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COMPARATIVE ADVANTAGE AND MEDIUM-TERM OUTLOOK IN BANGLADESH AGRICULTURE

QUAZI SHAHABUDDIN
PAUL DOROSH
MD. ABUL QUASEM
K.M. NABIUL ISLAM

JUNE 2001

FMRSP Synthesis Report No. 3

FMRSP Bangladesh
Food Management & Research Support Project
Ministry of Food, Government of the People's Republic of Bangladesh

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This work was funded by the United States Agency for International Development (USAID)

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS i

LIST OF TABLES iii

1. INTRODUCTION 1

2. PAST TRENDS, PATTERN OF GROWTH AND RECENT AGRICULTURAL PERFORMANCE IN BANGLADESH 4

RELATIVE IMPORTANCE OF AGRICULTURE IN THE BANGLADESH ECONOMY 4

TREND IN AGRICULTURAL GROWTH 6

GROWTH PERFORMANCE OF CROP SECTOR IN BANGLADESH 8

GROWTH PERFORMANCE OF NON-CROP AGRICULTURE 15

Fisheries 15

Forestry 16

Livestock 17

3. COMPARATIVE ADVANTAGE IN CROP AGRICULTURE 23

PROFITABILITY AND EFFICIENCY IN DOMESTIC PRODUCTION OF RICE AND NON-RICE CROPS 23

METHODOLOGY AND SOURCES OF DATA 24

COMPARATIVE ADVANTAGE IN CROP PRODUCTION 25

SENSITIVITY ANALYSIS 29

COMPARATIVE ADVANTAGE OF ALTERNATIVE CROP SEQUENCES 30

4. MEDIUM TERM OUTLOOK FOR RICE PRODUCTION AND DEMAND: PROJECTIONS TO 2020 33

ECONOMETRIC ESTIMATES OF SUPPLY PARAMETERS 33

SUPPLY PROJECTIONS WITH EXOGENOUS PRICES 35

SUPPLY AND DEMAND PROJECTIONS WITH ENDOGENOUS PRICES 37

5. DEMAND FOR POULTRY FEEDS: PROJECTIONS TO 2020 39

ESTIMATION PROCEDURES AND SOURCES OF DATA 39

PROJECTIONS OF CONSUMPTION OF POULTRY PRODUCTS (DEMAND ANALYSIS APPROACH) 40

PROJECTIONS OF POULTRY POPULATION (TREND ANALYSIS APPROACH) 40

PROJECTION OF GRAIN (WHEAT AND MAIZE) USE AS POULTRY FEEDS 41

6. CONCLUSIONS AND POLICY RECOMMENDATIONS 44

REFERENCES 47

LIST OF TABLES

Table 2.1 — Sectoral Shares of GDP 5

Table 2.2 — Sub-sectoral Composition of Agricultural Value Added 5

Table 2.3 — Share of Different Crops in Total Acreage and Gross Value of Production .. 6

Table 2.4 — Growth Rate of Agriculture and Different Sub-Sectors 7

Table 2.5 — Growth Rates in Agriculture 7

Table 2.6 — Trend Growth Rates in Area, Yield and Production of Rice Crops in Bangladesh 9

Table 2.7 — Share of Acreage and Production as well as Yield of Rice Crops in Bangladesh 10

Table 2.8 — Trend Growth Rates in Area, Yield and Production of Rice Crops in Bangladesh 12

Table 2.9 — Trend Growth Rate in Area, Production and Yield of Major Non-Rice Crops in Bangladesh 14

Table 2.10 — General Characteristics of Surveyed Poultry Farms 20

Table 2.11 — Feeding Practices, Weight Gained and Mortality 21

Table 3.1 — Financial and Economic Profitability, and Domestic Resource Cost of Rice Crops in Bangladesh: 1996/97 - 1998/99 25

Table 3.2 — Financial and Economic Profitability, and Domestic Resource Cost of Non-Rice Crops in Bangladesh: 1996/97 - 1998/99 26

Table 4.1 — Determinants of Area Planted to Foodgrains: Regression Results 34

Table 4.2 — Rice Area, Yield and Production Projections (Exogenous Price Model) 36

Table 4.3 — Rice Supply and Demand Projections with Endogenous Prices 38

Table 5.1 — Projected Use of Grain (Wheat and Maize) for Poultry Feeds (by Poultry Type) in Bangladesh 42

1. INTRODUCTION

This report is devoted to an assessment of comparative advantage of crop production in Bangladesh agriculture. Moreover, given the predominance of rice in the rural economy of Bangladesh, an attempt will be made to explore the medium-term outlook involving a prospective view of the future demand-supply balance of rice under increasing resource constraints. In most developing countries, including Bangladesh, social or economic profitability deviates from private profitability because of distortions in factor and product markets, externalities and government policy interventions that tend to distort relative prices. The analysis of comparative advantage, it may be emphasized, can help in deriving meaningful policy conclusions on how to reorient farming system towards more efficient crop activities. Secondly, while farmers would decide what to grow based on their own perceptions of potential and constraints, public policies concerning irrigation, water control, technology and prices can influence a farmer's choice of crop-growing decisions. A comparative evaluation of producing rice vis-a-vis other crops is, therefore, required to address the issue of foodgrain self-sufficiency in the country under the medium and long-term perspectives (Ahmed, 2000).

Thirdly, Bangladesh as a member of WTO is committed to the rules and regulations which the Uruguay Round applied to agriculture. The commitments cover a wide range of topics including those in the area of domestic support, market access and export subsidies in agriculture. The potential benefits of UR Agreements for Bangladesh would emerge from the trading regime in its present form and the potential trading opportunities for both import substitution and export promotion in Bangladesh. However, eventually, whether or not a country can take advantage of the new trading opportunities would depend upon its comparative advantage, without subsidies or with limited subsidies that are permitted for all trading partners by the rules governing the new trading

environment. Therefore, an assessment of comparative advantage of crop production either for import substitution or for export can be helpful in this respect.

Finally, Bangladesh will need a more diversified cropping pattern, including an increase in the contribution of non-rice crops to attain higher agricultural growth rates in the future. Besides enhancing growth, crop diversification also contributes to nutrition, poverty alleviation, employment generation and sustainable natural resources management (Ateng, 1998). The analysis of comparative advantage thus has important implications for scope and incentive for crop diversification in the country.[1]

The growth of Bangladesh agriculture in the past has centered around the adoption of modern varieties of rice, specially during the dry season. This has been achieved through investments in water sector infrastructure and research as well as through promotion of irrigation and extension services. Concerns have, however, been raised in the recent past on an excessive bias towards rice production and it is believed that Bangladesh may be on the verge of self-sufficiency in rice production, with increasing potential to produce surplus rice in some years.[2] Such changes in the production regime will have important implications for food policies. While the potentials exist, it is also believed that the prospects for expanding the dry season rice area is limited. Moreover, with potential for easy sources of irrigation nearing exhaustion, the cost of irrigation on marginal lands is likely to rise and structural reforms are likely to squeeze public expenditure for irrigation and rice research. Also, relative prices of attractive, high-value

[1] It may be noted here that most of the studies of comparative advantage of crop production were carried out in the context of analyzing the prospects of crop diversification in Bangladesh. However, the prospect of agricultural growth through crop diversification raises, apart from comparative advantage, a great many issues concerning agronomic sustainability, farm level incentive, changing technologies, marketing efficiencies and opportunities and macro level supplydemand balance (Mahmud et al., 2000).

[2] In fact, the potential seems to have been realized in recent years with the "food gap" virtually wiped out due to successive bumper harvests in boro and aman seasons in 2000 and 2001. How long this can be sustained, however, remainsopen to serious investigation.

crops may not be conductive to further expansion of rice area.[3] From an interventionist perspective, the issue, however, remains how to ensure availability of cheap rice to consumers while at the same time maintaining incentives in rice production. Rice continues to be the main source of livelihood in the rural areas and achievement of self-sufficiency of rice continues to be an important socio-economic objective. All these provide the rationale for looking into the prospects of the Bangladesh rice economy in the future.

[3] Although a few high-value crops such as fruits and vegetables yield both higher financial and economic returns than rice, because they still account for a small share of production and also face numerous difficulties in domestic as well as export market, they have yet to challenge the dominance of rice. The question, therefore, is how to exploit the potential of rice production, while markets for high-value crops gradually develop (Ahmed, 2000).

2. PAST TRENDS, PATTERN OF GROWTH AND RECENT AGRICULTURAL PERFORMANCE IN BANGLADESH

This chapter analyses the past trends and structural changes in the agricultural sector over the last three decades, and also highlights the growth performance of the sector in recent years. The growth performance has been analysed at the sectoral, sub-sectoral and crop-specific levels.

RELATIVE IMPORTANCE OF AGRICULTURE IN THE BANGLADESH ECONOMY

The relative importance of agriculture, as measured by its contribution to GDP has been steadily declining. During the nineties, agriculture's share in the GDP declined from about 30 percent in 1989/90 to about 25 percent in 1999/2000 (Table 2.1).[4] Despite such declines, the economy is still predominantly agrarian. The sector still provides employment to more than 60 percent of the country's labour force. If only rural areas are considered, the percentage of the labour force dependent on agriculture will be even larger. Moreover, agricultural production provides critical linkages for the development of the rest of the economy. The performance of agriculture thus has an important bearing on employment generation, poverty alleviation and food security in the country.

The figures in Table 2.2 indicate that although crop and horticulture remains the dominant activity, its share in total agricultural value added shows distinct declining trends – about 56 percent in 1999/00 as compared to about 66 percent in 1989/90. Of the other sub-sectors, although the shares of animal farming, and forest and related activities have remained stagnant, the share of fishing improved significantly – from about 15 percent in 1989/90 to about 25 percent in 1999/00.

[4] In fact, this share has decreased from about 47 percent during the 1970s to about 41 percent during the 1980s (Shahabuddin and Rahman 1998).

Table 2.1 — Sectoral Shares of GDP

(percent, constant *1995/96* prices)

Sector/Sub-sector	1989/90	1994/95	1996/97	1999/2000[a]
Agriculture	29.51	26.00	25.85	25.06
of which:				
Crop and horticulture	19.33	15.42	15.20	15.96
Animal farming	3.73	3.42	3.27	3.06
Forest and related activities	2.08	1.95	1.91	1.90
Fishing	4.37	5.21	5.47	6.15
Industry	20.77	24.27	25.00	25.82
Services	49.72	49.73	49.15	49.12
Total	100.00	100.00	100.00	100.00

Notes: a. provisional
b. includes mining and quarrying, manufacturing; electricity, gas and water supply; and construction.
c. includes all other sectors.
Source: Mujeri (2000).

Table 2.2 — Sub-sectoral Composition of Agricultural Value Added

(percent, constant 1995/96 prices)

Sector/Sub-sector	1989/90	1994/95	1996/97	1999/2000[a]
Crop and horticulture	65.51	59.31	58.77	55.68
Animal Farming	12.63	13.16	12.67	12.18
Forest and Related Activities	7.05	7.50	7.38	7.58
Fishing	14.81	20.03	21.18	24.56
Total Agriculture	100.00	100.00	100.00	100.00

Note: a. Provisional
Source: Mujeri (2000).

The share of different crops in total acreage and total gross value of production is shown in Table 2.3. Foodgrain, especially rice, dominates the total acreage, claiming a share of about 80 percent in recent years. The next in importance are pulses, oilseed and jute, whose shares, however, have been declining over time. The dominance of rice in total acreage is reflected in total crop production as well, claiming a share of about 72 percent during the nineties.

Table 2.3 — Share of Different Crops in Total Acreage and Gross Value of Production

(Percent)

Crops	1972/73-1979/80		1980/81-1989/90		1990/91-1999/00	
	Area	Gross Value of Production	Area	Gross Value of Production	Area	Gross Value of Production
1. Foodgrain	74.74	67.76	77.91	72.43	79.57	75.53
(a) Rice	73.30	66.76	73.85	69.48	74.43	72.01
(b) Wheat	1.44	0.99	4.06	2.95	5.14	3.52
2. Non-Foodgrain	25.26	32.24	22.09	27.57	20.43	24.47
(a) Jute	5.37	8.84	4.68	7.55	3.78	3.55
(b) Pulses	6.55	2.27	5.57	2.00	4.98	2.77
(c) Oilseeds	4.58	3.32	3.98	2.29	3.89	2.28
(d) Potato	0.65	1.52	0.75	1.68	1.13	2.62
(e) Vegetables	0.85	1.50	1.02	1.53	1.46	5.25
(f) Sugarcane	1.07	2.60	1.18	2.37	1.32	3.17
(g) Spices	1.12	2.33	1.03	1.87	1.20	2.40
(h) Tea	0.30	0.66	0.32	0.69	0.35	0.75
(j) Other Crops	4.77	9.20	3.56	7.59	2.33	1.68
3. All Crops	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: BBS and authors' calculations.

TREND IN AGRICULTURAL GROWTH

Agriculture grew at a rate of around 2 percent during the post-independent period (Table 2.4). This rate is much lower than the growth of GDP during the period. What is most striking is that the growth of agriculture considerably declined during the first half of the nineties. This can be attributed to a sharp decline in growth in the crop sub-sector. This sub-sector grew at a rate of 2.37 percent during the seventies and 1.77 percent during the eighties but hardly registered any growth during the first half of the nineties. Fishery and livestock, on the other hand, displayed substantial improvement in growth performance during the 1990/91 - 1994/95 period.

Table 2.4 — Growth Rate of Agriculture and Different Sub-Sectors

(percent, constant 1984/85 prices)

Sector/Sub-sector	1972/73-1994/95	1972/73-1979/80	1980/81-1989/90	1990/91-1994/95
Agricultute	1.98	1.85	1.83	0.86
Crop	1.99	2.37	1.77	-0.68
Forestry	3.19	3.01	2.60	3.40
Fishing	0.95	-4.02	2.24	7.52
Livestock	2.17	2.26	1.36	6.56
GDP	3.70	3.61	3.83	4.25

Note: Trend growth rates computed by fitting semi-log function to the data.
Source: Shahabuddin and Rahman (1998).

Table 2.5 — Growth Rates in Agriculture

(percent, constant 1995/96 prices)

Sector/Sub-sector	1991-1996	1996-97	1997-98	1998/99	1999/00[a]
Agriculture	1.81	6.00	3.19	4.77	6.43
of which:					
Crop and horticulture	-0.07	6.44	1.05	3.16	6.13
Animal farming	2.40	2.58	2.64	2.69	2.74
Forest and related activities	2.93	4.03	4.51	5.16	5.16
Fishing	7.79	7.60	8.98	9.96	9.50
GDP	4.43	5.39	5.23	4.88	5.47

Note: a. Provisional
Source: Mujeri (2000)

Table 2.5 provides a more promising picture of the growth performance of agriculture during the second half of the nineties. In fact, a significant feature of agriculture performance during the nineties is the rapid acceleration of growth in the second half of the decade. The average annual growth during the 1996/97 – 1999/00 period is over 5 percent as compared to about 2 percent during the 1990/91 – 1995/96 period. During the four years since 1996/97, agricultural growth has been 6 percent or more in two years – 1996/97 and 1999/00. While all the sub-sectors experienced accelerated growth since 1996/97, the growth of crop and horticulture, the major sub-sector was significant – 6.44 percent in 1996/97 and 6.13 percent in 1999/00. In fact, the average annual growth during the last four years is 4.2 percent, which is higher than any period in the past (Mujeri, 2000).

GROWTH PERFORMANCE OF CROP SECTOR IN BANGLADESH

As mentioned earlier, rice dominates crop production in Bangladesh, with an acreage and production share of 74.43 and 72.01 percent respectively. It is, therefore, not surprising that the growth of performance of the crop sector is largely dictated by the production performance of rice in the country. A breakdown of growth rates in area, yield and production of different varieties of rice in three crop seasons are presented in Table 2.6. The trend growth rate of rice production in the post-independence period (1972/73-1999/00) is estimated to be 2.27 percent, which can largely be attributed to growth in rice yield during the period.[5] The growth has been propelled by the dissemination of HYV rice, especially in the boro and aman seasons. The acreage of HYV boro and HYV aman has grown by 7.51 and 6.58 percent respectively over the last three decades. This is reflected in the overall growth of HYV rice acreage (6.39 percent) and production (6.56 percent) during the period.

This becomes more evident when one looks at the share of different varieties of rice in total acreage and production (Table 2.7). The share of HYV rice in total acreage was only 15.35 percent during the seventies but it almost doubled during the eighties and claimed more than half of the total acreage during the nineties. As a result, the contribution of HYV rice in total rice production more than doubled – from 30.01 percent during the seventies to 69.52 percent during the nineties. The shares of local rice in total acreage and production have correspondingly declined over the same period.

Among the HYV rice whose acreage and production shares have increased are HYV boro and HYV aman. The local varieties whose shares have perceptively declined include local aus and local aman. The increase in HYV boro has been accompanied by an almost equal decline in the acreage of local aus thereby pointing to the overlapping of the

[5] It should be emphasized here that this increase in yield is largely due to reallocation of land from local to high yielding variety of rice, rather than improvement in variety-specific yields.

Table 2.6 — Trend Growth Rates in Area, Yield and Production of Rice Crops in Bangladesh

(Percent)

Crops	1972/73-1999/00			1972/73-1979/80			1980/81-1989/90			1990/91-1999/00		
	Area	Yield	Production	Area	Yield	Production	Area	Yield	Production	Area	Yield	Production
Aus (Local)	-4.60	0.85	-3.73	-1.69	0.90	-0.79	-3.17	1.92	-1.25	-6.31	0.16	-6.15
Aus (HYV)	2.60	-1.61	0.98	23.30	-3.42	19.78	-1.70	-2.65	-4.35	2.35	0.98	1.37
Aus (Total)	**-3.47**	**1.08**	**-2.38**	**0.09**	**2.83**	**2.93**	**-2.93**	**0.79**	**-2.14**	**-4.12**	**0.91**	**-3.21**
Aman (Local)	-2.33	0.72	-1.61	0.45	3.40	3.85	-3.02	1.20	-1.81	-2.93	-0.75	-3.68
Aman (HYV)	6.58	0.04	6.62	2.27	0.64	2.91	5.46	0.77	6.23	2.30	-0.46	1.84
Aman (Total)	**-0.20**	**1.52**	**1.32**	**0.67**	**2.91**	**3.58**	**-1.17**	**1.90**	**0.73**	**-0.77**	**0.08**	**-0.68**
Boro (Local)	-3.07	0.61	-2.46	-3.80	-1.53	-5.33	-3.55	-2.41	-5.97	-2.53	1.40	-1.13
Boro (HYV)	7.51	0.33	7.85	4.59	-2.48	2.12	11.26	-0.70	10.56	4.17	1.84	6.00
Boro (Total)	**5.41**	**1.36**	**6.50**	**0.83**	**-0.75**	**0.08**	**8.08**	**0.35**	**8.42**	**3.58**	**2.08**	**5.66**
Rice (Local)	**-3.02**	**0.85**	**-2.17**	**-0.50**	**2.43**	**1.93**	**-3.08**	**1.19**	**-1.89**	**-3.78**	**-0.22**	**-4.00**
Rice (HYV)	**6.39**	**0.17**	**6.56**	**6.12**	**-1.28**	**4.84**	**6.99**	**0.11**	**7.10**	**3.24**	**0.99**	**4.23**
Rice (Total)	**0.06**	**2.21**	**2.27**	**0.52**	**2.28**	**2.80**	**-0.06**	**2.83**	**2.32**	**-0.04**	**1.81**	**1.77**

Note: The trend growth rates have been computed by fitting semi-log function to the data.
Source: BBS and author's calculations.

Table 2.7 — Share of Acreage and Production as well as Yield of Rice Crops in Bangladesh

Crops	Acreage (%)			Production (%)			Yield (MT/ha)		
	1972/73-1979/80	1980/81-1989/90	1990/91-1999/00	1972/73-1979/80	1980/81-1989/90	1990/91-1999/00	1972/73-1979/80	1980/81-1989/90	1990/91-1999/00
Aus (Local)	28.55	23.31	12.17	18.82	14.04	6.15	0.79	0.87	0.93
Aus (HYV)	3.03	4.50	4.18	5.81	6.04	4.05	2.43	1.91	1.78
Aus (Total)	**31.57**	**27.81**	**16.35**	**24.63**	**20.08**	**10.19**	**0.94**	**1.03**	**1.15**
Aman (Local)	51.56	44.50	33.07	46.30	37.25	22.34	1.09	1.19	1.24
Aman (HYV)	6.18	11.40	22.39	11.00	15.76	26.01	2.16	2.00	2.14
Aman (Total)	**57.75**	**55.90**	**55.47**	**57.30**	**52.91**	**48.35**	**1.20**	**1.36**	**1.60**
Boro (Local)	4.53	3.26	2.47	4.88	3.36	1.99	1.27	1.45	1.48
Boro (HYV)	6.15	13.03	25.71	13.20	23.65	39.46	2.61	2.68	2.80
Boro (Total)	**10.68**	**16.29**	**28.19**	**18.08**	**27.01**	**41.45**	**2.04**	**2.41**	**2.68**
Rice (Local)	**84.65**	**71.07**	**47.71**	**69.99**	**54.55**	**30.48**	**1.00**	**1.10**	**1.17**
Rice (HYV)	**15.35**	**28.93**	**52.29**	**30.01**	**45.45**	**69.52**	**2.38**	**2.28**	**2.44**
Rice (Total)	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**1.21**	**1.44**	**1.84**

Source: BBS and author's calculations.

growing season of these two varieties of rice. Table 2.7 also indicates that the yield of individual rice varieties – both local as well as high yielding varieties – has only shown some marginal improvements over the last three decades.

A comparison of rice production growth in different sub-periods indicates that there has been a deceleration of rice production over the last three decades. The trend growth declined from 2.80 percent during the seventies to 2.32 percent during the eighties, and further to 1.77 percent during the nineties (Table 2.6). What is more striking to note is the drastic deceleration of growth (-1.30 percent) during the first half of the nineties followed by a significant upsurge in growth in rice production (6.24 percent) during the second half of the decade (Table 2.8). While the negative trend can be largely attributed to the absolute fall in rice production in 1994/95 (by 1.21 million tons compared to the level attained in 1993/94), the growth momentum achieved in recent years is due to four successive bumper harvests in boro and aman seasons following the massive flood in 1998. How long this can be sustained, however, remains to be seen.[6]

The trend growth rates of production with a breakdown between acreage and yield growth for major non-rice crops are presented in Table 2.9. Wheat, potato, vegetables and tea registered production growth rates of over 2 percent per annum over the last three decades. Of these four crops, the production performance of wheat is most impressive with an annual growth of 8.94 percent over the period. This is largely attributed to growth in wheat acreage (6.70 percent) and only partly due to growth in yield (2.24 percent) during the period (1972/73 – 1999/00). A breakdown of production growth by

[6] In fact, whether and to what extent this should be attributed to an upward shift of the technological production frontier and to what extent, to a change in the methodology of estimation by the BBSince 1995/96 merits serious investigation. To address the former question, an indepth analysis of the resource base, technology choice, agronomic constraints and pricing as well as distribution policies of the government needs to be carried out.

Table 2.8 — Trend Growth Rates in Area, Yield and Production of Rice Crops in Bangladesh

Crops	1972/73-1999/00			1990/91-1989/90			1990/91-1994/95			1995/96-1999/00		
	Area	Yield	Production	Area	Yield	Production	Area	Yield	Production	Area	Yield	Production
Aus (Local)	-4.60	0.85	-3.73	-6.31	0.16	-6.15	-8.51	-1.77	-10.28	-5.42	3.18	-2.24
Aus (HYV)	2.60	-1.61	-0.98	2.35	-0.98	1.37	2.07	-2.65	-0.58	0.24	0.91	1.14
Aus (Total)	**-3.47**	**1.08**	**-2.38**	**-4.12**	**0.91**	**-3.21**	**-6.26**	**-0.63**	**-6.89**	**-3.74**	**2.98**	**-0.75**
Aman (Local)	-2.33	0.72	-1.61	-2.93	-0.75	-3.68	-2.27	-2.09	-4.36	-4.84	1.24	-3.60
Aman (HYV)	6.58	0.04	6.62	2.30	-0.46	1.84	2.45	-0.75	1.70	5.34	0.45	5.78
Aman (Total)	**-0.20**	**1.52**	**1.32**	**-0.77**	**0.08**	**-0.68**	**-0.55**	**-0.79**	**-1.34**	**-0.37**	**2.12**	**1.75**
Boro (Local)	-3.07	0.61	-2.46	-2.53	1.40	-1.13	-4.28	-1.54	-5.82	-1.25	1.73	0.48
Boro (HYV)	7.51	0.33	7.85	4.17	1.84	6.00	1.23	-0.32	0.91	8.98	3.62	12.60
Boro (Total)	**5.41**	**1.36**	**6.50**	**3.58**	**2.08**	**5.66**	**0.66**	**-0.14**	**0.51**	**8.21**	**3.89**	**12.10**
Rice (Local)	**-3.02**	**0.85**	**-2.17**	**-3.78**	**-0.22**	**-4.00**	**-1.08**	**-1.64**	**-5.72**	**-4.77**	**1.76**	**-3.00**
Rice (HYV)	**6.39**	**0.17**	**6.56**	**3.24**	**0.99**	**4.23**	**1.83**	**-0.70**	**1.13**	**6.78**	**2.81**	**9.59**
Rice (Total)	**0.06**	**2.21**	**2.27**	**-0.04**	**1.81**	**1.77**	**-1.28**	**-0.02**	**-1.30**	**1.81**	**4.43**	**6.24**

Note: Trend growth rates computed by fitting semi-log function to the data.
Source: BBS and author's calculations.

three sub-periods, however, shows that the growth was largely concentrated during the seventies with an annual growth of 30.01 percent, propelled by significant growth in both acreage (16.76 percent) and yield (13.25 percent). The eighties, on the other hand, witnessed negative growth in wheat production due to drastic deceleration in both acreage and yield growth during the decade. However, a significant improvement in production performance of wheat (7.76 percent) was observed in the nineties. This is attributed to improvement in the growth of both acreage (4.63 percent) and yield (3.12 percent) during the period.

The growth in production of potato (3.59 percent) has been largely due to growth in acreage (2.79 percent) over the last three decades. The production growth, however, has not been uniform over this long period. The growth rate was 2.78 percent during the seventies attributed largely to growth in acreage during the decade. Like wheat, the eighties witnessed drastic deceleration in acreage growth (only 0.09 percent) and hence in growth in production (only 0.46 percent), which, however, picked up significantly due to improvement in both acreage and yield growth during the nineties. Vegetables and tea displayed robust growth over the last three decades, although the sources of growth were different for these two crops. Growth in production of vegetables (2.73 percent) is attributed to the growth in acreage (2.85 percent), while the growth in yield (1.54 percent) has been largely responsible for growth in production of tea (2.38 percent) during this period. What is more significant, the production of vegetables maintained an upward trend in its growth due to sustained expansion in its acreage during the seventies, the eighties as well as in the nineties. Tea registered a respectable growth of over 6 percent during the seventies primarily due to growth in yield during the period. The growth in production slowed down drastically during the eighties but picked up due to growth in yield during the nineties.

Table 2.9 — Trend Growth Rate in Area, Production and Yield of Major Non-Rice Crops in Bangladesh

(Percent)

Crops	1972/73-1999/00			1972/73-1979/80			1980/81-1989/90			1990/91-1999/00		
	Area	Yield	Production	Area	Yield	Production	Area	Yield	Production	Area	Yield	Production
Wheat	6.10	2.24	8.94	16.76	13.25	30.01	0.69	-2.10	-1.41	4.63	3.12	7.76
Pulses	-1.51	0.26	-1.25	2.47	-1.62	0.85	-2.69	0.78	-1.91	-3.08	0.41	-2.67
Oilseeds	-0.84	1.41	0.57	1.52	0.51	2.03	-1.82	0.99	-0.83	-1.06	3.50	2.44
Vegetables	2.85	-0.12	2.73	1.89	-0.36	1.53	2.68	-0.56	2.12	4.26	-0.24	4.01
Potato	2.79	0.80	3.59	2.28	0.49	2.78	0.09	0.37	0.46	6.70	1.41	8.11
Spices	0.47	1.02	1.49	0.71	-1.95	-1.24	-0.31	2.23	1.92	5.76	-3.76	2.00
Tea	0.84	1.54	2.38	-0.20	5.99	6.19	0.65	-0.41	0.24	0.23	1.88	2.12
Jute	-1.79	3.36	1.58	-0.66	2.13	1.47	-0.97	1.88	0.91	-2.42	8.90	6.48
Sugarcane	1.03	-0.39	0.64	1.44	0.59	2.03	1.64	-1.36	0.28	-1.17	0.33	-0.84

Note: Trend growth rates have been computed by fitting semi-log function to the data.
Source: BBS and author's calculations.

Pulses registered negative production growth over the last three decades. This is most pronounced during the nineties. The failure of production to grow is attributed to the decline in acreage not offset by corresponding improvement in yield. Both oilseeds and sugarcane display positive but insignificant production growth over the last three decades. The growth performance of oilseeds, however, improved appreciably during the nineties due to improvement in its yield. The same cannot be said about sugarcane, which registered steadily declining growth over time. The growth of jute production also picked up significantly despite declining acreage due to vast improvement in its yield during the nineties.

GROWTH PERFORMANCE OF NON-CROP AGRICULTURE

Non-crop agriculture includes forestry, fisheries and livestock production. It may be mentioned here that the outputs of these subsectors have a higher nutritional and economic value as compared to production in the crop subsector. All animal protein for human consumption is supplied by fishery and livestock sub-sectors. Moreover, depending upon land and climatic suitability, production and earnings can be higher per unit of land and water resources from non-crop agriculture if production, processing and marketing systems can be effectively organized (CPD, 1995). The present production per unit of these resources is low and improved breeding and management practices can significantly enhance the level of production.

Fisheries

The fisheries resources in Bangladesh can be broadly divided into inland and marine fisheries. The country is well-endowed with inland water bodies which include rivers, canals, beels, floodplains, ponds, baors and lakes. Moreover, Bangladesh has a long coastal belt of 480 kilometers, with a marine water area of 16.6 million hectares. The country has thus substantial physical and biological resource base for fish production. However, these resources have not been exploited properly. In fact, for lack of proper

management, the production of fish has been growing at a slower rate. As a result, per capita consumption of fish declined from about 33 gm/day during the seventies to 21 gm/day in 1995 (CPD, 1996).

Although the total production of fish increased from 1.20 million tons in 1994/95 to 1.58 million tons in 1998/99, the production of captured fish has been declining steadily due to various natural and manmade factors. These include: overfishing through indiscriminate fishing of spawners and spawns, distinction of breeding grounds by blocking fish migration routes, reduction of water areas due to construction of flood control structures and drainage channels and indiscriminate use of agro-chemicals and pesticides. The programme of artificial stocking of open water with fish fingerlinks and redesigning of water control structure to facilitate fish migration, however, have created some positive impact on open water capture fisheries in recent years. For closed water culture fisheries, improved fish culture techniques have been introduced with credit support from the government and the NGOs (Mujeri, 2000).

Exports in the fisheries subsector have emerged as an important activity in recent years. However, much of the growth in fish exports is based on shrimp farming, using agricultural land in the coastal areas. In some areas, such growth in shrimp farming is displacing crop cultivation along with the exposure of the soil to long-term ecological degradation threatening the livelihood of the poor farmers. A careful and area-based strategy of shrimp cultivation is necessary to mitigate social and ecological adverse externalities of shrimp cultivation.

Forestry

Total available area for forestry operations and tree crops in Bangladesh is estimated to be 2.48 million hectares, of which 2.21 million hectares (89 percent) is government owned while the rest of 0.27 million hectares (11 percent) is privately controlled homestead forest land scattered all over the country. It is generally recognized

that between 25 to 30 percent of total land area should be kept under forestry or potential forest land. In Bangladesh, only about 17 percent of the total land area is either forest or potential forest land. What is more alarming, this area has been reduced to about 13 percent in recent years.

Forests supply a number of products such as timber, firewood, bamboo and raw materials for industries. With a steady decline in the forest area over time, per capita production of timber, firewood and bamboo has been reduced. In fact, the current production levels of timber and firewood are lower than those in the eighties. As mentioned above, the total forest area is increasingly becoming inadequate to provide the basis for preserving the ecological balance and long-term environmental security. The rapid depletion of forest resources is largely due to exploitative uses of timber as firewood, poles, wood based panels, pulpwood and other uses. The strategy to develop and protect forest resources through the people's participation under programmes of agro-forestry, homestead forestry, community forestry and other innovative efforts requires effective strengthening to arrest the degradation of forest resources in the country (Mujeri, 2000).

Livestock

Apart from its sizeable contribution (about 12 percent) to GDP originating in agricultural sector, livestock provides employment to about 20 percent of the rural population. Moreover, about 7 percent of the total foreign exchange earnings is contributed by this sub-sector, specially through exports of hides and skins and leather products. Therefore, livestock plays an important role in the agricultural economy of Bangladesh. The number of different animals as recorded in various censuses and surveys and the intercensal growth rates indicate that although poultry registered a robust growth rate of more than five percent during the 1960-1988/89 period, the growth of cattle has been quite dismal, registering growth of only 0.25 percent during the same

period. As a result, per capita availability of cattle declined from 0.34 in 1960 to only .19 in 1988/89 (Shahabuddin and Rahman, 1998).[7]

The situation, however, seems to have improved in recent years. All categories of animals – goat, sheep, cattle, milch cows and poultry – have displayed accelerated growth in the nineties. As a result, the production of milk, meat and eggs, the three important products of livestock has increased. However, the current production of milk, meat and eggs meet only 13 percent, 10 percent and 24 percent of their minimum requirements, indicating substantial shortages in the country (Alam, 1996). The total production of milk increased from 1.44 million metric tons in 1994/95 to 1.71 million metric tons in 1998/99. This has been made possible largely through the establishment of dairy farms in the private sector. There have also been improvements in breeds of milch cows with a significant increase in the number of private sector hybrid cow farms (Mujeri, 2000). The import of milk has declined with the greater availability of milk from domestic sources.

The production of meat also increased from 0.51 million metric tons in 1994/95 to 0.65 million metric tons in 1998/99. Commercial beef fattening, however, is still in its infancy in the country. The supply of poultry products including meat and eggs, has been increasing through a steady growth of poultry farms in the private sector. Intensive development efforts by the public and the private sectors, including NGOs, through increased vaccination, feed production and management training have contributed to the process. There has been a significant growth in egg production – around 9 percent per annum – and total production increased from 2539 million in 1995/96 to 3530 million in 1998/99. This is largely attributed to the growth of commercial poultry farms in recent years. We shall elaborate on this further for the reasons outlined below.

We have already observed that the contribution of agriculture to national income

[7] Among others, low birth rates, high mortality due to diseases and frequent natural hazards, slaughtering of cattle, specially during the festival and supply of meat throughout the year are the main reasons for the slow growth of cattle in the country.

in Bangladesh has declined from 51% in 1972/73 to 25% in 1999/2000, even with the moderate economic progress that was achieved over the last three decades. If Bangladesh succeeds in accelerating economic growth, the importance of agriculture will decline more rapidly, although the value added will continue to increase in absolute term. This structural transformation will take place within the agricultural sector itself because the increase in demand induced by income growth varies depending on the food item. Within food, the budget is allocated in favour of vegetables, fruits, fish and livestock products, away from staple grains, as household income increases. The expenditure pattern changes further with changes in consumer tastes and preferences associated with urbanization (Hossain and Shahabuddin, 1999). Moreover, the increasing demand for poultry products and the associated growth in poultry farms place increasing demand for poultry feed as well, which have important implications for the production and marketing of both maize and wheat in the country.[8]

The number of poultry farms in Bangladesh has been increasing dramatically, registering an annual growth of over six percent over the last decade. At present there are over sixty thousand farms, of which 75% are layer farms. However, broiler farms are growing fast in recent years. The farms are concentrated in Dhaka, Chittagong and other district towns to meet the local demand in the country. The study carried out by Quasem (2001), based on a small field survey covering 71 farms in three districts (Gazipur, Manikganj and Cox's Bazar), examines the existing feeding practices and their efficiencies at both household and commercial levels, and also analyses the implications for maize and wheat markets keeping in view the future prospects of poultry farms in the country. It is worthwhile to look at the major findings and recommendations of this study.

[8] A study was undertaken under the FMRSP to look into various aspects of poultry feed, specially its implications for maize and wheat markets in Bangladesh. See Quasem (2001).

Table 2.10 — General Characteristics of Surveyed Poultry Farms

	Layer Farms		Broiler Farms		All Farms
	Household	Commercial	Household	Commercial	
No. of Farms Surveyed	33	20	9	9	71
Age of Farms	3.9	6.1	4.3	6.6	5.1
Percent of Farms established after 1995	73	25	67	67	61
Initial cost of Investment (000 Taka)	47.8	1059.9	20.0	70.11	330.6
Stock of Birds (No.)	607	4870	622	1544	1872
No. of Workers	1.66	5.90	1.74	2.89	-

Source: Quasem (2001)

The majority of poultry farms surveyed were established after 1995, specially those dealing with the broilers. The average cost of establishment of a poultry farm is Tk. 3.31 lakh. The investment cost of a commercial layer farm is found to be as high as Tk. 10.60 lakh. Broiler farms, however, have a lower investment cost, the least costly being the household broiler farms (Table 2.10). This suggests that the NGOs can support the establishment of broiler farms through their poverty alleviation programmes.

The poultry farms use mixed feedgrains – maize and wheat, and also manufactured feeds commonly known as ready feeds. Mixed feeds are usually prepared by individual owners following the prescriptions distributed by the Department of Livestock Services and the feed mills. In the making of feeds, households or small-scale farms seem to be at a disadvantage due to a lack of proper technical knowledge and price information. Poultry farms, as mentioned above, consume both maize and wheat, while, among non-grain feed ingredients, rice polish, soybean meal and vitamin are important. Of the farms surveyed, half were exclusively maize users, 24% consumed ready feeds and the remaining 26% consumed both maize and wheat. In the individually prepared feed mixture, grains constitute over half of feed weight and the share of maize in feedgrains is very high (85%). Feed mills use a negligible proportion of wheat in their manufactured feeds. The feeding efficiency in broiler farms is 52% with a range of 46-52 percent for

household and commercial farms. Commercial farms are found to be more efficient. Feeding efficiency is far less in layers (22%), with little difference between household and commercial layers. It seems that feeding efficiency in boilers can be raised substantially, particularly in household farms. The farm owners may be properly trained in feeding principles and farm management.

Employment opportunities created through the establishment of poultry farms at the household level are largely limited to self-employment. A layer farm, on average,employs three persons, while a broiler farm two persons. Household farms engage less than two persons; commercial layer farms employ six people on average.

A rough estimate on the costs and returns of a poultry farm indicates that it is a profitable enterprise. Commercial farms are more efficient with higher returns in both broiler and layers. At the household level, broilers are more profitable than layers.

Table 2.11 — Feeding Practices, Weight Gained and Mortality

	Layer Farms		Broiler Farms	
	Household	**Commercial**	**Household**	**Commercial**
I. Amount of Feed Consumed by a Bird during the Growing Period (kg.)	6.86	6.45	3.64	3.17
II. (a) Proportion of Maize to Total Feed Weight (%)	45.1	45.3	44.7	40.8
(b) Proportion of Wheat to Total Feed Weight (%)	6.3	4.9	15.8	17.8
(c) Proportion of Non-grains to Total Feed Weight (%)	48.6	49.8	39.5	41.4
III. Weight Gained during the Growing Period	1.50 (average)		1.84 (average)	
IV. Mortality of Birds (%)	10	10	9	10

Note: Growing period for broilers is considered to be six weeks while that for layers is 20 weeks.

Source: Quasem (2001)

Prices of feedgrains (both maize and wheat) have been fairly stable both across regions and over time. The feedgrain market in the country thus is performing reasonably well. In both 1998 and 1999, retail prices of maize were lower than wheat by Tk. 0.45 per kg in the survey areas. The monthly price range is observed to be within Tk. 1.00 per kg, which appears to be reasonable in the context of Bangladesh. Commercial farms paid somewhat lower prices for feedgrains than those paid by household farms. This may be attributed to largescale grain purchases by the commercial farms and also their easier access to markets.

An analysis of price trends of maize and wheat during the 1995-1999 period indicates that it is reasonably stable. Moreover, the prices, if adjusted for inflation, i.e. the real prices of these grains, exhibit a declining trend over time. Along with the feedgrains, prices of other non-grain ingredients including one-day chicks are also observed to be stable. The degree of stability observed in the case of prices of all principal feed ingredients suggests that input markets are favourable to the development of poultry farms in the country.

3. COMPARATIVE ADVANTAGE IN CROP AGRICULTURE

Agricultural price and trade policies such as import tariffs, export taxes, input subsidies and other price policies can have a major impact on the private profitability of domestic agriculture. Broader macroeconomic policy and trade policy affect the profitability of agriculture as well, through influencing the exchange rate, overall level of inflation, interest rates and other determinants of prices and costs in the economy. Because of these intentional or even inadvertent distortions in prices, the total social costs and profitability of production may differ from private costs and profitability. It becomes, therefore, necessary to examine the relative efficiency of production of crops in Bangladesh from a social/economic point of view and their comparative advantage in international trade.

Relative efficiency in production depends on three factors – technology, resource endowments and prices. While farmers would decide what to grow based on their perceptions of potential and constraints, public policies concerning irrigation, water control, technology and prices can influence farmers' choices of crop-growing decisions. A comparative evaluation of producing rice vis-a-vis other crops sheds light on the issue of foodgrain self-sufficiency in the country under both medium and long-term perspectives. The analysis also has important implications for the scope and incentives for crop diversification in Bangladesh.

PROFITABILITY AND EFFICIENCY IN DOMESTIC PRODUCTION OF RICE AND NON-RICE CROPS

Several studies have looked into the profitability and efficiency of domestic production of different crops in the recent past. Prominent among them include the World Bank's Food Policy Review (1993), the World Bank Sector Report (1995), the IFPRI/BIDS study on agricultural diversification (Mahmud et al, 1994), IFPRI/CIMMYT

Research Report (Chowdhury, Morris and Meisner, 1994) and more recently, the FAO/Ministry of Agriculture Report on assessment of comparative advantage in Bangladesh agriculture (Shahabuddin, 1999), and FMRSP/Ministry of Food Working Paper on comparative advantage in Bangladesh agriculture (Shahabuddin and Dorosh, 2001).[9] Our analysis of the efficiency of domestic production of rice and non-rice crops is largely based on the Shahabuddin and Dorosh (2001) study which uses data for a more recent period. These are presented below.

METHODOLOGY AND SOURCES OF DATA

The comparative advantage of producing different crops in Bangladesh agriculture has been analyzed using basically two measures: (a) Net Economic Profitability (the profitability using economic, rather than financial costs and prices), and (b) Domestic Resource Cost Ratio, (the amount of cost of non-tradable domestic resources used in production divided by the value of tradable products). To calculate these efficiency indicators requires data related to (a) production coefficients (b) financial prices of crops and production inputs (c) economic (shadow) prices of crops and production inputs, and (d) shadow (equilibrium) price of foreign exchange. The empirical exercise has been carried out using data for the 1996/97-1998/99 period, except for the production coefficients which are derived from information collected in the survey on costs and returns of crop production carried out earlier (Zohir, 1993).[10]

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[9] The first study was conducted in 1992 as part of the World Bank's Food Policy Review (1993). This study relied on financial analysis of crop returns calculated by BRRI and BARI, based on surveys conducted by their economic evaluation units. The Food Policy Review reevaluated these results using economic opportunity costs to arrive at its conclusions. This was followed by the IFPRI/BIDS study on agricultural diversification, which used its own crop production cost survey as the basis for its analysis. IFPRI/CYMMYT report examined the economic value of wheat production, but in doing so it also assessed the comparative advantage of several crop alternatives, including rice. It was also based on a crop production cost survey which was unique in that it was conducted at the plot level and was therefore able to disaggregate results by plot characteristics (land level and soil types). Nonetheless, it should be noted that conclusions of the second and third studies were nearly identical to the initial study with the exception of wheat for which IFPRI/CIMMYT study was more optimistic under certain circumstances (Ateng, 1998).

[10] For a more elaborate discussion on the methodology and sources of data used in the study, see Shahabuddin and Dorosh (2001).

COMPARATIVE ADVANTAGE IN CROP PRODUCTION

When compared with financial returns, economic returns at the import parity price are considerably higher for all varieties of rice produced using different irrigation techniques (Table 3.1). Thus the economic profitability analysis demonstrates that Bangladesh has a comparative advantage in domestic production of rice for import substitution. However, at the export parity price the picture becomes completely different and the economic returns are now less than the financial returns for almost all varieties of rice. Moving to an export price regime implies a substantial decline in economic profitability for all rice crops. Moreover, when compared with economic profitability of many non-rice crops, it would appear that the country has more profitable options other than production for rice export. The estimated domestic resource cost (DRC) ratio for

Table 3.1 — Financial and Economic Profitability, and Domestic Resource Cost of Rice Crops in Bangladesh: 1996/97 - 1998/99

Rice Crops	Irrigation Technique	Net Financial Return (Tk./hectare)	Net Economic Return (Tk./hectare)		Domestic Resource Cost	
			Import Parity	Export Parity	Import Parity	Export Parity
Boro						
HYV	Modern	7299	18172	7254	0.70	1.12
Local	All	3953	9245	3758	0.93	1.40
Aman						
HYV	Modern	9782	19682	9090	0.62	0.96
HYV	Rainfed	11216	20490	10069	0.59	0.91
HYV	All	10459	19970	9644	0.61	0.93
Pajam	All	8528	17413	7863	0.67	1.03
Local T.	Rainfed	4250	10105	4003	1.04	1.57
Local B.	Rainfed	2735	7374	2583	1.55	1.40
Aus						
HYV	Rainfed	3831	10638	3710	0.81	1.27
HYV	Modern	5494	13918	5308	0.73	1.13
HYV	All	3410	10763	3428	0.82	1.30
Local B.	Rainfed/ Traditional	-2371	1757	-1834	1.25	1.91

Note: The estimates are average for 1996/97, 1997/98 and 1998/99, expressed at 1997/98 prices.

Source: Shahabuddin and Dorosh (2001).

Table 3.2 — Financial and Economic Profitability, and Domestic Resource Cost of Non-Rice Crops in Bangladesh: 1996/97 - 1998/99

Non-Rice Crops	Irrigation Technique	Net Financial Return (Tk./hectare)	Net Economic Return (Tk./hectare)		Domestic Resource Cost	
			Import Parity	Export Parity	Import Parity	Export Parity
Wheat	Modern	2819	6466	-	0.90	-
Wheat	Non-irrigated	3254	6101	-	0.91	-
Wheat	All	3165	6540	-	0.89	-
Jute (White)	Rainfed	751	-	8189	-	0.92
Jute (Tossa)	All	2804	-	11140	-	0.80
Cotton	Rainfed	18665	16886	-	0.55	-
Tobacco	Modern	11391	-	92425	-	0.20
Tobacco	All	9993	-	91212	-	0.21
Sugarcane (Sugar)	Modern	44081	33323	-	0.81	-
Sugarcane (Sugar)	Non-irrigated	25726	18575	-	1.11	-
Sugarcane (Gur making)	Modern	44081	1455	-	1.53	-
Sugarcane (Gur making)	Non-irrigated	25726	-5795	-	2.14	-
Mustard (oil)	Traditional/ Non-irrigated	4235	-2747	-	3.20	-
Mustard (seed)	Traditional/ Non-irrigated	4235	3576	-	1.25	-
Sesame (oil)	Traditional/ Non-irrigated	-1361	-6463	-	3.90	-
Sesame (seed)	Traditional/ Non-irrigated	-1361	-1274	-	1.75	-
Linseed (oil)	Traditional/ Non-irrigated	3542	-597	-	1.91	-
Linseed (seed)	Traditional/ Non-irrigated	3542	2885	-	0.86	-
Masur (Lentil)	Traditional/ Non-irrigated	8521	14543(H) 10358(L)	9715 -	0.43(H) 0.54(L)	0.56 -

Non-Rice Crops	Irrigation Technique	Net Financial Return (Tk./hectare)	Net Economic Return (Tk./hectare)		Domestic Resource Cost	
			Import Parity	Export Parity	Import Parity	Export Parity
Gram	Traditional/ Non-irrigated	6621	12184(H) 8407(L)	7826 -	0.44(H) 0.55(L)	0.57 -
Khesari	Traditional/ Non-irrigated	4538	8551(H) 5867(L)	5454 -	0.62(H) 0.78(L)	0.81 -
Chilli (dry)	Modern	16429	6549	-	1.11	-
Chilli (dry)	Traditional/ Non-irrigated	3118	-3318	-	1.64	-
Onion	All	97482	86322	-	0.25	-
HYV Potato (fresh)	Modern	52636	194815	29130	0.17	0.61
HYV Potato (fresh)	Rainfed	49036	183469	26701	0.18	0.63
HYV Potato (fresh)	All	49140	184665	26788	0.18	0.63
Local Potato (fresh)	All	12388	71876	3944	0.32	0.56
HYV Potato (chilled)	All	49140	120926	-	0.31	-
Brinjal	Modern	53206	-	322014	-	0.10
Brinjal	Traditional	39666	-	239561	-	0.11
Radish	Traditional/ Non-irrigated	13572	-	351669	-	0.07
Cucumber	Modern/Traditional	26213	-	194865	-	0.11
Barbati	Traditional/ Non-irrigated	27177	-	207248	-	0.12
Arum	Traditional/ Non-irrigated	35208	-	328966	-	0.07
Tomato	Modern/ Traditional	93730	-	553940	-	0.05
Cabbage	Modern/ Traditional	42638	-	498056	-	0.05

Note: The estimates are average for 1996/97, 1997/98 and 1998/99, expressed at 1997/98 prices.

Source: Shahabuddin and Dorosh (2001).

rice is generally consistent with the results of the economic profitability analysis discussed above.

The estimated domestic resource costs (DRC) of *wheat* are observed to be lower than unity under different irrigation conditions thereby demonstrating its efficiency of domestic production (Table 3.2). However, as compared to high yielding variations of rice, the ratios are observed to be higher implying that resources can be used more efficiently in the cultivation of modern varieties of rice under irrigated conditions. The DRC ratios for *jute* (0.80-0.92), though less than unity, are quite high relative to most other crops indicating its comparative advantage for export but at the same time, there may be some competing demand on resources for production of other crops from an efficiency point of view. The estimated DRC ratio for *cotton* (0.55) indicates its relative efficiency in domestic production for import substitution, especially during the aman season when it is produced. The relative efficiency of production for export of *tobacco* is observed to be quite pronounced as reflected in its very low DRC ratio estimates (0.20-0.21).

Sugarcane, on the other hand, hardly displays any comparative advantage in terms of efficiency in domestic production for import substitution, with estimated DRC ratios exceeding unity in almost all cases. This is largely attributed to the excessive milling costs incurred by inefficient sugar refineries under public ownership. The situation is even worse in the case of production of *oilseeds* for import substitution, considered either in terms of import of oil or of seeds. The estimated DRC ratios are observed to exceed unity by a large margin in most cases. This again can, at least, partly be attributed to the inefficiency of the local oil-milling industry.

The estimated DRC ratios of different types of *pulses* are observed to be less than one in all cases thereby demonstrating their efficiency in domestic production not only for import substitution but export as well. Of the two types of spices considered in this exercise, the production of *dry chilli* does not appear to be efficient under either modern

irrigation or traditional/non-irrigated conditions, with DRC exceeding unity in both cases. *Onion*, on the other hand, is observed to be highly efficient in production for import substitution, as reflected in its low estimate of the DRC ratio (0.25).

The production of *potato*, under both modern and traditional irrigation, seems to be highly efficient for both import substitution and export. The production of different types of *vegetables* considered in this exercise also would appear to be highly efficient, especially for exports as reflected in the extremely low estimates of the DRC ratio of these crops (0.05-0.12). In fact, *vegetables* appear to be highly competitive in terms of both financial and economic returns as well.

SENSITIVITY ANALYSIS

A sensitivity analysis has been carried out to examine the degree to which the efficiency measures estimated under the baseline assumptions are likely to be affected by possible changes in the values of basic parameters such as yield, prices and major components of costs of production. This exercise would demonstrate the robustness of the conclusions derived in this study. The condition for sensitivity analysis considered in the exercise included: (a) effect on financial profitability (b) effect of changes in output prices (economic) on efficiency in domestic production (c) effect of changes in shadow wage rate on efficiency in domestic production (d) effect of changes in shadow exchange rate and (e) effect of future changes in production technology. The results of sensitivity analysis indicate that the relative production efficiency is more sensitive to changes in yields and prices (both financial and economic prices) than to changes in components of production cost such as (shadow) wage rate and cost of irrigation. Production efficiency was observed to be fairly sensitive to changes in the shadow exchange rate. However, since there was hardly any variation across five crops considered in the exercise, their relative efficiency rankings remained unchanged.

COMPARATIVE ADVANTAGE OF ALTERNATIVE CROP SEQUENCES

The estimates of net economic returns per unit of cropland is one way of analysing comparative advantage in terms of efficiency of resource use and land allocation for production of different crops and crop mixes. However, in order to meaningfully interpret these estimates as an indicator of comparative advantage, it may be worthwhile to estimate the net returns of alternative cropping pattern and/or crop sequences in order to highlight the nature and scope of competition or complementarity in the choice of crops.

There are large variations in the cropping pattern observed among various regions of the country, and many of these variations can be related to agroclimatic factors. The cropping pattern in the country can be broadly classified into rainfed and irrigated patterns, which again vary according to the degree of seasonal flooding and land types. Based on data from a fairly representative nationwide survey carried out in 1987, the study estimated the net financial and economic returns associated with the cropping pattern across different land types and irrigated conditions.[11]

The nature of competition and/or complementarity in the choice of crops in different land types, however, is not fully reflected in the above analysis. Although most non-rice crops compete for land in the dry boro season, the substitution among dry-season crops may entail changes in other seasons as well. The study, therefore, analyzed the crop-sequences in three different seasons – Rabi, Kharif I and Kharif II – based on information from 10 selected thanas in 4 (new) districts in the Northwest Region of Bangladesh.

It was observed that although crop-sequence varies widely in the region, the most prevalent one is Boro-Fallow-T. Aman. Not only do 9 out of 10 selected thanas adopt this crop-sequence, the proportion of total land devoted to such a pattern is also quite high

[11] For a detailed discussion on net financial and economic returns of different land types and irrigation conditions, see Shahabuddin and Dorosh (2001).

(50.2%) – in fact, much higher than any other crop-sequence observed in the Region. Most of the crop sequences include T. Aman and this remains the single-most important crop in the Region. Wheat fits well into a number of crop-sequences (Wheat - T. Aus – T. Aman, Wheat – Fallow – T. Aman and Wheat – Jute – T. Aman) and seems to be widely cultivated in the Region, although the percentage of land cultivated is still much lower (ranging from 5.0% to 13.2% of total cultivated land), as compared to that involving irrigated boro.

Potato is one of the most important cash-cum-vegetable crops in the Region and fits well in the existing cropping pattern either as a lone crop or an intercrop. The resulting net returns are also relatively high. However, there are a number of constraints that impede a large-scale expansion of potato cultivation in the Region. Storage, preservation and marketing are major problems from the farmers' point of view. Vegetable combines either with cultivation of spices or with potato, with land remaining fallow in the Kharif II season. The amount of land devoted to such a cropping pattern, however, is small despite their high financial and economic returns. That this is so has been alluded to above while discussing the crop-sequences associated with potato, another high-value non-cereal crop. One can attribute this to a combination of technical and economic factors, as noted below (Mahmud et al. 1994).

There are very high risks associated with the marketing of these high-value crops. At the same time, the existing irrigation and on-farm water management systems do not allow rice and non-rice crops to be planted in the same service units. Growing non-rice crops under modern irrigation would, therefore, often require the farmer to allocate all of his land or the major part of it to these crops. This may hardly be a preferable option for a risk-averse farmer in Bangladesh.

Traditional irrigation, being of a divisible nature, allows farmers to grow the high-value, but risk-prone crops on small parcels of land. It is only when there are large economies of scale in marketing and/or assured markets (as in the case of vegetable belts

near urban centres) that non-cereal crops are found to be grown under modern irrigation on any significant scale.

4. MEDIUM TERM OUTLOOK FOR RICE PRODUCTION AND DEMAND: PROJECTIONS TO 2020

Bangladesh has made substantial progress in rice production, more than doubling production since the mid-1970s. In recent years of normal rice harvests, supply from domestic production has essentially met domestic demand so that imports have been very small. Future supply-demand balances will be determined in part by the price-responsiveness of supply and demand, along with technical change, income growth and other factors. This report provides estimates of the price-responsiveness of rice production (in particular, area planted to rice), and then simulates supply and demand balance for rice under alternative scenarios.[12]

ECONOMETRIC ESTIMATES OF SUPPLY PARAMETERS

Rice supply projections are based on estimated coefficients from regressions on area and yield by rice crop (aus, aman and boro). The area regression equations follow a basic Nerlovian model where area is expressed as a function of expected prices (proxied as lagged prices), lagged area and other factors. The yield regressions are simple estimates of logarithmic growth rates.

For the aman regressions, the sample data is from 1972/73 to 1999/2000. The real rice price[13] at planting time (the average price from October-December of the previous year) is used as a proxy for the expected rice price. Dummy variables for various years were added after examination of the outliers of plots of fitted versus historical values of the dependent variable (aman area). The best fit was obtained with dummy variables with a value of one for 1975, 1976, 1987, 1988, 1989 and 1999. The estimated short-run price

[12] A number of studies has carried out projections of demandsupply balance of rice recently. Notable among them include Goletti (1994), Shahabuddin and Zohir (1995) and Ahmed (2000).
[13] Real prices are calculated using the non-food CPI as a deflator.

Table 4.1 — Determinants of Area Planted to Foodgrains: Regression Results

	1973-2000	1979-2000	1973-2000	1979-2000
	Aus Area	Boro Area	Aman Area	Wheat Area
Constant	0.426	-0.410	-4.192	0.057
	(1.961)	(-1.123)	(-7.013)	(1.065)
Lagged Real Price	3.620	5.222	4.031	0.101
	(2.426)	(1.806)	(2.385)	(1.415)
Lagged Area	0.762	0.497	0.233	0.787
	(11.134)	(4.057)	(2.193)	(11.298)
Lagged Yield Rate	-	0.319	-	-
		(3.379)		
Adj R^2	0.978	0.989	0.777	0.934
D-W	2.298	1.896	1.996	2.134
SR Elasticity	0.106	0.164	0.051	0.120
LR Elasticity	0.443	0.326	0.067	0.563

Note: t-statistics are shown in parenthesis. Elasticities are computed at the arithmetic mean values of the respective price and area variables.
Source: Dorosh, Shahabuddin and Rahman (2001).

elasticity with this model is 0.051, with a long-run elasticity of 0.067. Long-run elasticities computed from alternative regressions range from 0.041 to 0.110 (Table 4.1).

The regression for the boro area includes lagged boro yields as well as lagged area, planting time price (October-December of the same fiscal year as the boro harvest), and dummy variables. The best regression includes a dummy variable with a value of 1 for 1998 and two other dummy variables equal to 1 for all years after 1988 and all years after 1998. These latter two dummy variables capture the large and apparently permanent increases in boro area after the 1988 and 1998 floods. Using the full sample from 1972/73 to 1999/2000, the estimated short-run price elasticity with this model is 0.089 with a long-run elasticity of 0.168. Using only a 1978/79 to 1999/2000 sample, the short-run elasticity is 0.164, with a long-run elasticity of 0.326. In the projections, the parameters from this latter regression are used. A similar methodology was also used for

the aus area, resulting in an estimated short-run elasticity of 0.106 and a long-run elasticity of 0.443.

SUPPLY PROJECTIONS WITH EXOGENOUS PRICES

The parameters above were used to project annual rice production from 2001 through 2020 using alternative assumptions regarding real prices and yield growth. In the base run, with no change in the real price of rice over time, total rice area increases by 11.0 percent, as the increase in boro area more than offsets the declines in aus and aman area. Boro and aus yields increase by 46.7 and 20.0 percent, respectively, over the twenty-year period. As a result, boro production increases by 77.3 percent, aman production is nearly constant, and aus production falls by 14.6 percent. Total rice production in 2020 in the base run is 31.1 million MTs, 35.1 percent higher than in 2000 (Table 4.2).

If real rice prices gradually increase by 20 percent over the period, (assuming a constant growth rate of real rice prices), total production rises to 31.8 million MTs. A 20 percent decline in real rice prices results in production of 30.4 million MTs. Thus, with only area assumed to be responsive to price changes, total production varies by only 1.37 million MTs in these three scenarios. Increasing aman yields by 1 percent per year along with a 20 percent increase in real rice prices over time raises production in 2020 to 34.0 million MTs. Cutting boro yield growth in half, together with a 20 percent reduction in real prices over time, lowers production in 2020 to only 25.6 million MTs. (Table 4.2).

Table 4.2 — Rice Area, Yield and Production Projections (Exogenous Price Model)

	Area				Yield			Production			
	Aman (mha)	Aus (mha)	Boro (mha)	Total (mha)	Aman (MT/ha)	Aus (MT/ha)	Boro (MT/ha)	Aman (mMT)	Aus (mMT)	Boro (mMT)	Total (mMT)
Year 2000 (Base)	5.71	1.37	3.65	10.73	1.81	1.26	3.01	10.30	1.73	11.00	23.03
Year 2020											
No Change in Price	5.61 (-1.7%)	0.98 (-28.8%)	4.41 (20.8%)	11.00 (2.5%)	1.81 (0.0%)	1.52 (20.0%)	4.42 (46.7%)	10.13 (-1.7%)	1.48 (-14.6%)	19.50 (77.3%)	31.11 (35.1%)
20% Increase in Price	5.66 (-0.8%)	1.10 (-20.2%)	4.51 (23.4%)	11.26 (4.9%)	1.81 0.0%)	1.52 (20.0%)	4.42 (46.7%)	10.22 (-0.8%)	1.66 (-4.2%)	19.91 (81.0%)	31.79 (38.0%)
20% Decrease in Price	5.56 (-2.5%)	0.85 (-37.7%)	4.32 (18.2%)	10.73 (0.0%)	1.81 (0.0%)	1.52 (20.0%)	4.42 (46.7%)	10.04 (-2.5%)	1.30 (-25.3%)	19.08 (73.5%)	30.42 (32.1%)
20% Increase in Price Higher Aman Yields	5.66 (-0.8%)	1.10 (-20.2%)	4.51 (23.4%)	11.26 (4.9%)	2.20 (22.0%)	1.52 (20.0%)	4.42 (46.7%)	12.47 (21.0%)	1.66 (-4.2%)	19.91 (81.0%)	34.04 (47.8%)
20% Decrease in Price ½ Boro Yield Growth	5.56 (-2.5%)	0.85 (-37.7%)	3.89 (6.6%)	10.31 (-3.9%)	1.81 (0.0%)	1.52 (20.0%)	3.65 (21.2%)	10.04 (-2.5%)	1.30 (-25.3%)	14.21 (29.2%)	25.55 (10.9%)

Notes: Higher aman yields: 1.0 percent increase in yields per year. Figures in parenthesis represent percentage changes over the base year (Year 2000) figures.

Source: Dorosh, Shahabuddin and Rahman (2001).

SUPPLY AND DEMAND PROJECTIONS WITH ENDOGENOUS PRICES

Table 4.3 presents projections of supply and demand where prices are determined endogenously. Prices are generally set equal to the autarky market-clearing price where domestic supply (production less 10 percent for seed, feed and losses) equals domestic demand. However, in simulations where the autarky price exceeds the import parity price (or falls below the export parity price), the import (export) parity price is used to recalculate supply, demand and imports (exports). The import parity price is calculated as the average 1995/96 to 1999/2000 import parity price of rice from India, expressed in dollars ($293/MT) multiplied by the 2000/2001 exchange rate of Tk. 54/$, or (15.8 Tk/kg). An export parity price of $240/MT (12.3 Tk/kg) is used, slightly above the average export parity price of $229/MT (11.7 Tk/kg) from 1995/96 to 1999/2000, and 10 percent higher than the actual price in 1999/2000. (This export parity price implies that if marketing channels had been established, the Bangladesh private sector could have profitably exported rice to India, or competed with Indian exports to third-country markets in 1999/2000).

In the base run, demand is modeled using an income elasticity of demand of zero, an own price elasticity of demand of –0.4 and population growth of 2 percent per year. Under these assumptions, real prices rise by 19.6 percent by 2020 as domestic demand increases faster than supply. Assuming per capita income growth of 5 percent per year and an income elasticity of demand of 0.2, domestic demand grows even faster. Prices rise to import parity by 2013 (an increase of 35 percent in real terms) and by 2020, imports reach 1.52 million MTs per year, equal to 5.0 percent of total consumption of 32.5 million MTs. Similarly, with base run demand parameters, but with slower growth in boro yields, prices rise to import parity by 2011, and by 2020 imports reach 2.67 million MTs per year.

If aman yields are assumed to increase by 1 percent per year, then in the absence of exports, real prices are almost constant over the twenty-year period, rising by only 4.9

percent by 2020. If export parity holds as a price floor, however, then exports reach 720 thousand MTs per year in 2020, equal to 2.4 percent of net production.

Table 4.3 — Rice Supply and Demand Projections with Endogenous Prices

	Production				2020	2020
	Aman (mMT)	Aus (mMT)	Boro (mMT)	Total (mMT)	Price (index)	Trade[a] (mMT)
2000 (Base)	10.30	1.73	11.00	23.03	0.050	0.00
Base Simulation 2020	10.22 (-0.8%)	1.70 (-2.1%)	19.95 (81.3%)	31.86 (38.3%)	0.060 (19.6%)	0.00 (0.0%)
Increased Aman Yields	12.39 (20.3%)	1.55 (-10.3%)	19.63 (78.5%)	33.58 (45.8%)	0.052 (4.9%)	0.00 (0.0%)
Increased Aman Yields With Rice Exports	12.42 (20.6%)	1.60 (-7.9%)	19.73 (79.4%)	33.74 (46.5%)	0.055 (10.0%)	0.72 (2.4%)
High Rice Demand	10.30 (0.0%)	1.87 (8.0%)	20.30 (84.6%)	32.47 (41.0%)	0.068 (35.0%)	-1.52 (-5.0%)
Slow Boro Yield Growth	10.30 (0.0%)	1.88 (8.2%)	15.22 (38.4%)	27.39 (18.9%)	0.068 (35.0%)	-2.67 (-9.8%)

Notes: [a]Share of imports or exports in net production is shown instead of the percentage change.
Base run: per capita income growth 3%; population growth 2%; income elasticity 0.0; Price elasticity of demand –0.4.
Increased aman yields; 1 percent increase in average yields per year.
High rice demand: per capita income growth 5%; income elasticity 0.2
Figures in parenthesis represent percentage changes over the base year (2000) figures.

Source: Dorosh, Shahabuddin and Rahman (2001).

5. DEMAND FOR POULTRY FEEDS: PROJECTIONS TO 2020

As we observed earlier, the poultry sub-sector has witnessed phenomenal growth in recent years. Wheat and Maize are important components of poultry feeds. The demand for wheat and maize, therefore, is expected to increase with the growth of poultry farms in the country. A study (Islam, 2001) has been undertaken to carry out projections of demand for poultry feeds and its implications for wheat and maize production in Bangladesh over the next 20 years.

ESTIMATION PROCEDURES AND SOURCES OF DATA

Two approaches have been employed to estimate demand for use of grain (wheat and maize) as poultry feeds: (1) the Demand Analysis Approach and (2) the Trend Analysis Approach. The study employs both the approaches in order to obtain a range of demand estimates for the use of grain as poultry feeds, for the year 2005, 2010, 2015 and 2020. The year 2000 is considered as the base year.

The Demand Analysis Approach involves projecting demand derived from the consumption of poultry products (meat and eggs) through the incorporation of factors such as population, urbanisation and income growth and income elasticities of demand. The projected quantities of poultry products are then translated into feed requirements and finally into projected use of grain for poultry feeds. The projections are carried out, disaggregated by village (scavenging) and commercial poultry birds (layers and broilers), using appropriate feed coefficients since the feeding practices vary significantly among these three types of birds.

Future feed requirements can also be projected based on the growth in the poultry population. The Trend Analysis Approach, thus, involves assessing future feed requirements through estimating historical trends of growth in the poultry population.

The projected poultry populations have been used to project future feed requirements, particularly for wheat and maize.

The study is largely based on information from secondary sources such as Agricultural Censuses and the FAO Yearbook. Such information is supplemented by primary data generated from field surveys. In particular, the data on the current poultry production system, generated by the field surveys, have been used. Also, some data were collected from a rapid market survey including a few key-informant interviews.

PROJECTIONS OF CONSUMPTION OF POULTRY PRODUCTS (DEMAND ANALYSIS APPROACH)

Besides population and income growth, the Demand Analysis Approach requires that the responsiveness of demand for poultry products to income growth be incorporated in the exercise. The estimated income elasticities are adopted from Alam (1997). Following this approach, the national consumptions of eggs are projected to be 4347 millions, 4878 millions, 5397 millions and 5866 millions for the years 2005, 2010, 2015 and 2020 respectively. Thus, the national consumption for eggs is estimated to increase by 62 percent by the year 2010 and by 95 percent by the year 2020. The corresponding national consumption for meat is projected to be 227, 255, 283 and 307 thousand metric tons for the four selected years respectively. Thus, the national consumption for meat is expected to increase by 48 percent by the year 2010 and by 78 percent by the year 2020.

PROJECTIONS OF POULTRY POPULATION (TREND ANALYSIS APPROACH)

Two estimates of poultry population are carried out, based on two methods: poultry population trend method and per capita (of poultry) trend method. One can use either of the two, or the mean of the two estimates. In this analysis, the mean of the two estimates is calculated, which have subsequently been used in the projection of grain use as poultry feeds. Starting from the base year figure of 172 million poultry population and using the past trend growth rates, projected poultry populations are estimated to be 218, 279, 356 and 451 million for the four selected years respectively. Thus, the Trend

Analysis Approach, based on past trends, suggests that the poultry population is expected to increase by 64 percent by the year 2010 and by 165 percent by the year 2020.

The use of high rates of past trend growth in the projection exercise has led to severe overestimation of poultry, poultry farms and hence feed requirements. The major reason relates to a lack of a longer and continuous data series from which trends have been estimated. On the other hand, it is more likely that the high trend growth rates, which demand appropriate and adequate policy supports to sustain, may not be applicable over the next twenty years. Under these circumstances, the analysis also uses the current population growth rate, as a proxy to past trend growth rates, for the projection of poultry population and poultry farms. The data derived from these projections have subsequently been used in the projection of grain use as poultry feeds.

PROJECTION OF GRAIN (WHEAT AND MAIZE) USE AS POULTRY FEEDS

The analysis presents projected use of grain (wheat and maize) for poultry feeds, by poultry type, for the four selected years. The projected use of grain for poultry feeds is estimated through adopting both the approaches and also, by the use of feed ingredients as well as feed coefficients obtained from the field surveys.[14]

The use of grain for poultry feeds for the base year 2000 is estimated to be 631 thousand metric tons. Of this, wheat accounts for 141 thousand metric tons (22 percent) and maize accounts for 491 thousand metric tons (78 percent). Current production levels for wheat and maize in Bangladesh are in the range of 1800 thousand and 65 thousand metric tons, respectively. Thus, total poultry feed requirement is approximately one-third of the total wheat and maize production in Bangladesh. The requirement of wheat as poultry feed is nearly 8 percent of the total domestic production and the requirement of maize as poultry feed is about 7.6 times its domestic production.

[14] For an elaborate discussion on this, see Islam (2001).

Table 5.1 — Projected Use of Grain (Wheat and Maize) for Poultry Feeds (by Poultry Type) in Bangladesh

Grain by poultry type	Base year 2000	Projected use of grain for poultry feeds (000 Tons)			
		2005	2010	2015	2020
	Demand Analysis Approach				
Scavenging					
Wheat	-	100.99	113.36	125.47	136.42
Maize	-	-	-	-	-
Layer					
Wheat	-	38.09	42.75	47.31	51.44
Maize	-	500.59	561.87	621.85	676.11
Broiler					
Wheat	-	8.63	9.69	10.72	11.66
Maize	-	16.56	18.59	20.58	22.38
Wheat	**140.56**	**147.71**	**165.80**	**183.50**	**199.52**
Maize	**490.51**	**517.15**	**580.46**	**642.43**	**698.49**
Total grain	**631.07**	**664.86**	**746.26**	**825.93**	**898.01**
	Trend Analysis Approach				
Scavenging					
Wheat	79.70	86.28	93.41	101.13	109.48
Maize	-	-	-	-	-
Layer					
Wheat	34.02	36.83	39.87	43.16	46.73
Maize	438.98	475.24	514..49	556.99	602.99
Broiler					
Wheat	26.85	29.06	31.46	34.06	36.88
Maize	51.53	55.79	60.40	65.39	70.79
Wheat	**140.56**	**152.17**	**164.74**	**178.35**	**193.08**
Maize	**490.51**	**531.03**	**574.89**	**622.38**	**673.78**
Total grain	**631.07**	**683.20**	**739.63**	**800.73**	**866.86**

Notes: The trend growth rate of both poultry population and commercial farms is taken as equal to current population growth rate (1.6%).
A 10 percent mortality rate is assumed. For both layers and broilers, consumptions are adjusted to for annual level. For layers, feed consumption (per week) level applies for the life cycle of 78 weeks, from which that for 52 weeks is estimated. For broilers, average feed consumption (per week) applies for the life cycle of 6 weeks. In all, 6 batches of broilers in a year are considered. That means, feed demand for 36 weeks is considered in a year. As estimated from the field survey, the wheat consumption by scavenging birds is equivalent to 10 percent of average quantify consumed by layers and broilers. No maize consumption is considered for scavenging birds. Half of scavenging birds are estimated to lay eggs in the whole year.

Adopting the Demand Analysis Approach, the use of total grain as poultry feeds is projected to be 665, 746, 826 and 898 thousand metric tons, for the years 2005, 2010, 2015 and 2020 respectively (Table 5.1). Thus, starting from the base-year requirements of 631 thousand tons, the projected use of grain for poultry feeds is expected to increase by 18 percent in 2010 and by 42 percent in 2020.

According to the Trend Analysis Approach using past trend rates of growth, the projected total grains as poultry feeds are 794, 1022, 1346 and 1817 thousand metric tons, for the years 2005, 2010, 2015 and 2020 respectively (Table 5.1). However, taking current population growth as the trend rate of growth, the Trend Analysis Approach suggests the projected total grains as 683, 740, 801 and 867 thousand metric tons, for the years 2005, 2010, 2015 and 2020 respectively (Table 5.1).

Two alternative projections, Demand Analysis Approach and Trend Analysis Approach (taking current population growth rate as the trend growth rate) appear to be within a reasonable range. Further refinements in the projections could be made if more data were available. Ideally, separate income elasticities for village and commercial poultry products, and separate income growths for rural and urban areas should used. Impacts of changes in prices could also be modeled. Nonetheless, both demand projections of poultry feed indicate substantial growth in the next two decades.

6. CONCLUSIONS AND POLICY RECOMMENDATIONS

The analysis of comparative advantage carried out in this exercise seems to suggest that the menu of crops that Bangladesh can produce efficiently either for import substitution or for export is quite large. In fact, the profitability estimates and estimated domestic cost ratio indicate that except for a few import-competing crops such as sugarcane, oilseeds and chilli, Bangladeshi has a comparative advantage in the production of most agricultural crops. The economic profitability analysis also demonstrates that Bangladesh has a comparative advantage in domestic production of rice for import substitution but not for export. In fact, moving to an export price regime implies a substantial decline in economic profitability for all rice crops. Moreover, when compared with economic profitability of many non-rice crops, it would appear that the country has more profitable options other than production for rice export.

There are a number of crops, namely vegetables, potato and onion, whose financial and economic returns are either as high as or higher that that of HYV rice. The fact that they have performed so poorly despite their higher returns can largely be attributed to high price risks associated with the marketing of such crops. Development of agroprocessing industries and marketing networks provide effective means for reducing variability in prices. Development of rural infrastructure including roads and inland water transport, rural electrification and communication facilities is an essential prerequisite for integrating localized rural markets with each other and with urban markets. At the same time, market links need to be established abroad and appropriate grading and processing facilities developed to promote the export of these products. The economic profitability of vegetable production for export has been observed to be fabulously high as compared with most other crops. However, their exports are presently constrained by a lack of experience with these crops in Bangladesh, as well as a variety of

marketing problems including product quality, acceptable packaging, high transport costs and market access. These problems need to be addressed to exploit the potential and scope of crop diversification in the country. The real prospects for diversification, however, would still depend on how far technological innovation could make non-cereal crops competitive under conditions of modern irrigation.

It has been observed that poultry farming in Bangladesh is largely import dependent with respect to feed ingredients and the chicks. There are unfortunately no clear rules and regulations regarding their imports and quality testing. Quality inspection for imported feed ingredients and the chicks is an urgent need. Appropriate steps should also be taken to produce the chicks domestically thereby reducing foreign dependency for their supplies. Adequate measures are also needed for increased production of maize and soybean, which have large potentials in the country.

Poultry farms in the country are now utilizing three-fourths of their production capacity. It is much lower in household farms, reportedly due to cash constraints. For efficient capacity utilization, formal credit supports are required. The mortality of birds is also high which can be reduced through adequate supplies of disease free chicks and quality vaccines and feeds.

Towards the long-term development of the poultry industry in the country environment- friendly technologies should be applied in the disposals of poultry litters and industrial wastes containing toxic elements to avoid health hazards in the locality. Institutional credit supports to the establishment of bio-gas plants using litters by farm owners can greatly help in this regard.

This report has also provided a medium term outlook of the rice sector involving supply and demand projections of rice under alternative scenarios, especially under both exogenous and endogenously determined prices. The following conclusions emerge from the empirical exercise carried out in the report.

(a) Without an increase in aman rice productivity or an acceleration of technological progress in boro rice production, Bangladesh may be a net importer of 1.5 to 2.7 million metric tons by 2020.

(b) With moderate productivity increases, however, Bangladesh could be a net rice exporter of about 720 thousand metric tons by 2020, if trading links are established and world prices remain at their average levels of the late 1990s.

(c) Thus, technological progress in rice production remains the key determinant of whether Bangladesh is surplus or deficit in demand-supply balance of rice in the next two decades.

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