PN-ABS-222

Working Paper No. 1

INPUT-OUTPUT COEFFICIENTS IN CROP PRODUCTION ACTIVITIES IN BANGLADESH
- with results on relative financial profitability at farm level

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June 1993

Funded by USAID under Contract No. 388-0027-C-00-9026-00

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Chapter I

Introduction

Technology in crop production is generally approached by economists in terms of production function analyses. Such an approach allows one to estimate contributions of various inputs to total output as well as infer on efficiency upon comparing with input prices. In the absence of data on input use at a national level, such exercises are available for household/plot level sample data; and it is difficult to establish the robustness of any one estimate. For most practical purposes, especially for macro modelling exercises, it is a common practice to assume fixed input-output relations for different crop production activities. The present exercise is an effort to identify the sets of such coefficients for a large number of crops currently cultivated in Bangladesh.

There are broadly two purposes for carrying out the exercise. First, the set of coefficients along with the relevant market prices will allow us to work out the farm-level financial profitability of individual crops. This is important since farmers' crop choices are presumably influenced by relative financial profitability. An extension of the exercise will be on measuring economic profitability and assessing the export/import-substituting potential of individual crops through calculation of domestic resource costs (DRC). A more import purpose of the exercise is to generate parameter estimates for modelling exercise on crop economy.

Since input mix and output may vary due to various agroecological factors, potential fruits to be reaped out of a particular technique depends much on the resource constraints. For example, if yield for a particular crop variety varies across various land elevation types and there is a given distribution of total land by land elevation types, the aggregate picture on potential may only be constructed if adequate knowledge is available at the disaggregated level. It was therefore necessary to design a survey that would capture the diversity. The various factors that may be of importance in explaining variations in output and input use are discussed in greater details in the next chapter.

The findings on input-output coefficients in crop production are available for numerous sample studies. Most of these are however for major crops, such as, different varieties of rice, wheat and jute. Information on minor crops are relatively scarce. Due to differences in sample areas and in years (of data collection), comparison across crop activities is often difficult. More importantly, in most cases, the findings are reported independent of the agroecological characteristics that may be associated with the outcomes. It was therefore necessary to design a separate survey and collect primary data. Chapter III outlines the survey design along with a brief critical review of the existing sources.

We are aware that the mean from a sample is just one point in the distribution for means. The solace is, the latter distribution has a smaller variance than the population variance.[1] In any case, it is necessary to cross-check one's estimates with similar estimates from other studies. This is done for output and two major inputs, labour and chemical fertilizer, in chapter IV. Chapter V outlines the various categories used in our calculation of

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1. Note that $S^2(\bar{x}) = \frac{S^2}{n} < S^2$ (for $n>1$), where s^2 is the variance for x and $\bar{x}$ is the sample mean.

profitability and presents the broader findings.[1] Since a number of factors will be identified in chapter II that are considered to be of importance in explaining variations in input-output coefficients (within a technique), the empirical findings on them are separately presented in chapter VI. While some of the implications of our findings for crop diversification will be discussed in chapter V, we avoid presenting any conclusion on this draft report.

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1. The detail findings are relegated to an appendix at the end of the text.

Chapter II

Factors Influencing Input-Output Coefficients

In the context of continuous production function that is conventionally considered to represent technology, input-mix and the associated output (i.e., the input-output vector) may vary due to changes in relative prices.[1] We however abstract from such variations and focus on the physical characteristics of land and some aspects of cropping practices on which data may be generated/availed.

The most obvious distinction one usually makes is between irrigated and rainfed conditions in the production of a particular crop. There are also attempts to distinguish between traditional and mechanized irrigation. Such classifications are attractive because of the apparent scope one gets to estimate return on irrigation. Ideally, however, it is the amount of water and their timing (under *ceteris paribus* conditions) that are expected to affect yields. Except for controlled experiments, it is very difficult to measure the water inputs, especially when various modes of availing the water exist and rainfall data at appropriate territorially disaggregated units are not available. It is quite possible that a plot, close to water body and irrigated with traditional modes, may ensure adequate water supply; while another plot under mechanized irrigation may not always ensure such supply. Similarly, in

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1. Systematic variation arises if one assumes economic efficiency to prevail.

the case of wet season crops, farmers may resort to mechanized irrigation in areas where there is inadequate rainfall. Thus, choice of any particular mode of irrigation depends on the extent and nature of available water sources. And, comparison of estimates (from cross-section data) across modes of availing water may not give any meaningful result.

One may however conjecture that availability of a particular mode of watering land (or, a mix across different cropping seasons) may affect choice of cropping pattern, and not necessarily the yields under individual crops. Such an assumption is implicit in the MPO exercise.[1] While this approach is quite valid, a more meaningful exercise should further account for possible variations in (beside cropping patterns) yields under individual crops across land types.[2] Land elevations are widely categorized in terms of the BARC's identification of flood-depth levels.[3] Since the aggregate-level mapping of land elevation by BARC fails to account for wide diversity in topography that exist even within a village, plot-specific surveys need to account for the topographic characteristics of the plots.

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1. MPO considers yield variations across five broad regions, but not across land (or irrigation) categories within a Planning Area.

2. The BIDS-DIS study finds significant yield variations across land types for some of the crops.

3. One classification includes Highland (flood-free), Medium High 1 (upto 30 cm.), Medium High 2 (30 to 90 cm.), Medium Low (90-180 cm.), Low (180-360 cm.) and Very Low (above 360 cm.). Classification by F-type lumps Medium High 1 and Medium High 2 into F1 land; and the rest are consecutively F0, F2, F3 and F4.

A related aspect that is of importance in both choice of crop and yield variations for any particular crop is the soil characteristics of land. While texture and chemical characteristics of soil may be of greater attraction to natural scientists, difficulties (and expansiveness) of soil testing induce many to confine within looking into the permeability condition of the soil. It is generally believed that less permeable soil (e.g., "atel") are more conducive for rice cultivation, while such crops as potato are more likely to be grown in more permeable soil[1].

Since BARC's agroecological zones (AEZ) supposedly capture the aforementioned topography and soil characteristics along with climatic conditions, there are temptations to believe that AEZs may suffice to explain yield variations. An attempt by the Bangladesh Bureau of Statistics in 1989-90 to capture the production data for major crops, taking representative sample from AEZs failed to produce desired output[2].

While extensive margin on land for individual crops may be defined in terms of land/soil types, or even the AEZs; such broad grouping may often fail to capture the trend in yields with expansion of area under individual crops. Thus, it is possible that some regions of the country where (say) modern variety Boro has been extensively adopted may give lower yield than elsewhere. A related field of query is whether flood control and drainage (FCD) projects affect yields, which has implications for project analyses as well as for projections.

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1. One may also expect the interactive term for irrigation and soil permeability to have bearing on yield.
2. See "Report on the Use of Agricultural Inputs for Major Crops in Bangladesh 1989-90", June 1991, BBS.

Finally, one important factor that is often recognized, but rarely dealt with in empirical investigations, is the possible influence of cropping patterns on yields under individual crops. Yield under, say, modern variety Boro rice may be significantly different on single cropped land from those obtained on double or triple cropped land. In the latter cases as well, yield may vary with variations in crops associated in the over all cropping pattern. Since there are reasons to believe that farmers choose a cropping pattern (as against an alternative cropping pattern) rather than a crop (as against another competing crop in the same season), one needs to verify if such decisions are affected by possible yield variations for a particular crop across various cropping patterns (that include the crop).

Chapter III

Sources of Data

Review of Existing Studies

Detail data on cost and returns are available from Agro-Economic Research (AER) of the Ministry of Agriculture on major cereals and jute. There are also many village-level studies, where data on crop production are available (e.g., BIDS-DIS study). A third source of data is from the Farming System Research Sites (FSRS) in six locations of the country. Among the more comprehensive studies completed on the area during the recent past, five are noteworthy. They are,[1]

(i the draft report of the Crops Diversification Programme (CDP) Committee for FFYP development process (July 1989);

(ii) BAU report of the Workshop on Irrigation Management for Crop Diversification (March 1991);

(iii) World Bank report (No. 9641-BD) on Food Policy Review: Adjusting to the Green Revolution (March 1991);

(iv) Crop-specific reports of the International Fertilizer Development Center (IFDC); and

(v) recent BBS study on the Use of Agricultural Inputs for Major Crops in Bangladesh.

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1. Results from the last two sources were available to us only during drafting of this report.

The available data and analyses have some shortcomings which compelled us to engage in the study as well as in collection of primary data. Some of these shortcomings are briefly outlined below.

Coverage under AER are limited both in terms of the crops and regional representation. Skepticism also prevail regarding the quality of data generated.

Published data on FSRS are highly localized and yield performances are likely to be biased upward since great deal of information are likely to be generated from contract farmers. In most cases, data are available only upto 1985-86 period. More importantly, in many of the studies by agriculturalists, the input use figures are quite often reported in monetary units; and distinctions between family and purchased inputs are missing.

The CDP Committee's report for FFYP development process has information on yield, seed rate and recommended fertilizer use for most minor crops. These are however for ideal situation crop production with high input-based technologies, and have been drawn from Tangail Annual Development Plan (TADP) source only.

World Bank study (August 1991) is a more comprehensive one that provides estimates on DRCs for a number of crops, with an attempt to associate them with regions, land elevation and cropping patterns. There are however a number of limitations with the production data. Other than major cereals, the study covers potatoes (with no distinction between local and MV), mustard,

lentils, chilly, jute, cotton and sugar. Thus, many of the minor crops that are of relevance for any study on crop diversification, have been left out of the WB's food policy study. Furthermore, the study makes use of secondary sources of data, much of which are drawn from FSRS. Thus, regional dimension of the study is captured only to the extent that location of FSR stations (say, Iswardi) are representative of the regions (say, North-west). It is true that no single estimate may be considered to be perfect representative of national (or regional) average. Yet, because of the peculiarities associated with the sources of WB data, their representativeness in terms of regions, land elevations and cropping patterns are questionable.

The IFDC regularly monitors the use of chemical fertilizer at the farm level during all the three crop seasons. Furthermore, a detail cost and returns study had supposedly been administered by them in 1990. The report has however not been made public yet. The recent reports based on farm-level fertilizer use survey provide some data on yield and input use under various crops.[1] Because of their exclusive focus, classifications such as "remote vs non-remote areas" and "irrigated vs non-irrigated" are included in IFDC reports; agroeconological characteristics are no where addressed. Furthermore, information on yield and non-fertilizer input use under many of the minor crops are not reported in these reports.

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1. The reports include "Report on 1990 Aus Season" (parts I and II), "Report on 1989/90 Rabi/Boro Season" (parts I and II), "Report on 1989 Aman Season".

BBS's attempt to capture input use under major crops, on the basis of a national level sample, is a noteworthy departure from the tradition. Unfortunately, the published reports suggest of lack of clearly defined (meaningful) objectives. In spite of a great deal of efforts put in the collection of data and stated intention of looking into variability across agroecological zones, the presentation does not account for the zones. One important deviation in the presentation is that labour inputs are reported in hours, so that comparisons are quite difficult. We are told that another long-term survey is going to be launched soon, and this will hopefully come out of the earlier deficiencies.

We also had, available to us, production data on some of the major crops, obtained by BIDS-DIS project from a national level sample of 62 villages. In terms of sample coverage, the study findings for Bangladesh level averages appear to be quite robust. This is however not true if one attempts region-specific analysis. Furthermore, a large number of crops (especially the minor ones that are of relevance in study on crop diversification) are left out by the Differential Impact Study (DIS) of BIDS.

During the recent past, Bangladesh Agricultural University (BAU) had carried out a study on Irrigation Management for Crop Diversification. The workshop report, available to us, suggest that primary data on crop production were collected from only four locations (Thakurgaon, Jhenidah, Chandina and Ghatail).[1] The study is possibly one of tne very few ones in Bangladesh that

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1. We could avail the report only after our field survey was completed.

provide production data on a large number of minor crops along with the major ones. The study also provides labour requirement (both human and animal) and fertilizer use under some of the major crops. While the report identifies the cropping patterns practiced in the study areas by land types, there are no indications as to their relative importance. The study provides estimates on profitability of various cropping patterns, which however are calculated from profitability of individual crops and do not therefore account for variations in performance of individual crops across cropping patterns.

All studies on crop production and input use in Bangladesh are based on sample surveys. Since many of these studies had different objectives, their sample designs varied and are not necessarily appropriate for capturing the various dimensions that are relevant for our purpose. We therefore made a fresh attempt in collection of data, the design of which is outlined in the following section.

Survey Design and Collection of Data

Our first attempt was to divide the country into a number of meaningful regions that are homogeneous in terms of cropping practices. The details of this zoning exercise and its results are presented in a separate paper.[1] From each of these regions, a number of thanas or parts of thanas, were selected so as to take representations from various agro-ecological zones (of BARC) and land elevation within each region. Details on the selection of study area are provided in Appendix A.

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1. See Zohir, S. "Zoning in Bangladesh Agriculture - an exercise based on land allocation under various crops", BIDS-IFPRI Agriculture Diversification Project working paper No.3, June 1993.

Once the study thanas were selected, we aimed at capturing variability due to presence (or absence) of Flood Control and Drainage (FCD) project and due to use of irrigation. Where it were possible, one village inside FCD project and another village outside the project were chosen in each upazila. In the absence of any (effective) FCD project in a upazila, we chose villages (maximum of two) to represent dominant topography in the area.

Data were collected by a group of university graduates who were given a week's training and field-level exposure in questionnaire survey prior to final recruitment. They were grouped in pairs to cover ten different areas, where each area had 4 to 5 of the selected thanas. Prior to sending the teams to the fields, members of the research team had made visits to the selected thanas and made tentative selection of the villages to be studied.

At the thana level, information on various agricultural aspects including land allocation under various crops (1990-91) were collected by filling-in a pre-structured questionnaire. In each of the study villages, six different sets of questionnaires were administered. The first dealt with identification of various cropping patterns practiced at the village level for irrigated and non-irrigated land and total land under each of these cropping patterns. These information were obtained by cross-checking with at least five knowledgeable farmers.[1] The second was also on village level information pertaining to

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1. Data from this part have been used in a separate exercise on cropping pattern. See, Zohir, S. "Scope of Crop Diversification in Bangladesh - an analysis with cropping pattern-based approach" BIDS-IFPRI Agriculture Diversification Project Working Paper No.2, June 1993.

timing of various operations under each crop production and labour(er) requirements for each such activity.[1] The third was a detailed questionnaire on yield, input use and prices for individual crops within a particular cropping pattern. These information were obtained from farmers (about six to ten in each village) and pertained to the plots they had cultivated during the previous year. Since prior information on cropping patterns were already made available at the village level all relevant crops (and cropping patterns) were covered. It was ensured that at least two different sources are availed in each village on each of the cropping patterns. In some of the thanas, two villages were not sufficient to provide information on all the crops that we expected.[2] In such cases, information were brought from other villages in the thana. Our fourth questionnaire dealt with marketing of agricultural crops; that addressed cost of home-based processing, storage, marketing costs and prices fetched. These are collected from the same farmers from which production data were collected. The fifth questionnaire dealt with cost and returns on pond-fishery. Only one such questionnaire was administered for each of the study villages. The last questionnaire was designed to capture production, input use and farmgate prices of such items as betel leaf, betel nut, guava, banana, lemon, pineapple, mango, papaya, jackfruit and olive.[3]

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1. Data on this part will be used in a separate exercise on labour demand in crop sector.

2. Based on 1983-84 census data, we had identified the crops that were expected to be produced in each of the study areas.

3. The fifth and sixth questionnaires provide inputs to two different reports: See, Bhuyan M.K. "Inland Fishery in Bangladesh: Prospects of Pond Culture" and "Cost and Returns for Some Fruits and Semi-perennial Crops in Bangladesh". BIDS-IFPRI Agriculture Diversification Project Working Paper Nos. 4 and 5 respectively.

The findings in this report, presented in the following chapters, make use of the plot-specific data on crop production. The initial focus will be on average picture, and contrast them with findings available from other studies (referred to at the beginning of this chapter). Since plot level characteristics on topography, soil and cropping patterns have been obtained, later exercises will highlight on some of the issues raised in chapter II.

Chapter IV

Output and Physical Inputs - a comparison of various findings

We have already noted in the previous chapter that there exists a number of studies wherefrom output and input use in crop production are available. Crop coverages under individual studies are however limited. Moreover, information on all relevant inputs are not always available. In spite of these, it is necessary to compare some of our findings with those of others so that a more acceptable set of input-output coefficients may be identified. Comparable findings on physical quantities[1] are available for output, labour and use of chemical fertilizer; they are separately presented in this chapter. An attempt is also made at the last section to identify a consensus set of coefficients for these variables in case of the major crops. The section also outlines the purpose and methodology of such an exercise; and makes brief comparison with national level (BBS) published data.

Crop Output

Yields under various crops, expressed as kilograms per hectare, are presented in Table IV.1 and IV.2. In case of major crops, our findings (BIDS-IFPRI) are generally in line with other findings. Two noticeable deviations are in cases of pajam Aman and jute, where our estimates are significantly higher. In the former case, over estimate may arise due to failure to

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Note that the physical quantities are likely to remain relatively more stable than the monetary figures.

Table IV.1

Yields under Major Crops - comparison of various studies

(kg/ha)

Crop name	BIDS-IFPRI	BIDS-DIS	AER	IFDC	BBS	Others (BRRI)
B Aman	1668	1831	1623	-	1475	-
LT Aman	2157	2335	2165	-	1991	1725
MV Aman	3741	3585	3630	3173	3134	3368
Pajam Aman	3692	3131	2780	-	2803	-
Local Aus	1683	1663	1547	1324	1437	-
MV Aus	3413	4633	2842	3015	2600	-
Local Boro	2091	2728	2091	1846	1900	-
MV Boro	4386	5404	4524	4228	3891	4127
Wheat (MV)	2155	2266	2177	1292	1668	3042
Jute	-	1596	-	-	1520	2093
Capsularis	1772	-	1327	1394	-	1628
Olitorious	1925	-	1497	1675	-	1964

Note: a. BIDS-DIS is the BIDS study on Differential Impact of Technology. Data were obtained from unpublished sources, and refer to 1988-89.

b. AER is the Agro-Economic Research. Averages of figures for recent years were taken.

c. IFDC is the International Fertilizer Development Centre. The figures are from 1989-90 Aman and Boro and 1990 Aus reports.

d. BBS is the Bangladesh Bureau of Statistics. Figures are averages of 1988-89 and 1989-90, obtained from Monthly Statistical Bulletin.

e. Others mostly include BRRI (Bangladesh Rice Research Institute) findings that are reported in their annual reports called Research Highlights.

Table IV.2

Yield under Minor Crops - comparison of various studies

(kg/ha)

Crop name	BIDS-IFPRI	BIDS-DIS	BBS	Other studies
Sugarcane	59148	55154	39253	-
Tobacco[1]	1445+458	1764	828	1900
Potato	-	18926	-	20601-20806
Local	7961	-	6870	-
MV	18502	-	11256	-
Sweet potato	12347	-	10131	11043-11290
Rapes & Mustard	894	749	630	1139-1166
Ground Nut	1872	-	1124	1060-1085
Onion	8078	7863	4139	-
Garlic	3570	-	3105	5928-6061
Ginger	8916	-	6153	11505-11762
Lentil (Masur)	818	845	717	724
Khesari	1088	1218	692	813
Gram	767	754	680	917
Mung	480	-	507	714
Country Pea (Motor)	862	-	667	551
Mashkalai	1179	-	729	709

1. We quote the by product (second term under BIDS-IFPRI) separately since the latter fetches substantial price and therefore may not be treated as in the case of products of other crops. It is possible that other studies include them under main product.

Source: See footnotes in Table IV.1.

distinguish pajam Aman from modern variety Aman, especially in Comilla and Chittagong areas. In case of both varieties of jute, our estimates are much higher than those by AER, but are closer to the sample findings of 1983-84 by BRRI. It is possible that depressed jute prices have compelled jute cultivation to get confined to the very suitable land and in areas (with poor yield) where no alternative crop may be grown; and we may have over-representation in our sample from the suitable land.

In case of the minor crops (see Table IV.2), most of our yield estimates generally conform with previous findings. However, in cases of sugarcane, groundnut, country pea and maskhalai (black gram); our estimates are quite significantly on the high side. In contrast, our yield estimate of mung appears to be on the low side.

Use of Labour

There are enormous difficulties in arriving at a consensus on labour use figures. While yield, and even fertilizer use, may be invariant to farm size; reported labour use figures are generally found to be systematically related with farm size. Thus, choice of sample will have bearings on the estimates. Further to this, units of measure raises difficulties. Length of work days may vary across operation periods and across regions. The recent surveys by BBS (on use of agricultural inputs) attempt to capture labour use in terms of work hours. In the absence of adequate information, it is however difficult to find hourly wage rate from daily wages that one observes in reality. Effective efforts are always difficult to measure, and our presentation confine to person days only.

Our estimate on labour use in the production of major crops are generally in line with the other findings (see Table IV.3). In case of local varieties of Aus and Boro, and for B. Aman, the estimates are on the low side. It may however be noted that incidence of tiller and thresher use are quite significant (for some crops) in our sample, so that labour use may be less. In case of the minor crops (see Table IV.4), deviations are significantly observed in cases of tobacco and country pea. For the former, labour used for post-harvest processing (drying) are separately included in aggregate cost calculation. The latter exclusion may largely explain our low estimate of labour figure for tobacco.

Use of Chemical Fertilizer

It is primarily urea, TSP and MP that are used in production of crops in Bangladesh. Two other chemical fertilizers that are marginally used are zinc and gypsum. While the latter are captured in our cost calculations, for the purpose of comparison, we present data that include the major three items only.

Table IV.3

Total Labour Use in Production of Major Crops - a comparison

(person days/ha)

Crop name	BIDS-IFPRI	BIDS-DIS	AER	IFDC	Other studies
B. Aman	126	183	138	-	-
L.T. Aman	163	173	158	-	144
MV Aman	195	225	188	-	142
Pajam Aman	195	213	175	-	-
Local Aus	158	195	173	119	-
MV Aus	190	311	185	158	-
Local Boro	111	146	148	-	-
MV Boro	215	230	210	185	185
Wheat (MV)	138	195	136	-	-
Jute	-	264	-	198	-
Capsularis	240	-	245	-	257
Oiltorious	257	-	232	-	245

Source: See footnotes in Table IV.1.

Table IV.4

Total Labour Use in Production of Minor Crops - a comparison

(person days/ha)

Crop name	BIDS-IFPRI	BIDS-DIS	Other studies
Sugarcane	342	336	-
Tobacco	255*	776	356
Potato	-	272	262-314
Local	237	-	-
MV	295	-	-
Mustard	118	146	133-138
Groundnut	229	-	371-378
Onion	321	353	321-329
Garlic	341	-	247-252
Ginger	307	-	309-316
Masur	82	121	72
Khesari	73	79	52
Gram	81	133	69
Mung	92	111	72
Country pea	86	-	37

* Labour used for drying tobacco is not included in the figure.

Source: See footnotes in Table IV.1.

Table IV.5

Use of Chemical Fertilizer in Production of Major Crops - a comparison

(kg/ha)

Crop name	BIDS-IFPRI	BIDS-DIS	AER	IFDC	Other studies
B. Aman	20	106	32	-	-
L.T. Aman	119	74	99	-	23
MV Aman	321	294	324	217	.141
Pajam Aman	274	185	161	-	-
Local Aus	109	54	116	62	-
MV Aus	289	331	225	213	-
Local Boro	69	-	84	54	-
MV Boro	390	329	353	329	356
Wheat (MV)	294	217	304	237	452
Jute	-	72	-	-	-
Capsularis	180	-	126	67	72
Olitorious	222	-	101	82	138

Source: See footnotes in Table IV.1.

Table IV.6

Use of Chemical Fertilizer in Production of Minor Crops - a comparison

(kg/ha)

Crop name	BIDS-IFPRI	BIDS-DIS	IFDC	Other studies
Sugarcane	541	492	-	-
Tobacco	347	398	306	79
Potato	..	815	875	272-1413
Local	327	-	-	-
MV	695	-	-	-
Mustard	207	136	272	336-470
Groundnut	104	-	45	25-45
Onion	192	274	-	-
Garlic	144	-	96	-
Chilly	435	-	351	519-529
Masur	92	-	40	-
Khesari	6	-	1	-
Mung	63	-	64	-
Country pea	6	-	12	-

Source: See footnotes in Table IV.1.

One observes wider variations in various estimates on use of chemical fertilizer than in the cases of crop yield and labour use. Beside possible biases in sample choice, one may cite two reasons for such discrepancy. It is generally believed that long-term trend in fertilizer consumption is on increase, even at the crop-specific level. Thus, studies done in different years would come up with different estimates. If this would be the only factor explaining variations, there would be less worries. Unfortunately, a more important reason is the posited pevalence of flood-centered cyclical variations in input use (especially, fertilizer use). There are reasons to believe that natural fertilization of top soil during a flood reduce the extent of chemical fertilizer use during the following year. Fertilizer use is however expected to increase persistently every year, in order to even sustain a given yield level, until the next flood. If this conjecture is true, one may expect unsystematic variations (i.e., non-trend variations) in estimates of different years[1].

Compared to other studies, our estimates on fertilizer use are found to be lower for B.Aman; marginally higher for MV Boro; and quite significantly higher for Pajam Aman, Jute, groundnut, lentil, khesari and country pea. The latter are however the crops where our yield estimates are also relatively on the high side. In case of most other crops, there do not appear to be any systematic deviation in our estimates.

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1. Later in the text, we carry out an exercise to estimate year-wise use of chemical fertilizer per unit of land, which shows increasing trend with fluctuations.

Attempt at Reconciliation of Various Estimates

One major purpose of our exercise is to arrive at a set of input-output coefficients at an aggregate (national) level that may be used for static profitability and for macro analyses. For various reasons already cited in previous sections, any single study is unlikely to capture the average scenario. The present section attempts to identify an average set of coefficients from the various studies including our own survey results. Such attempt may however be made in case of the major crops (cn which other estimates are available) and for the three variables discussed so far (output, labour and fertilizer use). The approach taken to do this is to take the average of various estimates (other than BBS) leaving out the extreme outliers. The results are presented in Table IV.7, along with the extent of deviations from our original estimates. Extent of deviations are found to be higher in case of fertilizer than in yield and labour use. In most cases, BIDS-IFPRI estimates were higher, which may be partly explained by the increasing trend in fertilizer doses and by the posited conjecture that the average fertilizer consumption (per cent of land) will continue to increase until another major flood.

For the purpose of later analyses, we stick to the revised average estimates for the crops identified. In case of other crops, however, we have very little flexibility but to adhere to our estimates. The solace is, except for a limited number of crops (e.g., groundnut, mashkalai and mung), our estimates appear to be close to normal expectations.[1] Prior to presenting the detail input-output coefficients along with the results on farm-level profitability in the next chapter, we conclude the present one by providing some consistency checks on our estimates.

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1. We cross-checked these numbers with many experts in the field of crop production.

Table IV.7

Revised Estimates on Some Major Crops

Crop name	Yield		Labour		Chemical fertilizer	
	kg/ha	% deviation	days/ha	% deviation	kg/ha	% deviation
B.Aman	1646	-1.3	132	+4.8	26	+30.0
L.T.Aman	2096	-2.8	160	-1.8	79	-33.6
M.V.Aman	3499	-6.5	188	-3.6	259	-19.3
P.Aman	2956	-19.9	194	-0.5	173	-36.9
L.Aus	1554	-7.7	161	+1.9	85	-22.0
M.V.Aus	3090	-9.5	178	-6.3	242	-16.3
L.Boro	2189	+4.7	135	21.6	69	-
M.V.Boro	4316	-1.6	199	-7.4	357	-8.5
M.V.Wheat	2199	+2.0	156	+13.0	272	-7.5
Jute caps.	1530	-13.7	247	+2.9	111	-38.3
Jute olit.	1765	-8.3	245	-4.7	136	-38.7

Note: (a) Derived from Tables IV.1, IV.3 and IV.5. The BIDS-DIS source is omitted in cases of MV Aus and MV Boro; while BIDS-IFPRI source is left out in obtaining the average figures for Pajam Aman. BBS is left out in all the calculations.

(b) The second column under each variable measures the percentage deviation of the revised estimate from original BIDS-IFPRI estimate.

Consistency at National Level

A conventional approach to validate sample estimates is to blow them up to national level and then compare these with national level official statistics. The latter is important since national income accounts as well as macro variables are estimated from them. The aforementioned validation exercise is justified on the ground that often parameters estimated from sample data ought to be used in macro modelling exercises. In our case of crop-specific data, we have the option to do the exercise for production and fertilizer consumption.

Based on our estimates of crop-specific use of chemical fertilizer and the BBS-reported acreage figures, estimated consumption of chemical fertilizer under major crops in 1990-91 are reported in Table IV.8. These crops, which account for 85 per cent of total cropped land, were estimated to have combinedly used about 2.17 million mt. of fertilizer. If the other minor crops are considered as well, a rough estimate suggests of about 2.3 million mt. for the whole crop economy of Bangladesh in 1990-91. During the same year, however, BBS reports of total distribution of chemical fertilizer amounting to 2.09 million mt. Compared to this, our estimate is about 10 per cent higher. In the absence of any information on private stocks, it is difficult to suggest of one to one correspondence between fertilizer consumption and distribution. And therefore, no precise conclusion may be reached on the extent of bias in our estimate.

Table IV.8

Estimates on Consumption of Chemical Fertilizer in 1990-91

Crop name	Acreage[1] ('000 ha)	Fertilizer use (kg/ha)	Estimated fertilizer consumption (mt.)
B.Aman	937.7	26	24380.2
L.T.Aman	2872.9	79	226959.1
M.V.Aman	1602.1	259	414943.9
P.Aman	363.4	173	62868.2
L.Aus	1743.0	85	148155.0
M.V.Aus	364.6	242	88233.2
L.Boro	282.1	69	19464.9
M.V.Boro	2209.6	357	788827.2
M.V.Wheat	598.9	272	162900.8
Jute	583.6	123.5*	72074.6
Sugarcane	179.3	541	97001.3
L.Potato	44.7	327	14616.9
M.V.Potato	67.8	695	47121.0
All crops			2167546.3

1. Figures on acreage for all cereal crops and jute are for 1990-91; whil for the last three crops, they are averages of 1988-89 and 1989-9 (Source: BBS). Based on 1989-90 figures, these crops account for abou 85 per cent of total cropped area; another 5.2 per cent is accounted b pulses, 4.1 per cent by oilseeds and 1.1 per cent by spices.

* It is the simple average of the estimates on fertilizer uses unde capsularies and olitorious varieties.

With regards to production, we had already noted that BBS yield estimates are lower (almost in every case) than any of the sample studies cited.[1] Our estimates on paddy production are compared with those of BBS in Table IV.9. In the aggregate, BBS figure is found to be 6.4 per cent lower than our estimate. It is possible that BBS estimates are national averages that account for crop damages while the other studies generally capture "good" plots. The argument in terms of crop damage does not however appear to explain the discrepancy completely, since the discrepancy remains quite large even in "good years"; and declines in BBS yield estimates are not substantial either during the "bad years". An alternative explanation may be in terms of the representativeness of the samples chosen under non-BBS studies. This aspect may broadly be pursued in two ways. First, the non-BBS studies may be biased towards landownership groups whose yields happen to be higher. At varietal level, systematic yield variations across landownership groups are however not well-established.[2] A second line of reasoning may be, the non-BBS studies choose farmers who are more intensive in the use of chemical fertilizer, and with latter's marginal contribution to output being positive, the yield estimates are found to be higher in non-BBS sample studies. Such a conjecture may appear to be quite appealing given the fact that our estimates on total fertilizer consumption is found to be about 10 per cent higher than the reported total distribution during 1990-91. One still remains to be convinced as to why all non-BBS studies consistently confront farmers who are more intensive in fertilizer use. A final explanation of the discrepancy may

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1. Except for some of the IFDC findings.
2. This is shown to be so in our case too. See Chapter VI.

Table IV.9

Production of Paddy in 1990-91, a comparison with BBS estimates

(production figures are in '000 mt. paddy)

Crop name	Our estimate	BBS	% deviation in BBS estimate
B.Aman	1543.4	1488.1	-3.6
L.T.Aman	6021.5	5856.7	-2.7
M.V.Aman	5605.9	5367.2	-4.3
P.Aman	1074.2	970.1	-9.7
L.Aus	2708.6	2432.8	-10.2
M.V.Aus	1126.7	1031.3	-8.5
L.Boro	617.4	607.5	-1.6
M.V.Boro	9536.6	8680.6	-9.0
All crops	28234.3 (18917)	26434.3 (17711)	-6.4

Notes: (a) All conversions from paddy to rice or vice versa are made on the assumption that 1 kg. paddy = 0.67 kg. rice.

(b) Figures in parentheses are figures for rice.

(c) Only pajam Boro and pajam Aus are left out which account for very insignificant portion of total rice acreage and production.

be provided by the proposition that national level published statistics are endogenous decision variables, and the BBS estimates on food production may be underestimates that are consistent with our other efforts to attract donour assistance.[1]

1. It is presumed that BBS quotes gross production, and not net of the produce retained for next year's seed. In a very recent BBS report on input use under Aman, yield under modern variety Aman is reported to be 3506 kg/ha which is close to various sample studies, but much higher than earlier BBS estimates. This appears to be a significant departure from past tradition that may bring in much desired revision in national level statistics in the future.

Trend in the Intensity of Fertilizer Use

Contribution of chemical fertilizer to the crop sector output in Bangladesh is a widely accepted proposition. Cross-sectional analyses within a conventional production function framework very often show significant positive marginal contribution of chemical fertilizer to crop output. Moreover, since shift towards high yielding crop varieties are associated with increased use of chemical fertilizer, the latter is found to be positively associated with total crop output. There are however skepticisms regarding the prospects of increasing yield at the variety level through marginal increases in the doses of chemical fertilizer. It is rather believed by some that doses of chemical fertilizer may have to be increased in consecutive years (on a piece of land) in order to sustain a given yield level. Controlled field experiments at BRRI suggest of declines in yield if doses of chemical fertilizer are maintained at the same level over consecutive years. Since time series data on input use for matched sample are not available, it has always been difficult to bring in empirical evidence support or against either of the aforementioned propositions. Based on our estimates on crop-specific fertilizer use during 1990-91, we make an attempt to decompose the increase in fertilizer consumption due to changes in varietal mix and due to changes in intensity of fertilizer use per unit of land.

Our focus remains confined to the major crops only; all varieties of paddy, wheat, two varieties of jute, sugarcane and local & modern varieties of potato. There are several assumptions we make. They are as follows:

(i) Relative intensities of fertilizer use for crops within the group considered has remained stable. In the absence of data other than 1990-91 (that we estimate), such a rigid assumption could not be avoided. Thus, change in the intensity of fertilizer use, estimated in the following exercise is applicable at the aggregate for the crop group.

(ii) Actual fertilizer consumption is same as fertilizer distribution reported by BBS. Since wi deal with a group of crops, their shares in total fertilizer consumption are assumed to decrease over time; 98 percent in 1980-81 to 94 percent in 1990-91.

(iii) When comparisons are made between two years, one estimate of fertilizer consumption in current year is obtained on the assumption that level of fertilizer use per unit of land is same as base year so that the estimate reflects change in variety mix. The residual, actual consumption minus the above estimate, provides change in fertilizer consumption due to change in intensity of fertilizer use. For estimating per hectare change in fertilizer use, we consider the base year acreage.

The mathematics of the above logic is simple. Total fertilizer consumption by n crops in time t is given by,

$$F_t = \sum_t f^i_t \, a^i_t \qquad n = 1, ----, n;$$

where f^n_t is the amount of chemical fertilizer per unit of land (kg/ha) used in the i-th crop variety during period t and a^i_t is the total acreage under i-th crop during time t .

Total differentiation of F_t gives,

$$dF_t = \sum_t f^i_t \, d^i_t + \sum_t a^i_t \, df^i_t.$$

The first term on the RHS of the above equation gives change in fertilizer consumption due to change in acreages under various crops upon assuming the intensity of crop-specific fertilizer uses to remain at their initial levels. The second term gives changes due to change in intensity of fertilizer use. Thus, change in average intensity is given by,

$$dFI = \frac{\sum_t a^i_t \, df^i_t}{\sum_t a^i_t}$$

We make an indirect estimate of $\sum_t a^i_t \, df^i_t$ at arrive at dFI. Table IV.10 provides details on the estimate. It is found that intensity of fertilizer use had declined on several occasions. The trend however is an increasing one. Estimates suggest that fertilizer doses (after controlling for change in varietal mix) increased by about 23 kg/ha during the early 80's, and by almost 43 kg/ha during the second half of 80's. Published time series BBS data on yields at variety level do not suggest of an increasing trend. One may therefore conclude that fertilizer doses have to be persistently increased in order to sustain a given level of yield.

Table IV.10

Indirect Estimates on Trends in Intensity of Fertilizer Use

Year	Est. Fert. consump. (ml.mt.)	Fert. dist. BBS (ml.mt.)	Fert. cons. crop gr. (ml.mt.)	Consumption with presenting year's variety mix (ml.mt.)	Change due to change in intens. (ml.mt.)	Acreage crop gr. (ha.)	Change in intensity (kg/ha)
1975-76	1.11	0.47	0.46	-	-	11015.95	-
1976-77	1.21	0.52	0.51	0.50	0.02	11500.36	1.57
1977-78	1.30	0.73	0.71	0.51	0.20	11332.41	17.63
1978-79	1.28	0.72	0.70	0.76	-0.06	11610.03	-5.49
1979-80	1.34	0.86	0.84	0.73	0.11	11620.14	9.19
1980-81	1.39	0.89	0.87	0.87	-0.00	11784.81	-0.14
1981-82	1.42	0.84	0.83	0.89	-0.06	11815	-5.16
1982-83	1.48	0.97	0.95	0.86	0.09	118774	7.43
1983-84	1.48	1.13	1.10	0.95	0.15	11848	12.32
1984-85	1.59	1.26	1.22	1.18	0.04	12108	3.68
1985-86	1.56	1.16	1.11	1.20	-0.09	12030	-7.56
1986-87	1.62	1.32	1.27	1.15	0.12	12117	9.78
1987-88	1.65	1.52	1.45	1.29	0.16	11585	13.54
1988-89	1.80	1.71	1.62	1.59	0.03	11540	2.84
1989-90	1.91	2.04	1.92	1.72	0.20	11445	17.55
1990-91	1.96	2.09	1.96	1.98	-0.01	11550	-1.08

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Chapter V

Input-Output Coefficients in Crop Production and Financial Profitability at Farm Level

We incorporate the revisions in case of cereals and jute (outlined in Chapter IV), and provide a complete set of coefficients for different crops in Appendix B at the end of the text. Here we clarify some of the categories on which data were compiled. Furthermore, we have calculated costs and returns under various crops, details of which are included in the Appendix B. The text outlines the method of calculation, and provides a broad overview of the results and their implications for crop diversification.

Definition and Method of Calculations

We had covered a large number of crops in our survey. The crops on which more reliable estimates have been obtained are listed in Table V.1. Plot-specific information on input use, output and prices (of inputs and output) were obtained for all these crops. These are briefly described below before discussing relative profitability of various crops.

Of all the crops covered under the study, there is one pulse variety, identified here as "Helen dal", that has been introduced during the recent past and is quite extensively cultivated in the south-east region of the country. One further aspect to note is the possible confusion between pajam and modern variety Aman at the field level.[1]

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1. See discussion in Chapter IV.

Table V.1

Crops Covered in the Profitability Analyses

CEREALS	
Local Transplanted Aman	
Pajam Aman	
Modern Variety Aman	
Broadcast Aman	
Local Boro	
Modern Variety Boro	
Local Aus	
Modern Variety Aus	
Braus (late Boro-early Aus)	
Wheat	
Maize	
CASH CROP	
Jute Capsularis	
Jute Olitorious	
Cotton	
Tobacco	
Sugarcane	
"Gur"	
SPICES	
Raw (Green) Turmaric	[.114]
Dry Chilli	[.499]
Green Chilli	
Ginger	[.048]
Corriander Seed	
Garlic	[.091]
Onion	[.248]
VEGETABLES	
Brinjal	[.270]
Pumpkin	[.100]
Radish	[.186]
Cucumber	
Beans (Barbati)	[.068]
Tomato	[.111]
Cauliflower	[.078]
Cabbage	[.076]
Ladies Finger	
Kakrol	
Lal Shak (Red Spinach)	
Arum ("Kachu")	[.111]
TUBER ROOTS	
local Potato	
Modern Variety Potato	
Sweet Potato	
OIL SEEDS	
Rapeseed & Mustard	[.628]
"Til" (Seaseme)	[.157]
Linseed ("Tishi")	[.143]
Groundnut	[.072]
PULSES	
Masur (Lentil)	[.303]
Gram	[.147]
Khesari	[.339]
Mashkalai	[.099]
Moong	[.085]
Country Pea (Motor)	[.027]
"Helen dal"	

Note: Figures in [ ] are weights according to acreage shares in the selected subset of each crop group, used in constructing later Tables.

Information on yields of both main product and by-products were obtained. In most cases, these were available in terms of weights. In instances such as for maize, numbers (of cobs) were translated into weight figures. There were however some problems with the weight figures, especially in case of spices. For such items as garlic, ginger, and turmaric, weights decline with the span of time and extent of drying. Since the extent of weight variation is quite large in these cases, we have tried to confine to (immediate) post-harvest weight and prices unless otherwise mentioned (e.g., in case of dry chilli).

Type of by-products vary according to crop groups. In case of pulses, while we provide information for most varieties, reliable estimate on by-product for "mung" and "helen dal" could not be obtained. While almost all by-products go for own consumption[1], they are marketed in case of tobacco. These are mostly dried stems that fetch a lower price than the dried leaves.

Of the inputs, the broad categories used in the Tables in Appendix B are seed/seedling cost, labour, bullock use, organic manure, chemical fertilizer, pesticide, irrigation, machine use, transport cost and post-harvest processing. In cases of cereals, pulses, oilseeds, tuber roots, jute and some of the spices, seed use by the farmers were more common. Thus, information on seed quantity could be obtained. However, for vegetables and such spices as onion (and some instances of chilli), there were wide variations across farmers. Some chose to use seeds while others bought seedlings of different

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1. In case of gur , the juice-free fibres are dried and used as fuel for gur-making.

maturity. In these cases, we chose to report seedling cost rather than quantity and price of seeds. The same approach was taken for tobacco since farmers reported that many failed to germinate the seeds the BTC distributed free of charge; and had to buy seedlings from the market.

Labour use was measured in person days while bullocks were in pair days. Data on labour use were collected for different operations involved; and reportings in terms of hours were converted to standard days on an 8-hour basis.

While information on fertilizer use were obtained on item basis, they were inputed separately for organic manure, urea, TSP and MP. The rest, which includes some organic as well as inorganic fertilizers, have been included under 'cost of other fertilizer'. A part of the latter includes dried hyacinth and oil cakes; and the other part includes such chemical fertilizers as zinc and gypsum. It needs mentioning that often farmers manure (organic) the land once a year which raised difficulty in identifying crop-specific figure. We distributed the amount equally to crops involved.

Information on pesticides were obtained in term of quantity of particular variety and their prices. Since there are wide variations in the types of pesticides used (and their prices), we include this item under "pesticide cost".

Irrigation raised a number of problems. In cases of traditional irrigation availing labour use only, the costs have been captured under

labour. In case of mechanized irrigation, the payment to pump-owners for availing irrigation water is included under "irrigation cost". Since the average picture aggregates over various modes of irrigation, including rainfed situation, one observes wide variations across crops in the values obtained under irrigation cost.

Other than irrigation, information on machine use and their costs were obtained for three different stages in production. First, tractor/power tiller were reported to have been used by many farmers. These were on hiring basis so that the actual cost for the purpose could be availed. In case of sprayers for pesticide use, the tools were mostly owned. Therefore, based on its current price, life time and area coverage in a year; cost under this head was calculated. The third stage was post-harvest processing, where (if applicable) the technology varied across crops. For cereals, many reported of using threshers; while in case of gur, crushers were rented to perform the job. In contrast to these two cases, the drying technology in case of tobacco was more labour-intensive. While we retain separately the costs due to tractor/power tiller and sprayer use; various types of post-harvest processing costs are included under the single title "post-harvest processing cost". In the tables on distribution of cost, however, we include the latter under machine cost. Note also that traditional threshing of paddy or processing of jute fibre are accounted for in labour and bullock use variables.

Prices for outputs were obtained for the month following harvest. Wage rates were obtained for various stages of operations and weighted wage rates were calculated on the basis of shares of labour use in individual stages. it

may be noted that cropping practices in an area are likely to be associated with other socio-economic variables. It is therefore quite expected that a crop is more extensively produced in an area where the wages are low, while another crop may be more frequently observed in an area where the wages are relatively high. The same phenomenon is also observed in cases of bullock-hiring rates and prices paid for chemical fertilizer. In order to capture the current situation on relative profitability, we present costs & returns based on crop-specific input prices. We also present a separate set of results based on average input prices (labour, bullocks, organic and chemical fertilizers) to capture relative profitability in a situation of wider diffusion of technology.

Returns have been calculated in the conventional way by deducting costs from revenue. In Revenue I, we include only main product; while Revenue II includes value of by-product as well. Costs are calculated for cash costs as well as on full-cost basis. In the latter case, market prices of inputs are considered without discounts. In the calculation of cash cost, we include seed/seedling costs, wages on hired labour, hiring of bullocks, chemical fertilizer, a part of other fertilizer, irrigation cost, pesticide cost, machine cost, post-harvest processing cost and transport cost[1]. Since two sets of revenues are presented, we have two sets of returns under both "cash cost basis" and "full cost basis".

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1. We include the seed/seedling cost even though they are often from own sources, in order to bring in uniformity across crops.

Financial Profitability at Farm Level

Prior to discussing the results on costs and returns, there are some points of disclaimer to be made. In a number of cases we feel that some of our estimates may significantly deviate from the real world average. our estimates on yields under mashkalai and groundnut are possibly on the high side while that under mung appears to be on the low side. In case of output prices, barbati (beans) and ladies finger may be marginally on the high side, while the reported prices of gur and pumpkin may be on the low side. Finally, reported wage rate under pajam Aman is significantly higher than wages under other crops, possibly due to locational specificity (i.e., observations on it were mostly from Comilla and Chittagong region). However, since calculations are also provided for average input prices, there may not be much difficulty in assessing the relative standing of pajam Aman.

It is difficult to discuss costs and returns under all individual crops in the text (see Appendix B). We have instead tried to capture the relative profitability of different crops through Table V.2. Since the focus is on crop diversification and there are beliefs that expansion of modern variety Boro may be a hindrance to crop diversification, we consider the return under this crop as the reference figure. We then calculate the prices of individual crops that will make the returns (per hectare) on this crop same as that under MV Boro. The last two columns in Table V.2 show the percentages change in prices required to ensure such return. Thus, for example, price of ladies finger may decline by 67 per cent from the current level (1990-91) and yet the

Table: V.2

Relative Profitability of Various Crops
at Farm Level, 1990-91 *.

Crop name	Current Price	MV Boro-parity price *		% changed required	
		Cash Cost	Full Cost	Cash Cost	Full Cost
LADIES FINGER	7.72	2.15	2.55	-72.20	-66.97
KAKROL	10.72	2.92	3.58	-72.72	-66.60
CAULIFLOWER	5.98	1.72	2.30	-71.16	-61.59
TOMATO	4.69	1.40	1.88	-70.08	-60.00
RAW TURMARIC	5.24	1.98	2.13	-62.28	-59.27
ONION	6.76	3.09	3.19	-54.26	-52.80
GARLIC	18.41	8.08	9.05	-56.13	-50.83
GUR	11.05	5.39	5.45	-51.18	-50.69
CABBAGE	2.68	1.35	1.55	-49.54	-42.11
GREEN CHILLI	9.88	4.83	5.78	-51.16	-41.45
SUGARCANE	0.94	0.57	0.57	-39.06	-39.19
ARUM	4.59	2.19	2.80	-52.29	-39.01
CORIANDER SEED	26.79	13.28	16.66	-50.41	-37.83
BRINJAL	4.04	2.03	2.58	-49.87	-36.10
TOBACCO	35.83	22.56	23.08	-37.04	-35.59
BARBATI	6.77	3.18	4.81	-53.08	-28.90
MV POTATO	3.00	2.08	2.20	-30.61	-26.62
CUCUMBER	3.70	2.83	2.77	-23.49	-25.09
GINGER	7.37	4.63	5.60	-37.23	-24.07
COTTON	18.49	14.19	14.61	-23.25	-21.01
RADISH	3.11	2.18	2.58	-29.95	-17.01
BRAUS	5.48	5.52	5.31	0.74	-3.15
MASHKALAI	11.28	12.68	10.94	12.39	-3.03
SWEET POTATO	2.27	2.00	2.27	-11.73	-0.12
MV BORO	5.90	5.90	5.90	0.00	0.00
GROUND NUT	12.17	10.49	12.27	-13.76	0.83
MV AMAN	5.97	6.11	6.19	2.40	3.74
MV AUS	6.06	6.77	6.93	11.75	14.42
L. POTATO	3.31	3.74	4.09	12.91	23.57
DRY CHILLI	42.82	43.28	53.25	1.07	24.36
P. AMAN	6.23	7.41	8.16	18.95	30.93
L. BORO	5.80	8.62	7.83	48.60	34.98
LT. AMAN	6.01	8.71	8.36	44.92	39.12
GRAM	12.49	20.79	17.71	66.44	41.81
MASUR	11.10	19.59	16.66	76.50	50.05
HELEN	12.12	15.84	18.44	30.68	52.18
B. AMAN	6.00	10.33	9.20	72.18	53.34
JUTE OLI.	7.23	11.55	11.09	59.76	53.40
WHEAT	5.67	9.14	8.85	61.21	56.06
RAPE & MUSTARD	10.72	19.39	18.09	80.88	68.77
C. PEA	8.48	17.12	14.84	101.90	75.01
L. AUS	5.85	11.10	10.74	89.80	83.67
LINSEED	11.90	27.22	22.79	128.73	91.52
PUMPKIN	1.68	3.74	3.22	122.45	91.62
KHESARI	5.74	13.91	11.03	142.32	92.10
LAL SHAK	2.57	4.80	5.55	86.70	115.79
MOONG	12.67	31.58	28.32	149.26	123.48
TIL	10.48	24.30	23.87	131.83	127.75
JUTE CAP.	5.80	13.63	13.29	135.04	129.11
MAIJE	7.61	21.36	20.50	180.67	169.34

* Relative profitability is expressed in term of the percentage change in farm level price of a crop required to make the crop as profitable as MV Boro. Thus, negative signs in the last two columns imply the crop is more profitable.

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return from its production will not be lower than that under modern variety Boro. In contrast, price of jute (capsularis) would have to be raised by about 129 per cent in order to make it competitive with MV Boro. The crops are listed in Table V.2 in descending order of profitability. One needs to note that not all crops compete for the same land (either within a season or across cropping patterns). Furthermore, there is perennial crop like sugarcane and semi-perennial ones like turmaric and ginger which may be competing with a mix of two or more crops. The findings have therefore to be interpreted accordingly. They generally suggest that most of the vegetables and spices are much more profitable than MV Boro; while pulses and oilseeds are generally less profitable.

The above findings are more evident in Table V.3 where crop group specific costs and returns are presented. Compared to modern variety Boro cultivation, spices and vegetables appear to be much more profitable. While exports of vegetables and expanding domestic urban market along with liberalization in the imports of seed, may explain higher profitability of vegetables, one wonders how spices came out to be high on the list. It is true that some of the spices compete with mix of two or three crops, and necessary discounts have to be made. Inspite of it, spices appear to hold much potential for crop diversification. Unfortunately, its dismal performance in the past, and its displacement during the early years of MV Boro expansion, may raise doubts about the reliability of our estimates. The trend value of prices do not suggest that the relative prices of spices (vis-a-vis rice) increased as it has been in the cases of vegetables and pulses (see Table V.4). It however needs to be noted that prices of pulses and

Table : V.3

Cost and Return at Farm Level :
Comparision Across Crop Groups

(Tk./hectare)

Item Name	MV Boro	MV Aus	MV Potato	Oilseed	Spices	Pulses	Vegetable
Revenue I	25464.40	18725.40	55506.35	9760.43	44586.30	7960.06	53273.88
Revenue II	13200.29	8389.15	25977.50	4651.93	15565.67	2956.44	13297.30
Cash Cost	18019.13	13604.93	32913.38	8481.37	24526.99	5241.78	24334.65
Based on crop-specific input prices :							
Return on Cash Cost Basis I	12264.11	10336.25	29528.85	5108.50	29020.63	5003.62	39976.57
Return on Full Cost Basis I	7445.27	5120.47	22592.97	1279.06	20059.32	2718.29	28939.23
Based on average input prices :							
Return on Cash Cost Basis I	12568.42	10770.36	29569.96	4758.47	23150.58	4696.78	35083.19
Return on Full Cost Basis I	7852.33	5850.46	22549.78	803.50	13787.93	2111.18	24690.03

Note : (a) Oilseeds includes Til, Rape & Mustard, Ground Nut, and Linseed, Spices includes Onion, Garlic, Turmaric, Ginger, and Chilli (Dry), Pulses includes Gram, Masur, C. Pea, Moong, Mashkalai, and Khesari Vegetables includes Brinjal, Pumpkin, Arum, Cauliflower, Cabbage, Tomato, Radish and Barbati.

(b) In most cases, weight on individual crops are based on their average acreage share in the group during 1988-89 and 1989-90. In case of price/wages weights account for average share and the physical quantities involved (see text).

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Table V.4

Harvest Price Indices for Major Crop Groups

(1980-81 = 100)

Year	Rice	Pulses	Oilseeds	Spices	Vegetables
1980-81	100.0	100.0	100.0	100.0	100.0
1931-82	112.6	99.6	86.3	68.3	93.8
1982-83	124.5	94.8	90.7	65.2	90.2
1983-84	145.1	125.8	142.6	121.8	161.2
1984-85	167.5	109.6	129.9	128.9	155.2
1985-86	154.5	165.3	142.7	119.7	188.8
1986-87	190.6	185.44	148.1	151.5	218.7
1987-88	197.7	168.9	145.7	176.1	163.3
1988-89	202.9	253.7	172.9	390.9	298.0
1989-90	190.8	239.5	168.8	166.8	230.5

spices have widely fluctuated, more than any other crop groups. Especially high prices of certain periods, no matter how short-lived they are, may have induced more commercially-oriented farmers to cultivate the crop. These farmers are likely to be more innovative. While there are hardly any scope for availing new species in pulse with higher yield, there are reasons to believe that new adoptions have taken place in the field of spices. It is also to be noted that better farm management practices are of utmost importance in ensuring higher yields under both spices and vegetables. And significant improvements in this area are likely to have taken place in Bangladesh during the very recent past.

Implications

Relative profitability analyses at farm level suggest that prospects of crop diversification in future lie not only in vegetables, but also in spices.

This is consistent with our observation on trends in acreage expansion during the recent past (see Appendix C) as well as our findings on prevalent cropping patterns under minor irrigation.[1] While we have suggested explanations in terms of adoption of better variety and farm management practices, further probings need to be made to confirm such proposition.

Often we are concerned about the prospects of diversification since home markets for such crops as spices and vegetables are limited, and there is no assurance of an expanding international market. The figures presented in Table V.2 suggest that farmers may choose to cultivate vegetables and some of the spices even if there be substantial price declines. One needs to find out, to what extent demand may expand remaining within the price band. Since processing/packaging of both spices and vegetables are quite possible, it is worth verifying the extent of net benefits to be accrued from additional investment on such activities. In this regard, it is worth mentioning that spices in powder form and dried ginger for chewing are now widely available in the urban markets.

Expansion of area under spices and vegetables have a number of implications for the factor market. Both types of crops are relatively more labour intensive; labour use is 1.65 to 1.8 times that under modern variety Boro (see Table V.5). Thus, more labour could be absorbed in crop production

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1. See discussion on cropping pattern in Zohir, S. "Scope of Crop Diversification in Bangladesh - an analysis with cropping pattern based approach". JUne 1993.

Table : V.5

INPUT-OUTPUT COEFFICIENTS :
Comparision Across Crop Groups

(per hectare)

Item Name	MV Boro	MV Aus	MV Potato	Oilseed	Spices	Pulses	Vegetable
Main product (Kg.)	4316	3090	18502	890	4615	910	13006
By-product (Kg.)	3299	2481	0	993	0	840	0
Seed quantity (Kg.)	67	61	1040	20		50	
Seedling cost (Tk.)					4121		1858
Total Labour use (person days)	199	178	295	129	356	79	329
Hired Labour use (person days)	124	100	198	68	195	41	141
Bullock labour (pair-days)	37	35	57	37	57	24	59
Hired bullock (pair-days)	9	9	9	8	11	6	22
Chemical fertilizer (kg.)	357	242	695	156	328	45	456
Urea (Kg.)	169	113	274	63	129	11	171
TSP (Kg.)	127	87	269	63	136	24	196
MP (Kg.)	61	42	152	31	63	9	88
Cost of other fertilizer (kg.)	115	89	276	6	55	1	384
Pesticide cost (Tk.)	690	451	774	99	297	37	725
Irrigation cost (Tk.)	3678	576	1582	85	721	13	613
Tractor/power tiller cost (Tk.)	188	170	111	30	56	61	33
Sprayer cost (Tk.)	42	40	29	20	34	10	75
Post-harvest processing cost (Tk.)	55	82	0	3	0	0	0

Note : (a) Oilseeds includes Til, Rape & Mustard, Ground Nut, and Linseed, Spices includes Onion, Garlic, Turmaric, Ginger, and Chilli (Dry), Pulses includes Gram, Masur, C. Pea, Moong, Mashkalai, and Khesari Vegetables includes Brinjal, Pumpkin, Arum, Cauliflower, Cabbage, Tomato, Radish and Barbati.

(b) In most cases, weight on individual crops are based on their average acreage share in the group during 1988-89 and 1989-90. In case of price/wages weights account for average share and the physical quantities involved (see text).

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with their expansion. Generally, labour requirements are more spaced out under these crops so that seasonal (within the growing period of a crop) underemployment is likely to be less acute. These crops also require more intensive ploughing of land so that use of bullock labour is almost 1.6 times of that under modern variety Boro. Given the shortage of draft power in this country, it is possible that expansion of area under spices and vegetables may increase the pace of mechanization at the tilling stage[1].

After all that have been said, one needs to note that both spices and vegetables are highland (high and medium-high in terms of flood-depth) crops. This suggests that mv Boro may have greater difficulty in encroaching into high land. It also implies that beside the market size, the limits to expansion of spices and vegetables are set by the size of available high land. The latter may be expanded with the FCDs; and the prospects are worth probing.

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1. This is however also true for mv Boro, when compared with traditional varieties.

Chapter VI

Variations in Yield - Results from the Survey Data

The previous chapter identified an average scenario on inputs used and output under various crops in Bangladesh. It is however possible that such coefficients vary across various agroecological characteristics of land, type of cropping patterns associated, irrigation mode, and even across land ownership groups. The last of the list would have implication for the association between land distribution and potential output to be achieved. In other cases, if variations exist, projection analyses would have to account for the various physical constraints. The present chapter makes a modest attempt, primarily through regression analyses, to identify the factors that influence yield. At first, findings on yield variation across landownership groups are briefly presented. A single equation regression equation is then identified, followed by the presentation of our findings and their interpretations. The analysis is a cross-sectional one using the primary data (plot-level) collected under the BIDS-IFPRI project on agricultural diversification.

Variations across Landownership Groups

Yields across various landownership groups are provided for some major crops in Table VI.1. Significant variation across groups are found in only four out of 13 crop varieties on which data are presented. The findings do not suggest of any systematic association between landownership and yield even

Table VI.1

Yield Variation by Landownership Groups

Crop Name	I	II	III	IV	Inter-group variation is statistically significant between:
Jute Cap.	1668	1710	2053	1549	
Jute Oli.	1539	1937	1757	2073	
LT. Aman	1848	2034	2056	2543	(I,IV), (II,IV), (III,IV)
Aman Pajam	3682	3645	4082	3719	
Aman MV	3751	3758	3850	3721	
Aman Broadcast	1339	2147	1712	1633	(I,II), (II,III)
Boro Local	1707	1903	2009	2291	
Boro MV	4006	4702	4107	4532	(I,II), (II,III)
Aus Local	1517	1836	1836	1515	(I,II), (I,III), (II,IV,(III,IV)
Aus MV	3529	3267	3262	3598	
Wheat	2310	2051	2189	2160	
Potato Local	8762	7865	7813	9630	
Potato MV	17171	20403	17619	20053	

Note: (a) Landownership group : I=1-250 dec., II=251-500 dec., III=501-750 dec., IV=above 750 dec.

(b) Statistical significance in yield difference are based on t-test.

for the fertilizer-intensive crops. It however needs to be noted that cross-country variation in landownership pattern may diffuse our results. Since earlier findings in the field do not suggest of any systematic relation between farm size and productivity at crop variety level[1], we address other physical characteristics and input use in the rest of the chapter.

Determinants of Yield - specification of regression equation

A number of factors were identified in Chapter II, that are normally expected to influence yield of crops. While it is true that land inundation levels, timing of inundation, soil type, and amount and timing of rainfall restrict the choice of cropping patterns and the associated crops[2], same crop is often produced on many types of land. This is especially so in case of rice, expectedly due to increasing population pressure on land. Our focus will therefore confine to some of the rice varieties where future potentials are presumed to exist.

At the intensive margin, output on a given piece of land is expected to be determined by the levels of input use. Among such inputs are included; chemical fertilizer, labour and irrigation water. In order to capture the

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1. See for example, Sen, A. and A. Rudra, "Farm Size and Labour Use: Analysis and Policy", Economic and Political Weekly, vol. 53, pp. 202-211, where empirical findings on India are summarized to suggest that at individual crop level, yield does not vary systematically across farm sizes.

2. Some aspects of this are discussed in Zohir, S. "Scope of Crop Diversification in Bangladesh -- An Analysis with Cropping Pattern-Based Approach", June 1993.

second degree variation due to changes in use of chemical fertilizer, we introduce a square term for it. Only pre-harvest labour is considered, a la Bliss and Stern (1978)[1], since harvest and post-harvest labour may be presumed to be determined by yield.

Among the physical characteristics, we are able to capture only the land inundation level and permeability of soil. Land inundation classification generally follows BARC'S definition with minor modification; high (upto 30 cm.), medium high (30-90 cm.), medium low (90-180 cm.), low (180-360 cm.) and very low land (above 360 cm.). In case of soil permeability, plots were identified in terms of "Atel" (clayey), "Atel-Doass" (clayey-loamy), "Doass" (loamy), "Bele-Doass"(sandy-loamy) and "Bele" (loamy), that are in order of increasing permeability.

Two other issues that are of interest to policy makers are, whether yield is declining at the extensive margin, and whether Flood Control and Drainage (FCD) projects have any significant impact on yields. Beside pure academic curiosity, for projection purpose, one needs to know whether the yield parameter is stable, increasing or decreasing. The interest on FCD variable is of importance in the context of investment analyses - both for short term analyses and long term projections. We capture the yield changes at the extensive margin by introducing a dummy for districts where the adoption rate (i.e., percentage of net cropped area) is high (compared to other districts)

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1. See Bliss, C.J. and N.H. Stern, Palanpur: Studies in the Economy of a North Indian Village, Oxford University Press, 1982.

for a particular crop. Since study villages were chosen to represent areas under both FCD and non-FCD, the differences in the two subsets have been contrasted by having a dummy for FCD villages.

Finally, we include a cropping pattern variable to capture possible yield variation across cropping patterns. The relevance of this variable arises since farmers' choice of crops may be influenced by relative profitability across alternative cropping patterns. While a more detailed analyses on the subject is dealt with elsewhere, for the present purpose, we have introduced dummy variables either separately for double and triple cropping, or for multiple cropping.

Conventionally, one estimates a production function (and there are many variants of it) or its dual counterpart, a profit or a cost function, in order to identify the determinants of output (i.e., factors with marginal products statistically significant from zero). At a simpler level, one could adopt bivariate analyses and contrast yields across different characteristics. Since dealing with more than two dimensions become cumbersome in the latter analyses, and we have more than one variables to control for, regression techniques are adopted. The purpose is not to estimate the parameters of a production function, but to verify if crop yield varies due to variation in some physical (e.g., land and soil types) and agronomic (e.g., cropping pattern) characteristics.

To serve our purpose, we consider the following general equation:

$$Y = a + b_1 \text{CFA} + b_2 \text{CFA2} + b_3 \text{PHLA} + b_4 \text{DHL} + b_5 \text{DLL} + b_6 \text{DLPS} + b_7 \text{DPS} + b_8 \text{DI} + b_9 \text{DCP2} + b_{10} \text{DCP3} + b_{11} \text{DFCD} + b_{12} \text{DHA} + U;$$

where a is the constant term, b_j (j = 1,..,12) are coefficients and U is the disturbance term. The list of variables is given below,

Y	=	main output (kg.) per acre;
CFA	=	chemical fertilizer (kg.) per acre;
CFA2	=	square of CFA;
PHLA	=	pre-harvest labour (days) per acre;
DHL	=	1 if high land (upto 30 cm. flood), otherwise 0;
DLL	=	1 if medium low or low land (more than 90 cm. flood), otherwise 0;
DLPS	=	1 if less permeable soil, otherwise 0; (may very across regressions);
DPS	=	1 if permeable soil, otherwise 0; (may very across regressions);
DI	=	1 if irrigated, otherwise 0;
DMI	=	1 if mechanized irrigation, otherwise 0 (used in lien of DI);
DCP2	=	1 if the observation is associated with double cropping, otherwise 0;
DCP3	=	1 if the observation is associated with triple cropping, otherwise 0;
DCP	=	1 if multiple cropping, otherwise 0 (used instead of DCP2 and DCP3);
DFCD	=	1 if the plot is inside FDC project, otherwise 0;
DHA	=	1 if the observation is from districts with high adoption rate of particular modern variety rice.

Regression Results on Yield Variation

We focus on the modern variety rice produced in three different seasons. The only exception is in case of LTG Aman, which we include because of its predominance in Bangladesh rice economy. Since subsets of data have often been considered to control for disturbances, some of the variables do not show up in some of the regressions. The regression estimates are presented separately in Tables VI.2 to VI.6. The findings are briefly discussed below.

In all cases, except modern variety Boro by land types (Table VI.5), we find the pre-harvest labour coefficient to be statistically insignificant. Since labour requirements may be affected by weed situation, distance from plot and farm size; it would be coincidental if one arrived at some systematic result. In most of the regression results provided, we have therefore omitted the PHLA variable.

Use of chemical fertilizer does not appear to have much significant effect on yield in cases of modern variety Aman and Boro; while it has significant positive effect after a minimal dose in case of MV Aus and LT Aman. The estimates do not suggest that yield would have remained unchanged if there were no use of fertilizer. Rather, one would read the results to suggest that farmers cultivating modern variety Aman and Boro are using fertilizer doses[1] at levels wherefrom yield increases may not be achieved through further increases in fertilizer use[2].

The cross-sectional estimates suggest that yields of modern variety Aus and Aman are not significantly higher under irrigated condition compared to rainfed condition. The results do not throw light on the prospect of yield increase through providing supplementary irrigation. They however suggest that if there are areas where rainfall is adequate in some years, farmers may not choose to go for irrigation. In case of modern variety Boro, the results suggest that yields are generally higher under mechanized irrigation compared to other modes (see Tables VI.4 and VI.5).

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1. We are not in a position to suggest on the optimal mix, nor the timing and method of fertilization.
2. If CFA2 variable is dropped, chemical fertilizer use per acre (CFA) is found to have significant positive effect on yield. Thus, possible positive role of fertilizer use at the margin cannot be outrighly rejected.

In a separate paper we look into the impact of FCD on crop choice. Here, only yields are compared between FCD and non-FCD areas. On lands where modern variety Aus/Aman are cultivated, all our findings suggest that yields are significantly lower inside FCD. One major implication of this finding is for project analyses: yields in non-FCD areas should not be assumed to hold true for FCD areas. Thus, for projection analysis, if expansions in acreages under modern variety Aus and Aman are sought through investments on FCD, a declining trend in yield may have to be assumed. The same finding of lower yield under FCD is observed in case of modern variety Boro on less permeable soil, and less significantly in case of medium-low land[1].

The results on yield variations at the extensive margin (captured by DHA) are quite interesting. It is known that adoption rates are high in case of MV Boro, medium in case of MV Aman and low in case of MV Aus. Thus, the level of adoption in the high adopting districts also vary in the same order.[2] The results show that yield of MV Aus and MV Aman are significantly higher on high land in HA district; they are however lower on more permeable soil in HA districts. The yields are significantly lower for high adopters in most cases

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1. Note that a low land under non-FCD may turn out to be high land once FCD is in place. One may therefore have to contrast yields between (say) non-FCD medium high with FCD high land. This, we plan to do later.

2. In case of MV Aus, Chittagong and Comilla are considered as high adopters (HA); Chittagong H.T., Chittagong, Comilla, Jessore, Bogra and Rajshahi for MV Aman; and Chittagong, Comilla, Jamalpur, Tangail, Bogra and Pabna are considered as high adopters in MV Boro. The groupings are based on BBS figures on acreages during 1990-91.

of MV Boro. The findings generally suggest that further expansion of modern variety Aus and Aman may be expected on high land; and the yields of MV Boro are on decline in high adopting districts.

Finally, yield variations across cropping patterns, when the latter is defined broadly in terms of double and triple crops,are found to be crop-specific. In case of MV Aus on high land, yields are significantly lower if associated with triple crops. In the case of MV Aman, no systematic variation is observed, while yield under LT Aman may be higher under triple crops[1]. In all cases of MV Boro, multiple cropping (double or triple) significantly reduces yields.

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1. It is possible that under triple crops, more fertilizer are used in other seasons so that there is lag positive effect on yield of LT Aman.

Table VI.2

Yield Variation under Modern Variety Aus, regression results

Explanatory Variables	High land	Medium high land	Bele-Doass soil
CFA	5.87 (1.11)	-5.67 (2.11)	-3.04 (0.98)
CFA2	0.01 (0.28)	.03 (3.08)	.03 (2.14)
PHLA	-4.86 (1.39)	-2.27 (0.92)	-1.44 (0.61)
DI	205.19 (1.32)	80.69 (0.50)	-92.86 (0.53)
DCP3	-724.73 (2.41)	67.59 (0.38)	-109.11 (0.29)
DFCD	-153.66 (1.36)	-266.80 (2.08)	-300.42 (2.15)
DHA	308.80 (2.46)	-205.65 (1.36)	-339.56 (2.56)
R^2	.45	.30	.42
N	73	59	51

Note: N = numbers of observations. Regression for high land included DLPS, DPS and DCP2, that of medium-high land included DPS, and the last one included DHL and DCP2. They are not reported since t-statistics were very low.

Table VI.3

Yield Variability under Modern Variety Aman, regression results

Explanatory Variables	HL/* Doass soil	Bele-Doass soil	Doass soil
CFA	3.43 (0.90)	1.62 (0.75)	1.20 (0.39)
CFA2	.01 (0.61)	-.001(0.20)	.002 (0.20)
PHLA	-2.90 (0.82)	-2.17(1.44)	-.94 (0.40)
DFCD	-301.91 (2.46)	-320.80 (3.52)	-262.42 (2.70)
DHA	301.91 (2.48)	-105.52 (1.41)	239.32 (2.95)
R^2	.37	.25	.27
N	55	95	96

* DFCD and DCP3 were found to be highly correlated; DCP3 was therefore omitted.

Note: The first regression included DI; the second included DHL, DI and DCP3; and the last one included DHL, DLL, DI and DCP3. All these are not reported since t-statistics were very low.

Table VI.4

Yield Variation under Modern Variety Boro, regression results controlling for soil types

Explanatory Variables	Atel-Doass		Doass	
CFA[1]	4.12	(1.45)	8.41	(1.40)
CFA2	-n	(0.14)	-.01	(0.51)
DHL[2]	-18.39	(0.08)	-192.47	(0.79)
DLL[2]	-502.17	(2.36)	-141.36	(0.63)
DMI	385.06	(1.56)	89.70	(0.43)
DCP	-885.11	(3.67)	-981.93	(3.32)
DFCD	-55.35	(2.23)	-10.55	(0.04)
DHA	-747.79	(3.19)	-133.12	(0.72)
R^2	.50		.42	
N	52		43	

n = negligible.

1. If CFA2 is dropped, CFA has significant positive coefficients in both equations.

2. DHL is for high land and DLL is for medium-low land; the reference category is medium-high land.

Table VI.5

Yield Variation under Modern Variety Boro, regression results controlling for land types

	Medium high[1]		Medium low[2]	
CFA	.20	(0.95)	5.33	(1.76)
CFA2	n	(0.09)	-.002	(0.46)
PHLA	5.33	(2.05)	-	
DLPS	166.28	(1.47)	-132.47	(0.71)
DMI	257.37	(1.69)	-298.83	(1.17)
DCP	-285.44	(1.47)	-931.50	(4.24)
DFCD	-147.52	(0.94)	-363.66	(1.39)
DHA	-374.18	(3.28)	-674.98	(3.21)
R^2	.36		.53	
N	51		50	

1. Includes Atel-Doass, Doass and Bele-Doass land; DLPS captures Atel-Doass.
2. Includes Atel-Doass and Doass land; DLPS captures Atel-Doass.

Table VI. 6

Yield Variation under Local Transplanted Aman, regression results

Explanatory Variables	Atel-Doass, MH & ML land	Bele-Doass and Atel-Doass, MH land
CFA	-4.20 (1.39)	-11.53 (3.40)
CFA2	.054 (2.74)	.08 (2.69)
DLL	31.95 (0.34)	-
DPS	-	23.83 (0.27)
DI	147.69 (0.62)	340.78 (2.25)
DCP3	489.04 (4.04)	-26.13 (0.31)
DFCD	-	-13.85 (0.12)
R^2	.69	.49
N	27	32

APPENDIX A

List of Study Villages

Appendix A

List of Villages Studied

Village Name	Thana Name	FCD Code Yes=1 No=2	BIDS Zone Number	AEZ Number
Bikrichara	Bandarban Sadar	2	01	29
Chunati	Lohagara	2	01	29
Bikna	Jalakati Sadar	2	02	13
Char Bhatara Kanda	"	2	02	13
Patiabandaha	Fultola	2	03	11
Naudari	"	2	03	11
Gadaipur	Paikgacha (South-part)	1	03	13
Paikgacha	"	1	03	13
Helatala	Kalaroa	2	03	11
Jhikra	"	2	03	11
Budhar	Agailjhora	1	04	14
Manosi-Fulosri	"	2	04	14
Tarochar	Muladi (North-part)	2	04	12
Chardegree	"	1	04	12
Kalikapur	Begumganj	2	04	19
Darbeshpur	"	2	04	19
Asampara	Gowanighat (North-part)	2	04	22
Zatugram	"	2	04	22
Sabantangra	Biswanath	2	04	20
Gangkul	Baralekha	2	04	29
Moorikandi	"	2	04	29
Mohipur	Sherpur	2	05	25
Shewagseha	"	2	05	25
Jabai	Sapahar	2	05	26
Tilnachar	"	2	05	26

Appendix A (Contd.)

Village Name	Thana Name	FCD Code Yes=1 No=2	BIDS Zone Number	AEZ Number
Kusumba	Manda	1	05	03
Chackshabai	"	2	05	03
Murad Nagar	Rangunia	1	06	29
Noagaon	"	2	06	29
Kharana	Patiya	2	06	23
Bhatikhain	"	1	06	23
Shahapur	Senbagh	2	06	19
Kadra	"	2	06	19
Anindapur	Parsuram	1	06	23
Fatehpur	"	2	06	23
Bhangnahati	Sreepur	2	07	28
Bairagirchala	"	2	07	28
Gobindapur	Melandah	2	07	09
Kolapara	Parsuram	2	06	23
Baniapara	Khaliajuri	2	07	21
Sangram Simul	Modhupur	2	07	09
Kakraid	"	2	07	09
Noapara	Mirpur	1	08	11
Katlamari	"	2	08	11
Paikpara	Kaliganj	2	08	11
Dulalmondi	"	2	08	11
Bagliakul	Tungipara	1	09	14
Sreeram kandi	"	2	09	14
Kallanpur	Rajbari Sadar	1	09	12
Gachiadah	"	2	09	12
Jhaudia	Ishurdi	2	09	11
Kalicapur	"	1	09	11
Arkandi	Singra (South-part)	2	10	05
			10	05
Hatdelna	Ullapara	2	10	04

Appendix A (Contd.)

Village Name	Thana Name	FCD Code Yes=1 No=2	BIDS Zone Number	AEZ Number
Deorgach	Chunarughat	2	10	22
Uttar Narapati	"	2	10	22
Mobarakdi (Baradia)	Matlab	2	10	16
Dakhkhin Torki	"	1	10	16
Niamatpur	Muradnagar	2	10	19
Dhamgarh	"	2	10	19
Batisha	Chowddagram	2	10	22
Satbaria	"	2	10	22
Dudumari	Panchagarh Sadar	2	11	01
Mirgarh	"	2	11	01
Jamubari	Badarganj	2	11	27
Khalahati	Gaibandah Sadar (East-part)	1	11	03
Baguria	"	2	11	03
Balugram	Nawabganj Sadar (S & S-W)	1	12	10
Kalinagar	"	2	12	10
Aksa	Tanore (S-W)	2	12	26
Vhadrakanda	"	2	12	26
Dakhin Fatekorkul	Ramu	1	14	29
Joaria Nala	"	2	14	29
Utkool	Bagerhat Sadar	2	15	14
Kartikdia	"	2	15	14
Phikolia	Dhamrai	2	10	08

APPENDIX B

Complete Data on Input-Out Coefficients and Costs & Returns

Table : B.1

INPUT-OUTPUT COEFFICIENTS :

(per hectare)

Item Name	LT. AMAN	P. AMAN	MV. AMAN	B. AMAN	L. BORO	MV BORO	L. AUS	MV AUS	BEAUS	WHEAT	MAIZE	JUTE CAP.	JUTE OLI.	COTTON	TOBACCO	SUGAR-CANE	GUR	L. POTATO	MV POTATO
Main product (Kg.)	2096	2956	3499	1646	2189	4316	1554	3090	4361	2199	1128	1530	1765	1306	1445	59148	6696	7961	18502
By-product (Kg.)	2290	1847	2799	2692	2395	3299	1936	2481	2293	2060	2373	1852	2266	2021	458	7455	8939	0	0
Seed quantity (Kg.)	66	59	66	58	63	67	98	61	62	124	33	10	7	20	1	4444	4444	599	1040
Seedling cost (Tk.)	672	634	693	605	665	680	769	644	649	1436	238	374	374	64	182	4490	4490	6702	10557
Total Labour use (person days)	160	194	189	132	135	199	161	178	185	156	204	247	245	211	255	342	450	237	295
Hired Labour use (person days)	97	111	115	86	92	124	81	100	110	88	154	173	173	75	143	263	359	131	198
Bullock labour (pair-days)	39	41	39	32	23	37	32	35	41	41	38	40	37	25	37	47	47	55	57
Hired bullock (pair-days)	6	6	9	8	2	9	5	9	10	7	16	15	7	5	8	13	13	11	9
Organic Manure (kg.)	820	975	1792	455	285	1384	1109	2320	1239	1412	2762	1971	2185	224	1445	3927	3927	2945	3408
Chemical fertilizer (kg.)	79	173	259	26	69	357	85	242	421	272	321	111	136	235	347	541	541	327	695
Urea (Kg.)	39	78	125	19	42	169	48	113	216	124	127	55	58	100	140	222	222	135	274
TSP (Kg.)	28	63	92	7	22	127	26	87	125	102	105	38	57	110	132	214	214	120	269
MP (Kg.)	12	32	41	0	5	61	11	42	79	46	89	19	20	25	75	106	106	72	152
Cost of other fertilizer (kg.)	14	92	78	0	0	115	4	89	61	63	80	3	10	7	3	33	33	109	276
Pesticide cost (Tk.)	236	521	522	31	174	690	95	451	228	121	988	53	224	1668	452	746	746	328	774
Irrigation cost (Tk.)	28	258	268	48	397	3678	9	576	4159	843	791	0	298	97	1346	427	427	926	1582
Tractor/power tiller cost (Tk.)	26	100	143	124	0	188	10	170	0	8	0	108	32	147	208	88	88	52	111
Sprayer cost (Tk.)	19	22	28	6	19	42	2	40	5	2	0	4	40	75	61	53	53	20	29
Transport cost (Tk.)	0	0	40	0	0	10	9	17	0	26	0	0	36	0	842	2368	0	0	14
Post-harvest processing cost (Tk.)	4	82	36	0	0	55	6	82	0	0	0	0	0	0	9353	0	913	0	0

BEST AVAILABLE DOCUMENT

All monetary figures are in 1990/91 prices.

Table : B.1

Item Name	SWEET POTATO	RAPE & MUSTARD	TIL	LINSEED	GROUND NUT	RAW TUR-MARIC	DRY CHILLI	GREEN CHILLI	GINGER	CORIAN-DER SEED	GARLIC	ONION	MASUR	GRAM	KHESARI	MASHKALAI	MOONG
Main product (Kg.)	12347	894	775	508	1872	13469	649	5742	8916	1168	3570	8078	818	767	1088	1179	480
By-product (Kg.)	0	1085	1481	553	0	0	0	0	0	2347	0	0	807	836	942	1440	0
Seed quantity (Kg.)	960	15	13	11	92	812	7	7	1307	23	257	63	40	55	69	37	19
Seedling cost (Tk.)	2402	7976	318	246	290	2394	9668	1126	1126	17503	843	8658	3344	908	1265	829	755
Total Labour use (person days)	244	118	196	51	229	211	413	383	307	164	341	321	82	81	73	77	92
Hired Labour use (person days)	134	64	117	19	89	101	218	210	124	24	172	214	45	43	42	28	33
Bullock labour (pair-days)	60	35	51	27	34	63	60	60	0	53	59	60	28	28	17	26	19
Hired bullock (pair-days)	12	8	21	0	2	0	13	13	0	0	10	14	6	5	5	10	0
Organic Manure (kg.)	2643	926	366	0	553	5486	2895	2895	2306	2242	2028	3203	445	751	0	0	340
Chemical fertilizer (kg.)	200	207	91	32	104	290	435	435	371	206	144	192	92	55	6	15	63
Urea (Kg.)	80	87	36	0	35	160	176	176	93	94	47	58	19	20	1	10	12
TSP (Kg.)	89	86	40	0	40	98	182	182	185	81	70	77	50	30	3	5	37
MP (Kg.)	31	34	16	32	30	32	77	77	93	31	26	57	23	5	2	0	14
Cost of other fertilizer (kg.)	18	9	0	0	0	0	90	90	0	0	17	35	2	0	0	0	0
Pesticide cost (Tk.)	7	120	116	0	84	135	467	467	350	0	33	118	33	69	16	0	133
Irrigation cost (Tk.)	608	136	0	0	0	0	1220	1220	0	0	0	452	44	0	0	0	0
Tractor/power tiller cost (Tk.)	0	29	78	0	0	0	111	111	0	0	0	0	32	0	0	56	489
Sprayer cost (Tk.)	0	26	20	0	0	54	54	54	0	0	0	4	8	15	8	0	38
Transport cost (Tk.)	0	4	0	31	0	0	0	0	0	0	0	10	54	51	17	0	0
Post-harvest processing cost (Tk.)	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

BEST AVAILABLE DOCUMENT

Item Name	C. PEA	HELEN	BRIN-JAL	PUMP-KIN	RADISH	CUCUM-BER	BAR-BATI	TOMATO	CAULI-FLOWER	CABB-AGE	LADIES FINGER	KAKROL	LAL SHAK	ARUM
Main product (Kg.)	862	1067	14679	4929	10722	8449	7696	16365	15062	19909	11913	14456	3915	13912
By-product (Kg.)	405	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed quantity (Kg.)	50	23												
Seedling cost (Tk.)	434	928	423	386	303	1331	1314	1216	1525	2821	1584	1807	7529	802
Total Labour use (person days)	86	160	458	124	267	164	352	332	371	275	291	604	168	296
Hired Labour use (person days)	36	61	216	107	117	104	109	109	136	142	103	386	55	91
Bullock labour (pair-days)	32	29	56	43	63	32	49	61	57	40	72	94	61	90
Hired bullock (pair-days)	5	4	25	18	25	23	38	20	21	8	20	14	14	18
Organic Manure (kg.)	0	1858	3841	3630	2765	4006	4340	2076	6223	3890	7276	5691	4557	2408
Chemical fertilizer (kg.)	6	23	601	96	433	317	304	372	399	502	500	706	304	653
Urea (Kg.)	6	16	228	19	157	138	119	163	141	209	244	349	131	230
TSP (Kg.)	0	5	260	12	181	117	142	140	164	206	112	245	116	337
MP (Kg.)	0	2	113	66	94	62	42	70	94	86	143	112	57	85
Cost of other fertilizer (kg.)	0	15	681	0	428	103	9	44	62	895	45	1189	0	379
Pesticide cost (Tk.)	0	5	1622	118	350	202	357	266	1098	804	767	1190	286	84
Irrigation cost (Tk.)	0	0	1132	147	328	988	0	575	366	1689	1263	0	172	103
Tractor/power tiller cost (Tk.)	0	0	49	0	35	529	0	92	41	0	346	0	247	0
Sprayer cost (Tk.)	0	0	142	0	24	59	58	21	0	345	158	190	55	0
Transport cost (Tk.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post-harvest processing cost (Tk.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0

BEST AVAILABLE DOCUMENT

Table : B.2

Prices and wages at Farm Level :
at 1990-91

(TK./UNIT)

Item Name	LT. AMAN	P. AMAN	MV. AMAN	B. AMAN	L. BORO	MV BORO	L. AUS	MV AUS	BRAUS	WHEAT	MAIZE	JUTE CAP.	JUTE OLI.	COTTON	TOBACCO	SUGAR-CANE	GUR	L. POTATO	MV POTATO
Main product (Kg.)	6.01	6.23	5.97	6.00	5.80	5.90	5.85	6.06	5.48	5.67	7.61	5.80	7.23	18.49	35.83	0.94	11.05	3.31	3.00
By-product (Kg.)	0.50	0.66	0.53	0.32	0.22	0.30	0.41	0.50	0.55	0.33	0.94	1.28	1.06	0.44	7.92	0.37	0.65	0.16	0.21
Seed (Kg.)	10.39	10.88	10.60	11.76	11.04	10.24	10.22	10.68	10.50	11.44	7.72	37.81	52.68	3.32		1.09	1.09	12.32	10.38
Daily Wage rate (Tk.)	42.02	58.44	45.62	35.18	49.73	44.27	36.08	46.45	35.02	37.83	45.97	37.56	33.39	31.70	35.63	35.56	36.22	47.10	42.96
Hiring rate for animal labour (Tk.)	36.37	51.25	42.56	48.51	38.75	41.64	41.59	42.60	30.63	37.30	51.25	44.34	40.26	46.79	47.67	40.78	40.78	43.04	41.50
Organic manure	0.14	0.25	0.20	0.15	0.11	0.20	0.11	0.20	0.07	0.14	0.11	0.16	0.14	0.05	0.20	0.12	0.12	0.21	0.18
Urea (Kg.)	5.31	5.17	5.28	5.58	5.50	5.36	5.39	5.26	5.60	5.44	4.95	5.43	5.38	5.39	5.44	5.31	5.31	5.43	5.23
TSP (Kg)	5.75	5.58	5.71	6.04	5.95	5.72	5.83	5.68	6.03	5.98	5.10	5.59	5.77	6.28	6.10	5.67	5.67	5.86	5.66
MP (Kg.)	4.89	4.61	4.81	4.81	5.25	4.77	4.85	4.86	5.36	4.93	4.58	4.77	4.83	4.97	4.90	4.74	4.74	4.89	4.75
Seasonal land rental value (hectare)	5661	7266	6833	2817	7840	8396	3999	6047	0	4731	4903	4986	4782	4134	7113	12013	12013	6790	6208

BEST AVAILABLE DOCUMENT

Table : B.2

Item Name	SWEET POTATO	RAPE & MUSTARD	TIL	LINSEED	GROUND NUT	RAW TUR-MARIC	DRY CHILLI	GREEN CHILLI	GINGER	CORIAN-DER SEED	GARLIC	ONION	MASUR	GRAM	KHESARI	MASHKALAI	MOONG	C. PEA
Main product (Kg.)	2.27	10.72	10.48	11.90	12.17	5.24	42.82	9.88	7.37	26.79	18.41	6.76	11.10	12.49	5.74	11.28	12.67	8.48
By-product (Kg.)	0.13	0.28	0.38	0.27	0.27	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.30	0.31	0.60	0.46	0.00	0.27
Seed (Kg.)	3.71	20.58	18.42	25.29	25.72	10.25			13.40	38.58	35.01		22.69	24.37	12.32	20.36	23.73	18.58
Daily Wage rate (Tk.)	47.08	41.82	36.92	41.89	44.98	37.96	43.63	43.52	70.83	44.25	35.09	32.17	36.36	32.33	34.13	38.35	35.72	28.49
Hiring rate for animal labour (Tk.)	47.00	41.92	48.68	42.50	48.33	30.00	45.00	45.00	0.00	40.00	41.11	35.56	43.38	44.52	44.50	45.00	50.00	49.00
Organic manure	0.23	0.17	0.13	0.00	0.32	0.16	0.22	0.22	0.21	0.18	0.11	0.14	0.12	0.15	0.09	0.00	0.17	0.00
Urea (Kg.)	5.31	5.32	5.20	0.00	5.25	5.57	5.28	5.28	5.25	5.38	5.60	5.69	5.35	5.29	5.25	5.00	5.75	5.25
TSP (Kg)	5.75	5.75	5 .3	0.00	5.25	5.80	5.74	5.74	5.75	6.00	5.75	5.89	5.67	5.80	5.67	5.00	6.00	5.00
MP (Kg.)	4.50	4.91	4.75	5.00	4.75	5.50	4.81	4.81	4.50	0.00	5.00	4.68	4.76	4.83	4.50	4.50	5.00	4.50
Seasonal land rental value (hectare)	6289	6125	5946	2077	8463	8882	7320	7320	4530	6178	3058	5182	3127	2068	3314	4371	3158	2498

BEST AVAILABLE DOCUMENT

Table : B.2

Item Name	HELEN	BRIN-JAL	PUMP-KIN	RADISH	CUCUM-BER	BAR-BATI	TOMATO	CAULI-FLOWER	CABB-AGE	LADIES FINGER	KAKROL	LAL SHAK	ARUM
Main product (Kg.)	12.12	4.04	1.68	3.11	3.70	6.77	4.69	5.98	2.68	7.72	10.72	2.57	4.59
By-product (Kg.)	0.00	0.73	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Seed (Kg.)	17.65												
Daily Wage rate (Tk.)	57.13	42.63	37.95	43.53	50.03	62.06	46.69	43.91	44.52	32.10	41.73	42.61	46.03
Hiring rate for animal labour (Tk.)	57.14	46.23	43.33	47.00	55.00	50.00	41.54	46.00	47.50	55.00	41.00	45.00	41.00
Organic manure	0.27	0.19	0.11	0.18	0.20	0.27	0.17	0.22	0.20	0.30	0.20	0.18	0.30
Urea (Kg.)	5.30	5.27	5.25	5.21	5.17	5.07	5.31	5.21	5.44	5.20	5.10	5.25	5.21
TSP (Kg)	5.40	5.66	5.50	5.48	5.50	5.86	5.73	5.67	5.94	5.80	5.68	5.66	5.71
MP (Kg.)	4.50	4.69	4.81	4.93	4.88	5.25	4.82	4.83	5.25	5.10	4.50	4.60	4.75
Seasonal land rental value (hectare)	6325	8105	2293	8267	10230	6450	7628	11738	8203	5807	3089	8134	6072

BEST AVAILABLE DOCUMENT

Table 5.1

Distribution of Total Cost based on crop-specific input prices.

BEST AVAILABLE DOCUMENT

(figures in %)

Item Name	LT. AMAN	P. AMAN	MV. AMAN	B. AMAN	L. BORO	MV BORO	L. AUS	MV AUS	BRAOS	WHEAT	MAIJE	JUTE CAP.	JUTE OLI.	COTTON	TOBACCO	SUGAR-CANE	GUR	L. POTATO	MV POTATO
Seed	7.06	3.91	5.09	9.27	7.43	3.78	11.25	4.77	4.24	12.23	1.65	3.00	3.29	0.58	0.71	18.64	16.90	29.81	32.79
Human Labour	69.27	69.59	6. 26	63.41	72.05	48.89	65.44	60.77	42.32	50.70	61.25	74.15	69.59	59.39	35.66	46.80	56.83	45.06	38.47
Animal labour	14.72	12.87	12.03	21.51	9.69	8.60	15.20	11.07	8.21	13.26	12.70	14.21	12.76	10.20	6.86	7.34	6.66	9.60	7.23
Chemical fertilizer	4.44	5.71	10.17	2.02	4.16	10.86	5.24	9.70	15.74	13.15	10.43	4.77	6.34	12.03	7.58	11.16	10.12	7.37	11.42
Organic fertilizer	1.29	1.89	2.98	0.93	0.34	1.98	1.41	3.87	0.85	2.08	2.35	2.53	2.66	0.15	1.14	1.90	1.72	2.81	2.45
Pesticides	2.43	3.20	3.77	0.43	1.87	3.83	1.07	3.32	1.49	1.04	6.46	0.42	1.90	14.83	1.77	2.87	2.60	1.32	2.35
Irrigation	0.29	1.58	1.94	0.66	4.26	20.41	0.10	4.23	27.14	7.25	5.17	0.00	2.53	0.86	5.27	1.64	1.49	3.74	4.81
Machine cost	0.50	1.24	1.49	1.77	0.21	1.59	0.20	2.14	0.03	0.08	0.00	0.90	0.61	1.97	37.70	0.54	3.68	0.29	0.43
Transport cost	0.00	0.00	0.29	0.00	0.00	0.05	0.10	0.12	0.00	0.22	0.00	0.00	0.30	0.00	3.30	9.11	0.00	0.00	0.04

Distribution of Total Cost based on average input prices.

(figures in %)

Item Name	LT. AMAN	P. AMAN	MV. AMAN	B. AMAN	L. BORO	MV BORO	L. AUS	MV AUS	BRAOS	WHEAT	MAIJE	JUTE CAP.	JUTE OLI.	COTTON	TOBACCO	SUGAR-CANE	GUR	L. POTATO	MV POTATO
Seed	6.81	4.99	5.32	8.42	8.21	3.87	10.04	5.04	3.78	11.29	1.73	2.76	2.75	0.49	0.67	16.85	15.27	31.32	32.75
Human Labour	67.18	63.90	60.14	68.69	67.73	47.51	67.61	58.14	45.42	52.15	58.54	75.84	72.75	66.55	39.93	50.19	59.46	42.39	37.78
Animal labour	16.83	13.80	12.75	17.36	11.91	9.11	14.05	11.84	10.30	14.15	11.23	12.72	11.43	7.95	5.87	7.02	6.36	10.11	7.51
Chemical fertilizer	4.28	7.51	10.71	1.75	4.43	10.93	4.61	10.33	13.20	11.79	11.90	4.40	5.27	9.56	6.92	10.18	9.23	7.60	11.58
Organic fertilizer	1.81	2.11	3.26	1.18	0.71	2.11	2.37	4.27	1.76	2.70	4.37	3.06	3.32	0.39	1.13	2.95	2.67	2.95	2.76
Pesticides	2.34	4.08	3.94	0.39	2.07	3.92	0.95	3.50	1.33	0.96	6.79	0.39	1.59	12.55	1.68	2.59	2.35	1.39	2.35
Irrigation	0.28	2.02	2.03	0.60	4.71	20.88	0.09	4.47	24.18	6.69	5.44	0.00	2.12	0.73	4.99	1.49	1.35	3.93	4.80
Machine cost	0.48	1.59	1.56	1.60	0.23	1.62	0.18	2.27	0.03	0.08	0.00	0.83	0.51	1.67	35.68	0.49	3.32	0.31	0.43
Transport cost	0.00	0.00	0.30	0.00	0.00	0.05	0.09	0.13	0.00	0.21	0.00	0.00	0.25	0.00	3.12	8.24	0.00	0.00	0.04

Table : 6.3

BEST AVAILABLE DOCUMENT

Item Name	SWEET POTATO	RAPE & MUSTARD	TIL	LINSEED	GROUND NUT	RAW TUR-MARIC	DRY CHILLI	GREEN CHILLI	GINGER	CORIAN-DER SEED	GARLIC	ONION	MASUR	GRAM	KHESARI	MASHKALAI	MOONG	C. PEA
Seed	17.65	3.75	2.22	7.61	15.68	39.76	4.21	4.43	41.61	7.60	36.77	13.62	15.49	23.28	20.22	14.86	7.68	19.71
Human Labour	56.97	59.18	67.56	57.25	68.10	38.32	67.36	65.65	51.72	62.17	48.88	57.60	51.17	45.44	59.65	58.30	57.12	49.41
Animal labour	13.91	17.79	23.19	30.10	11.00	9.01	10.02	10.54	0.00	18.24	9.97	11.98	20.94	21.69	18.39	23.45	16.54	31.23
Chemical fertilizer	5.35	13.48	4.58	4.22	3.50	7.81	8.86	9.33	4.68	8.52	3.28	5.92	8.53	5.29	0.74	1.50	6.25	0.65
Organic fertilizer	3.08	1.97	0.45	0.00	1.17	4.20	2.62	2.76	1.15	3.47	0.96	2.63	0.94	1.96	0.00	0.00	1.00	0.00
Pesticides	0.04	1.43	1.08	0.00	0.55	0.65	1.75	1.84	0.83	0.00	0.13	0.66	0.57	1.20	0.39	0.00	2.30	0.00
Irrigation	3.01	1.63	0.00	0.00	0.00	0.00	4.57	4.80	0.00	0.00	0.00	2.52	0.75	0.00	0.00	0.00	0.00	0.00
Machine cost	0.00	0.72	0.92	0.00	0.00	0.26	0.62	0.65	0.00	0.00	0.00	0.02	0.68	0.26	0.19	1.89	9.12	0.00
Transport cost	0.00	0.05	0.00	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.92	0.89	0.42	0.00	0.00	0.00

Item Name	SWEET POTATO	RAPE & MUSTARD	TIL	LINSEED	GROUND NUT	RAW TUR-MARIC	DRY CHILLI	GREEN CHILLI	GINGER	CORIAN-DER SEED	GARLIC	ONION	MASUR	GRAM	KHESARI	MASHKALAI	MOONG	C. PEA
Seed	19.03	30.02	3.70	2.07	7.53	16.64	36.40	4.35	4.56	52.52	7.61	33.12	15.34	14.19	20.39	17.74	14.12	7.13
Human Labour	55.07	41.59	58.86	71.80	57.45	67.66	39.02	66.81	65.18	33.78	59.07	52.34	62.00	54.60	52.14	65.08	61.18	67.35
Animal labour	13.75	12.93	18.04	19.23	30.18	10.41	11.86	9.91	10.40	0.00	19.68	9.47	11.76	19.07	18.79	15.63	21.56	13.7[illegible]
Chemical fertilizer	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Organic fertilizer	3.05	2.57	2.37	0.67	0.00	0.61	5.04	2.59	2.72	1.45	4.05	1.61	3.20	1.49	7.40	0.00	0.00	1.15
Pesticides	0.04	0.28	1.41	1.02	0.00	0.59	0.59	1.80	1.89	1.05	0.00	0.12	0.54	0.52	1.05	0.34	0.00	2.13
Irrigation	3.25	0.34	1.60	0.00	0.00	0.00	0.00	4.71	4.95	0.00	0.00	0.00	2.07	0.69	0.00	0.00	0.00	0.00
Machine cost	0.00	0.00	0.71	0.86	0.00	0.00	0.24	0.64	0.67	0.00	0.00	0.00	0.02	0.62	0.22	0.17	1.80	3.47
Transport cost	0.00	0.00	0.05	0.00	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.85	0.78	0.37	0.00	0.00

Table B.4

Cost and Return at Farm Level

(Tk./hectare)

Item Name	LT. AMAN	P. AMAN	MV. AMAN	B. AMAN	L. BORO	MV BORO	L. AUS	MV AUS	BRAUS	WHEAT	MAIZE	JUTE CAP.	JUTE OLI.	COTTON	TOBACCO	SUGAR-CANE	GUR	L. POTATO	MV POTATO
Revenue I	12597	18416	20389	9876	12696	25464	9091	18725	23897	12468	8584	8874	12761	24141	51760	55599	73989	26353	55506
Revenue II	13742	19635	22373	10737	13223	27114	9885	19966	25158	13148	10815	11244	15163	25031	55385	58358	79800	26353	55506
Cash Cost	5720	9370	8854	4468	6331	13200	4719	8389	11539	7564	11558	8322	7851	5991	20053	21348	23587	17219	25977
Full Cost	9705	16292	13850	7324	9318	18019	8377	13605	15325	11639	15301	12511	11756	11249	25521	25992	28662	24743	32913
Based on crop-specific input prices :																			
Return on Cash Cost Basis I	6877	9046	12035	5408	6365	12264	4372	10336	12358	4904	-2973	552	4910	18150	31707	34251	50402	9133	29529
Return on Full Cost Basis I	2891	2124	7039	2552	3378	7445	213	5120	8572	830	-6717	-3637	1005	12892	26239	29607	45328	1610	22593
Return on Cash Cost Basis II	8023	10265	13519	6269	6892	13914	5166	11577	13519	5584	-743	2922	7312	19039	35332	37009	56213	9133	29529
Return on Full Cost Basis II	4037	3343	8523	3414	3905	9095	1007	6361	9833	1510	-4487	-1267	3407	13781	29865	32366	51138	1610	22593
Based on average input prices :																			
Return on Cash Cost Basis I	6802	10901	12432	4874	7048	12536	3904	10770	11447	4525	-2422	-161	3446	17436	31047	32407	48274	9795	29570
Return on Full Cost Basis I	2532	5642	7654	1812	4265	7820	-859	5850	6699	-140	-5969	-4720	-1287	10854	24796	26857	42260	2808	22550
Return on Cash Cost Basis II	7947	12120	13915	5735	7575	14185	4698	12011	12708	5205	-192	2209	5848	18326	34672	35165	54084	9795	29570
Return on Full Cost Basis II	3677	6861	9138	2673	4792	9469	-66	7091	7960	540	-3739	-2350	1115	11744	28421	29615	48070	2808	22550

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Table : B.4

Item Name	SWEET POTATO	RAPE & MUSTARD	TIL	LINSEED	GROUND NUT	RAW TUR-MERIC	DRY CHILLI	GREEN CHILLI	GINGER	CORIAN-DER SEED	GARLIC	ONION	MASUR	GRAM	KHESARI	MASHKALAI	MOONG	C. PEA
Revenue I	28027	9530	8125	6050	22776	70578	27782	56735	65706	31297	65722	54608	9080	9574	6244	13296	6083	7306
Revenue II	28027	9883	8688	6200	22776	70578	27782	56735	65705	31790	65722	54608	9322	9833	6809	13959	6083	7416
Cash Cost	12204	4791	6301	1303	7105	14035	15542	15172	28710	2983	16295	12441	3490	3399	2594	2407	2627	2215
Full Cost	20175	8348	10685	3768	15146	20924	26730	25396	42073	11638	24498	17556	5804	5758	4175	5074	5775	4967
Based on crop-specific input prices :																		
Return on Cash Cost Basis I	15623	4782	1824	4747	15671	56493	12239	41562	36998	28314	49427	42166	5590	6175	3650	10889	3456	5091
Return on Full Cost Basis I	7852	1232	-2560	2282	7630	49654	1052	31339	23635	19659	41224	36651	3275	3817	2069	8222	308	2340
Return on Cash Cost Basis II	15623	5092	2387	4897	15671	56493	12239	41562	36998	28807	49427	42166	5832	6434	4215	11552	3456	5201
Return on Full Cost Basis II	7852	1536	-1997	2432	7630	49654	1052	31339	23635	20152	41224	36651	3517	4076	2634	8885	308	2449
Based on average input prices :																		
Return on Cash Cost Basis I	16522	4757	1351	4750	15959	56114	12651	41944	40559	28241	48196	39930	5310	5750	3305	10778	3259	4622
Return on Full Cost Basis I	9316	1113	-3286	2239	8503	47723	1897	32074	32372	19677	38520	32807	2744	3001	1486	7955	-135	1316
Return on Cash Cost Basis II	16522	5061	1914	4900	15959	56114	12651	41944	40559	28734	48196	39930	5552	6009	3870	11440	3259	4732
Return on Full Cost Basis II	9316	1417	-2723	2388	8503	47723	1897	32074	32372	20170	38520	32807	2586	3260	2051	8618	-135	1425

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Table : B.4

Item Name	HELEN	BRIN-JAL	PUMP-KIN	RADISH	CUCUM-BER	BAR-BATI	TOMATO	CAULI-FLOWER	CABB-AGE	LADIES FINGER	KAKROL	LAL SHAK	ARUM
Revenue I	12935	59305	8281	33344	31260	52103	76754	90070	53356	91968	154969	10063	63857
Revenue II	12935	59305	8281	33344	31260	52103	76754	90070	53356	91968	154969	10063	63857
Cash Cost	4368	17196	5885	10821	11382	11909	10427	13440	14389	13035	29741	6251	17933
Full Cost	11865	30077	8048	19852	15596	29226	22881	26776	23068	22560	43947	13895	31130
Based on crop-specific input prices :													
Return on Cash Cost Basis I	8568	42109	2396	22523	19878	40194	66327	76630	38967	78933	125228	3812	45925
Return on Full Cost Basis I	1070	29228	233	13493	15664	22877	53873	63294	30288	69408	111022	-3832	32728
Return on Cash Cost Basis II	8568	42109	2396	22523	19878	40194	66327	76630	38967	78933	125228	3812	45925
Return on Full Cost Basis II	1070	29228	233	13493	15664	22877	53873	63294	30288	69408	111022	-3832	32728
Based on average input prices :													
Return on Cash Cost Basis I	9593	42380	1910	22773	20933	42466	66756	76901	39503	79677	124963	3868	47326
Return on Full Cost Basis I	3978	29638	-652	14051	17271	30815	55193	64238	31174	68006	110656	-3773	34862
Return on Cash Cost Basis II	9593	42380	1910	22773	20933	42466	66756	76901	39503	79677	124963	3868	47326
Return on Full Cost Basis II	3978	29638	-652	14051	17271	30815	55193	64238	31174	68006	110656	-3773	34862

BEST AVAILABLE DOCUMENT

APPENDIX C

Figures on Trends in Acreages

Figure C.1

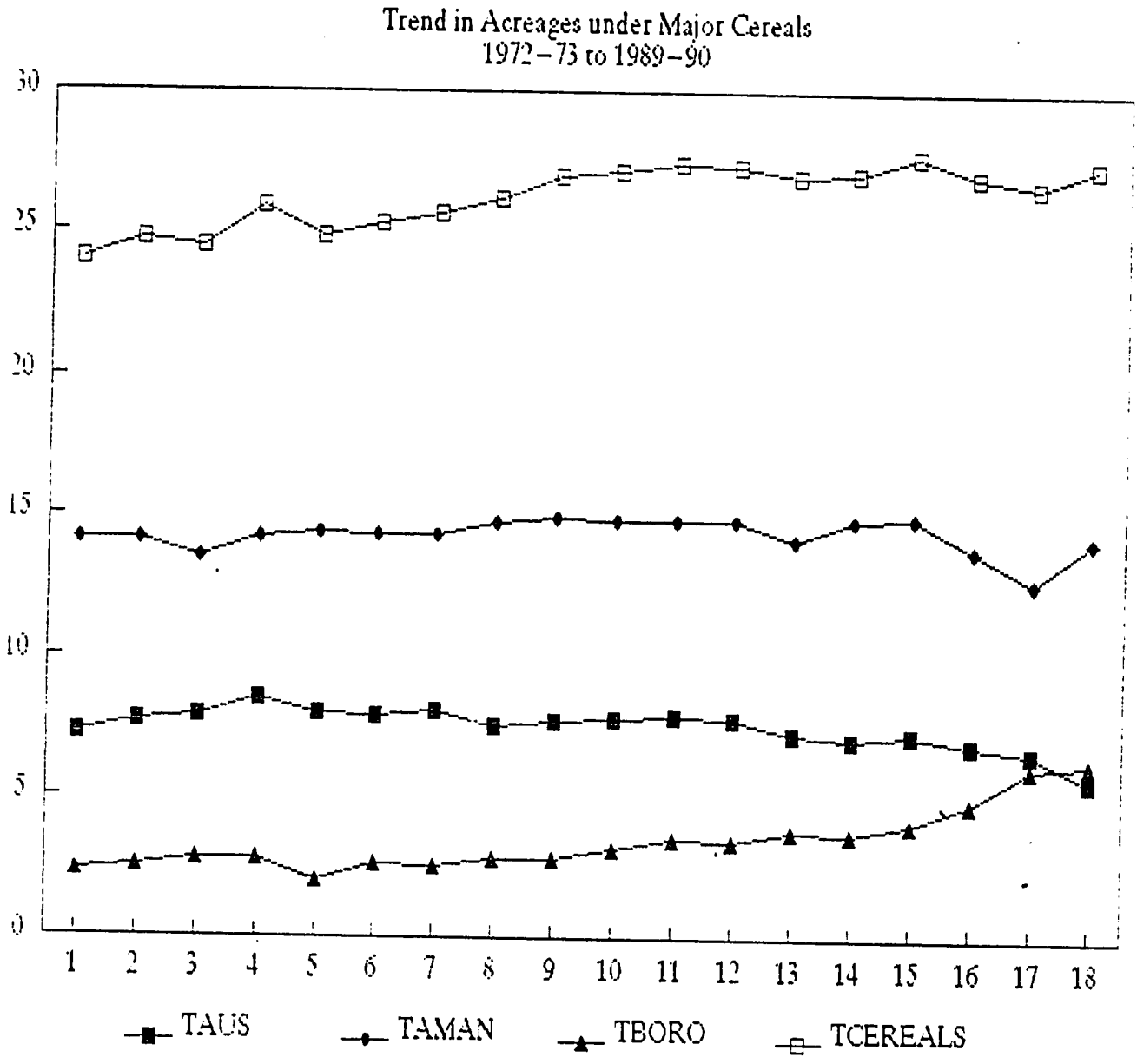

Trend in Acreages under Major Cereals
1972–73 to 1989–90
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
TAUS
TAMAN
TBORO
TCEREALS

Figure C.2

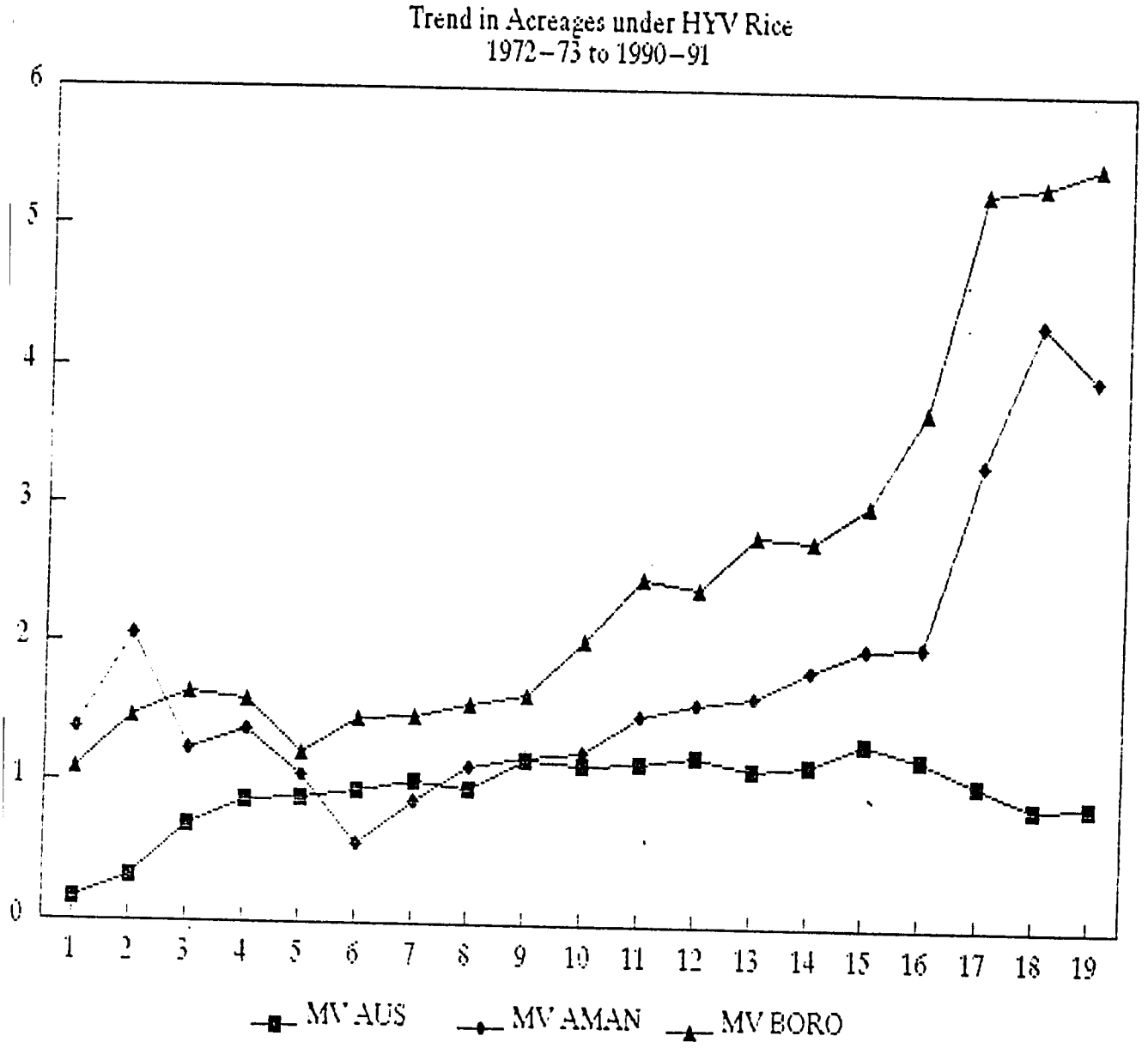
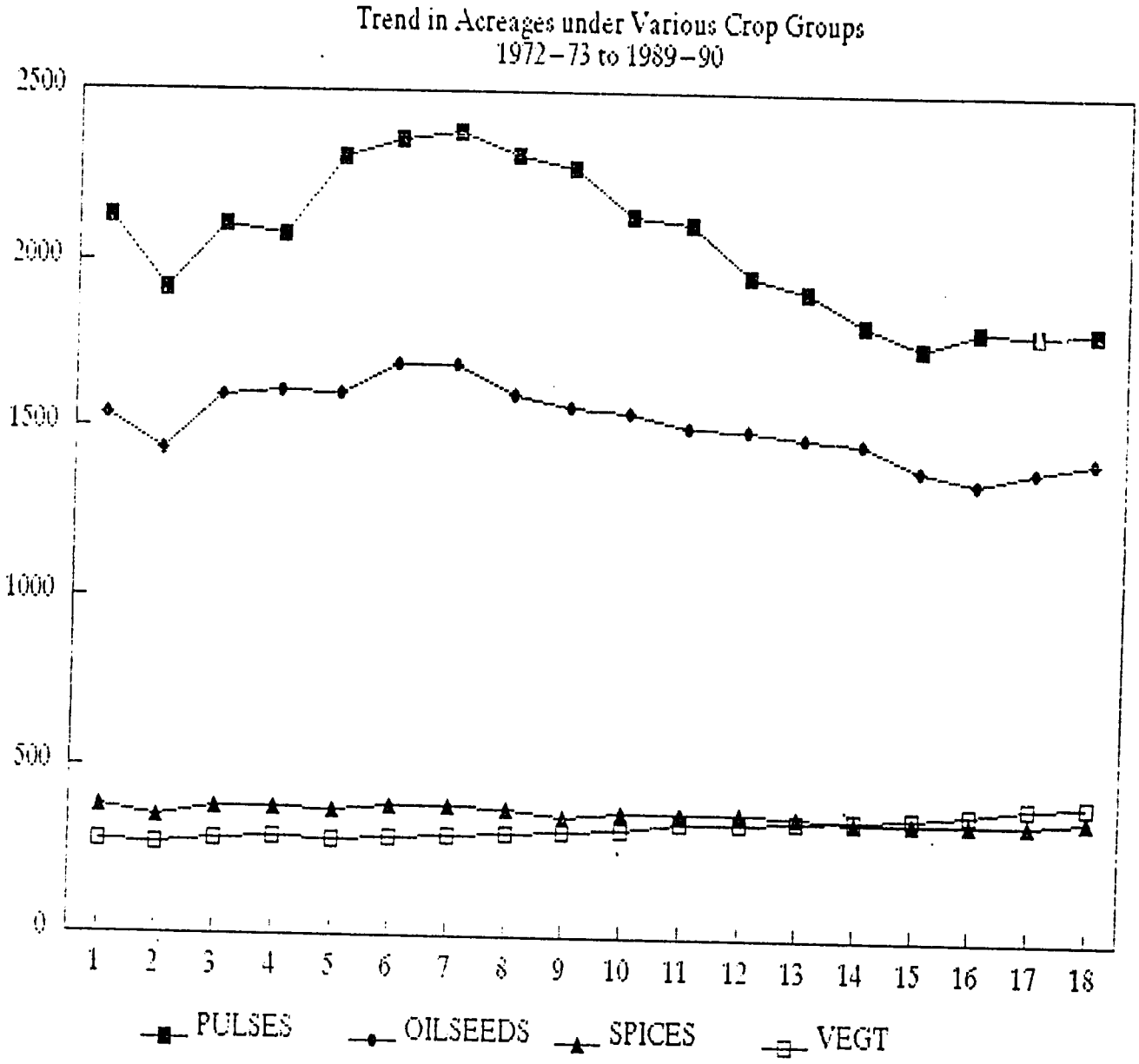

Trend in Acreages under HYV Rice
1972–73 to 1990–91
6
5
4
3
2
1
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
MV AUS
MV AMAN
MV BORO

Figure C.3


Trend in Acreages under Various Crop Groups
1972-73 to 1989-90
2500
2000
1500
1000
500
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
PULSES
OILSEEDS
SPICES
VEGT