

MARKETING BANGLADESH POTATOES:

Present
Patterns
and Future
Prospects

Gregory J. Scott

A Herman
never grows!!
Gregory Vent
Cuba 19/5/88

The International Potato Center (CIP) is an autonomous, nonprofit scientific institution established through agreement with the Government of Peru to develop and disseminate knowledge for greater use of the potato as a basic food. International funding sources for technical assistance in agriculture finance the Center.

The purpose of this study is to encourage debate, exchange of ideas, and advancement of social science knowledge about production and utilization of the potato. The views expressed in the study are those of the author and do not necessarily reflect the official position of the International Potato Center. Comments are invited.

**MARKETING BANGLADESH'S POTATOES :
PRESENT PATTERNS AND FUTURE PROSPECTS**

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January 1988

Published by :

International Potato Center (CIP), Lima, Peru.

**Australian Development-Assistance Bureau (ADAB)
Canberra, Australia.**

Bangladesh Agricultural Research Council (BARC)

Dhaka, Bangladesh.

*Potato 5969
Lima, Peru*

Correct Citation :

Scott, Gregory J. 1988.

Marketing Bangladesh's Potatoes :

Present Patterns and Future Prospects

CIP-ADAB, Dhaka. pp-107 .

4

Printed at :

BRAC Printers, Dhaka, Bangladesh.

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Currency Equivalents¹ (February-April 1984)

Bangladesh Taka (Tk.)

1 Tk.

100 Tk.

1000 Tk.

- Currency Unit
- US \$.04
- US \$ 4.00
- US \$ 40.00

1 Approximate.

Weights and Measures

Bangladesh Systems

1 seer

1 maund (md)

- Equivalent
- .93 kilos (kg)/2.05 (lb)
- 37.5 kilos (kg)

Terms

Aratdar

Bepari

Cold store

Dalal

Deshi potato

Godown

Hat

- Wholesaler/commission agent
- Produce buyer
- Refrigerated storage facility
- Produce broker
- Variety introduced decades ago, now considered "local"
- Simple, unrefrigerated warehouse
- Rural farmers' market

Abbreviations

AST/CIDA	- Agricultural Sector Team/Canadian International Development Agency
AMD	- Agricultural Marketing Department
BARC	- Bangladesh Agricultural Research Council
BADC	- Bangladesh Agricultural Development Corporation
BARI	- Bangladesh Agricultural Research Institute
BARD	- Bangladesh Academy for Rural Development
BAU	- Bangladesh Agricultural University (Mymensingh)
BBS	- Bangladesh Bureau of Statistics
BCSIR	- Bangladesh Council for Scientific Research
BKB	- Bangladesh Krishi Bank
BSCIC	- Bangladesh Small and Cottage Industries Corporation
BSRB	- Bangladesh Shilpa (Industry) Rin (Credit) Bank
CARE	- Co-operative for American Relief Everywhere
CIP	- International Potato Center
FAO	- Food and Agriculture Organization of the United Nations
FFW	- Food for Work
GOB	- Government of the People's Republic of Bangladesh
HYV	- High Yielding Variety
IADS	- International Agricultural Development Service
INFS	- Institute of Nutrition and Food Science
MCC	- Mennonite Central Committee
MOF	- Ministry of Food
MOI	- Ministry of Industry
SIRD	- Small Industries Rural Development
USAID	- United States Agency for International Development

I. Introduction

Bangladeshi policymakers continually face the awesome challenge of providing a rapidly growing population with basic needs: food employment and improved standard of living. While achievements in the area of food production have been remarkable since independence, there is a feeling among decisionmakers that farmers could raise their productivity and consumers enrich their diets provided that marketing activities were better understood and improvements in existing trade arrangements implemented. Potatoes represent perhaps the most striking example of this concern over the relation between increases in production and consumption, and the appropriate marketing initiatives to help bring this about.

With a remarkable (300%) increase in production during the last two decades and a current annual harvest of over 1.1 million tons, the potato presently ranks fourth behind rice, sugar cane, and wheat as the country's most important food crop in terms of total production. Moreover, Bangladeshi scientists and foreign experts both agree that additional increases in potato output and productivity can be achieved with available technology. Nevertheless, recent bumper crops—resulting in poor producer prices—combined with an estimated 100,000 t of underutilized cold storage capacity raise a key question: if Bangladeshi farmers produce more potatoes, where will they be marketed?

Questions related to potato marketing of concern to policymakers, program administrators and researchers include:

How might the financial risks associated with potato production be reduced?

Can the potato help improve nutrition?

What measures might be taken to alleviate the crisis in the cold storage industry?

How might potatoes help Bangladesh improve its balance of foreign trade?

In the course of this study and in the context of addressing the above mentioned questions, the evidence presented aims to provide a descriptive analysis of principal marketing channels and practices including wholesaling, retailing, transportation and storage; an analysis of the factors responsible for the fluctuations in potato prices during the year; a preliminary identification of alternative approaches to potato preservation, such as simple processing, to reduce market gluts and seasonal price movements; examples of potato marketing policies or programs from other countries that would be useful to decisionmakers in Bangladesh; and, recommendations for future research to improve potato marketing.

Food Systems Approach

This study utilizes a food systems approach to address the questions and issues listed above. In other words, the evolution and current state of potato marketing practices are

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considered in the context of the wider economy and the structure of potato production and consumption to which they are linked. This approach facilitates a better appreciation of the factors beyond the marketing system itself that account for the particular nature of existing trade arrangements and their future trajectory. It also offers insights into how marketing has been influenced by production and consumption. Most importantly, the food systems approach provides the basis for a comprehensive appraisal of marketing prospects based on commercial phenomena such as prices but also on underlying trends in production, shifts in eating habits and the impact of government policies.

These perspectives on potato marketing in Bangladesh are developed in the course of five chapters. Each chapter forms part of what is intended to be an integrated view of the marketing of a single commodity. Considered as a whole, this approach consists of an analysis of long-term trends in production, consumption and trade; examination of the current structure and organization of production; consideration of existing consumption and demand patterns; review of marketing outlets, channels, prices and margins; presentation of the secondary statistics employed; and a detailed bibliography.

The study begins with a brief overview of the economy of Bangladesh in Chapter II. This chapter highlights the problems of providing food, employment, and income for the rapidly growing and predominantly rural, Bangladeshi population. Recent trends in agricultural production and foreign trade are then examined. The potential for potatoes to alleviate these problems is also discussed.

Chapter III treats potato production. National and district-wise production trends are analyzed. The distribution of potato producers by farm-size, input-use and production costs are treated. Principal potato varieties and their characteristics are described. The chapter concludes with a discussion of major farm-level production constraints. Chapter III pulls together the results of earlier farm surveys by Ahmed (1982a), Elias et al. (1980, 1982, 1984a, 1984b), Elias and Islam (1982) and Miah (1983). These findings are compared with secondary statistics and the data gathered in informal interviews carried out for this study.

Chapter IV focuses on potato consumption. The changing role of the potato in the Bangladeshi diet is first explained qualitatively. Estimates of past, present, and future potato consumption are then presented. Chapter IV also describes consumer tastes and preferences for potatoes. It then reviews the research on the influence of prices and incomes on potato consumption. The most important constraints to increased potato consumption are noted. Previous studies by Pitt (1983), Poats (1986), and Sabur (1983) receive particular attention in this chapter.

Potato marketing is treated in detail in Chapter V. The overwhelming importance of domestic, as opposed to foreign, trade is indicated. The principal potato marketing channels and their participants are then described. These findings serve as the basis for deriving trends in potato prices, in the ratio of potato prices versus the prices of other foods, and estimates of marketing margins for potatoes. Throughout the chapter, these

various topics are also treated in relation to potato storage. A review of government potato marketing policies and programs proceeds consideration of the principal constraints to improved potato marketing. In Chapter V, findings on potato marketing of Elias and Hossain (1985) and Maziruddin (1982, 1986) are discussed in some detail.

Chapter VI synthesizes the results of the study. This serves as the basis for answering the aforementioned questions about potato marketing and presenting the policy implications. The chapter concludes with some suggestions for future research.

An extensive set of data on potato production, consumption and marketing appears in the Appendix. A detailed bibliography concludes the study.

This study does not present any formal quantitative models of marketing. While it does treat results from this type of research, the study itself offers a more applied approach to the issues examined. This approach consists of interviews with numerous producers, traders, cold storage owners, and various government officials; participant observation of potato marketing activities at all points of the marketing chain; synthesis of available secondary data, and review of the existing literature. As this study represents the first attempt to integrate the considerable information and knowledge available on potato marketing in Bangladesh, considerable time and effort were required simply to collect, organize, and present the basic findings. Hopefully, subsequent studies can build on the results.

A second limitation of this study is the uneven coverage and variable amount of information presented. For instance, little is said about transportation. Trading patterns and practices at the retail level are not examined in detail. Moreover, for the topics treated, the available evidence is not always unequivocal. Still, the coverage largely reflects the current knowledge accumulated in secondary sources and what could be observed in the field work carried out for this study. Finally, by adapting a producer-to-consumer research focus, the study not only identifies the interrelation between different activities and agents but also makes clear the areas that merit greater attention in the future.

Acknowledgements

I would like to take this opportunity to thank all those who helped make this study possible. I am particularly grateful to Mr. Lyle C. Sikka IADS/BARC - CIP representative for Bangladesh; Dr. S. M. Elias, head, Agro-economic Research Division, Bangladesh Agricultural Research Institute (BARI); Dr. M. M. Rashid, head, National Potato Program (BARI); Dr. K. U. Ahmed, (former) Member-Director, field crops, Bangladesh Agricultural Research Council (BARC); Dr. E. Ahsan, Member-Director, agricultural economics (BARC); Dr. Kazi Maziruddin, (former) Director of the Agricultural Marketing Directorate and members of his staff in each of the districts visited. Without their council, support and patience, I would not have been able to complete the job. I also appreciate the lively discussions with Prof. M. M. Miah, Professor of Geography, University of Dhaka;

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Mr. E. J. Leitjens formerly of Dutch Technical Assistance, Bangladesh; and Mr. D. Clements of CIDA/AST. They certainly helped clarify my ideas. In carrying out the field work and preliminary data analysis, I owe special thanks to Mr. T. Hossain for his able assistance and Mr. K. N. Haque (BARI) for his perseverance in serving as translator and traveling companion throughout my stay in Bangladesh.

I am also indebted to Dr. E. Ahsan, Mr. K. Maziruddin, Mr. Lyle C. Sikka, Dr. S. M. Elias, Dr. A. Hossain (BARC), Mr. Ahmed (BARC), Mr. J. M. Khalilur Rahman (BARC), and Dr. J. A. Khan (BARC) for providing useful comments on an earlier draft of this study. I would like to thank as well Dr. C. Crissman, Dr. A. Monares, and particularly Dr. D. Horton for their most helpful suggestions for improving the study. Finally, I am most grateful for the financial assistance towards the printing costs of the report provided by the Australian Development-Assistance Bureau (ADAB), Australia through the Australian High Commission, Dhaka, Bangladesh.

II. Macro-economic Setting

Interest in the potato's potential in Bangladesh has emerged as a part of a broader discussion aimed at promoting national economic development. The particular features of the Bangladesh economy, recent development trends as well as planning goals and strategies are essential elements of this debate. Questions of overriding longer-term importance are the provision of adequate food supplies and productive employment opportunities for the large and growing rural population (Planning Commission, 1983: 23-24). A related problem, but perhaps of more immediate concern, is the food intake of the nutritionally most vulnerable segments of Bangladeshi society. Bangladesh's continued, albeit reduced, dependence on food imports is an additional consideration. The interrelation between production, distribution and consumption therefore represents a useful perspective from which to consider food related issues and their impact on national economic development. Future marketing prospects for the potato are best considered in this context.

2.1 Economic Development in Bangladesh: A Brief Overview

Bangladesh is among the world's youngest and most densely populated countries. The nation achieved independence less than two decades ago (December, 1971) after a ten month war of liberation with West Pakistan. Gross National Product (GNP) per capita is estimated at US\$ 150 (World Bank, 1987); daily caloric supply per capita (1,899) represents less than 85% of estimated requirements; life expectancy is 51 years (Ibid.)¹. With a population of over 95 million people in 144 thousand sq. km, population density is approximately 660 inhabitants per square kilometer. Thus, despite a sharp decline in estimated growth rates, Bangladesh's population is projected to surpass 140 million by the year 2000.

Gross Domestic Product (GDP) grew at annual rate of 5.2% from 1973 to 1983 (Wennergren, 1983a:3). Growth was particularly vigorous in industry (8.1%) and services (7.4%) during this period— ample evidence of a remarkable underlying resourcefulness— all the more noteworthy in light of the damage to basic infrastructure and the depleted public administration in the aftermath of the war of independence. The industrial and service sectors comprise 13% and 40% of GDP respectively.

The agricultural sector expanded at a more modest pace (3.2%) between 1973 and 1983. Hence, it continued to decline as a share of GNP from 53% to 50% (World Bank, 1987).

In spite of these various achievements, continued population expansion absorbed much of the improvement in total output during the last decade, as GNP per capita increased at an average annual growth rate of 0.4%. The average index of food production per capita (1979-81=100) declined slightly (1983-85=97).

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Of even greater concern, perhaps, has been Bangladesh's widening foreign trade deficit. The merchandise trade deficit expanded throughout much of the last decade. It reached US\$ 713 million in 1983 as the average annual growth of imports (4.1%) from 1973 to 1983 sharply exceeded that of exports (1.7%).² Thus, although imports by value remain comparatively modest on a per capita basis, the supply of essential foreign goods to expand the country's modest industrial base continues to be jeopardized by the economy's weak export base (Wennergren, 1983a:10).

These developments have serious implications both for the growth in employment opportunities and for food intake per capita. Some 53% of the population is considered to be of working age (15-64 years), i.e. 53 million people (World Bank, 1987). The projected annual average growth rate of the labor force is estimated to be 3% for the period 1985-2000. The urban industrial and service sectors traditionally have been too small to absorb massive numbers of new job-seekers. Many of these workers are without the training and experience to meet job requirements; others lack the resources to leave rural areas and seek out jobs in towns and cities.

Food intake— measured in grams per capita per day— fell slightly from 1975 to 1982 (Ahmad and Hassan, 1983). Consumption of protein, carbohydrates and essential nutrients such as Thiamine and Riboflavin also declined. These trends are all the more worrisome given that the 1975-76 food intake levels were already below minimum daily requirements. In addition, trends in food prices and real wages have raised additional concern about the ability of the less-well-off segments of the population to maintain even existing, food intake levels (Wennergren, 1983a:25-29).

In light of these various trends, much of the development debate in Bangladesh has focused on progress within the agricultural sector to increase food supplies and employment opportunities.

2.2 Bangladesh Agriculture: Principal Crops and Production Trends

Agriculture remains not only the most important sector of the economy, the principal source of employment and foreign exchange earnings but also constitutes the essential foundation of future economic development. Within agriculture, crop production remains the most important sub-sector representing about 75% of the sector's total contribution to GDP.³

Structure of Crop Production

Crop production in Bangladesh is dominated by rice. With an average area planted of 10.3 million hectares and average total output of 21.9 million tons, rice remains by far the country's most important food crop (Table 2.1). Furthermore, rice production increased by 23% between 1973 and 1985, an increase only to be surpassed by that of wheat and potatoes among the principal food crops in terms of total output.

Table 2.1. Bangladesh : Production, area and yield of principal food crops, 1983-85.

	1983-85			Percent change 1973/75-1983/85		
	Production (000t)	Area (000ha)	Yield (kg/ha)	Production (000t)	Area (000ha)	Yield (kg/ha)
Rice	21,860	10,373	2.1	23.1	4.1	18.4
Sugarcane	7,066	165	42.9	14.0	10.0	3.4
Wheat	1,257	573.7	2.2	1,082.5	366.4	155.3
Potatoes	1,162	110.3	10.5	47.1	35.8	8.2
Sweet potatoes	714	66	10.9	4.7	3.1	1.4
Bananas	705	n.a.	n.a.	19.9	n.a.	n.a.

n.a. = not available.

Source : FAO Production Yearbook.

Wheat has shown the most spectacular increase in output since 1973 (Figure 2.1) as output rose by over 1,000%. The introduction and adoption of high-yielding varieties (HYV) has been a key catalyst in this regard as yields per hectare more than doubled (Wennergren, 1983a:86).

Potato production also showed rapid growth. As a result, the potato now ranks as the fourth most important food crop on the basis of total production. This achievement is all the more remarkable given that this increase in output was largely due to growth in area planted. This trend therefore suggests that the potential contribution of the potato to agricultural and rural development in Bangladesh while impressive to date, has yet to be fully realized

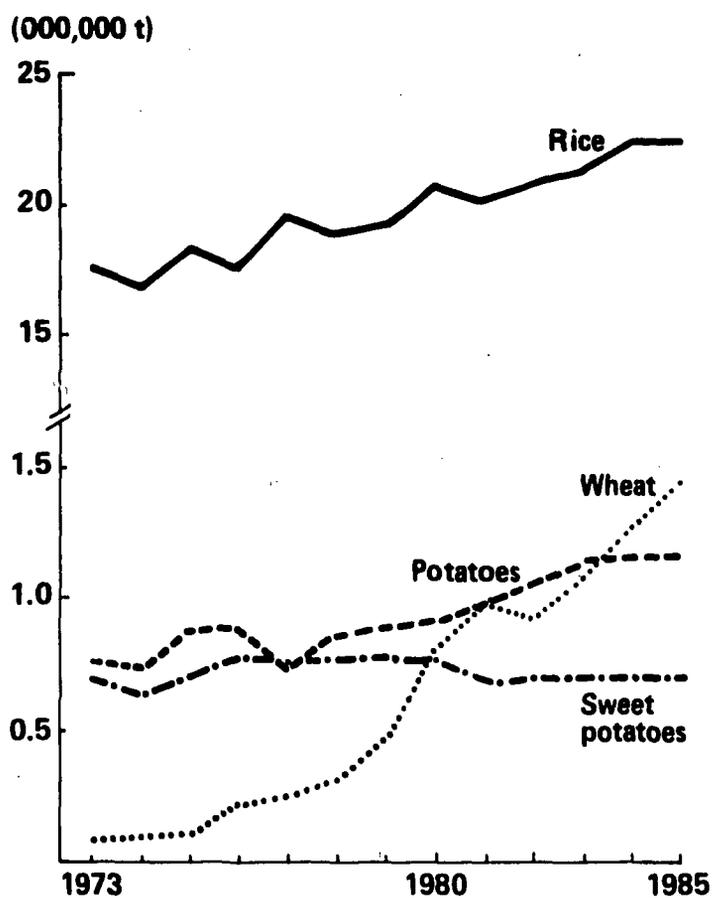
Farm-size and the Landless

A major contributing factor behind past crop production trends and one certain to influence future development is the increasing pressure on land. In 1978, 48% of all farm households owned 0.8 ha of land or less. Ten years ago, average farm-size was less than 1.5 ha (Wennergren, 1983a:55-59). Continued population expansion has undoubtedly reduced average farm-size since then. Consequently farm households have been forced to utilize available cropland more intensively and to devote more resources to high yielding, more remunerative crops. Past efforts to facilitate more intensive use of available farmland therefore have acquired renewed importance. The trend towards reduced farm-size has also raised concern about its impact not only on production patterns but also on marketing activities.

Fifty percent of all rural households in Bangladesh owned little or no land in 1978 (Wennergren, 1983a: 57). A second inevitable consequence of increasing population

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Figure 2.1. Bangladesh: Production of principal food crops, 1973-85.



Source: FAO Production Yearbook.

pressure in the countryside is that more rural families will find themselves without land in the future. Nevertheless, knowledgeable observers agree that agriculture can help generate more employment through labor-intensive practices to increase farm productivity and intensify land-use. Moreover, agriculturally based, cottage industry might provide additional rural employment. For the growing numbers of rural landless these jobs will have a crucial bearing on their future livelihood.

Agriculture and Foreign Trade

Agricultural products comprise about 30% of total merchandise imports during 1982-84 (Table 2.2).⁴ This consisted primarily of rice, wheat and edible oils. While food aid in cereals fell from 2.1 million tons in 1974/75 to 1.5 million tons in 1984/85, cereal imports actually rose slightly from 1.9 to 2.1 million tons between the same two years (World Bank, 1987). As a result, food grains and other traditional agricultural imports have fallen from 66% of total merchandise imports in 1973 to less than half that proportion in more recent years (Wennergren, 1983a:15). Moreover, it is anticipated once domestic production of urea reaches full capacity, imports of chemical fertilizers—currently about US\$ 95 million annually—will no longer be necessary (Ibid.).

Table 2.2. Bangladesh : Average annual value (US\$000) of agricultural imports and exports, 1982-84.

	<u>Imports</u> Value (US\$000,000)	% ¹		<u>Exports</u> Value (US\$000,000)	% ¹
Agricultural products, total	521.7	29	Agricultural products, total	181.0	25
Food and animals	306.0	17	Food and animals	68.0	9
Rice	45.9	3	Tea	50.9	7
Wheat	193.5	11			
Beverages and tobacco	3.7	#	Beverages and tobacco	1.8	#
Crude materials	91.3	5	Crude materials	111.1	15
Textile fibres	81.3	5	Jute	105.8	15
Animal vegetable oil	120.7	7	Animal vegetable oil	0.1	#
Soybean oil	31.1	2			
Palm oil	45.7	3			
Fish and fishery products		#	Fish and fishery products	64.3	9
Forest products	5.8	#	Forest products	5.1	#
Agricultural requisites	115.9	6	Agricultural requisites	6.9	#
Manufactured fertilizers	96.2	5			
Total	1,795.3		Total	727.2	

less than 1%.

Source : FAO Trade Yearbook, Vol. 38 and 39.

1 Percent of total merchandise trade.

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Agricultural products have traditionally been a major source of foreign exchange for Bangladesh. Currently they account for about 25% of total merchandise exports and consist almost entirely of raw jute and tea (Table 2.2). In addition, exports of jute goods represented another 50% of total exports throughout the late 1970s, early 1980s (Wennergren, 1983a:17). Frozen fish, shrimps and frog legs have contributed another 9% of total export earnings.

The inability of Bangladesh to expand the volume and value of merchandise exports in general and agricultural exports in particular has continued to handicap development plans. Instead of serving as an additional source of much needed capital, the trade deficit has been a major drag on economic expansion. Moreover, the narrow set of exports itself has made the economy extremely vulnerable to declining terms of trade (Planning Commission, 1983:20).⁵ As a result, policymakers have developed a keen interest in measures to increase exports of agricultural goods as well as to reduce the country's dependence on food aid and food imports.

2.3 Potential for Potatoes in Bangladesh

Potatoes have considerable potential in Bangladesh for a number of reasons. Potatoes are a short-duration crop that produces a large number of calories in a minimum amount of time. Potatoes are also a labor-intensive crop. Thus, they offer considerable promise in terms of generating increased rural employment opportunities, an important consideration in Bangladesh's land-scarce, labor-abundant rural economy. In addition, potatoes fit well into established cropping patterns. In fact, their short vegetative cycle helps free land for other crops. Potatoes do not require intensive irrigation. Unlike rice, potatoes will do well in the dry season with relatively modest amounts of water. Finally, potatoes are a crop that growers are familiar with (MCC, 1978:19). Given available technology in the form of higher-yielding varieties, better quality seed and improved agronomic practices, the possibilities for increased productivity and output are promising indeed.

At the consumption level, potatoes are a vegetable that most people like to eat. Furthermore, as a result of exemplary media campaigns and a tireless promotion of the tuber by program officials, Bangladeshi consumers are increasingly aware of the potato's numerous culinary characteristics and its various nutritional attributes. Finally, during the last 10-15 years, potatoes have become relatively less expensive in comparison to other foods. This factor alone makes potatoes an attractive commodity for the growing number of low-income rural and urban consumers.

At the marketing level, potatoes represent an increasingly important source of cash income for growers. This is especially true in the winter months when potatoes are a major source of revenue. Potato marketing itself is a labor-intensive activity that provides additional jobs in both the countryside and the city. The potential exists to expand income and employment generating activities related to potatoes by promotion of potato processing by cottage industry. Potatoes might also help improve the balance of trade by either increasing exports or reducing imports of substitute products.

In summary, the problems of food production, rural employment generation, and rural incomes are the vital components of future economic development in Bangladesh. Efforts in the agricultural sector are key determinants of whether these problems can be solved. Interest in potato production, consumption and in particular, potato marketing emerge in this context. As the three sets of activities are distinct, but interrelated, the study now considers each in turn for the purpose of better assessing the future market prospects for potatoes and the crop's potential contribution to the nation's economic development objectives.

Notes

- 1 Estimates of GNP per capita and of daily calorie supply per capita are for 1985 (see World Bank, 1987).
- 2 Most statistics indicate the deficit of merchandise trade was over US\$ 1 billion in 1984 (see Table 2.2).
- 3 A rough estimate for 1982/83 based on data from the Bangladesh Bureau of Statistics.
- 4 According to the World Bank (1987), the remainder of merchandise imports is made up of machinery and transport equipment (18%), other manufacturers (33%), fuels (17%) and other primary commodities (8%).
- 5 For example, between 1972/73 and 1979/80, the terms of trade declined by 63% (Ibid.).

III. Potato Production

An evaluation of the marketing prospects for Bangladesh potatoes begins with a review of current production patterns for several reasons. Production trends provide one indicator of the potential for a growing volume of marketable surpluses. Identification of where and when potatoes are produced contributes essential information about the location and timing of sales. Examination of producer types and production technology indicates the types of farmers that sell potatoes; their capacity to increase production, hence sales; and the profitability and risk associated with the commercial cultivation of the crop. This chapter considers all these issues, then concludes with a brief review of farm-level production constraints.

3.1 Production, Area and Yields

Potato production increased from 759,000 t in 1973 to over 1.1 million t in 1985 (Table 3.1). Area planted expanded by 20,000 ha to 112,000 ha. Yields improved much more modestly, from 9.6 t/ha to 10.4 t/ha.

Table 3.1. Bangladesh: Production, area and yield of potatoes in the most important (old) districts, 1984/85 and growth rates, 1965-85.

District (old)	1984/85			Growth rates (%) ¹								
	Production	Area	Yield	Production			Area			Yield		
	(000t)	(000 ha)	(t/ha)	65/75	75/85	65/85	65/75	75/85	65/85	65/75	75/85	65/85
Dhaka	259	19.4	13.4	43.9	1.6	27.8	19.6	2.1	13.8	1.4	2.8	2.4
Comilla	239	17	14.1	38.6	16.0	64.2	20.2	5.5	17.9	5.5	3.4	5.7
Bogra	87	10.5	8.3	2.7	7.2	6.4	1.5	2.7	2.4	4.7	-0.7	1.9
Dinajpur	81	9.7	8.4	6.5	8.3	4.9	-0.9	5.5	2.2	1.5	1.3	1.5
Rangpur	73	8.1	9.0	12.7	-2.0	4.2	1.8	-0.2	0.8	8.7	-2.2	4.3
Sylhet	56	4.5	12.4	9.0	1.0	5.7	2.3	-0.1	1.2	4.9	1.1	3.4
All others districts	365	42.1	8.7	2.9	5.7	5.5	2.8	3.0	3.6	3.5	-0.8	1.3
Bangladesh (Total)	1,160	111.3	10.4	10.5	4.5	10.6	4.5	2.8	4.6	3.8	-1.2	1.1

Source: Tables A.1—A.4.

1 Growth rates are for periods 1962/65—1972/75, 1972/75—1982/85 and 1962/65—1982/85.

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While potato production has attracted growing attention in recent years, the latest growth in potato output represents but the current phase of an upward trend than began in the 1950s (Table A.1). In fact, it is noteworthy that yields, in particular, improved at a much more rapid rate in the 1960s, early 1970s than during the post-independence period (Table 3.1).¹ A combination of supply and demand factors have contributed to the recent evolution in potato production.

On the supply-side, production increases are largely attributable to the expansion of area planted (Wennergren, 1983a:95-96).² Many farmers have switched to potatoes rather than plant a third crop of rice in the cool, dry, winter months because, given their high yields and short vegetative cycle, potatoes are more profitable. The shortened growing period of the improved rice varieties has actually allowed for a third crop and thereby facilitated this trend. Farmers have also found that a rice-potato-rice crop rotation is less demanding on soil nutrients than continuous rice cultivation. At the same time, the lower water requirements for potatoes versus rice has meant potato cultivation is feasible in the dry season—especially in areas like Munshiganj—simply by mulching to retain soil moisture (Hussain, 1983:3). The latest spread of irrigation in the northwestern districts has allowed more intensive use of farmland, especially in the dry season, the ideal growing period for potatoes. Potatoes are also less perishable than other winter vegetables; hence, they are easier to harvest, transport and sell (SCR, 1969).

The introduction of high yielding varieties from Germany, Denmark, Australia, but primarily from the Netherlands and India has been a second key element (Ahmed, 1982a).³ These varieties and the related program of seed importation and multiplication meant growers have had a source of clean material to offset the serious decline in yields due to virus infection. In fact, the decline in seed imports during the 1970s would appear partly responsible for the slow improvement in yields during the last decade.⁴ The government has responded to this problem by setting up its own national program of seed multiplication and distribution with production headquarters at Debiganj.

A third key component in the increase in potato production has been the steady expansion of cold storage facilities. Continuous construction of additional cold stores meant growers had a place to store and to purchase seed potatoes. Growers could observe tuber sales at the local store and continuously assess the up-coming seed supply situation. In such fashion, the cold stores improved the supply of seed potatoes—imported seed potatoes sometimes arrived too late for multiplication prior to the planting period—thereby allowing for greater land area to be planted as well as making it less problematic.

On the demand-side, the cold stores also induced greater potato production both directly and indirectly. They did so directly by generating additional buyers for potatoes (i.e., traders or store owners who wanted to keep tubers versus those who wanted to sell or utilize them immediately), whose presence in the market cushioned the seasonal decline in producer prices at harvest time. They did so indirectly by making table potatoes available year round—unlike the case for most other winter vegetables. As potatoes

became more continuously available, they became a more regularly accepted part of the diet. The resulting subtle shift in eating habits caused the demand for this vegetable to increase thereby calling forth still greater production.

Additional demand-related considerations that spurred the growth in potato production have been: (1) the rapid growth of the rural, landless population and (2) the periodic shortfalls in the supply of cereals due to unfavorable climatic conditions or natural disaster. The landless have continued to increase both in absolute numbers and as a percent of the rural population throughout the seventies and eighties (Wennergren, 1983a:56-59). The evidence also suggests that these consumers suffered declining real wages (Khan, 1984); they also have been less effectively served than urban residents by the government's food distribution schemes. For low-income consumers generally and the rural landless specifically, potatoes serve as a cheap substitute for rice, particularly in the winter months when potato prices decline sharply. Furthermore, recurrent natural disasters have prompted farmers themselves to use potato production as a food security measure to ensure against a shortage of rice (see Etienne, 1977:434; FAO, 1982:9).⁵

Location of Production

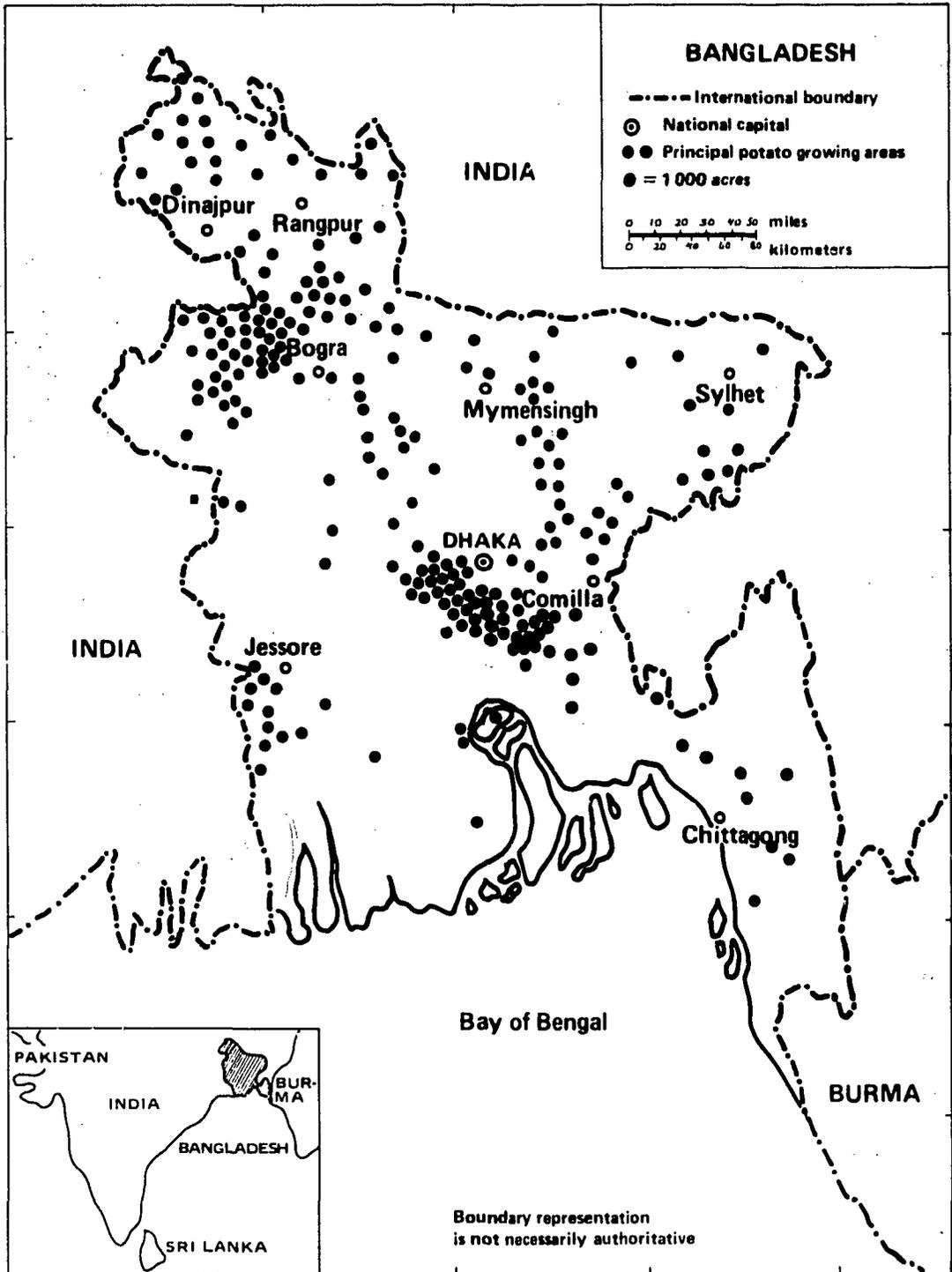
Potatoes are produced in all 23 districts in Bangladesh (Map 3.1). However, production and, to a lesser extent, area planted are highly concentrated. Old Dhaka (24%) and Comilla (20%) districts alone produce nearly half of all the country's potatoes (Figure 3.1). These districts combined with Bogra (7%), Dinajpur (7%), Rangpur (6%) and Sylhet (5%) produce over two-thirds of total output.

Beginning in the 1960s, the center of potato cultivation shifted away from the northwestern part of the country towards central and east central growing areas. Growth rates were particularly rapid for (old) Dhaka and Comilla districts, where production infrastructure (e.g., irrigation), the rapid expansion of cold storage facilities and availability of improved varieties have favored potato cultivation (Sabur, 1983:36).⁶ In addition, these districts are by far the most densely populated—inducing more intensive cropping patterns—and are strategically located in the center of the country, adjacent the major urban markets (Wennergren, 1983a:69). In contrast, few potatoes are grown in the southern districts where the winter is warmer and shorter than in other regions (Ahmed, 1982a).

Growing Seasons and Ecological Zones

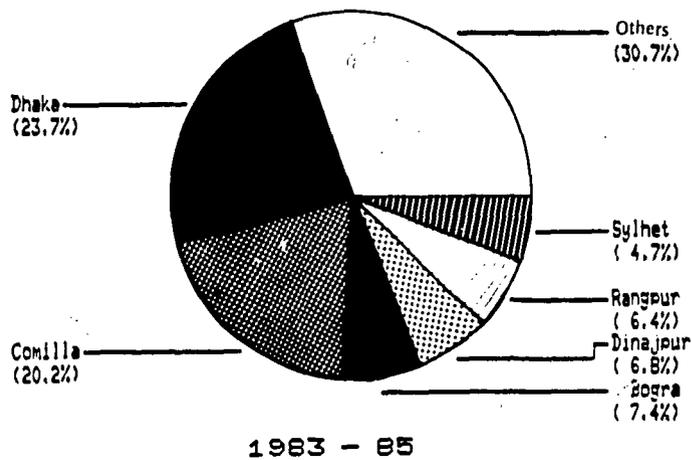
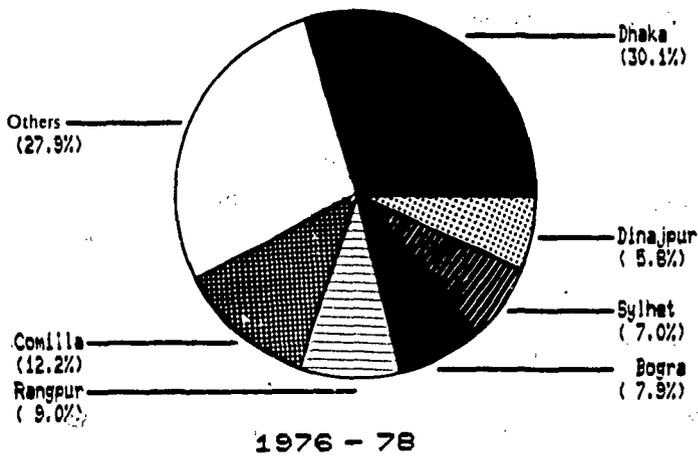
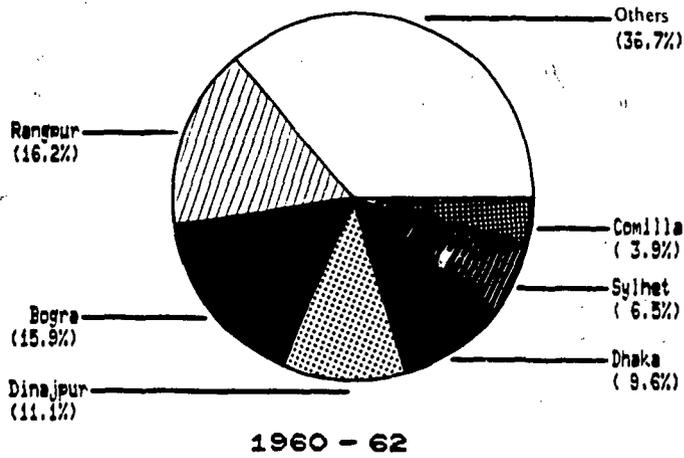
The growing seasons for potatoes correspond to the country's four, broadly defined agro-ecological zones: (1) northwest, (2) east central, (3) northeast and (4) southern (Map 3.2, Table 3.2). Winter in Bangladesh comes earliest to the low hills of the northwest region. As a result, some potatoes are planted in this region in late September, early October for harvest in late November, early December. Traditionally these potatoes receive exceptionally high prices because they are the first fresh potatoes available as the stock of stored potatoes runs out (Elias et al., n. d.). In the northwest region, cooler

Map 3.1. Bangladesh: Location of potato production.



Source: Elaborated for this study based on Miah (1983).

Figure 3.1. Bangladesh: Percentage of total production of principal potato producing districts, 1960-62 - 1983-85.



Source: Table A.2.

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temperatures and more moderate rainfall also allow for an exceptionally long growing season (150 days) in certain areas. Consequently, some growers either delay planting to mid-November, mid-December or take advantage of these climatic conditions to plant a second crop (Bryan, 1974:4-5).⁷ In the latter instance, they typically cultivate *deshi*, or so called "indigenous" varieties, that are grown primarily for household consumption.⁸

In the east central region, the growing season for potatoes begins about mid-November. Planting actually starts with the decline in rain-fall, after the rivers have receded and the flooded rice paddies have dried out. The summer inundation is such in many parts of this region that below the surface of the soil sufficient moisture has accumulated to make irrigation unnecessary. Growers will simply mulch between rows to prevent excessive dehydration of soils.

Table 3.2. Bangladesh: Principal agro-ecological zones for potatoes.

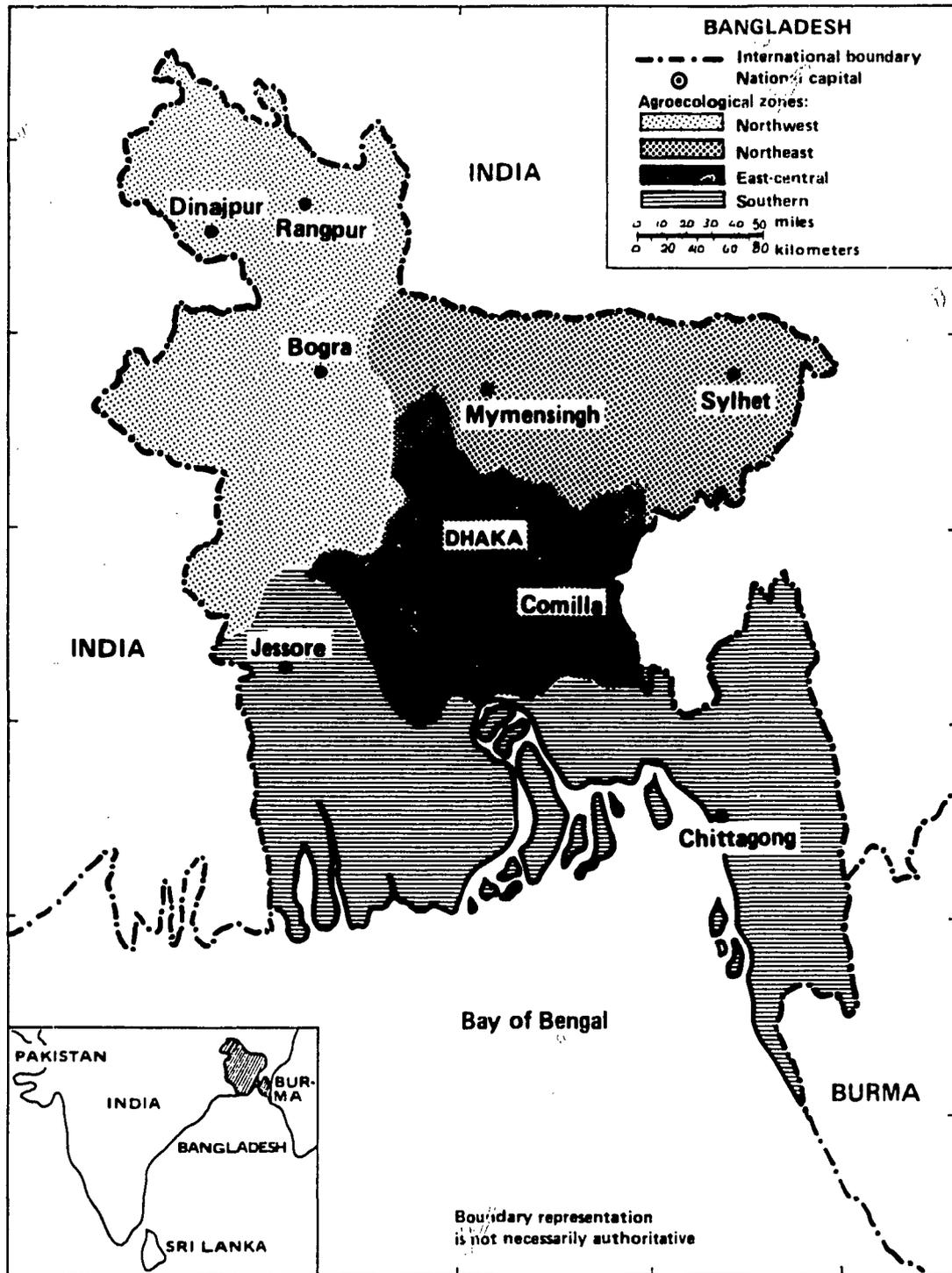
Characteristic	Zone			
	Northwest	Northeast	East Central	Southern
Principal potato districts	Bogra, Dinajpur, Rangpur	Sylhet	Comilla, Dhaka	Chittagong, Khulna
Soils	Clay, silt, sand	Silt, sand	Clay	Sand, clay, saline
Topography	Flat plain rising to low plateau	Hilly	Flat plain	Hilly: mangrove forest
Rainfall (mm/yr) ¹	1,700 - 2,200	up to 3,200	1,900 - 2,400	up to 3,500
Winter temperature ²				
Max.	28 - 40	28 - 37	30 - 40	30 - 35
Min.	1 - 16	5 - 16	5 - 17	9 - 18
Growing season	late September to March	mid-December to March	November to March	mid-December to mid-March
Varieties	Deshi: red-skinned HYV	white-skinned HYV	white-skinned HYV	white-skinned HYV

Source: Ahmed (1982a), Wennergren (1983a); fieldwork for this study.

1 Based on average annual rainfall for selected districts (Wennergren, 1983a:46).

2 Maximum and minimum temperatures (centigrade) based on monthly averages October through for selected districts (Wennergren, 1983a:45).

Map 3.2. Bangladesh: Agro-ecological zones for potatoes.



Source: Elaborated for this study based on Islam and Miah (1981).

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In the southern region, potato cultivation is more problematic. The summer rains end later (mid-December); hence, the growing season is shorter (about 90 days). Temperatures are generally not as cool, raising the risk of severe pest damage. Soils are more alkaline than in other growing areas and therefore less suited to potatoes. Growers also have to be more concerned about an early monsoon. Potatoes that have been dug, but have yet to be transferred from field to farmhouse or market (by mid-March) can be harshly affected by unexpected rainfall.

The northeast region shares common characteristics with each of the three other regions. It has a relatively short growing season (90 days) that begins in mid-December and finishes at the end of March. It has silty/sandy soils, but a hilly topography. Apart from growing seasons and ecological zones, Bangladesh potato production is also characterized by differences between types of producers and their technology.

3.2 **Producers and Their Technology**

The number and size distribution of farms have important implications for the marketing of any crop. A few, large farmers suggest one type of marketing pattern, thousands of small growers another. In Bangladesh, potatoes are frequently said to be produced by "big" farmers. The evidence on this issue is mixed.

In the absence of a national agricultural census, recent pilot surveys have found that the vast majority of potato producers are small, family farmers (Table 3.3). They typically plant less than 0.5 ha of land in potatoes. Production is spread across as many as a dozen tiny plots further reducing the scale of farm operations. However, these same surveys also found that larger growers do plant more land in potatoes. Their yields are frequently higher because— among other reasons— they can afford to employ more chemical fertilizer (Elias et al., 1980:15-17). Larger growers, therefore, harvest a disproportionate share of total production and in one study were found, along with medium growers, to produce more kilos of potatoes than all the small growers combined (Table 3.3). Yet, even in this case, a "large" producer cultivated 4 ha of land on average with 1 ha devoted to potato production." In summary, given the massive number of landless and near landless in rural Bangladesh, growers with 0.5 ha of arable land might be considered "large" relative to many marginal rural households, while still being quite small in an absolute sense. Based on the limited data available, this appears to be the case with potatoes.

Are small producers being pushed out of potato cultivation by, for example, increasing production costs? Both population and economic pressure are forcing marginal rural households out of agriculture. Available evidence also shows that the smallest farms frequently have insufficient land and capital to engage in the cultivation of high cost crops like potatoes (Miah, 1983:18). Nevertheless, these same pressures are simultaneously inducing growers to plant more of their land area in shorter duration, higher yielding, and potentially more lucrative crops such as potatoes. In fact, one farm survey found

Table 3.3. Bangladesh: Small, medium and large potato producers according to different studies.

Farm type	Study			
	1	2	3	4
Small				
Cultivated area (ha)	0.51	<1.00	<1.00	<1.21
Area in potatoes (ha)	0.47	0.25	0.29	0.52
% growers	65	50	n.a.	70
% production	50	26	n.a.	n.a.
Medium				
Cultivated area (ha)	0.51	1.0-2.0	1.0-2.0	>1.21, <2.83
Area in potatoes (ha)	0.91	0.55	0.49	0.84
% all growers	29	30	n.a.	21
% production	37 ¹	35 ¹	n.a.	n.a.
Large				
Cultivated area (ha)	3.79	2.01 and above	2.01 and above	2.83 and above
Area in production (ha)	1.31	0.91	0.91	2.99
% all growers	6	20	n.a.	9
% production	13 ¹	40 ¹	n.a.	n.a.

n.a. = not available.

Source: 1, Elias et al. (1980); 2, Elias and Islam (1982); 3, Elias, Hossain and Mondal (1982); 4, Miah (1983).

1 Total production estimated by multiplying average yield per plot times average area planted in potatoes.

that the evolution of cropping patterns (1978/82) showed an increase in the number of small farmers producing potatoes and in the area they devoted to this crop (op. cit.: 36).¹⁰ Thus, it is not altogether clear whether potato production is becoming more or less concentrated in the hands of larger growers.

The orientation of production is also an important determinant in characterizing producer marketing patterns. Farmers in Bangladesh plant potatoes primarily, albeit not exclusively, as a source of cash income. The importance of potato production in this regard is perhaps best appreciated by considering the potato's position in the cropping cycle.

Although potatoes cover less than 1% of the cultivated area in Bangladesh (Wennergren, 1983a:90), they represent a far more important percentage of cropland planted in the prime potato-growing areas, particularly in the winter months. Thus, for example, a farm survey conducted in Tongibari and Bogra districts found that producers planted potatoes in 25% and 11% of their total cropped area per year and that potato acreage represented 50% and 25% of average cultivated area in the winter months (Elias et al., 1982:9).

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Moreover, in the prime growing areas near Dhaka, the average proportion of land planted in potatoes during the *boro*, or winter, season can reach 75% for even the most marginal of growers (Miah, 1983:27). As a result, growers' incomes from the sale of agricultural crops in the winter season are highly dependent on potatoes. They are therefore extremely vulnerable to fluctuations in prices for inputs or outputs.

Production Technology

Intensive use of certain physical inputs (labor, chemical fertilizer) and the high cost of production are perhaps the most distinguishing characteristics of producer technology for potatoes in Bangladesh.¹¹ The former, in the case of labor, is an especially important attribute in an increasingly labor-abundant, rural economy (Wennergren, 1983b:16). Three further general observations are in order: (1) small farmers tend to use less seed and fertilizer and more labor—especially family labor—and animal manure than larger growers on a per hectare basis; (2) partly for this above-mentioned reason, cash costs per hectare of small farmers tend to be lower than those of larger growers; and (3) regional differences in the use of physical inputs are often more marked than those between different-sized farmers. Hence, both the use of physical inputs and their costs merit closer examination.

Seed Utilization

Recent farm surveys have generated estimates of the quantity of seed potatoes used that vary from 450 kg/ha to 2,300 kg/ha (Table 3.4). This reflects differences in planting techniques (e.g. planting whole tubers versus eyes) as well as spacing between seeds and rows (see Miah, 1983: 54-57) associated with the use of different varieties in different regions.¹²

Table 3.4. Bangladesh: Use of physical inputs by potato producers at different locations.

Input	Location ¹					
	A	B	C	D	E	F
Seed (kg/ha)	1,674	1,994	1,365	461	1,037/1,499	2,304
Labor (days/ha)	452*	273	367	375	326	n.a.
Fertilizer (t/ha)	0.9	0.8	0.3	0.3	0.2	1.2
Manure (t/ha)	4.5	6.9	15.8	6.4	22.1	19.1

n.a. = not available.

Source: 1, Elias et al. (1980); 2-3, Elias and Islam (1982); 4-6, Miah (1983).

1 Locations are as follows: A = Munshiganj (old Dhaka district); B = Tongibari (old Dhaka district); C = Bogra Sadar (old Bogra district); D = Bishnapur (old Mymensingh district); E = Nischintapur (old Rangpur district); F = Tajpur (old Dhaka district).

Seed also accounted for the largest percentage—from 32% to 45%—of total production costs (Table 3.5). However, most farmers utilize their own seed—with the larger farmers relying the least on purchased seed. Nevertheless, purchased seed is common in certain areas, especially Bogra (Elias and Islam, 1982: 22), Mymensingh and Rangpur (Miah, 1983: 46) where cold storage facilities are less common.

Table 3.5. Bangladesh: Distribution (%) of potato production costs per hectare at different locations.

	Location ¹					
	A	B	C	D	E	F
Seed	32.4	40.8	34.8	40.7	44.3	36.2
Labor	20.2	20.7	30.3	18.8	28.0	27.6
Fertilizers and manure	23.4	19.3	15.6	23.6	19.1	28.2
(fertilizer)	(21.1)	(n.a.)	(n.a.)	(n.a.)	(n.a.)	(n.a.)
Bullock and power tiller	13.4	9.4	9.1	10.4	3.9	4.8
(Bullock)	(7.6)	(1.4)	(9.1)	(1.4)	(3.9)	(4.8)
Other	10.4	8.9	9.9	6.4	4.7	3.1
(interest)	(8.1)	(6.8)	(5.6)	(2.1)	(2.1)	(2.2)
Total	100.0	100.0	100.0	100.0	100.0	100.0
Cash cost (Tk/ha)	12,473	13,866	13,528	12,259	13,085	9,542
(Tk/kg)	0.57	0.55	1.02	0.42	1.05	0.38
Total cost (Tk/ha)	18,218	23,097	21,065	21,442	15,934	17,584
(Tk/kg)	0.81	0.92	1.35	0.74	1.28	0.71

n.a. = not available.

Source: 1, Elias et al. (1980); 2-3, Elias and Islam (1982); 4-6, Elias, et al. (1982).

1 See note Table 3.4.

Labor

Farmers utilize between 270 and 450 man days to produce potatoes (Table 3.4). Growers in some areas require less labor because they employ power tillers to facilitate land preparation. In addition, certain cultural practices, like weeding or earthing up, are simply not done.

Family labor constitutes between 20% and 80% of all labor employed in potato production. The more labor-intensive farmers utilize more family labor. Furthermore, some large growers rely almost exclusively on hired labor.

Labor accounts for between 20% and 30% of the total cost of potato production on all farms (Table 3.5). Small farmers reduce their cash costs considerably by relying more on family labor than larger growers.

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Fertilizer and Manure

Estimates of the quantity of chemical fertilizers used per hectare vary considerably. In the case of urea, survey results indicate the doses range from 200 kg/ha to over 1,100 kg/ha (Table 3.4). Growers tend to apply more manure— from 4.5 t/ha to 22.1 t/ha—the less chemical fertilizer that is employed. However, growers in certain areas use large quantities of both inputs.

Fertilizers and manure represent between 15% and 28% of total production costs (Table 3.5). Available information indicates nearly all these costs are attributable to chemical fertilizers.

In summary, seed, labor, fertilizer and manure, and animal or mechanical traction constitute 90% or more of potato production costs (Table 3.5). By way of contrast, according to available studies, pesticides, land rental, and irrigation costs are small or non-existent. Interest charges are also a minor percentage of total costs.

Recent farm surveys have found that total costs of production for potatoes vary considerably from one region to the other, and much more so than total cash costs (Table 3.5). This pattern appears to reflect more the greater use of non-purchased inputs in certain areas (e.g. family labor, growers' seed) than differences in the quantities or prices paid for purchased inputs. Nevertheless, the competitiveness of input markets as affects potato producers in different regions has not been closely examined.

Recent research also shows that **higher total production costs** frequently result in **lower unit production costs** (Table 3.5). In other words, "costlier" production is frequently more than compensated for by higher yields, hence greater efficiency on a cost per unit of output basis. This result suggests in turn that those growers who were willing to assume the additional risk associated with greater investment in potato production were more likely to have lower costs per kg and, assuming that output prices remained the same, earn greater profits.

3.3 Varieties Planted

Three different types of potato varieties are utilized in Bangladesh: "local", high-yielding varieties (HYV) from Holland and HYV from India. The so-called "local" varieties were brought from what was then colonial India and Burma centuries ago and eventually found their way into the region of present day Bangladesh. These varieties have been grown locally for decades, if not centuries; hence their name. No one knows precisely how many different local varieties are grown, but the most prominent ones include: Lalpakri, Sindur Kota, Kumari, Shilbilati, and Hagrai (Table 3.6).

From a post-harvest/marketing point of view, local varieties are important because they store well, are frequently considered better tasting (i.e., less watery) than HYVs and often are sold at higher prices than the more recently introduced varieties.

Table 3.6. Bangladesh: Principal potato varieties and their characteristics.

Name grown	Origin	Vegetative Cycle (days)	Region	Skin color, size, shape	Other Characteristics
Cardinal	Holland	90	Mostly Rajshahi Division	Pinkish red, large, elongated	Highest yielder
Kufrisindhuri	India	95	Ibid.	Red, medium round	High yield; deep eyes
Diamond	Holland	90	Dhaka Division	White, medium large round	Bad keeping quality
Ukama	Holland	85	Dhaka Division	White, large round	High yield
Multa	Holland	90	All over	White, medium round	Medium yield
Patrones	Holland	100	All over	White, glossy medium round	Medium yield with good keeping quality, 150 mds/acre
Lalpakri	Desi	90-100 100	Bogra, Rajshahi Division	Red, small, round	Yellow eyes, 100-130 mds/acre in trial
Sindur Kota	Desi	125	Bogra, Rangpur	Dark red, small elongated	Good yielder, most tasty, 70/80 mds/acre Bogra
Kumari	Desi	n.a.	Rangpur	Reddish brown, small to medium, elongated	70/80 mds/acre Bogra
Silbilati	Desi	100-105	Rajshahi Division	Reddish white skin, small to medium, round	Good yield, mds/acre
Hagrai	n.a.	n.a.	Ibid.	Pinkish, small, round	No yellow eyes, 70/80 mds

n.a. = not available.

Source: Field work for this survey.

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Government marketing personnel calculate that local varieties constituted roughly 38% of area planted and 29% of total potato production in 1984/85 (Maziruddin, 1986:3). According to these same figures, this represents a 12% decline over the five-year period since 1980/81. While the absolute percentages must be considered only "best estimates", the declining importance of these varieties is almost certain because as area planted increases there is no source for additional seed other than the farmers own potatoes.

Beginning in the 1970s, a number of Indian hybrid potato varieties were formally introduced into Bangladesh. These varieties were evaluated first in field trials by BARI scientists and then the most successful were released for multiplication and distribution.

The most prominent Indian HYV presently grown by potato producers in Bangladesh is Kufri Sindhuri. This variety is prized for its high yields (Table 3.6). Nevertheless, official statistics indicate Indian HYVs as a group constitute less than 1% of area planted and production of potatoes in Bangladesh (Maziruddin, 1986).

High-yielding varieties of Dutch origin constitute the most important group of potatoes grown in Bangladesh. These varieties were first introduced in the late 1950s, early 1960s. After successful field trials and on-farm experiments, they were rapidly adopted by growers because of their high yields. They also represented—along with minor quantities of Indian seed—the only improved quality seed available in a country where local seed is highly prone to degeneration due to virus infection. Current official estimates indicate roughly 60% of area planted and 70% of production consist of HYV Holland varieties.

The most important HYV Holland varieties grown in Bangladesh include: Cardinal, Diamond, Ukama, Multa, and Patrones. While these varieties all do well under local soil and climatic conditions, with yields in trial plots commonly exceeding 25 t/ha, they often produce very large tubers not particularly well suited to local culinary practices. Moreover, growers frequently complain about their poor storability (particularly Diamond). Nevertheless, it is often noted that the high yields of the Dutch HYV's more than compensate for their less attractive characteristics such that growers can earn higher returns producing these varieties than any others.

3.4 Farm-level Production Constraints

Seed, credit and extension are the principal farm-level production constraints. The seed constraint, in particular, involves a number of distinct considerations. Bangladeshi growers have been handicapped by the shortage of improved quality seed for years (Dalrymple and Akeley, 1968:42, Miller, 1979:7, Maziruddin, 1982:13). They also have had problems with the timely availability of improved seed (MCC, 1979:15; Hashem, 1979:12) and its high cost (Elias et al., 1980:15). A further concern is the shortage of storage facilities for seed potatoes in certain districts (e.g. Mymensingh). Finally, the seed constraint manifests itself in the need for varieties that meet local requirements. For example, the northwest region needs short-duration, red-skinned varieties; the east central region requires

a longer maturing tuber with white skin (Horton, 1987:197). Marginal growers nation-wide could use varieties that do not require abundant doses of chemical fertilizer in order to be high yielding (Elias et al., 1980:3).

The potato is a relatively capital intensive crop, though the estimates differ about how much more expensive it is to produce versus possible substitutes. Securing production credit at reasonable interest rates has been difficult, particularly for smaller growers (Miller, 1978:10; Elias et al., 1980:17-18). These growers have also had problems in obtaining credit to store their own seed (Maziruddin, 1982:15).

Extension and on-farm research are also important production handicaps. Numerous farm surveys have found growers apply excessive quantities of chemical fertilizer. Elias et al. (1980:26) have called for improved guidelines on fertilizer use both to promote a more effective use of a scarce resource and to help growers lower production costs. Until quite recently little field research has been carried out on the socio-economic aspects of potato production, consumption and marketing. This has led to sharp differences between experiment station versus on-farm results (op. cit.: 3). Better integration of research activities could help improve productivity, lower unit production costs, reduce the financial risks associated with potato production and raise growers' net returns.

In summary, the potential for an increase in marketable surpluses of potatoes appears to exist for several reasons. First, although area under cultivation expanded by nearly 30% since the early 1970s, yields per hectare have improved only modestly. Hence, merely raising output per unit of land area would boost production. Second, the expansion in potato production has been particularly strong in only two districts, Dhaka and Comilla, where improvements in production (irrigation) and post-harvest (cold storage) infrastructure have been greatest. This development suggests that if similar infrastructure were available elsewhere, increases in potato output might become more widespread. Third, potatoes are currently a high-input, high-cost crop. Nevertheless, small farmers are increasingly inclined to plant potatoes because pressure on land and the prospects of high cash returns have a push and a pull effect on grower decisionmaking. Should lower-cost technology become available, then it seems reasonable even more growers would be induced to cultivate potatoes. As the potato harvest is currently concentrated during February and March thereby placing intense seasonal pressure on the marketing system, the prospects for increased potato sales are inevitably linked to questions about consumption (who eats potatoes?) and marketing (how are they sold?).

Notes

- 1 Some observers have raised doubts about the statistics on potato yields (see, e.g. Clay, 1981:21-22).
- 2 Based on regression analysis, Wennergren (1983a) attributes 76% of the increase in potato production 1973-74 versus 1981-82 to the increase in area planted and 24% to yields.

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- 3 This was particularly true from the late 1950s through the early 1970s.
- 4 Such a relationship is hard to prove given the dubious statistics on yields (see Note 1).
- 5 For example, some observers partly attribute the sharp rise in area planted in potatoes in 1974/75 to the severe flood in 1974.
- 6 As of June, 1986, ninety-one of Bangladesh's 156 cold stores were located in (old) Dhaka (64) and Comilla (27) districts (Maziruddin, 1986:18). In the past, these districts also received a disproportionate percentage of all imported seed (Dalrymple and Akeley, 1968:42).
- 7 Some growers simply conduct two harvests from the same mother plant (see Akanda and Khan, n.d.:39). The early-maturing tubers can be sold to capture the high prices prevailing at the beginning of the season; the less mature tubers are then left in the ground to avoid costly re-planting.
- 8 These tubers, in fact, are what remains from the earlier introduction of varieties of the sub-species *andigena* (Horton, 1987: 191).
- 9 By comparison, a large potato producer of Peru would plant from 5 to 100 ha in potatoes (Scott, 1985:64).
- 10 As was pointed out to me during my visit, there are over 60 thousand villages in Bangladesh; hence these findings, based on interviews in only a small number of villages, must be interpreted with caution.
- 11 See Wahid (1964) for results of one of the earliest farm surveys on production costs. See also BADC (1982), Ministry of Agriculture and Forests (1980) and Shamsuzzaman (1981) for more recent results.
- 12 Given these widely divergent seeding rates, calculations of global seed requirements based on the estimated average seed use of 1,100 kg/ha must be considered with caution (Maziruddin, 1982:13). Specifically, nearly all estimates are well above 1,100 kg/ha (see also Elias et al., 1982). This issue deserves closer attention in future research in support of the seed multiplication program.

IV. Potato Consumption

Although knowledge about the evolution of potato consumption in Bangladesh is scarce, a review of the available literature indicates a gradual shift in the utilization of this tuber during the last three to four decades. In the 1940s and 1950s, the potato appears to have been eaten as a minor, winter vegetable. As production increased, cold storage facilities expanded and potatoes became more readily available in the 1960s and early to mid-1970s, it gradually assumed the role of the most important vegetable and an occasional substitute for rice, the staple in Bangladesh. As the annual supply of potatoes continued to expand rapidly in the late 1970s and early 1980s, the potato strengthened its position as a complementary food and became a more regular, albeit partial, substitute for rice in certain months of the year. In this chapter, the current status and historical evolution of potato consumption in Bangladesh are examined in greater detail. The impact of potato consumption on the present and future marketing prospects for this tuber are of particular interest.

4.1 Potatoes in the Bangladeshi Diet

Rice dominates the Bangladeshi diet. Potatoes serve primarily as a complementary vegetable. Rice provides roughly 75% of the calories and 65% of the protein consumed on an average daily basis (Table 4.1). Calories from rice are supplemented primarily by those from wheat-based products, coarse brown sugar, mustard oil, potatoes and sweet potatoes. Bangladeshis do not eat much meat, milk or milk products. Fruit consumption is highly seasonal. According to FAO statistics, potatoes provide about 1% of the calories and protein consumed on an average daily basis. Nevertheless, these data appear to underestimate the important contribution of potatoes to the local diet for the following reasons.

Results of the recent nutrition survey of rural households indicate that potatoes constitute 6% of average daily food intake (Table 4.2).¹ On a gram per capita per day basis, this represents nearly double the FAO estimate 45.2 vs. 23.5 (Ahmad and Hassan, 1983:19; FAO, 1985:21). Furthermore, results of the same nutritional survey found that potato intake had increased by more than 200% since the previous survey in 1975-76 (Ahmad and Hassan: *op. cit.*). This contrasts markedly with the declining consumption of other foods (e.g., rice, sweet potatoes) during the same period. Thus, potatoes are a considerably more important component of the rural diet than for all diets generally and their importance as a complementary vegetable to rice is growing with time.

Average annual statistics of the potato's importance in the diet overlook the seasonal production/consumption patterns for this tuber. Potato consumption is undoubtedly higher

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Table 4.1. Bangladesh: Daily per capita supply of calories and proteins by major food group, 1979-81.

Food group	Daily per capita supply of calories	% of total	Daily per capita supply of proteins (grams)	% of total
Cereals	1,569	85.4	31.2	78.6
(rice) //	(1,402)	(76.3)	(26.3)	(66.2)
(wheat)	(162)	(8.8)	(4.7)	(11.8)
Sugars and honey	64	3.5	0.1	0.3
Oils and fats	51	2.7	—	—
Roots and tubers	37	2.0	0.6	1.5
(potatoes)	(16)	(0.9)	(.4)	1.0
Milk	22	1.2	1.2	3.0
Pulses	21	1.1	1.3	3.3
Fruit	19	1.0	0.2	0.5
Meat and offals	16	0.9	1.6	4.0
Fish and seafood	14	0.8	2.2	5.5
Spices, nuts and oilseeds	14	0.8	0.4	1.0
Vegetables	7	0.4	0.4	1.0
Eggs	3	0.2	0.2	0.5
Total	1,837	100.0	39.7	100.0

Source : FAO (1985).

Table 4.2. Bangladesh : Food intake of the rural population, 1975-76 vs. 1981-82.

Food group	1975 Intake gr/capita/day	% of total	1981-82 Intake gr/capita/day	% of total	(%) change 1975-76 vs. 1981-82
Cereals	523	65	488	64	7
Roots and tubers	52	6	63	8	21
(potatoes)	(17)	(33)	(45)	(6)	(165)
Pulses	28	3	8	1	-71
Vegetables	126	16	120	16	-5
Fruits	21	3	17	2	-19
Meat	4	1	5	1	25
Fish	23	3	23	3	0
Milk and products	17	2	15	2	-12
Fats and oils	3	1	3	1	0
Others	10	1	23	3	130
Total	807	100	765	100	-5

Source : Ahmad and Hassan (1983).

from February to June, during and after the main harvest, than during other months.² Consequently, potatoes assume a more important role in the diet—that of a partial substitute to rice—at this time (Elias and Hossain, 1985:10; Poats, 1986: 45-46).

Apart from being a supplementary source of calories, potatoes also provide an abundant source of ascorbic and amino acids.³ According to the rural nutrition survey, potatoes contribute approximately 15% of Vitamin C intake on an average daily basis (Ahmad and Hassan, 1983:19).⁴ They also furnish important quantities of lysine, an amino acid limiting in rice.⁵

Potatoes also are eaten as a high-priced, luxury vegetable at certain times of the year. In early November, fresh potatoes are extremely scarce as only the early crop in the northwest region is being harvested and sold. Under these circumstances, expensive, new potatoes are often eaten as a high status food by more affluent urban consumers.

Utilization and Cooking

Potatoes are nearly always consumed fresh. Though some village-level processing is done, it currently is of minor relative importance. Nevertheless, this activity appears to have considerable potential (see Shaw, 1982) and merits closer scrutiny.⁶ In addition, bakeries in towns and cities frequently sell potato crisps, or similar snack foods made of processed potatoes but this remains a small-scale activity (Shikder and Rob, 1984:19). Attempts have also been made to utilize potatoes for industrial processing i.e., to produce starch, liquid glucose and dextrose. However, the high price of potatoes in recent years has made such processing uneconomical (Maziruddin, 1986:38).

Boiled potatoes is the most common form of preparation (Poats, 1986:50). Bangladeshis also fry potatoes in various ways but this culinary practice is much less common. Grilling or roasting of potatoes is rare, though not unheard of.

Popular potato dishes include curry, *sana* and *bhaji* (Elias and Hossain, 1985:7-8). In the case of curries, the potatoes are peeled before cooking.⁷ For preparation of *sana*, they are peeled after cooking. Bangladeshis generally do not eat potato skins (Poats, 1986:51).

4.2 Types of Consumers

Potatoes are eaten by various consumers in Bangladesh. In rural areas, different types of producers as well as non-producers eat potatoes. In urban areas, high, middle and low income consumers include potatoes in their diets. The variety of potato consumers has raised questions about the actual level of potato consumption both nationally and by specific types of consumers.

Consumption Levels

Three sets of estimates of national potato consumption in Bangladesh are currently

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available: (1) FAO, Food Balance Sheet statistics (FAO, 1985), (2) the results of national nutrition surveys (Ahmad and Hassan, 1983) and (3) the findings of the recent pilot potato consumption survey (Poats, 1986).

According to FAO, per capita potato consumption increased from 4 kg/yr in 1961-63 to 9 kg/yr in 1982-84 (Table 4.3). This estimate is based on FAO's yearly statistics for national production, foreign trade and domestic utilization of potatoes. These annual

Table 4.3. Bangladesh : Potato production, availability, and per capita apparent consumption, 1961-84.

Year	Total production (000t)	Potato imports ¹ (000t)	Availability (000t)	Seed (000t)	Other use (000t)	Total apparent consumption (000t)	Per capita consumption (kg)
1961	343.4	13.4	356.8	55.8	47.3	253.6	4.7
1962	336.3	19.6	355.9	57.9	51.9	246.1	4.5
1963	362.7	27.7	390.4	55.4	58.5	276.4	5.0
1964	324.1	37.3	361.4	55.4	65.0	240.9	4.2
1965	401.3	52.3	453.6	60.7	87.6	305.3	5.2
1966	493.8	26.5	520.3	70.4	73.0	376.9	6.3
1967	600.5	42.7	643.2	76.1	100.3	466.8	7.6
1968	712.3	42.0	754.3	84.2	111.4	558.7	8.8
1969	799.6	43.0	842.6	85.4	120.3	636.9	9.8
1970	864.7	49.4	914.1	86.6	134.6	692.9	10.4
1971	862.6	28.8	891.4	76.2	113.1	702.0	10.2
1972	752.8	28.8	781.6	79.6	102.2	599.8	8.5
1973	758.7	31.3	790.0	80.1	103.1	606.8	8.4
1974	730.1	26.9	757.0	93.9	95.9	567.2	7.6
1975	880.4	10.0	890.4	95.9	98.0	696.4	9.1
1976	903.0	20.2	922.2	77.4	110.5	734.3	9.3
1977	735.3	10.6	745.9	90.0	81.4	574.5	7.1
1978	913.8	7.1	920.9	96.7	95.3	728.9	8.7
1979	909.3	2.6	911.8	96.5	91.5	723.8	8.4
1980	917.1	3.3	920.4	102.1	92.9	725.4	8.2
1981	998.9	2.8	1,001.7	107.7	101.2	792.9	8.7
1982	1,096.2	1.9	1,098.1	109.1	110.1	878.9	9.4
1983	1,149.3	2.0	1,151.1	110.1	115.5	925.5	9.7
1984	1,166.4	1.4	1,167.8	112.0	116.8	939.0	9.5

Source : Basic Data Unit FAO.

¹ These data do not coincide with FAO foreign trade statistics (see Table 5.1).

estimates show a fairly steady upward trend in consumption. However, these data are estimates of availability, which may not be equal to actual consumption. Furthermore, the estimates themselves are derived from national statistics on production, exports, imports, marketing losses, seed and industrial use. Under or overestimation of any of these data—a common occurrence in the case of potatoes—can alter final consumption estimates considerably (see Poats, 1983).

Sabur (1983:71) and Maziruddin (1986:8) used a similar, food balance sheet approach to estimate per capita potato consumption at 9 kg/yr and 11 kg/yr in 1978-81 and 1985 respectively.⁸ In other words, their data indicate that potato consumption continued to increase from the early to mid-1980s.

Results of the national rural nutrition surveys indicate potato consumption in the countryside rose from 6 kg/yr in 1975-76 to 16 kg/yr in 1981-82 (Ahmad and Hassan, 1983:19).⁹ These estimates are more precise than those derived using the food balance sheet method because they measure actual food intake by a cross-section of rural households. Their limitation is two-fold. They refer only to rural areas; consumption may be higher or lower in urban areas. They refer only to two specific years.

Poats (1986) estimates per capita potato consumption at 44 kg/yr, based on household interviews (n=199) she carried out at five sites in 1982.¹⁰ While Poats questioned household members about potato consumption specifically, her estimate appears too high because over half the households she contacted produced potatoes (Table A.5).

Based on these diverse estimates and their respective methodologies, three observations about the level of potato consumption in Bangladesh appear in order. First, the current level of per capita potato consumption is probably higher than the estimates based on the food balance sheet method would indicate, but lower than those calculated by Poats. Direct observation of food intake as in the rural nutrition survey, suggests a level of per capita consumption of around 15 kg/yr. Second, all indications are that per capita potato consumption is expanding. In rural areas—where roughly 80% of all Bangladeshis reside—this increase was on the order of 200% between 1975-76 and 1981-82 alone. Third, the FAO estimates for total demand for potatoes in Bangladesh have proven to be too low.¹¹ Recurrent observations that potato consumption has reached the saturation point (see, e.g. Miller, 1979) have been inaccurate and therefore misleading.

Consumption Levels by Types of Consumers

Results of the rural nutrition surveys also provide information on changes in the level of potato consumption by different types of consumers (Table 4.4). Between 1975-76 and 1981-82, potato consumption increased by over 100% for non-producers and by nearly 300% for producers. In fact, for every category of consumer the levels of per capita potato consumption reported are 50% or more higher than the FAO estimates for the country as a whole.

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Table 4.4. Bangladesh : Potato consumption by different types of rural consumers, 1975-76 vs. 1981-82.

Type of consumer	Consumption level (kg/cap/yr) ²	
	1975-76	1981-82
Producer	9.2	27.0
Non-producer	5.6	13.3
Low income	n.a.	13.8
Middle income	n.a.	19.8
Upper middle income	n.a.	13.9
High income	n.a.	18.3
Overall average	6.2	16.5

n.a. = not available.

Source : Bangladesh Institute of Nutrition and Food Science, University of Dhaka.

- 1 I greatly appreciate the kindness of the Dr. Kamaladdin Ahmad in providing me with these unpublished statistics.
- 2 Consumption estimates listed here are based on gram/capita/day figures multiplied by 365 and divided by 1,000.

The rural nutrition survey results also indicate sharp increase in potato consumption—19 vs. 13 kg/yr— as rural consumers pass from low to middle income. This finding suggests that for the poorest segments of the rural population the correlation between incomes and potato consumption is strongly positive.

Poats (1986) provides the few published estimates available of potato consumption by both rural and urban consumers (Table 4.5). The results of her anthropological research can be summarized briefly as follows:

— Estimated levels of average annual per capita potato consumption ranged between 23 kg/yr and 63 kg/yr ;

— In rural areas, consumption was higher among small and medium-sized farmers than among larger potato producers;

— Non-potato producers— both farmers and the rural landless— consume considerable quantities of potatoes, as high as 63 kg/yr in Munshiganj; and,

— Urban consumers also eat lots of potatoes— from 23 kg/yr to 51 kg/yr on an average annual basis— particularly lower income consumers in Bogra (48 kg/yr) and Dhaka (51 kg/yr).

Although the levels of potato consumption estimated by Poats must be interpreted with caution due to the small size of her sample and the large percentage of potato producers interviewed, her findings merit two observations.

First, estimated levels of potato consumption Poats reports are higher than the frequently mentioned national average potato consumption of 10 kg/yr-11 kg/yr, for every group of

Table 4.5. Bangladesh.: Potato consumption (kg/cap/yr) by region and by functional group.

Functional group	Region				
	Bogra	Comilla	Dhaka	Munshiganj	Domar
Producer					
Small	57	35	—	58	31 ⁴
Medium	62	48	—	59	42 ⁵
Large	51	27	—	45	58 ⁶
Non-potato producing farmers	25 ¹	29	—	63	—
Urban					
Poor	48		51	—	—
Middle income	51	32.5 ²	40 ³	—	—
Wealthy	43		23	—	—

Source : Poats (1986).

- 1 Rural landless.
- 2 Urban residents.
- 3 Average of upper middle income, lower middle income.
- 4 Local variety producers.
- 5 Local and hybrid variety producers.
- 6 Cold storage users.

consumers, for every region she studied. Poats' findings therefore tend to re-inforce the results of the other, recent research that indicate that potato consumption is higher than commonly believed.

Second, the range in potato consumption levels— as high as 50 kg/yr-60 kg/yr— suggests that, contrary to popular opinion, there is considerable potential to expand intake of potatoes beyond existing levels in the years ahead. Factors that influence potato consumption will now be examined more closely.

4.3 Tastes, Preferences, Prices and Incomes

Tastes and Preferences

From the consumers' perspective, variety and skin color are the most prominent characteristics for potatoes. Tuber size and quality (fresh versus stored) are also important. Tuber uniformity and shape constitute lesser considerations.

Many consumers (and producers), especially in the northwest prefer so-called 'local' or *deshi* varieties to the more recently introduced hybrids. There are several reasons for this. Local varieties are considered to be better tasting. According to some consumers,

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they are less watery and have a more floury consistency than the hybrids. Local varieties are also more suited to inclusion in curries because they commonly consist of small, egg-sized tubers. Finally, local varieties— especially the early potatoes harvested in November— are sometimes preferred because they are not only fresh but also expensive. Hence, they confer a certain status on those households that can prepare and serve such potatoes when most consumers cannot afford them.

Not all consumers prefer local varieties over hybrids. In fact, Poats' (1986:44-45) consumption survey found that most households prefer and eat hybrid varieties (Table 4.6) Non-producers prefer hybrid varieties over local tubers because they frequently are cheaper. Producer/consumers often choose hybrid varieties because they yield more kilos, often in a shorter period of time, than local varieties. In informal interviews carried out for this study, restaurant and hotel personnel often expressed a preference for large tubers— most often associated with hybrid varieties— because they make for easier peeling and preparation.

Table 4.6. Bangladesh : Consumer preferences and eating habits by type of potato.

Location	Type like best (%)			Type eat most (%)			
	Local	Hybrid	No preference	Local	Hybrid	No preference	Other
Bogra	50	44	6	21	63	16	0
Comilla	30	70	0	30	70	0	0
Dhaka	58	37	5	22	73	5	0
Munshiganj	0	100	0	0	100	0	0
Domar	60	27	13	30	17	40	13
Total ¹	40	55	5	20	66	12	2

Source : Poats (1986).

¹ Total percentage is weighted average.

Red-skinned potatoes frequently sell for higher prices than white skinned tubers in Bogra, Rangpur and Dinajpur (old) districts. The opposite holds true for the central and southeast part of the country. Fresh potatoes nearly always sell for more than stored tubers.¹²

Price Elasticities

Price and incomes have an important influence on potato consumption in Bangladesh. However, the precise nature of their impact— particularly incomes— is the subject of considerable debate.

Various studies have estimated the impact of a decline in the real price—the current price deflated by the consumer price index—of potatoes on the retail demand for this commodity. Molla et al. (1974) used panel data from a pilot consumption survey carried out in Mymensingh town in 1973 to estimate a price elasticity of about -1.0 .¹³ In other words, a one percent fall (rise) in the price of potatoes would result in a one percent increase (decrease) in the quantity of potatoes demanded.

Similar results are reported by Sabur (1983:64-68). He calculated his estimate using a model that included food balance sheet type estimates of average annual per capita availability of potatoes for the period 1960-61 to 1981-82, plus retail prices for potatoes and disposable incomes both deflated by the consumer price index.

Pitt (1983) employed results of a national, rural household budget survey carried out in 1973-74 to estimate elasticities for poorer and for richer households. The elasticities he reports were nearly -1.0 for richer households and -1.7 for very poor households. In fact, the own **price elasticities for potatoes were higher than those for any other food commodity** (rice, wheat, pulses, fish, mustard oil, onions, spices and milk). Thus, Pitt's study indicates that a drop in price would result in a significantly greater quantity of potatoes demanded.

Pitt's results also indicate that low-income households, in particular, are especially inclined to want to include potatoes in their diets as the result of a decline in price.¹⁴ While Pitt's work is based on survey data now over 10 years old, the pilot consumption survey carried out by Poats (1986) found a similar tendency to still be in evidence in 1982 (Table 4.7). Poats also found that the high price of potatoes at certain times of the year discourages greater potato consumption by those households who reported that they want to eat more potatoes (op.cit.:32). The weight of the evidence therefore clearly indicates that lower prices for potatoes would increase their consumption.

Income Elasticities

Some Government of Bangladesh officials contend that incomes and potato consumption are negatively correlated (see, e.g., Maziruddin, 1986:9). This claim is hard to interpret for three reasons. First, it raises questions about the magnitude of this correlation for the average consumer. Second, it remains unclear whether such a correlation exists for all consumers or only those with certain income/potato consumption levels. Third, it appears to indicate a certain pessimism about the future prospects for increased potato consumption without being explicit as to the reason(s). In fact, while estimates of the relation between incomes and potato consumption in Bangladesh are few, they invariably are positive and near unity (or higher) thus indicating a positive correlation exists between incomes and potato consumption.

Molla et al. (1974:57) used panel data from a 1973 households survey in the town of Mymensingh to calculate an income elasticity of 0.9. FAO (1983:8-10) used the results

Table 4.7. Bangladesh: Households (%) who want to consume more potatoes by region and by functional group.

Functional group	Region				
	Bogra	Comilla	Dhaka	Munshiganj	Domar
Producer					
Small	8	38	—	25	15 ⁴
Medium	7	17	—	0	45 ⁵
Large	0	100	—	0	0 ⁶
Non-potato producing farmers	60	50	—	0	—
Urban					
Poor	60 ¹		40	—	—
Middle income	30	17 ²	5 ³	—	—
Wealthy	0		40	—	—

Source: Poats (1986).

- 1 Rural landless.
- 2 Urban residents.
- 3 Average of upper middle income, lower middle income.
- 4 Local variety producers.
- 5 Local and hybrid variety producers.
- 6 Cold storage users.

of the 1973/74 household expenditure survey to estimate income elasticities at the national urban and rural level of between 1.2 and 1.6. Pitt (1983) employed data from the 1973/74 rural household budget survey to estimate expenditure elasticities for richer and poorer households to be 1.9 and 1.6. Moreover, **his estimated expenditure elasticities were strikingly higher for potatoes than for any other food commodity except milk.** Sabur (1983:65-67) employed 1976-77 cross-section data on incomes and expenditures to estimate a national (0.9), urban (0.9), and rural (1.0) income elasticity for potatoes.¹⁵ While research based on more recent income and consumption data would be useful, available results indicate:

- a positive correlation exists between incomes and potato consumption;
- both low and high income households would increase potato consumption by a percentage roughly equally to the percentage increase in their incomes; and,
- estimates of income elasticities are highest for rural consumers; as the overwhelming majority of all consumers in Bangladesh reside in the countryside, the prospects for increased potato consumption resulting from increases in real incomes are promising indeed.

4.4 Constraints to Increased Consumption

Seasonal availability, the average household's limited food budget and mistaken beliefs

about nutritional quality are the principal limiting factors to increased potato consumption in Bangladesh.

Potatoes are most widely consumed from February to June, during and after the main potato harvest, when they are seasonally abundant and cheap. Unlike in other developing countries (e.g. Peru, Rwanda), agro-climatic conditions in Bangladesh impede year round potato production and steady consumption of freshly harvested tubers. Furthermore, off-season consumption is discouraged by the shortage of cold storage facilities in certain areas. High cold storage fees and the lack of official, postharvest credit schemes prevent more widespread utilization of existing cold storage capacity, especially by small producers. Poor storability of certain hybrid varieties restricts some grower's ability to increase rustic, on-farm storage for delayed consumption. Limited village-level potato processing also prevents more continuous consumption of potato-based products.

The vast majority of all households in Bangladesh are low-income, subsistence producers or rural landless. These consumers have diets that consist primarily of family food production or wages in kind in the form of food. Hence, those households that produce or are employed to help cultivate potatoes include them in their diets. Higher-income, urban residents—that can afford a diversified diet—regularly consume potatoes. Potato consumption by low-income urban consumers is much more restricted. Thus, more widespread consumption of potatoes is limited by the modest means of production of most farm families, the high cost of production for this crop, and the meager purchasing power of the rural landless and urban poor.

Despite intensive, laudable efforts by public officials, the news media and private development groups, a substantial number of Bangladeshis still consider potatoes a potentially harmful food (see Poats, 1986: 47-49). The reasons frequently given (e.g. they contain too much fat, sugar or carbohydrate) reflect a limited knowledge about potatoes and their nutritional characteristics in relation to those of other foods. As food beliefs play an important role in determining what people eat, these mistaken or distorted opinions about potatoes undoubtedly affect the potential for increased consumption.

In summary, potato consumption has expanded in Bangladesh over the last two decades and this expansion in use has accelerated with time. Results of the most recent rural nutrition survey indicate that potato consumption increased by 200% between 1975-76 and 1981-82. The potato has evolved then from a minor vegetable to become a complement to and an occasional substitute for rice during this period (Ayubur Rahman, 1986:46-52). Several factors have contributed to this trend. Growth in annual potato production and the increase in cold storage capacity have made more potatoes available throughout a more extended period during the year. Furthermore, estimates of price and income elasticities indicate lower prices and higher incomes would contribute to even higher consumption levels for potatoes, especially among low-income households. These developments raise questions about the marketing system and its ability to transfer potatoes from producers to consumers in an effective fashion so that the potential for increased consumption can be fully realized.

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Notes

- 1 Over 80% of all Bangladesh live in the countryside (World Bank, 1987).
- 2 Results of the rural nutrition survey found that when comparing food intake in the Dhaka area during December-January vs. May-June, intake of rice (gr/capita/day) fell by 30% and that of roots and tubers doubled. Precise estimates of seasonal shifts in the importance of potatoes in the diet unfortunately are not available.
- 3 On a per kilo basis, potatoes are not an abundant source of energy, but they supply high-quality protein (Ahmed, 1982b). See Woolfe (1987) for a detailed treatment of these issues.
- 4 This contribution is especially important as rural Bangladeshis presently consume only half the estimated requirements of this important vitamin (Ahmad and Hassan, 1983:29).
- 5 This observation is based on Woolfe (1986) and a knowledge of the Bangladeshi diet generally. Specific estimates of the lysine made available to Bangladeshis by potato consumption are not available.
- 6 Various groups are currently experimenting with low-cost processing technology for potatoes (see Maziruddin, 1986:38).
- 7 Boiling peeled potatoes results in some loss in vitamins and minerals, but by no means is all the protein dissipated in this preparation (see Woolfe, 1987:103-110). Specific estimates on the protein loss for boiling peeled potatoes in Bangladesh are not available.
- 8 This estimate is subject to the same limitations as the FAO figures mentioned briefly above.
- 9 Annual per capita potato consumption (kg) estimates listed here are based on published gram/per capita/day estimates multiplied by 365 days and divided by 1000.
- 10 Elias and Hossain (1985) also present estimates of weekly potato consumption, albeit on kg/household basis.
- 11 805,000t in 1980 and 933,000t in 1985 are the unpublished estimates of total demand for potatoes in Bangladesh prepared by Commodity and Trade Division, FAO, Rome.
- 12 However, this latter type of distinction in price is sometimes blurred by the high price of sprouted seed tubers recently taken from storage versus common, albeit fresh, ware potatoes.
- 13 The authors indicate that this result is only tentative due to the inconsistencies of related results for income and expenditure (see Molla et al., 1974:56).
- 14 Pitt (1983) refers to this as the "participation response". He found that this component represented 82% of the total own-price elasticity for potatoes. In other words, poor households, who do not now consume potatoes, will be greatly inclined to include this tuber in their diets by a fall in price.
- 15 Sabur (1983:64) also used time-series analysis, annual estimates of average national potato consumption, prices and incomes for the period 1961-82 to calculate an income elasticity of 0.6.

V. Potato Marketing

Potatoes are a cash crop in Bangladesh with virtually all tubers being sold in the domestic market. A variety of well-established, although informal marketing channels exist for the distribution and sale of this vegetable. Aside from growers themselves, key participants in potato marketing activities are large-scale wholesaler/commission agents and cold storage operators. Government agencies play only a supportive role. Nevertheless, future marketing prospects for potatoes will depend, albeit not entirely, on government policies directed at overcoming key marketing constraints. A crucial element in the formulation and implementation of such policies is an improved understanding of current marketing patterns.

5.1 Domestic and Foreign Trade Percentage of Production Sold

Official estimates of the annual quantity of potatoes sold nation-wide do not exist. Most observers calculate that well over half of the potatoes produced each year are marketed. Some government officials suggest this figure may be as high as 90% of total output. Nevertheless, given on-farm consumption and use as seed, 75% would seem to be a more reasonable estimate of the percentage of potatoes sold yearly.¹

Both the percentage of total production sold and the quantity of potatoes sold varies by region. Farm surveys conducted over a series of years indicate growers in the prime, potato-producing districts, such as Dhaka and Bogra, tend to sell 80%–90% of all the potatoes that they produce (Elias and Islam, 1982:43; Elias et al., 1982; Elias et al., 1984a:55; Elias et al., 1984b:9). Producers in Noakhali and Comilla districts sell a smaller share of their total harvest, 77% and 71% respectively (Miller, 1979:11). Those in Rangpur (76%) and Dinajpur (62%) also sell a lower percentage of total potato production (Elias et al., 1984b:9).

Farmers in Bogra and Dhaka can market a greater percentage of their potato crop because they tend to have a larger land area planted in potatoes and higher yields than farmers in other areas (see Elias et al., 1984b:8). Growers in Bogra also keep few potatoes for seed (Ibid.:9), no doubt in part because less cold storage capacity exists there than in other districts. Growers in more marginal producing areas (e.g. Noakhali, Dinajpur) have lower yields, fewer potatoes and therefore must keep a greater percentage for on-farm utilization.

Foreign Trade

Foreign trade in potatoes— total imports and exports— has been less than 5,000 t/yr

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since independence (Table 5.1).² Potato imports have been less than 2,500 t since 1979.³ This represents less than 0.5% of total potato availability versus 10%-12% some twenty years ago (Table 4.1). Successful efforts to establish a local seed production and distribution program have been a major contributing factor to the decline in seed imports (Horton, 1987).

Potato exports have been less than 150 t in every year but one since 1974 (Table 5.1). Table potatoes have been shipped primarily to Penang (Malaysia) and Singapore, but also to the Gulf States. Given the rapid increase in potato production and the limited exports to date, various observers have noted the interest on the part of government officials, representatives of the cold storage industry and independent traders in expanding exports as a means of expanding the market for Bangladesh potatoes, increasing receipts of hard currency, and broadening the economy's export base (see, e.g. Maziruddin, 1982:15; Elias et al., 1984b:35). The question therefore emerges: why hasn't Bangladesh exported more potatoes?

Table 5.1. Bangladesh: Volume and value of potato imports and exports, 1970-85.

Year	Imports		Exports	
	Volume (t)	Value (US\$ 000)	Volume (t)	Value (US\$ 000)
1970	1,400 ¹	237	—	—
1971	2,095	362	—	—
1972	2,095 ²	362 ²	—	—
1973	4,444	809	—	—
1974	4,500 ¹	1,100 ²	—	—
1975	4,500 ²	1,100 ²	—	—
1976	—	—	1,032	150
1977	—	—	—	—
1978	—	—	—	—
1979	2,221	1,280	128	13
1980	2,352	1,403	—	—
1981	1,718	964	20	4
1982	1,575	811	—	—
1983	1,500 ¹	820 ²	150	25
1984	8	1	30	6
1985	1,280 ¹	500 ²	—	—

Source: FAO Trade Yearbook.

1 Unofficial estimate.

2 FAO estimate.

While agricultural exports are attractive to policymakers, recent experience has shown that the costs, complications, and competition associated with shipping potatoes to foreign markets are far greater than originally imagined (see Ali, 1982; Maziruddin, 1986:35-38). For example, Bangladesh lacks the necessary temporary cold storage infrastructure in the principal port of Chittagong (Rahman, 1982). Construction of such a facility will take time and money. Bangladeshi shippers have no government representative in markets like Singapore to promote and sell their potatoes. Most importantly, the size of the relevant market is small and rival suppliers represent formidable competition. Potato shipments to the Gulf States— Abu Dhabi, Dubai, Bahrain, Kuwait and Saudi Arabia— are dominated by Lebanon, Egypt and Cyprus (Table A.11-A.14). These countries have greater proximity to the region and also benefit from traditional trading ties with fellow Arab countries. Annual potato imports in Malaysia (45,000 t) and Singapore (35,000 t) are more promising due to lower transportation costs. However, these markets require fresh potatoes (Maziruddin, 1986)— which limits Bangladesh's exports to 2½ months a year— and are currently linked to low-cost producers in China, Taiwan and Indonesia (Scott, 1986a:34-36; Tables A.9-A.10). Consequently, virtually all of Bangladesh's potatoes are sold through domestic marketing channels.

5.2 Marketing Channels, Participants and Procedures

Marketing Channels

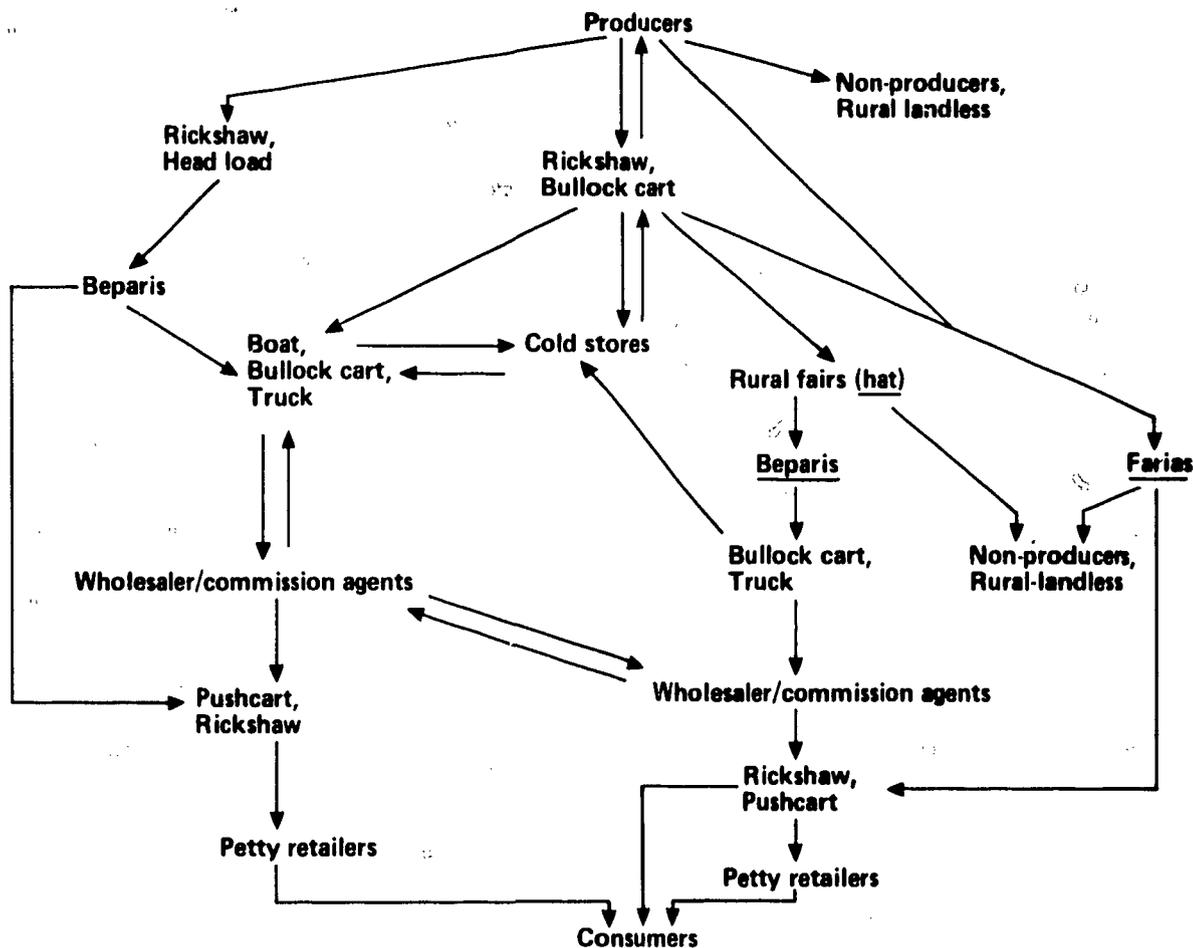
Given the geographic dispersion of the country's producers and consumers as well as the informal organization of the potato trade, Bangladesh's potatoes pass from farmer to final user in a variety of different ways. Nevertheless, for the purpose of analytical review— and at the risk of some oversimplification— three principal types of marketing channels for potatoes can be identified:

- local
- regional, and
- interregional.⁴

Local marketing channels are characterized by the tendency for fewer middlemen to intervene between potato producers and consumers, relative to regional and interregional channels. Exchange itself also tends to be more rapid in part because trading procedures are often simpler in these channels than in others. The quantity of potatoes per transaction is also smaller on average. The means of transport is therefore more likely to be bullock (or push) cart, rickshaw or simple headload.

Local marketing channels include sale (or barter) at the village to local traders or to other producers (non-potato producers).⁵ The potatoes are then utilized in the village itself. Local marketing also encompasses trade between producers and rural assemblers in one village and wholesaler/commission agents or cold storage operators in another, or in a nearby urban area (Figure 5.1). Finally, it involves producers sale:(a) to rural assemblers who in turn supply, local cold storage operators with potatoes, or (b) to storage operators directly, for eventual re-sale to local traders, consumers or producers (in the form of seed).⁶

Figure 5. 1. Bangladesh: Principal marketing channels for potatoes.



Source: Based on Akhter (1973), Elías et al. (1984 b), Maziruddin (1986) and field work for this study.

The bulkiness of the potatoes, its widespread cultivation throughout the country, Bangladesh's poor, rural road network, the seasonal scarcity of other food crops at the time of the main potato harvest and the heavy concentration of the population in rural areas— particularly in the foremost potato producing districts like Comilla and Dhaka— together suggest a major share of all table potatoes that are traded reach the final consumer through local marketing channels. Interviews with potato traders in Togibari, Bogra, Chandina, Rangpur and Dinajpur found that most sell the majority of their potatoes within 2 miles of their place of business (Elias et al., 1984b: 28-29). Furthermore, producers who buy potatoes tend to do so in markets within five miles from home (Elias and Hossain, 1985:5). There are no government statistics for this variable. However, 50%- 60% seems reasonable as an estimated percentage of total potato sales that are sold through local channels.⁷

Regional marketing channels are comprised of an extended chain of intermediaries between producer and consumer. These channels are also distinguishable by the larger quantity of potatoes involved in most transactions as well as the greater utilization of trucks and sailboats (along rivers) for transporting them from place of purchase to place of sale. In regional marketing channels, the lapse of time between starting and finishing a sale is more extended (e.g. due to great shipping time) and commercial procedures themselves frequently are more complicated than in local marketing channels.

Regional marketing channels are exemplified by shipments from the farm-gate, to rural agricultural fairs (*hats*), to urban commission agents, to urban retailers and finally to urban consumers. Regional marketing channels also include shipments from field to riverside, to urban wholesale market, to second wholesale market, to cold store, to itinerant trader, to urban/rural consumer. In essence, regional marketing channels consist of larger shipments, greater distances and more middlemen than in the case of local trading. Nonetheless, they are confined to a radius of about 75 miles from the place of production. About 30% of all table potatoes traded in Bangladesh are sold through regional marketing channels.⁸

Interregional marketing channels are virtually by definition the most lengthy, both in terms of the number of traders involved and the distances over which the potatoes are shipped. Trading in these channels nearly always requires the use of a truck and/or sailboat as a means of moving large lots of potatoes from one location to another. While some participants prefer to travel personally great distances to complete such transactions, others rely on established contacts to conduct this type of potato trading. The latter, of necessity, involves more time to develop and nurture than the former. In addition, each transaction in itself typically requires more time to set-up, undertake and complete than is the case in local or regional marketing channels (e.g. due to the additional transportation required). An added characteristic of interregional marketing channels is that they are most active only at certain periods during the calendar year. At these times, interregional disparities in price are greatest due to differences between local supply/demand conditions (see, e.g. Maziruddin, 1986:31); hence, the prospects for long distance trading are best.

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A prime example of interregional potato marketing channels would be the shipment of early potatoes from northwest Bangladesh to traders in Bogra or Dhaka for re-sale both locally and in other, more distant markets around the country during late November, early December (Map 5.1). Some 10% to 20% of all potatoes sold in Bangladesh move through interregional marketing channels.⁹

Marketing Participants

Several different participants in potato marketing in Bangladesh can be identified:

- Producers;
- Rural assemblers;
- Wholesaler/commission agents;
- Cold storage owners; and,
- Petty retailers.

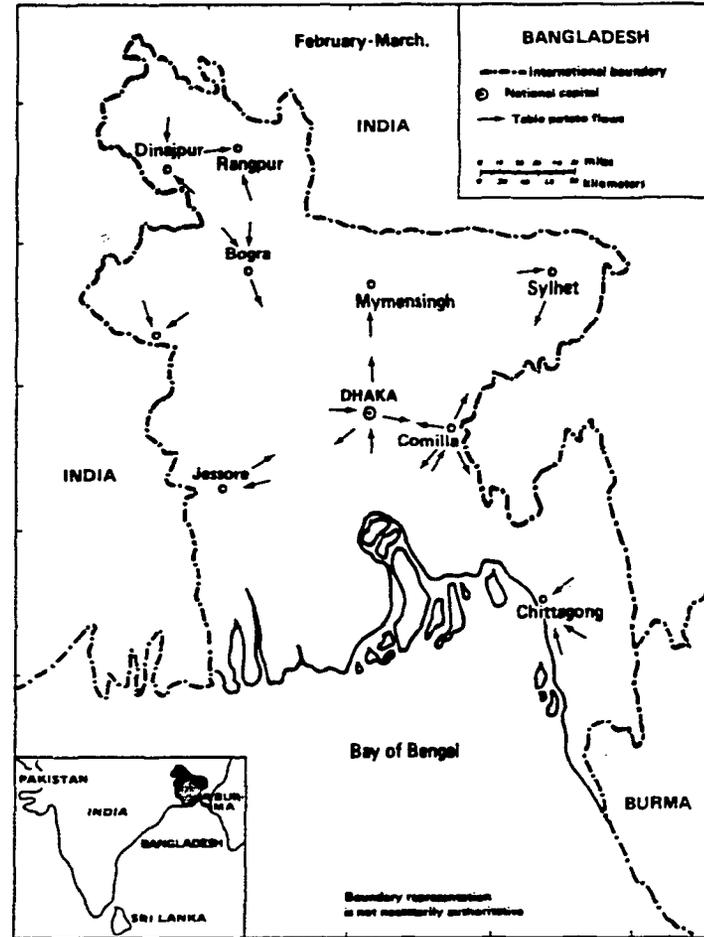
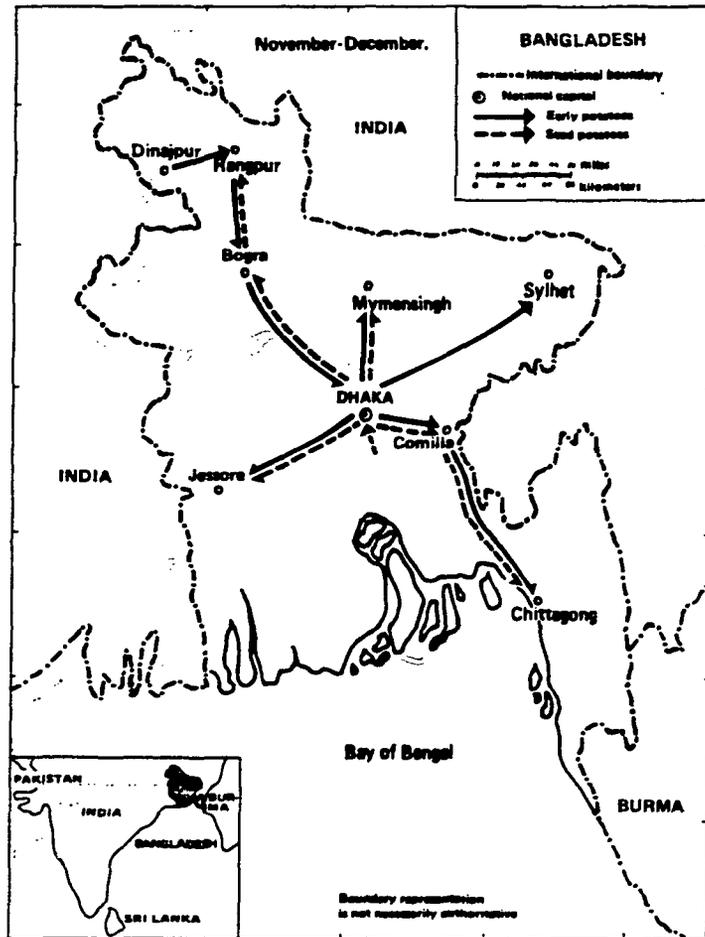
The division of labor between them is not always clear. Nevertheless, their principal activities can be described briefly as follows:

Producers. Nearly all producers sell most of the potatoes they harvest. However, how much they sell, when they sell, where they sell and to whom they sell differs by region and from year to year. Growers around Dhaka on average sell around 90% of all the potatoes that they produce. Their first sales typically occur in February-March during the main potato harvest. But, the distribution of their potatoes sales— at harvest time, after harvest from household stores (April to June), or after harvest but from cold storage facilities (July-November/December)— varies considerably depending on annual supply/demand conditions.

If prices are considered good (1983), then these producers may sell up to 60% of all their potatoes at harvest and store only 15% for later sale (Elias et al., 1984b:9).¹⁰ Alternatively, if prices at harvest time are low (1981), then growers will sell a minor percentage (20%) of their potatoes at the time of digging and store for later sale over 60% of total production (Elias and Islam, 1982:43).¹¹ Similarly, the tendency is for growers in this district to make greater use of cold storage, given the greater availability of these facilities (Table 5.2). Nevertheless, not all potato producers in this district store potatoes, nor do those that do so necessarily keep them in cold stores. For example, only 27% of the Dhaka growers that stored potatoes in 1982, kept them in cold stores versus 73% that kept them at home (Elias and Hossain, 1985:11-12). Nevertheless, the following year 86% of the growers in this same district kept potatoes in cold stores and 34% kept them at home, albeit a larger percentage of all potatoes stored (57%) were stored at home (Elias et al., 1984b:17-18).

Nearly all growers in Dhaka district sell their potatoes at home (or at the farm site). Less than 10% sell their potatoes in the market (Ibid.:16). These sales are typically to a rural assembler (*bepari*) for cash. Some growers— particularly those with greater quantities to move to market— will supply a wholesaler/commission agent (*aratdar*) with

Map 5.1. Bangladesh: Principal potato flows by season.



Source: Elaborated for this study.

Table 5.2. Bangladesh: Cold storage capacity by (old) district, 1966/67, 1980/81 and 1984/85.

District (old)	1966/67		1980/81		1984/85		Growth(%) in capacity		
	Capacity (000t)	Production (%)	Capacity (000t)	Production (%)	Capacity (000t)	Production (%)	1966/67- 1980/81	1980/81- 1984/85	1966/67- 1984/85
Dhaka	8.5	11.0	69.0	24.0	153.2	59.2	712	122	1,702
Comilla	1.7	3.0	15.5	10.7	71.6	30.0	812	362	4,111
Rangpur	—	—	9.5	11.5	24.2	33.2	—	155	—
Khulna	1.1	5.6	12.3	39.5	18.0	41.9	1,018	46	1,536
Bogra	1.6	2.9	4.2	5.3	16.6	19.1	163	295	9,375
Rajshahi	—	—	4.5	7.8	12.9	16.8	—	223	—
Sylhet	1.2	3.4	5.2	7.9	10.2	18.2	333	96	750
Dinajpur	1.0	1.9	3.5	5.5	9.7	12.0	250	177	870
Pabna	—	—	—	—	8.6	35.8	—	—	—
Chittagong	2.5	7.7	6.2	16.3	6.2	18.8	148	0	148
Jessore	1.0	14.1	1.0	7.7	6.0	18.2	—	500	500
Noakhali	—	—	2.0	30.8	4.5	40.9	—	125	—
Kishoreganj	—	—	2.3	8.4	2.8	6.0	—	22	—
Barisal	1.0	8.5	1.0	10.2	1.0	7.7	—	—	—
Kushtia	—	—	1.5	22.7	1.0	9.1	—	-33	—
Bangladesh (total)	19.6	3.3	137.7	14.0	346.5	29.9	603	152	1,678

Source: 1966/67, Dalrymple and Akeley (1968:21); 1980/81, Maziruddin (1982:15); 1984/85 Maziruddin (1986:18).

potatoes, i.e. after the trader sells the potatoes, he deducts his commission and the farmer receives the remainder.

Although growers in Bogra district also sell most of the potatoes they produce, their participation in potato marketing has a number of distinctive characteristics. While Bogra producers sell 90%-95% of all the potatoes harvested, they spread out their sales during the early harvest (November-January), the late harvest (February-March), and partly later in the year. Thus, although Bogra growers sell nearly all their potatoes "at harvest", their sales are not confined to a relatively short period of time as this might suggest. On the contrary, the evidence indicates that these growers avoid just such a situation by extending their harvesting over many months both to reduce the risk of a momentary collapse in prices and to minimize the need for cold storage. For example, in 1982, 37% of all Bogra potato producers interviewed by Elias et al. (1982) harvested their potatoes

in December, 18% harvested in February, 40% in March and the remainder in November and January. Moreover, from year to year, the percentage of potatoes sold "at harvest" versus sold later in the year can also change. In 1981, 90% of potato output was sold at harvest and only 4% sold later in the year (Elias and Islam 1982:43). In 1982, 75% of total potato output by surveyed growers in Bogra was sold at harvest and 16% was sold later in the year (Elias et al., 1982; see also Poats, 1986:40).

In addition to selling fewer potatoes later in the year, Bogra growers are much less likely to sell potatoes from cold storage than those located around Dhaka (Elias et al., 1984:9,18). The feasibility of staggered harvests reduces the need for such a marketing strategy. Furthermore, the shortage of cold storage facilities and the additional costs involved limit its attractiveness (ibid.).

Bogra producers are as equally inclined to sell their potatoes at home or in the market. As these growers spread their harvests over many more months and their yields are lower than producers around Dhaka, they tend to sell smaller quantities per transaction.¹² Such sales are facilitated by forward hauling to rural markets (*hats*) where rural assemblers can purchase numerous small lots simultaneously.

Bogra growers sell their potatoes through a greater variety of middlemen than producers in other regions. According to Elias et al.(1984b:15), nearly half of all the growers they interviewed reported selling their potatoes to more than one type of buyer. Bogra growers in particular are more accustomed to sell to a broker (i.e. a trader who either buys or sells potatoes (or both) on a commission basis) or to utilize a substantial share of total output to pay off a production loan.

The marketing patterns of potato producers in other districts (e.g. Comilla, Dinajpur, Rangpur) have received much less scrutiny.¹³ Farm surveys have found that growers in Comilla (Chandina) and Dinajpur tend to sell a smaller percentage of what they produce (60%-70%) and to use more potatoes for on-farm consumption and seed. In Dinajpur, for example, this reflects the much smaller land area in potatoes and lower yields, that in turn results from a greater preference for *deshi* varieties such as Pakari and Hograi (Ibid.:8,14).

Growers in Comilla also tend to sell a very large percentage of their potatoes to small-scale traders (*faris*). These merchants purchase and sell meager quantities of potatoes within a short period of time.¹⁴ Such a practice is explicable in part by the fact that Comilla producers tend to harvest nearly all their potatoes in a 2-3 week period, average farm size in Comilla is smaller than in any other district (Wennergren, 1983a:59) and there are no centrally located, large rural markets to facilitate rural assembly. Thus, small-scale traders deal directly with the numerous, small-scale potato producers to move potatoes from the field to consumers.

Rural assemblers. Growers frequently sell their potatoes to some type of rural trader

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rather than transport them to town themselves or sell them to local, rural consumers. Most traders perform two, possibly three, essential marketing functions. First, they assemble small lots of potatoes into larger quantities. Second, they transport the potatoes from production areas to consumption centers. Third, they may do grading and bagging (common practice in rural *hats* of northwest Bangladesh). The principal services that these traders provide growers include: (a) eliminating the time and cost associated with transporting small lots of potatoes to larger urban markets; (b) reducing the risk associated with marketing farm produce away from home or nearby market; and, (c) providing cash payment when and where growers want to sell.

Several different types of middlemen are engaged in the rural trade for potatoes. Furthermore, these individuals may assume different roles depending on the particular transaction. Nevertheless, the "pure" types can be identified briefly as follows.

A *bepari* is primarily a rural assembler. He accumulates small lots of potatoes for re-sale (wholesale) to other *beparis*, urban wholesaler/commission agents or cold storage owners. He typically assembles potatoes in the countryside, rather than become involved in trade between two cities. He may work independently by buying the potatoes with his own capital; or, as is commonly the case, he may be employed by some other trader to purchase potatoes on his behalf. Some *beparis* act as a sort of commission agent. They offer to grade, bag, transport and sell the potatoes for a certain fee per maund.

A *bepari* usually operates with minimal infrastructure. He might rent a room, house or small building to collect and dispatch potatoes for several weeks, but he has no large, well-established place of business like a broker, wholesaler, commission agent, or cold store owner. Instead, he is essentially an itinerant merchant.

A *faria* is a small-scale rural assembler. He is to be distinguished from a *bepari* by the smaller quantities of potatoes he handles per season (49t versus 7t, Elias et al., 1984b:22), his practice of buying and then re-selling the potatoes in a short period of time, and his willingness to engage in both wholesale and retail trade. In fact, the extent to which he re-sells the potatoes wholesale, the more he is like a commission agent. The more he retails his potatoes, the more he operates as an independent petty trader. Both types of *farias* are involved in the rural potato trade.

Potato producers themselves are also involved in rural trade. Some growers sell at least part of what they market direct to other farmers, to the rural landless or to consumers in nearby towns. Based on the limited available evidence, however, these sales appear to represent a minor share of all potatoes marketed. Similarly, cold store owners and urban-based wholesaler/commission agents also procure potatoes in the countryside. However, they generally prefer to leave rural assembly to someone else and only acquire potatoes at their established place of business.

Transporters. Movement of potatoes from field to market to consumer is carried out

by numerous means of transport. These include: rickshaws, bullock carts, push carts (in urban areas), trucks, and boats. In addition, potatoes are carried short distances by headload, e.g. from boat to cold store, from truck to market. Headload and boat are the most common form of transport for potatoes around Dhaka and Comilla (Elias et al., 1984b:24) due to the extensive network of rivers and inland canals in these districts. By contrast, bullock carts and rickshaws are more widely employed in Bogra, Rangpur and Dinajpur.

Some truck or boat operators not only handle freight but also engage in buying and selling cargo. Alternatively, *beparis*, cold storage owners, or wholesaler/commission agents may use their own means of transport in addition to contracting the services of independent owner/operators. A precise breakdown of what percentage of transporters are engaged primarily in shipping versus those involved in shipping and buying is not available. Nevertheless, informal interviews and participant observation carried out for this study suggest most transporters specialize in this activity and leaving buying and selling to traders.

Wholesaler/commission agents. Potatoes shipped to towns and cities frequently pass first through the hands of urban wholesaler/commission agents. These traders typically have a godown, or simple unrefrigerated warehouse, e.g. near the central market in Bogra and in Comilla (Akhter, 1973:114) or adjacent the river front in old Dhaka. At this location, they receive and weigh lots of potatoes, store them temporarily in loose form, as well as grade and bag them prior to sale. Distinguishing characteristics of their participation in potato marketing include: the tons of potatoes they regularly handle on a wholesale basis, their sales of both fresh market and stored potatoes, and their specialization in potatoes, and one or two other vegetables.

Depending on supply/demand conditions, these traders will either buy potatoes or receive them on a commission basis. During and for several months after the main harvest, they are commonly supplied by *beparis* and larger growers. Although some wholesaler/commission agents will rent space in a cold store, most appear to prefer to leave this type of risk to someone else. They do, however, supply potatoes to cold store operators interested in buying and storing tubers. They also receive table and seed potatoes kept in cold stores for wholesale marketing. Urban wholesaler/commission agents sell potatoes primarily to urban petty retailers, cold store operators, urban wholesaler/commission agents in other towns, and growers (seed).

Cold store owners. Owner/operators of cold storage facilities are also involved in potato marketing. Currently, 156 of such units are in operation around the country.¹⁵ Of this total, some 144 are privately owned, 5 run by the Bangladesh Agricultural Development Corporation (BADC), 6 by co-operators and 1 by a non-governmental organization (NGO).

The basic service cold store owners provide is space in a refrigerated store, for several months of time, for a set fee. In the wake of the increased competition between cold store owners in certain areas, due to the very rapid growth in capacity from 1981 to

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1985 (Table 5.2), some owners have been forced to lower their storage fees or the terms of payment (e.g. 100% at the time potatoes enter the store). Others have begun to offer one or more of the following additional services:

- Free transport from the field to the cold stores;
- Small cash advances upon depositing the potatoes at the store, with no storage payment until the potatoes are taken out of the store; and,
- Prizes for storing potatoes (e.g. radio, hoe).

Furthermore, in a number of cases, cold store owners have been forced to resort to other strategies (e.g. to buy potatoes) to increase capacity utilization.

Cold store owners usually begin storing (and/or buying) potatoes once the main harvest has reached its peak. In so doing, they avoid stocking pre-maturely harvested potatoes that will rot in storage, buying potatoes before the price has bottomed out or tying up their capital for an unnecessarily extended period of time. In practical terms this normally means that they fill their stores from mid-February to mid-May.

Similarly, cold storage operators try to hold off releasing potatoes on to the market until the price has risen sufficiently to at least make storage profitable. Thus, they usually begin to take potatoes out of storage in the months of July or August, planning to liquidate all stocks by mid-December prior to the beginning of the next harvest.¹⁶

Cold store owners procure potatoes both from traders— principally *beparis* and wholesaler/commission agents— and from producers themselves. No official statistics exist on the quantity of stored potatoes that are owned by traders or producers versus the quantity owned by the cold store owners themselves. Conversely, cold store owners sell potatoes to traders and growers alike. However, their marketing patterns have not been closely studied, hence a precise breakdown of their sales is not available.

Petty retailers. In rural markets, towns and cities, potatoes are also marketed by petty retailers. These traders handle a few hundred kilos of potatoes a week. They typically have the most basic infrastructure, e.g. a small scale for weighing potatoes and some sort of stall or rented space in the marketplace from which to display and sell their potatoes. The most important service that petty retailers provide is that they offer the possibility of buying a few kilos of potatoes selected by the consumer himself and at a convenient location.

Petty retailers procure potatoes from wholesaler/commission agents, (e.g. *farias*). Their sales clients include consumers, eating establishments (such as restaurants, hotels) and farm families that do not produce potatoes. In the off-season, they may also sell potatoes to potato producers who have exhausted their own supplies (Elias and Hossain, 1985:4).

Marketing Procedures

Marketing procedures for potatoes are informal. Potatoes are bought and sold on the

basis of negotiations at a given time and place. No official grades for potato exist, although tubers placed in cold storage are reportedly graded according to generally accepted sizes (Maziruddin, 1986:21). Written contracts or receipts (except for storage) are virtually non-existent. One particularly unusual feature of rural potato marketing in Bangladesh is that producers often sell their potatoes based on what they say is the weight of the tubers. In rural markets traders accept this weight and bargain only on the price to be paid per kilo.¹⁷

In the countryside, rural assemblers will frequently contact growers prior to harvest and attempt to secure a promise that the potatoes will be marketed through them. Growers' bargaining position is partly a function of the quantity of potatoes they offer for sale, their degree of geographic isolation from alternative market outlets and supply/demand conditions. If prices are favorable, growers are reluctant to arrange a sale prior to digging. In field work for this study, it was observed that producers may even wait at the weekly market until late in the day before selling or take the potatoes home again rather than accept a low price. However, if prices are down, then growers feel compelled to sell to whomever is willing to buy their potatoes.¹⁸

Storage fees are normally less negotiable. However, recent developments have engendered a great deal more competition between cold store owners. As a result, there exists a much greater propensity to arrange storage charges on a case by case basis. Still, this also depends on the particular local circumstances.

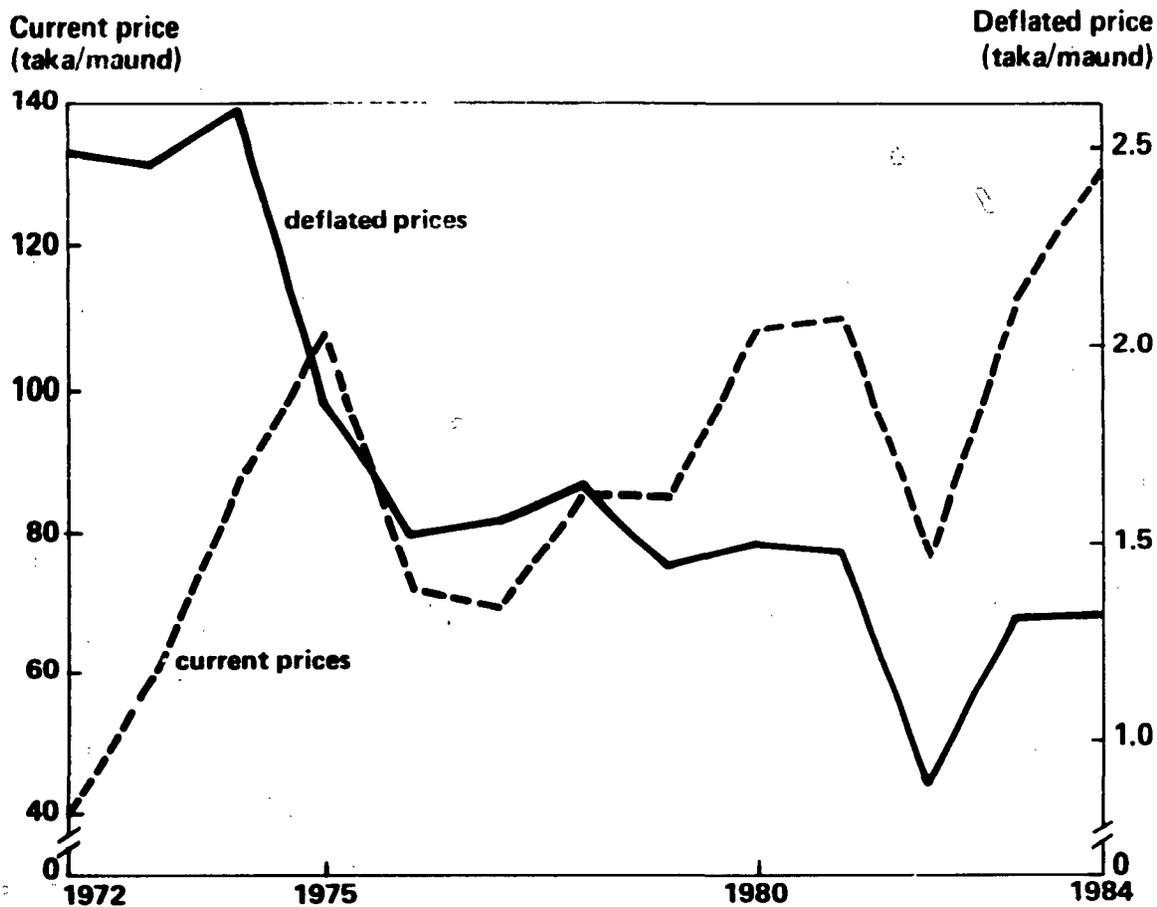
Trading between *beparis*, wholesaler/commission agents and cold store owners has not been closely studied. However, field work for this study indicates that well established familial and business ties often influence actual buying and selling as well as the exchange of information about market conditions and likely future developments. Thus, although entry into potato marketing is unrestricted, competition is often reduced at a given time and place by the close links between the most local prominent middlemen, (see also Wennergren, 1983a:146-147). Trading conditions at the level of *farias* and urban petty retailers is much more atomized and therefore from a market structure perspective, more closely approximates perfect competition.

5.3 Prices and Margins

Prices

Inflation has obscured the public's perception of the movements in potato prices to a considerable extent. Thus, for example, the current monthly wholesale price of potatoes (Holland white) rose from an annual national average of 40 (taka/md) in 1972 to 131 (taka/md) in 1984. These rising prices imply that potatoes became more expensive and— all other things being equal— demand weakened. However, wholesale potato prices deflated by the index of wholesale food prices demonstrated a considerably different tendency (Figure 5.2). Deflated prices fell by nearly 50% between 1972 and 1984.

Figure 5.2. Bangladesh: Average annual wholesale prices (current and deflated) for potatoes, 1972-84.



Source: Table A.6 and A.8.

This downward trend in potato prices is consistent with the steady increase in potato production since 1972 (Table A.1). In other words, as more potatoes became available, the wholesale price declined. Furthermore, this helps explain the rise in potato consumption (Table 4.3). As potatoes became cheaper, demand for potatoes increased.

The decline in monthly wholesale prices from July to December has been equally, if not, more impressive. For example, monthly wholesale prices for November 1972-74 were 3.8 (taka/md) vs. 1.7 (taka/md) in 1982-84 (Table A.8). Thus, **the drop in potato prices was more substantial in the off-season months than in the peak harvesting period.** The sharp upturn in potato production in Bogra and Dinajpur districts between 1975 and 1985 would partly explain this (Table 3.1). As growers in these areas harvest earlier, the increase in potato production in these districts suggests more potatoes were available at this time of the year. In addition, the increase in storage capacity has meant greater availability of potatoes in the off-season generally (Table 5.2).

Seasonal Price Movements

Seasonal price movements for potatoes also were lower in 1982-84 than in 1972-74. The spreading out of harvesting dates, as explained above, and the growth in cold storage capacity both contributed to a lower within-year price variation for potatoes when comparing these two periods (Table A.8). This development further spurred the demand for potatoes by making them less a strictly winter vegetable, but rather one that is available year round.

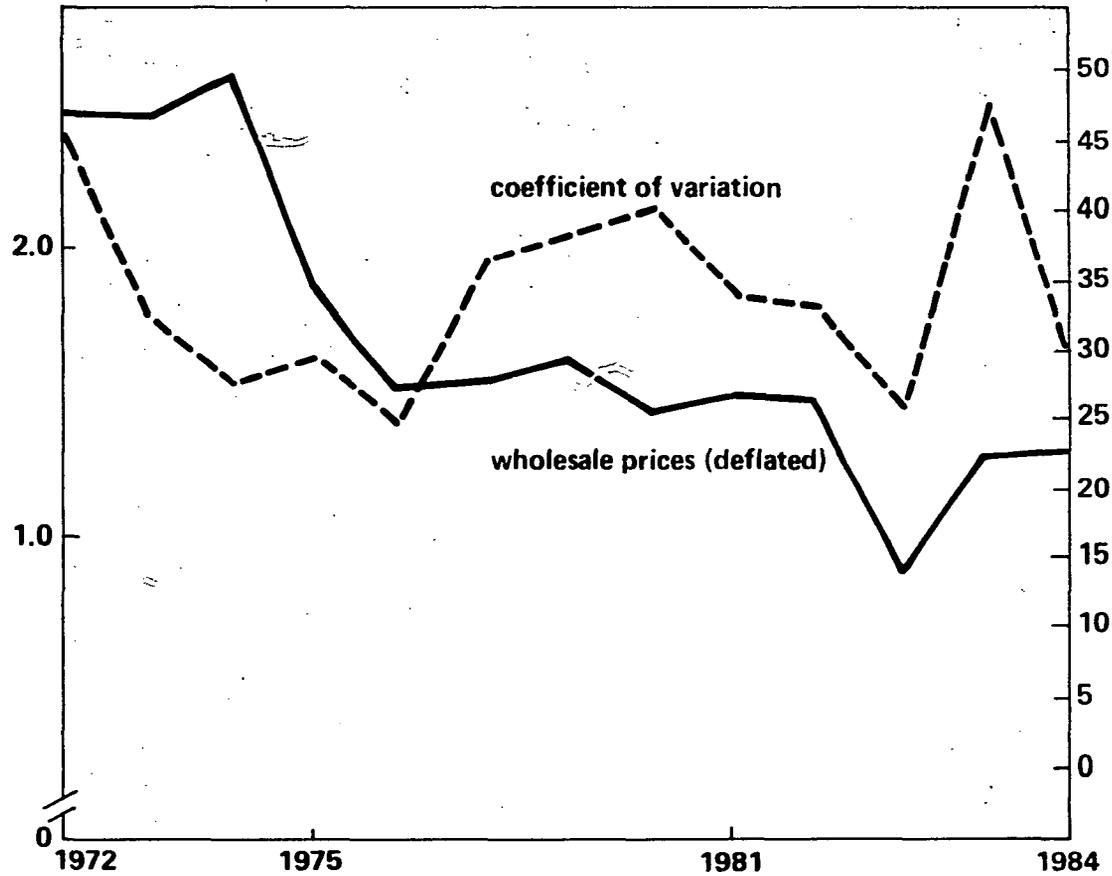
The sharp annual variation in seasonal price movements in recent years (Figure 5.3) merits additional commentary. Between 1981 and 1982, storage capacity increased by 150,000 t, or over 100% (Maziruddin, 1982:14; Shikder and Rob, 1984:10). This surge in capacity no doubt resulted in much greater storage in 1982 as the bumper crop resulted in very low prices at harvest and for several months thereafter (Table A.6). However, when prices failed to rise—in part because of greater availability of potatoes in the off-season—many individuals lost money (Shikder and Rob, 1984:7). These parties were therefore unable or unwilling to store potatoes the following year, resulting in less storage and contributing to an abrupt widening of seasonal price movements (Table A.8).¹⁹ Continued expansion of storage capacity has contributed to a great deal more uncertainty about seasonal price movements (Maziruddin, 1986:16). As a result, potato prices have become vulnerable to erratic movements during the year.

Relative Prices

A related question is whether other food commodities became more or less expensive relative to potatoes during the last decade? A comparison of annual average monthly statistics in Dhaka (1973-83) indicate that the price ratio of rice (medium quality) to potatoes went from 1.7 in 1973 to 2.7 in 1983 (Table 5.3). Hence, rice became 50% more expensive relative to potatoes. Moreover, for the months January to June, this

Figure 5.3. Bangladesh: Average annual wholesale prices for potatoes and within year coefficient of variation (CV), 1972-84.

(taka/maund)



Source: Table A.8.

Table 5.3. Bangladesh: Monthly price ratio for rice (medium quality) vs. potatoes in Dhaka, 1973-83.

Year/Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average
1973	2.19	2.80	1.98	1.82	2.03	1.88	1.41	1.38	1.41	1.48	1.27	1.12	1.73
1974	1.37	1.74	2.21	2.15	2.16	2.06	1.64	1.76	2.07	2.56	2.60	2.36	2.06
1975	3.97	4.43	4.47	3.25	2.22	1.74	1.74	1.48	1.49	1.13	0.79	1.08	2.32
1976	1.64	2.55	2.47	2.31	2.39	1.98	1.64	1.47	1.43	1.56	1.52	1.05	1.83
1977	2.64	3.31	2.99	2.88	2.40	2.62	2.86	1.85	2.12	1.91	1.12	1.06	2.31
1978	1.84	3.04	3.31	2.83	2.87	2.45	1.83	1.39	1.54	1.40	1.13	1.41	2.09
1979	3.12	3.57	3.69	3.94	3.61	3.74	3.35	2.31	2.11	2.04	1.93	1.67	2.92
1980	3.04	4.05	3.37	2.73	2.29	2.21	1.78	1.59	1.56	1.71	1.17	1.14	2.22
1981	2.47	3.41	2.85	2.44	2.48	3.38	2.28	1.51	1.58	1.59	1.05	3.23	2.36
1982	3.07	4.38	4.51	5.48	5.85	5.25	4.61	2.44	2.79	2.83	2.96	2.18	3.86
1983	3.36	4.21	4.78	3.54	2.97	2.47	2.28	2.08	1.96	1.68	1.36	1.16	2.65
Monthly Average	2.61	3.41	3.33	3.03	2.84	2.71	2.31	1.75	1.82	1.81	1.54	1.59	

Source: Economic Indicators of Bangladesh and calculations for this study.

Note: Ratio = (Retail price of rice) / (Retail price of potato).

ratio went from 2.1 to 3.7. In other words, the relatively higher price of rice to potatoes was particularly pronounced in the earlier part of the year during and after the main potato harvest. This result reinforces the findings of Elias and Hossain (1985:10) that the high price of rice has contributed to greater potato consumption.

Potatoes, in fact, became less expensive relative to various food commodities: pulses, rice (coarse quality), wheat products (whole and atta), fish and onions between 1974/75 and 1982/83 (Table 5.4). This represents further evidence that potatoes became a more attractive food item from an economic point of view and that this encouraged greater consumption.

Producer-level Price Comparisons

Relatively less information is available about spatial price differences for potatoes. At the producer level, Elias et al. (1984b:10-11) report differences of up to 75% in the average prices received by farmers in Bogra and Dhaka districts for the same variety of potato during the 1982/83 harvest (e.g. Multa, Patrones). Part of this price variation might be explained by the different time periods when growers sell their potatoes. Producers in Bogra, for example, sell 35%- 40% of their potatoes in late November,

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Table 5.4. Bangladesh: Annual price ratio (taka/seer) for selected food commodities vs. potatoes in Dhaka, 1974-83.

Period	Pulse		Rice		Wheat Products				Fish		Onion		Potatoes
	Masoor	/pot.	(coarse quality)	/pot.	(whole)	(Atta.)	/pot.	/pot.	(Rohu cut pieces)	/pot.	/pot.	/pot.	
1974/75	6.31	2.63	3.71	1.55	2.31	0.96	2.56	1.07	15.98	6.66	2.69	1.12	2.40
1975/76	4.97	2.67	3.42	1.84	1.96	1.05	2.31	1.24	17.31	9.31	2.94	1.58	1.86
1976/77	6.91	3.16	4.03	1.84	2.33	1.06	2.74	1.25	18.60	8.49	1.64	0.75	2.19
1977/78	6.43	2.87	4.37	1.95	2.38	1.06	2.82	1.26	22.12	9.88	5.30	2.37	2.24
1978/79	8.17	3.07	5.93	2.23	3.19	1.20	3.81	1.43	30.64	11.52	5.00	1.88	2.66
1980/81	11.09	3.90	5.12	1.80	3.05	1.07	3.60	1.27	32.50	11.44	4.28	1.51	2.84
1981/82	13.09	4.73	6.15	2.22	3.72	1.34	4.68	1.69	38.08	13.75	10.12	3.65	2.77
1982/83	11.71	4.84	6.99	2.89	4.50	1.86	5.55	2.29	37.71	15.58	6.39	2.64	2.42

Source: Economic Indicators of Bangladesh 1977-83 and calculations made for this study.

Note: /pot. = (Retail price of x) / (Retail price of potato).

early December when prices are generally highest (Table A.6). In addition, Bogra growers are much more likely to sell their potatoes in rural markets, thereby assuming certain additional costs (e.g. transport); these costs are not customarily assumed by Dhaka growers as they generally sell their potatoes at home (*Ibid.*:16). Bogra potato producers also are more inclined to sell their potatoes to a broker *dalal* (*Ibid.*:15). This procedure implies that they do not sell their tubers for cash, but rather on a commission basis. It therefore seems reasonable that if they assume the added risks associated with this type of marketing procedure, then partly for this reason they may well be able to receive higher prices than growers in Dhaka who sell to a *bepari* for cash. Finally, the geographic isolation of producers in Dhaka district, where the rudimentary rural road network is crissed-crossed by rivers and canals, places them in a more vulnerable bargaining position vis-à-vis traders than potato farmers in Bogra. This factor probably also contributes to the lower prices Dhaka farmers receive versus those paid to growers in Bogra.²⁰ To summarize, spatial price differences for potatoes sold at the producer level are attributable to various considerations. Based on available data, however, time, form and selling procedure appear the most important explanatory factors.

Wholesale Prices

A comparison of annual average monthly wholesale prices for potatoes (Holland white) in 20 cities indicates that prices were lowest in Dhaka for every year during 1977-82 (Tables A. 15-20). Dhaka has the greatest concentration of potato production (Table 3.1) and storage capacity (Table 5.2). It also is centrally located in the heart of the country (Map 3.1). All these considerations helped contribute to a relatively abundant supply of

potatoes, hence lower prices year round. Similar factors would help explain the tendency for prices to be low in Bogra (1977-78, 1980 and 1982) and Comilla (1977-79, 1982). It would appear that prices in Comilla were higher and more dispersed during 1980 partly because of the dip in production (Table A.2) resulting from the sharp cut back in area planted (Table A.3).

Low prices in Chittagong from 1979 to 1982 (Table A.17-20) are somewhat more paradoxical. As local production declined slightly during these years (Table A.2), one might have expected higher prices due to the apparent decline in supply. Nevertheless, in nearby Comilla the 120,000t increase in potato output between 1979/80 and 1982/83 (Table A.2) and the surge in storage capacity (Table 5.2) probably made more potatoes available for shipment to the Chittagong market. In fact, traders in Comilla district interviewed for this study indicated that Chittagong was a frequent shipping point for them. Elias et al. (1984b:32) observed a similar practice on the part of Comilla (Chandina) traders. Thus, lower prices probably resulted from the growing availability of potatoes transferred to Chittagong from neighboring production centers with expanding market surpluses.

Wholesale prices tended to be highest from 1977-82 in Pabna, Patuakhali, Rajshahi, Rangamati and Sylhet. These cities are in areas that either produce relatively few potatoes locally (Pabna) or are geographically isolated from the rest of the country (Rajshahi, Sylhet), or both (Patuakhali, Rangamati).

Wholesale Price Correlations

Correlation matrices for average monthly wholesale prices for potatoes in selected cities during 1982 suggest a very high degree of market integration (Table A.21).²¹ Based on the available statistics, monthly prices in these markets tended to evolve in quite similar fashion throughout this time period. Nevertheless, much as a comparison of producer-level prices probably overestimates the real differences in prices received by growers, these data no doubt exaggerate the similarities in wholesale prices in major urban markets for several reasons.

First, these prices fail to take account of the relevant prices for comparison between certain markets. For example, prices for red-skinned potatoes or local varieties are a more realistic measure of supply/demand conditions for potatoes in Bogra than those for white-skinned varieties. Monthly price data for 1985 indicate that price differences between Bogra and Dhaka were considerably greater for red-skinned and local varieties than for white-skinned tubers (Maziruddin, 1986:31).

Second, interviews with Agricultural Marketing Department (AMD) personnel in several cities found that there are considerable differences in average prices they record for fresh versus stored potatoes, for 'best quality' versus lower grade tubers, for red-skinned versus white-skinned indigenous (Ahmad and Kader, 1981). These differences are obscured in

the published average monthly prices. This also dampens the magnitude of the difference in prices between markets.

Third, average monthly price comparisons give no indication of how fast prices adjust **within** a given month. This type of additional information would provide a more profound appreciation of the nature of inter-city wholesale price movements for potatoes.

Fourth, these data give no indication of the volume of potatoes traded that these prices reflect. Thus, wholesale prices for 'Holland white' potatoes may be quite similar in two locations, but with little commonality in terms of other trading characteristics, e.g. potatoes bought and sold, numbers of traders, movement of potatoes between sites. Furthermore, the greatest volume of potatoes that are traded, are sold and consumed in the countryside. Thus, a more meaningful indicator of price movements would be wholesale prices in major rural markets.²² Researchers might consider exploring this type of price comparison, albeit between rural markets, in greater detail in the future.

Margins

It is often argued that growers receive only a minor share of the final retail price for potatoes. Empirical evidence to support (or to refute) this hypothesis is scarce. One estimate of marketing margins for potatoes can be derived by comparing annual average producer, wholesale and retail prices. According to these data, growers in (old) Dhaka district received between 60% and 70% of the retail price during 1981-85 (Table 5.5).²³ The estimates are especially detailed for 1981-1982/83. For these years, they are based on grower returns per hectare as recorded in farm surveys. Wholesale prices are average prices for February-March only for 'Holland white' potatoes (the varieties grown by Dhaka growers) and retail prices for February-March.

Estimates of the producer's share of the final retail price prepared by AMD personnel indicate growers received 60%-70% of the price paid by consumers in Dhaka in 1983 and 1985 (Table 5.5). These various results strongly suggest that growers receive a higher share of the retail price than is commonly believed.

What accounts for the difference between the price growers's receive and the retail price? Shikder and Rob (1984:15) estimate that in 1983 the producer received 69% of the retail price for fresh potatoes. The remainder went to cover handling and transport costs (11%), retailers margin (8%), *araddar's* commission (6%), *bepari's* margin (2%) and miscellaneous costs, i.e. IWTA charge, weighing charge and physical losses (5%). Maziruddin (1986:32) reports a similar percentage breakdown for 1985. Moreover, the share of the retail price that each marketing participant received for the sale of stored potatoes was roughly identical, but with one important exception. The costs of cold storage—deducted from the price received by potato producers—meant that the net share of the retail price obtained by growers fell by about 50%. These findings merit several observations.

Table 5.5. Bangladesh : Prices (taka/kg) and marketing margins for potatoes sold in Dhaka according to different studies, 1981-85.

	1981	1982	1982-83	1983	1985
Producer price	1.27 ¹	1.07 ¹	1.09 ¹	1.29 ³	1.33 ²
margin	67%	57%	58%	69%	60%
Wholesale price	1.43 ³	1.36 ³	1.45 ⁴	1.55 ⁴	1.73 ⁴
margin	8%	15%	19%	14%	18%
Retail price	1.90 ⁵	1.88 ⁵	1.87 ⁵	1.86 ⁶	2.20 ⁶
margin	25%	28%	22%	17%	21%

Source : Producer prices, 1981 (Elias and Islam, 1982:36), 1982 (Elias et al., 1982), 1982-83 (Elias et al., 1984a:49), 1983 (Shidker and Rob, 1984), 1985 (Maziruddin, 1986); wholesale prices, 1981, 1982, 1982-83, 1983 (Shidker and Rob, 1984), 1985 (Maziruddin, 1986); retail prices, 1981, 1982, 1982-83 (Economic Indicators of Bangladesh), 1983 (Shidker and Rob, 1984), 1985 (Maziruddin, 1986).

- 1 Gross return per hectare divided by yield per hectare for growers in Tongibari.
- 2 Growers in Dhaka district.
- 3 Average wholesale price for potatoes (Holland white) sold during February-March.
- 4 Average wholesale prices for potatoes (Holland white) sold during January-June.
- 5 Average retail price for potatoes sold during February-March.
- 6 Average retail price for potatoes sold during January-June.

First, the largest portion of the overall marketing margin consists of handling and transport costs. This is due to the highly labor-intensive nature of this activity. It also results from the local topography, namely that villages are cut-off from towns and highways by various rivers and inland canals. Shipment by road is therefore impractical.

Second, amongst traders themselves, the highest margin per maund goes to petty retailers. This would appear to reflect their small volumes handled, their basic technology and the risks associated with being involved in this type of trade. Similar large, retail margins for urban petty retailers involved in potatoes marketing prevail in other developing countries (see Scott, 1983:51-53, 1985:104-105 and 1986a:32-34).

Third, retailer and *bepari* margins are referred to by AMD personnel as 'profit margins'. This phrase is misleading because it suggests that these traders have no other costs than physical losses or those that they pay for directly (e.g. transport, weighing, taxes). Everything else is pure profit. These margins are perhaps better understood as gross profit margins for they fail to take account of costs such as operating capital, the traders' own labor or that of his family, or the tax on trading imposed by local market authorities.²⁴

Fourth, these costs and margins refer only to Dhaka. While they might be representative

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for shipments sent to the capital, they may not accurately reflect the marketing margins for potatoes sold and consumed in the countryside. In particular, given the large number of traders competing in Dhaka and the large quantities of potatoes sold there, marketing margins might well be lower at this location than in other areas. As most potatoes are traded in local marketing channels, it would be extremely useful to get estimates of marketing margins for rural trade as well.

Fifth, estimates provided for 1983 and 1985 indicate that there was virtually no difference in the net price received by growers who sold their potatoes fresh versus those who sold their potatoes from the cold store (Shikder and Rob, 1984:16; Maziruddin, 1986:33).²⁵ In other words, the entire increase in price after harvest went to cover storage charges. This phenomenon is a very specific example of the risks associated with cold storage and might also help explain why cold store owners have been forced to offer growers incentives to store their potatoes or to buy potatoes themselves to fill their cold stores.

5.4 Government Programs and Policies

Direct government intervention in potato marketing is minimal. Although the Government of Bangladesh (GOB) has provided producer floor prices for rice and wheat (Wennergren, 1983a:149-150), no such floor prices have existed for potatoes, nor has the government subsidized the consumption of potatoes as it has the consumption of rice and wheat.²⁶ In 1986, however, a pilot project was prepared to distribute 600t of potatoes through the Food for Works Program (Maziruddin, 1986:39).

Buying and selling of potatoes is almost entirely in the hands of producers, private traders and a small number of agricultural co-operatives. Local authorities collect market taxes or weighing charges. Government agencies also collect a small fee on freight shipped by inland waterway.

The Agricultural Marketing Department records and distributes information on potato prices, cold store capacity and fees, export prospects as well as domestic supply/demand conditions. These data are published in an annual potato situation report.

Government officials have been active in trying to promote potato consumption through newspaper articles, books and publications, displays in agricultural fairs and generating additional interest on the part of the regular public media. In recent years, efforts have also been intensified to promote the sale of potatoes in foreign markets. In addition, research has been carried out on how to process potatoes at the Institute of Food Technology, Bangladesh Council for Scientific and Industrial Research. Similar processing work has been done at the local level by researchers attached to the Bangladesh Agricultural University, Mymensingh and by private donor organizations.

Financing the construction of cold storage facilities has been the area of greatest involvement in potato marketing by government agencies. The Department of Industries

has provided the licenses to import equipment and materials for cold stores. This Department also grants concessionary rates on import duties as well as tax holidays.²⁷ In addition, financing is available through government banks. For example, the government owned Bangladesh Krishi Bank alone lent 407 million taka for the construction and equipment of cold storage facilities (see also Rahman, 1982:46).²⁸ Bank officials interviewed for this study acknowledged that the co-ordination between the different lending institutions and the Department of Industries has not been good. As a result, the individual banks were not aware of the total number of cold stores that were being planned, nor their intended location. This partly accounts for the very rapid increase in cold storage capacity between 1981 and 1985, the heavy concentration of such facilities in certain areas, and the subsequent crisis over utilization, storage fees, returns to storage and the inability of lenders to meet their loan obligations.

5.5 Constraints to Improved Marketing

Principal constraints to improved potato marketing include: the scarcity of high-yielding tropicalized varieties that store well under rustic conditions throughout the year, the rudimentary rural road network, the lack of cold stores in certain areas, the shortage of post-harvest credit (other than to build and equip a large cold store), weak post-harvest extension, and the limited distribution of market information.

Growers' capacity to alter the timing of their potato sales is largely influenced by: (a) their planting and harvesting dates and (b) their ability to store potatoes inexpensively after harvest. Without varieties that are more adapted to tropical growing conditions, the growing season for potatoes remains restricted to the traditional winter months. Consequently, growers entry into the potato market is similarly confined to certain time periods. Without high yielding varieties that store well in rustic conditions beyond the month of May, growers must sell their potatoes in a relatively short period or pay for cold storage. These factors limit their marketing options.

The bulk of the potatoes bought and sold in Bangladesh are traded in the countryside. Rural transportation is therefore a key ingredient in determining market access for growers and traders. Although potato marketing is most intense in the dry, winter months when roads are more passable, many market participants are handicapped by their geographic isolation resulting from dry inland canals or the shortage of timely transportation (Elias et al., 1984b:25).

While cold storage capacity expanded by 200,000t between 1981 and 1985, many potato producing districts remain without such facilities.²⁹ Furthermore, cold stores may be in operation in a given district, but still be located far from the emerging potato production centers. For example, growers located south of Chittagong near Dorhazari are at a considerable distance from the nearest cold store.

Government credit programs are almost exclusively for potato production. Small producers

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who would like to store at least some of their potatoes are prevented from doing so by their cash requirements at harvest, the high cost (for them) of storage and the meager amount of credit available to finance post-harvest activities.

Extension service personnel tend to concentrate almost exclusively on production related producer activities with some additional, albeit limited, attention devoted to storage. Field days for peasant producers that focus on buying and selling practices or the provision of technical information about simple potato processing are much less common.

Agricultural Marketing Department personnel stationed in district capitals regularly record and forward to Dhaka information about wholesale potato prices. Headquarters staff also collect a number of other data on production, consumption and marketing. Much of this information is extremely useful, but its circulation tends to be restricted to a fairly reduced number of individuals and institutions. For example, little information about potato prices in rival markets is available to farmers who attend rural *hats*.

In summary, the last 15 years have witnessed a remarkable expansion in the quantity of potatoes marketed in Bangladesh. Most of these potatoes have been sold in local marketing channels for rural consumption. However, the decline in real prices for potatoes as well as an increase in the relative price of rice and other commodities versus potatoes—especially in the winter and spring months—have spurred increased sales of potatoes in urban areas. The near tripling of cold storage capacity of 350,000t since 1981 contributed to a contraction in seasonal price movements thereby further encouraging potato sales. While the available evidence is limited, current information indicates growers' received between 60% and 70% of the price paid by consumers from 1981-85, a much higher percentage than commonly believed. These various trends suggest that the market for potatoes in Bangladesh is broadening. Given rapid population growth and favorable prospects for declining potato prices the market appears headed for additional expansion. A key element in this scenario is the set of policy decisions that have to be made in support of potato development.

Notes

- 1 These percentage differences equal 200,000t in absolute terms, i.e. a substantial amount of potatoes. Given the quantities involved and their potential impact on supply/demand conditions, this issue perhaps merits more systematic examination in the future.
- 2 The sources differ by several thousand tons on the quantities of seed potatoes imported, especially in more recent years (see Dalrymple and Akeley, 1968:40-43; Balarman, 1980: Annex IV; Maziruddin, 1982:13; Beukema, 1983:2; and Beukema, 1986:2).
- 3 Most of these potatoes are certified or foundation seed shipped by boat from Holland (Ahmed, 1982a:46; Van Ham and Luitjens, 1982b:4). Although the estimated value of these tubers is about US\$ 800,000 annually (Table 5.1), this is somewhat misleading. Their purchase has actually been made possible through Dutch commodity aid, i.e. they represent aid in kind rather than in cash (Scott, 1983:71).

- 4 Potato exports are minimal as indicated in Section 5.1; hence, they do not merit special consideration.
- 5 According to recent farm surveys, gifts or payments of potatoes to workers are insignificant (see Elias et al., 1984b:9; Elias and Hossain, 1985:6).
- 6 Elias et al. (1984b:9) report that Bogra growers they interviewed in 1983 used 30% of the harvest for loan repayment.
- 7 It should be emphasized that this is only the author's rough estimate based on the above-mentioned reasoning. A more definitive calculation of this percentage must await the results of future research.
- 8 See footnote 7 above.
- 9 See footnote 7 above.
- 10 A similar pattern was observed in 1980 (see Elias et al., 1980:29).
- 11 As knowledge of the share of total potato production produced by different sized farms is limited (see Chapter 3), precise information about the quantities of potatoes released on to the market by size of farm remains unavailable. The percentages cited above are averages per producer.
- 12 This observation is consistent with the finding that they transport nearly all their potatoes to market by either headload or rickshaw (Elias et al., 1984b:17).
- 13 See also Akhter (1973), Miah (1983:76-78), and Poats (1986:40-41).
- 14 In 1982, Elias et al. (1982) found 80% percent of all the Comilla (Chandina) growers they interviewed harvested their potatoes the last week of February or first week of March.
- 15 As of June 1986; as of January 1987, the number of cold stores reached 164.
- 16 Potatoes were released from storage beginning in June in 1985 due to uncertainty about price trends (Maziruddin, 1986:16).
- 17 In Dohazari market (near Chittagong), producers weigh their potatoes utilizing the public scales before selling. In most farmers' markets visited by the author, the farmers merely stated the weight of their potatoes.
- 18 Larger growers in close proximity to urban markets often prefer commission sales regardless of market conditions (Maziruddin, 1986:11).
- 19 Preliminary indications are that a similar contraction, expansion in seasonal price movements occurred in 1985 in relation to 1986. Thus, seasonal movements have tended to be smaller and more unstable than suggested by Wustman et al. (1985:18).
- 20 Elias et al. (1984b:9) do not indicate whether potatoes offered as loan payment— 30% of production for the Bogra growers they interviewed— were included in the calculations for determining the prices farmers received. This obscures somewhat the exact nature of their bargaining position.
- 21 Similar results were found for years 1977-81. However, market integration in itself says nothing about whether this is attributable to collusion or competition.
- 22 According to Wennergren (1983a:146), there are an estimated 6,500 primary markets and an additional 2,000 village markets in Bangladesh.
- 23 By way of comparison, growers in North Kivu, Zaire, receive less than 10% of the final retail price for potatoes sold in Kinshasa some 2,000 km away (Scott, 1986b:147).
- 24 See Scott (1985:85-106) for a discussion of these issues in the case of Lima, Peru.

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- 25 The extremely high assembler's (*bepari*) profit margin listed by Shikder and Rob (1984) seems unreasonable, particularly in light of Maziruddin's (1986) more modest figure. Therefore, it has not been considered as a possible explanatory factor for the low net price received by growers for stored potatoes.
- 26 In 1982, the subsidy to food grain consumption amounted to Tk.1.97 billion (Wennergren, 1983a:156).
- 27 In 1984, the concessionary import duty was 15% for developed areas and 2.5% for underdeveloped; tax holidays were 5 years for developed areas and 9 years for underdeveloped. 'Developed' refers to construction in municipal areas, such as Dhaka, Chittagong; 'underdeveloped' refers to rural areas such as Munshiganj.
- 28 Approximately US\$ 16 million.
- 29 In 1986, there were no cold stores in the (old) districts of Mymensingh, Jamalpur, Tangail, Faridpur, Patuakhali and Chittagong Hill Tracts (Maziruddin, 1986:18).

VI. Summary and Policy Recommendations

An assessment of the future marketing prospects for Bangladesh's potatoes involves consideration of the following contributing factors: (1) the current state of the overall economy: food supplies, employment and international trade patterns, (2) the evolution of potato production, types of producers and the constraints to increased output, (3) the role of the potato in the diet, types of consumers and consumption constraints and (4) present marketing patterns, government institutions and policies. Results of this study will now be briefly reviewed in each of these areas. Interested readers are urged to consult the relevant chapters for a more detailed treatment of specific issues and findings.

6.1 Summary of the Principal Findings

Macro-economic Setting

Bangladesh is among the world's youngest, poorest and most densely populated countries. Having achieved independence less than two decades ago after a bloody and costly war of liberation, Bangladesh has a Gross National Product (GNP) per capita of about US\$ 130. The agricultural sector employs some 90% of the labor force, accounts for about half of Gross Domestic Product (GDP) and the bulk of merchandise exports. Population is currently computed at over 95 million— in a land area of 144 thousand sq. km— resulting in a population density of over 9 persons per cultivated hectare. Furthermore, although roughly 80% of the nation lives in the countryside, available estimates indicate nearly 50% percent of all rural households are landless. Thus, in light of projected population growth rates, provision of adequate food supplies and productive employment opportunities for rural areas are issues of overriding importance.

Under such circumstances, renewed interest has developed in the potential of the potato to help raise producer incomes, promote rural employment, ameliorate nutrition levels and improve the balance of foreign trade. Given the strong commercial orientation of potato producers and their growing specialization in this crop— as a source of cash— in the winter season, marketing issues such as returns to potato production, availability and cost of storage, access to expanding markets have emerged as questions of major importance.

Potato Production

Potato production increased from about 800,000t in 1973 to over 1.1 million tons in 1985. Area planted expanded by 20 thousand hectares during the last decade to about 110

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thousand hectares. Yields remained nearly constant. Principal contributing factors to the growth in potato production include the availability of imported, high-yielding varieties, the growth in cold storage capacity, and an effective seed multiplication program. In addition, growing numbers of low-income consumers generated increasing demand for a cheap complement—and occasional substitute—to rice.

Dhaka (22%) and Comilla (21%) districts now produce about half the country's potatoes.

In Bangladesh, potatoes are frequently said to be produced by "big farmers". The evidence on this issue is mixed. The vast majority of producers who do cultivate potatoes plant less than 1 ha of land in this crop on an average annual basis. Still, growers with more than 1 ha planted in potatoes tend to have higher yields. Hence, they produce and market a disproportionate percentage of all the potatoes sold.

Although potatoes are grown in all of Bangladesh's 23 districts, regional differences in altitude, rainfall (both the timing and the amount), soils and production infrastructure have led to diverse production patterns throughout the country. Growers in the northwestern districts plant earlier (roughly one in five plant both an early and late crop) and are more likely to use red-skinned hybrids and so-called "traditional" varieties than white-skinned hybrids. They also use more animal manure and less chemical fertilizer, rely more on irrigation and more widely employ draft animals—rather than power tillers—than producers in the central part of the country.

High production costs—especially for seed—and the scarcity of good quality planting material are key technological constraints nation-wide. Furthermore, marginal growers are discouraged from planting potatoes by their meager resources in relation to the costs and risks associated with potato production. The limited manpower of the extension service also prevents more effective utilization of available farm inputs, e.g. chemical fertilizer. In addition, location specific constraints include: for the northwest the shortage of red-skinned, high yielding, short-duration varieties as well as the absence of storage facilities in certain areas (e.g. Debiganj); storage is also scarce around Mymensingh and in growing areas northeast (e.g. Hathazari) and southeast of Chittagong. In the central and east central growing areas, late maturing, white-skinned, high-yield varieties represent more of a constraint.

Potato Consumption

Potatoes are a complementary vegetable to rice, the staple in Bangladesh. However, when rice becomes scarce potatoes are eaten as a temporary, partial substitute. On an average annual basis, potatoes provide as much as 6% of the daily per capita calories and protein consumed in rural areas and a much higher percent of total food intake during the winter months when they are in seasonally abundant supply. Potatoes are also an important source of vitamin C. Nearly all potatoes are eaten fresh as only minor quantities are used in the preparation of snack foods, principally potato crisps.

Average annual potato consumption in Bangladesh is about 15 kg per capita. This represents a doubling in per capita consumption since the mid 1970s. Given the marked differences in consumption levels by residence (urban versus rural), occupation and income groups, considerable potential would appear to exist for expanding potato consumption. Important factors limiting increased consumption are the meager food budgets of most households and the high price for this tuber at certain times of the year, the shortage of cold stores in certain areas, the underdeveloped cottage industry for processed food products made from potatoes, and mistaken opinions about the potato's nutritional value.

Potato Marketing

Potatoes are a cash crop in Bangladesh, with growers selling most of what they produce. Some estimates calculate as much as 90% of production is marketed. Nearly all these sales are for the domestic market with less than 0.5% for export.

Three principal marketing channels exist for potatoes in Bangladesh: local, regional and interregional. Previous survey results and field work for this study indicate about 50%-60% of all potato sales take place in local channels, another 20%-30% pass through regional channels, and 10-20% are sold through interregional channels.

Producer marketing patterns for potatoes are considerably more flexible than commonly believed. For example, if prices at harvest (February-March) are low, producers in Dhaka district sell a few potatoes and store the rest— although not necessarily in cold storage— for sale later in the year. If prices at harvest are high, producers sell most of their potatoes immediately. In Bogra, growers sell most of their potatoes at harvest, but they spread their harvest over several months to reduce the risk of low prices. Similarly, most Dhaka growers sell their potatoes at home or out of the field; Bogra producers divide their sales equally between sales at home and at rural markets (*hats*).

Principal participants in potato marketing include growers themselves, rural assemblers, brokers, transporters of various types, wholesaler/commission agents, urban petty retailers and cold storage operators. Large-scale rural assemblers (*beparis*) tend to be more active in certain areas (e.g. Bogra and Dhaka districts), whereas small-scale rural assemblers (*farias*) are more conspicuous in others (e.g. Comilla district). Wholesaler/commission agents are generally based in towns and cities. Nevertheless, the division of labor between these various traders is not always very clear, e.g. a *bepari* may occasionally act as a simple broker (*dadal*). Furthermore, cold store owners have become increasingly involved in the purchase and sale of potatoes as a means of making more intensive use of their facilities.

Cold storage capacity has expanded from 20,000t to 350,000t in the last 20 years— by over 200,000t during 1981-86 alone. Current facilities are capable of storing roughly 30% of annual output. While the growth in capacity has reduced seasonal price fluctuations, poor co-ordination among banks, government agencies, international lending institutions and cold store owners has resulted in excess capacity in certain areas and a shortage in

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others. Consequently, cold storage has not only become less profitable, but the prospect of financial losses in the years ahead has generated a crisis of major proportions within this sector of the potato industry.

In 1982-84, average monthly wholesale prices potatoes in real terms were half the 1972-74 level. Seasonal price fluctuations were also less pronounced largely due to increased potato production and expanded cold storage capacity.¹

It is frequently argued that growers receive only a minor share of the final retail price for potatoes. Empirical evidence to support (or to refute) this hypothesis is scarce. However, available data indicate farmers receive 60%-70% of the retail price of potatoes during and immediately after the main harvest. Growers in more isolated areas receive a smaller percentage of the retail price as do those that keep potatoes in cold stores. Apart from growers and cold store operators, retailers receive the highest marketing margin, roughly 15%-20% of the price paid by consumers.

Government initiatives in the area of potato marketing have focused largely on promotion of consumption, collection of market information, credit and investment incentives for cold storage facilities. Apart from minor taxes, charges, permits and licenses, public officials have left potato marketing to the private sector.

Principal constraints to improved potato marketing include the geographic isolation of production centers in light of the rudimentary rural road network; the scarcity of varieties that store well under rustic conditions throughout the year; the absence of cold storage facilities in certain areas; the shortage of post-harvest extension and credit at the farm-level; and, the limited diffusion of market information.

6.2 Conclusions and Policy Recommendations

The potato sector of the Bangladesh economy has developed remarkably since independence. Production has expanded, real prices declined and consumption increased significantly. All this has been achieved without government price supports or consumer subsidies. However, recent low producer prices and under-utilized cold storage capacity have raised doubts about future marketing prospects for potatoes.

Lowering the Financial Risks

The financial risks associated with potato production may be reduced by **reducing the total cost of production**. One way this can be achieved is by expanded domestic seed production, multiplication and distribution so as to lower the cost of this input. Cold storage space for seed, especially in areas that suffer from a shortage of such facilities, would also contribute to this end. Propagation of simple guidelines on chemical fertilizer use would help minimize unnecessary expenditures. Bangladesh authorities would also do well to push ahead with research on new ways to bring down production costs, e.g. the use of true potato seed, seed production by farmers themselves.

Lower unit costs (total cost divided by total yield) could also reduce growers vulnerability with respect to year-to-year price changes for potatoes. All other things equal, **unit costs can be brought down by raising yields**. Availability of improved varieties— appropriate to local growing conditions and consumer tastes— could facilitate this improvement.

A more widely disseminated, timely distribution of information about potato production and marketing developments during the year could assist growers in their decisionmaking about how many potatoes to plant and when to stagger their planting.² Prompt reports about supply/demand conditions in major rural and urban markets as well as up-to-date information about storage charges, space available, etc. could also help growers explore alternative market outlets.

Release of tropicalized varieties with superior storage quality would give growers greater flexibility in terms of planting and harvesting dates, give more options as regards time of entry into the market, and thereby would help reduce the risk of low prices at harvest. Such varieties would also enable growers to spread out their harvesting periods and reduce pressure on marketing infrastructure at this time of year.

Potatoes and Nutrition Levels

Some authors have suggested that prospects for increased potato consumption in Bangladesh are limited given the current per capita consumption levels for cereals (Maziruddin, 1986:9). This observation is misleading in several respects. First, it implies that Bangladesh consumers have already become satiated on available food supplies, e.g., for consumption of potatoes to increase, consumption of cereals would have to decline. In fact, average per capita intake of calories has fallen by 16% since 1964-65 and currently is less than 90% of minimum requirements (Ahmad and Hassan, 1983:28). Hence, there is an urgent need to increase existing food consumption levels, particularly among low-income groups.

Second, a 20% increase in per capita potato consumption— about 3 kg— would raise annual potato intake to 18 kg, or about equal to the average for all of Asia (Horton and Fano, 1985:98). Such an increase would require producing more than 200,000t more of potatoes. In other words, given the population of Bangladesh, major increases in potato production are required for minor increases— on a per kg basis— in potato consumption. Moreover, simply to maintain existing per capita consumption levels in the year 2000 will require an increase in production on the order of 550,000t between now and the end of this century.

Third, rather than simply being thought of as potential source of calories, potatoes are perhaps best considered as an important source of proteins, vitamins and minerals, e.g. vitamin C (AST/CIDA, 1983:19). Most rural households currently consume 50% or less of the recommended requirements of this important vitamin (Ahmad and Hassan, 1983:29).³ Furthermore cereals— unless sprouted— provide no vitamin C whatsoever. Thus, potatoes

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can both complement the calories and supplement the vitamins made available by cereal intake, in Bangladesh.

Clearly, additional potato consumption could help improve the nutritional standards of Bangladeshi consumers beyond what is available through cereals and without drastic adjustments in current eating habits. The real challenge then is to make potatoes more readily available to consumers at reasonable prices throughout the year without making them unprofitable for farmers to produce. More specifically, efforts to improve low-cost, on-farm storage and simple processing could extend the current utilization period on the farm to the months of May and June, one of two periods during the year when food supplies are leanest (Ahmad and Hassan, 1983:230).

Cold Storage Crisis

Bangladesh had about 80,000t of unutilized cold storage capacity in 1985. Competition between cold store operators was so intense that many operators reportedly lowered their storage charges to less than their operating costs. As a result, these cold store operators lost money in 1985. A series of measures may be necessary to rationalize use of available storage space and improve operating procedures.

Agricultural Marketing Department (AMD) personnel have observed that building new cold stores is hard to justify (Maziruddin, 1986:26). Results of this study indicate that while the suspension of new cold storage construction may be too strong an initiative, a re-evaluation of existing incentives (e.g. concessionary import duties, lower tax rates) would appear to be appropriate. These measures could help insure that new stores are constructed where little or no cold storage space currently exists. The government might also want to consider tightening up the licensing procedures for cold stores so as to guarantee that: (1) operators have the necessary training and experience and (2) the design of newly constructed facilities be sufficiently flexible to allow them to be used for potatoes and other crops. This will require improved co-ordination among financial institutions, the Department of Industry (which issues the licenses to import equipment and spares), the cold storage association, the AMD, and national potato program representatives.

Bangladeshi authorities could also work with the owners of existing cold storage facilities to make better use of available capacity (AST/CIDA, 1983:24). The government could help by seeing to it that organizations such as the Bangladesh Agricultural Development Corporation (BADC) rent space in existing private stores whenever possible, rather than building a new store where excess capacity already exists. The timely provision of credit both to growers and to cold store owners in order to (buy and) store potatoes is also essential. Moreover, public institutions could also provide information about re-designing and credit to cold store owners so that they might make their facilities capable of handling commodities besides potatoes.

Potatoes and the Balance of Trade

The idea of increasing foreign exchange earnings by exportings potatoes or potato-based products has long been discussed in Bangladesh. While there is a clear need to diversify the mix of export products and to increase foreign exchange earnings, attention may have been too narrowly focused on the gains from trade to be derived from potato exports. Available evidence suggests instead that greater benefits may be achieved through a realization of the potato's potential to help reduce food imports.

A preliminary assessment of the export prospects for Bangladeshi potatoes involves consideration of the size and location of prospective export markets, Bangladesh's capacity to compete in these markets, the investments required to facilitate this trade, and the likely impact on the domestic potato market.⁴

Principal export markets for Bangladesh potatoes— with annual potato imports listed in parenthesis— are Singapore (45,000t), Malaysia (35,000t), Saudi Arabia (100,000t), Bahrain (9,000t), Abu-Dhabi (20,000t) and Dubai (3,000t). In the case of the Gulf States, Bangladesh is at a disadvantage relative to rival suppliers like Lebanon, Egypt, and Cyprus which are closer and hence have lower shipping costs. Moreover, these countries are more capable of supplying potatoes on short-notice. They also have strong traditions of exporting potatoes. Both Egypt and Cyprus, for instance, annually export thousands of tons of potatoes to the highly competitive W. European market. They also maintain well-established commercial links with the Gulf States. These observations suggest export prospects to Malaysia and Singapore are probably greater. In fact, the bulk of Bangladesh potato exports in the last few years have been sent to these latter two countries.

Bangladesh's capacity to supply and to compete in potential export markets is influenced primarily by the price and quality of the potatoes. Recent experience indicate Bangladeshis have difficulty in supplying stored potatoes because these tubers require special handling and infrastructure (e.g. cold storage facilities at the port of Chittagong) to prevent shrinkage and rotting. Stored potatoes are therefore more expensive and of lower quality than freshly harvested tubers. Moreover, buyers in Malaysia and Singapore prefer fresh tubers. Consequently, Bangladeshis can effectively compete in these markets for only about 2½ months during the peak domestic harvesting period (Maziruddin, 1986:37). Thus, there is a potential to supply about 20,000t to Southeast Asia.⁵ However, the vast majority of ships that enter Bangladesh's ports travel from East to West, hence their is limited capacity— particularly refrigerated storage space— to handle potatoes sent to Malaysia and Singapore.⁶ Under such circumstances, it is hard for Bangladeshi traders to establish themselves as a reliable source of supply. In addition, foreign buyers frequently request potatoes be sent on a commission basis. Such trading arrangements in foreign markets are hard for local suppliers to scrutinize and reportedly are in violation of Bangladesh's controls on foreign exchange. Finally, promoting an export market for fresh potatoes implies encouraging the shipment of potatoes out of the country. However, this runs counter to the government's objective of increasing utilization of available cold storage facilities. In summary, there may be potential to export potatoes; however,

available information indicates the export market is restricted to Southeast Asia, quite demanding in terms of quality and services required and involving considerable financial risk.

While considerable time and effort have gone into devising schemes to increase potato exports, much less attention has been devoted to the economics of using potatoes to reduce cereal imports, or the subsidized production and sale of domestically produced food grains. Yet, the facts are quite compelling. Bangladesh's are known to substitute potatoes for rice when it is scarce and expensive. Bangladesh imported an average of 400,000t of rice annually from 1983-85 (valued at US\$ 55.6 million).⁷ A six percent reduction in rice imports, i.e. 25,000 t would save Bangladesh US\$ 3.3 million. This volume of rice represents the caloric equivalent of about 100,000t of fresh potatoes—cold storage space currently under utilized in the country. Hence, considerable marketing infrastructure is already in place to distribute the additional potatoes. Such quantities would not appreciably alter either per capita consumption levels of rice or potatoes. This is only a hypothetical example. But past growth in potato production, the associated decline in potato prices and the propensity of consumers to eat more potatoes as the price declines together suggest efforts to increase potato output in the future would expand the existing size of the market accordingly.

Topics for Future Research

While highly useful and pioneering studies have been done on the socio-economics of potato production, marketing and consumption, there is ample need for additional work in any of these areas. Topics of particular interest and related questions include:

- (i) **seed marketing:** what are the existing formal and informal seed marketing channels and how they might be affected by or improved to accommodate the anticipated increases in seed production?
- (ii) **potato consumption:** based on a comparison of the 1975-76 and 1981-82 rural nutrition surveys, which areas and income groups increased/decreased potato consumption and why? Have gluts in 1982 and 1985 been exaggerated because growth in local potato production rose rapidly as local consumption declined? What are income and direct price elasticities for potatoes based on these latest survey data? How do they compare with findings of Pitt (1983) for the 1973-74 survey?
- (iii) **potato processing:** what are current potato processing practices in rural areas? What factors favor (or limit) widespread adoption of new, simple potato processing techniques?
- (iv) **cold storage for potatoes:** a study of the costs and returns to potato storage would be useful; in this regard, how important are local supply/demand for potatoes, storage fees and terms, perception of management's business practices as factors which influence the degree of capacity utilization? and,
- (v) **potato retailing:** how might these marketing margins most effectively be lowered? Improved technology? Credit? Market infrastructure? In addition to trained professionals currently employed by government agencies, university students working on their theses offer a potential source of manpower to carry out this research.

Notes

- 1 Nevertheless, nominal prices showed a sharp seasonal variation during 1986.
- 2 Government purchase and storage schemes to stabilize producer prices in other developing countries have not been successful e.g. Bhutan (Scott, 1983:56-57), Peru (Scott, 1985:36-37).
- 3 Dissemination of information on the most nutritional ways to prepare potatoes—**boiling with the skins**— would be extremely useful in this regard.
- 4 The preliminary nature of this assessment should be emphasized in that the export markets for Bangladesh's potatoes was not a major focus of this study.
- 5 This assumes potato imports are evenly spread throughout the year in the two countries; 20,000t is about 2½ months of potato imports for Malaysia and Singapore.
- 6 These observations are based on informal interviews carried out in Chittagong in March, 1984.
- 7 FAO Trade Yearbook, Vol. 39.

Appendix Tables

Table A.1. Bangladesh : Potato production, area and yield, 1955-85.

Year	Production (000 t)	Area (000 ha)	Yield (t/ha)
1955/56	124.3	25.9	4.8
1956/57	189.5	29.0	6.5
1957/58	173.5	31.2	5.6
1958/59	223.9	35.5	6.3
1959/60	276.7	47.2	5.9
1960/61	338.3	55.8	6.1
1961/62	331.2	56.0	5.9
1962/63	356.6	57.8	6.2
1963/64	318.7	55.6	5.7
1964/65	395.4	55.6	7.1
1965/66	486.2	60.8	8.0
1966/67	590.6	70.4	8.4
1967/68	700.9	75.9	9.2
1968/69	786.5	84.1	9.4
1969/70	850.8	85.4	10.0
1970/71	849.3	86.6	9.8
1971/72	740.9	76.3	9.7
1972/73	746.7	79.6	9.4
1973/74	718.5	80.1	9.0
1974/75	866.5	93.9	9.2
1975/76	888.8	96.0	9.3
1976/77	723.7	77.4	9.4
1977/78	849.4	90.1	9.4
1978/79	895.0	96.7	9.3
1979/80	902.6	96.5	9.4
1980/81	983	102.0	9.6
1981/82	1,067	106.1	10.1
1982/83	1,149	110.1	10.4
1983/84	1,166	110.1	10.6
1984/85	1,160	111.3	10.4
Growth rate (%), annual average			
1955/58—1962/65	15	10	2.8
1962/63—1974/75	9	4	3.1
1972/73—1984/85	3	2	0.9
1955/56—1984/85	23	10	3.4

Source : Bangladesh Bureau of Statistics.

Table A.2. Continued.

District (old)	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76
Barisal	15.6	15.9	17.6	12.9	11.7	8.2	10.5	11.2
Bogra	57.0	67.6	60.6	42.8	46.6	48.2	49.0	64.1
Chittagong	45.0	47.1	43.1	43.8	41.4	42.1	43.0	39.0
Chittagong H.T.	6.7	8.0	7.9	5.6	6.0	7.4	7.5	5.7
Comilla	67.7	72.0	68.3	65.3	61.5	62.1	126.6	92.6
Dhaka	236.1	268.9	267.5	266.6	259.1	250.9	217.5	236.9
Dinajpur	53.6	50.0	50.5	16.2	41.0	39.6	41.9	48.0
Faaidpur	7.0	7.1	7.4	6.5	2.1	4.3	7.4	9.6
Jamalpur	—	—	—	—	—	—	—	—
Jessore	6.9	8.3	8.4	6.7	6.0	6.9	8.1	7.6
Khulna	25.1	26.8	27.7	23.5	17.8	11.9	12.9	25.4
Kishoreganj	17.5	17.9	17.5	17.2	18.0	12.4	14.4	30.9
Kushtia	6.8	6.2	6.3	5.3	4.9	4.3	5.5	3.8
Mymensingh	34.1	29.3	33.0	25.1	22.7	22.6	32.6	30.3
Noakhali	21.0	19.6	20.3	16.5	15.5	12.7	16.1	6.2
Pabna	10.7	11.7	12.9	11.6	11.3	11.2	11.4	12.1
Patuakhali	1.2	1.3	4.9	1.1	0.7	0.3	0.4	0.3
Rajshahi	46.1	46.6	49.0	43.0	42.0	43.2	59.1	62.6
Rangpur	85.0	86.1	88.1	85.3	92.6	91.0	118.1	117.7
Sylhet	43.1	53.0	49.8	39.2	39.6	34.0	79.4	77.5
Tangail	—	7.4	8.5	6.8	6.7	5.4	5.2	7.1

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Table A.2. Continued.

District (old)	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85
Barisal	7.1	11.3	11.6	9.1	9.8	10.0	10.8	12	13
Bogra	59.8	64.9	72.6	70.8	78.6	79.0	84.4	86	87
Chittagong	31.7	37.8	37.8	37.6	38.0	35.0	33.1	34	33
Chittagong H.T.	3.0	3.0	2.9	2.9	2.1	4.0	3.9	4	5
Comilla	87.0	105.0	118.3	102.3	145.0	189.0	222.3	230	239
Dhaka	218.9	253.9	252.6	277.0	287.0	291.0	301.6	293	259
Dinajpur	41.3	50.6	58.5	60.2	63.1	67.0	75.7	77	81
Faridpur	5.0	4.6	4.4	4.7	5.8	6.0	6.4	7	7
Jamalpur	—	—	10.1	10.2	10.9	16.0	15.6	17	18
Jessore	7.9	10.5	10.8	13.1	13.0	31.0	33.3	25	33
Khulna	16.3	16.6	20.5	20.9	31.1	31.0	32.5	33	43
Kishoreganj	37.4	40.0	35.6	30.0	27.1	28.0	32.9	57	47
Kushtia	4.5	6.1	6.6	7.0	6.6	7.0	8.6	10	11
Mymensingh	26.2	30.3	20.3	20.4	20.5	20.0	21.0	21	22
Noakhali	3.2	3.8	4.0	5.8	6.5	7.0	8.7	10	11
Pabna	8.7	12.0	14.4	15.4	16.7	18.0	22.6	25	24
Patuakhali	0.2	0.2	0.2	0.3	0.3	—	1.2	1	1
Rajshahi	43.8	52.3	52.1	56.9	51.4	58.0	71.9	75	77
Rangpur	60.5	80.6	93.5	89.1	82.9	84.0	86.6	77	73
Sylhet	57.1	53.6	50.3	52.3	65.8	66.0	60.4	53	56
Tangail	9.1	12.3	17.8	18.4	21.0	20.0	16.0	17	19

Source : Bangladesh Bureau of Statistics.

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Table A.3. Continued.

District (old)	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76
Barisal	4.0	3.8	4.5	3.5	3.5	2.5	3.1	3.2
Bogra	20.4	21.9	21.8	17.3	19.4	21.5	22.0	28.1
Chittagong	8.0	8.2	8.2	8.4	7.9	7.9	8.0	7.3
Chittagong H.T.	2.0	2.0	2.0	1.6	1.7	1.8	1.8	1.8
Comilla	21.2	22.5	21.5	20.4	19.7	20.7	36.9	25.1
Dhaka	39.7	38.9	39.1	40.7	40.3	40.2	36.9	43.0
Dinajpur	17.8	16.5	16.6	6.6	12.7	14.3	15.1	16.3
Faridpur	2.4	2.5	2.5	2.1	1.5	1.5	2.2	2.5
Jamalpur	—	—	—	—	—	—	—	—
Jessore	1.9	8.3	2.4	2.1	1.9	2.1	2.5	2.3
Khulna	5.7	5.8	5.9	5.3	4.8	3.5	3.6	6.1
Kishoreganj	8.1	8.2	8.2	8.2	9.9	7.8	9.9	12.0
Kushtia	1.5	1.5	1.5	1.3	1.4	1.2	1.6	1.1
Mymensingh	15.2	12.6	13.0	11.4	12.0	12.3	14.9	14.4
Noakhali	4.1	4.1	4.3	3.7	3.5	3.3	3.7	1.5
Pabna	4.0	4.4	4.8	4.3	4.3	4.3	4.4	4.6
Patuakhali	0.4	0.4	1.5	0.4	0.3	0.1	0.1	0.2
Rajshahi	21.3	20.3	20.5	19.2	18.9	20.2	22.4	23.6
Rangpur	19.3	19.4	19.5	19.0	20.5	20.5	25.7	25.9
Sylhet	10.8	13.0	12.8	10.0	10.4	9.1	14.7	14.2
Tangail	—	3.0	3.5	3.0	3.0	2.9	2.8	3.8

Table A.3. Continued.

District (old)	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85
Barisal	2.0	3.1	3.2	2.5	2.7	3.0	2.9	3.0	4.0
Bogra	20.5	22.3	25.3	24.6	27.0	27.0	27.7	28.0	26.0
Chittagong	5.9	7.1	7.1	7.0	7.1	7.0	7.3	7.0	7.0
Chittagong H.T.	1.0	1.1	1.1	1.0	0.8	1.0	1.0	1.0	1.0
Comilla	22.3	25.8	28.2	24.6	31.9	35.0	40.4	42.0	42.0
Dhaka	37.1	42.1	44.2	48.0	48.6	49.0	48.8	48.0	48.0
Dinajpur	15.9	19.8	22.7	22.9	22.3	23.0	21.4	22.0	24.0
Faridpur	1.4	1.4	1.3	1.4	1.4	2.0	1.8	2.0	2.0
Jamalpur	—	—	—	4.1	4.3	5.0	4.9	5.0	5.0
Jessore	2.2	2.8	2.8	3.3	3.3	5.0	4.9	4.0	6.0
Khulna	4.4	4.6	5.3	5.7	6.6	9.0	8.3	8.0	8.0
Kishoreganj	10.3	11.4	11.6	10.2	9.9	10.0	10.6	14.0	14.0
Kushtia	1.1	1.4	1.6	1.6	1.6	2.0	2.4	2.0	3.0
Mymensingh	10.5	13.0	8.8	8.9	8.9	9.0	9.0	9.0	9.0
Noakhali	1.1	1.3	1.4	1.8	2.0	2.0	2.3	2.0	3.0
Pabna	4.1	0.5	6.4	6.8	7.2	7.0	8.3	8.0	9.0
Patuakhali	0.1	0.1	0.1	0.1	0.1	—	0.5	—	—
Rajshahi	17.7	21.1	21.4	22.3	21.8	24.0	28.0	28.0	27.0
Rangpur	18.4	23.4	26.3	25.3	24.2	24.0	24.3	21.0	20.0
Sylhet	11.3	10.2	9.2	9.5	11.4	11.0	11.8	11.0	11.0
Tangail	3.5	4.6	6.7	6.6	7.3	7.0	5.6	6.0	6.0

Source: Bangladesh Bureau of Statistics.

Table A.4. Continued.

District (old)	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76
Barisal	3.9	4.2	3.9	3.7	3.4	3.2	3.4	3.5
Bogra	2.8	3.1	2.9	2.5	2.4	2.2	2.2	2.3
Chittagong	5.7	5.9	5.2	5.2	5.3	5.3	5.4	5.4
Chittagong H.T.	3.9	3.9	3.6	3.6	4.2	4.3	3.2	2.8
Comilla	3.2	3.2	3.2	3.2	3.1	3.0	3.4	3.7
Dhaka	6.0	6.9	6.8	6.6	6.4	6.2	5.9	5.5
Dinajpur	3.0	3.0	3.1	2.4	3.2	2.8	2.8	2.9
Faridpur	2.9	2.9	2.9	3.1	1.4	2.9	3.3	3.8
Jamalpur	—	—	—	—	—	—	—	—
Jessore	3.6	3.6	3.6	3.2	3.1	3.3	3.3	3.3
Khulna	4.4	4.6	4.7	4.4	3.7	3.4	3.6	4.2
Kishoreganj	2.2	2.2	2.1	2.1	1.8	1.6	1.5	2.6
Kushtia	4.6	4.3	4.3	4.1	3.1	3.5	3.6	3.4
Mymensingh	2.2	2.3	2.5	2.2	1.9	1.8	2.2	2.1
Noakhali	5.1	4.8	4.8	4.5	4.4	3.8	4.3	4.2
Pabna	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6
Patuakhali	3.3	3.3	3.2	3.0	2.7	2.6	2.4	2.2
Rajshahi	2.2	2.3	2.4	2.2	2.2	2.1	2.6	2.6
Rangpur	4.4	4.4	4.5	4.5	4.5	4.4	4.6	4.5
Sylhet	4.0	4.1	3.9	3.9	3.8	3.7	5.4	5.5
Tangail	—	2.5	2.5	2.3	2.2	1.8	1.9	1.8

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Table A.4. Continued.

District (old)	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85
Barisal	3.5	3.6	3.6	3.6	3.6	3.3	3.7	4.0	3.3
Bogra	2.9	2.9	2.9	2.9	2.9	2.9	3.1	3.1	3.3
Chittagong	5.3	5.3	5.4	5.4	5.4	5.0	4.5	4.9	4.7
Chittagong H.T.	2.8	2.7	2.6	2.8	2.6	4.0	3.9	4.0	5
Comilla	3.9	4.1	4.2	4.2	4.5	5.4	5.5	5.5	5.7
Dhaka	5.9	6.0	5.7	5.8	5.9	5.9	6.2	6.1	5.4
Dinajpur	2.6	2.5	2.6	2.6	2.8	2.9	3.5	3.5	3.4
Faridpur	3.7	3.4	3.3	3.4	4.1	2.9	3.6	3.5	3.5
Jamalpur	—	—	2.5	2.5	2.5	3.2	3.2	3.4	3.6
Jessore	3.6	3.8	3.8	4.0	4.0	6.2	6.7	6.3	5.5
Khulna	3.7	3.6	3.9	3.7	3.6	3.4	3.9	4.4	5.4
Kishoregonj	3.6	3.5	3.1	2.8	2.7	2.8	3.1	4.1	3.4
Kushtia	4.1	4.2	4.3	4.3	4.1	3.5	3.6	5.0	3.7
Mymensingh	2.5	2.3	2.3	2.3	2.3	2.2	2.3	2.3	2.4
Noakhali	2.9	2.9	2.9	3.2	3.3	3.5	3.8	5.0	3.7
Pabna	2.1	2.16	2.3	2.3	2.3	2.6	2.7	3.1	2.7
Patuakhali	2.3	2.3	2.4	2.4	2.3	—	2.6	—	—
Rajshahi	2.5	2.5	2.4	2.6	2.4	2.4	2.6	2.7	2.9
Rangpur	3.3	3.4	3.6	3.5	3.4	3.5	3.6	3.7	3.7
Sylhet	5.1	5.3	5.5	5.5	5.8	6.0	5.1	4.8	5.1
Tangail	2.6	2.7	2.6	2.8	2.9	2.9	2.9	2.8	3.2

Source : Bangladesh Bureau of Statistics.

Table A.5. Bangladesh : Number of households interviewed in pilot potato consumption survey, 1982.

Functional group	Region				
	Bogra	Comilla	Dhaka	Munshiganj	Domar
Producer					
Small	13	8	—	16	13 ⁴
Medium	14	6	—	7	11 ⁵
Large	3	1	—	12	6 ⁶
Non-potato producing farmers	12 ¹	6	—	5	—
Urban					
Poor	5		10	—	—
Middle income	13	6 ²	20 ³	—	—
Wealthy	2		0	—	—
Total	<u>62</u>	<u>27</u>	<u>40</u>	<u>40</u>	<u>30</u>

Source : Poats (1086).

- 1 Rural landless.
- 2 Urban residents.
- 3 Urban upper middle income and lower middle income.
- 4 Local variety producers.
- 5 Local and hybrid variety producers.
- 6 Cold storage users.

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Table A.6. Bangladesh : Average monthly current wholesale price (taka/maund) of potatoes, 1972-84.¹

Month	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Monthly Average
January	25	36	71	74	75	46	84	58	81	80	78	63	114	68.1
February	19	27	58	60	49	37	52	44	54	57	59	51	71	49.1
March	17	35	52	62	44	39	46	46	53	67	61	45	79	49.7
April	27	48	62	74	50	46	54	50	71	79	63	62	88	59.2
May	29	50	63	96	55	60	50	61	96	93	56	83	98	68.5
June	34	54	81	116	61	61	63	66	103	99	54	101	139	79.4
July	42	70	96	128	77	60	78	74	120	98	62	112	166	91.0
August	48	76	108	133	92	82	101	113	130	137	110	126	170	109.7
September	52	75	116	130	91	84	106	130	129	142	107	136	158	112.0
October	60	76	114	137	87	91	126	130	144	152	100	175	166	119.8
November	77	82	113	156	89	111	141	127	156	176	91	201	175	130.4
December	55	84	109	127	87	111	120	120	166	144	76	203	146	119.1
Annual Average	40.0	59.4	86.9	107.8	71.4	69.0	85.1	84.9	108.6	110.3	76.4	113.2	130.8	88.0
Maximum	77.000	84.000	116.000	156.000	92.000	111.000	141.000	130.000	166.000	176.000	110.000	203.000	175.000	130.385
Minimum	17.000	27.000	52.000	60.000	44.000	37.000	46.000	44.000	53.000	57.000	54.000	45.000	71.000	49.077
Max/Min	4.529	3.111	2.231	2.600	2.091	3.000	3.065	2.955	3.132	3.088	2.037	4.511	2.465	2.657
Standard Dev.	17.986	19.285	23.824	31.562	17.647	25.189	31.713	34.202	36.784	36.630	19.755	54.006	37.031	28.136
Coef. of Var.	44.965	32.457	27.410	29.292	24.710	36.506	37.273	40.277	33.876	33.199	25.851	47.722	28.304	31.977

Source : Agricultural Marketing Department, Dhaka.

1 I am grateful to Douglas Horton of CIP for providing me with these data.

Table A.7. Bangladesh : Monthly index (1984=100) of wholesale food prices, 1972-84.¹

Month	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
January	16	24	34	58	47	45	52	59	73	75	86	87	100
February	16	24	34	58	47	45	52	59	73	75	86	87	100
March	16	24	34	58	47	45	52	59	73	75	86	87	100
April	16	24	34	58	47	45	52	59	73	75	86	87	100
May	16	24	34	58	47	45	52	59	73	75	86	87	100
June	16	24	34	58	47	45	52	59	73	75	86	87	100
July	16	24	34	58	47	45	52	59	73	75	86	87	100
August	16	24	34	58	47	45	52	59	73	75	86	87	100
September	16	24	34	58	47	45	52	59	73	75	86	87	100
October	16	24	34	58	47	45	52	59	73	75	86	87	100
November	16	24	34	58	47	45	52	59	73	75	86	87	100
Annual Average	16	24	34	58	47	45	52	59	73	75	86	87	100

Source : FAO

1 I am grateful to Douglas Horton of CIP for providing me with these data.

Table A.8. Bangladesh : Average monthly deflated wholesale prices (taka/maund) of potatoes, 1972-84.¹

Month	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Average
January	1.55	1.48	2.11	1.27	1.59	1.03	1.62	0.98	1.11	1.06	0.91	0.72	1.14	1.275
February	1.18	1.11	1.72	1.03	1.04	0.83	1.00	0.74	0.74	0.76	0.69	0.58	0.71	0.933
March	1.05	1.44	1.55	1.07	0.93	0.88	0.78	0.78	0.73	0.89	0.71	0.52	0.79	0.932
April	1.36	1.98	1.84	1.27	1.06	1.03	1.04	0.84	0.97	1.05	0.73	0.71	0.88	1.135
May	1.80	2.06	1.87	1.65	1.16	1.35	0.96	1.03	1.32	1.24	0.65	0.95	0.98	1.309
June	2.11	2.22	2.41	2.00	1.29	1.37	1.21	1.11	1.41	1.32	0.63	1.16	1.39	1.510
July	2.60	2.88	2.85	2.20	1.63	1.35	1.50	1.25	1.65	1.30	0.72	1.28	1.66	1.759
August	2.97	3.13	3.21	2.29	1.94	1.84	1.94	1.91	1.79	1.82	1.28	1.44	1.70	2.097
September	3.22	3.09	3.45	2.24	1.92	1.89	2.04	2.19	1.77	1.89	1.24	1.56	1.58	2.160
October	3.72	3.13	3.39	2.36	1.84	2.04	2.42	2.19	1.98	2.02	1.16	2.00	1.66	2.301
November	4.77	3.38	3.36	2.69	1.88	2.49	2.71	2.14	2.14	2.34	1.06	2.30	1.75	2.539
December	3.41	3.46	3.24	2.19	1.84	2.49	2.31	2.02	2.28	1.92	0.88	2.33	1.46	2.295
Annual Average	2.478	2.447	2.583	1.855	1.510	1.549	1.628	1.432	1.491	1.468	0.888	1.296	1.308	1.687
Maximum	4.77	3.46	3.45	2.69	1.94	2.49	2.71	2.19	2.28	2.34	1.28	2.33	1.75	2.54
Minimum	1.05	1.11	1.55	1.03	0.93	0.83	0.76	0.74	0.73	0.76	0.63	0.52	0.71	0.93
Max/Min	4.543	3.117	2.226	2.612	2.086	3.000	3.474	2.959	3.123	3.079	2.032	4.481	2.465	2.724
Standard Dev.	1.114	0.795	0.709	0.545	0.372	0.565	0.621	0.576	0.506	0.487	0.229	0.619	0.370	0.552
Coef. of Var.	44.965	32.498	27.437	29.384	24.625	36.456	38.153	40.235	33.932	33.209	25.772	47.736	28.304	32.714
(%) Change														
Feb./Jan.-Sep./Nov.	56.133	8.967	8.626	3.846	2.920	17.582	43.687	44.889	13.926	18.821	1.466	49.490	5.053	20.275

Source : Tables A.6 and A.7.

1 I am grateful to Douglas Horton of CIP for providing me with these data.

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Table A.9. Singapore : Volume and value of potato imports, 1980-83.

Year	Origin Country	Volume (000t)	Value (S\$000) ¹
1980	China	28.4	13.0
	Taiwan	7.3	2.9
	Holland	6.7	4.3
	Australia	3.2	1.6
	Other	0.9	—
	Total	46.7	22.6
1981	China	31.9	13.9
	Holland	10.2	6.7
	Taiwan	6.8	2.0
	Australia	2.1	1.3
	Other	0.6	0.5
	Total	51.6	25.1
1982	China	27.7	12.7
	Holland	10.0	7.7
	Australia	5.3	3.3
	Taiwan	3.6	2.1
	Other	1.1	0.7
	Total	47.7	26.5
1983	China	24.3	10.1
	Holland	14.4	8.6
	Taiwan	3.0	1.7
	Australia	2.3	1.2
	Other	1.5	1.0
	Total	45.6	22.6

Source: Trade Statistics of Singapore, Statistical Department, Singapore.

1 S\$ = Singapore dollars.

Table A.10. Malaysia : Volume and value of potato imports, 1978-84.

Year	Origin Country	Volume (000 t)	Value (US\$000)
1978	China	11.8	n.a.
	Taiwan	5.3	n.a.
	Indonesia	2.4	n.a.
	Thailand	1.6	n.a.
	Holland	12.1	n.a.
	Total	31.8 ¹	5,600
1879	India	3.6	n.a.
	China	16.5	n.a.
	Taiwan	4.7	n.a.
	Indonesia	1.4	n.a.
	Holland	9.8	n.a.
	Other	2.7	n.a.
	Total	38.7	7,570
1980	China	25.9	n.a.
	Taiwan	7.4	n.a.
	Holland	9.3	n.a.
	Australia	1.7	n.a.
	Indonesia	1.0	n.a.
	Other	1.0	n.a.
	Total	46.4	9,163
1981	China	16.9	n.a.
	Holland	11.7	n.a.
	Taiwan	7.4	n.a.
	Australia	2.5	n.a.
	Indonesia	1.8	n.a.
	Other	4.7	n.a.
	Total	45.0	8,100
1982	China	17.0	n.a.
	Holland	14.6	n.a.
	Indonesia	3.6	n.a.
	Australia	2.6	n.a.
	India	1.8	n.a.
	Other	5.4	—
	Total	45.0	11,931

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Table A.10. Continued.

Year	Origin Country	Volume (000 t)	Value (US\$ 000)
1983	China	12.3	n.a.
	Holland	16.9	n.a.
	Indonesia	8.9	n.a.
	Taiwan	5.8	n.a.
	Other	<u>2.7</u>	<u>n.a.</u>
	Total	46.6	11,013
1984	Indonesia	12.0	n.a.
	Holland	7.6	n.a.
	China	6.7	n.a.
	Taiwan	6.6	n.a.
	Other	<u>2.8</u>	<u>n.a.</u>
	Total	35.7 ²	9,500

n.a. = not available.

Source : Volume, Malaysia Annual Statistics of External Trade ; Value, FAO Trade Yearbook, various years.

1 Estimated data from FAO Trade Yearbook, Vol. 33, 1979.

2 January to October only.

Table A.11. Saudi Arabia : Volume and value of potato imports, 1978-84.

Year	Origin Country	Volume (000 t)	Value (US\$ 000)
1978	Lebanon	17.1	n.a.
	Turkey	6.3	n.a.
	Cyprus	3.2	n.a.
	Holland	2.3	n.a.
	Egypt	1.5	n.a.
	Other	<u>3.7</u>	<u>2,396</u>
	Total	34.1	20,301
1979	Lebanon	23.2	n.a.
	Cyprus	7.7	n.a.
	Turkey	4.7	n.a.
	Pakistan	1.4	n.a.
	Holland	1.6	n.a.
	Other	<u>9.2</u>	<u>n.a.</u>
	Total	47.8	12,506

Table A.11. Continued.

Year	Origin Country	Volume (000 t)	Value (US\$ 000)
1980	Lebanon	41.0	n.a.
	Cyprus	7.0	n.a.
	Egypt	5.9	n.a.
	Turkey	4.4	n.a.
	Holland	1.3	n.a.
	Other	<u>5.9</u>	<u>n.a.</u>
	Total	65.3	17,531
1981	Lebanon	58.2	n.a.
	Cyprus	8.0	n.a.
	Turkey	6.0	n.a.
	Egypt	3.0	n.a.
	Syria	1.8	n.a.
	Other	<u>4.7</u>	<u>—</u>
	Total	81.7	17,602
1982	Lebanon	59.7	n.a.
	Egypt	8.9	n.a.
	Cyprus	4.2	n.a.
	Turkey	3.9	n.a.
	Jordan	3.4	n.a.
	Other	<u>4.2</u>	<u>5,370</u>
	Total	84.2	51,841
1983	Lebanon	71.5	n.a.
	Egypt	16.7	n.a.
	Cyprus	8.9	n.a.
	Turkey	4.2	n.a.
	Jordan	2.2	n.a.
	Other	<u>6.3</u>	<u>n.a.</u>
	Total	109.7	21,214
1984	Total	102.3	18,316

n.a. = not available.

Source : Volumes, 1978-83, Saudi Arabia Trade Statistics, 1984, FAO Trade Yearbook ; Value, FAO Trade Yearbook.

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Table A.12. United Arab Emirates : Volume and value of potato imports, 1978-81.

Year	Origin Country	Abu-Dhabi		Dubai		
		Volume (000t)	Value (Dirham 0')	Volume (000t)	Value (Dirham 0')	
1978	Lebanon	13.9	16,920	Pakistan	1.9	840
	Cyprus	2.2	2,831	France	0.3	781
	Turkey	0.8	1,118	Iran	0.1	10
	Egypt	0.6	892	Other	0.2	199
	Other	0.5	538			
	Total	18.0	22,299	Total	2.4	1,830
1979	Lebanon	13.9	n.a.	Pakistan	3.5	n.a.
	Cyprus	2.3	n.a.	France	1.0	n.a.
	Turkey	0.3	n.a.	Iran	0.1	n.a.
	Holland	0.2	n.a.	France	0.5	n.a.
	Other	n.a.	n.a.	Other	0.4	n.a.
	Total	16.0	n.a.	Total	4.7	n.a.
1980	Lebanon	15.5	n.a.	Pakistan	2.9	n.a.
	Cyprus	1.7	n.a.	Egypt	0.1	n.a.
	Egypt	0.2	n.a.	India	0.1	n.a.
	Turkey	0.3	n.a.	Other	0.4	n.a.
	Other	0.5	n.a.			
	Total	18.2	n.a.	Total	3.5	n.a.
1981	Lebanon	21.3	21,920	Pakistan	1.9	1,222
	Cyprus	1.7	1,682	Holland	0.3	427
	Turkey	0.5	501	France	0.3	739
	Syria	0.5	508	India	0.2	173
	Jordan	0.5	460	Other	0.1	46
	Other	0.4	—			
Total	24.1	24,487	Total	2.8	2,607	

n.a. = not available.

Source : Foreign Trade Statistics, UAE Customs Department Abu Dhabi. External Trade Statistics; Statistics Office of Central Accounts Section.

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Table A.13. Bahrain : Volume and value of potato imports, 1976-84.

Year	Origin country	Volume (000t)	Value (US\$ 000)
1976	Dubai	0.5	n.a.
	Lebanon	1.5	n.a.
	Iran	0.9	n.a.
	S. Arabia	0.4	n.a.
	Other	0.5	n.a.
	Total	3.7	n.a.
1977	Lebanon	2.5	n.a.
	India	1.1	n.a.
	Iran	1.4	n.a.
	S. Arabia	0.5	n.a.
	Other	0.7	n.a.
	Total	6.2	n.a.
1979	Total	10.0	2,371
1980	Total	7.1	1,019
1981	Total	8.3	1,590
1982	Total	8.8	1,466
1983	Total	10.0	1,640
1984	Total	9.0	1,600

n.a. = not available.

Source : Volumes, 1976-77, Annual Trade Returns of Bahrain, 1979-84, FAO Trade Yearbook, Vol. 35-38 ; Value, FAO Trade Yearbook, Vol. 35-38.

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Table A.14. Kuwait : Volume and value of potato imports, 1979-84.

Year	Origin country	Volume (000t)	Value (000 Dinars)
1979	Lebanon	14.1	n.a.
	Cyprus	3.3	n.a.
	Turkey	1.8	n.a.
	Pakistan	1.5	n.a.
	Other	<u>3.2</u>	<u>n.a.</u>
	Total	23.9	2,183
1980	Lebanon	13.9	n.a.
	Turkey	2.4	n.a.
	Cyprus	2.8	n.a.
	Pakistan	1.2	n.a.
	Other	<u>3.4</u>	<u>n.a.</u>
	Total	23.7	2,028
1981	Lebanon	20.9	n.a.
	Turkey	3.1	n.a.
	Cyprus	2.0	n.a.
	Egypt	2.4	n.a.
	Other	<u>3.8</u>	<u>n.a.</u>
	Total	32.3	3,019
1982	Total	28.8	10,047 ¹
1983	Total	28.0	9,200 ¹
1984	Total	30.0	10,500 ¹

n.a. = not available.

Source : 1979-81, Foreign Trade Statistics, Ministry of Planning, Central Office of Statistics; 1982-84, FAO Trade Yearbook, Vol. 38.

¹ US\$ 000.

A.15. Bangladesh : Average monthly wholesale prices (takamaund) for potatoes (Holland white) in selected cities, 1977.

	DHAKA	KHOSHTA	WASHINGT	FAJALPUR	PABNA	BOGRA	RANGPUR	DINAJPUR	RASHHAT	KUSHTA	JESSORE	KHULNA	PATTAHALI	BARISAL	COMILA	SILHET	CHOWNAGANI	CHITTAGONG	RAJSHAYI
36,000	45,000	53,000	43,000	52,000	42,000	37,000	45,000	42,000	50,000	46,000	54,000	55,000	48,000	51,000	50,000	63,000	50,000	53,000	54,000
33,000	30,000	43,000	35,000	35,000	31,000	31,000	36,000	41,000	37,000	39,000	41,000	37,000	35,000	37,000	38,000	42,000	38,000	38,000	46,000
35,000	28,000	43,000	36,000	39,000	32,000	33,000	38,000	41,000	45,000	45,000	45,000	41,000	41,000	39,000	36,000	39,000	36,000	38,000	44,000
38,000	42,000	46,000	42,000	45,000	44,000	35,000	47,000	44,000	51,000	48,000	45,000	45,000	47,000	47,000	46,000	56,000	46,000	45,000	62,000
50,000	53,000	64,000	51,000	57,000	61,000	46,000	58,000	56,000	57,000	60,000	62,000	58,000	63,000	61,000	59,000	70,000	59,000	58,000	76,000
45,000	59,000	65,000	62,000	59,000	61,000	68,000	66,000	59,000	60,000	57,000	62,000	61,000	63,000	60,000	60,000	70,000	60,000	62,000	83,000
44,000	65,000	61,000	79,000	59,000	62,000	60,000	70,000	64,000	70,000	64,000	64,000	61,000	63,000	60,000	60,000	65,000	60,000	64,000	60,000
70,000	76,000	85,000	83,000	87,000	90,000	71,000	79,000	80,000	92,000	82,000	86,000	81,000	96,000	87,000	83,000	81,000	83,000	84,000	72,000
71,000	90,000	87,000	86,000	87,000	90,000	87,000	101,000	89,000	90,000	79,000	85,000	80,000	89,000	86,000	79,000	86,000	79,000	82,000	80,000
77,000	98,000	99,000	91,000	91,000	99,000	90,000	101,000	99,000	104,000	86,000	92,000	87,000	100,000	93,000	87,000	94,000	88,000	88,000	92,000
95,000	110,000	113,000	117,000	119,000	128,000	116,000	119,000	111,000	118,000	111,000	110,000	108,000	132,000	104,000	116,000	114,000	116,000	98,000	100,000
93,000	108,000	103,000	112,000	123,000	107,000	110,000	94,000	93,000	127,000	123,000	122,000	118,000	126,000	116,000	130,000	140,000	130,000	141,000	150,000

Source : Agricultural Marketing Department, Dhaka.

A.16. Bangladesh : Average monthly wholesale prices (takamaund) for potatoes (Holland white) in selected cities, 1978.

	DHAKA	KHOSHTA	WASHINGT	FAJALPUR	PABNA	BOGRA	RANGPUR	DINAJPUR	RASHHAT	KUSHTA	JESSORE	KHULNA	PATTAHALI	BARISAL	COMILA	SILHET	CHOWNAGANI	CHITTAGONG	RAJSHAYI
57,000	7,000	83,000	84,000	86,000	92,000	81,000	79,000	93,000	95,000	88,000	61,000	84,000	73,000	88,000	79,000	101,000	86,000	92,000	104,000
49,000	49,000	57,000	49,000	49,000	65,000	53,000	54,000	63,000	55,000	80,000	55,000	50,000	51,000	50,000	47,000	60,000	49,000	57,000	62,000
51,000	31,000	50,000	50,000	43,000	60,000	45,000	45,000	48,000	56,000	48,000	49,000	47,000	44,000	46,000	41,000	55,000	44,000	55,000	59,000
50,000	39,000	56,000	55,000	52,000	60,000	47,000	53,000	58,000	56,000	53,000	55,000	53,000	57,000	56,000	51,000	66,000	52,000	62,000	68,000
49,000	55,000	55,000	62,000	52,000	60,000	64,000	58,000	67,000	59,000	54,000	56,000	55,000	56,000	56,000	51,000	66,000	51,000	58,000	62,000
57,000	59,000	68,000	63,000	57,000	68,000	64,000	69,000	72,000	70,000	61,000	65,000	63,000	64,000	61,000	59,000	61,000	61,000	64,000	75,000
73,000	72,000	86,000	85,000	76,000	83,000	75,000	81,000	89,000	80,000	83,000	80,000	79,000	85,000	79,000	76,000	92,000	79,000	74,000	78,000
88,000	100,000	103,000	102,000	105,000	110,000	96,000	105,000	106,000	99,000	105,000	104,000	101,000	111,000	97,000	98,000	99,000	99,000	87,000	81,000
93,000	106,000	114,000	106,000	106,000	110,000	105,000	118,000	114,000	107,000	109,000	109,000	102,000	115,000	103,000	103,000	107,000	101,000	93,000	100,000
115,000	121,000	132,000	130,000	127,000	136,000	131,000	130,000	123,000	127,000	141,000	133,000	127,000	136,000	128,000	118,000	114,000	117,000	114,000	100,000
131,000	137,000	143,000	138,000	147,000	150,000	123,000	139,000	128,000	143,000	151,000	149,000	143,000	156,000	140,000	137,000	148,000	118,000	139,000	130,000
100,000	114,000	118,000	140,000	144,000	118,000	92,000	112,000	101,000	119,000	129,000	129,000	147,000	138,000	131,000	125,000	120,000	121,000	146,000	90,000

Source : Agricultural Marketing Department, Dhaka.

A.17. Bangladesh : Average monthly wholesale prices (takamaund) for potatoes (Holland white) in selected cities, 1979.

DHAKA	KHOSHEGA	WERSENG	JAMULUR	TANGAIL	FAJURRA	MANA	BOGA	BARAKTA	DHAKUR	KASBAH	KISHTIA	ISSRE	HEHUA	PATUAKHALI	BARAKL	COMILA	SHUET	CHOWHAN	CHITTAGONG	BARANGANJI		
42,000	63,000	66,000	67,000	57,000	57,000	55,000	48,000	47,000	60,000	56,000	63,000	53,000	60,000	49,000	51,000	53,000	49,000	51,000	52,000	85,000	50,000	65,000
35,000	40,000	58,000	45,000	50,000	43,000	38,000	40,000	42,000	59,000	47,000	46,000	46,000	40,000	40,000	41,000	40,000	40,000	40,000	50,000	45,000	40,000	60,000
36,000	34,000	56,000	50,000	56,000	42,000	61,000	52,000	50,000	53,000	54,000	43,000	46,000	40,000	43,000	41,000	42,000	40,000	40,000	42,000	37,000	44,000	69,000
41,000	44,000	56,000	55,000	55,000	50,000	64,000	52,000	54,000	56,000	58,000	53,000	45,000	46,000	45,000	48,000	45,000	46,000	46,000	50,000	44,000	44,000	64,000
59,000	60,000	61,000	61,000	56,000	59,000	70,000	69,000	64,000	67,000	64,000	56,000	59,000	55,000	58,000	55,000	54,000	58,000	55,000	58,000	49,000	51,000	63,000
53,000	70,000	66,000	64,000	64,000	65,000	74,000	66,000	66,000	59,000	70,000	64,000	64,000	75,000	58,000	60,000	60,000	66,000	60,000	66,000	55,000	55,000	70,000
59,000	91,000	78,000	67,000	75,000	67,000	85,000	68,000	94,000	73,000	74,000	85,000	77,000	64,000	82,000	73,000	60,000	82,000	73,000	60,000	70,000	67,000	75,000
102,000	126,000	117,000	119,000	115,000	119,000	105,000	99,000	108,000	114,000	117,000	113,000	128,000	111,000	116,000	115,000	115,000	101,000	101,000	101,000	100,000	107,000	90,000
110,000	138,000	128,000	135,000	131,000	130,000	147,000	121,000	122,000	137,000	135,000	140,000	133,000	112,000	135,000	115,000	128,000	125,000	125,000	125,000	120,000	112,000	116,000
109,000	130,000	135,000	132,000	145,000	136,000	150,000	128,000	122,000	135,000	135,000	120,000	116,000	107,000	134,000	124,000	123,000	117,000	114,000	114,000	114,000	134,000	120,000
109,000	123,000	126,000	136,000	135,000	135,000	140,000	119,000	130,000	149,000	126,000	120,000	111,000	97,000	125,000	126,000	119,000	111,000	111,000	111,000	120,000	100,000	140,000
93,000	115,000	119,000	105,000	110,000	170,000	130,000	105,000	78,000	127,000	115,000	145,000	94,000	93,000	128,000	119,000	107,000	109,000	109,000	109,000	100,000	140,000	144,000

Source : Agricultural Marketing Department, Dhaka.

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A.18. Bangladesh : Average monthly wholesale prices (takamaund) for potatoes (Holland white) in selected cities, 1980

DHAKA	KHOSHEGA	WERSENG	JAMULUR	TANGAIL	FAJURRA	MANA	BOGA	BARAKTA	DHAKUR	KASBAH	KISHTIA	ISSRE	HEHUA	PATUAKHALI	BARAKL	COMILA	SHUET	CHOWHAN	CHITTAGONG	BARANGANJI
65,000	71,000	75,000	80,000	47,000	89,000	91,000	67,000	61,000	77,000	73,000	76,000	82,000	85,000	80,000	79,000	76,000	61,000	90,000	74,000	87,000
46,000	42,000	59,000	61,000	47,000	57,000	44,000	42,000	50,000	59,000	44,000	42,000	50,000	53,000	49,000	57,000	56,000	53,000	73,000	45,000	73,000
45,000	37,000	53,000	57,000	57,000	48,000	62,000	45,000	52,000	57,000	54,000	47,000	57,000	52,000	51,000	50,000	42,000	57,000	45,000	45,000	68,000
61,000	57,000	78,000	73,000	59,000	70,000	85,000	69,000	76,000	71,000	68,000	69,000	73,000	65,000	79,000	70,000	67,000	73,000	54,000	65,000	80,000
83,000	71,000	97,000	93,000	95,000	95,000	110,000	104,000	105,000	99,000	104,000	87,000	100,000	88,000	101,000	90,000	93,000	99,000	73,000	80,000	102,000
85,000	87,000	100,000	109,000	101,000	103,000	110,000	101,000	103,000	115,000	101,000	94,000	96,000	87,000	105,000	96,000	98,000	100,000	93,000	91,000	103,000
100,000	109,000	119,000	112,000	115,000	115,000	123,000	104,000	113,000	125,000	116,000	108,000	114,000	108,000	124,000	108,000	104,000	118,000	105,000	105,000	100,000
115,000	125,000	134,000	146,000	138,000	133,000	128,000	128,000	133,000	130,000	140,000	137,000	157,000	123,000	142,000	128,000	128,000	120,000	120,000	122,000	115,000
125,000	134,000	144,000	150,000	140,000	140,000	160,000	136,000	140,000	138,000	142,000	141,000	138,000	134,000	141,000	130,000	130,000	125,000	140,000	122,000	125,000
110,000	118,000	134,000	144,000	140,000	141,000	148,000	129,000	139,000	142,000	147,000	135,000	126,000	123,000	145,000	125,000	133,000	128,000	140,000	118,000	127,000
142,000	146,000	178,000	167,000	160,000	148,000	150,000	158,000	164,000	171,000	151,000	157,000	147,000	150,000	178,000	150,000	151,000	160,000	210,000	163,000	160,000
159,000	157,000	144,000	154,000	143,000	176,000	167,000	167,000	133,000	124,000	150,000	168,000	151,000	151,000	191,000	169,000	196,000	204,000	178,000	157,000	157,000

Source : Agricultural Marketing Department, Dhaka.

A.19. Bangladesh : Average monthly wholesale prices (taka/maund) for potatoes (Holland white) in selected cities, 1981

DDMM	COMSILLA	NETHERCHAL	JAMUNNA	TAKSIL	FARIDPUR	NAHA	BOGRA	BAKERE	DHULIAN	RAJSHAH	KUSTHA	ESSEN	NETINA	PAITURHALLI	BARISAL	COMILLA	STREET	CHOWNAGAN	CHITTAGONG	RAJSHAHI	
64.0000	70.0000	86.0000	74.0000	77.0000	84.0000	86.0000	58.0000	57.0000	75.0000	67.0000	76.0000	77.0000	77.0000	79.0000	75.0000	69.0000	81.0000	69.0000	67.0000	72.0000	105.0000
47.0000	45.0000	66.0000	49.0000	60.0000	59.0000	66.0000	54.0000	55.0000	64.0000	56.0000	59.0000	54.0000	57.0000	52.0000	54.0000	51.0000	62.0000	57.0000	51.0000	51.0000	63.0000
60.0000	54.0000	80.0000	72.0000	80.0000	60.0000	88.0000	71.0000	78.0000	79.0000	76.0000	68.0000	71.0000	56.0000	62.0000	68.0000	63.0000	68.0000	50.0000	64.0000	64.0000	71.0000
70.0000	74.0000	92.0000	87.0000	89.0000	76.0000	95.0000	84.0000	92.0000	96.0000	99.0000	77.0000	80.0000	75.0000	84.0000	78.0000	69.0000	84.0000	69.0000	70.0000	78.0000	70.0000
79.0000	88.0000	96.0000	94.0000	96.0000	88.0000	102.0000	97.0000	105.0000	100.0000	94.0000	86.0000	91.0000	89.0000	94.0000	86.0000	88.0000	73.0000	80.0000	83.0000	90.0000	90.0000
76.0000	86.0000	97.0000	101.0000	100.0000	100.0000	92.0000	92.0000	99.0000	90.0000	92.0000	85.0000	90.0000	82.0000	95.0000	83.0000	91.0000	102.0000	85.0000	85.0000	112.0000	112.0000
80.0000	95.0000	92.0000	98.0000	95.0000	106.0000	100.0000	102.0000	98.0000	99.0000	99.0000	93.0000	90.0000	86.0000	96.0000	94.0000	89.0000	101.0000	80.0000	85.0000	110.0000	110.0000
118.0000	132.0000	144.0000	150.0000	150.0000	139.0000	127.0000	121.0000	134.0000	142.0000	143.0000	141.0000	135.0000	118.0000	144.0000	136.8200	130.0000	136.0000	140.0000	133.0000	130.0000	130.0000
129.0000	143.0000	145.0000	156.0000	151.0000	146.0000	140.0000	138.0000	132.0000	145.0000	157.0000	138.0000	136.0000	131.0000	153.0000	131.0000	131.0000	135.0000	140.0000	131.0000	140.0000	140.0000
137.0000	127.0000	143.0000	160.0000	156.0000	154.0000	156.0000	154.0000	158.0000	141.0000	155.0000	142.0000	150.0000	147.0000	161.0000	144.0000	136.0000	132.0000	146.0000	136.0000	140.0000	140.0000
157.0000	168.0000	176.0000	188.0000	163.0000	163.0000	183.0000	170.0000	197.0000	168.0000	178.0000	167.0000	174.0000	194.0000	183.0000	173.0000	155.0000	154.0000	180.0000	156.0000	140.0000	140.0000
129.0000	140.0000	150.0000	148.0000	180.0000	165.0000	138.0000	123.0000	101.0000	94.0000	144.0000	113.0000	147.0000	134.0000	133.0000	137.0000	183.0000	162.0000	140.0000	129.0000	131.0000	131.0000

Source : Agricultural Marketing Department, Dhaka.

A.20. Bangladesh : Average monthly wholesale prices (taka/maund) for potatoes (Holland white) in selected cities, 1982

DDMM	COMSILLA	NETHERCHAL	JAMUNNA	TAKSIL	FARIDPUR	NAHA	BOGRA	BAKERE	DHULIAN	RAJSHAH	KUSTHA	ESSEN	NETINA	PAITURHALLI	BARISAL	COMILLA	STREET	CHOWNAGAN	CHITTAGONG	RAJSHAHI	
65.0000	81.0000	78.0000	76.0000	82.0000	79.0000	80.0000	64.0000	59.0000	65.0000	78.0000	76.0000	60.0000	85.0000	93.0000	85.0000	73.0000	76.0000	82.0000	69.0000	78.0000	78.0000
50.0000	50.0000	66.0000	63.0000	65.0000	59.0000	71.0000	53.0000	60.0000	65.0000	61.0000	59.0000	65.0000	58.0000	57.0000	65.0000	50.0000	68.0000	50.0000	53.0000	66.0000	66.0000
52.0000	52.0000	65.0000	66.0000	67.0000	61.0000	70.0000	49.0000	60.0000	69.0000	65.0000	59.0000	65.0000	53.0000	59.0000	63.0000	51.0000	70.0000	56.0000	56.0000	66.0000	66.0000
50.0000	54.0000	64.0000	61.0000	67.0000	60.0000	67.0000	47.0000	56.0000	55.0000	54.0000	58.0000	66.0000	61.0000	61.0000	62.0000	55.0000	68.0000	58.0000	49.0000	78.0000	78.0000
38.0000	53.0000	51.0000	55.0000	58.0000	52.0000	53.0000	46.0000	54.0000	53.0000	55.0000	51.0000	51.0000	51.0000	54.0000	50.0000	53.0000	57.0000	56.0000	48.0000	70.0000	70.0000
35.0000	46.0000	46.0000	50.0000	57.0000	44.0000	50.0000	50.0000	55.0000	52.0000	55.0000	42.0000	47.0000	46.0000	49.0000	48.0000	57.0000	61.0000	51.0000	45.0000	73.0000	73.0000
45.0000	49.0000	52.0000	56.0000	65.0000	55.0000	63.0000	57.0000	62.0000	66.0000	73.0000	55.0000	63.0000	61.0000	65.0000	66.0000	60.0000	68.0000	63.0000	54.0000	73.0000	73.0000
103.0000	90.0000	100.0000	94.0000	98.0000	117.0000	100.0000	85.0000	98.0000	101.0000	121.0000	115.0000	113.0000	99.0000	116.0000	118.0000	105.0000	115.0000	120.0000	114.0000	105.0000	105.0000
80.0000	86.0000	92.0000	104.0000	102.0000	116.0000	100.0000	90.0000	92.0000	102.0000	111.0000	102.0000	91.0000	99.0000	109.0000	96.0000	97.0000	99.0000	120.0000	88.0000	120.0000	120.0000

Source : Agricultural Marketing Department, Dhaka.

A. 21. Bangladesh : Correlation matrix for average monthly wholesale prices for potatoes in selected cities, 1982.

Field	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1	1.0000																					
2	0.9307	1.0000																				
3	0.9801	0.9307	1.0000																			
4	0.9521	0.9261	0.9567	1.0000																		
5	0.9694	0.9535	0.9598	0.9866	1.0000																	
6	0.9846	0.9459	0.9662	0.9842	0.9900	1.0000																
7	0.9724	0.9559	0.9836	0.9734	0.9758	0.9709	1.0000															
8	0.9296	0.9004	0.8819	0.9440	0.9633	0.9605	0.9168	1.0000														
9	0.9430	0.8190	0.8757	0.9064	0.9134	0.9467	0.8975	0.9483	1.0000													
10	0.9414	0.8221	0.8971	0.9417	0.9344	0.9518	0.9377	0.9497	0.9767	1.0000												
11	0.9595	0.8945	0.8977	0.9234	0.9496	0.9621	0.9212	0.9747	0.9711	0.9681	1.0000											
12	0.9963	0.9436	0.9743	0.9589	0.9741	0.9915	0.9682	0.9413	0.9456	0.9427	0.9656	1.0000										
13	0.9510	0.7828	0.9045	0.8597	0.8745	0.9151	0.9070	0.8548	0.9534	0.9297	0.9174	0.9409	1.0000									
14	0.9496	0.9722	0.9409	0.9461	0.9810	0.9652	0.9492	0.9449	0.8664	0.8769	0.9302	0.9606	0.8379	1.0000								
15	0.9640	0.9791	0.9404	0.9428	0.9797	0.9717	0.9422	0.9510	0.8904	0.8947	0.9561	0.9729	0.8578	0.9917	1.0000							
16	0.9833	0.9285	0.9585	0.9079	0.9478	0.9536	0.9536	0.9146	0.9067	0.9071	0.9547	0.9794	0.9269	0.9560	0.9702	1.0000						
17	0.9422	0.9302	0.8789	0.9057	0.9449	0.9550	0.8793	0.9675	0.9406	0.9025	0.9694	0.9517	0.8707	0.9416	0.9640	0.9314	1.0000					
18	0.9876	0.8834	0.9421	0.9173	0.9426	0.9642	0.9412	0.9320	0.9700	0.9510	0.9704	0.9793	0.9705	0.9148	0.9384	0.9716	0.9504	1.0000				
19	0.9537	0.9466	0.9064	0.9503	0.9744	0.9802	0.9717	0.9755	0.9418	0.9286	0.9727	0.9674	0.8746	0.9626	0.9773	0.9330	0.9875	0.9456	1.0000			
20	0.9804	0.9107	0.9319	0.8974	0.9260	0.9547	0.9155	0.9193	0.9486	0.9255	0.9712	0.9795	0.9435	0.9153	0.9488	0.9767	0.9552	0.9849	0.9461	1.0000		
21	0.8471	0.8387	0.7962	0.8989	0.8990	0.9144	0.8184	0.9182	0.8971	0.8637	0.8746	0.8726	0.7949	0.8680	0.8659	0.7847	0.9173	0.8434	0.9426	0.8202	1.0000	

Source : Elaborated for this study.

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