute's Variety.

Source: Farm Survey of the Owner and Sharecropped Farms in East Pakistan (Conducted for this study).

SHARING OF FERTILIZER AND IRRIGATION COSTS IN SHARECROPPED LAND IN THE IRRIGATED AREAS OF THAKURGAON

Crop	Variety	Total No. of Share-cropped Farmers	Number of Farmers Using Fertilizer	Distribution of Cost of Fertilizer (No. of Cases)		
				Share-cropped	Land-owner	Shared By Both
Aus	T.V.	10	3	-	-	3
Aus	IRRI	6	5	-	4	1
Aman	T.V.	18	6	1	3	2
Jute	T.V.	8	2	1	1	-
Sugar-cane	T.V.	6	3	1	1	1
Oil Seeds	T.V.	4	3	1	1	1
TOTAL		52	22	4	10	8

T.V. = Traditional Variety

IRRI = International Rice Research Institute's Variety

Source: Farm Survey of the Owner and Sharecropped Farms in East Pakistan (Conducted for this study).