Analysis Of The Food Problem In Bangladesh: An Econometric Investigation

by

Muhammad Khorshed Alam Chowdhry

A thesis
presented to the University of Manitoba
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy
in
Department of Economics, University of Manitoba.

Winnipeg, Manitoba

(c) Muhammad Khorshed Alam Chowdhry, 1986

Permission has been granted to the National Library of Canada to microfilm this thesis and to lend or sell copies of the film.

The author (copyright owner) has reserved other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without his/her written permission.

L'autorisation a été accordée à la Bibliothèque nationale du Canada de microfilmer cette thèse et de prêter ou de vendre des exemplaires du film.

L'auteur (titulaire du droit d'auteur) se réserve les autres droits de publication; ni la thèse ni de longs extraits de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation écrite.

ISBN 0-315-34066-5

ANALYSIS OF THE FOOD PROBLEM IN BANGLADESH: AN ECONOMETRIC INVESTIGATION

BY

MUHAMMAD KHORSHED ALAM CHOWDHRY

A thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

DOCTOR OF PHILOSOPHY

© 1986

Permission has been granted to the LIBRARY OF THE UNIVERSITY OF MANITOBA to lend or sell copies of this thesis, to the NATIONAL LIBRARY OF CANADA to microfilm this thesis and to lend or sell copies of the film, and UNIVERSITY MICROFILMS to publish an abstract of this thesis.

The author reserves other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without the author's written permission.

I hereby declare that I am the sole author of this thesis.

I authorize the University of Manitoba to lend this thesis to other institutions or individuals for the purpose of scholarly research.

Muhammad Khorshed Alam Chowdhry

I further authorize the University of Manitoba to reproduce this thesis by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

Muhammad Khorshed Alam Chowdhry

The University of Manitoba requires the signatures of all persons using or photocopying this thesis. Please sign below, and give address and date.

ABSTRACT

The general objective of the research is to examine the dimensions of the food problem in Bangladesh. Widespread malnutrition, hunger and starvation have become endemic to Bangladesh itself. Various hypotheses have been put forward to explain the "silent" problem ranging from unfavourable weather cycles to demographic explosion to food availability decline. None of these explanations seem adequate to explain the problem afflicting Bangladesh. Total availability of foodgrains has been maintained at an adequate level by a steady food import. Hence, the food availability decline (FAD) hypothesis does very poorly in the explanation of the problem. Sen's hypothesis of declining food entitlements offers a better explanation to the widespread hunger prevailing in Bangladesh. Food entitlements of a particular class of people are declining in the form of increased landlessness and indebtedness, falling real wages, and adverse movement of agricultural terms of trade, exposing them to stark hunger and starvation. Unfortunately, without relevant micro-level data, this preferred approach could not be pursued any farther.

A "second-best" approach of estimating the food demand of Bangladesh was attempted. Food demand has different conno-

tations like "food requirements" (biological demand) and "market demand" (effective demand). One study by Hamid (1980) made an elaborate attempt at synthesizing the two approaches. However, this study had numerous flaws which required a re-calculation.

Specifically, this research was directed towards building a market demand function for food. A price flexibility market model was specified and time series data were used to estimate the model. Using time series data raised numerous statistical problems. Tobin's (1950) and Durbin's (1953) method of combining extraneous information from budget data were used to derive efficient parameter estimates. Demand projections, based on alternative price and income growth, were made. Calculations show that there is very little "market deficit" in food. Similar conclusions are also derived from a three sector macro food demand and supply model. According to the macro model the food gap ranges from 1 per cent to 3 per cent depending on the productivity of the different sectors. Simulation runs show that a target 7 per cent growth of GDP, as envisaged by the National Perspective Plan 1980-2000, is internally consistent. On the other hand, food autarcky, another plan objective, and the target growth rate are mutually exclusive.

Because of massive imports of food into Bangladesh each year, fears are raised that it exerts disincentive price effects on domestic food production. Using a multi-equation simultaneous model we were able to show that food imports do not have any disincentive effects on domestic food production. In addition to supply shifts associated with food imports, there are also demand shifts because of the fact that imported food is distributed at a subsidised rate through the rationing system. Therefore, more, not less, food aid can be recommended, which gives planners a greater degree of freedom in food planning.

Bangladesh's food problem can be seen as an extension of the poverty syndrome prevailing in the country. Hence, the solution to the problem must be seen in the eradication of poverty. Both short-term and long-term measures are suggested to raise income and employment of the poor people.

Data concerning the study are from published government documents and from numerous published articles. Mathematical calculations are done with the WATFIV program and the regression analyses are done with the help of the SHAZAM package. ETS/SAS subroutine PROC ARIMA is also used to identify, estimate and forecast the ARIMA model.

ACKNOWLEDGEMENTS

I am extremely grateful to my advisor Prof. Henry Rempel for initiating and stimulating interest in this research. His meticulous comments and constant encouragement has helped to bring the research to the stage where it is now. Thanks are due to my committee members, Prof. Wayne Simpson and Prof. G.N. Ramu, for reading the thesis and helping me sharpen many ideas. Prof. Simpson was always available to discuss and clarify many knotty technical points.

Researchers go through cycles of frustration and optimism in the course of their investigation. Mr. Rabiul Islam Khan, now at the National Board of Revenue, Bangladesh, helped reduce the amplitude of these cycles by sending me vital data which were otherwise unavailable. Mr. Ansari Khan wrote flexible computer programs which were fun to play with.

My parents, Badsha and Nuri, through their constant prayers and encouragement were a source of inspiration during difficult times. My brothers, Taher and Quasem, were very appreciative of my work.

I am also grateful to Chittagong University, Bangladesh, for granting me leave of absence. Thanks are also due to the J.W. Dafoe Fellowship Foundation for funding me during 1982-84. I am also grateful to the Department of Economics, University of Manitoba, for financing me through sessional lecturerships. Moreover, computer dollars from the department were liberally spent as free goods.

Although statisticians omit uxorial love from GNP calculations, this does nor preclude me from acknowledging my debt to my wife, Mamta, here. My son Ishraque and my wife Mamta endured countless lonely evenings while I was working on this research. But they cheerfully granted me the leave of absence that I needed for this research. Their smiles and nod in the head were a source of renewal for me.

Finally, thank Allah the Almighty that I am able to finish the project.

DEDICATION

This thesis is dedicated to my advisor Prof. Henry Rempel.

CONTENTS

Appendix page

LIST OF TABLES

LIST OF FIGURES

Chapter I

INTRODUCTION

1.1 THE PROBLEM

Bangladesh's food problems combining production, procurement and distribution of foodgrains have reached such a critical level that it can be termed endemic to Bangladesh itself. A few manifestations of the food problem are widespread hunger, malnutrition, disease and death affecting a sub-set of population whose number is increasing over time. Ironically, Bangladesh is the fourth largest producer of rice and yet it is the largest importer of rice and the largest recipient of food aid (World Bank,1979:1). Despite governmental efforts to increase food production and achieve autarcky in food, grain imports in recent years have soared and the goal of self-sufficiency remains elusive.

Implications of the food problem are severe. Per capita foodgrain consumption is falling steadily over time leading to under-nourishment of the growing population. Apart from the quantitative decline in food, nutritional studies[1] in

---

[1] Three nutritional studies were done in Bangladesh. (1) Nutritional Survey of East Pakistan, March 1962-January 1964, (2) Nutritional Survey of Rural Bangladesh, 1975-76 and (3) Nutritional Survey of Rural Bangladesh, 1981-82 (draft).

Bangladesh show that there has been qualitative decline in consumption especially among the poorer section of the population. These studies also show that both "calorie and protein" gaps exists among the lowest income groups and at the same time rural dwellers are worse off than their urban counterparts.

The nature of the problem is difficult to tie down. Hunger and malnutrition are visibly seen in an acute form when some disasters, natural or contrived, interrupt the food supply in Bangladesh. Speedy relief of hunger in emergencies is not in itself at the heart of the food problem. The more fundamental issue is whether the present system of food production, import and distribution is adequate to meet the nutritional demands of a growing population.

It seems prudent to believe that we cannot propose a set of policies and strategies to alleviate or, optimistically, to solve Bangladesh's food problem unless we are in considerable agreement as to what the problem is. Unless we understand the basic and intermediate causes, it hardly is likely that we can bring about desired changes.

Historically it is seen that hunger is associated with countries which have had plentiful food; and Bangladesh is no exception. The land constituting Bangladesh today --- East Bengal --- was a prosperous economy with self-sufficiency in food except in periods of bad crops and abnormal events.[2] Bengal in India once provided the life blood of mercantile and industrial capitalist development (Frank;1966:28). After the partition of India in 1947, East Bengal became the eastern wing of Pakistan, the food situation changed drastically, and by 1960-61 she was importing under half a million tons of food. Thus, Bangladesh inherited the food problem after two successive colonial rules extending over two centuries. The cause for this problem is the 'colonialist mode of production' in agriculture. Bangladesh agriculture, particularly the 90 per cent of the rural population, were subjected to a high rate of 'primitive capital accumulation' which was transferred to finance the growth of West Pakistani capitalism and industrialisation (Khan;1972:29).

After the creation of Bangladesh in 1971, food situation worsened primarily because of the War of Liberation and most importantly because of the apathy and corruption of the ruling party, and in one year (1973-74) food imports reached an alarming 2.8 million tons. Even such a high import could not avert famine and quasi-famine related deaths during 1973-74 and 1978-79. Optimistic projections put the import

---

[2] Bengal had a severe famine in 1943 in which about three million perished. This was largely due to harvest failure, improper distribution of foodgrains due to World War II and widespread speculation which led to outright hoarding of foodgrains by a small section of traders. Sen (1981), however, argues that the famine occured during the boom phase of the economy and was not caused by a decline of food availability but because of erosion of 'entitlements'.

figure for Bangladesh to be around 2 million tons a year in future unless miraculous achievements take place in food production (World Bank;1979:xii). Increasing imports of foodgrains place Bangladesh vulnerable to external dependence.[3] And at the same time there is no assurance that the vulnerable poorest section of the population will be adequately fed.

The persistent food problem in Bangladesh has received inadequate attention from politicians, planners and researchers; and therefore, very little systematic and rigorous analysis of the problem seems to be available so far. The most common and popular view regarding the food problem in Bangladesh is the one expressed by the World Bank Report (1979). The World Bank Report (1979) views the food-gap in Bangladesh to be one of insufficient production[4](supply). This view represents the "productionists" viewpoint so popular among western scholars, politicians, press and the media. This is a view also shared by Bangladeshi scholars and government. As Chen and Chaudhury (1975:222-223) write:

---

[3] Sobhan (1979) narrates the way donor countries of foodgrain have used food as a weapon to achieve their political objectives in Bangladesh during the crisis of 1973-74.

[4] World Bank Report (1979:i) "... ... the food problem of Bangladesh is fundamentally a production problem ... ...".

The Report further observes that, " It is firstly a production problem, the solution of which requires a set of policies, programs and projects designed to accelerate the growth of food output, which has lagged behind population growth during the last two decades" (1979:iv).

> Domestic food production in Bangladesh has failed to keep up with food demand generated by population growth over the past 15 years......Regardless of the performance in agriculture, long range food demand cannot be met without substantial and sustained reduction of population growth rates.

The above view is biased, inadequate and provides a superficial explanation of the food problem which exonerates particular economic interests and institutions from blame. It is biased because it is built on neo-Malthusian premises. And it is superficial because if people are hungry, the presumption is that there must not be enough food!

Those who take a production centred view of Bangladesh's food problem have relied heavily on aggregative projections of future output and demand (requirement). It is relatively straight forward to take the balance between the growth in food production and the increase in population and hence to calculate what additional output will be needed to maintain or increase per capita availability of food in the light of the expected demographic trends. Recent food production and demographic figures promise a not-too-undaunting outlook for Bangladesh. Fears are rampant --- fears not just of starvation but consternation of the amorphous spectre of the submersion of the "civilized values" and the emergence of thousands of "desperadoes" for every one now terrorizing the rich today. Thus not only the diet appears to be at stake for some, but the very fabric of the civilisation is threatened by the hungry seeking food (Lappe and Collins;1977:4).

The "productionist" view is also shared by the Bangladesh government whose oft repeated slogan is to boost production and curb population growth. But this is not more than a mere lip-service since less and less resources are allocated to increase food production and few reforms are made to remove the bottlenecks in food production. Much of the theory and practice of the "Green Revolution" is tacitly based on the premise that the food problem should almost exculsively be battled from the supply-side, i.e., by increasing yields through bio-chemical technology, etc. However, what is missing in this paradigm is that insufficient effective demand may be the dominant constraint to larger food production. Likewise, income distribution from increased output and income is important to this whole problem. The poor are hungry because they are poor and cannot afford to buy food, and as long as poverty persists, it will simply not be profitable to grow food that the poor need. A production biased strategy which often leads to marginalisation and landlessness of the vast majority of small farmers and share-croppers can, therefore, never in itself overcome the food problem in Bangladesh.

The "productionists" view population outstripping food supply. In contrast, the contra-Malthusian hypothesis is that food supply increases in response to population growth. This hypothesis rests on the assumption that a stock of improved technology is accumulated (fortuitously) but adoption depends on population pressure (Boserup:1965). Both the neo-Malthusian and contra-Malthusian explanations of the relationship between the rates of growth in population and food supplies assume that causation is uni-directional and rule out any feedback. An alternative hypothesis is that as growing food supplies induce population expansion, so population growth induces further growth in food supplies. It is immaterial whether food supply or population is the cause or effect.

With some of the most fertile soils in the world, abundant rainfall and enormous reserves of natural gas, Bangladesh clearly has the potential to feed all its people (Lappe and Collins;1977:19). But the lingering food problem is, in part, a problem of proper distribution and management. As Lappe and Collins (1977:19) remark:

> Bangladesh probably now produces enough to keep all its people sufficiently fed. But the rich eat several times more grain than the poor. They consume 30 per cent more calories than the poor and twice the protein. Even more revealing is the fact that food hoarders smuggle as much as one third of all Bangladesh's marketed grain across the border to India to be sold for much valued rupees at prices twice as high as Bangladesh. As in other countries, the poor do not eat no matter how much food there is. While many starved after the 1974 floods, an estimated 4 million tons of rice stacked up for want of buyers because, in the words of National Geographic, "the vast majority .... were too poor to buy it." Much of this rice was grown by the very hungry who needed it. In order to pay off high interest debts to money lenders, they had to sell at harvest times when prices were at their lowest. Forced later to borrow again to buy at speculator's prices and in competition with high income city dwellers in India, they obviously faced increased chances of even greater hunger the following year.

Thus, there is scarcity, but it is not a scarcity of food. The scarcity is that of the people, who have neither access to the means to grow their own food nor the money to buy it. When the government's rationing system is taken into consideration --- a system whereby imported foodgrains as well as locally procured foodgrains from the countryside are distributed at a subsidised price to well-off urban dwellers much to the neglect of the poor, hungry masses in the rural areas --- another new dimension is added to the food problem. In humanitarian terms, these food imports do not reach the people for whom it is intended. And as for development, availability of cheaper foodgrains is alleged to under-cut the growth linkages of food production. Using Reutlinger's (1977) terminology, Bangladesh's food problem is not the "overt" type; but a mute and "silent" food crisis affecting the poorest section of the population.

The key to this "silent" food crisis of who goes hungry, regardless of whether aggregate food supplies are scarce or bountiful, is the distribution of effective demand or what Sen (1981) calls "exchange entitlements". Any economic change causing a decline in per capita real income, i.e., reduced working hours, open or disguised unemployment, or a sharp rise in the price of food or other basic necessities, will tend to "squeeze" the consumption of low income households. Comparative static analysis shows that some reduction in food consumption is expected out of given increase in the price of food. Since, the price elasticity of demand for food is lower for 'higher' income groups than for 'lower' income families --- the scale of the cut in per capita consumption will be inversely related to family income. Whereas 'high' income families may hardly need to reorganise their consumption basket, some poor families will be virtually priced out of the market. This is the tragic outcome of a free enterprise system. In Bangladesh there is strong evidence of continued erosion, for some identifiable classes (landless labourers and servants, marginal and small farmers, share-croppers, etc.), of the existing means of access to the available food. This is in sharp contrast to the African situation where entitlements are being eroded periodically (Rempel;1985:4).

Thus, the food problem can be viewed as one of poverty and maldistribution (Reutlinger;1977) --- maldistribution of income and productive power as well as contrived maldistribution of available foodstuffs. What emerges from the above discussion is that there is just not one but many food problems, and surprisingly large number of them are the result of human and governmental decisions rather than of immutable forces. Bangladesh's predicament is not exclusively an over-population scarcity diagnosis: people are hungry because prices are high in relation to income; and on the other hand, there is not enough production because producers do not receive incentive prices and also due to the presence of other factors which are not conducive to increased output.

The country's extra-ordinary food potential remains untapped not because of any divine condemnation, but because of the man-made impediments of a social and political order that seriously limits the scope for increased food production.

Based on the above discussion, the following insights of the problem may be helpful.

1. Within an aggregative framework of food production and anticipated demand, there is little evidence that supply will, of itself, be limiting in the near future, although significant efforts will be necessary to meet demand.
2. Underlying the aggregate figures is a problem of uneven distribution of foodgrains which shows up as widespread malnutrition and undernourishment in areas where incomes are chronically low and among disadvantaged groups even when average incomes are more satisfactory.
3. The poor and economically vulnerable groups, whose numbers are steadily swelling, are at present faced with the additional hazard of bearing the brunt of fluctuations in food prices and food availability arising from natural and contrived conditions.

This is a study of the problem of food in Bangladesh; an attempt at unfolding the conditions of political biases, institutional rigidities and social imbalances which combine with natural vicissitudes to produce a crisis. The aim is to study the problem in more exact terms, incorporating different perspectives hitherto overlooked within a broader analytical framework. This study suggests an alternative approach to the problem of food problem and hunger in Bangladesh, implying thereby that the conceptual framework within which the problem has been traditionally cast is sometimes deficient, unconvincing and most often misleading. In particular, we shall attempt to estimate the demand for food and project the future level of demand; and to dispel the notion of Bangladesh being a "basket-case" with its entire people condemned to perennial hunger; and also to establish that hunger is neither natural nor inevitable in Bangladesh.

The salient feature of this study is the empirical investigation of food demand in Bangladesh. Apart from the theoretical misconception of the food problem, it is further compounded by the fact that no proper estimate of market demand for food is available. So far food demand has been interpreted to be food "requirement" based on recommended dietary standards. This view of food demand is totally unsatisfactory since no market information is incorporated in the analysis. By estimating a market demand for food we thereby take into account the effect of market forces in influencing food demand. Other novel empirical features include (i) the identification, estimation and prediction of an ARIMA food "requirement" model; (ii) A three Sector Macro food demand-supply model taking into account the structural relationships within the sectors; and (iii) A simultaneous equation model to study the likely effect of food imports on Bangladesh food production. So far only casual remarks about the likely disincentive effects of food imports on domestic food production are found in the literature.

1.2 STRUCTURE OF THE STUDY

Chapter II comprises a review of trends in food production and population growth both at the aggregate level and disggregated levels. Attention is given to the incidence of malnutrition, hunger and the causes for them.

Chapter III concentrates on Hamid's (1980) study of food demand calculation which was deficient in many respects. Attempts were made to recalculate Hamid's model by removing the indequacies. As an illustration of alternative approach, in Appendix C an ARIMA food demand ("requirement") model is identified, estimated and optimal forecasts are obtained. These are all done within the methodology suggested by Box and Jenkins (1976).

Chapter IV constitutes an econometric estimation of market demand for food function for Bangladesh using both time series and cross-section data. Using only time series data creates numerous econometric problems. Therefore, Tobin's (1950) and Durbin's (1953) procedure of incorporating extraneous information from cross-section data into time series data will be attempted. Alternatively, a three Sector Macro food demand model will be built and some simulations will be done.

Chapter V will look into the likely effects of food imports on domestic agriculture. This will be done with the help of a simultaneous equations model. Lastly, Chapter VI summarises the findings of this study.

Chapter II

POPULATION AND FOOD SUPPLY IN BANGLADESH

It is increasingly recognised that Bangladesh is in crisis. Food scarcity is chronic, episodically becoming so severe as to lead to famine. Already there have been two severe food crises --- one in 1973-74 and the other in 1978-79 --- taking a severe toll on human lives and endless misery to the countless living the aftermath. And there are growing fears that such a famine will recur in future and the worst is yet to come unless proper production, procurement, import and distribution of foodgrains is ensured.

Various hypotheses have been put forward to explain these crises: unfavourable weather cycles, slow growth of agriculture, a bias in favour of urban areas, the demographic explosion. None of these explanations seem to be complete or fully convincing. Over the past twenty five years or so, the number of the rural poor has increased and their standard of living has tended to fall; and at the same time the problem of hunger, starvation and malnutrition has emerged.

An attempt is made here to describe the traditional view of the food problem in Bangladesh first, i.e. the relationship between food production and population growth. Under it we shall mainly focus on the following issues:

1. Has the food situation truly deteriorated in Bangladesh? If so, by how much and what has been the salient feature of this decline?
2. What is the relationship between food production and population?
3. Are all the districts/regions of Bangladesh in food "deficit"?

Secondly, we shall investigate the problem under Sen's (1981) methodology of "exchange entitlement" failure.

2.1 FOOD PRODUCTION TREND IN BANGLADESH

Food is used as a collective term for the end products that consumers buy to eat or drink. Food is considered not merely as a collection of inputs to satisfy human nutritional requirements but also as possessing a multi-dimensional range of consumer demands, e.g., taste, appearance, choice, novelty, convenience, entertainment, status and security.[5] Definitionally, food in this study would refer to rice and wheat only because of the overwhelming importance of these crops in Bangladesh. Production-wise they account for about 99 per cent of the total foodgrain production and cover over 80 per cent of the total cropped land (Government of Bangladesh (GOB) Statistical Year Book,1982). Consumption-wise, rice and wheat account for about 85 per cent of total calo-

---

[5] The multi-dimensional properties of commodities is an important aspect analysed in Lancaster (1966).

rie intake and households spend about 65 per cent of their entire budget on these two items alone (Household Expenditure Survey (HES),1977).

The production of foodgrains from 1960-61 to 1981-82 is presented in Table 2.1. Because the production levels of rice and wheat change due to weather conditions and other extraneous influences, it is necessary to eliminate periodicities and estimate the trend of these two crops. The annual growth rates of food production is summarised in Table 2.2.

For the sake of comparison, we divided our study period into two sub-periods: one covering 1960-61 to 1969-70 and the other from 1970-71 to 1981-82 respectively. Our findings, from Table 2.2, show that cereal production, rice and wheat production growth[6] rates are higher in the second period than the first. Overall cereal production was very sluggish and grew at less than 2 per cent per annum. Rice production accounted for this slow growth because of the overwhelming importance of rice, in terms of acreage, in the overall cereal production. Wheat production increased sensationally and grew overall at 16.75 per cent per annum over

---

[6] Annual growth rates were obtained by Ordinary Least Squares by fitting semi-logarithmic trend lines for different crop activities.
$Q = A \, Exp [bt]$ where, Q = quantity on the trend line, A = intercept term, b = annual growth rate and t = time period.

TABLE 2.1

Gross Production of Rice and Wheat 1960-61 to 1981-82

YEAR	RICE	WHEAT	CEREAL (RICE+WHEAT)
1960-61	9519	32	9551
1961-62	9465	39	9551
1962-63	8730	44	8774
1963-64	10457	34	10491
1964-65	10337	31	10368
1965-66	10335	35	10370
1966-67	9424	58	9482
1967-68	10995	58	11053
1968-69	11165	92	11257
1969-70	11718	103	11821
1970-71	10967	110	11077
1971-72	9774	113	9887
1972-73	9932	90	10022
1973-74	11721	109	11830
1974-75	11109	115	11244
1975-76	12561	215	12776
1976-77	11567	255	11822
1977-78	12763	343	13106
1978-79	12647	586	13233
1979-80	12539	810	13349
1980-81	13662	1075	14737
1981-82	13415	952	14367

Note: Figures in thousand tons.

Source: World Bank Report (1979) for data 1960-61 to 1978-79 and,
GOB,Statistical Year Book,1982,for data 1980-81 to 1981-82.

the 22 year period. One striking feature of the trend in food production is that both rice and wheat registered a higher growth rate in the latter period than the former period. One explanation for the higher growth of both rice and wheat during the 1970-71 to 1981-82 period is perhaps

TABLE 2.2

Annual Growth Rates in Production Levels of Rice and Wheat

Period	Annual Growth Rates (Per Cent) Rice	Wheat	Cereals
1960-61 to 1969-70	2.34	11.9	2.40
1970-71 to 1981-82	2.65	24.91	3.28
1960-61 to 1981-82	1.66	16.75	1.94

Source: Calculated from Table 2.1.

due to diffusion of "Green Revolution" techniques of production which started in Bangladesh in the mid-1960's.

The role of acreage expansion in rice and wheat production is by no means less important. Effective acreage was enhanced through multiple cropping as cropping intensity increased from 1.30 in 1960-61 to about 1.54 in 1981-82. The sources[7] of production change due to changes in acreage and yield for Bangladesh over the relevant periods are summar-

[7] Let, P = Production, A = Acreage, L = Yield and t = time (0 = base and 1 = current).

$P_1/P_0 = A_1L_1/A_0L_0$ Taking logarithms and by suitable transformation yields:

$$\log(A_1/A_0)/\log(P_1/P_0)+\log(L_1/L_0)/\log(P_1/P_0)= 1.$$

Hence,
Production Effect (100%) = Acreage Effect (%) + Yield Effect (%).

TABLE 2.3

Sources of Variation of Production

CROPS	PERIOD	PRODUCTION EFFECT ACREAGE (%)	YIELD (%)
AMAN	1960-69	43	57
	1970-81	26	74
	1960-81	28	72
AUS	1960-69	172	-72
	1970-81	-9	109
	1960-81	84	16
BORO	1960-69	53	47
	1970-79	80	20
	1960-81	60	40
TOTAL RICE	1960-69	73	27
	1970-81	27	73
	1960-81	49	51
WHEAT	1960-69	64	36
	1970-81	67	33
	1960-81	66	34

ised in Table 2.3 . Bangladesh has 3 main rice crops[8] mainly (1) AMAN (July-December), (2) AUS (April-August) and (3) BORO (December-April). Among the rice crops, Aus and Boro show dominant acreage effect in their change in output while

[8] 'AMAN' occupies 59 per cent of the total rice acreage and contributes to about 50 per cent of the rice production.
'AUS' occupies roughly 33 per cent of the acreage and contributes to about 25 per cent of the total production of rice.
'BORO' occupies 9 per cent of the acreage and produces 14 per cent of the total rice crop.

Aman shows the opposite. For the case of total rice production, the total effect is divided almost equally among acreage and yield effect. For wheat, the acreage effect is dominant which reveals among other things that the spectacular growth we have seen in Table 2.2 may be attributed to acreage expansion.

If we run a regression to determine the trend in the production, acreage expansion and yields of all the rice varieties and wheat, the above statement is substantiated. The trend in each of these crops is obtained by fitting semi-logarithmic trend lines to each crop and the results are shown in Table 2.4.

TABLE 2.4

Trend in Production, Acreage Expansion and Yield in Bangladesh

	PRODUCTION (%)			ACREAGE (%)			YIELD (%)		
CROPS	'60-69	70-81	60-81	'60-69	70-81	60-81	'60-69	70-81	60-81
AMAN	0.38	3.28	0.47	0.40	0.74	0.07	-0.04	2.01	0.48
AUS	2.65	2.46	1.25	3.77	0.21	1.11	0.56	2.15	0.14
BORO	16.46	1.51	9.50	8.62	2.24	5.94	7.68	0.42	3.29
TOTAL RICE	2.34	2.65	1.66	2.34	2.65	1.66	0.56	2.38	1.02
WHEAT	11.90	24.91	16.75	7.66	15.32	10.37	4.92	9.26	6.48

Table 2.4 indicates that overall increases in rice production were sluggish and grew at a rate of only 1.66 per cent per annum during the period 1960-81, but the rate of increase was slightly higher during the second sub-period from 1970-81 than during 1960-69. On the other hand, wheat production showed dramatic increases in the growth rate and likewise wheat production fared a lot better during 1970-81 period than in 1960-69 period. In terms of acreage expansion, the decade 1960-69 registerd higher increases, with the exception of Aman and wheat, for Aus and Boro varieties than in 1970-81 period. Overall during 1960-81 period, only Boro and wheat showed relatively higher increases in acreage while Aman and Aus acreage remained virtually stagnant.

In terms of productivity, the picture is dismal. Only wheat showed some signs of productivity gains while Aman, Aus and Boro productivity increases are only marginal. It may be mentioned that Bangladesh's productivity in rice and wheat cultivation is one of the lowest in South Asia, and Japan, with similar soil conditions to Bangladesh, has a productivity of about 400 per cent higher than Bangladesh (UNESCO;1975). Stagnation in acreage expansion signifies that virtually a physical limit in area has already been reached and any significant breakthrough in food production can only come through productivity increases by better farming techniques, innovation (i.e. crops with shorter gestation span, among others etc.) and removal of certain biases[9] from the economy.

2.1.1 Constraints on Increased Production

Faaland and Parkinson (1976:132), citing a World Bank report in 1971, concluded that the current rice production of about 13 million tons could be quadrupled by the end of the century with the help of already known state of the arts in combination with gradual development of irrigation and drainage facilities. The limitations of all such technocratic projections is that they explicitly abstract from political, socio-economic and other constraints; nevertheless these estimates do serve to highlight the contrast between present and potential levels of production. The constraints facing Bangladesh food production are summarised below:

(1) Resource Constraints: The major constraint to realising the potential for growth is the under-investment in agriculture specially by the public sector. Table 2.5 highlights the allocation of funds to agriculture and related activities in recent years. The following conclusion can be reached from above:

(i) Agriculture has not received its due share in the developmental funds. While the share of agriculture in GDP is around 55 per cent to 60 per cent, it has received less than

---

[9] Vylder (1982) lists these biases as follows: (1) urban (2) foreign (3) bureaucratic (4) capital (5) production (6) landlord (7) rice and (8) private.

TABLE 2.5

Allocation of Funds to Agriculture

Year	Allocation to Agriculture and Related Activities (Million Taka)	Allocation as % of Annual Development Plan
1973	1537	29.2
1974	1715	32.7
1975	3123	32.9
1976	3218	32.0
1977	3721	29.1
1978	4089	36.0
1979	-	-
1980	4261	17.9
1981	4825	17.8

Source: Hossain (1980:53).
GOB, Statistical Year Book, 1982 p 663.

30 per cent from the development budget and the share is on the decline. The neglect of agriculture does not stop here. As Vylder (1982:30) observes:

> Within the agricultural sector proper, a large part --- over 40 per cent on the average during the last five years --- of development expenditure is allocated to subsidies on fertilizers and pesticides, items which should be classified as current expenditure. These input subsidies have been essential for the strategy of increasing the use of the modern seed fertiliser technology but they almost exclusively benefit the big farmer; to a large extent they can be regarded as constituting consumption subsidy enabling the rural rich to prop up their demand for urban-produced industrial goods. If these subsidies are excluded, then the share of developmennt expenditures going to agriculture goes down to some 7 or 8 per cent.

The preeminent emphasis on industrialisation and other tertiary sectors to the utter neglect of the agricultural sector is what Vylder (1982) terms as "urban bias".

(2) Socio-Economic Constraints: Another major constraint to achieving a high rate of growth in Bangladesh agriculture is the prevalent agrarian structure. Two salient features in the structure which are believed to influence growth are:

1. The concentration in land ownership.
2. Prevalence of share tenancy.

The most recent 1977 Land Occupancy Survey in Bangladesh shows that although there are few large land owners, the degree of concentration in ownership is very high. The top 10 per cent of rural households owned about 50 per cent of the total land, about 20 per cent being concentrated in the hands of the top 1.8 per cent of households. About 24 per cent of the total land was tenant cultivated, about 22 per cent of the land was under share tenancy under which the tenant received 50 per cent or less of the produce while sharing the full costs of the inputs.

The relationship between land concentration and growth canot be determined *a priori*. One line of argument postulates that concentration adversely affects growth. High concentration of land facilitates the ability of the rural rich to extract more surplus through exploitative share-cropping and usury credit markets, reducing the incentive for direct investment in the process of production as a means to increasing their income. The tenancy and credit markets develop a patron-client relationship which is used as a power base by the gentry. It is in the interest of the power groups to maintain the status quo so that the poor cannot free themselves from the bondage. Such power groups resist changes --- changes in agricultural practices to improve yield and productivity and misuse government's incentives and misdirect agricultural investment fund into less risky trade or business or doling out consumption loans at onerous terms. In short, high concentration of land ownership does not lead to higher investment primarily because control over the land market is the key to the control over other related markets.

The relationship between share tenancy and growth is also controversial. The general line of argument is that a share cropping system adversely affects growth because of the disincentives inherent in the system. Under the system neither the landlord nor the tenant is interested in making investment on land or in applying modern inputs because (i) the tenant is insecure about his tenancy and (ii) the landlord appropiates a share of the increased output. So sharecropping on adverse terms does not promote growth at all. An empirical investigation by Hossain (1980:64) concluded that besides the low level of education among farmers and non-availability of water, land concentration and high incidence of share-tenancy are the major constraints in the adoption of high yielding varieties (HYV) of rice.

2.2 DEMOGRAPHIC CHANGE AND FOOD IN BANGLADESH

Bangladesh is the eighth largest country in the world in terms of population with a man-land ratio of over 1500 people per square mile. With a growth rate of about 2.8 per cent per annum, the population of Bangladesh continues to expand rapidly. Optimistic projections assuming substantial fertility reduction show that the population of Bangladesh will be around 128 million by the year 2000 (GOB; Statistical Year Book, 1982).

Population census of Bangladesh (formerly East Bengal, East Pakistan) was conducted first in 1871-72 during the British rule and has been taken every ten years, except in 1971.[10] The latest census was conducted in 1981. The size of the population of East Bengal was about 17 million in the year 1200 (ESCAP;1981); and the growth in population was very slow as shown in Table 2.6. Thewannuale between 1700 and 1850 was below 0.5 per cent in this period. High birth rates coupled with high death rates contributed to this small natural increase.

---

[10] Because of the War of Liberation in 1971 this census was done in 1974.

Up to the mid 1920's Bangladesh's demographic history is one of continued slow population growth against environmental and technological constraints, interrupted by large-scale setbacks (Arthur and McNichol;1978:29). Thereafter, mortality rates declined steadily, a decline interrupted by the Bengal Famine of 1943 and the inter-religious strifes of the 1947 Partition of India. As a consequence, population growth increased sharply and in the 1930's Bangladesh's population growth rate exceeded the 1 per cent per annum mark over a decade.

The cause for this increase was a drastic drop in the mortality rate from above 40 per thousand to a level of about 20 per thousand. A host of factors were responsible for this massive decline in the death rates whose relative weights were unevenly distributed. These include reduction and /or elimination of killer diseases like malaria, cholera and smallpox, some improvements in public health and treatment of epidemic diseases and more importantly, reduction of famine related deaths due to improvement in transport and communication. Nevertheless, death rates are quite high. There has been no comparable secular trend in the fertility rate and this ranges from 45 to 50 per thousand --- a rate not substantially lower than a century ago.

The population figures since 1872 are presented in Table 2.7. As can be seen from Table 2.7, prior to 1931, the annual population growth rate was below 1 per cent. It in-

TABLE 2.6

Population of Bangladesh in the Pre-Census Period

YEAR	POPULATION (million)	ABSOLUTE INCREASE (million)	ANNUAL GROWTH (per cent)
1700	17.0	---	----
1750	19.0	2.0	0.22
1770	15.0	-4.0	-1.18
1800	17.0	2.0	0.42
1850	20.0	3.0	0.33

Source: ESCAP (1981)

TABLE 2.7

Evolution of Population in Bangladesh, 1872-1981

YEAR	POPULATION (million)	PERCENTAGE CHANGE	ANNUAL GROWTH (per cent)
1872	22.78	----	----
1881	24.93	9.43	1.00
1891	27.01	8.36	0.80
1901	28.93	7.10	0.69
1911	31.53	8.98	0.86
1921	33.25	5.38	0.53
1931	35.60	7.07	0.68
1941	42.00	17.96	1.65
1951	41.93	-0.15	-0.02
1961	50.84	21.24	1.93
1974	71.48	40.60	2.62
1981	87.12	22.10	2.93

Source: ESCAP (1981) and GOB, Statistical Year Book, 1982.

creased to over 1.5 per cent during the decade of 1931-41, and in the following decade the population growth rate fell primarily because of mass exodus of hindu population from East Bengal to India. Since 1961 the population growth rate increased sharply and presently stands at about 3 per cent per annum. However, these staggering figures conceal even harsher realities and some observers are of the opinion that the 1961 and 1974 censuses are guilty of under-enumeration (Chen and Chaudhury;1975:206).

2.2.1 Demographic Change at the District Level

Turning from the national figures to the district level figures, we notice a high growth rate of population increase in all the districts. We calculated the population change for 3 periods namely 1961-74, 1974-81 and the overall population change covering 1961-84 period. Interestingly, these periods also coincide with the census years. The range of population growth rate over 1961-81 period is 2.02 per cent in Faridpur to 3.38 per cent in Dhaka and Kushtia districts. This is shown in Table 2.8.

From Table 2.8, we are able to identify four population growth zones based on the variation of population over the period 1960-81. These zones are classified as low, moderate, high and very high[11] growth zones. The low growth zone

[11] High and low growth rates should be interpreted in a relative sense rather than in absolute sense of the term. Low growth = (2.00 < 2.25) per cent per annum; Moderate =

TABLE 2.8

Population Growth in Bangladesh by Districts

DIVISION	DISTRICTS	POPULATION (thousands)			GROWTH RATE (%)		
		1961	1974	1981	'61-74	74-81	61-81
CHITTAGONG							
	Bandarban	---	---	171	----	----	----
	Hill Tracts	383	508	580	2.17	1.89	2.07
	Chittagong	2983	4315	5491	2.84	3.44	3.05
	Comilla	4389	5819	6881	2.17	2.39	2.25
	Noakhali	2383	3234	3816	2.33	2.36	2.35
	Sylhet	3490	4759	5656	2.39	2.46	2.41
DHAKA							
	Dhaka	5096	7611	10014	3.09	3.92	3.38
	Faridpur	3179	4060	4764	1.88	2.28	2.02
	Jamalpur	----	2059	2454	----	2.51	----
	Mymensingh	5532	5508	6568	-0.03	2.51	0.86
	Tangail	1487	2078	2444	2.57	2.32	2.48
KHULNA							
	Barisal	3068	3928	4667	1.90	2.46	2.10
	Jessore	2190	3327	4020	3.22	2.70	3.04
	Khulna	2447	3557	4329	2.87	2.81	2.85
	Kushtia	1166	1884	2292	3.69	2.80	3.38
	Patuakhali	1194	1449	1843	1.49	3.44	2.17
RAJSHAHI							
	Bogra	1574	2231	2728	2.68	2.87	2.75
	Dinajpur	1710	2571	3200	3.14	3.13	2.13
	Pabna	1959	2815	3424	2.79	2.80	2.79
	Rajshahi	2889	4268	5270	3.00	3.01	3.01
	Rangpur	3796	5447	6510	2.78	2.55	2.70

Source: GOB, Statistical Year Book, 1982.

includes the districts of Chittagong Hill Tracts (CHT), Faridpur, Barisal and Patuakhali while the moderate growth zone

(2.25 < 2.50) per cent per annum; High = (2.50 < 3.00) per cent per annum and Very High = (> 3.00) per cent per annum.

includes Comilla, Noakhali, Sylhet and Tangail districts. The high growth zone includes Mymensingh, Khulna, Bogra, Pabna and Rangpur districts and the very high growth zone includes Chittagong, Dhaka, Jessore, Kushtia, Dinajpur and Rajshahi districts. It is evident from the classification that the majority of the districts fall either in high or very high growth zones.

Table 2.9 shows the variation of population growth in the different growth zones during 1961-74 and 1974-81 periods.

2.2.1.1 Quantum of Population Change: An Analysis of Variance

For the purpose of analysing the variations in population growth in the above mentioned population growth zones, we have done a two-factor analysis of variance to separate out the variations associated with defined sources. Here we shall refer to the two time periods (1961-74 and 1974-81) as the "treatments" and the four growth zones as the "blocks". Therefore, the Two-Factor Analysis of Variance model can be written as follows:

$$Yijk = \mu + \theta j + \lambda k + (\theta\lambda)jk + \epsilon ijk$$

where, $Yijk$ = the ith observation in the cell that is the jth level of Factor A and the kth level of Factor B.

μ = the grand mean of all values.

θj = the effect of level j of factor A on $Yijk$.

λk = the effect of level k of Factor B on $Yijk$.

TABLE 2.9

Population Variation in Different Growth Zones in Bangladesh

REGION	DISTRICTS	PERCENTAGE VARIATION 1961-74	1974-81
LOW		109.63	77.50
	CHT	32.63	14.17
	Faridpur	27.61	17.33
	Barisal	28.03	18.81
	Patuakhali	21.36	27.19
MODERATE		144.39	72.71
	Comilla	32.58	18.25
	Noakhali	35.71	18.00
	Sylhet	36.36	18.85
	Tangail	39.74	17.61
HIGH		174.16	104.37
	Mymensingh	0.00	19.24
	Khulna	45.24	21.70
	Bogra	41.74	22.28
	Pabna	43.69	21.63
	Rangpur	43.49	19.52
VERY HIGH		305.58	149.26
	Chittagong	44.65	27.25
	Dhaka	49.35	31.57
	Jessore	51.92	20.83
	Kushtia	61.58	21.66
	Dinajpur	50.35	24.47
	Rajshahi	47.73	23.48

Source: Calculated from Table 2.8.

$(\theta\lambda)jk$ = the interaction effect on Yijk of the jth level of Factor A and the kth level of Factor B.

ϵijk = the random error term of the ith observation in column j and row k.

The analysis of variance is presented in Table 2.10 which is calculated on the basis of the data presented in Table 2.9.

TABLE 2.10

Two-Factor Analysis of Variance Table

Sources of Variation	Sum of Squares	D.F	M.S.S	Fcal.	Ftab.
Treatment	2866.32	1	2866.32	18.77	4.17
Blocks	1209.96	3	403.32	2.64	2.92
Interaction (T X B)	430.50	3	143.50	0.94	2.94
Error	4582.16	30	152.74		
Total	9088.94	37			

Source: Calculated from Table 2.9.

2.2.1.2 Test of Hypotheses

We have tested three sets of hypotheses which are:

1. Ho: $\theta_1 = \theta_2 = \theta_3 = \ldots = \theta j = 0$. This null hypothesis says that no level of Factor A (Time) has any influence on the dependent variable Y. In our case Fcalc = 18.77 which is greater than Ftab = 4.17, we reject the null hypothesis and conclude that time is a significant factor in the variation of population.

2. Ho: $\lambda_1 = \lambda_2 = \lambda_3 = \ldots = \lambda k = 0$. This null hypothesis says that no level of Factor B (Growth Zones) has any influence on the dependent variable Y. Fcalc = 2.64 which is smaller than Ftab = 2.92. Hence we accept the null hypothesis and conclude that the different growth zones had imperceptible effect on the variation of population.

3. Ho: $(\theta\lambda)jk = 0$ for all combinations of j and k. This null hypothesis says that there is no interaction effect for any combination of Factor A (Time) and Factor B (Growth zones). From our calculation we see that Fcalc = 0.94 which is smaller than Ftab = 2.92 . Hence we conclude that both Time and Growth Zones interact to produce population variation in Bangladesh.

2.2.2 Causes of High Population Growth

There are several factors which may work towards an individual seeking a large family size given the prevailing situation in Bangladesh. This is true for some groups of people, i.e., marginal and destitute people as well as those who are not destitute and have a fighting chance for survival. For the above mentioned groups there is some scope for rational decision making regarding the optimal family size. The present agrarian structure is characterised by extreme seasonality which implies that for families depending on the sale of labour (landless labour in particular) an extra earning member can smoothen out fluctuations in earnings of the family. When contract labour is on a family basis or share of produce is the remuneration, a large family implies a greater control over wage goods. Under share-cropping arrangements, a family's capacity to lease land depends on the labour endowment of the family; and a large family clearly helps. Moreover, in the absence of any social security arrangement for people owning no income generating assets, earning members in the family provide the only source to draw upon during indisposition, old age or disability. In the Bangladeshi society, where physical conflicts cannot be ruled out, security considerations of the family dictates a large family to protect life and possession.

On balance children do typically represent a good investment prospect in Bangladesh. A study in Bangladesh pointed to the relatively optimistic conclusion that the average village boy can be credited with the triple achievements of earning enough to pay for his food by the age of 12; paying for all his past consumption by the age of 15; and paying for the consumption of his sister as well by the age of 21 (Eberstadt;1980:51).

2.2.3 Implications of High Population Growth

High population growth in Bangladesh has serious implications for the nutritional standard of the people. Table 2.11 summarises the situation and shows that over the twenty year period imports of foodgrains has increased nearly three times, per capita domestic production of foodgrain has decreased, while per capita availability of foodgrain has remained steady.

TABLE 2.11

Population, Production, Imports and Availability of Foodgrains in Bangladesh 1960-81

Year	Population	Net Domestic Production	Imports	Per Capita Availability	Per Capita Domestic Production	Imports As % of Dom. Production
1960	53.90	8596	460	16.49	357.24	5.35
1961	54.53	8554	580	16.45	351.38	6.78
1962	56.96	7897	540	14.54	310.56	6.83
1963	57.43	9442	770	19.25	368.28	8.16
1964	58.94	9331	490	16.36	354.62	5.35
1965	60.48	9333	340	15.70	345.67	3.64
1966	61.94	8534	890	14.94	308.62	10.43
1967	63.43	9948	1080	17.07	351.31	10.86
1968	64.95	10131	1020	16.86	349.40	10.07
1969	66.52	10639	1120	17.36	358.26	10.53
1970	68.12	9969	1550	16.60	327.81	15.55
1971	69.77	8898	1280	14.32	285.67	14.39
1972	72.39	9020	2830	16.07	279.11	31.37
1973	74.37	10647	1670	16.26	320.68	15.69
1974	77.03	10120	2290	15.82	294.29	22.63
1975	78.96	11497	1490	16.15	326.16	12.96
1976	80.82	10640	780	13.87	294.90	7.33
1977	82.71	11795	1690	16.01	319.44	14.33
1978	84.66	11910	1150	15.15	315.12	9.66
1979	86.64	12014	1800	15.66	310.61	14.98
1980	88.68	13263	1900	16.79	335.01	14.33
1981	90.63	12929	2000	16.17	319.55	15.47

Note: Population (in million).
Production and Imports (in thousand tons).
Per Capita Availability (ounces per day).
Per Capita Domestic Production (pounds per year).

Source: GOB, Statistical Year Book, 1982.

Total net availabilty of foodgrain to consumers is obtained by subtracting ten per cent from gross production for seed, feed and wastage and adding imports. Net domestic production of foodgrain increased over the period 1960-61 to 1981-82 but the rate of growth was slower than the rate of growth of population over the same period. This situation is clearly indicated by a declining per capita domestic food production. The estimated trends in per capita food production, imports and per capita food availability are shown in

TABLE 2.12

Growth Rates of Per Capita Food Availability, Production and Imports in Bangladesh 1960-81

	1960-69	1970-81	1960-81
Per Capita Food Production	0.03	0.69	-0.61
Per Capita Food Availability	0.56	0.17	-0.17
Per Capita Food Imports	7.02	-2.68	4.23

Source: Calculated from Table 2.11.

Table 2.12.

Table 2.12 substantiates the assertion that per capita food production declined at the rate of 0.61 per cent per annum over the period 1960-81. Also per capita availability of foodgrain declined at the rate of 0.17 per cent per annum over the same period. Per capita food availability would have been worse if it was not boosted by increased per capita food imports whose trend is a staggering 4.23 per cent per annum during the period 1960-81.

The implications of the changes on the average Bangladeshi diet are shown in Table 2.13 where a profile of per capita daily consumption of different categories of nutrients are shown.

If one compares the figures in Table 2.13 with that of Chen and Chaudhury (1975), figures in Table 2.13 are not only at variance but also appear to be inflated. But there is similarity in the two in that they both show a declining trend in nutritional standards over time in Bangladesh. Nutritional Surveys in Bangladesh are government sponsored and hence the figures are often inflated to conceal the facts. On the other hand, Chen and Chaudhury's (1975) estimates are downwardly biased in that they have also omitted foodstuffs (e.g. meat, eggs, fruits etc.) from which calories and protein are obtained.

Assuming that the Nutritional Survey 1981-82 figures are correct, there has been about fourteen per cent decline in caloric consumption and twenty per cent reduction in protein consumption in Bangladesh over the twenty year period. Shifts of even a small magnitude can be devastating from the

TABLE 2.13

Nutrition in Bangladesh at Different Time Periods

FACTORS	1962-64	1975-76	1981-82	RECOMMENDED
Calories	2301.0	2094.00	1943.00	2273.00
Protein (grams)	57.9	58.50	48.40	45.30
Fat (grams)	15.8	12.20	9.80	N/A
Carbohydrate (grams)	482.0	439.00	412.00	N/A
Iron (m.g.)	10.3	22.20	23.40	7.60
Calcium (m.g.)	273.0	305.00	260.00	450.00
Vitamin A (i.u.u)	1870.0	730.00	763.00	2013.00
Thiamine (m.g.)	1.5	1.65	1.38	0.90
Riboflavine (m.g.)	0.5	0.87	0.68	1.35
Niacine (m.g.)	23.2	22.21	13.15	14.84
Vitamin C (m.g.)	48.0	9.51	13.26	26.00

Source: Nutritional Survey of Rural Bangladesh 1981-82 (draft) quoted from the weekly "Shachitra Shandhani" May 6,1984 p.15.

health point of view because the 1960's figures already represent the bottom of the pit. If this rate of decline is real and persisting, and assuming that the activity level of the people is constant, then there is reason to conclude that the average body-weight of a typical Bangladeshi is on the decline. Malnutrition enervates the body and impedes both mental and physical development which is another form of "brain-drain' for Bangladesh.

2.3 REGIONAL DIFFERENTIALS IN FOOD PRODUCTION AND CONSUMPTION

National level figures indicate that Bangladesh has a food deficit which is increasing over time. These national aggregate figures conceal considerable regional diversities in production and consumption. While consumption differences are not so pronounced, primarily due to smallness of size and geographical contiguity of Bangladesh, public distribution of foodgrains have fluctuated significantly among regions to cause considerable changes in the net availability of foodgrain for the people of a given region. The World Bank Report (1979) views the Bangladesh's food problem as one of "production" shortage. In fact, it is the "production" problem coupled with improper "distribution" of foodgrain which creates most of the problems plaguing Bangladesh on the food front.

In this section some estimates of regional differences in foodgrain production and availability for 1981-82 are made. The year 1981-82 is choosen because relevant data beyond this period are not available. At the outset it is appropiate to explain some terms and make explicit some of the assumptions made in this exercise.

2.3.1 Definitions

(1) Production gap: net production in the ith region/district - consumption requirement in the ith region/district.
Net production = gross production - 10 per cent for seed, feed and wastage.
Consumption requirement = population in the ith region/district X 15 ounces per day per capita.[12]

(2) Total availability for consumption = net production in the ith region/district - procurement of foodgrain from ith region/district + public distribution of foodgrain in the ith region/district.
Public distribution of foodgrain = total internal procurement of foodgrain + total imports. Implicitly, this either assumes that all procured and imported foodgrain in a given year is wholly distributed or future stocks are maintained at the level equal to the previous stocks.[13]

(3) Availability gap = total availability of foodgrain in the ith region/district - consumption requirement in the ith region/district.

---

[12] Chen (1975:108) suggests an adequate diet of 14.2 to 14.5 ounces of food per capita per day based on age, sex, body-weight, and activity level. However, we made an extra allowance of 0.5 ounces to cover the nutritional wastage which may arise.

[13] We made two types of calculations: (1) under the assumption that previous stock is equal to future stock and (2) future stock increasing by 150 thousand tons a year as suggested by the World Bank (1979).

This gap, when compared to the production gap, highlights the effect of Public Food Distribution System (PFDS) on the overall food situation.

It can be demonstrated from the data from Bangladesh that not all regions/districts are in deficit and the PFDS can do one of the following in a given region/district:

1. Increase deficit in food availability.
2. Reduce deficit in food availability.
3. Reduce deficit and turn a region/district into surplus i.e. create surplus.
4. Increase surplus in food availability.

While situation (1) is clearly undesirable and sub-optimal in terms of the objectives of the PFDS, situation (4) is also disequilibrating and defeats the government's objectives of balanced foodgrain distribution. The results of this quantitative exercise are merely illustrative broadly and in the absence of a detailed household survey, it is impossible to conclude definitely about the status (surplus or deficit) of a typical household in a given region/district. Hence, it would be premature to make presumptions that every household has surplus grain availability in a "surplus" region/district and vice-versa. Data limitations preclude us from carrying out that exercise.

In order to understand the effect of PFDS on the availability of food, it is important to understand the modus operandi of the PFDS in Bangladesh.

2.3.2 Public Food Distribution System (PFDS)

Briefly, the total supply for the Public Food Distribution System (PFDS) comes from two sources: (1) through internal procurement of foodgrains by the government and (2) food imports, mostly on concessionary terms in the form of P.L. 480 shipments from the U.S.A. and other donor countries. The main objectives of the government's food procurement from the domestic market are

(a) to reduce dependency on food imports,

(b) to stabilize food prices,

(c) to raise food production by guaranteeing incentive prices to farmers and,

(d) to ensure adequate food stock and stable food supply from the PFDS.

In practice, the internal food procurement stategy is geared to achieving objective (d) primarily and other objectives are relegated to minor importance.

The PFDS began as a relief measure during the great Bengal Famine of 1943 and now it has degenerated into a system of providing subsidised food to a majority of urban dwellers in a few select urban centres covering a small proportion[14] of the total population of the country. The system suffers from urban bias, is costly to the exchequer[15] and is politi-

[14] Six cities/towns are covered namely Dhaka, Narayanganj, Chittagong, Khulna Rajshahi and Rangamati. The total coverage of the PFDS is about 22 to 25 per cent of the total population of Bangladesh.

cally motivated to appease only a small but powerful[16] segment of the population.

2.3.3 Results

Table 2.14 summarises the regional diversities in production and availability for 1981-82. In Table 2.14 we only show the differences in terms of the broad adminstrative regions (Divisions) in Bangladesh and in Table 2.15 we illustrate the production and availabilty situation in each adminstrative district. The basis of Tables 2.14 and 2.15 is Table A.1 which is in the Appendix.

From Table 2.14 we see that out of four adminstrative Divisions Dhaka, Chittagong and Khulna were in deficit in terms of food production and Rajshahi Division was in surplus. With the PFDS the situation changed dramatically so that Dhaka and Chittagong became surplus in terms of food availability and Rajshahi's surplus increased. Interestingly, Khulna still remained in deficit in terms of food availability although the gap narrowed due to the positive impact of the PFDS. Bangladesh's overall situation showed surplus in terms of availability.

---

[15] Nearly one billion to two billion Taka is spent annually to finance the PFDS (GOB, Statistical Year Book, 1982).

[16] Apart from supplying six city dwellers, PFDS also supplies full ration to "priority groups" such as (1) police, (2) members of the armed forces, (3) government employees and (4) workers of large industrial establishments.

TABLE 2.14

Regional Gaps in Foodgrain Production and Availability
1981-82

DIVISIONS	PRODUCTION GAP	AVAILABILITY GAP		EFFECT OF PFDS		
		(a)	(b)	(a)	(b)	
Rajshahi	410	597	575	+46%	+40%	Increase Surplus
Khulna	-537	-191	-218	+64%	+59%	Reduce Deficit
Dhaka	-718	212	150	+130%	+121%	Create Surplus
Chittagong	-343	193	155	+156%	+145%	Create Surplus
BANGLADESH	-276	209	172	+176%	+162%	Create Surplus

Note: (a) Under the assumption the future stock = previous stock.
(b) Under the assumptions that future stock is higher than the previous stock or previous stock was nil and provision is made for future stock.

Figures are in thousand tons.

Source: Summarised from Table A.1.

Table 2.15 shows the foodgrain production and availability positions at the district level. Of all the surplus food production districts, Rangpur, Bogra, Mymensingh, Tangail, and Sylhet, the effect of the PFDS was to increase the surplus in these districts. Only in Dinajpur and Patuakhali, did the PFDS operation reduce their respective surpluses. On the other hand, of the food production deficit districts, all of them benefitted from the PFDS. PFDS reduced the deficit of all these districts and in Chittagong it created a surplus.

TABLE 2.15

Foodgrain Production and Availability Gaps at the District Level 1981-82

DISTRICTS	PRODUCTION GAP	AVAILABILITY GAP		EFFECT OF PFDS
SURPLUS PRODUCTION DISTRICTS				
		(a)	(b)	
Rangpur	+ 269	330	324	Increase Surplus
Bogra	+ 118	145	142	Increase Surplus
Mymensingh	+ 337	388	381	Increase Surplus
Tangail	+ 81	124	121	Increase Surplus
Sylhet	+ 120	193	155	Increase Surplus
Dinajpur	+ 162	142	139	Reduce Surplus
Patuakhali	+ 49	40	38	Reduce Surplus
DEFICIT PRODUCTION DISTRICTS				
		(a)	(b)	
Rajshahi	- 67	- 10	- 16	Reduce Deficit
Pabna	- 57	- 11	- 15	Reduce Deficit
Kushtia	- 125	- 66	- 70	Reduce Deficit
Jessore	- 78	- 7	- 12	Reduce Deficit
Khulna	- 209	- 45	- 56	Reduce Deficit
Barisal	- 175	-113	-118	Reduce Deficit
Dhaka	- 837	- 94	-140	Reduce Deficit
Faridpur	- 299	-205	-211	Reduce Deficit
Comilla	- 137	- 13	- 22	Reduce Deficit
Noakhali	- 91	- 33	- 42	Reduce Deficit
Chittagong Hill Tracts	- 31	- 18	- 20	Reduce Deficit
Chittagong	- 203	+ 50	+ 32	Create Surplus

Note: Figures are in thousand tons.
(a) Under the assumption that future stock = previous stock.
(b) Under the assumption that future stocks grows by 150 thousand tons a year and or previous stock was nil and provision is made for future stock.

Source: Summarised from Table A.1.

2.3.4 Implications

The implications of this exercise are enormous. PFDS's main objective is to ensure proper foodgrain distribution in the country in order to stabilize foodgrain prices, production and maintain equilibrium in the nutritional status of the people. PFDS's activities can be termed a success if it redistributes and reallocates foodgrain in such a manner that a surplus is reduced and deficit wiped away. In this respect, generally speaking the PFDS has been successful to a large extent in Bangladesh as can be seen from Table 2.15. PFDS has enabled 12 districts in Bangladesh (see bottom half of Table 2.15) to reduce their deficit on the one hand, and on the other, helped to reduce surplus in 2 other districts. But the PFDS has been a failure in its objectives because it increased surplus in 5 surplus districts in Bangladesh. However, these conclusions are broadly aggregative and are merely suggestive. It must be borne in mind that the PFDS operation is mainly concentrated in a few urban centres and therefore the conclusions about the likely effect of PFDS must be taken cautiously. Firm conclusions can only be drawn by studying the rural and urban households and unfortunately we do not have the data to carry out such an exercise.

It may be mentioned here that this exercise of enumerating "surplus" and "deficit" in production and availability is appropiate for a given point in time only, i.e., for

1981-82. This situation is unlikely to hold and be stable over time. "Surplus" and "deficit" of a district depends on a myriad of factors which are quite uncertain and constantly subjected to change. To name a few of these uncertainties: production in any region depends on the weather conditions, pest and insect infestations, supply and distribution of inputs from the government agencies. All these factors have a bearing on the production of foodgrain. The distribution of foodgrain depends on the internal procurement and import of foodgrain and also on government policy as to how much will be distributed and to which district. Import of foodgrain depends on government policy and allocation of funds, donor countries commitment and disbursement of food aid. And lastly internal procurement of foodgrain depends among other things on prices offered by the government and on the production condition at a given time period. Because of these numerous interrelationships and factors involved, production and distribution parameters are constantly changing over time and it is difficult to predict the values of these parameters in the future.

Last but not the least, one can easily conclude that there is a lot of production and consumption diversities among the different regions/districts in Bangladesh. The recognition of these diversities can help the government in formulating appropiate procurement and distribution startegies. Thus the appropiate policy would be to procure foodgrain from the surplus districts and redirect the public food distribution towards the deficit regions. Surplus and deficits are defined in aggregate terms and should not imply that every individual/household is in surplus in the surplus region and vice-versa. Because of data limitation we are unable to conclude definitely about the status of a given individual/household or group, but one study by Ahmed (1978:15), using Household Expenditure Survey data of 1973-74, concluded that the PFDS affects favourably the bulk of the urban population, and secondly, in the absence of the PFDS the nutritional standard of the urban poor would have been precariously lower than their rural counterparts. Thus there is the evidence that the PFDS does ameliorate urban poverty to some extent. However, more detailed study is necessary in this field.

2.4 SEN'S FOOD ENTITLEMENT HYPOTHESIS

In the previous sections we have seen the trend in food production and population growth. There is no doubt that population growth has outpaced domestic food production. At the same time, we have seen that food availabilty per capita has been maintained at a level prevailing in 1960-61, primarily through increasing imports, both commercial and aid financed. We have also seen that, on the aggregate, out of 4 Divisions in Bangladesh 3 Divisions had a production-deficit in 1981-82. When the effect of the rationing system is taken into account, 2 Divisions registered a surplus, 1 registered an increase in surplus, while in the other the deficit was reduced (Table 2.14). At the same time, on the aggregate, Bangladesh's position changed from shortage to one of surplus.

Inspite of this, hunger is pervasive and rapidly proliferating in Bangladesh as shown by the successive Nutritional Surveys. The nutritional status of the people is on the decline. Hence, we can firmly reject the hypothesis that hunger and malnutrition --- the ugly facets of the food problem --- is due to the food availabilty decline (FAD) in Bangladesh. Bangladesh's food problem is definitely not an "overt" but a "silent" food problem, to use Ruetlinger's (1977) phraselogy. For a large proportion of the population, wages, employment and real income remain very low by any criterion, which prevents them from consuming an adequate diet. Taking the scenario a step further, the poorer sections of the population are saddled in a situation where even a slight impact by an unfavourable exogenous force may seriously jeopardize their chances of survival. They are caught in the 'Below Poverty Level Equilibrium Trap' (Alamgir;1978:2). In this context Sen's (1981) food entitlement hypothesis seems appropiate and useful in analysing the "silent" food problem in Bangladesh.

Ownership of food is one of the most primitive property rights and every society has a set of rules governing this particular right (Sen;1981a:434). Sen sees starvation resulting from failure on the part of groups of people to establish entitlement over a required amount of food.

Food entitlement, according to Sen, critically depends on two parameters viz. the resource endowment vector and an exchange entitlement mapping, which specifies the set of commodity bundle which a person can choose through "exchange" (trade and production). The exchange entitlement mapping will in general depend on the legal, political, economic and social characteristics of the society in question and the persons position in it (Sen;1981a:435). Rempel (1985:4) lucidly summarises Sen's arguments and are reproduced below:

(1) One has access to the food one can obtain by trading what one owns with a willing party (or, multilaterally, with a willing set of parties).

(2) One has access to the food one is able to produce by arranging production using one's owned resources, or resources hired from willing parties meeting the agreed conitions of trade;

(3) One is entitled to the output of one's own labour power, which provides access to the food related to one's labour power, whether produced for own consumption or obtained via trade;

(4) One is entitled to the food that is willingly given to one by another who legitimately owns it.

Food security is reduced whenever one or more of these means to access to food are eroded. Direct access to food is eroded when a household can no longer produce an adequate supply of food to meet the nutritional needs of the household members. The ability to trade for needed food is eroded when the household's factor endowment is reduced, household labour is unemployed or becomes incapacitated, or the household is faced with an adverse shift in its terms of trade (Rempel;1985:4).

2.4.1 Bangladesh's Food Problem: A Case of "Entitlement" Failure

Available statistical data point to the fact that Bangladesh's hunger, starvation and malnutrition are all due to increasing poverty and inequality, characterised by the progressive deterioration of "exchange entitlement". There are various manifestations of entitlement decline in Bangladesh i.e. (1) resource endowment loss and (II) unfavourable shifts in exchange entitlement mapping.

(1) Endowment Loss: In the absence of a developed money market, land constitute an important asset in the portfolio of the people of Bangladesh. Over the years there has been a progressive loss of this vital endowment for a vast majority of the people. Landlessness is increasing at a very high rate exposing a particular segment of the population to starvation.

In desperate economic crisis households employ a hierarchy of coping startegies e.g. austerity, consuming or selling capital (productive) assets, rearrangement and substitution of various foods and lastly migration (Rempel;1985:3). While this is very much true in Bangladesh, the poor often resort to the sale of land as a means to overcoming their hardship. Distress sale of land is the last resort. Land sale proceeds in stages. Land is mortaged in return for a loan which is never retired; and within a few years a portion or the whole land is sold as debt settlement. The process ends when all the land including the homestead is sold and from here the process of destitution starts. In the short term, possession of saleable assets, like land, provide a line of credit that makes the marginal farmer less vulnerable than the landless. But in the long run, the dynamic instability of this group threatens to aggravate the problem of poverty and food security by swelling the ranks of the landless (Clay et al. 1981:7).

The proportion of landless households in total household and of agricultural wage labourers in the total agricultural working population are increasing. Abdullah et al. (1976) and Khan (1977) have made attempts to obtain some idea about the trend in the extent of landlessness in Bangladesh. Combining their findings and ignoring the problem of definition, it is found that the percentage of landless households to total households increased from 14.3 per cent in 1951 to 17.52 per cent in 1961 and to 33.48 per cent in 1973-74. Clearly the figures are alarming.

Chowdhry (1981) found the problem to be acute when the proportion of agricultural wage labour to agricultural labour force is taken into account. This is shown in Table

TABLE 2.16

Landless Agricultural Force in Bangladesh

Year	Agricultural Labour Force (Million)	Landless Labour (Million)	Landlessness (Percentage)
1960	16.27	2.7951	17.18
1961	16.80	2.9400	17.50
1962	17.34	3.0605	17.65
1963	17.96	3.1968	17.80
1964	18.74	3.4294	18.30
1965	19.13	3.5964	18.80
1966	18.96	3.6592	19.30
1967	19.52	3.8649	19.80
1968	20.11	4.4402	22.08
1969	20.71	5.0449	24.36
1970	20.00	5.3280	26.64
1971	18.00	5.2056	28.92
1972	19.82	6.1838	31.20
1973	20.13	6.7395	33.48
1974	20.44	7.7263	37.80
1975	20.75	8.7419	42.13
1976	21.06	9.7823	46.45
1977	21.38	10.8546	50.77
1978	21.82	11.7784	53.98

Source: Chowdhry (1981:30) Table 2.8.

2.16 below. From Table 2.16 it is seen that landless labour as a proportion of total agricultural labour force increased more than 300 per cent from the 1960-61 level. A partial explanation can be found in the following quote by Abdullah *et al*. (1976:215):

> With limited land, expanding rural population, and limited opportunities for urban employment, one would expect rural landlessness to be growing in any case, even without the polarizing effect of market forces.

However, Khan (1977:158) correctly points out

> The rise in landlessness cannot be explained by demographic factors alone.

Over the entire period of analysis a drastic fall in the purchasing power caused by spiralling prices, and increasing indebtedness seem to have pushed marginal families with land to sell their meagre holdings of land and other assets thus accelerating the process of landlessness (Chowdhry;1981:27). Therefore, increasing landlessness signifies that food exchange entitlement through endowment has been drastically reduced for an increasing number of people without land.

There is the second method whereby poor peasants are losing their food entitlement through the tenurial system. Tenurial arrangement reflects the operational aspect of agriculture. Three types of market involvement prevail in Bangladesh depending upon the economic position of the participant.

1. There is, first, the category of operators with clearly dominant bargaining position like the big landlord in the land (lease) market or the money lender in the credit market. These operators are powerful enough to be able to exploit the market from

a position of vantage and more importantly, are able to shape the character of the market relations themselves through contracts which interlock markets.

2. Secondly, we can envisage the category of the economically very weak section of the peasantry, i.e., landless agricultural labour, very small owners or tenants, all of whom have an extremely weak bargaining position in the markets. Yet they cannot avoid market operations. As they do not have enough land to cultivate, they have to depend upon hiring out their labour and hence submit to the vagaries of the labour market. Given the uncertainty of employment they prefer to lease a tiny plot of land even on extremely onerous conditions. Not having enough circulating capital to produce even their subsistence they have to rely upon the credit market.

3. The third category of peasants falls somewhere between the first two: while not powerful enough to exploit markets like the large operators, they can be somewhat more self-reliant than the landless or marginal farmers and may be able to protect themselves from markets if they turn unfavourable. They have (or can at least make provision for) adequate circulating capital, possess bullocks and implements of their own with some holding capacity over market supplies of output.

Over time the following pattern of tenurial arrangement has emerged. This is shown in the Table 2.17.

TABLE 2.17

Land Tenure in Bangladesh

Types of Farm	Average Size of Farms (Acres)			Percentage of Farms		
	1960	1968	1978	1960	1968	1978
Owner operated	3.1	2.7	2.4	61	66	65
Owner - cum - tenant operated	4.3	4.0	2.1	37	30	28
Tenant operated	2.4	3.0	N.A.	2	4	7
Total	3.5	3.2	--	100	100	100

Source: Chowdhry (1981:7) Table 2.1.

Owner operated farms accounted for 61 per cent of total farms in 1960 and the proportion increased to 65 per cent in 1978. During the same period the percentage of owner-cum-tenant farms declined from 37 per cent to 28 per cent of the total farms; and that of tenant farms increased from 2 to 7 per cent. This indicates that increasing landlessness in the country whereby the marginal farmers with small parcels of land are being pushed to the category of pure tenants. Although pure tenant farms form between 2 to 7 per cent of the total farms, they only account for between 18 to 25 per cent of the farm area cultivated as is shown in the table

TABLE 2.18

Percentage of Farm Area According to Tenancy

Types of Tenure	Percentage of Farm Area 1960	1968	1978
Owner Operated	82	83	75
Tenant Operated	18	17	25

Source: Chowdhry (1981:8) Table 2.2.

below.

The tenancy markets have two adverse effects:

1. It tranfers land from small owners to large owners; and
2. The terms of tenancy are such that it tranfers a large proportion of income generated from the operator to the owner of land.

Available data indicate a considerable deterioration in the distribution of landholding (operational) in rural areas in Bangladesh. The share of the bottom 60 per cent of farms in total farm area declined from 25 per cent to nearly 19 per cent in 1974; while that of top 10 per cent incresed from 36 per cent in 1960 to 38 per cent in 1974 (Alamgir;1975:268). The overall Gini concentration ratio moved from 0.49 in 1960 to 0.56 in 1974 which shows an increase in inequality. The trend over time in the distribution of operational landhold-

TABLE 2.19

Distribution of Farm Area (Operational) in Bangladesh by Ordinal Groups

Cumulated % of Farms	Percentage of Farm Area 1960	1968	1974
Bottom 10% operates	0.77	0.94	0.80
Bottom 20% operates	2.27	3.04	1.60
Bottom 30% operates	3.89	6.60	2.40
Bottom 40% operates	10.70	11.30	4.99
Bottom 50% operates	15.52	16.77	11.87
Bottom 60% operates	25.00	24.62	19.36
Bottom 70% operates	35.00	34.32	29.71
Bottom 80% operates	46.15	46.97	45.01
Bottom 90% operates	63.71	64.15	62.09
Bottom 100% operates	100.00	100.00	100.00
Concentration Ratio	0.49	0.48	0.56

Source: Alamgir (1975:268) Table V.

ing can be seen from Table 2.19.

Overall landlessness has increased and secondly there has been an increasing concentration of land in a few hands in Bangladesh. It may be possible that the new HYV technology has created a 'hunger' for land due to the increased profitability from it. Scale neutrality of HYV technology is not maintained in Bangladesh because institutional arrangements are such that bigger farms have disproportionately easy access to modern inputs than the smaller and marginal farms. The implication of this phenomenon is that a growing section of the population is being dispossessed of their entitlement to grow their own food or to engage in any form of exchange to acquire food. This has generated a process in which a significant proportion of the work force in agriculture is becoming alienated from the object of production, act of production and fellow men. Since the worker is gradually losing control over means of production, he is becoming a slave of his object in the sense that it provides him with the basis of work and that it provides him with physical subsistence (Alamgir 1978:111). In the face of growing landlessness, the only alternative is to exchange their labour power in the market --- a market where their bargaining strength is very little.

(II) Exchange Entitlement Decline: There are numerous manifestation of the exchange entitlement decline in Bangladesh of which an unfavourable movement in (i) real wages and (ii) terms of trade are the most important.

(i) Trend in Real Wages: Real wages of agricultural labourers have fallen considerably over the study period. This phenomenon raises some concern because the wages are by far the lowest from amongst all categories of labour. The trend in real wages for the agricultural labourers are shown in

TABLE 2.20

Real Wages in Bangladesh

Year	Real Wage (Taka/day)	Real Wage Index (1959 = 100)
1960	2.06	106.19
1961	2.27	117.02
1962	2.21	113.93
1963	2.36	121.66
1964	2.66	137.12
1965	2.22	114.44
1966	1.90	97.95
1967	1.92	98.98
1968	2.04	105.16
1969	2.22	114.44
1970	2.24	115.47
1971	2.17	111.86
1972	1.60	82.48
1973	1.59	81.96
1974	1.42	73.20
1975	1.59	81.96
1976	1.64	84.54
1977	1.50	77.33
1978	1.48	76.29
1979	1.46	75.25
1980	1.41	72.68
1981	1.37	70.62

Source: Chowdhry (1981:42) for data up to 1978. Rest from GOB, Statistical Year Book, 1982 p.511.

Table 2.20.

Since 1964, despite some short term fluctuation, there has been a pronounced downward trend in real wages in Bangladesh. In the early 1970's the rate of decline accelerated shaply and real wages reached a lower level in the early 1980 than in any period during the preceeding two decades. Consumer prices increased faster than money wages during most of the period (Chowdhry;1981:44). On the other hand, the demand for labour, and hence employment opportunities, increased at a slower rate than output (Islam;1979:393). It may be added that HYV technology introduced in the mid 1960's did not have a favourable impact as such on real wages because of low (about 0.5) elasticity of employment (Clay and Khan;1977). It is, therefore, unlikely that the absolute share of labour in output has risen. And the relative share of labour (i.e., the ratio of wage-income to output) must have fallen because: (i) labour requirements have not increased in proportion to output, and (ii) wage rates have failed to rise. Thus declining real wages and small (if any) increases in employment opportunities combined are additional indicators of the worsening living standards of over half the rural population who are nearly or entirely landless.

(ii) Terms of Trade in Agriculture: Food entitlement is eroded by an adverse movement of terms of trade between agriculture and industry. In Bangladesh, the gross barter terms of trade of the agricultural sector deteriorated sharply at independence in 1971 (Chowdhry;1981:57). The terms of trade of the agricultural sector are shown in Table

TABLE 2.21

Terms of Trade between Agriculture and Industry

Year	Terms of Trade (Percentage) 1961-62 = 100
1960	96.99
1961	96.26
1962	105.34
1963	111.37
1964	123.34
1965	123.39
1966	126.07
1967	129.56
1968	132.32
1969	134.13
1970	136.17
1971	135.23
1972	73.51
1973	78.46
1974	118.92
1975	93.28
1976	84.52
1977	85.96
1978	91.33

Source: Chowdhry (1981:59) Table 3.4.

2.21.

Since independence the terms of trade of the agricultural sector have been deliberately and systematically depressed to benefit the growth of the industrial sector in Bangladesh

(Chowdhry;1981:62). The squeeze of agriculture is brought about by some overt and covert taxation of agriculture and controls over foreign trade which include:

1. Promotion of extreme and high non-uniform rates of protection.
2. The use of direct quantitative controls on imports through a detailed licensing scheme.
3. The maintenance of an over-valued exchange rate.
4. Cheap foodgrain policy.

Chowdhry (1981:66) observes that:

> The internal pricing, procurement and distribution policies combined with a set of exchange rate and import-export regulation which created a situation in which the implicit exchange rate for a unit of agricultural commodity was considerably lower than that of manufactured commodity and also at international prices agriculture sector was losing about 33 per cent in its exchange with the manufacturing sector due to distortion in domestic prices. The total effect of the two was a transfer of income from agriculture to manufacturing which turned out to be highly inequitable because it implied a transfer, among other, from the rural poor to the urban rich.

Conversely, because of the operation of the food rationing system in the urban areas, the transfer of substantial amount of money from the urban consumers to rural grain growers do not take place (Stepanek;1979:60).

While losing land endowment through poverty and indebtedness; and gradually pushed to farming smaller tracts of land as tenants, with menacing unemployment and declining real wages and terms of trade, the exchange entitlement mapping of landless labour and other rural poor "took deep plunges" during the entire study period. All available evidence points to the fact that in Bangladesh there has been a continual erosion of food entitlement for these sub-groups and gradually a growing section of the people in the rural areas are deepening into poverty, starvation and malnutrition. Starvation is a matter of some people not having enough food to eat, and not a matter of there being not enough food to eat (Sen;1981a:434). Food availability in Bangladesh, on the aggregate, remained steady at around 16 ounces per head per day, which should, by Chen's (1975:108) criteria, adequately feed every man, woman and child. Unfortunately, food availability --- an inert statistic according to Sen (1980:621) --- is a necessary but not a sufficient condition to avoid hunger, starvation and malnutrition. What has to be guaranteed to prevent starvation is not food availability but food entitlement (Sen;1980:618).

2.5 SUMMARY

Bangladesh's lingering food problem is in part "production" oriented and in part "distribution" (income) related. Increases in domestic food production have been sluggish compared to population growth. But increasing food imports have made adequate provision to ensure adequate per capita availabilty of food. Despite a steady per capita food availability, malnutrition and hunger are rampant. Available evidence reveal growing poverty and inequality among various sections of the population. "Exchange entitlement" mappings of the rural population have declined exposing them to starvation. Large increases in domestic production and/or imports need not be required if entitlements change to assure access by all to the available food. Therefore, food entitlement must be restored for these hungry people.

Sen's entitlement hypothesis is the preferred approach in analysing the "silent" food problem affecting a particular and identifiable class of people in Bangladesh. Unfortunately, Sen's analysis cannot be pursued any farther with the available macro-level data from Bangladesh. Detailed micro-level data on income and asset distribution are vital for carrying out Sen's hypothesis to its fullest extent. Unfortunately, such data[17] is currently unavailable from Bangladesh. Hence, we have to abandon this preferred approach and opt for a "second-best" method of estimating the food demand of Bangladesh. In estimating a market demand function for food, we implicitly take into consideration "entitlements" since prices and income determines one's effective access to food.

---

[17] No survey has yet been carried out to study this aspect.

Chapter III

A CRITIQUE OF HAMID'S FOODGRAIN DEMAND MODEL

3.1 QUANTUM OF FOOD DEMAND

Three separate and distinct situations on the food front can be enumerated for the future years:

1. domestic demand increasing at a faster rate than domestic supply
2. domestic demand increasing at a slower rate than domestic supply; and
3. the two growing at the same rate.

Food management and control will be different under each of these different scenarios and will depend on the quantum and magnitude of imbalances and instabilities in demand and supply. If production lags behind demand, imports and restriction on demand will become necessary. Similarly, if production exceeds domestic demand export markets have to be explored to market the surplus. In either case conscientious planning is imperative. Of paramount importance to Bangladesh, therefore, is short-term and medium-term food planning and a critical ingredient in this planning exercise is the simple but knotty question: What is the food demand of the population of Bangladesh?

Traditional estimation of food demand consists of food balance-sheet which takes the form of adding up domestic production and imports of food to indicate the total availability of foodgrain to the population. Thus, total availability, per capita or otherwise, is taken to be a rough measure of food demand. But the principal limitation of the food balance-sheet approach to the estimation of food demand is that it is "supply-led". Gross amounts produced domestically and imported from abroad may not be consumed or metabolically utilized by its population. Moreover, availability figures assume that a movement of foodgrains across national borders is absent.[18]

Another commonly employed technique for estimating foodgrain demand (need/requirement) is to compute physiologic requirements (biological demand) for energy (calories) based on internationally accepted norms for human beings of different age, sex, body weight and for populations living in different environments and undertaking varying levels of physical activity. A less commonly used method for estimating food demand consists of an assessment of individual or household consumption patterns. Consumption data obtained

[18] Smuggling of foodgrains to India is a thriving business in Bangladesh in return for certain non-food consumer goods like saris, cosmetics, spices, 'biri' (hand made cigarette) leaves etc. Price differential of foodgrains between these countries makes smuggling all the more lucrative. Although no exact amount can be placed on the amount taken out illegally each year, some observers place the figures around half a million to two million tons or about fifteen to twenty per cent of total food availability in the country.

through dietary sample surveys are extrapolated for the nation as a whole. This approach, to some extent, incorporates market information regarding prices of food and income of the household and the influence that each of these variables have on food demand.

One thing is clear from the above discussion: these three approaches are independent of one another and do not estimate the same parameter value. Food balance-sheets estimate only the quantity of food available to the population through domestic production and imports. In the second approach, physiologic requirements indicate the caloric (energy) needs of a population based on recommended requirements that may be applied to any human population. In the third approach, consumption levels relate to the amounts of food actually purchased given the prices and income levels. These distinctions are vital because the parameter values will be different in each case and will also provide independent views of a nation's food situation.

These three connotations of food demand mentioned above compound the problem of food management in Bangladesh. Food planners often resort to the computation of "physiological requirement" in their calculation of food demand. On this basis, domestic demand (requirement) far exceeds domestic production and huge importation of food is recommended and in fact made each year. Under this approach, as was seen in the previous chapter, there is absolutely no guarantee that food will be actually available in equal amounts to all sections of the population, and even if available, that all groups of people can buy all the food that is biologically required to provide an adequate nutrition.

Earlier Studies:

Little empirical work is available on Bangladesh in each of the three areas mentioned above. Available studies can be categorised in three groups:

1. Physiological demand (requirement) e.g. Chen (1975).
2. Economic demand e.g. Alamgir and Berlage (1973b) and Mahmud (1979).
3. Hybrid of physiological and economic demand e.g. Hamid (1980).

Physiological Demand Study.

Chen (1975) estimated the consumption requirements for Bangladesh based on physiological needs for the period 1960-70. Taking into account the population distribution and making suitable adjustments for different activity levels, Chen's findings for the decade show that the physiological requirements are 13.2 ounces per capita per day in Bangladesh. Assuming a nutritional wastage of 8-10 per cent Chen (1975:108) concluded that an average per capita availability of about 14.5 ounces per day is a "... reasonably safe level for Bangladesh. Provided planners were willing to accept an unimproved state of nutrition in the population, such a level could be expected to sustain the population over a long-run, such as a decade."

One fundamental flaw in Chen's analysis is that the total food availability per capita is not a problem *per se*, because food availability is supply-determined (consisting of net domestic production and imports). What is important in this debate is whether the food that is "required" physiologically is actually received and consumed by the individuals since prices of foodgrains and incomes of the individuals act as constraining factors in consumption. Therefore, it would be meaningful to know the actual amount consumed/demanded by individuals given their need for food, the prices of foodgrains and their income level.

Economic Demand Studies:

Alamgir and Berlage (1973b) tried to estimate the income elasticity of foodgrains from cross-section data for urban and rural households in Bangladesh. Using the Household Expenditure Survey data of 1963-64, 1966-67, and 1968-69, the authors concluded that "... the available sample data do not provide definite evidence about the coefficients of the demand function for foodgrain in Bangladesh, and consequently, about the income elasticity" (Alamgir and Berlage;1973b:398). Another important finding of this study is that the coefficients were found to be unstable from sample to sample based on the Chow-test, and hence there is no scope for pooling data from different samples.

Mahmud (1979) attempted to estimate the foodgrain demand elasticity of rural households in Bangladesh by using pooled cross-section data from several rounds of family budgetary survey conducted during 1963-64, 1965, 1966-67 and 1968-69. A per capita demand function had been fitted to the data on household income groups to yield elasticity estimates which are income-group specific. Since this study was aimed at estimating the rural household food demand no attempt had been made to extrapolate the per capita demand for food-grains into national figures.

Hybrid Demand Studies:

The salient feature of Hamid's (1980) work is the projection of demand for foodgrains through "alternative approaches" up to the year 2000. The alternative approaches to demand projection considered by Hamid (1980) are two, namely:

(i) economic demand and,

(ii) physiological demand.

Hamid's (1980) concept of economic demand is a hybrid form of the "physiological demand" approach and the "economic demand" approach discussed earlier. Hamid (1980) postulates that "economic demand" is based on base year demand for food, growth in population and income elasticity of demand for food. Based on these parameters Hamid (1980) projected the demand for food in Bangladesh up to the year 2000.

In this Chapter our objective is to critically analyse Hamid's (1980) hybrid food demand model for Bangladesh. This is purely a corrective exercise. In particular, we are not interested in the "physiological demand" for food. Further, we shall postpone the analysis of "economic (market) demand" for food to a later Chapter. Our objective in this Chapter is to re-calculate Hamid's (1980) model for a number of reasons. First, what Hamid terms as "economic demand" is not truly economic because the essential ingredients of demand, such as prices and income, are missing. Second, Hamid's projection have significant calculation errors which cannot be ignored. Third, Hamid's model is calculated on the basis of parameters whose values are questionable. Therefore, re-calculation of Hamid's (1980) model with plausible parameter values is necessary. Fourth, Hamid's forecasts lack statistical precision. Therefore, a model with stronger theoretical statistical foundation is required to provide robust and accurate forecasts. As an illustration of such an alternative, a simulation Box-Jenkins ARIMA model is identified and estimated. The simulation model plus a set of simulated forecasts are reported in Appendix C.

3.2 CRITICAL ANALYSIS OF HAMID'S (1980) MODEL

According to Hamid (1980), foodgrain demand emanates from two sources: (1) population growth and (2) growth in income. Symbolically,

$$\dot{F} = F(\dot{P}, \dot{Y}) \qquad 3.1$$

where, $\dot{F}$ = growth rate of food demand;

$\dot{P}$ = population growth rate; and

$\dot{Y}$ = income growth rate.

To arrive at the aggregate demand for food at any point in time, Hamid (1980) used two formulas to project future demand for food.

FORMULA 1: $$Ft = F_0 (1 + r_1 + r_2 Ed)^n \qquad 3.2$$

FORMULA 2: $$Ft = F_0 (1 + r_1)^{nPe} (1 + r_2)^{nEd} \qquad 3.3$$

where, Ft = projected demand at period t;

F_0 = base period demand;

r_1 = rate of population growth;

r_2 = rate of per capita real income growth;

Pe = population elasticity (assumed to be 0.98);

Ed = income elasticity of demand; and

n = number of years elapsed from the base year.

Hamid (1980:174) projected the economic demand for food from 1976-2000 in Bangladesh by using Formulas 1 and 2. But his projections, regrettably, had calculation errors. For the sake of illustration and comparison these calculations are shown in Table 3.1.

From Table 3.1, it is evident that Hamid's (1980) calculation was erroneous. In all cases, except for 1989-90, the figures over-estimated the actual numbers. Another aspect of the discrepancy is that the errors were increasing in magnitude over time.

TABLE 3.1

Computational Errors in Hamid's (1980) Model

'EAR	HAMID'S VALUES		CORRECTED VALUES		ERRORS	
	FORMULA 1 (million	FORMULA 2 tons)	FORMULA 1 (million	FORMULA 2 tons)	ERROR1 (million	ERROR2 tons)
976-77	13.09	13.09	N/C	N/C	-----	-----
977-78	13.52	13.50	N/C	N/C	-----	-----
979-80	14.43	14.41	14.435	14.418	0.000	0.000
984-85	16.96	16.91	16.825	16.778	0.135	0.132
989-90	18.70	19.60	19.073	18.994	-0.373	0.606
994-95	22.69	22.56	21.405	21.298	1.285	1.262
999-00	25.82	25.64	23.202	23.069	2.618	2.571

lote :

) Hamid's values are from Hamid (1980:174) Table III.

:) Error = Hamid's Values - Corrected Values. Error1 and Error2 are or FORMULA 1 and 2 respectively.

;) N/C = Not calculated, since it is not clear as to what parameter 'alues were used for 1976-77 and 1977-78.

<u>Hamid's assumptions are unrealistic</u>:

The projection of foodgrain demand depends critically on the following parametric values:

1. initial (base year) food demand;
2. population growth rate;
3. income elasticity of demand; and

4. income growth rate.

All of the above parameter values assumed by Hamid (1980) are open to question for the reasons to be explained below.

(1) Base Year Food Demand (F_0):

Base year food demand is the kingpin in Hamid's calculation. To arrive at the aggregate demand for food at any point in time Ft, equation 3.1 has to be multiplied by the initial level of food demand F_0 to yield equations 3.2 and 3.3. Thus, the initial food demand F_0 enters the calculation in a multiplicative way.

Hamid (1980) assumed total availability (supply) = demand for food. He used two formulas for calculating total availability namely:

FORMULA A: $TA = NDP + M$ 3.4

FORMULA B: $TA = NDP - IP + OF$ 3.5

where, TA = total availability;

NDP = net domestic production;

M = imports;

IP = internal procurement; and

OF = off-take (distribution) from PFDS.

Hamid (1980) then calculated the availability for the years 1975-76, 1976-77 and 1977-78 under each formula. These figures were relatively close, according to Hamid (1980), who again averaged the two estimates which was 12.63 million tons of foodgrain.

Hamid (1980) used a second method (consumption approach as opposed to the availability approach in the former case) based on the data of per capita consumption of food from Household Expenditure Survey 1973-74. The per capita consumption of food per day was estimated at 16.1 ounces and with this consumption level for 1976-77 (base year), the estimated base year demand was arrived at 13.55 million tons.

Hamid (1980) obtained two estimates from two approaches namely 12.63 million tons from "availability approach" and 13.55 million tons from "consumption approach". "A purely arbitrary solution is to take the average of the two estimates" which is 13.09 million tons as the base year demand F_0 (Hamid;1980:172).

Hamid's (1980) calculation of the base year demand F_0 is *ad hoc* and "purely arbitrary" (in Hamid's own words). The base year demand F_0 is an amalgam of two entirely different approaches. Therefore, it is conceptually imprudent and meaningless to integrate the two. In one instance, the critical parameter is total food availability (supply) and, in the other, the crucial parameter is the food actually purchased, given prices and income, under the consumption approach.

Second, the philosophy of taking the means is to smooth out the effect of seasonality, cyclical factors and random disturbances. In the availability approach, Hamid (1980) took the average of 1975-76, 1976-77 and 1977-78. In fact, these were good crop years following the severe famine and food disaster of 1973-74. As a result net domestic production and imports were above normal. Hence, total availability figures were above normal for Bangladesh during those three years. Hamid (1980) should have used the average of availability of foodgrains over a number of years[19] and in that way a trend regarding the availability of foodgrains could have been calculated. Therefore, Hamid's selection and calculation of the base year demand is _ad hoc_, arbitrary, inflated and calculated from two disjoint approaches.

(2) Assumptions regarding population growth rate r_1:

Hamid's (1980) Table II shows the crude birth rate (CBR), crude death rate (CDR) and natural growth rate (NGR) and population figures for Bangladesh. The source of these vital statistics were reportedly taken from the Statistical Pocket Book 1978 published by Bangladesh Bureau of Statistics (BBS). Hamid (1980) is quite inconsistent in his data source because his Table I is based on the Statistical Year Book, 1979 also published by BBS. In fact, it would have been to Hamid's advantage to use the latter source because (1) the figures are revised and current as of then and (2) because the latter has complete data on CBR, CDR, and NGR which are often missing for some years in Table II of Ham-

[19] Say 10, 15, 20 or 25 years and then estimate the trend with the help of moving average of suitable length of time.

id's (1980). Hamid's (1980) Table II is reproduced in Table

TABLE 3.2

Hamid's Table II

YEAR	CBR	CDR	NGR	POPULATION
1973-74	---	---	---	76.05
1974-75	---	---	---	78.18
1975-76	44.5	16.5	2.80	80.37
1976-77	---	---	---	82.62
1977-78	---	---	---	84.94
1979-80	43.0	16.0	2.70	89.63
1984-85	39.3	14.8	2.45	101.66
1989-90	35.5	13.5	2.20	113.89
1994-95	32.0	12.5	1.95	126.06
1999-00	29.0	12.0	1.70	137.82

Source: Statistical Pocket Book 1978.
Note: Hamid's (1980:173) Table II is reproduced.

3.2.

It is not clear why Hamid kept switching his data source from table to table. This not only creates confusion but also leads to inaccuracy in calculation. Hamid's (1980) Table II should have been as is reported in Table 3.3.

A comparison of natural growth rate (NGR) of Table 3.2 and Table 3.3 shows that Hamid's NGR figures are over-estimated. Thus, Hamid (1980) used inflated population growth rate figures in his calculation. Table 3.4 measures the extent of over-estimation of NGR by Hamid.

TABLE 3.3

CBR, CDR and NGR in Bangladesh

YEAR	CBR	CDR	NGR
1970-75	43.00	18.00	2.50
1975-80	39.70	16.50	2.32
1980-85	35.80	14.20	2.16
1985-90	32.70	13.70	1.90
1990-95	30.50	13.00	1.75
1995-00	28.60	12.60	1.60
2000-05	26.60	11.60	1.50
2005-10	25.00	11.30	1.37
2010-15	23.70	11.00	1.27
2015-20	22.74	10.62	1.23
2020-25	22.09	10.48	1.16

Note: CBR = crude birth rate (per thousand).
CDR = crude death rate (per thousand).
NGR = natural growth rate (per cent).

Source: GOB, Statistical Year Book, 1979, Table 2.22 p.66.

In absolute terms, the difference between Hamid's (1980) values and BBS (1979) values ranged from 0.48 per cent to 0.04 per cent; while in relative terms the over-estimation ranged from 21 per cent to 2 per cent. The difference between the two values decreased, both in absolute and relative terms, over time.

(3) Assumptions regarding income growth rate r_2:

Hamid's (1980) assumption regarding r_2 is as shown in Table 3.5. However, these figures are assumed low compared to the figures reported in the Statistical Year Book (1982) as

TABLE 3.4

Magnitude of Over-Estimation of NGR by Hamid

Year	Hamid's Value (%)	BBS 1979 Value (%)	Absolute Difference	Relative Difference
1975-76	2.80	2.32	0.48	20.69
1976-77	2.70	2.32	0.38	16.38
1984-85	2.45	2.16	0.29	13.43
1989-90	2.20	2.16	0.04	1.85
1994-95	1.95	1.75	0.20	11.43
1999-00	1.70	1.60	0.10	6.25

Source: Calculated from Table 3.2 and Table 3.3.

TABLE 3.5

Real Income Growth in Bangladesh

YEAR	Real Income Growth (Percentage)
1973-78	1.1
1978-80	1.5
1980-90	1.8
1990-00	2.0

Source: Hamid (1980).

shown in Table 3.6. Comparing Table 3.5 and Table 3.6, Hamid's (1980) estimate of real income growth rate is under-es-

TABLE 3.6

GNP, Population and Income Growth Rate in Bangladesh 1976-2000

YEAR	GNP (%)	POPULATION (%)	INCOME (%)
1973-75	4.0	2.50	1.50
1975-78	4.0	2.32	1.68
1978-80	3.5	2.32	1.18
1980-84	3.6	2.16	1.44
1984-85	4.08	2.16	1.92
1985-89	4.08	1.90	2.18
1989-90	4.69	1.90	2.79
1990-94	4.69	1.75	2.94
1994-95	4.96	1.75	3.21
1995-99	4.96	1.60	3.36
1999-00	4.42	1.60	3.22

Source: GOB, Statistical Year Book (1982).

timated for all years except for 1978-79 to 1983-84.

(4) Income Elasticity of Demand (Ed):

Another critical parameter in the calculation was the value of income elasticity of demand for food. Hamid (1980) assumed this value to be 0.41. A survey of the literature on this subject, as presented in Table 3.7, illustrates that Hamid's (1980) estimate is very low compared to the findings elsewhere. Mellor (1966) argues that because taste and preferences differ so widely between countries, comparisons of international data are not likely to be useful for detailed studies. He admits, however, that for broad aggregates of commodities, the international comparisons provide estimates surprisingly close to those from intracountry cross-section studies.

Our estimates of income elasticity of demand for food in Bangladesh using Household Expenditure Survey data of 1963-64, 1966-67, 1968-69, 1973-74 and 1976-77 ranged from 0.97 to 0.64 for different functional forms.[20] Taking the median (also the mean) value of these estimates[21] the income-elasticity of demand for food in Bangladesh was estimated to be 0.78 which is quite reasonable and in line with the findings of the rest of the literature.

---

[20] Three functional forms were used:

$$C = a_0 + b_0 Y \qquad \ldots(1)$$

$$C = a_1 + b_1 \text{Ln } Y \qquad \ldots(2)$$

$$\text{Ln } C = a_2 + b_2 Y \qquad \ldots(3)$$

where, C = consumption, Y = income and Ln = natural logarithm.

[21] Results of these regressions are shown in Appendix B Table B.1.

TABLE 3.7

ncome Elasticity of Demand for Food in Different Countries

EAR	AUTHOR(S)	COUNTRY	INCOME ELASTICITY
967	National Council of Applied Economic Research, New Delhi	India	0.58 for wheat. 0.47 for rice.
969	Pak,Ki Hyuk & Hau, Hee Chun.	Republic of Korea	0.55 for grain. 0.54 for all food.
960	Goreaux, L.M.	Summary of several FAO studies.	0.85 at income $50.00. 0.25 at income $1500.00.
958	Coale, A.J. & Hoover, E.M.	India	0.80 Palvia's estimate up to 1971 quoted by them.
965	Stevens, R.D.	Data from 35 countries	0.80 at income $50.00. 0.60 at income $1000.00.
965	Stevens, R.D.	Data from 13 countries	0.8 at low ($75) income. 0.56 at high ($100) income.
965	Stevens, R.D.	Data publis-hed by Kuzn-nets.	0.75.
966	Mellor, J.W.	Developing countries in general	Range from 0.9 at low incomes to 0.5 at high incomes.
961	Johnston, B.F. & Mellor, J.W.	For develop-ing countri-es.	0.6 or higher.
973	Alamgir, M. & Berlage, L.J.J.B.	Bangladesh	0.37 (Authors expressed skepticism about the estimate).
978	Mahmud, W.	Bangladesh	0.55.

3.3 RE-CALCULATION OF HAMID'S MODEL WITH PLAUSIBLE PARAMETER VALUES

In the last section, we have argued cogently that the parameter values assumed by Hamid (1980) were unrealistic and implausible according to the facts available for Bangladesh. This calls for a re-calculation of the whole exercise. And to this end we turn.

Assuming the base year demand to be 12.88 million tons,[22] income elasticity of demand for food to be 0.78,[23] population growth rate and income growth rate to be that as shown in Table 3.6, the total demand (requirement) for foodgrains in Bangladesh from 1976 through 2000 A.D. is shown in Table 3.8.

Given the outlook of the Bangladesh's economy up to the end of the century, food demand (requirement) is going to increase by about 253 per cent compared to the benchmark demand of 1976. This increase is unlikely to be met from domestic production given the present state of land, labour and other inputs, tenurial arrangement and the state of technology in Bangladesh. If domestic supply of foodgrains is insufficient to meet the requirements for foodgrains, then the only alternative is to import the shortfall. This option, although easy to prescribe, is extremely costly for Bangladesh.

[22] Detailed calculation of the base year demand for food is shown in Appendix B Table B.2.

[23] Calculation shown in Appendix B Table B.1.

TABLE 3.8

Foodgrain Demand (Requirement) in Bangladesh 1976-2000

YEAR	FOODGRAIN DEMAND FORMULA 1 (million tons)	FORMULA 2 (million tons)
1976	12.88	12.88
1977	13.35	13.35
1978	13.73	13.72
1979	14.17	14.16
1980	14.66	14.64
1981	15.14	15.12
1982	15.63	15.62
1983	16.15	16.12
1984	17.17	17.15
1985	17.71	17.69
1986	18.35	18.33
1987	19.01	18.98
1988	19.69	19.67
1989	20.40	20.37
1990	22.43	22.42
1991	23.34	23.33
1992	24.28	24.27
1993	25.27	25.25
1994	27.26	27.26
1995	28.25	28.25
1996	29.44	29.44
1997	30.69	30.68
1998	31.98	31.98
1999	32.54	32.53

Note:

FORMULA 1: $Ft = F_0 (1 + r_1 + r_2Ed)^n$

FORMULA 2: $Ft = F_0 (1 + r_1)^{nPe} (1 + r_2)^{nEd}$

3.4 SUMMARY

In this Chapter our task was purely to carry out a corrective exercise on Hamid's (1980) model. We have shown that Hamid's (1980) model of projecting foodgrain demand in Bangladesh was open to question and these "errors" were increasing over time. Next we argued cogently to show that Hamid's (1980) model was calculated on the basis of some parametric values which were either questionable or were out of line with the existing situation. Hence, Hamid's (1980) model was re-calculated with a set of plausible parameters. Lastly, as a simulation exercise, an ARIMA (1,1,2) time series was identified, estimated and optimal forecasts made up to the year 2009-2010. This is shown in Appendix C.

Chapter IV

ANALYSIS OF THE MARKET DEMAND FOR FOOD IN BANGLADESH

Economic theory postulates that demand for a commodity can be considered as a function of the price of the commodity, and the disposable income of the consumer, other things remaining constant. By direct analogy, we may extend this relationship to all consumers and think that the total demand for the commodity can be considered as a function of price of the commodity and of total disposable income of all consumers. In the previous Chapter we have calculated the food demand for Bangladesh using different formulas and methodologies without incorporating the vital market information regarding price and income. Unless confronted with a vector of prices and incomes, a given consumer may not be able to choose the optimal quantity of the commodity in question. Demand in economics refers to effective demand i.e., how much of a given commodity is actually bought at given prices and incomes. What was referred to as economic demand by Hamid (1980) may be dubbed as food "requirement" of the people and an extension of the Balance-Sheet Approach to food accounting cited in the previous Chapter. We believe that the estimation of food requirement based on dietary standards has limited significance in planning for food production and distribution. The reasons are: (i) any procedure for estimating food needs is likely to be unsatisfactory because estimating requirements for nutrients is only a first step to establishing food needs since there are infinite combinations of food items that will satisfy a set of nutritional requirements; (ii) this sort of target setting --- in terms of nutrients or commodities --- is not an interesting thing to emphasize; and (iii) the consumers are rational to take care of the nutritional needs within their budgets given the price of food.

In this Chapter our objectives are two-fold. Our primary task is to derive a statistical demand function for food for Bangladesh and to analyse the methods, techniques and problems associated with estimating such a demand function. The estimation of the demand function will be done within a system of simultaneous equations since the demand function belongs to a wider system of simultaneous equations. In this way we can avoid the problems of identification[24] and simultaneity bias[25] involved with single-equation estimation.

[24] Identification is a problem of model formulation, rather than of model estimation. A model or equation is said to be identified if it is in a unique statistical form, enabling unique estimates of its parameters from sample data. Over-identified equations may have non-unique parameter estimates while un-identified equations do not yield any parameter estimates from sample data. Identification of an equation depends on some conditions namely (1) order (necessary) condition and (2) rank (sufficient) condition. Cf. Kmenta (1971)

[25] This bias is independent of sample size and is not eliminated by increasing the number of observations in the sample.

Secondly, our task is to develop a Macro Food Demand Model assuming a 3-Sector classification of the Bangladesh economy.

Earlier Studies on Demand for Food in Bangladesh:

Earlier studies on this particular subject are scanty. Econometric studies of demand for foodgrains in Bangladesh were done by Alamgir and Berlage (1973b) and by Mahmud (1979). Alamgir and Berlage (1973b) based their study on the 1963-64 Report on Quarterly Survey of Current Economic Conditions in Pakistan, by the Central Statistical Office and two other subsequent surveys for the years 1966-67 and 1968-69.

The general approach taken in Alamgir and Berlage's (1973b) paper was to estimate the parameters of the demand functions for foodgrains separately for each sample and to find out if they gave approximately the same results. To that end, Alamgir and Berlage (1973b) specified two demand functions:

$$C = \alpha_1 + \beta_1 \text{ Log } Y + \gamma_1 \quad \text{(semi-log form)}$$

$$C = \alpha_2 + \beta_2(1/Y) + \gamma_2 \quad \text{(inverse form)}$$

where, C = monthly per capita consumption of foodgrains;

Y = monthly per capita income;

γ = food price index; and

α's and β's are the parameters.

The price term collapses with the intercept term when estimated for a single sample.

Alamgir and Berlage (1973b) then proceeded to estimate the income elasticity of demand for foodgrain for Bangladesh as a whole and computed income elasticities for rural and urban Bangladesh separately. Their conclusions are rather startling. Chow-tests rejected the hypothesis of equality of the coefficients for all the three samples under consideration. Hence, they concluded that there is no room for pooling data from different samples. The authors partially answer this phenomenon by remarking that subsistence peasants adjust their foodgrain consumption rather closely to their production. Therefore, they conclude that the available sample data do not provide definite evidence about the coefficients of the demand function for foodgrain in Bangladesh. Demand functions estimated from individual samples provide only partial information on the parameters.

Mahmud (1979) also used pooled cross-section data from the Quarterly Survey of Current Economic Conditions conducted by the Central Statistical Office (of former Pakistan) for the years 1963-64, 1965 (Jan-June), 1966-67 and 1968-69. Mahmud's objective was to estimate the foodgrain demand elasticities of rural households in Bangladesh. The estimated elasticities are income-class specific and are based on a demand-theoretic specification of own-price, cross-price and income elasticities of consumer demand. Mahmud (1979) specified a semi-log demand function of the form:

$$C = a + b \text{ Log } (Y/Pf) + d \text{ } (Pf/Pm)$$

where, C = per capita consumption;

Y = per capita income;

Pf = food price index; and

Pm = non-food price index.

Mahmud (1979) then went on to estimate (1) demand function for rural Bangladesh, (2) demand function for Lower Income Groups and (3) demand function for Higher Income Groups. Mahmud's (1979) study revealed, among other things, that income elasticity, cross elasticity and own elasticity are all inversely related to ordinal income groups, i.e., all the elasticities fall in magnitude with a rise in income of the households.

The two studies cited above have similarities and dissimilarities in them. They are similar in the sense that they are single-equation model and use cross-section data to estimate foodgrain income elasticities of demand. These two studies are dissimilar in more than one way. Mahmud (1979) tries to estimate rural foodgrain demand elasticity which are income-class-specific whereas Alamgir and Berlage (1973b) attempt to estimate income elasticity of demand for food for rural and urban Bangladesh in general, and then to test the stability of the parameters from sample to sample. Moreover, the functional form chosen by the two authors were also different from one another.

Obviously time series data, despite its blemishes, has been over-looked in the studies cited above. No accurate information about price elasticity of demand for food can be extracted from cross-section samples. Even the proper formulation and estimation of a statistical demand function for food for Bangladesh as a whole has been neglected thus far. Therefore, our task here is to fill in the void left by the earlier studies.

4.1 DEMAND FOR FOOD: THE PRICE FLEXIBILITY MODEL

Foodgrain demand is considered here as a composite demand for rice and wheat as cited earlier. Traditionally, consumers in Bangladesh preferred rice to wheat, and local rice to imported rice and wheat.[26] However, with the passage of time consumer's preference patterns have changed considerably and now both rice and wheat are equally preferred. Hence, we can assume perfect substitution for all categories of rice and wheat.

In general terms, the market for total foodgrain in Bangladesh can be summarised by the following system of equations:

Demand: $D = f\ (Y, P)$ 4.1

Supply: $S = (1-d)Q - IP + OF$ 4.2

where, D = demand for foodgrains;

S = supply of foodgrains;

Y = per capita real disposable income;

---

[26] This was due to certain taboos among the people that wheat was hard to digest and therefore it was hard on the people's digestive system. Moreover, women-folks disliked wheat (flour) because it meant extra work of kneading the dough, rolling and baking. But these taboos have waned over the years.

P = market retail price index of foodgrains deflated by non-food price index;

d = coefficient of wastage due to seed, feed etc.;

Q = gross domestic production of foodgrains;

IP = internal procurement of foodgrains; and

OF = off-take of foodgrains through rationing;

Assuming, OF = Imports + IP, equation (4.2) can be re-written as below:

$$S = (1-d)Q + \text{Imports} = FA \qquad 4.2a$$

where, FA = foodgrain availability.

Thus, the supply function of equation (4.2a) is assumed constant (fixed) comprising of net domestic production and imports of food from outside. Therefore, FA can be treated exogenous.

There are three basic reasons for the assumption of exogenous supply function. These are:

1. The over-riding objective in this study is to estimate a demand function for food and not a supply function. Therefore, the assumption of price inelasticity of supply takes care of the identification and simultaneity problems. Moreover, calculation of the parameters are simplified. Thus, parsimony is achieved.
2. Total supply of food is a sum total of domestic supply and imports (foreign supply). Import of food as a proportion of food availability is substantial.

Food imports depend on such factors as domestic production, population, total foreign exchange reserves, import prices and government policy. Alamgir (1980:39) discusses the complexities of the problem of food imports in Bangladesh. Therefore, it is imprudent to make supply of food a function of the price of food in Bangladesh.

3. Agriculture in low-income country is often a sector of "highly inelastic aggregate supply" and the aggregate supply elasticity of basic foodgrains is estimated as low as -0.1 (Mellor;1978:17). Our findings in Chapter V show a very low (0.1) price elasticity of supply of food which is also statistically insignificant. Therefore, it would not be implausible to assume price inelasticity of supply.

Postulating a linear function for foodgrain in price and disposable income, equation (4.1) can be written as follows:

$$D = \alpha + \beta P + \gamma Y + u \qquad 4.3$$

where, α, β, γ, are the structural parameters of the system, and u is the random disturbance term. The market equilibrium of the system requires the equality of equations (4.2a) and (4.3) to yield the following:

$$FA = \alpha + \beta P + \gamma Y + u \qquad 4.4$$

In equation (4.4) we can treat FA and Y to be exogenous in the sense that none of them depends on the simultaneous values of the other variables in the system. The reduced form of equation (4.4) can be written as below:

$$P = -(\alpha/\beta) - (\gamma/\beta)Y + (1/\beta)FA - (u/\beta) \qquad 4.5$$

or, alternatively as

$$P = \Pi_0 + \Pi_1 Y + \Pi_2 FA - (u/\beta) \qquad 4.5a$$

where, $\Pi_0 = -(\alpha/\beta)$; $\Pi_1 = -(\gamma/\beta)$ and $\Pi_2 = (1/\beta)$; thus the Π's represent the reduced form parameters. The situation of the present model can be termed as a market that operates by price adjustment.[27]

Unique estimates[28] of the structural parameters α, β, γ, can be found through the estimation of equation (4.5a). In estimating equation (4.5a) we resort to a transformation that leaves the data intact but reparameterizes the problem. By this transformation we simplify the estimation problem, generally at the cost of proliferating the number of parameters to be estimated. Having obtained estimates of the parameters in the context of the transformed (reparameterized) problem, we then employ the inverse transformation on the resulting estimators in order to recover information on the structural parameters that are of primary interest to us. The solution for α, β, and γ is as shown in equations (4.6a) through (4.6c):

$$-\alpha = \Pi_0/\Pi_2 \qquad 4.6a$$

$$-\gamma = \Pi_1/\Pi_2 \qquad 4.6b$$

$$\beta = 1/\Pi_2 \qquad 4.6c$$

---

[27] Similar market model can be found in Tobin (1950) and Cramer (1971:208-210).

[28] The demand equation (4.3) is exactly identified by the order and rank conditions of identification.

From equations (4.6a), (4.6b) and (4.6c) we see that the structural parameters α, β, γ, are non-linear functions of the Π's.[29] While it is easy to derive estimates of the structural parameters through the reduced form parameters, the estimation of their respective standard errors is not very easy and straight-forward. However, the large sample variance of the structural parameters can be found out by Kmenta's (1971) approximation formula.[30]

---

[29] Π's are unbiased and consistent estimators. Since, α, β, γ, are non-linear functions of the Π's; α, β, γ, are biased in small samples but are consistent. As Kmenta (1971:443) writes " As for the desirable properties of the resulting estimators, we note that those estimators which are non-linear functions of the unconstrained coefficients inherit the desirable asymptotic, but not small sample properties from the unconstrained estimators. The reason is that unbiasedness does not "carry over" via non-linear functions." We shall, therefore, have to be content with estimates with this asymptotic quality alone.

[30] As Kmenta (1971:443) writes "The formula refers to the general case where an estimator, say α, is a function of k other estimators such as β_1, β_2, ...βk; i.e.,

$$\alpha = f(\beta_1, \beta_2, \ldots \beta k)$$

Then the large-sample variance of α can be approximated as $Var(\alpha)=\Sigma[\delta f/\delta\beta k]^2 Var(\beta k)+2\Sigma[\delta f/\delta\beta j][\delta f/\delta\beta k]Cov[\beta j,\beta k]$

$$(j,k = 1,2 \ldots k)(\ j < k\ )$$

(The approximation is obtained by using Taylor's expansion for $f(\beta_1, \beta_2, \ldots \beta k)$ around β_1, β_2, ..., βk dropping terms of the order two or higher and then obtaining the variance by the usual formula)".

4.2 ESTIMATION OF THE PRICE EQUATION

The price equation (4.5a) is estimated by using time series data from 1960-61 through 1981-82. The data used in the estimation of this equation is reproduced in Table 4.1. While estimating equation (4.6), the availability of foodgrain FA was taken in per capita term, P is the retail food price index deflated by non-food price index, and Y is the per capita real income. The result of OLS estimation are as follows:

$$P = 223.55 + 0.2067Y - 1.1639FA \qquad 4.7$$
$$(194.12) \quad (0.0142) \quad (1.1767)$$

where, figures in parentheses are standard errors of the respective parameters.

The other summary statistics of the regression equation (4.7) are as follows:

$$R^2 = 0.9196 \; ; \; R^{-2} = 0.9112$$

[Note: R^{-2} = adjusted R^2. This notation will be used throughout.]

$$F = 108.701; \; S.E.E. = 52.059$$

$$D.W. = 1.8898; \; \rho = -0.0231$$

<u>Discussion of Results</u>

(1) In terms of R^2 the price equation (4.7) provides an excellent fit. Nearly 92 per cent of the variation in the dependent variable P is explained by the independent variables Y and FA . The Durbin-Watson statistic, D.W. =

TABLE 4.1

Per Real Capita Income, Per Capita Food Availability Food Price Index and Non-Food Price Index in Bangladesh

YEAR	PER CAPITA REAL INCOME (Tk/year)	FOOD PRICE INDEX (Base=1959)	NON-FOOD PRICE INDEX (Base=1959)	PER CAPITA FOOD AVAIL. (Tons/year)
1960	283.54	104.32	107.35	0.16801
1961	301.58	103.07	113.93	0.16750
1962	293.35	112.31	116.75	0.14812
1963	318.09	103.98	118.46	0.17782
1964	316.44	109.96	128.21	0.16663
1965	322.35	122.10	118.12	0.15994
1966	315.60	162.52	129.15	0.15215
1967	336.17	141.91	129.74	0.17386
1968	337.95	158.06	134.70	0.17169
1969	336.65	157.32	138.47	0.17677
1970	430.56	153.61	141.35	0.16910
1971	519.79	165.96	144.82	0.14588
1972	596.81	287.82	152.91	0.16370
1973	644.16	363.21	156.34	0.16562
1974	650.41	853.36	158.39	0.16111
1975	693.19	482.79	157.82	0.16448
1976	691.10	524.29	160.61	0.14130
1977	734.76	661.13	162.83	0.16304
1978	750.28	694.33	168.82	0.15426
1979	747.50	954.36	171.35	0.15944
1980	781.45	827.11	174.85	0.17099
1981	772.75	1034.60	184.91	0.16472

Source: (1) Food Availability from Table 2.11.

(2) National Income from GOB, Statistical Year Book, 1982.

(3) Food Price Index calculated from data published by Islam, R. (1980) Table V. Rest from GOB, Statistical Year Book, 1982.

(4) Non-Food Price Index is from Bureau of Statistics, Dhaka, Bangladesh.

1.8898, which indicates an absence of serial correlation in the data. Also the first-order auto-correlation coefficient, ρ = 0.0231, is very small which substantiates the absence of auto-correlation in the data.

(2) R^2 is not all that matters! The reduced form parameters Π_1 and Π_2 have the necessary a priori expected signs, but Π_0 and Π_2 are clearly statistically insigificant because of their large standard errors. This makes the Price equation (4.7) rather difficult to justify statistically because all the reduced form parameters, save Π_1, in equation (4.7) are not significantly different from zero. On the other hand, on the basis of the F-test, we are unable to accept the null hypothesis that $\Pi_1 = \Pi_2 = 0$. Hence, multi-collinearity among the regressor variables is suspected in equation (4.7). Theoretically, multi-collinearity is often suspected when R^2 is high (say between 0.7 to 1.0) and when zero-order correlation are also high, but none or few of the partial regression coefficients are individually statistically significant on the basis of the conventional t-test. In equation (4.7), R^2 is very high (0.9196), zero order correlation between Y and FA is also high (0.8973), the parameters are all insignificant save one, yet the F-test does not accept that the parameters are jointly zero. Hence, we have reasons to believe that our estimates in equation (4.7) are marred by the problem of multi-collinearity. Nevertheless, the estimates in equation (4.7) are unbiased but do not possess the minimum variance criterion re-

quired of "efficient" estimators. Hence, hypothesis testing becomes problematic.

On the basis of estimates of equation (4.7), we can derive the structural demand equation (4.3) via the relationships given by equations (4.6a) through (4.6c). Thus, the estimated structural equation can be written as follows:

$$D = \underset{(219.26)}{192.070} - \underset{(0.869)}{0.8592P} + \underset{(0.1822)}{0.1776Y} \qquad 4.8$$

Figures in parentheses are the standard errors calculated on the basis of Kmenta's (1971:443) approximation formula cited earlier.

Based on equation (4.8) we can proceed to derive forecasts about foodgrain demand in Bangladesh based on alternative assumptions about price level changes and income growth in Bangladesh in future. Prediction in the presence of multi-collinearity is not a serious problem because the higher the R^2, the better the prediction.[31] But this may be so if the collinearity existing among the regressor variables in a given sample will also continue to exist in the future. It may be mentioned here that multi-collinearity is a sample phenomenon and not a population problem. However, if the approximate linear relationship among the regressor variables in a sample does not continue into the future (sam-

---

[31] Cf Geary (1963).

ples), prediction will become increasingly uncertain.[32] Nevertheless, the foodgrain demand forecasts derived from equation (4.8) are shown in Appendix D Table D.1.

4.3 COMBINING TIME SERIES AND BUDGET DATA: THE SOLUTION

Quantitative data on demand for consumer goods and services are of two different varieties: namely, time series and household expenditure survey data. Time series data are mostly aggregative data where observations in successive periods of time of total national consumption and other explanatory variables like income and prices are recorded. On the other hand, household expenditure surveys show us a set of observations of the expenditures on the goods and services by families who differ in income, and other chosen characteristics. In Bangladesh both time series and household expenditure survey data are available but the data suffer from some shortcomings.[33] Pray (1980:2)) warns researchers, planners and policy makers on the danger of overly relying on these data.

---

[32] Malinvaud (1970:220-21) discusses this point clearly.

[33] Pray (1980) deals at length with the data problem in Bangladesh and its sources of inaccuracy. The inaccuracy stems from the 'subjective' method of reporting data in time series together with the infrastructural weaknesses of the data collecting agencies in Bangladesh. Household expenditure surveys are most often inaccurate because the duration of the survey over which they are conducted are too short usually 24 hours. Cf. Chen and Chaudhury (1975).

It is customary to use data of one kind or the other in the statistical analysis of consumer behaviour.[34] In this study, we have used time series data for estimating equation (4.7). The estimation of parameters from time-series data encounters numerous statistical pitfalls which are elaborated by Stone (1945) and were supported by Tobin (1950). Nobel Laureate Stone's (1945:296-297) arguments are worth reproducing here:

> 3.1 The need to ascertain that there is sufficient independent variation can most easily be seen by an example. Consider the case of three variates in which we expect the observations to lie around a plane in three-dimensional space, and suppose that there are no errors in the data, and that each pair of series is perfectly correlated. The data will then lie not on a plane, but on a line --- i.e., at the intersection of two planes --- and it will be possible to fit an infinite number of planes to the data. A plane which passes through the observed points will, by rotation, generate an infinite family of planes which satisfy the same condition.
>
> In these circumstances the ordinary least squares fitting procedure of minimizing the sums of squares in the direction of the dependent variate will reflect this indeterminacy by providing 0/0 as the estimates of the regression coefficients in the three-set. But if the correlations are not perfect, the fitting procedure will ascribe definite values to the coefficients which may be due not to any systematic influence at work, but simply to unsystematic disturbances.
>
> 3.1.1 It might be supposed that this situation would be reflected by the standard errors of the regression coefficients, but this is not necessarily the case. This can be seen by writing out the expression for the error variance of the regression coefficient connecting variates 1 and j out of a set of (p + 1) variates when the sums of squares are minimized in the direction of variate

[34] Both Mahmud (1979) and Alamgir and Berlage (1973b) have used pooled cross-section data in their studies.

1. Denoting this coefficient by $b_1j^{(1)}$, we have in the usual notation

$$V(b_1j^{(1)}) = cjj\ V(e)$$

$$= V(e)/\ \Sigma x^2j\ (1 - R^2jk...)$$

$$=[1/n-p-1]\Sigma x^2{}_1/\Sigma x^2j\ {}_{(1}-R^2{}_1jk.)/(1-R^2jk..) \quad (3)$$

Where V(e) is the variance of the discrepancy between the observed and calaculated values of the dependent variate; p is the number of determining variates; $R^2{}_1..jk...$ is the square of the multiple correlation coefficient between the dependent variate and the p determining variates; and $R^2jk...$ is the square of the multiple correlation between the jth determining variate and the rest.

Given the value of n and p, the only source of variation lies in the third term of (3). In the circumstances envisaged, the denominator of this term will be very close to zero, showing that, other things being equal, a high intercorrelation between the determining variates leads to large error variances in the regression coefficients. This is to be expected on common-sense grounds, since if the determining variates are interrelated it may not be easy to ascribe the variation in the dependent variate to one determining variate rather than another.

But in practice other things will ususally not be equal, since the numerator of the last term of (3) will frequently be very small as well, so that the last term as a whole will not be large. Accordingly we cannot rely on the error variances of the coefficients to indicate that an unexpected relationship may be approximately satisfied by the sample of observations, and other methods must be adopted to find out if this is so.

In a system of equations, as the one we have in the previous section, multi-collinearity creates even greater problems. In a major theoretical study of the problem of multicollinearity in multiple equation models, Klein and Nakamura (1962) noted that multi-collinearity involves not only statistical and theoretical problems mentioned by Stone (1945) but also problems on the mundane level of arithmetic. As Klein and Nakamura (1962:276) write:

> In most estimates of single equation, it is unlikely that the number of explanatory variables will exceed 15, and it is quite possible that the most advanced computing machines will be able to provide accurate estimates of any single equation calculated by standard least squares methods. However, the initial step in many equation systems methods of estimation is the estimation of properties of a large set of regression equations. These equations are likely to include more than 20 explanatory variables, and the computing problem, as it arises when multicollinearity is present, might be formidable. This has been our sad experience.

To circumvent the problem of high inter-correlation among the regressor variables we can use extraneous information on one of the parameter estimates into our time series data. Tobin (1950), among others,[35] have imposed consumption income regression coefficients obtained from family budget data at a particular point in time upon analyses in which the regressor of consumption on price were to be estimated from time series. Incorporation of budget information into time series data provides a method of "rescuing" the analysis from the "traps" encountered when relying solely on time series.[36] Tobin (1950:113) argues that there are both eco-

---

[35] Stone (1945); Wold (1953:47) refers to this technique as "regression analysis with side conditions on the parameters, or briefly, conditional regression analysis".

[36] By the same token budget studies are by themselves insufficient and incomplete to test a complete set of hypotheses concerning demand and or to estimate all the parameter of the demand function, at least, until such time budget studies are more numerous than the ones currently available to us.

nomic and statistical advantages of incorporating budget studies into time series data. Some of the relevant variables change only with the passage of time and their likely effects can only be captured by using time series data only.

In this Section we shall attempt to derive a statistical demand function for food in Bangladesh incorporating extraneous information regarding the income parameter derived from the Household Expenditure Survey data. The basic idea of this pooling technique is to obtain estimates of one coefficient from the cross-section data, insert them in the original function, and then regress the dependent variable on the transformed independent variable, obtaining estimates of the remaining coefficient from the time series sample.

At the simplest level, extraneous information regarding a parameter can come about in two different forms. These are as follows:

(1) "Exact" extraneous information, i.e., $\gamma^* = \gamma$.

Here, the extraneous information is assumed non-stochastic. Tobin (1950) has used this type of extraneous information in his study, and it is by far the most fashionable method in empirical research,[37] primarily because of the simplicity of the approach in overcoming the statistical problems mentioned earlier.

(2) Unbiased extraneous information, i.e., $\gamma^* = \gamma + v$,

[37] Stone (1945), Wold (1953) and Fox (1968), among others, have made extensive use of exact extraneous information .

where, γ^* is stochastic because of the random disturbance term v associated with it. It is, therefore, essential that we take the random nature of γ^* into account while estimating our demand function. The above prior information may be statistical and from an independent sample, and even possibly the work of another investigator. This method has a strong theoretical foundation and deep realistic appeal and yet this method has been neglected so far in empirical research.

In this study we shall incorporate these two types of extraneous information in the estimation of the foodgrain demand function and then we shall be able to compare the results obtained by changing the assumptions regarding the extraneous information.

4.3.1 Exact extraneous information a la Tobin (1950)

The reduced form model of equation (4.5) can be written as:

$$P = -(\alpha/\beta) - (\gamma/\beta)Y + (1/\beta)FA - (u/\beta) \qquad 4.5$$

Assuming that an exact estimate of $\gamma = \gamma^*$ is obtained from pooled Household Expenditure Survey data[38] then equation (4.5) can be written as a restricted model with the value of γ^* as given. The restricted reduced form model is given below:

---

[38] The value of γ^* is 0.36 as reported in Appendix B Table B.1.

$$P = -(\alpha/\beta) + (1/\beta)[FA - \gamma^*Y] - (u/\beta) \qquad 4.9$$

or alternatively as,

$$P = \Pi'_0 + \Pi'_1 [FA - \gamma^*Y] - (u/\beta) \qquad 4.9a$$

where, the restricted reduced form parameters are $\Pi'_0 = -(\alpha/\beta)$ and $\Pi'_1 = (1/\beta)$. Thus, the least squares estimate of Π'_1 depends on the value which we preassign on the basis of our information to the parameter γ. If our information on γ^* is accurate, Π'_1 will not suffer from the preassigned value of γ^* . If on the other hand there are errors in the preassigned γ^*, the estimate of Π'_1 will also have some error.[39] Goldberger (1964) goes a stage further: " It is also apparent that the imposition of "exact" linear restrictions may be advantageous even when the restrictions are false; the error may be handled as a sampling error" (Goldberger;1964:259).

The most obvious statistical advantage of imposition of "exact" restrictions is that the restricted parameter Π'_1 is more efficient (i.e., have smaller sampling error) than its unrestricted counterpart. And the economic gain arising out of this situation is that the imposition of restrictions avoids the aggregation bias inherent in time series if the distribution of income is changing over time. Obtaining the income coefficient from the cross-section sample avoids the aggregation bias since the distribution of income is given

---

[39] Fox (1968:490-91) discusses the sensitivity of estimated coefficients to alternative values pre-assigned to some coefficients.

in the sample and thus the estimate of the income coefficient will be free from aggregation bias.

<u>Restricted OLS Estimation Results</u>:

Ordinary Least Squares can be applied to equation (4.9a) to yield the following results:

$$P = 126.89 - 0.577[FA - (0.36)Y] \qquad 4.10$$
$$(13.19) \quad (0.0384)$$

where, figures in parentheses are the standard errors of the respective parameters.

The other summary statistics of equation (4.10) are as shown below:

$R^2 = 0.9186$; $R^{-2} = 0.9145$

$F = 225.624$; S.E.E. $= 51.072$

D.W. $= 1.8463$; $\rho = 0.0439$.

<u>Discussion of Results</u>:

(1) In terms of R^2, equation (4.10) shows an excellent fit. Nearly 92 per cent of the variation in P is explained by the dependent variable.

(2) The coefficient Π'_0 and Π'_1 have the expected *a priori* signs i.e., $\Pi'_0 > 0$ and $\Pi'_1 < 0$. These reduced forms coefficients are highly significant even at the 1 per cent level. On the basis of the F-test we can conclude that the overall significance of the equation is maintained.

(3) D.W. = 1.8463 which suggests that the random disturbances are not serially correlated. The first-order ρ is 0.0439 which is negligible and this also substantiates the claim that there is no serial correlation.

From the estimated reduced form coefficients in equation (4.10) we can extract the structural parameters α and β by the following transformation:

$$-\alpha = (\Pi'_0/\Pi'_1) = [126.89/-0.577] = -219.913$$

$$\beta = (1/\Pi'_1) = [1/-0.577] = -1.733$$

$\gamma = \gamma^* = 0.36$ (known extraneously from cross-section regression as reported in Appendix B Table B.1).

Therefore, the estimated structural demand function for food can be expressed as below:

$$D = \underset{(19.05)}{219.913} - \underset{(0.1153)}{1.733}\,P + \underset{(0.04)}{0.36}\,Y \qquad 4.11$$

where, figures in parentheses are the standard errors of the parameters calculated with the help of Kmenta's (1971:443) approximation formula referred to earlier.

Equation (4.11) is well estimated as is seen by the small standard errors of the parameters and also the parameters have the expected a priori signs. Equation (4.11) can be used to forecast foodgrain demand in Bangladesh in future under alternative price regimes. This is shown in Table 4.2.

TABLE 4.2

Foodgrain Demand Forecast under Alternative Price Regimes

EAR	Y GROWTH	FOODGRAIN DEMAND						
		P = 0	P = 10	P = 20	P = 30	P = 40	P = 50	P = 100
976	0.00	7.91	6.93	5.94	4.96	3.97	2.98	-1.94
977	4.00	9.57	8.56	7.55	6.54	5.53	4.52	-0.52
978	3.50	9.61	8.57	7.54	6.51	5.48	4.44	-0.72
979	3.50	9.83	8.77	7.72	6.66	5.60	4.55	-0.74
980	3.60	10.10	9.02	7.94	6.86	5.77	4.69	-0.72
981	3.60	10.32	9.22	8.11	7.01	5.90	4.80	-0.73
982	3.60	10.55	9.42	8.29	7.16	6.03	4.90	-0.75
983	4.08	10.98	9.83	8.67	7.52	6.36	5.21	-0.56
984	4.08	11.22	10.04	8.86	7.68	6.50	5.32	-0.58
985	4.69	11.64	10.45	9.25	8.06	6.86	5.66	-0.32
986	4.69	11.95	10.72	9.49	8.27	7.04	5.81	-0.33
987	4.69	12.18	10.93	9.68	8.43	7.17	5.92	-0.33
988	4.69	12.41	11.14	9.86	8.59	7.31	6.04	-0.34
989	4.96	12.78	11.48	10.18	8.88	7.58	6.28	-0.22
990	4.96	13.02	11.69	10.37	9.05	7.72	6.40	-0.22
991	4.96	13.25	11.91	10.56	9.21	7.86	6.51	-0.23
992	4.96	13.49	12.11	10.74	9.37	8.00	6.63	-0.23
993	4.96	13.73	12.33	10.93	9.54	8.14	6.75	-0.23
994	4.83	13.89	12.47	11.05	9.63	8.21	6.79	-0.31
995	4.83	14.12	12.68	11.24	9.79	8.35	6.91	-0.31
996	4.83	14.35	12.88	11.41	9.95	8.48	7.02	-0.32
997	4.83	14.56	13.08	11.59	10.10	8.61	7.12	-0.32
998	4.83	14.80	13.29	11.77	10.26	8.75	7.24	-0.33
999	4.83	15.03	13.50	11.96	10.42	8.89	7.35	-0.33

ote: Y Growth = per capita real income growth (per cent).
P = (.) denotes price level change per annum (per cent).
Foodgrain demand (million tons).

ource: Calculated from Equation (4.11) [Tobin's method].

In Table 4.2 we have predicted foodgrain demand for Bangladesh based on equation (4.11). Given the population and per capita income growth for a given year, we calculated foodgrain demand assuming price level changes of 0 per cent, 10 per cent, 20 per cent, 30 per cent, 40 per cent, 50 per cent, and even 100 per cent per annum. Price inflation of either zero or 100 per cent per annum is implausible, but we are simply simulating a scenario over which prices can vary. Thus, Table 4.2 highlights foodgrain demand in a given year under price flexibility.

4.3.2 Unbiased Extraneous Information: Durbin's (1953) Generalized Least Squares

Section 4.3.1 depicts a situation where the prior information was assumed "exact", i.e., $\gamma^* = \gamma$. In economics, or in other disciplines in social science, such a piece of "exact" information is unlikely to be found. It is more likely that the information about a parameter in question is unbiased and has some sampling errors. This is the most realistic situation we often encounter, i.e.,

$$\gamma^* = \gamma + v \qquad 4.12$$

where, v is the random error term associated with γ.

In general, the model with unbiased extraneous information can be expressed as below

$$y = X\beta + u$$

where, $E(u) = 0$ and $E(u\ u') = \sigma^2 I$ and other OLS assumptions.

Let the unbiased estimate of one of the parameters β_1 be written as:

$$b_1{*} = \beta_1 + d$$

with $E(d) = 0$ and $E(d,u) = 0$.

therefore, we can write the extraneous and sample information together as

$$\begin{bmatrix} y \\ b_1{*} \end{bmatrix} = \begin{bmatrix} X & \beta \\ R & \end{bmatrix} + \begin{bmatrix} u \\ d \end{bmatrix}$$

where, $R = [\ I \quad 0\ ]$. We have the covariance matrix of the composite disturbance term as follows:

$$E \begin{bmatrix} u \\ d \end{bmatrix} [\ u \quad d\ ]' = \begin{bmatrix} \sigma^2 I & 0 \\ 0 & W \end{bmatrix}$$

Therefore, the Generalized Least Squares estimates are:

$$b{**} = \{\ (\ X' \ R')\begin{bmatrix} \sigma^2 I & 0 \\ 0 & W \end{bmatrix} \}' \ (X'R') \begin{Bmatrix} \sigma^2 I & 0 \\ 0 & W \end{Bmatrix}^{-1} \begin{Bmatrix} y \\ b_1 \end{Bmatrix}$$

$$b{**} = [\ \{1/\sigma^2\}\ X'X + R'W^{-1}R]^{-1} \ [\{1/\sigma^2\}\ X'y + R'W^{-1}b_1{*}]$$

This method requires knowledge of σ^2 and W, up to a factor of proportionality. An approximate use of the method is to employ unbiased estimates of these variances and covariances which can be calculated from the samples.

In our model, given the prior information contained in equation (4.12), we can incorporate this information and then derive a better (realistic) estimate of the parameters of the model. This method is due to Durbin (1953). Unfortunately, this method, although realistic and technically superior has been rarely put to use. Perhaps this might be due to complications it creates with the original disturbance term and the cumbersome tranformation of the data required to purge the composite disturbance term. Let us see how Durbin's (1953) method works in our model.

Rewriting equation (4.5) and the unbiased extraneous information of equation (4.12), we have

$$P = -(\alpha/\beta) - (\gamma/\beta)\ Y + (1/\beta)\ FA - (u/\beta) \qquad 4.5$$

$$\gamma^* = \gamma + v \qquad 4.12$$

with, $E(v) = 0$; $E(v^2) = \sigma^2 v$ and $E(uv) = 0$.

Incorporating equation (4.12) in equation (4.5) we have the following:

$$P = -[\alpha/\beta] - [1/\beta][\ FA - \gamma^* Y] + e \qquad 4.13$$

where, $e = (u/\beta)[\ (v/u)Y - 1\ ]$ is the composite error term.

The new (composite) error term e is clearly heteroscedastic because of the presence of the variable Y in it. But this problem of heteroscedasticity can be overcome if we apply the method of Generalized Least Squares (GLS), i.e., to apply ordinary least squares to transformed original data. The type of transformation required can be seen from the form of the variance of the composite error term. The appropiate solution to this particular problem is to multiply equation (4.13) by the term $[1/Y][\sigma u/\sigma v]$ to yield the following:

$$P^{**} = \Pi_0^{**} + \Pi_1[FA - \gamma^* Y]^{**} + e^{**} \qquad 4.14$$

where, $** = [1/Y][\sigma u/\sigma v]$; $\Pi_0 = -(\alpha/\beta)$ and $\Pi_1 = (1/\beta)$. It can be shown that e^{**} is homoscedastic and therefore we can now proceed to apply OLS to equation (4.14) to obtain estimates of the reduced form parameters.

Practically, estimation of equation (4.14) proceeds in a few steps:

(1) We need the value of σu. We can get an unbiased estimate of σu from equation (4.5) after adjusting for the value of β.

(2) We also require the value of σv. Since, $\sigma v = \sigma\gamma^*$, we can find this out from the regression which gave us the information about γ^*.

(3) Because of the incorporation of stochastic extraneous information, the composite error term becomes heteroscedastic as in equation (4.13). Therefore, equation (4.13) has to be multiplied by the factor $[1/Y][\sigma u/\sigma v]$ so that OLS can be validly applied to equation (4.13). This is done in equation (4.14).

Generalized Least Squares Estimation Results:

Applying OLS to equation (4.14) yields the following results:

$$P^{**} = \underset{(4.132)}{120.36^{**}} + \underset{(0.0441)}{0.617}[FA -(0.36)Y]^{**} \qquad 4.15$$

where, the figures in parentheses are the standard errors of the respective parameters. The other vital statistics of the above regression equation are shown below:

$R^2 = 0.1802$; $R^{-2} = 0.1392$

S.E.E. = 41.731.

D.W. = 1.8144 ; $\rho = 0.0463$.

Discussion of Results obtained in Equation (4.15).

(1) In terms of the statistical significance, both the parameters of equation (4.15) are highly significant even at the 1 per cent level of significance. The coefficients are also well estimated and they do have the expected *a priori* signs.

(2) D.W. = 1.8144 which suggests that the disturbance term is not serially correlated. This is also confirmed by the very low value of ρ.

(3) One conspicuous feature of equation (4.15) is that R^2 is considerably low. This should not be surprising at all! As Pindyck and Rubinfeld (1981:146) summarise it: " ....R^2 associated with weighted least squares procedure is lower than the R^2 associated with the unweighted procedure. The decline in R^2 should not be taken as an indication that the heteroscedasticity correction was incorrect, since the weighted least squares procedure involves the use of a transformed dependent variable." It may be remarked here that it is invalid to compare the R^2 obtained from equation

(4.15) and R^2 obtained from similar price equation (4.7) or (4.10), because the dependent variable in equation (4.15) is different from the others because of the transformation.

The derived demand function from equation (4.15) can be written as follows:

$$D = 195.07 - 1.621\,P + 0.36\,Y \qquad 4.16$$
$$(13.20) \quad (0.116) \quad (0.04)$$

Forecasts based on equation (4.16) are shown in Table 4.3. As in Table 4.2, forecasts are derived based on alternative levels of price increases and a given level of per capita income growth in Bangladesh.

TABLE 4.3

Foodgrain Demand Forecasts under Alternative Price Regimes

EAR	Y GROWTH	FOODGRAIN DEMAND						
		P = 0	P = 10	P = 20	P = 30	P = 40	P = 50	P = 100
976	0.00	8.89	8.20	7.51	6.82	6.14	5.45	2.01
977	4.00	10.56	9.86	9.16	8.45	7.75	7.05	3.53
978	3.50	10.63	9.91	9.18	8.46	7.74	7.02	3.42
979	3.50	10.87	10.14	9.40	8.66	7.93	7.19	3.50
980	3.60	11.17	10.41	9.66	8.91	8.15	7.40	3.62
981	3.60	11.42	10.64	9.87	9.10	8.33	7.56	3.70
982	3.60	11.67	10.88	10.09	9.30	8.51	7.72	3.78
983	4.08	12.12	11.32	10.51	9.71	8.90	8.10	4.07
984	4.08	12.39	11.57	10.74	9.92	9.10	8.27	4.16
985	4.69	12.83	11.99	11.16	10.32	9.49	8.65	4.48
986	4.69	13.16	12.30	11.45	10.59	9.73	8.88	4.60
987	4.69	13.41	12.54	11.67	10.80	9.92	9.05	4.69
988	4.69	13.67	12.78	11.89	11.00	10.11	9.22	4.78
989	4.96	14.06	13.15	12.25	11.34	10.43	9.53	4.99
990	4.96	14.32	13.40	12.48	11.55	10.63	9.71	5.09
991	4.96	14.59	13.65	12.71	11.76	10.82	9.88	5.18
992	4.96	14.84	13.88	12.93	11.97	11.01	10.06	5.27
993	4.96	15.10	14.13	13.16	12.18	11.21	10.24	5.37
994	4.83	15.29	14.30	13.31	12.32	11.33	10.34	5.39
995	4.83	15.55	14.54	13.53	12.53	11.50	10.51	5.48
996	4.83	15.79	14.77	13.75	12.73	11.70	10.68	5.57
997	4.83	16.03	15.00	13.96	12.92	11.88	10.84	5.65
998	4.83	16.29	15.24	14.18	13.13	12.07	11.02	5.74
999	4.83	16.55	15.48	14.41	13.34	12.26	11.19	5.83

ote: Y Growth = per capita income growth (per cent).
P = (.) denotes price level change per annum (per cent).
Foodgrain Demand (million tons).

ource: Calculated from Equation (4.16) [Durbin's method].

4.4 COMPARISON OF RESULTS

In the previous section we have estimated the reduced form price equation under the following assumptions:

1. No restrictions (unrestricted) on the parameters of the price equation.
2. "Exact" extraneous information about γ, i.e., $\gamma = \gamma^*$. This is the Tobin's procedure.
3. Stochastic extraneous information about γ, i.e., $\gamma^* = \gamma + v$. This procedure is due to Durbin (1953).

Following the estimation of the price equation under the above assumptions, we shall likewise have three sets of estimates of the structural parameters α, β and γ. Hence, it will be interesting to compare the reduced form parameters as well as the structural parameters. This comparison is done next.

From Table 4.4 we see that the value of Π_0 diminishes as we move on from the unrestricted model to the restricted models. Likewise, the standard errors of Π_0 fall sharply. The value of Π_2 also falls (absolutely) and so does their standard errors. We can only validly compare the adjusted R^2 of equation (4.7) and (4.10). The adjusted R^2 improves slightly with the imposition of restriction. We cannot, however, compare R^2 of equation (4.15) with the R^2 of equation (4.7) and (4.10) because (1) the dependent variable is different in equation (4.15) and (2) equation (4.15) has no

TABLE 4.4

Comparison of the Parameters of the Price Equation

stimation Method	Eqn.#	Π_0	Π_1	Π_2	R^{-2}	F	D.W.
nrestricted Or-inary Least Sq.	4.7	223.55 (194.12)	0.2067 (0.014)	-1.1639 (1.177)	.911	108.70	1.89
estricted Or-inary Least Sq.	4.10	126.89 (13.19)	N.A.	-0.577 (0.038)	.915	225.62	1.85
eneralized Lea-t Squares	4.15	120.36** (3.896)	N.A.	-0.617 (0.042)	.139	N.A.	1.81

ote: N.A. = Not Applicable.

$\Pi_0 = -(\alpha/\beta)$; $\Pi_1 = -(\gamma/\beta)$; $\Pi_2 = (1/\beta)$.

Figures in parentheses are the standard errors of the respective parameters.

Equations (4.7) and (4.10) are not directly comparable to equation (4.15) for the reasons cited in the text.

intercept term because of transformation. The Durbin-Watson statistic shows the absence of auto-correlation in all the three models.

In terms of the structural parameters of the demand equation, Table 4.5 shows that the value of α declines with a restriction and so does its standard errors. The parameter β registers some increase with "exact" restriction in equation (4.11) and then drops in value in equation (4.16). Even though the value of β rises with restrictions, the

TABLE 4.5

Comparison of the Structural Parameters of the Demand Equation

stimation Method	Equation No.	α	β	γ
nrestricted Ordinary east Squares	4.8	192.07 (219.26)	-0.8592 (0.869)	0.1776 (0.182)
estricted Ordinary east Squares	4.11	219.91 (19.050)	-1.7330 (0.115)	0.3600 (0.040)
eneralized Ordinary east Squares	4.16	195.07 (13.20)	-1.6210 (0.116)	0.3600 (0.040)

standard error of β falls off sharply in equations (4.11) and (4.16). The parameter γ's value was 0.1776 initially in equation (4.8) but it remains constant at 0.36 in equations (4.11) and (4.16) because these values were extraneously incorporated from cross-section data.

4.5 FOODGRAIN SUPPLY-DEMAND BALANCE IN BANGLADESH

In the previous sections we have calculated foodgrain demand in Bangladesh under alternative price regimes using different assumptions. These demand projections are shown in Tables 4.2 and 4.3. Now we are in a position to measure the food supply-demand balance (imbalance) in Bangladesh. This will enable us to assess the overall food situation in the country.

Total food supply (availability) = domestic food supply

plus

foreign food supply. 4.17

Domestic food supply = net domestic production of food. 4.17a

Foreign food supply = total food imports 4.17b

In equilibrium:

Total food supply (availability) = total food demand 4.18

Therefore,

Total food demand = net domestic production + imports 4.19

Alternatively,

Net domestic production - total food demand = - imports.

where, (-) import denotes food shortage, and

(+) import denotes food surplus.

On the basis of equation (4.19) we can calculate the food supply-demand balance (surplus/shortage) for Bangladesh, provided we have figures for net domestic production.

4.5.1 Net Domestic Production (Domestic Supply) of Foodgrains in Bangladesh

It must be borne in mind that the projection of agricultural production like foodgrains is a very complex exercise. Future production depends on a host of factors which are to a large extent uncertain and uncontrollable, such as the influence of weather and natural calamities; and institutional factors such as proper and timely distribution of seeds, fertilizers and irrigation water, etc., are some of the examples in point.

Nevertheless, of all the methods, one can employ the trend mechanism in projecting future production levels. Trend values are found by regressing production level to a time trend variable. Two types of trends are assumed in production namely:

(1) $NDP = a + bt$ (linear production trend) 4.20

(2) $Ln\ NDP = c + dt$ (exponential production trend) 4.21

where, NDP = net domestic production of foodgrains.

t = time trend variable.

Ln = natural logarithm.

and a, b, c and d are the parameters.

Using net domestic production figures from 1960-61 through 1981-82, the following results are obtained:

$$NDP = 8106.9 + 202.34\ t \qquad 4.20a$$

$$(27.45) \quad (8.41) \qquad R^2 = 0.7794.$$

$$Ln\ NDP = 9.0191 + 0.01944\ t \qquad 4.21a$$

$$(316.82) \quad (8.38) \qquad R^2 = 0.7784.$$

where, figures in parentheses are the respective t-ratios of the parameters.

Using the trend equations of (4.20a) and (4.21a), the expected net domestic production of foodgrains are shown in Table 4.6. The two production levels are fairly close, although the exponential trend shows a higher value; but the gap between the two widens with the passage of time. Based on the figures in Table 4.6, Table 4.2 and Table 4.3 we can calculate the magnitude of supply-demand balance for foodgrains in Bangladesh. These figures are shown in Table 4.7 and 4.8 respectively. Table 4.7 shows the foodgrain supply-demand balance based on the demand equation (4.11) and Table 4.8 shows the foodgrain supply-demand balance based on the demand equation (4.16).

TABLE 4.6

Projection of Net Domestic Production

YEAR	LINEAR TREND (million tons)	EXPONENTIAL TREND (million tons)
1976	10.640	10.640
1977	11.795	11.795
1978	11.910	11.910
1979	12.014	12.014
1980	13.263	13.263
1981	12.930	12.930
1982	12.760	12.904
1983	12.963	13.157
1984	13.165	13.415
1985	13.368	13.677
1986	13.570	13.945
1987	13.772	14.219
1988	13.975	14.497
1989	14.177	14.781
1990	14.379	15.071
1991	14.582	15.366
1992	14.784	15.667
1993	14.986	15.974
1994	15.189	16.287
1995	15.391	16.606
1996	15.593	16.931
1997	15.796	17.262
1998	15.998	17.601
1999	16.201	17.946

Note: Linear Trend is calculated from Equation (4.20a). Exponential Trend is calulated from Equation (4.21a).

TABLE 4.7

Food Supply-Demand Gap Under Different Price Regimes and Domestic Supply Conditions

	P=0		P=10		P=20		P=30		P=40		P=50		P=100	
EAR	LIN	EXP	LIN	EXP	LIN	EXP	LIN	EXP	LIN	EXP	LIN	EXP	LIN	EXP
976	2.7	2.7	3.7	3.7	4.7	4.7	5.6	5.6	6.6	6.6	7.6	7.6	13	13
977	2.2	2.2	3.2	3.2	4.2	4.2	5.3	5.3	6.3	6.3	7.3	7.3	12	12
978	2.3	2.3	3.3	3.3	4.4	4.4	5.4	5.4	6.4	6.4	7.5	7.5	13	13
979	2.2	2.2	3.2	3.2	4.3	4.3	5.3	5.3	6.4	6.4	7.5	7.5	13	13
980	3.2	3.2	4.3	4.3	5.4	5.4	6.4	6.4	7.5	7.5	8.6	8.6	14	14
981	2.6	2.6	3.7	3.7	4.8	4.8	5.9	5.9	7.0	7.0	8.1	8.1	14	14
982	2.2	2.3	3.4	3.5	4.5	4.6	5.7	5.8	6.8	6.9	7.9	8.0	14	14
983	2.0	2.2	3.2	3.4	4.3	4.5	5.5	5.7	6.6	6.8	7.8	8.0	14	14
984	2.0	2.2	3.2	3.4	4.3	4.5	5.5	5.7	6.7	6.9	7.9	8.1	14	14
985	1.8	2.1	3.0	3.3	4.1	4.4	5.3	5.6	6.5	6.8	7.7	8.0	14	14
986	1.7	2.0	2.9	3.2	4.1	4.4	5.3	5.6	6.6	6.9	7.8	8.1	14	14
987	1.6	2.0	2.9	3.3	4.2	4.6	5.4	5.8	6.6	7.0	7.9	8.3	14	15
988	1.6	2.1	2.8	3.4	4.1	4.6	5.4	5.9	6.7	7.2	8.0	8.5	14	15
989	1.4	2.0	2.7	3.3	4.0	4.6	5.3	5.9	6.6	7.2	7.9	8.5	14	15
990	1.4	2.1	2.7	3.4	4.0	4.7	5.4	6.1	6.7	7.4	8.0	8.7	15	15
991	1.3	2.1	2.7	3.5	4.0	4.8	5.4	6.2	6.7	7.5	8.1	8.9	15	16
992	1.3	2.2	2.7	3.6	4.1	5.0	5.4	6.3	6.8	7.7	8.2	9.1	15	16
993	1.3	2.3	2.7	3.7	4.1	5.1	5.5	6.5	6.9	7.9	8.3	9.3	15	16
994	1.3	2.4	2.7	3.8	4.1	5.2	5.6	6.7	7.0	8.1	8.4	9.5	16	17
995	1.3	2.5	2.7	3.9	4.2	5.4	5.6	6.9	7.0	8.2	8.5	9.7	16	17
996	1.3	2.6	2.7	4.0	4.2	5.5	5.7	7.0	7.1	8.4	8.6	9.9	16	17
997	1.2	2.7	2.7	4.2	4.2	5.7	5.7	7.2	7.2	8.7	8.7	10.2	16	18
998	1.2	2.8	2.7	4.3	4.2	5.8	5.7	7.3	7.3	8.9	8.8	10.4	16	18
999	1.2	2.9	2.7	4.4	4.2	5.9	5.8	7.5	7.3	9.0	8.8	10.5	17	18

ote: Figures are in million tons. (+) = Surplus and (-) = Deficit.
LIN = Linear Production Trend are from Table 4.6.
EXP = Exponential Production Trend are from Table 4.6.
P(.) = Annual price inflation of food (per cent).
Demand figures are from Table 4.2 [Tobin's model].
(Figures are rounded to one decimal place.)

TABLE 4.8

Food Supply-Demand Gap Under Different Price Regimes and Domestic Supply Conditions

	P=0		P=10		P=20		P=30		P=40		P=50		P=100	
EAR	LIN	EXP	LIN	EXP	LIN	EXP	LIN	EXP	LIN	EXP	LIN	EXP	LIN	EXP
976	1.8	1.7	2.4	2.4	3.1	3.1	3.8	3.8	4.5	4.5	5.2	5.2	8.6	8.6
977	1.2	1.2	1.9	1.9	2.6	2.6	3.4	3.4	4.0	4.1	4.7	4.7	8.3	8.3
978	1.3	1.2	2.0	2.0	2.7	2.7	3.5	3.5	4.2	4.2	4.9	4.9	8.5	8.5
979	1.9	1.9	1.9	1.9	2.6	2.6	3.4	3.4	4.1	4.1	4.8	4.8	8.5	8.5
980	2.1	2.1	2.9	2.9	3.6	3.6	4.4	4.4	5.1	5.1	5.8	5.9	9.6	9.6
981	1.5	1.5	2.3	2.3	3.1	3.1	3.8	3.8	4.6	4.6	5.4	5.4	9.2	9.2
982	1.1	1.2	1.9	2.0	2.7	2.8	3.5	3.6	4.3	4.4	5.0	5.2	9.0	9.1
983	0.8	1.0	1.6	1.8	2.5	2.6	3.3	3.4	4.1	4.3	4.9	5.1	8.9	9.1
984	0.8	1.0	1.6	1.8	2.4	2.7	3.2	3.5	4.1	4.3	4.9	5.1	9.0	9.3
985	0.5	0.8	1.4	1.7	2.2	2.5	3.0	3.4	3.9	4.2	4.7	5.0	8.9	9.2
986	0.4	0.8	1.3	1.6	2.1	2.5	3.0	3.4	3.8	4.2	4.7	5.1	9.0	9.3
987	0.4	0.8	1.2	1.7	2.1	2.5	3.0	3.4	3.9	4.3	4.7	5.2	9.1	9.5
988	0.3	0.8	1.2	1.7	1.9	2.6	3.0	3.5	3.9	4.4	4.8	5.3	9.2	9.7
989	0.1	0.7	1.0	1.6	1.9	2.5	2.8	3.4	3.7	4.4	4.6	5.3	9.2	9.8
990	0.1	0.8	1.0	1.7	1.9	2.6	2.8	3.5	3.7	4.4	4.7	5.4	9.3	10
991	0.0	0.8	0.9	1.7	1.9	2.7	2.8	3.6	3.8	4.5	4.7	5.5	9.4	10
992	-0.1	0.8	0.9	1.8	1.8	2.7	2.8	3.7	3.8	4.7	4.7	5.6	9.5	10
993	-0.1	0.9	0.9	1.8	1.9	2.8	2.8	3.8	3.8	4.8	4.7	5.7	9.6	11
994	-0.1	1.0	0.9	2.0	1.9	3.0	2.9	4.0	3.9	5.0	4.8	5.9	9.8	11
995	-0.2	1.1	0.9	2.1	1.8	3.1	2.9	4.1	3.9	5.1	4.9	6.1	9.9	11
996	-0.2	1.1	0.8	2.2	1.8	3.2	2.9	4.2	3.9	5.2	4.9	6.3	10.0	11
997	-0.2	1.2	0.8	2.3	1.8	3.3	2.9	4.3	3.9	5.4	5.0	6.4	10.1	12
998	-0.3	1.3	0.8	2.4	1.8	3.4	2.8	4.4	3.9	5.5	5.0	6.6	10.3	12
999	-0.3	1.4	0.7	2.5	1.8	3.5	2.9	4.6	3.9	5.7	5.0	6.8	10.4	12

ote: Figures are in million tons. (+) = Surplus and (-) = Deficit.
LIN = Linear Production Trend are from Table 4.6.
EXP = Exponential Production Trend are from Table 4.6
P(.) = Annual price inflation of food (in per cent).
Demand figures are from Table 4.3 [Durbin's model].
(Figures are rounded to one decimal place.)

4.5.2 Market Deficit of Food in Bangladesh 1976-77 to 1999-2000

Food supply-demand balance is crucial to Bangladesh because it not only highlights the overall picture (shortage/surplus) on the food-front but it also shows the real magnitude of shortfall and or surplus. Tables 4.7 and 4.8 show us exactly this situation. These tables are calculated based on a wide spectrum of price level increases per annum. Three such categories of price level increases can be discerned:

(a) Low price increases (0 - 10) per cent per annum.

(b) Medium price increases (20 - 30) per cent per annum.

(c) High price increases (40 - 100) per cent per annum.

Past experience shows a continually increasing trend in food prices. While price increases of over 50 per cent in food are recorded in a few years in the past decade, price level increases of food were basically contained within a band of 20 to 30 per cent per annum on the average. World Bank (1983:10-11) statistics show that the Consumer Price Index rose by about 19 per cent per annum in the last decade in Bangladesh, and food obviously captures a dominant share in the market basket of Consumer Price Index. Therefore, it would not be unrealistic to assume price increase of 20 to 30 per cent for food each year in Bangladesh.

From Tables 4.7 and 4.8, with a food price inflation of 20 to 30 per cent each year, we see that Bangladesh's food situation is quite healthy overall. Paradoxically, this is in sharp contrast to the grim fact that Bangladesh imports about 1.3 million tons to 1.8 million tons of food every year. Now the moot question is: What seems to be the likely cause(s) for the discrepancy in the food position? The answer to this question is not very easy or straight-forward but a complex one.

4.5.3 The Causes

Methodological: Perhaps an answer can be found by distinguishing between the following two terms; (i) market deficit and (ii) nutritional deficit. Market deficit can be defined as the difference between market demand for food and food supply. Tables 4.7 and 4.8 measure the market deficit as defined above. Obviously, our calculations show that before 1985 there is no market deficit in food. From 1985, a market deficit develops assuming that domestic production is following a linear trend. This deficit widens slowly over time and by the year 1999-2000 the deficit is about 1.3 million tons (Table 4.8 only). On the other hand, if we assume an exponential trend in domestic food production, Bangladesh never faces a market deficit of food until the end of the century. Behind all these assertions there is the explicit assumption that food price inflation is about 20-30 per cent per annum.

In contrast, imports of food are calculated by measuring the food gap. The food gap is calculated by the following relationship:

Food gap = domestic production - domestic requirement.

While,

Domestic requirement = per capita requirement X population.

The above method is popularly known as the "Balance Sheet Approach" to food accounting. If domestic "requirement" exceeds domestic food supply then imports are necessary to fill in the "nutritional" deficit. In Bangladesh there is definitely a "nutritional" deficit of food. The Balance Sheet has one glaring shortcoming in that it depends on the recommended nutritional per capita "requirement".[40] The required foodgrain may not be metabolically consumed by the population primarily for two reasons.

1. Lack of adequate purchasing power because of a skewed income distribution; and
2. The foodgrain may not be tangibly available to the very people for whom it is meant for because of the malfunctioning of the distribution system.

As for (1), Parkinson (1981:86-87) writes:

[40] For the food gap calculation, a per capita amount of 15.5 ounces assumed by the government creates a larger total import requirement. An analysis by Chen (1975) suggests that the physiological foodgrain requirement is approximately 13.2 ounces per day, and when nutritional and cooking losses are included, this need becomes 14.4 to 14.6 ounces per day. Therefore, a mere extra 1 ounce per day creates an extra 0.85 to over 1 million tons of extra import for Bangladesh each year, which is unnecessary.

> Conditions of employment and income are such that the price at which it is economical to grow rice is so high that an adequate diet on a regular and sustained basis remains beyond the reach of large segments of the population. In the long run, the answer to this kind of problem might be found in the creation of employment opportunities by promoting labour intensive development in urban as well as rural areas. In the short run, income supplements or price subsidies, designed and operated with the explicit objective of offsetting the high price of food to those with insufficient incomes, may bring temporary relief.

Thus, there is the "under-consumptionist" process at work in Bangladesh because of very low income and high food prices (compared to income), which is further excerbated by a declining "food entitlement" as shown in an earlier Chapter.

As for (2), foodgrain imported from abroad is distributed through the rationing system operated by the government in six urban centres. The government rationing operation scratches only the fringes of the country side after the town-dwellers, government employees, police and members of the armed forces are provided for. Thus, there is some kind of "over-importation" of food --- food imported to feed the poor people gets caught in the mesh of inequitable distribution net --- inequities based not only on poor planning and management, inadequate transport, but also on deliberate and conscious political choice. Rather than feeding the hungry millions in the rural areas, food is distributed at a subsidised price through a ration system largely to feed the better-off urban middle class population and prevent any urban unrest which might undermine the government in Dhaka.

Budgetary support: There is the budgetary reason for the government to "over-import" foodgrains each year. Food imports mainly consisted of food-aid (concessionary sales plus outright grant) from the U.S. under P.L. 480 Title I and II. Government earnings from the sale of food-aid on the ration system normally accounts for an estimated 20 per cent to 41 per cent of Bangladesh's national revenue budget. Table 4.9 shows the Food Department's cash surplus as a percentage of

TABLE 4.9

Food Department Cash Surplus and Total Revenue Receipts of the Bangladesh Government

YEAR	FOOD DEPARTMENT CASH SURPLUS (million taka) A	TOTAL REVENUE RECEIPTS (million taka) B	RATIO A/B (%)
1973	1580.5	3884.5	40.69
1974	1554.2	5295.0	29.35
1975	2639.2	9087.2	29.04
1976	-	-	-
1977	2829.3	12371.7	22.87
1978	3982.9	16362.0	24.34
1979	3660.3	18695.0	19.58

Source: IMF (1984) Government Finance Statistics Year Book, Vol.VIII pp.115-19.

national revenue each year.

As seen from Table 4.9, the revenue earnings of the government is inextricably tied with food imports. The situation becomes grim and alarming for the government during good harvest years, when the price differential between the open market food price and ration price is lowered, because the ration shop revenue drops because of drop in the off-take from the ration shop. Thus, there are severe budgetary consequences for the government in that (1) there is an immediate budget deficit because of drop in ration revenue and (2) government lacks the liquidity and resources to procure foodgrain internally to build a food buffer stock and also to stabilise price and thereby future production. Ironically, Bangladesh government tends to import "more" during a good harvest.

Budgetary dependence on food-aid often motivate to deflate the local production and overplay the shortfall. As McHenry and Bird (1976:78-79) note:

> The international donors have no idea what the "food gap" is in any particular year...... One World Bank official admits that the food gap this year could have been anywhere from minus 500,000 tons to plus 2 million tons. He cited the admission of a Bengali official that the estimates for the December crop had been doctored to under-represent the actual harvest by more than 300,000 tons. The crop figures looked too good on paper and would jeopardize both the Dacca regime's request for future food-aid and their negotiations with the Indian government over the diversion of irrigation waters from the Ganga River. When asked whether this kind of misrepresentation would influence the donors in their allocation of food-aid for next year, this World Bank source said, "The Bengalis obviously think they can get away with it --- and they are probably right."

Food bungle: Last but not the least, there is the recondite blueprint of the food bungle in Bangladesh master-minded by two different interest groups. They often in unison or in isolation perform their acts. The actors are

(1) External forces --- food donors (specially the U.S.);

(2) Internal forces --- comprising of corrupt businessmen in collaboration with indiscreet politicians and members of the law enforcment agencies (i.e., armed forces personnel, police, ansars etc.).

Their particular roles are elaborated below.

External Influence --- The U.S. Food-Aid Policy.

Although the U.S. Congress appropiated food assistance out of humanitarian concern, politics --- not humanitarian impulses --- plays the supreme role in the allocation of food-aid. Food is considered as a means of exerting pressure on global politics. As Rothschild (1976:294) observes,

> The political power of the U.S. as a leading oligopolist of food most obviously concerns countries in the first categories (developing world). The CIA analyst addresses this prospect, briskly speaking the unspeakable. If the weather is more or less the same for the next decades, they argue, " it is essentially the poorer LDCs that will become ever more dependent on US food exports". These countries will apply to the United States for credit to buy food or for food as aid; "moreover, ability to provide relief food in periods of shortage or famine will enhance U.S. influence". If the weather were to become cooler, the dependence of the poor would get more pronounced. ("Washington would acquire virtual life and death power over the fate of the multitudes of the needy"). It is in this circumstance of bad weather that the analysts conceive of the United States as surpassing its economic and political dominance ..... of the immediate post-World War II years.

This is exactly the policy that the U.S. is pursuing in Bangladesh.

Throughout the 1970's, P.L. 480 Title I food-aid was allocated with a keen eye on the internal politics as well as the geo-political situation of the region. (1) U.S. food-aid to Bangladesh was meant to wean off "Indian hegemony" over Bangladesh. (2) Increasing food-aid was directed towards stabilization of the Bangladesh economy and thereby local politics. If the explosive political situation degenerated into anarchy and chaos, other super-powers like China, U.S.S.R. and India may be drawn into the already muddy waters. Fears were there that India might overthrow the government and replace it with a government more sympathetic to Moscow and India, which might be detrimental to U.S. interest in the region. So, increasing amount of food-aid was doled out to "enhance US influence" among the people and the government of Bangladesh.

(3) There was even a sinister motive of giving food-aid. The donors wanted to develop a pervasive relief mentality among the politicians and bureacrats and have Bangladesh in perpetual bondage. A complacency has settled among Bangladeshi politicians and bureacrats that the international community has a responsibility to feed Bangladesh in times of need and there is very little that they can do to solve the food problem. One of the surest signs of the relief mentality is a reluctance to invest in agriculture by the

government. Less than a third of the budget is spent on agricultural extension services. Besides developing dependency, food aid does not allow Bangladesh to pursue its independent foreign policy. In a severe famine situation of 1974-75, U.S. food shipment was delayed because Bangladesh had exported jute to blacklisted Cuba in the previous year. This is by now a familiar episode. On the other hand, food aid continued to pour from the U.S. when in January 1975 the Dhaka government trampled popular demaocracy, invoked one-party presidential rule, banned political opposition, gagged the press and went on a political repression of the dissidents. The U.S. approved to this, much against its decided norms, because the then Dhaka government's existence was stabilizing to U.S. interest in the region. As Parkinson (1981:97) writes, " .... the variable but heavy reliance on food imports and food aid placed Bangladesh in a position of recurring dependence for survival on major foreign country, which could and did exercise their "food power"."

<u>The Internal forces</u>:

The rationing mechanism provides a vehicle through which indiscreet politicians, members of the law enforcing agencies and businessmen acting as a syndicate embezzles the scarce foodgrain imported and internally procured by the government. Food bungle is encouraged by the price differential between the open market price and the subsidised ration price of food within the country, on one hand, and on the other, by the price differential of food in neighbouring India and in Bangladesh due to the depreciated Bangladeshi Taka. Parkinson (1981:94-95) makes the following observation:

> The great divergence between free market and ration prices gave the incentive of personal gain for any adminstrators willing to provide extra ration cards in return for illegal income, or to withhold ration cards in the absence of a bribe. The dealers or intermediaries in the distribution of rationed food had an incentive to sell in on the black market at high prices, or to sell additional amounts to selected customers while providing inadequate supplies to others on the grounds of 'inadequate deliveries' by the central agencies, which could not be checked and supervised. The high price in the free market for foodgrain also provided an incentive for forging and stealing ration cards. The rural population was particularly prone to these abuses because it was difficult to give the far flung modified rationing scheme adequate surveillance.

Parkinson's above observation is particularly pertinent in the context of internal food fraud. Simple arithmetic shows that any one engaging in an arbitrage will benefit from it. Price divergence between the two markets is often illusory and conceals the real price discrepancy. This is due to the operation of a dual-exchange rates in Bangladesh. Foodgrain is imported at the official exchange rate. This price does not represent the true scarcity value and therefore under-represent the real price of food. Thus, based on an over-valued Taka, we can calculate the "real" and "illusory" price divergence of foodgrain. This quantitative exercise is shown in Table 4.10.

TABLE 4.10

eal and Illusory Price of Food: Covert and Overt Subsidy in Rationing

(1) EAR	(2) ER(1) Tk/$	(3) ER(2) Tk/$	(4) C&F RICE PRICE $/ton	(5) C&F RICE PRICE(2) Tk/ton (4 X 3)	(6) C&F RICE PRICE(1) Tk/ton (4 X 2)	(7) RATION PRICE Tk/ton	SUBSIDIES COVERT Tk/ton (5-6)	OVERT Tk/ton (6-7)	REAL Tk/ton (5-7)
972	6.03	9.50	315.96	3001.62	1905.24	803.79	1096.4	1101.5	2197.8
973	7.78	10.50	650.56	6830.88	5062.01	937.76	1768.9	4124.3	5893.1
974	7.97	11.00	477.94	5257.34	3807.27	1607.58	1450.1	2199.7	3649.8
975	8.88	13.00	404.26	5255.38	3588.21	1741.55	1667.2	1846.7	3513.8
976	14.85	21.00	332.84	6989.64	4943.34	2411.37	2046.3	2532.0	4578.3
977	15.47	22.00	481.63	10595.86	7449.37	2411.37	3146.5	5038.0	8184.5
978	15.12	21.50	384.87	8274.71	5820.00	2679.30	2454.7	3140.7	5595.4
979	15.22	22.00	515.74	11346.28	7851.11	3215.16	3495.2	4636.0	8131.1
980	15.48	23.00	516.86	11887.78	7999.96	3751.02	3887.8	4248.9	8136.8
981	16.35	24.00	621.42	14914.08	10157.11	4420.85	4757.0	5736.3	10493.0

ote: ER(1) = official exchange rate.
ER(2) = import permit rate or the free market exchange rate.

ource: Exchange rate from World Bank (1983) World Tables 3rd Ed.p10-11

FOB Rice Price from World Bank (1981) Commodity Trade and Price Trends, p.42.

Freight rates (from US Gulf Ports to Indian Eastern Ports) from FAO (1983) FAO Trade Year Book, p.23.

Ration price of rice from GOB (1982), Statistical Year Book, 1982. Ration price is officially quoted in Tk/maund. Maund is a local measure of weight equal to 0.0373241 metric ton.

The above table shows that there are, in fact, two types of subsidies associated with imported food distributed through the rationing system.

(1) 'Overt' subsidies which is often reported and apparently seen in black and white. This is the difference between food price imported at the official exchange rate and the government ration price.

(2) 'Covert' subsidy which is never reported and goes undetected. This is due to the over-valued exchange rate of Bangladesh Taka. The covert subsidy is the difference between food price imported at the market rate of exchange and the food price imported at the official exchange rate.

Hence, the 'real' subsidy on food is greater than what is reported by the government; and it takes into account both the 'covert' and 'overt' subsidy which is simply collossal and provides an incentive to sell food in the black market or to smuggle it out to India.

McHenry and Bird's (1977:76-77) observation appears to be accurate:

> International aid officials openly admit now that food aid during this period was sold on the black market and smuggled to India in Bangladesh navy vessels under the supervision of Rahman's (Sheikh Mujibur Rahman -- father of the nation) relatives........ In some years, such as 1976, smuggling alone accounts for Bangladesh's "food gap". Hoarding and smuggling of foodgrain to India, due to higher prices in the Calcutta market, was encouraged by the influx of large quantities of foreign foodgrains at virtually no cost to the government.

Faaland and Parkinson (1976:127) provide some estimates on the amount of food taken out illegally each year. They concede that at least half a million tons each year and perhaps more than one million tons are annually smuggled out to India. Even this staggering amount seems an under-estimate of the real quantity taken out of Bangladesh each year under the guidance and supervision of the politicians, businessmen, army and representatives of the donor countries.

The effect of smuggling and hoarding on the price and availability of food can be seen in the aftermath of the assassination of Sheikh Mujibur Rahman on August 15, 1975. Forces opposed to Rahman imposed martial law and sealed the border with India. Despite that being a lean season when supplies were low, food prices nose-dived immediately because grain-traders, businessmen and politicians involved in grain business no longer enjoyed the protection of their political ally. What is true of Mujib era is also true of the subsequent adminstrations. The political actors were the same every time the adminstration changed hands. It was the same ball game with the same players donning new jersies under new umpires.

In fine, it may be emphatically said that except for a few isolated areas of food shortage, Bangladesh does have the potential to feed its entire population. What is missing, however, is a will and commitment to feed the hungry people by the people at the helm of affairs. The problem is that food is not available at the right place, at the right time and at the right price so that everybody could afford to buy food they need. No amount of food imports, distributed inequitably and fraudulently through a politically motivated ration system --- a system which has enormous opportunities for illicit tradings and distribution --- can overcome the food deficit in Bangladesh.

4.6 A 3 SECTOR MACRO FOOD DEMAND MODEL: AN ALTERNATIVE APPROACH

Between 1972 and 1982 Bangladesh economy grew by about 5.1 per cent per annum (in constant prices of 1972). This slow growth is attributable to several factors of which a recovery from the War of Liberation in 1971, OPEC oil price increases in 1973 and 1976, severe crop failure in 1974, and political instability are the prominent ones. The annual rates of growth of the individual sectors are very unequal however. Agricultural food production grew at 3 per cent per annum, the industrial growth rate was 8.3 per cent per annum while the service sector grew at 7.8 per cent per annum.

This pattern of unequal growth of individual sectors is normal in developing countries, and to a lesser extent in mature economies as well. Without this structural change, rapid growth cannot be achieved. Unequal sectoral growth implies a shift of employment from the slowly growing sectors to the dynamic industries. This shift is one of the concomitants of productivity increase: the sectors with low growth rates are mainly sectors with sub-average productivity levels while the dynamic industries generally have a higher labour productivity . The increase in overall productivity accompanying the relative increase of employment in the higher productivity sectors of the economy may be called the "structural productivity effect." The achievement of higher growth rates is thus linked with the achievement of rapid structural change.

Simultaneously, however, unequal growth of individual sectors tends to create bottlenecks and impediments to growth whenever these sectors are linked by input-output relations. The particular instance, with which we are concerned here, is agricultural production of foodgrains. Food is the most important input for non-agricultural sectors (industrial and service sectors). Demand for marketed surpluses of foodstuffs depends critically upon the rate of development in the non-agricultural economy; and if food production lags too much behind the rate of growth of these sectors food will become scarce, prices will rise and the economy may slip into a state of structural inflation with its familiar consequences: i.e., rising food prices will trigger off wage increases; this leads to reduced competitiveness in the world market and to reduced profitability of import-substituting industries. Food imports will soar with adverse effects on the balance of payments. Efforts to overcome this impasse through quantitative and qualitative import restrictions and tariffs or by deficit financing will only reinforce the inflationary tendency. What is needed in this situation is an accelerated food production strategy. The only other alternative would be to boost exports, which seems unlikely due to rising costs, which makes it possible to pay for the increased food imports.

It would be an exaggeration to maintain that Bangladesh has reached the threshold to structural inflation; it would be imprudent, however, to disregard certain symptoms (food production near stagnation in the past, increasing frequency of periods of high prices, soaring imports and declining per capita availability).

There is all the more reason for concern about the food situation if we recall that a substantial increase in the rate of growth of the economy is planned for the near future. According to the "Perspective Plan 1980-2000" GNP is to rise by 7 per cent annually over this period. Since the gap between the growth rates of different sectors tends to increase with the rate of overall growth this implies that the gap between the growth of the sectors inducing demand for foodstuffs and the sector producing food is likely to increase.

It is certainly desirable to exploit the productivity gains of structural change as far as possible, but there are definite limits to this development strategy. At a certain stage, the inflationary effects of stepping up the growth of the non-agricultural sectors begin to outweigh the advantage of further marginal growth. What degree of price increase for food appears a tolerable price for more rapid growth is an eminently political decision. The purpose of my study here is to investigate the effects of more rapid growth and more rapid structural change on inter-sectoral relations and on demand for and supply of food in particular.

4.6.1 Effect of Growth and Structural Change on Demand for and Supply of Food --- A Model

The intent and purpose of the model is to explore the growth of demand for and the supply of foodgrains in broad aggregative terms assuming intersectoral transferance of labour along the lines of structural change outlined above. The size of the gap between demand and supply will be taken as an indicator and measure of disequilibrium. The analysis refers to the short future, this term being defined as a period too short to bring about substantial changes in the elasticity of supply of domestic foodgrains. The model which we are going to develop is a simple one. Quantitative exercises of this kind cannot be more refined than the statistical data on which they are based. The number of variables has, therefore, been reduced to the most relevant ones. For simplicity, the national economy consists of three broad sectors namely:

(1) Agricultural (agr) sector for food including the allied occupations of fisheries and livestock, and adjusting for non-food crops and forestry.

(2) Industrial (ind) manufacturing sectors consisting of (i) Large and small scale industries, (ii) mining and quarrying, (iii) power, gas, water and sanitary services and (iv) transport, storage and communication.

(3) Service (ser) sector consisting of the following: (i) trade services, (ii) housing services, (iii) public administration and defence, (iv) banking and insurance, and (v) professional and miscellaneous services.

The model consists of a Demand equation, a Supply equation and a Labour equation. The model is outlined below: The increase in demand for food in the non-food (industry and service sector) producing sector depends, in the first place, upon the increase in employment in these sectors:

$$(1+\Delta_1) = \frac{\{Cind[Yind/Y][1+\lambda ind] + Cser[Yser/Y][1+\lambda ser]\}}{\{Cind[Yind/Y] + Cser[Yser/Y]\}} \qquad 4.22$$

The symbols are defined as follows:

Δ_1 = rate of increase of demand for food in the non-food producing sectors attributable to increase in employment.

[Yind/Y] = share of the industrial sector in GDP.

[Yser/Y] = share of the service sector in GDP.

Cind = share of food consumption in total income of Yind.

Cser = share of food consumption in total income of Yser.

λind = rate of increase of employment in the industrial sector.

λser = rate of increase of employment in the service sector.

The increase in employment in these sectors is defined as the increase in production of a sector divided by the increase in productivity in that sector. Hence,

$$(1 + \lambda ind) = (1 + \sigma)/(1 + \pi ind) \qquad 4.22a$$

$$(1 + \lambda ser) = (1 + \chi)/(1 + \pi ser) \qquad 4.22b$$

The symbols are defined as follows:

σ= rate of increase of production in the industrial sector.

χ= rate of increase of production in the service sector.

πind = rate of increase of productivity in the industrial sector.

πser = rate of increase of productivity in the service sector.

Substituting the above equations (4.22a) and (4.22b) into equation (4.22), we get the following:

$$(1+\Delta_1)=\frac{\{Cind[Yind/Y][1+\sigma/1+\pi ind]+Cser[Yser/Y][1+\chi/1+\pi ser]\}}{\{Cind[Yind/Y] + Cser[Yser/Y]\}} \qquad 4.23$$

Demand for food in the non-food producing sectors also depends on the increase in per capita income. Thus,

$$(1+\Delta_2)=\frac{\{Cind[Yind/Y][1+\omega ind]+Cser[Yser/Y][1+\omega ser]\}}{\{Cind[Yind/Y] + Cser[Yser/Y]\}} \qquad 4.24$$

The symbols used are defined as follows:

Δ_2 = rate of increase of demand for food in the non-food producing sectors attributable to increasing per capita incomes.

ωind = rate of increase of per capita demand for food in the industrial sector, and

ωser = rate of increase of per capita demand for food in the service sector.

The increase of per capita demand for food is defined by the product of the increase in per capita income and the income elasticity of demand for food. The increase of per capita income in each sector is equal to the increase in per capita production, i.e., of labour productivity. Thus,

$$(1 + \omega ind) = [1 + (\pi ind)(\eta ind)] \qquad 4.24a$$

$$(1 + \omega ser) = [1 + (\pi ser)(\eta ser)] \qquad 4.24b$$

The symbols used are defined below:

ηind = income elasticity of demand for food in the industrial sector; and

ηser = income elasticity of demand for food in the service sector.

Substituting equations (4.24a) and (4.24b) in equation (4.24), we have the following:

$$(1+\Delta_2) = \frac{\{Cind[Yind/Y][1+(\pi ind)(\eta ind)] + Cser[Yser/Y][1+(\pi ser)(\eta ser)]\}}{\{Cind[Yind/Y] + Cser[Yser/Y]\}} \qquad 4.25$$

Combining the two determinants of the increase in demand for food in the non-food producing sectors, we obtain the total demand for food equation (4.26) below:

$$(1+\Delta) = \frac{\{Cind[Yind/Y][1+\sigma/1+\pi ind][1+(\pi ind)(\eta ind)] + Cser[Yser/Y][1+\chi/1+\pi ser][1+(\pi ser)(\eta ser)]\}}{\{Cind[Yind/Y] + Cser[Yser/Y]\}} \qquad 4.26$$

where, Δ = rate of increase of demand for food in the non-food producing sectors.

The Labour equation of the model constitutes the vital link between the Demand equation and the Supply equation and makes their interdependence explicit. The mechanism is as follows: If the growth rate of one sector exceeds the rate of growth of population, assuming constant labour participation rate, this means that the transfer of labour from the residual sector of agricultural food production to either the industrial sector or the service sector takes place. If, on the other hand, the industrial and service sectors are stagnant, virtually all of the population (labour) increase must be absorbed in the agricultural food production sector. This is the extreme Lewis (1954) assumption.

The drainage effect of population (labour) is quantified by the Labour equation. We start with the following definition:

$$(1+\lambda)=[Lind/L][1+\lambda ind]+[Lser/L][1+\lambda ser]+[Lagr/L][1+\lambda agr] \quad 4.27$$

The symbols introduced are explained below:

λ = rate of increase of population and of total employment (since constant participation rate is assumed);

Lind/L = share of the industrial sector in total employment;

Lser/L = share of the service sector in total employment;

Lagr/L = share of the agricultural sector in total employment; and

λagr = rate of increase of employment in the agricultural food sector.

The above equation (4.27) merely states that the total increase in employment is equal to the weighted average of the sectoral rates of increase in employment; and the weights being the respective sectoral employment share. Substituting $[1+\sigma/1+\pi ind]$ for $(1+\lambda ind)$ and $[1+\chi/1+\pi ser]$ for $(1+\lambda ser)$, we can re-write equation (4.27) as follows:

$$(1+\lambda agr)=[L/Lagr][1+\lambda]-[Lind/Lagr][1+\sigma/1+\pi ind]-[Lser/Lagr][1+\chi/1+\pi ser] \quad 4.28$$

From the above Labour equation (4.28), we see that the rate of increase of employment in the agricultural food sector is the inverse of agricultural labour ratio times the rate of increase in total employment net of increase in employment in the non-food producing sectors. The increase of productivity in the agricultural food producing sector (πagr) needs some explanation. The model is over-determined for the ex-post calculation if we choose rates of productivity increase for all the three sectors. Once πind and πser are determined, the rate of increase of employment in food production λagr is given by the Labour equation (4.28). With λagr we automatically obtain πagr from the relation given in equation (4.29). This means that the higher the productivity increase in non-food producing sectors, the lower the rate of transfer from agricultural food production sector and lower, accordingly, the required rate of increase of productivity in food production.

Finally, the Supply of food equation can be written as follows: The increase in food production depends on the rate of increase of employment and the rate of increase of labour productivity. Hence,

$$(1+\delta)=\{[1+\lambda agr][1+\pi agr][Yagr/Y]\}/[Cind[Yind/Y]+Cser(Yser/Y)] \quad 4.29$$

The symbols used are explained below:

δ = rate of increase in production in the agricultural food sector.

πagr = rate of increase of labour productivity in the agricultural food sector.

From food production we must subtract food consumption of the producers of food themselves to arrive at net supply of food (marketable surplus). The increase in consumption of food by the producers depends, as before, on the increase in per capita income (as expressed by productivity increase) and the income elasticity of demand for food. Hence, we can write:

$$(1+\gamma) = \frac{\{Cagr[Yagr/Y][1+\lambda agr][1+(\pi agr)(\eta agr)]\}}{\{Cind[Yind/Y] + Cser[Yser/Y]\}} \qquad 4.30$$

where, γ = rate of increase of demand for food in the agricultural food sector.

ηagr = income elasticity of demand for food in the agricultural food sector.

Joining the two, we get the net supply of food (marketable surplus) as follows:

$$(1+\Sigma)=\frac{\{[1+\pi agr][1+\lambda agr][Yagr/Y]-Cagr[Yagr/Y][1+\lambda agr][1+(\pi agr)(\eta agr]\}}{\{Cind[Yind/Y] + Cser[Yser/Y]\}} \qquad 4.31$$

Since, Cind[Yind/Y] + Cser[Yser/Y] + Cagr[Yagr/Y] = Yagr/Y, therefore, equation (4.31) can be re-written as below:

$$(1+\Sigma)=\{[1+\pi agr][1+\lambda agr]-Cagr[[1+\lambda agr][1+(\pi agr)(\eta agr)\}/[1-Cagr] \qquad 4.32$$

where, Σ = rate of increase of supply of food available for the non-food producing sectors; and

Cagr = share of consumption in total income of agricultural food sector.

The rate of increase of employment in food production (λagr) is determined by the Labour equation and subsequently fed into the Supply equation.

4.6.2 Application of the Model in Bangladesh

We shall apply the model initially to the development of the decade 1972-73 to 1981-82 for which we have the basic data of the relevant parameters. The result will provide us with a bench mark which will help us to assess the significance of results obtained subsequently from future trends of demand and supply. The numerical values of the parameters for the past period will be listed below along with an explanation for them. Since the rates of increase of productivity are the most sensitive parameters, alternative calculations were made with various combinations of sectoral productivity increases. These combinations were, however, subject to the constraint that the weighted average had in each case to be equal to the actual overall productivity increase.

4.6.2.1 Parameter Values for the Bench Mark Years (1972-81)

The numerical values chosen for the calculation of demand and supply tendencies in the period 1972-81 are discussed here. They relate to the results obtained and presented in Table 4.12. Sensitivity tests showed a low sensitivity of many parameters because many of the structural parameters serve as weights to rates of change which often do not differ much from each other. In all cases where the correct value was unknown or uncertain, the value was chosen in such a way as to minimise the bias.

(1) The sectoral shares in total GDP [Yi/Y] --- The shares were calculated on the basis of the sectoral share of GDP at constant prices. The ten year average (1972-81) of the sectoral shares are found to be as follows:

Yagr/Y = 53.25 per cent; Yser/Y = 13.75 per cent and Yser/Y = 33.0 per cent.

Source: GOB, Statistical Year Book, 1979. p 342 for figures from 1972-76.
GOB, Statistical Year Book, 1982, p.533 for figures from 1977-81.

(2) Sectoral shares in total employment [Li/L] --- The seven year average (1973-79) of the sectoral employment is as follows:

Lagr/L = 70 per cent; Lind/L = 14 per cent and Lser/L = 16 per cent.

Source: GOB, Statistical Pocket Book, 1980. pp 560-61.

Note: Surprisingly, GOB, Statistical Year Books, 1979 & 1982 do not provide any statistics on this subject!

(3) The share of consumption of food in total income (Ci) --- the choice of numerical values for the three sectors is subject to the condition that

$$Cind[Yind/Y] + Cser[Yser/Y] + Cagr[Yagr/Y] = Yagr/Y$$

Since food consumption in relation to income is higher in low income sectors, it appeared reasonable to vary the share inversely with per capita income of the individual sectors. The result is:

Cagr = 0.6; Cind = 0.42 and Cser = 0.54.

(4) Income elasticity of demand for food (ηi) --- we had calculated the income elasticity of demand for food for Bangladesh economy as a whole to be 0.78. In the absence of reliable information on the income elasticities of demand for food in the individual sectors we used the constraint

$[Yagr/Y]\eta agr + [Yind/Y]\eta ind + [Yser/Y]\eta ser = 0.78$

Then we arbitrarily selected the elasticities of ηagr and ηser so that ηind is automatically determined from the above constraint. The result is:

$\eta agr = 0.85$; $\eta ind = 0.58$ and $\eta ser = 0.75$.

(5) Population growth rate (λ) --- the rate of population increase was assumed to be 2.41 per cent per annum over the decade 1972-81. A constant rate of participation was assumed. This makes the rate of increase in total employment equal to the rate of increase of population.

Source: GOB, Statistical Year Book, 1982.

(6) Sectoral productivity increases (πi) --- the sectoral productivity increases were found by fitting a semi-logarithmic trend for data 1973-80. The regression results are:

$\pi agr = 1.08$ per cent; $\pi ind = 8.27$ per cent and $\pi ser = 1.41$ per cent.

Source: GOB, Statistical Pocket Book, 1980, p.393.

(7) Sectoral growth increases (δ, σ and χ) --- the sectoral growth rates were found by fitting a semi-logarithmic trend to data from 1972-81. The results are:

δ = 3.02 per cent; σ = 9.35 per cent and χ = 7.82 per cent.

Discussion of Results:

Based on the parameter values explained above, the following results are summarised in Table 4.11.

TABLE 4.11

Development of Demand and Supply of Foodgrains During 1972-81 Under Various Assumptions with Respect to Sectoral Productivity Increases

	PRODUCTIVITY INCREASES							RATE OF PRICE INCREASE AT PRICE ELASTICITY OF		
	Πind (%)	Πser (%)	Πagr (%)	λagr (%)	Δ (%)	Σ (%)	[Δ-Σ] (%)	0.66 (%)	0.75 (%)	1.00 (%)
ctual	8.27	1.41	1.20	1.80	7.05	3.29	3.75	5.68	5.00	3.75
ssumed	10.00	4.00	0.29	2.72	6.39	3.09	3.30	5.00	4.40	3.30
ssumed	7.00	2.50	1.18	1.82	6.96	3.29	3.67	5.50	4.89	3.67
ssumed	6.00	1.00	1.73	1.27	7.36	3.41	3.95	5.98	5.27	3.95

We have made four types of demand and supply calculations. These are:

(a) The actual calculation is based on the actual productivity increase figures in the economy.

(b) Three other calculations are also made and these are based on various assumptions about sectoral productivity increases which will be explained shortly.

Based on Table 4.11, with the non-food producing sectors (industrial and service sectors) growing at 9.4 per cent and 7.8 per cent respectively, the demand for food in these sectors is growing between 6.4 per cent to 7.4 per cent. Supply of food lags behind demand and is growing between 3.1 per cent and 3.4 per cent. Hence, a food gap emerges which is in the range of 3.3 per cent to 4.0 per cent per annum. The possible range of corresponding price increases has been set out in the last columns of Table 4.11 based on the range of price elasticity of demand for food. The price increases range from 3.3 per cent to about 6.0 per cent per annum. It is very difficult to judge whether the ensuing marginal demand-supply gap and the food price increase is an adequate reflection of the real course of events in Bangladesh in the recent past. Bangladesh imported more foodgrains than what is shown in Table 4.11. Also, the price increase of foodgrains is under-stated. But when we take into consideration the substantial amount (15 to 20 per cent annually) of foodgrains traded illegally, then the above calculation captures the real picture of the food situation in Bangladesh.

On the strength of the general plausibility of these results, at least as far as the order of magnitudes is concerned, we may now fix the range of productivity increases to be used for further calculation. The assumptions for sectoral productivity increases are as follows:

(1) πind = 10 per cent and πser = 4 per cent: High productivity increase.

(2) πind = 7 per cent and πser = 2.5 per cent: Medium productivity increase.

(3) πind = 6 per cent and πser = 1 per cent: Low productivity increase.

Another important aspect of Table 4.11 is that we can calculate the transfer of labour between the sectors. Column λagr shows exactly this phenomenon. When actual productivity figures were used, agricultural food production sector registered 1.8 per cent increase in employment out of total of 2.41 per cent. This suggests that the rest 0.61 per cent moved to other sectors and were employed in the non-food producing sectors. On the other hand, there was a reverse transfer of 0.31 per cent from the non-food producing sectors when we assumed a high productivity increase in these sectors. This shows that the higher the productivity increase in non-food sectors, the lower will be the transfer of labour from the residual food producing sector. Hence, this has important policy implications.

4.6.3 Effect of More Rapid Growth on Demand for and Supply of Foodgrains as Envisaged by the National Perspective Plan 1980-2000

The proposed National Perspective Plan 1980-2000 of Bangladesh indicates a possible scenario of planned population, investment, employment and income of the country at the end of the 20th century based on certain strategies and programme priorities. Some of the socio-economic perspectives of the Plan during the period cover, among others, the following:

(i) Provision of basic needs such as staple food, coarse cloth, minimum housing with sanitation and primary health care for all.

(ii) Sustained economic growth at 7 per cent per annum as a necessary condition for a steady reduction and ultimate elimination of poverty.

(iii) Food self-sufficiency by the end of the Second Five Year Plan in 1985.

[Source: GOB, Statistical Year Book, 1982, pp.669-674.]

Given a target 7 per cent growth rate of GDP, our task in this respect is to investigate the following:

(1) Calculate the demand and supply of foodgrain under the above situation, and calculate the food gap, if any.

(2) Investigate whether a 7 per cent growth rate is feasible given the inter-sectoral relationship.

(3) Investigate the transfer of labour necessitated by such a high rate of growth.

(4) Investigate the conditions under which a food self-sufficiency is possible.

Before we can set out to attack the above issues, we must investigate the basic question: which pattern of sectoral growth rates is compatible with achieving the target growth rate of 7 per cent? Nothing explicit has been published or indicated by the government on this topic as yet. It may be useful, therefore, to discuss this point clearly.

First, we shall split up the 7 per cent overall growth into several options for sectoral growth patterns. Four such options are envisaged keeping the growth rate of the service sector constant at 7.8 per cent as before. The options are as follows:

OPTIONS	δ (%)	σ (%)	χ (%)
I	6.04	7.05	7.82
II	5.00	8.88	7.82
III	4.00	10.65	7.82
IV	3.00	12.41	7.82

It appears that options I and IV do not make much sense. Option I is overly ambitious for the agricultural food producing sector. If option I is to be in effect this would mean doubling the growth rate from that which was prevailing during the decade 1972-81. Moreover, it would also mean a reduction of the industrial growth rate which is antithetical to the objectives of the National Perspective Plan 1980-2000. On the other hand, option IV would leave the agricultural food production sector virtually stagnant while over-emphasizing the industrial sector. Option IV would also thwart the objective of achieving food self-sufficiency.

Therefore, the best solution would be either option II or III. If option III is chosen, this would mean that the rate of growth of food production sector would increase to 4 per cent from the bench mark level of 3 per cent. Industrial sector growth rate would have to be increased from 9.35 per cent to 10.65 per cent per annum. Thus, the preliminary conclusion is that if we decide to pursue the 7 per cent GDP growth target, feasible solutions --- if there are any at all --- are likely to be in the range of options II and III, i.e., with growth targets for the industrial sector of 8.88 - 10.65 per cent annually. The conclusion is a very preliminary one because we have not yet touched the main question: whether a certain combination of sectoral growth rates does not lead to severe bottlenecks in input-output relations between the sectors.

Before we report the results of our calculation, it is appropiate to briefly outline the changes in the structural parameters to take account of the development between 1981-2000. These changes are shown below:

(1) The structure of GDP shall be as follows:

$Yagr/Y = 0.37$; $Yind/Y = 0.21$ and $Yser/Y = 0.42$.

(2) The structure of employment shall as follows:

$Lagr/L = 0.60$; $Lind/L = 0.18$ and $Lser/L = 0.22$.

(3) The sectoral consumption share shall be as follows:

Cagr = 0.45; Cind = 0.25 and Cser = 0.36.

(4) Income elasticity of demand for food is assumed constant as before.

ηagr = 0.85; ηind = 0.58 and ηser = 0.75.

(5) Population growth rate (λ) is 1.3 per cent per annum.

(6) Sectoral productivity increase were subjected to three types of hypotheses viz.,

πind = 10 per cent & πser = 4 per cent --- High.

πind = 7 per cent & πser = 2.5 per cent --- Medium.

πind = 6 per cent & πser = 1 per cent --- Low.

(7) Sectoral growth rates have two variants namely;

Option II: δ = 4 per cent; σ = 10.65 per cent and χ = 7.82 per cent.

Option III: δ = 5 per cent; σ = 8.88 per cent and χ = 7.82 per cent.

It may be mentioned that, since we assumed the rate of growth of the service sector to be constant at 7.8 per cent throughout, the rate of growth of food production and the whole pattern of sectoral growth rates is automatically determined with the choice of σ.

Based on the parameter values listed above, the result of the calculation is shown in Table 4.12.

Discussion of Results obtained in Table 4.12.

Based on the figures given in Table 4.12, the following points are worth mentioning:

TABLE 4.12

Prospective Development of Demand for and Supply of Foodgrains Under Condition of a 7 Per Cent Growth Target

	Productivity Increase Hypotheses		
	High (%)	Medium (%)	Low (%)
ate of increase of Agricultural Labour (λagr):			
Option II : σ = 10.65%	0.64	-0.76	-1.62
Option III: σ = 8.88%	1.13	-0.26	-1.12
ate of agricultural food sector (δ):			
Option II : σ = 10.65%	3.99	3.99	3.99
Option III: σ = 8.88%	4.99	4.99	4.99
ate of increase of demand for food in the non-ood producing sectors (Δ):			
Option II : σ = 10.65%	6.69	7.28	7.67
Option III: σ = 8.88%	6.25	6.83	7.23
ate of increase of marketable surplus (Σ):			
Option II : σ = 10.65%	4.41	4.58	4.69
Option III: σ = 8.88%	5.47	5.65	5.75
arginal food gap ($\Delta - \Sigma$):			
Option II : σ = 10.65%	2.28	2.70	2.98
Option III: σ = 8.88%	0.78	1.18	1.48
DP growth rate:			
Option II	7.00	7.00	7.00
Option III	7.00	7.00	7.00

(1) Due to the rapidly rising labour requirement of the non-food producing sectors, employment in agricultural food sector will grow at a lower rate. The annual transfer[41] of

[41] The rate of transfer of total population is given by $[\lambda - \lambda agr][Lagr/L]$.

labour is substantial: in the case of Option II and Low productivity increase hypothesis, the transfer is about 1.75 per cent of the total population or nearly 135 per cent of the total population increase. On the other hand, in the case of Option III and High productivity increase hypothesis, the transfer is a mere 0.1 per cent of the total population or nearly 7.8 per cent of the total population increase.

(2) According to the model, demand for food increases 6.3 per cent to 7.7 per cent annually, while marketable surplus increases by about 4.4 per cent to 5.6 per cent per year. Thus, demand increases faster than supply at all times and a food gap emerges. The lower the productivity increase in the non-food producing sector, the higher is the demand for food; while at the same time the supply of food increases (due to transfer of labour). Ironically, food demand increases faster than supply, and hence the food gap is the largest when the productivity in the non-food producing sector is the lowest.

(3) The food gap is between less than 1 per cent to approximately 3 per cent. Under a 7 per cent growth rate of GDP this is quite tolerable. However, if the surreptitious dealing in food continues, as in the past, the food gap is expected to be even larger than what is seen here.

(4) Finally, and important of all, it is seen that the objective of a 7 per cent growth rate is achieved overall: the realized growth of GDP is approximately 7 per cent. This goes to prove that the plan is internally consistent.

Our next task is to investigate the conditions under which the objective of food self-sufficiency is achieved. Specifically, we want to know (i) whether self-sufficieny in food is compatible with a 7 per cent growth target? (ii) What are the implications for sectoral growth rates? And (iii) What is the quantum of labour that is required to be transferred from one sector to the other? Self-sufficiency in food would imply a stable food price for Bangladesh --- a phenomenon which has not being experienced before. The answer to these questions are given in Table 4.13.

TABLE 4.13

Characteristics of the Price-Stability Solution where Foodgrain Demand is Equal to Supply

	Productivity Increase Hypotheses		
	High (%)	Medium (%)	Low (%)
ıcrease in Agricultural Labour	1.58	0.40	-0.32
ıcrease in Agricultural food sector	5.47	5.70	-5.86
ıcrease in Industrial sector	7.23	6.53	6.03
əalized GDP growth rate	6.83	6.76	6.72
ıortfall in target GDP growth rate	0.17	0.24	0.28

In terms of Table 4.13 the following observations can be made:

(1) The target growth rate of 7 per cent is not even achieved if self-sufficiency in food is targetted for. There is a shortfall of 0.2 per cent to 0.3 per cent in the growth rate.

(2) Growth in the agricultural food sector has to be very high in the neighbourhood of 5.5 per cent to 6 per cent per annum in order to fulfill the objective of food autarchy. This means that growth rate in the food production sector has to double compared to the bench-mark years. This is rather ambitious considering the fact that the agricultural growth rate has been the lowest in the bench-mark years in relation to the other sectors.

(3) At the same time, the industrial growth rate would have to be around 6 to 7.23 per cent. This would mean that the industrial growth rate would have to fall below the growth rate achieved during the bench-mark years. This is clearly undesirable considering the fact that the government wants to diversify the economy and generate income and employment in small, medium and large industries. Therefore, it seems that industrial growth and food self-sufficiency are not compatible with each other.

(4) Lastly, achieving self-sufficiency in food would involve a considerable high transfer of population form the food production sector to other sectors, specially if Medium and Low productivity increase hypothesis is assumed.

Implications of the Model

Basically there are two types of problems emanating from pursuing the dual objectives of a 7 per cent GDP growth target and self-sufficiency in food simultaneously.

(1) If a 7 per cent GDP growth target is pursued, then a food gap of less than 1 per cent to 3 per cent per annum emerges. Assuming a price elasticity of demand for food to be less than unity, there will be a modest price inflation of food.

(2) On the other hand, if food self-sufficiency is targetted, then (i) agricultural food production has to be doubled and industrial growth rate has to slow down; (ii) most importantly, the targetted GDP growth rate is not realized.

These constellations are of interest as far as economic policy is concerned. Political decision makers have to choose among the alternatives. The former would involve a modest price inflation of food and the latter would signify the concerted efforts at raising food production to the relative neglect of the industrial sector.

The first alternative is rather a safe and easy course of action. Bangladeshis are used to price inflation (to the tune of 20 to 30 per cent) of food in the past, but the benefits from this course of actions are many. Agricultural growth rate would be around 33 to 66 per cent higher, industrial growth rate would be 12 to 15 per cent higher than what they were during the period 1972-81. Such an increase in the growth pattern is a healthy sign for the over all economy. Rising food prices can be taken care of by a carefully designed food subsidy scheme such as food rationing to the targetted needy and vulnerable groups.

The second objective of food self-sufficiency will be very expensive and time consuming to implement. Doubling the growth rate in the agricultural food production sector is by no means an easy affair and it will depend on the time horizon. Past experience suggests that the dynamics of development do not by themselves provide an incentive to substantial growth in this sector. In fact, many of the concomitants of development had a distinctly adverse effect on the food production sector: this applies to the transfer of labour to other sectors with the ensuing deterioration of both age and sex structure of the rural population. Before a noticeably faster increase of food production is achieved, millions of farmers must be contacted and instructed in the use of improved methods. Moreover, there are barriers to be overcome, e.g., inertia, institutional barriers like land tenure and tenancy practices, provision of agricultural extension services like credit, irrigation water, seeds, fertilizers etc., must be improved over all. This obviously cannot be done from one year to the next.[42]

[42] "Agricultural development thus cannot avoid a time dimension, both technological and human, of a different order from that in most non-agricultural industries. Attempts to telescope this dimension face formidable obstacles;

4.7 SUMMARY

The purpose of this Chapter was to formulate and estimate a market demand function for foodgrains using time series data. This was done using a model of demand and supply of foodgrains in Bangladesh. We encountered statistical problems, namely multicollinearity, while estimating the model using time series data only. However, following the methods of Tobin (1950) and Durbin (1953) of combining cross-section to time series data helped us to avoid those problems.

Next we made foodgrain demand and supply projections and found that Bangladesh has no 'market' deficit in food. However, Bangladesh faces a 'nutritional' deficit which is further excerbated by surreptitious trading in food in Bangladesh.

Alternatively we have developed a three Sector Macro Model for estimating foodgrain demand and supply. Based on the findings of the model, Bangladesh has a food shortfall of about 4 per cent per annum during the decade 1972-81. Next, we investigated the likely implications of a 7 per cent GDP growth target on demand and supply of food, and found that the food gap was around 0.78 per cent to 2.98 per cent annually. Finally, we also investigated whether the objective of food self-sufficiency and a 7 per cent GDP growth target are compatible. Calculations show that these two objectives

even where initially feasible, 'buying time' may involve substantial costs" (Johnston and Southworth;1967:11).

are in conflict with each other; moreover, fulfilling the two objectives simultaneously would be very difficult.

Chapter V

EFFECT OF FOOD IMPORTS ON FOOD PRODUCTION IN BANGLADESH

One of the most disquieting aspects of the food problem in Bangladesh is the phenomenal increase in food imports. The statistics on food imports are very grim. In absolute terms, food imports, including food aid, rose from under half a million tons in 1960 to about two million tons in 1981; and in 1972 food imports approached a precarious peak of nearly three million tons. Food imports in terms of domestic food production and total food availability are also very high as can be seen from Table 5.1. Imports as a proportion of domestic production ranged between 3.6 per cent to 31.4 per cent during 1960-81, and the mean of the entire period is about 12 per cent per annum. Similarly, imports as a proportion of total food availability ranged between 3.5 per cent to 23.9 per cent and the mean of the period 1960-81 is about 11 per cent per annum. Importation of foodgrains on such a massive scale places vulnerable during periods of food crises. The much stressed national goal of "self-sufficiency in food" remains unfulfilled.

A few things must be noted at the outset about food imports in Bangladesh. First, food imports are a monopoly of the government. The Ministry of Food and the Food Depart-

TABLE 5.1

Production, Imports and Availability of Foodgrains in Bangladesh

Year	Net Dom. Prodn.	Imports	Total Avail.	Imports as % of Dom. Prodn.	Imports as % of Avail.
1960	8596	460	9056	5.35	5.08
1961	8554	580	9134	6.78	6.35
1962	7897	540	8437	6.84	6.40
1963	9442	770	10212	8.16	7.54
1964	9331	490	9821	5.25	4.99
1965	9333	340	9673	3.64	3.51
1966	8534	890	9424	10.43	9.44
1967	9948	1080	11028	10.86	9.79
1968	10131	1020	11151	10.07	9.15
1969	10639	1120	11759	10.53	9.52
1970	9969	1550	11519	15.55	13.46
1971	8898	1280	10178	14.39	12.58
1972	9020	2830	11850	31.37	23.88
1973	10647	1670	12317	15.69	13.56
1974	10120	2290	12410	22.63	18.45
1975	11497	1490	12987	12.96	11.47
1976	10640	780	11420	7.33	6.83
1977	11795	1690	13485	14.33	12.53
1978	11910	1150	13060	9.66	8.81
1979	12014	1800	13814	14.98	13.03
1980	13263	1900	15163	14.33	12.53
1981	12929	2000	14929	15.47	13.40

Note: Figures are in thousand tons.
Imports include food aid.

Source: Production figures are from GOB, Statistical Year Book , 1979 and 1982.
Import figures are from Stepanek (1979) and World Bank (1979).

ment along with the External Resources Division of the Planning Ministry coordinates the entire operation of food imports. Second, food imports in Bangladesh are largely aid-financed --- either concessionary sales, e.g., P.L. 480 food sales or in the form of outright grants for humanitarian reasons. There are occasions when the government resorts to commercial imports. Unfortunately, data on commercial imports are unavailable (unreported) in any government document. In the absence of such data, it may be plausible to assume that the volume of commercial imports is negligible compared to the volume of aid financed food imports. Hence, food imports and food aid can be termed coterminous. Third, the greater part of food imports continues to be wheat, usually around 80 per cent of the total (Clay;1978:109). Fourth, contrary to popular belief, food imports into Bangladesh are not completely dominated by the US supplies (Clay;1979:109). Before independence (1971), the US was the only supplier of significance and since 1971 the US supply has varied. Canada, the EEC, the World Food Programme, Australia and even India have all supplied food on different terms. With the signing of P.L. 480 agreement in 1973-74, the US has restored its position as a major donor. Finally, imported food is distributed through the government rationing system.

Apart from the pecuniary costs to the exchequer, massive food imports are said to have definitive disincentive effect on domestic food production. This debilitating effect on domestic food production due to foodgrain imports can be termed "Shultz-Fisher" hypothesis. The genesis of this hypothesis lies in Shultz's (1960:1027-1029) "speculative" apprehension about the "potentially serious long-run" price disincentive effects of food imports on agricultural production in importing countries. Briefly stated, Shultz's (1960:1028) example is based on the hypothesis that the effect of a 1 per cent increase in food supplies on price is measured by the reciprocal of the price elasticity of demand.

Fisher (1963) carried Shultz's argument a step farther, and in a simple and neat theoretical exposition was able to show:

> the magnitude of the price effect in question when the surplus is first imported is given to a first approximation by 1 over the sum of domestic demand and supply elasticities and not merely as 1 over the reciprocal of the price elasticity of demand alone as in Shultz's example (1963:865).

Fisher (1963:864) argued that in Shultz's example the price effect will be "overstated" unless the supply curve of domestic production is perfectly inelastic (a case denied by Shultz).

Secondly, Fisher (1963:866) showed that the magnitude of price effects may be even "less" depending on the way imported foodgrains are priced and distributed in the importing country. Taking the extreme case of gratis distribution to the poorer segments, Fisher concluded:

> Surprising as it may sound, it is in fact the case that such a policy will generally be less harmful to domestic agriculture than the policy of sale so far considered, provided that arbitrage by the recipient can be prevented (1963:866).

The availability of food to some consumers at a concessional price represents an increase in real income to consumers in the aggregate and thereby implies a shift in the aggregate demand curve. In Figure 5.1, for example, food imports equal to Q_1Q_3 would depress prices from P_1 to P_2 and domestic output from Q_1 to Q_0 without a demand shift. However, if demand shifts from D to D', due to the income effects generated by food imports, price is not depressed and domestic production remains the same. This is an important

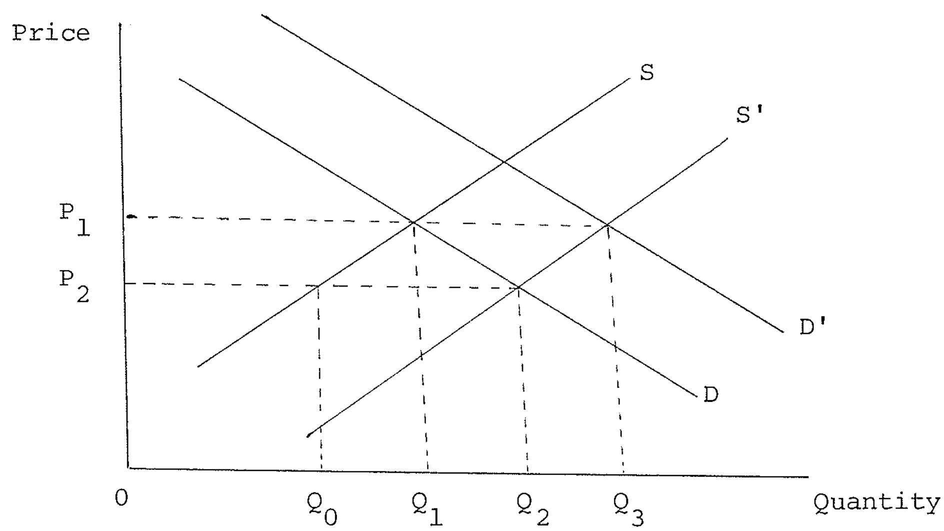


Figure 5.1: Graphical Illustration of Shultz-Fisher Hypothesis

aspect that should be investigated.

The objective of this Chapter is to develop a theoretical model to test the Shultz-Fisher hypothesis; namely that there is negative effect of food imports on domestic prices and production and such adverse effects are much less (or could be non-existent at all!) if priced and distributed differently in the importing country. If this hypothesis can be supported empirically then the alleged fears of disincentive price and production effect from collossal food imports into Bangladesh can be allayed to some extent.

Earlier Studies.

Estimation of negative production impacts resulting from food imports thus rests heavily on measurement of price changes and related production response. In this context we must emphasize that no empirical work is available for Bangladesh thus far. Stepanek (1979:59-60) casually examined the "macroagricultural disincentives of these food imports". These disincentives can be summarised as follows:

1. Adverse price effect leading to production disincentives (Shultz-Fisher argument).
2. Adverse distributional effects, i.e., availability of cheap foodgrains through rationing does not allow the income transfer to take place to the producers.
3. Adverse policy effects, i.e., cheap foodgrains leads to governmental apathy towards the agricultural sector. This may, however, be deliberate on the part of the government because of its industrial bias in providing cheap subsistence wage goods (food) to the urban industrial sector.

All of these disincentive effects may be present with food imports, but Stepanek did not base his arguments on any concrete empirical investigation. Pending empirical testing these criticisms by Stepanek should be taken cautiously for what it is worth.

Clay (1978:113-115) echoes much of the same sentiment as Stepanek but his arguments and evidence have a weak basis. To quote him:

> The most substantive evidence of the disincentive effects of low prices on production is the fall in number of pump-sets rented out by the government input corporation, BADC, for winter irrigation, from 36,382 in 1975/76 to 28,324 in 1976/77, when there were no longer supply problem for inputs that had hampered HYV rice cultivation during the early 1970's (Clay;1978:113-114).

The fall in the hiring of irrigation pump-sets, as mentioned by Clay, is by no means a conclusive test of disincentive effects of prices on production. There may be several possibilities contributing to the fall in the hiring of pump-sets: (a) mechanical breakdown for which pumps could not be hired out; (b) pumps could not be hired out to the farmers timely due to adminstrative bottlenecks of BADC; and (c) corruption among BADC officials who did not release pumps without sufficient kick-backs. The list of causes may be expanded and therefore Clay's "substantive evidence" does not measure up at all in this situation.

5.1 THEORETICAL MODEL

Mann (1967) did a pioneering work to study the impact of P.L. 480 imports on prices and production in India and concluded that food imports had disincentive effects on prices and production. Later Rogers _et al_. (1972) using a modified Mann model came up with similar findings for India. For this study we shall use Mann's basic model to study the impact of food imports on prices and production of domestically produced foodgrains. A theoretical framework of analysis is set up in terms of (1) a supply equation (2) a demand equation, (3) an income-generation equation, (4) a withdrawal from stocks equation and (5) a market-clearing identity.[43]

Supply of Food:

The supply function is conceptualized as

$$Qs,t = f_1(Pt-1, t) \quad 5.1$$

where, Qs,t = the per capita quantity of food available out of domestic production;

Pt-1 = the price of cereals during period t-1; (Mann used prices prevailing in period t-2);

t = time trend variable as a surrogate for technology and weather (Mann used lagged yield instead).

---

[43] Mann's (1967) model consisted of 6 equations including a commercial import equation. This equation is dropped because commercial import figures are unavailable (unreported) and are assumed to be negligible. This, however, does not affect the model in any respect.

Demand for Food:

$$Qd,t = f_2(Pt, Yt) \quad 5.2$$

where, Qd,t = per capita quantity of cereals demanded in period t;

Pt = price of cereals in period t; and

Yt = per capita consumer income in period t.

Income-generation Function:

$$Yt = f_3(Qs,t, Gt) \quad 5.3$$

where, Gt = per capita government expenditure.

Withdrawal (Off-takes) from Stocks Function:

$$Wt = f_4(Qs,t, Mt, IPt) \quad 5.4$$

where, Wt = per capita withdrawal (off-take) from rationing in period t;

Mt = per capita imports in period t; and

IPt = per capita internal procurement of foodgrains in period t.

There are 5 endogenous variables in the model: Qs,t; Qd,t; Pt; Yt; and Wt. But there are only 4 equations. Hence, a market clearing identity is added to close the system:

$$Qd,t = Qs,t + Mt + IPt \quad 5.5$$

5.1.1 The Statistical Model

Assuming that the various functions in equations 5.1 through 5.4 are linear and adding the portmanteau disturbance term to each equation, the system can be written in the normalized form below:

Supply equation:

$$Y_1 + \gamma_{11}X_1 + \gamma_{12}X_2 + \gamma_{01} = u_1 \qquad 5.6$$

Demand equation:

$$Y_2 + \beta_{23}Y_3 + \beta_{24}Y_4 + \gamma_{02} = u_2 \qquad 5.7$$

Income-generation equation:

$$Y_4 + \beta_{31}Y_1 + \gamma_{33}X_3 + \gamma_{03} = u_3 \qquad 5.8$$

Withdrawal (Off-take) from Stocks equation:

$$Y_5 + \beta_{41}Y_1 + \gamma_{44}X_4 + \gamma_{45}X_5 + \gamma_{04} = u_4 \qquad 5.9$$

Market-clearing identity:

$$Y_1 - Y_2 + X_4 + X_5 = 0 \qquad \text{for } t = 1,2,\ldots.T. \qquad 5.10$$

where, Y_1 = per capita net domestic production of food;

Y_2 = per capita cereals demanded;

Y_3 = price index of cereals deflated by Non-food price index;

Y_4 = per capita income;

Y_5 = per capita off-take from rationing;

X_1 = lagged price by one period;

X_2 = time trend variable;

X_3 = per capita government expenditure;

X_4 = per capita import of cereals; and

X_5 = per capita food procurement.

There are five equations in five endogenous variables namely Y_1, Y_2, Y_3, Y_4 and Y_5; and hence the model is complete. There are five exogenous or predetermined variables which include X_1, X_2, X_3, X_4 and X_5. The values of these variables are given at a particular point in time and are not subject to determination by the model.

5.1.2 Empirical Results

The structural form reveals the interaction of the various variables in the system of equations. In order to study the explicit dependence of the endogenous variables on the predetermined variables and the disturbances, the structural form is solved for the endogenous variables to derive the reduced form. Equations 5.6 through 5.9 are over-identified by the order and rank conditions of identification, and hence the Theil-Basmann Two Stage Least Squares (2SLS) is appropiate in obtaining consistent estimates of coefficients for the endogenous variables (β's) and the predetermined variables (Γ's).

The structural equations of the model have been estimated by using data from Bangladesh economy during 1960-81 period and these data are collected from a number of published sources. Table 5.2 gives the basic data of the variables.

TABLE 5.2

Basic Data of Variables

ear	Qt,s	Qt,d	Yt	Mt	Wt	Pt	IP	Gt	Pop
960	8596	9056	16357	460	201	97.18	26.3	785	53.90
961	8554	9134	17491	580	255	90.47	10.1	867	54.53
962	7897	8437	18527	540	710	96.20	4.1	881	56.96
963	9442	10212	18706	770	444	87.78	124.8	1106	57.43
964	9331	9821	20672	490	709	85.77	12.4	1203	58.94
965	9333	9673	22870	340	964	103.37	92.1	1416	60.48
966	8534	9424	26456	890	1056	125.84	7.4	1389	61.94
967	9948	11028	28197	1080	648	109.38	21.8	1560	63.43
968	10131	11151	29880	1020	1038	117.34	9.4	1793	64.95
969	10639	11759	32630	1120	1354	113.61	6.1	2010	66.52
970	9969	11519	36154	1550	1318	108.67	6.0	2483	68.12
971	8898	10178	39678	1280	1734	114.60	0.2	2687	69.77
972	9020	11850	43203	2830	2618	188.23	0.1	2131	72.39
973	10647	12317	67925	1670	1728	232.32	70.9	3462	74.33
974	10120	12410	123050	2290	1764	538.77	127.9	5655	77.03
975	11497	12987	101370	1490	1676	305.91	415.0	6360	78.96
976	10640	11420	99621	780	1473	326.44	313.6	8215	80.82
977	11795	13485	140430	1690	1847	406.02	550.4	8477	82.71
978	11910	13060	165750	1150	1796	411.28	355.2	10876	84.66
979	12014	13814	191110	1800	2402	556.97	350.0	11407	86.64
980	13263	15163	225620	1900	2000	473.04	1100.0	13254	88.68
981	12929	14929	256950	2000	1900	559.50	5539.0	16531	90.63

urce: Qt,s; Qt,d; Mt are from Table 2.11. Figures are in thousand tons.
Yt is from GOB, Statistical Year Book, 1979,1980,1982. Figures are in million Taka.
Wt is from Alamgir (1973a:45) for figures from 1960-63. 1964-67 figures are from Islam (1980:100). 1969-79 figures are from Clay et al. (1981:61). Figures are in thousand tons.
Pt is Food Price Index deflated by the Non-food Price Index as shown in Table 4.4.
IPt is from Islam (1980:94) for 1960-73; 1974-78 from World Bank (1979:199); 1979-80 from Clay et al. (1981:54). Figures are in thousand tons.
Gt figures are from Alamgir and Berlage (1974:240) for 1960-68; Rest are from GOB, Statistical Year Book, 1979, 1982. Figures are in million Taka.

5.1.3 Results of Statistical Estimation

The units of measurement of the varaibles Y_1, Y_2, Y_5, X_4, and X_5 are in pounds and X_3 is in Takas. As stated Two Stage Least Squares is used to estimate the structural equations except for equation (5.6) because it contains no endogenous variables as its explanatory variables and hence ordinary Least Squares is applied instead. The estimated coefficients of the structural equations are presented in

TABLE 5.3

Two Stage Least Squares Estimates of Structural Equations

Equation No.	Estimated Equation
5.6*	$Y_1 = \underset{(9.78)}{348.49} + \underset{(0.06)}{0.11}\, X_1 - \underset{(1.49)}{4.38}\, X_2$
5.7	$Y_2 = \underset{(13.34)}{375.90} - \underset{(0.25)}{0.13}\, Y_3 + \underset{(0.25)}{0.11}\, Y_4$
5.8	$Y_4 = \underset{(162.35)}{130.14} - \underset{(0.49)}{0.35}\, Y_1 + \underset{(0.16)}{3.12}\, X_3$
5.9	$Y_5 = \underset{(107.0)}{252.72} - \underset{(0.30)}{0.68}\, Y_1 + \underset{(0.29)}{0.20}\, X_4 + \underset{(0.44)}{0.43}\, X_5$

Note: * denotes coefficients are estimated by OLS. Asymptotic standard errors are given in parentheses under the coefficients.

Table 5.3.

The supply equation indicates that supply is positively related to lagged price but inversely related with the time trend variable. The time trend variable is used as a proxy for technology; and the sign of this coefficient may be positive or negative depending on the relationship with supply. In this case technological impact on supply is negative.

The demand equation has signs on all coefficients that agree with economic theory, indicating that demand for food is positively related to income and negatively with price. The income-generation equation indicates that income falls with an increase in the supply of food which is contrary to a priori expectation. On the other hand, income increases with an increase in government expenditure. One line of reasoning for decrease in income due to supply increase is that as supply increases the price level of foodgrains declines so that the total revenue of sales from foodgrains falls with an inelastic demand.

Finally, the withdrawal (off-take) from rationing equation shows that off-take is inversely related to domestic supply. This is an all too familiar situation in Bangladesh because if domestic supply increases, off-takes from rationing slackens because the price differential between the open-market and rationing is narrowed. It is also observed from the equation that off-take increases with domestic procurement and import of foodgrains.

The estimated reduced form coefficients are of particular interest in this study. These are reported in Table 5.4. The reduced form coefficients which are of direct interest are those associated with the variable X_4 (food imports).

TABLE 5.4

Estimated Reduced Form Coefficients to Measure Impact of Food Imports on the Bangladesh Economy, 1960-81

quation	Intercept	X_1	X_2	X_3	X_4	X_5
ipply	348.49 (9.97)	0.1108 (0.06)	-4.3781 (1.49)	0.0000	0.0000	0.0000
emand	367.26 (15.83)	0.0036 (0.11)	-4.7964 (3.27)	0.0952 (0.40)	0.8374 (0.48)	2.2750 (1.81)
icome	-18.76 (15.92)	0.0406 (0.11)	-5.4949 (3.29)	3.4064 (0.41)	1.5644 (0.48)	1.4992 (1.82)
ice	-28.60 (42.78)	0.1578 (0.29)	-4.2922 (8.84)	3.3963 (1.00)	2.3941 (1.30)	-3.5055 (4.88)
f-take	8.59 (4.56)	-0.0219 (0.03)	4.0557 (0.94)	-0.2605 (0.12)	0.2514 (0.14)	-0.0501 (0.52)

The response of prices and domestic supply of cereals to a change in imports of cereals is examined in terms of a once-for-all unit shock in imports. That is, the imports are increased by one pound per capita during the year 1 and then reduced to the original level during the year 2 and maintained there subsequently. The effect of this change are embodied in the various multipliers.

The coefficient or impact multiplier from the reduced form model indicate that increasing imports by one pound per capita increases cereal prices by 2.4 percentage points (π_{45}) of the price index; increases demand by 0.84 pounds per capita (π_{25}); increases income by Taka 1.56 per capita (π_{35}) and finally, increases off-take from the ration shops by 0.25 pounds per capita (π_{55}). Due to the time lag in supply response, domestic supply is unaffected in period t.

To help trace the influence on future values of price we can construct Table 5.5. The delay multiplier equals $[\pi_{45}][\pi_{42}]^{t-1}$ for t = 1, 2, 3,..... periods. The long-run

TABLE 5.5

Distributed Lag Effect on Price of a One Unit, Once-all-All Increase in Imports

Time	Lag	Delay Multiplier	Cumulated Multiplier
1	0	2.3941	2.3941
2	1	0.3778	2.7719
3	2	0.0596	2.8315
4	3	0.0094	2.8409
5	4	0.0015	2.8424
6	5	0.0002	2.8426

multiplier equals $\pi_{45}/1-\pi_{42}$.

From Table 5.5 we can see that the delay multiplier for cereal price is 0.38 in second year, 0.06 in the third year and virtually disappears by the sixth year. The six-year cumulative multiplier is 2.84 which is approximately equal to the long-run multiplier value. The delay multipliers can be graphically represented as in Figure 5.2.

Secondly, the impact on domestic supply is measured by the delay multiplier $[\pi_{12}][\pi_{45}][\pi_{42}]^{t-2}$ for t = 2, 3, 4, ... periods. These multipliers are shown in Table 5.6. The long-run supply multiplier is given by $[\pi_{12}][\pi_{45}]/1-\pi_{42}$. The initial shock of imports affects supply in period 2 after a lag of one year, because supply and price are related with a lag of 1 period. The initial shock dissipates quickly and by the year 5 the impact is negligible. The five-year cumulated multiplier is 0.32 which is also approximately equal to the long-run supply multiplier.

The production effect can also represented graphically as in Figure 5.3.

The net effect of food imports on production is always positive. Thus food imports does not decrease (displace) domestic production; rather food imports make a positive contribution to food availability, however negligible it may be. This finding negates the assertions of Stepanek (1979:59-60) and Clay (1978:113-115) about the definitive

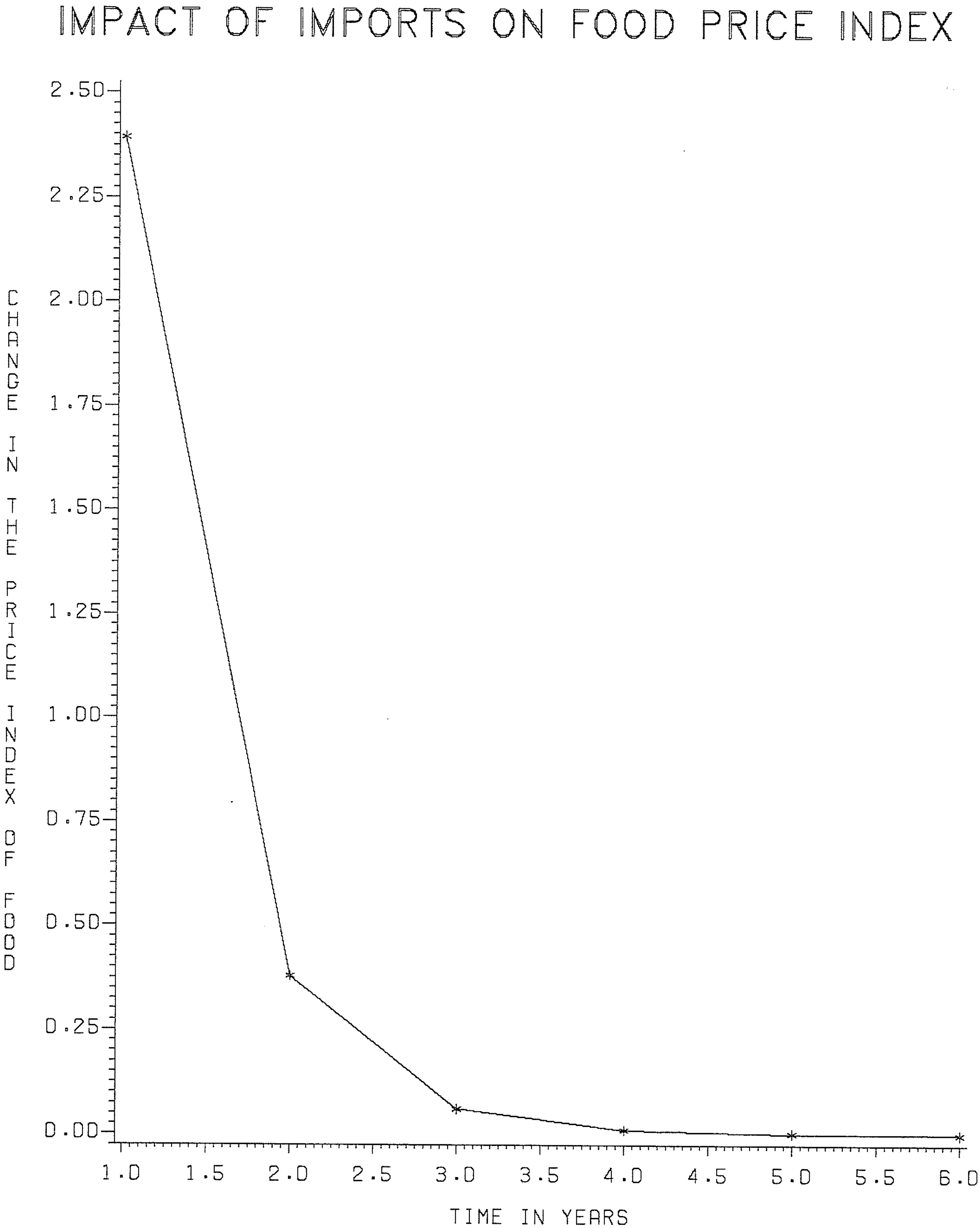

IMPACT OF IMPORTS ON FOOD PRICE INDEX
CHANGE IN THE PRICE INDEX OF FOOD
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
TIME IN YEARS

FIGURE 5.2

TABLE 5.6

Total Effect of Food Imports on Domestic Production in Bangladesh

Time	Lag	Delay Multiplier	Cumulated multiplier
1	0	---	---
2	1	0.2653	0.2653
3	2	0.0419	0.3072
4	3	0.0010	0.3082
5	4	0.0002	0.3084

disincentive effects on Bangladesh's food production due to food imports.

This finding is, however, not too startling. According to Shultz-Fisher argument, food imports lead to increases in the supply of food which cause a fall in food prices. This is partly or wholly offset by the income effect of the distribution scheme in the importing country. In Bangladesh, availability of ration food to urban consumers causes their real income to increase substantially (Ahmed, R;1978:15). Fisher (1963:869) further observes:

> I find it hard to believe that the demand for food in food deficit countries can be very price inelastic, especially when one considers the large income effect which is likely to occur when food prices fall. The existence of a large demand which is not satisfied because prices are high seems to me to be a likely characteristic of food deficit countries. If this is so, then the effect of the surplus on price and on domestic supply will be less serious than would otherwise be the case (1963:869).

IMPACT OF IMPORTS ON FOOD PRODUCTION

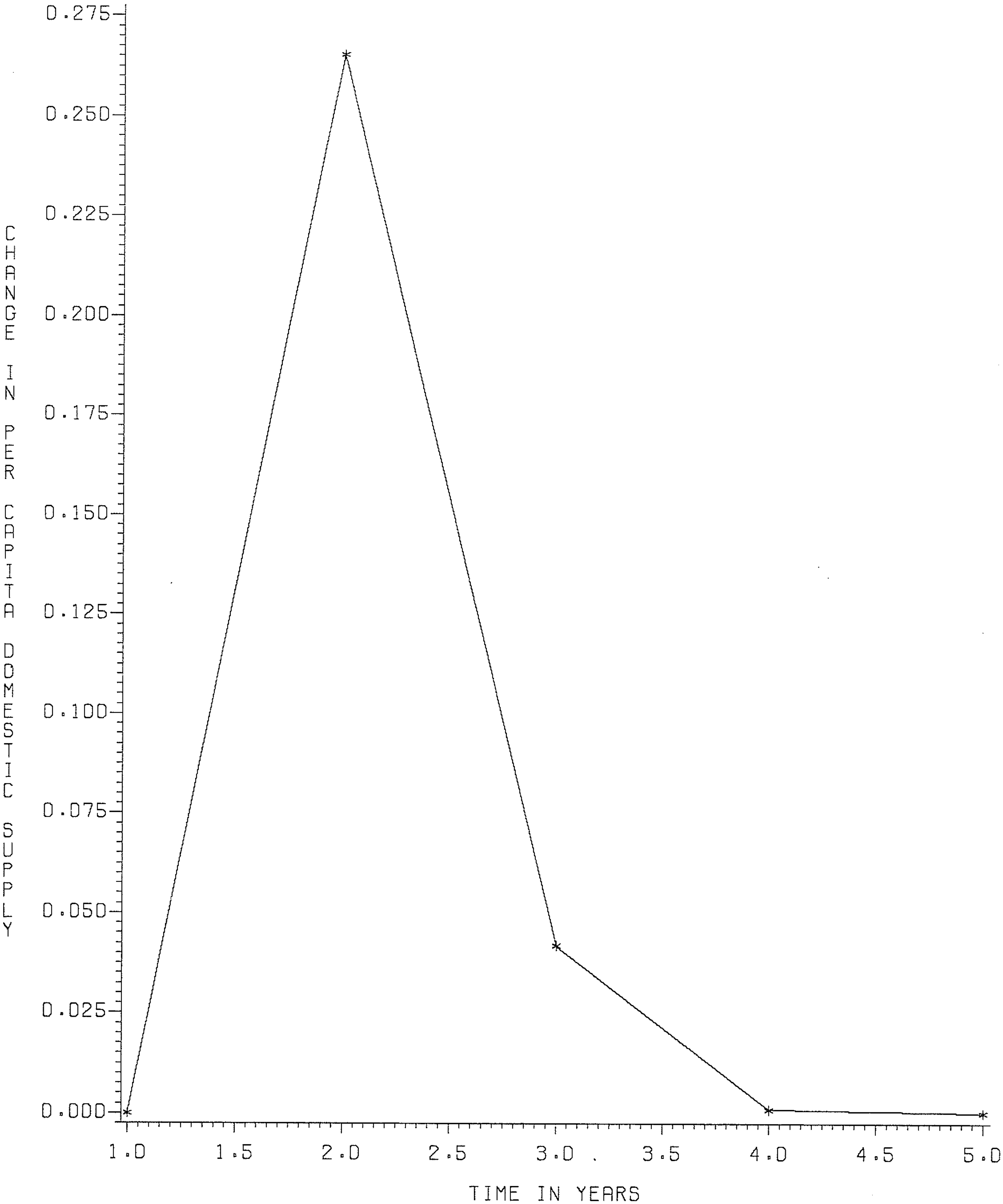


FIGURE 5.3

5.2 SUMMARY

The analysis is based on a system of simultaneous equations including supply, demand and other related functions. The system of equations was over-identified and therefore 2SLS was used in estimating the parameters of the structural form. From the structural parameters, the reduced form parameters were obtained. The analysis was based on various multipliers which were functions of the elements of the matrix of reduced form coefficients.

The analysis does not support the belief that imported foodgrains depress food prices and has disincentive effects on production. From this analysis we see that prices in fact rise by about 2.4 percentage points due to an unit increase in imports. As a result, domestic supply of foodgrains reacts, after a lag of 1 year, positively to price increase but the supply response is small which is about one-third of an unit. This positive price and production effect is perhaps due to the special way in which imported food is priced and distributed in Bangladesh. Hence, the rationing system has a silver lining in its clouds. However inequitable the rationing system may be in its operation, at least it prevents the disincentive effects on production. Nevertheless, we have a policy dilemma here between equity and efficiency of the rationing system. This may be best resolved by a social Cost-Benefit analysis of the whole rationing system.

Chapter VI

SUMMARY AND CONCLUSIONS

6.1 MAJOR FINDINGS OF THIS STUDY

Bangladesh has a deepening food crisis. Hunger, malnutrition and starvation are the ugly facets of these crises. The salient feature of the crisis are that hunger and malnutrition is not generally among the entire population or a particular geographical locale of the country. Rather they are problems afflicting a particular, identifiable sub-set of the population whose rank and file is growing alarmingly over time. Hunger is not a disease or a single biological state and is caused by restricted choices of basic food quantities available to individual consumers (Timmer et al. ;1983:7). It is also a mute problem taking its toll among the very young, nursing mothers and agricultural farm labourers. It is only during periods of severe food shortages, such as after some natural disasters in 1973-74 and 1978-79, that the problem becomes apparent and visibly seen in the form of destitution and famine-related deaths on the streets of major cities in Bangladesh.

Explanations of the crises range from unfavourable weather cycles, a demographic explosion, and an economy which is seen to be unresponsive to economic incentives. The dominant view, as the one expressed by the World Bank (1979), explains the problem in terms of insufficiency of food supply compared to food demand. This view is not only biased but also is a casual explanation of the prevailing situation in Bangladesh. Failure to identify and diagnose the problem has led to inappropiate policy responses with near disastrous outcomes. Efforts to raise food supply exclusively through the "Green Revolution" miracle technology has not produced the promised "cornucopia" --- rather, it has opened the "Pandora's box" in Bangladesh. The Green Revolution has been a costly and colossal failure in Bangladesh. Food production has been sluggish while available statistics show deteriorating income and employment situation in Bangladesh.

In this research we studied the relationship between food production and population growth in Bangladesh. Domestic food production has grown very slowly over the study period. Land utilisation data shows that the extensive margin of land has been virtually reached and effective acreage cannot be increased much beyond the present cropping intensity level. Whatever little growth is achieved is due to productivity increase which presently is one of the lowest in South Asia. Resource constraints along with "industrial bias" of the government are seen as principal factors responsible for stagnation in food production.

On the other hand, population increased rapidly at around 2.5 to 3 per cent per annum. High poulation growth coupled with a large population base has increased the total population to around 95 million. Governmental efforts aimed at arresting this runaway population growth has not achieved the desired objective. A substantial reduction in fertility is unlikely to come about given the prevailing socio-economic situation in Bangladesh. A large family size is often desired as a part of optimal and rational decision making process of the households. Children are viewed as investment goods who can produce a stream of income over their lifetime which can not only pay for their past consumption but also support themselves and their parents during their old age.

Rapidly rising population does exert strong pressure on the domestic food supply in terms of declining per capita food availability. But such adverse effects have been cushioned by burgeoning food imports, mostly aid financed, to the tune of 10 to 30 per cent of total food availability in Bangladesh. Imported foodgrains along with locally procured foodgrains are distributed through the government rationing system primarily targetted towards 6 cities and other "priority" groups. Calculations for 1981, which is representative of other years, show that the distribution resulted Bangladesh from a deficit situation to one of surplus!

Given the massive injection of food imports into the economy, the aggregate per caput daily availability of food never fell below 15 ounces over the study period. This should adequately feed every individual in Bangladesh according to Chen's prescription of 14.4 ounces per capita per day. Unfortunately, such is not the case. Nutritional Surveys in Bangladesh show that calorie-protein intake of the people are falling over time along with the intake of vitamins and iron. Herein lies the paradox. Domestic production and imports (= total availability) ensures a state of adequate nutrition whereas malnutrition, hunger and starvation remain so rampant in Bangladesh! Obviously, certain sub-set of the population do not have the access to food that they require. Therefore, the food availability decline hypothesis (FAD) is inadequate and does not "fare well" in explaining the crisis in Bangladesh.

The key to this silent problem of who goes hungry or not depends on the ownership of food "entitlements" as elaborated by Sen. Ownership of food entitlements give access to food to the owner in varying amounts. Sen sees hunger resulting from failure on the part of groups of people to establish entitlement over a requisite amount of food.

Food entitlement critically depends on two parameters namely: resource endowment vector and an exchange entitlement mapping which specifies the set of commodity bundle which a person can choose through exchange (production and trade). These entitlement mappings, in general, depend on the legal, political, and economic characteristics of the society in question and the person's position in it. Direct access to food is eroded when a household can no longer produce an adequate supply of food. The ability to trade for needed food is eroded when the household's labour is unemployed or incapacitated or through adverse shifts in its terms of trade. Available statistical data point to the fact that Bangladesh's malnutrtion and hunger are due to progressive deterioration of "exchange entitlements" in two principal ways. First, an endowment loss in the form of increasing landlessness (over 53 per cent of the households) exposes a large section of population to starvation. Secondly, losing land exposes these people to the vulnerability of the market where they do not wield much power. As a result their terms of trade _vis a vis_ other dominant market powers also decline. This is seen in declining real wages for agricultural labour.

Declining "entitlements" cannot be explained by demographic factors alone. Immutable market forces work against a particular class of people causing a continual erosion of their food entitlements. Participation in the market activity of the food system, however, as a food buyer or seller or a wage labour, adds to the uncertainty and the vulnerability because market forces are as far beyond the household's control as are whims of the weather and locusts (Timmer _et al_. ;1983:7). Poor people are by far the most vulnerable to misfortune. Market connections simultaneously extend the rage of misfortunes that might befall them, while bringing opportunities to end their poverty or cushion their local misfortunes. Unfortunately, we had to abandon this preferred approach because of lack of relevant micro level data from Bangladesh. Therefore, a "second-best" approach was adopted to study this problem. Hence, our objective is to measure the quantum of food demand for Bangladesh. While estimating a market food demand we, implicitly, take into account the entitlements of the people because prices and income reflect entitlement.

This "second-best" approach consists of estimating the amount of food demand of Bangladesh. Estimation of "food demand" raises different problems of interpretation of the term. Food demand is primarily interpreted in terms of "physiological requirements", i.e., the amount of energy required by a population to maintain a normal level of physical activity. Physiological food demand is unimportant in the assessment of the amount of food a given population actually consumes given food prices and their income. Demand should be interpreted in the sense of effective demand to determine the nutritional status of the population. Food that is physiologically required may not be actually available, or even if available, may not be metabolically consumed by the population because of lack of purchasing power.

Previous food demand studies in Bangladesh have concentrate their analysis on physiological demand or some variants of it. On the other hand, truly economic demand studies concentrated attention on the estimation of demand function of specific groups of people using cross-section data only. One study by Hamid (1980) made an elaborate attempt in synthesizing these two approaches. Unfortunately, his demand projection model was flawed for a number of reasons and hence, called for a re-calculation. Hamid's (1980) model contained calculation errors which were significant. The model was built around parameters which were unrealistic and more importantly, the model lacked statistical foundation. Because of these inadequacies we re-calculated Hamid's (1980) model with plausible parameter values.

Our principal task in this study was to formulate and estimate a market food demand model for Bangladesh. The previous exercise with Hamid's model was merely corrective to remove the inadequacies in the model. A price flexibility market model was specified and estimated using time series data only. Using time series data raised statistical problems, especially multicollinearity, which made the model difficult to rationalise econometrically. Therefore, cross-section data were combined with time series data to rescue the model from the "traps" it encountered.

The technique of combining time series data and cross-section data dates to the works of Stone (1948) and Tobin (1950), and since then this technique has been widely used by Wold (1953) and Fox (1968) because of the numerous statistical advantages of the procedure. Goldberger (1964) suggests that even "false" extraneous information should be incorporated into time series data and the discrepancy can be taken care of as "sampling error." In this study we went beyond the popular Tobin (1950) technique of using "exact" extraneous information. A more realistic assumption of incorporating "unbiased" extraneous information into the time series sample was made to derive the parameter estimates. Hence, we successfully derived the market demand for food using these two types of extraneous information from cross-section samples.

Food demand projections, based on alternative price regimes and income growth, were made for Bangladesh. Then these demand figures were compared with the projected domestic supply figures to reveal the supply-demand gap in Bangladesh. The size of this gap measures the extent of foodgrains import requirements for Bangladesh. Based on our calculations we see that there is virtually very little "market deficit" in food in the near future. However, the margin between supply and demand is very low because of "under-consumptionist" tendency due to higher foodgrain prices compared to incomes.

Identical results about the marginal food balance have been derived from a three sector macro food demand-supply model. Simulation runs on the model show the demand-supply gap ranges between 3 to 4 per cent per annum. The structural macro model was tested to see the likely effect on food demand-supply balance under a target 7 per cent growth rate in GDP as envisaged under the National Perspective Plan of Bangladesh. Given the structural change of the economy and the different growth paths commensurate with 7 per cent growth of GDP, the food gap ranges from under 1 per cent to about 3 per cent per annum. The model was further tested to see the conditions under which food autarcky in Bangladesh is feasible. It was found that that food autarcky and the desired 7 per cent growth rate are inconsistent. Food autarcky brings about a GDP growth rate which is below 7 per cent. Moreover, food autarcky requires the agricultural sector to double its growth rate and the industrial sector to slow down considerably. Therefore, the optimal course of action would be to achieve the desired 7 per cent growth rate and absorb a moderate food price inflation.

If one compares the demand-supply gap in this study and the import of foodgrains in Bangladesh, then the two figures are obviously at wide variance. The discrepancy could largely be explained by the fact that a substantial amount of food (to the tune of 15 to 20 per cent of availability) is traded illegally across the border each year. Taking part in this organised racket are corrupt politicians (including head of the government), bureaucrats, businessmen, members of the law enforcing agencies with the connivance of agents of international food giving agencies.

Finally, this research looks into the likely effects of massive food import on agricultural production in Bangladesh. Fears are raised that food imports cause domestic food prices to fall due to supply shifts thus reducing producer's incentives. Using a multi-equation simultaneous model we were able to allay those fears of price disincentive effects. Perhaps this may be due to the special way in which imported foodgrains are priced and distributed in Bangladesh. Along with supply shifts there is also a demand shift to the right smothering some of the disincentive price effects.

6.2 IMPLICATIONS

We come a full circle to our starting point of the problem. There is an acute shortage of food in the hands of the poor, though not in general terms countrywide. This hunger and consequent malnutrition is needless nor is it inevitable in Bangladesh. In a low income country, such as Bangladesh, the silent food problem must be seen simply as an extension of the poverty situation prevailing in the country. Poverty, in absolute terms, signifies the deprivation of the basic needs of life and the inability of the individual or household to obtain the minimum amount of goods and services. To quote Sen:

> There is an irreducible core of absolute deprivation in our idea of poverty which translates reports of starvation, malnutrition and visible hardship into a diagnosis of poverty without having to ascertain first the relative picture (Sen;1977:11).

Sen further adds:

> Much about poverty is obvious enough. One does not need elaborate criteria, cunning measurement, or probing analysis to recognise raw poverty and to understand its antecedents.....There is indeed much that is transparent about poverty and misery.....But not everything about poverty is quite so simple. Even the identification of the poor

> and the diagnosis of poverty may be far from obvious when we move away from extreme to raw poverty (Sen;1981b:vii).

Poverty-linked hunger and malnutrition in Bangladesh are not just functions of low average per capita incomes, nor are they likely to disappear in the course of economic growth in the absence of substantial structural and policy changes that would drastically alter employment and incomes of the poverty stricken people. A whole array of policy measures can be suggested which can be categorised into two groups: short-term policy responses and long-term policy interventions. The objective of the short term policies is to stem the tide and prevent a sudden, violent shakeup in the nutritional status of the vulnerable groups. The long-term policies are designed at improving the overall nutritional status of the population. The former would not require substantial policy interventions but only a rationalisation of the existing situation.

Short-term policy measures:

The issue of food security should dominate in any policy proposal that we suggest. It is not true that malnutrition and hunger are due to inefficient allocation of resources by households. At the micro level, households are rational and allocate resources to their optimal limits. To avoid hunger households adopt a bevy of strategies from substitution of higher priced foods to lower priced foods, to dissaving by selling of valuable assets like land and draught animals. Recently a very disturbing pattern has developed which can be seen to be a perfectly rational point of view. Teen-age boys are being married and married men are taking more than one wife in return for a dowry consisting of land or other valuables which can be redeemed for food. However myopic it may be from the social point of view, this behaviour is not totally irrational because it causes a temporary respite from hunger for a few months or a few days. However, the ramifications of this practice are far reaching.

Poor individuals have very little power to cause any change in their economic position. Therefore, genuine governmental efforts and intervention are required to improve the situation. These can be summarised as follows:

Government should monitor the food situation closely and special government departments should be able to detect and warn the nation of an impending food crisis. Disaster prone Bangladesh requires ample food reserves to meet frequent and unexpected calamities to the tune of 600-800 thousand metric tons for the present population (Stepanek;1979:68). This huge amount can be easily built if illegal trading in food can be stopped either through moral persuasion or coercion. Moreover, food aid can give the adminstrators a greater degree of freedom in the creation of a buffer stock. This food reserve can effectively be used in open market sales to moderate the amplitude of the food price fluctuations between harvests. Therefore, a concerted contingency plan is required to adequately face crises as in 1973-74 and 1978-79.

Food priorities should be reordered. Because of the overwhelming proportion of people living in the rural areas, the present rationing system must be extended to the rural areas to make any significant impact on the under-nutrition situation prevailing in the country. If the system cannot be expanded, the other alternative is to phase out rationing in the urban areas and to the "priority" groups and expand the rationing facilities in the rural areas. This would be more equitable and fair since the system started as a program of feeding the destitute in the 1940's and has now become a permanent urban welfare system.

Government should manage food distribution in a much more activist fashion by converting food into a near-public good to vulnerable groups such as the very young, pregnant and lactating mothers. Supplementary feeding centres should be opened for these groups of people to ensure adequate nutrition. The enforcement, adminstration and costs of these projects are high but the results can have a very high payoff in terms of human capital development.

Long-term policy measures:

Because of the close link which exists between poverty and hunger, elimination of poverty in the longer term becomes the surest way of ameliorating hunger. Policies should be directed at raising employment and income generating activities of the poor. Attention should also be directed towards ensuring food entitlements and that these do not suffer a decline along the way. For this a general redistribution of income is essential. A longer term policy perspective should run along the following lines.

Agrarian reform is the first and foremost step towards a longer term income redistribution programme. Agrarian reforms are programmes designed to modify the institutional order, i.e., the forms of economic systems of agriculture, particularly as such systems are related to the social and political structure of the society (Parsons;1984:19). Agrarian reform is much wider in scope than a mere land reform and it encompasses the reform of tenurial practices, availability of necessary inputs, credit etc. In Bangladesh there is very little scope for redistributive land reform because the average farm size is small and further sub-division would render them uneconomic.[44] Therefore as a first step, accepting the present owner-cultivator relationship as it is, reforms can be pressed which reduce the exploitative and onerous practices and insecurity of the tenants. Moreover adequate provision should be made to ensure timely distribution of water, seeds, pesticides and more importantly institutional credit. The broad goal of an agrarian reform would be increased production by modifying the institutional order. A second phase of reform would be to bring farms below a certain critical size into communal ownership or management to provide an effective means of sharing employment

---

[44] Islam (1978:30-40) outlines the pros and cons of such a redistributive scheme.

and income.[45]

It is often argued that because of "urban bias" rural areas receive disproportionately low shares of development resources. Rural development should be given a higher priority in order to reduce the bias. Income generating avenues should be created in the rural areas in the form of capital construction works i.e., physical infrastructures. There is a close interdependence between a rural works programme designed to build up rural infrastructure and agricultural development.[46] The former facilitates agricultural development which in turn creates demand for additional infrastructures and serves as a potential source of financing increased investment in rural infrastructure. Rural public works can be seen as a "redistributive measure" aimed at increasing income and employment.

The success of any programme depends on the participatory actions of the people. The poor people should be seen as partners in development and not passive spectators. Participatory measures include all such activities which enable the poor to organize themselves, identifying their own needs and sharing in the design, implementation and evaluation of programmes or projects which fulfil such needs. These pro-

---

[45] Islam (1978:40) presents a strong case for producer cooperatives to maximise output and employment in Bangladesh.

[46] Islam (1978:41) stresses the importance of designing and implementing rural development projects to raise income and employment in the rural areas of Bangladesh.

grammmes may also include action programmes to instill a political awareness into the poor either through trade unions or peasant associations and enable them to act as pressure groups.[47] Proshika funded by the Canadian International Development Agency (CIDA) aims at identifying appropiate persons among the rural under-privileged and helping them achieve self-awareness, see their own problems and finding their own ways of solving them.

Concluding thought:

Much depends on implementation of the proposals. Beautiful blueprints often gather dust because of non-implementation emanating from apathy and lack of political will. The policies suggested above require some political commitment to implement. The difficulties with implementation are manifest. The success stories of land reforms in Japan, Republic of Korea and Taiwan were introduced and carried under direct pressure from foreign occupational forces. On the other hand, China, Cuba and Vietnam all carried out their reforms under a people's revolutionary government.

Unfortunately, not all governments are platonic. The military oligarchy in Bangladesh, which have ruled or have been in power for 12 years of the 16 years of the existence of Bangladesh, has very little political commitment to the people. Hence, very little can be expected out of such a

---

[47] El Ghonemy (1984:1-17) suggests various participatory actions aimed at resolving poverty.

goverment whose primary interest is to retain state power at all cost.

Appendix A

REGIONAL DIFFERENCES IN FOODGRAIN PRODUCTION, CONSUMPTION AND DISTRIBUTION IN BANGLADESH

Crucial to what happens on the food front is the understanding of Bangladesh's unique features. With an area of 55,125 square miles Bangladesh is the world's largest delta formed by the Ganges-Brahmaputra river system. Bangladesh is a homogeneous entity --- homogeneous in terms of climate, culture, race, religion and language. Based on these characteristics, the food habits of the people of Bangladesh are uniform throughout with rice being the staple food along with fish, vegetable and meat being a typical meal. Wheat is now becoming increasingly popular and fast replacing rice.

Despite the fact that Bangladesh is an alluvial floodplain, there exist considerable diversity in soil composition. Soil characteristics vary from district to district. As a result food production exhibits a considerable diversity in various districts.

The following table highlights the considerable diversities in production, consumption and distribution of foodgrain in a country like Bangladesh. This table is calculated for the year 1981-82 since relevant data for the later years were not available.

TABLE A.1 Regional Differences in Food Grain Production, Consumption & Distribution in Bangladesh 1981-82

DIVISION	DISTRICTS	1 POPULATION	2 GROSS FOOD PRODUCTION	3 NET FOOD PRODUCTION	4 INTERNAL PROCUREMENT	5 PUBLIC DISTRIBUTION (1)	6 PUBLIC DISTRIBUTION (2)	7 ACTUAL AVAILABILTY (1)
RAJSHAHI		21132	4281670	3853542	168582	355658	333353	4040618
	DINAJPUR	3200	758845	683000	63664	44009	41249	663345
	RANGPUR	6510	1477380	1329642	36592	97824	91689	1300874
	BOGRA	2728	625500	562950	19001	45922	43042	589871
	RAJSHAHI	5270	880160	792144	46426	103564	97069	849282
	PABNA	3424	539785	485806	2899	64339	60304	547246
KHULNA		17151	2508540	2257684	79218	425019	398364	2603485
	KUSHTIA	2292	275990	248391	1567	60273	56493	307097
	JESSORE	4020	641675	577507	5563	76298	71513	648242
	KHULNTA	4329	552035	496831	10696	173882	162977	660017
	BARISAL	4667	650805	585724	21587	83712	78462	647849
	PATUAKHALI	1843	388035	349231	39805	30854	28919	340280
DHAKA		26242	3979459	3158171	64291	995220	932804	4089100
	MYMENSINGH	6568	1563254	1406929	61470	12892	105812	1458351
	JAMALPUR	2452	470380	423342	--	--	--	--
	TANGAIL	2444	532095	478885	1097	44009	41249	521797
	DHAKA	10014	883560	795204	1215	744083	697417	1538072
	FARIDPUR	4764	530170	477153	509	94236	88326	570880
CHITTAGONG		22595	3709965	3338968	79766	615883	577258	3875085
	SYLHET	5656	1157130	1041417	28326	121981	114331	1135072
	COMILLA	6881	1093720	984348	13516	137049	128454	1107882
	NOAKHALI	3816	589830	530847	16180	69122	64787	583789
	CHITTAGONG	5491	768275	691447	18414	271467	254442	944500
	HILL TRACTS	751	101010	90909	3291	16264	15244	21982

TABLE A.1 Regional Differences in Food Grain Production, Consumption & Distribution in Bangladesh 1981-82

DIVISION	DISTRICTS	8 ACTUAL AVAILABILITY (2)	9 CONSUMPTION REQUIREMENT	10 PRODUCTION GAP	11 ADDITIONAL GRAIN ARRIVAL (1)	12 AVAILABILITY GAP (1)	13 ADDITIONAL GRAIN ARRIVAL	14 AVAILABILITY GAP (2)
RAJSHAHI		4018313	3443385	+ 410157	+ 187076	+ 597233	+ 164771	+ 574928
	DINAJPUR	660585	521429	+ 161571	- 19655	+ 141916	- 22415	+ 139156
	RANGPUR	1384739	1060781	+ 268861	+ 61232	+ 330093	+ 55232	+ 324093
	BOGRA	586991	444518	+ 118432	+ 26921	+ 145353	+ 24041	+ 142473
	RAJSHAHI	842787	858728	- 66584	+ 57138	- 9446	+ 50643	- 15941
	PABNA	543211	557929	- 57405	+ 61440	- 10683	+ 57405	- 14718
KHULNA		2576830	2794694	- 537010	+ 345801	- 191209	+ 319146	- 217864
	KUSHTIA	303317	373473	- 125022	+ 58706	- 66316	+ 54926	- 70096
	JESSORE	643457	655045	- 77538	+ 70735	- 6803	+ 65950	- 11588
	KHULNTA	649112	705395	- 208564	+ 163186	- 45378	+152281	- 56283
	BARISAL	642599	760471	- 174747	+ 62125	- 112622	+ 56875	- 117872
	PATUAKHALI	339345	300310	+ 48921	- 8951	+ 39970	- 10886	+ 38035
DHAKA		4026684	3876496	- 718325	+ 930929	+ 212604	+868513	+ 150188
	MYMENSINGH	1451271	1070232	+ 336697	+ 51422	+ 388119	+ 44342	+ 381039
	JAMALPUR	--	--	--	--	--	--	--
	TANGAIL	519037	398241	+ 80644	+ 42912	+ 123556	+ 40152	120796
	DHAKA	1491406	1631746	- 836542	+ 742868	- 93674	+696202	- 140340
	FARIDPUR	564970	776277	- 299124	+ 93727	- 205397	+ 87817	- 211307
CHITTAGONG		3836460	3681775	- 342807	+ 536117	+ 193310	+497492	+ 154685
	SYLHET	1127422	921625	+ 119792	+ 93655	+ 213441	+ 86005	+ 205797
	COMILLA	1099286	1121234	- 136886	+ 123533	- 13353	+114938	- 21948
	NOAHALI	579454	621804	- 90957	+ 52942	- 38015	+ 48607	- 42350
	CHITTAGONG	927475	894739	- 203292	+ 253053	+ 49761	+236028	+ 32736
	HILL TRACTS	102862	122373	- 31464	+ 12973	- 18491	+ 11953	- 19511

SOURCE

(1) Population & Gross Food Production Figures are from GOB, Statistical Year Book, 1982

NOTE

(1) Net Food Production + Gross Food Production - 10% for seed, feed & wastage.

(2) Internal Procurement = Assumed to be equal to Procurement/Net Domestic Production Ratio of 1978 as reported in World Bank Report (1979) Table 8.3, page 116.

(3) Public Distribution = Assumed to be equal to Distribution/Net Domestic Production Ratio of 1978 as reported by World Bank Report (1979). It is equal to Internal Procurement and Imports.

(4) Public Distribution (1) = No Allowance for "Dead Stock"

(5) Public Distribution (2) = Allowance of 150,000 tons for "Dead Stock"

(6) Actual Availability (1) = Net Food Production - Procurement & Public Distribution (1) i.e. Col. 7 = Col.3 - Col. 4 + Col. 5.

(7) Actual Availability (2) = Net Food Production - Procurement & Public Distribution (2). i.e. Col. 8 = Co.l 3 - Col. 4 + Col. 6

(8) Consumption Requirement = Population X 16 ozs. per Head per day.

(9) Production Gap = Net Food Production - Consumption Requirement
i.e. Col. 10 = Col. 3 - Col. 9
+ = Surplus; - = Deficit

(10) Additional Grain Arrival = Effect of PFDS.
Col. 11 = Col. (7 - 3) = Col. (5 - 4)
Col. 13 = Col. (8 - 3) = Col. (6 - 4)

(11) Availability Gap = Production Gap + Additional Grain Arrival
Col. 12 = Col. (10 + 11) = Col. (7 - 9)
Col. 14 = Col. (10 + 13) = Col. (8 - 9)

Appendix B

ESTIMATION OF INCOME ELASTICITY OF DEMAND FOR FOOD IN BANGLADESH

Three functional forms were used in the estimation of income elasticity of demand for food in Bangladesh. These were:

(1) $C = a_0 + b_0 Y.$

(2) $C = a_1 + b_1 \text{Ln } Y.$

(3) $\text{Ln } C = a_2 + b_2 \text{Ln } Y.$

where, C and Y are consumption and income respectively and Ln = natural logarithm. The parameters are represented by a's and b's.

Cross section data for 1963-64, 1965-66, 1968-69 are taken from Alamgir and Berlage (1973b). Household Expenditure Survey data for 1973-74 and 1976-77 are taken from GOB, Statistical Year Book, 1979 and 1982 respectively. Regressions results are reported in Table B.1.

TABLE B.1

Income Elasticity of Food

Functional Form	Estimates of 'b' 1976-77	Estimates of 'b' Pooled	Estimate of Elasticity 1976-77	Estimate of Elasticity Pooled data
1.	0.4543	0.3618	0.8118	0.9732
2.	321.84	178.49	0.6365	0.7168
3.	0.8030	0.7615	0.8030	0.7615

Note: 1976-77 = HES 1976-77 data.
Pooled = Pooled data as cited.

Source: Computer Results.

Arranging the estimates of income elasticities in ascending order we have the following array:

[0.64 ; 0.72 ; 0.76 ; 0.80 ; 0.81 ; 0.97].

Therefore, the median value of the above array is 0.78. The median (also the mean) value of income elasticity is taken to be 0.78 for Bangladesh.

B.1 ESTIMATION OF BASE YEAR FOOD DEMAND

The following Table B.2 shows the calculation of Base Year Food Demand, F_0.

TABLE B.2

Estimation of Base Year Demand F_0

YEAR	FOOD AVAIL.	9 YEAR M.A.	ADJUSTED M.A.
1971	10.178		
1972	11.850		
1973	12.317		
1974	12.410		
1975	12.987	12.39	
1976	11.420	12.95	12.88
1977	13.485	13.29	
1978	13.060		
1979	13.814		
1980	15.163		
1981	14.929		

Note: Figures are in million tons.
M.A. = moving average.

Source: From Table 2.11.

Appendix C

FORECASTING FOODGRAIN DEMAND (REQUIREMENT) IN BANGLADESH: AN APPLICATION OF UNIVARIATE BOX-JENKINS TIME SERIES MODEL

In Chapter III we generated forecasts for foodgrain demand in Bangladesh by using two formulas. These formulas essentially involved stochastic variables like population growth rate and income growth rate rendering the forecasts stochastic. The forecasts can be generally assumed to be realizations of jointly distributed random variables of some stochastic process.[48] In this section we are interested in identifying the underlying process that is supposed to have generated this particular realization, and then forecast future values with some accuracy, assuming the same mechanism continues to produce future observations.

At the beginning of a period, the unknown joint probability distribution, called the predictive distribution of foodgrain demand one period ahead, can possibly be estimated from the previous observation. It is assumed that foodgrain demand follows a normal univariate auto-regressive integrated moving average (ARIMA) process i.e., foodgrain demand is a linear function of only its past values and the present

---

[48] Process in time series is equivalent to population in classical statistics and realization is the sample counterpart.

and past values of a composite error. The composite error term is assumed to be normally, identically and independently distributed random variable with a zero mean a constant variance ("white noise"). In general the ARIMA model can be written as follows:

$$\phi(B)(1-B)^{d}\,Yt = \mu + \theta(B)\ at \qquad \text{A3.1}$$

where, Yt = food demand at time t;

B = backshift operator;

d = degree of difference;

$\phi(B)$ = autoregressive operator;

$\theta(B)$ = moving average operator;

μ = mean of the process; and

at = composite disturbance term.

Both $\phi(B)$ and $\theta(B)$ are polynomials in B such that

$$\phi(B) = 1 - \phi_1(B) - \phi_2(B^2) - \ldots - \phi p(B^{p}) \qquad \text{A3.2}$$

$$\theta(B) = 1 - \theta_1(B) - \theta_2(B^2) - \ldots - \phi q(B^{q}) \qquad \text{A3.3}$$

such that the roots of $\phi(.)$ lie outside the unit circle insuring the stationarity[49] of $(1-B)^{d}$ Yt; all of the roots of $\theta(.)$ lie outside the unit circle insuring invertibility of the process, and there is no common root of $\phi(.)$ and $\theta(.)$,

---

[49] Two types of non-stationarity are common in time series data namely: (1) non-stationary mean and (2) non-stationary variance. Non-stationary realizations which can be transformed into stationary series by differencing are called homogeneous non-stationarity. Series with non-stationary variance often require differencing (for obtaining stationary mean) as well as logarithmic transformation to induce stationarity.

which avoids parameter redundancy. These useful properties are discussed at length by Box and Jenkins (1976) and Pankratz (1983). The parameters p, d and q are integer-valued and represent the order of auto-regression, differencing and moving-average respectively and at is the composite error term assumed to be white noise. It should be noted that if Yt is homogeneous non-stationary then $(1-B)^d$ Yt, which is the dth difference of Yt is stationary.

With the assumptions specified above, it can be shown that Yt has a univariate normal distribution with mean as a function of all the past observations and covariance matrix [ ]. Both the mean and covariance matrix involve the unknown parameters of the model. The Non-Linear Least Squares (NLS) and the Maximum Likelihood Estimates of the model are obtained by using the SAS/ETS USER'S GUIDE (1982) subroutine PROC ARIMA.[50] The estimation of mean and variance for univariate time series is discussed by Box and Jenkins (1976). Their three steps of identification, estimation and prediction are followed precisely. As a check of the adequacy of the model, the Ljung-Box (1978) Q-statistic[51] is computed; it follows a Chi-Squared distribution with appropiate degrees of freedom.

---

[50] For computational details please refer to SAS/ETS USER'S GUIDE (1982:87-88).

[51] Originally Box-Pierce Q-Statistic was used. But Ljung-Box Q-statistic yields a better fit to the asymptotic Chi-Square distribution (SAS/ETS USER'S GUIDE;1982:88).

The mean of the predictive distribution is also the minimum mean-squared-error predictions. As a test of the adequacy of the model, these predictions are compared with their corresponding actual values. The estimation of the predictive distribution and the various adequacy tests are reported next.

C.1 IDENTIFICATION, ESTIMATION, PREDICTION AND ADEQUACY OF THE ARIMA MODEL

Data are yearly and extend from 1976 through 1999 as presented in Table 3.4 (Formula 1).[52] Gauss-Marquardt algorithm was used to generate the Maximum Likelihood Estimates of the parameters. We observed that the original data was homogeneously non-stationary (Figure C.1) but the first-differenced series was stationary (Figure C.2). Based on analysis of auto-correlation function (ACF), inverse auto-correlation function (IACF) and partial auto-correlation function (PACF), the following identification of the ARIMA (1,1,2) process is made:

$$(1-\phi_1 B)\ Xt = \mu + (1 - \theta_1 B - \theta_2 B^2)at \qquad \text{A3.4}$$

where, $Xt = (1 - B)Yt$

---

[52] We have 24 time series observations. According to SAS/ETS USER'S MANUAL (1982:77) "... there should be more than 30 observations and less than 2000. With fewer than 30, the parameters are not estimated very well." However, here we are interested in identifying the underlying stochastic process.

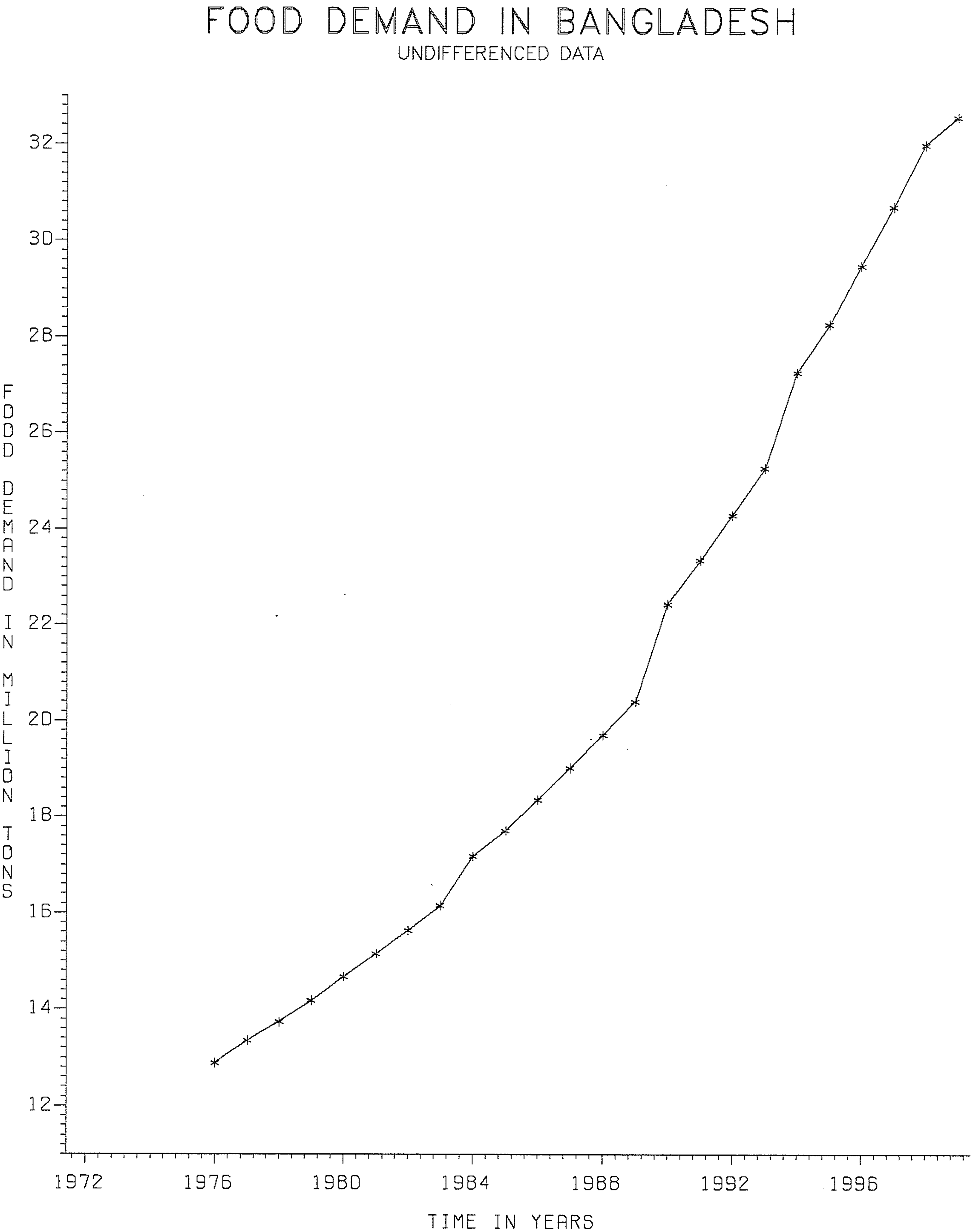

FOOD DEMAND IN BANGLADESH
UNDIFFERENCED DATA
FOOD DEMAND IN MILLION TONS
32
30
28
26
24
22
20
18
16
14
12
1972
1976
1980
1984
1988
1992
1996
TIME IN YEARS

FIGURE C.1

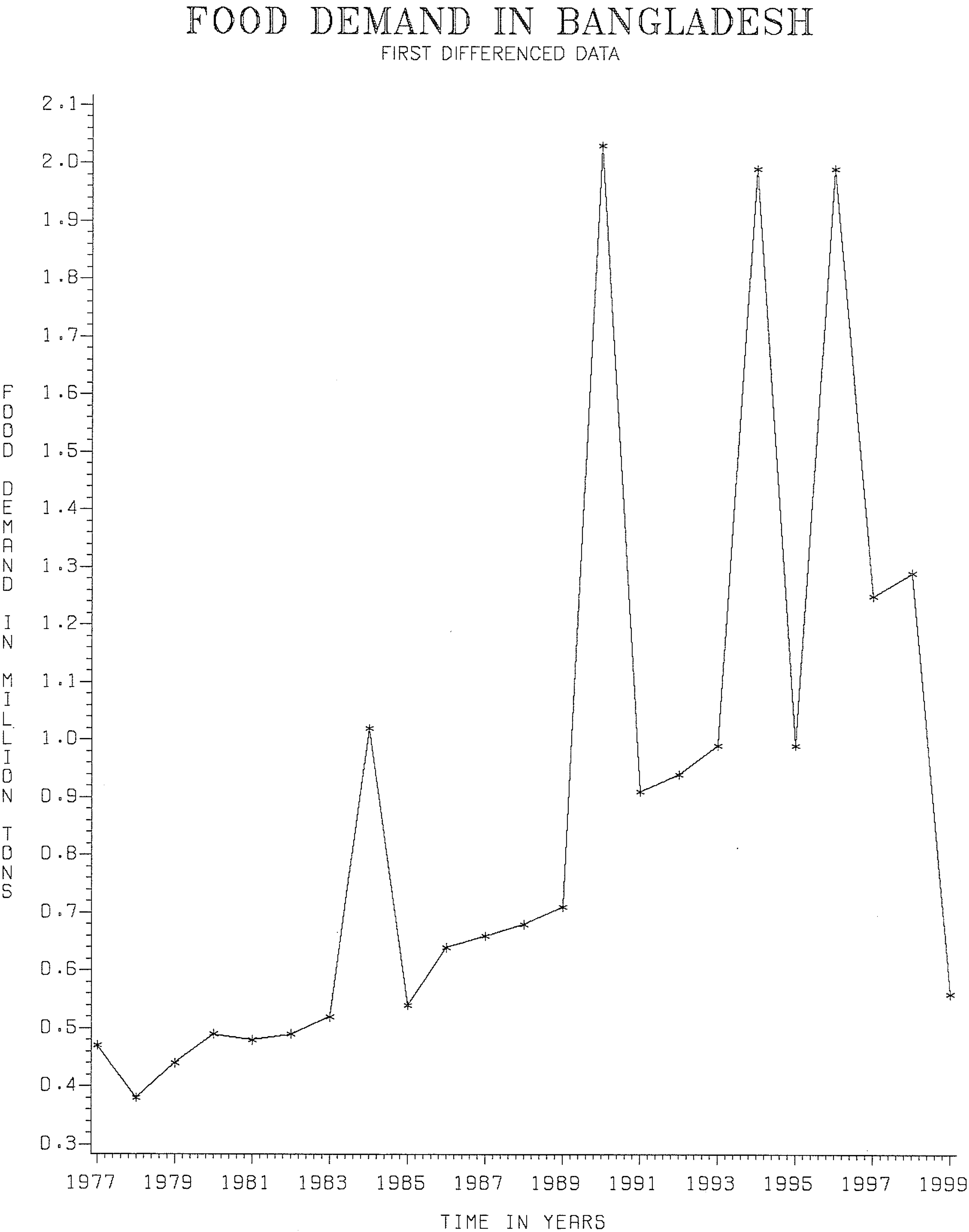

FOOD DEMAND IN BANGLADESH
FIRST DIFFERENCED DATA
FOOD DEMAND IN MILLION TONS
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
TIME IN YEARS

FIGURE C.2.

The estimated values of the parameters of equation A3.4 is given below:

$$(1 - 0.8804B)Xt = 0.8029 + (1- 0.9099B + 0.3175B^2)\ at \quad A3.5$$
$$(0.1911) \quad (0.2554) \quad (0.2991) \quad (0.2462)$$

Figures in parentheses under equation A3.5 are standard errors.

TABLE C.1

Correlation Matrix of the Estimates

	MU	MA1,1	MA1,2	AR1,1
MU	1.0			
MA1,1	0.262	1.0		
MA1,2	0.137	-0.278	1.0	
AR1,1	0.351	0.650	0.363	1.0

The correlation matrix of the estimates is shown in Table C.1. Table C.1 shows that there is a low degree of correlation between the estimated coefficients which suggests that the estimates are of high quality.[53]

[53] "....very high correlations between estimated coefficients suggest that the estimates may be of poor quality. When coefficients are highly correlated, a change in one

Estimation and Diagnostic Checking:

In Equation A3.5 we have estimated ARIMA (1,1,2). The coefficients μ, ϕ_1, θ_1, and θ_2 are well estimated and significant at 95 per cent confidence level except for θ_2 which is significant at the 80 per cent confidence level.
Stationarity requires that $\phi_1 < 1$, which is satisfied.
Invertibility requires that $\theta_1 + \theta_2 < 1$, which is also satisfied.
Thus, our estimated model ARIMA (1,1,2) conforms to the conditions of stationarity and invertibility which ensures the stability of the model.

Ljung-Box Chi-Squares test for residuals:

The null hypothesis for testing whether the residuals of the model are white noise can be written as follows:

Ho: $\rho_1(at) = \rho_2(at) = \rho_3(at) = \ldots\ldots = \rho k(at) = 0$

with test statistic,

---

coefficient can easily be offset by a corresponding change in another coefficient with little impact on the Sum Of Squares of Residuals. Thus, if estimated coefficients are highly correlated the final coefficient estimates depend heavily on the particular realization used; a slightly different realization could easily produce quite different estimated coefficients. If different realizations from the same process could easily give widely different estimated coefficients, the resulting estimates are of rather poor quality." Pankratz (1983:203).

$Q^* = n(n+2)\Sigma(n+k)^{-1}rk^2$ (at) ¬ Chi-Square with (k-m) degrees of freedom.

where, m = number of parameters estimated; k = number of lags; and rk = residual auto-correlation.

$Q^* = 12.22$ with 14 degrees of freedom. Since, Q^* is less than Q-tabulated we can accept the null hypothesis Ho that the residuals are white noise.

<u>Closeness of Fit: Root Mean Square Error.</u>

The Root Mean Squared Error (RMSE) of the model is 0.4289.

where, $RMSE = [\ \Sigma at^2/n]^{1/2}$

The adjusted $RMSE = [\ \Sigma at^2/(n-m)]^{1/2}$ where, m = number of parameters estimated.

The adjusted RMSE is useful for comparing competing models estimated from the same realizations. The adjusted RMSE in our model is 0.4719. Both the RMSE and the adjusted RMSE are low which suggests that the ARIMA (1,1,2) model fit the available data very closely and most of the statistical "noise" has been removed with ARIMA (1,1,2). This is absolutely essential for producing efficient forecasts to which we turn our attention now.

C.2 FORECASTING FOOD DEMAND (REQUIREMENT) IN BANGLADESH WITH ARIMA (1,1,2)

Having identified the ARIMA (1,1,2) model, our ultimate task is to forecast future values of foodgrain demand (requirement) for Bangladesh. This is shown in Table C.2. Forecasts from ARIMA models are said to be optimal forecasts. This means that no other univariate forecasts have a smaller mean squared error (MSE).[54] This is easily substantiated by the very low values of root mean squared error (RMSE) and adjusted root mean squared error (ARMSE) obtained in the previous section.

The forecast values are shown in Table C.2 and in Figure C.3 and the forecasts lie within the 95 per cent confidence band. The forecasts suggest that food demand in Bangladesh will grow approximately 200 per cent by the year 2000 compared to the benchmark period of 1980. Obviously, it must be borne in mind that ARIMA forecasts are specially appropiate for short and medium-term forecasting, because ARIMA models place heavy emphasis on the recent past rather than the distant past. Therefore, forecasts that we have made must be judged cautiously. Nevertheless, these forecasts, at least, gives us an idea about the trend and direction of the movement in the series with subsidiary emphasis on the magni-

---

[54] Box-Jenkins (1976;127-28) demonstrate that the ARIMA forecast is the minimum MSE forecast and the robustness of ARIMA forecast with respect to sampling error in parameter estimates is discussed by Box-Jenkins (1976;306-8).

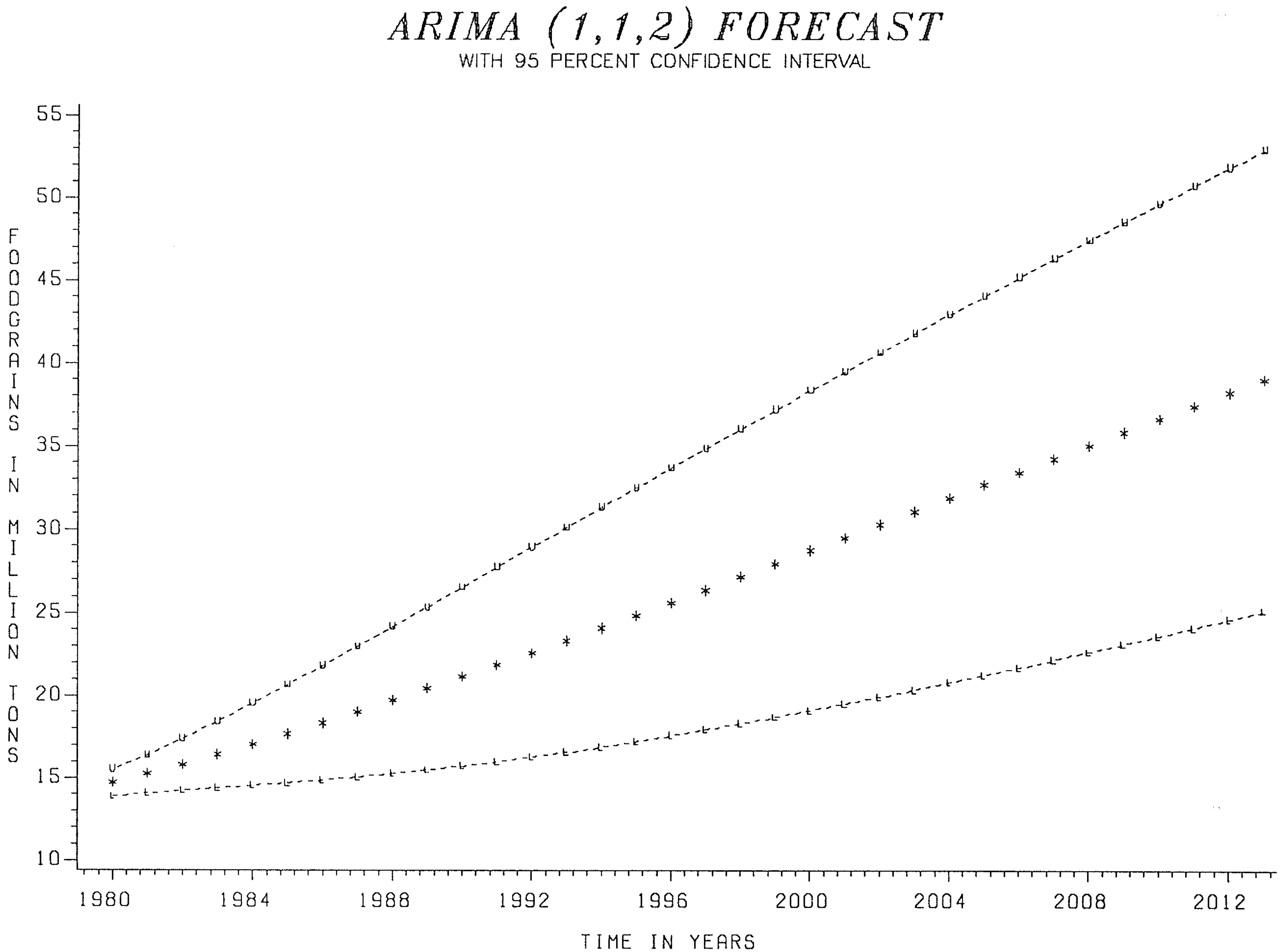
TABLE C.2

Forecasts for Food Demand in Bangladesh: ARIMA (1,1,2)

YEAR	ACTUAL	FORECAST	RESIDUAL	95% CONFIDENCE LIMITS	
				LOWER	UPPER
1980	14.66	14.71	-0.05	13.87	15.55
1981	15.14	15.25	-0.11	14.08	16.42
1982	15.63	15.82	-0.19	14.24	17.40
1983	16.15	16.42	-0.27	14.38	18.45
1985	17.17	17.04	0.13	14.53	19.54
1986	17.71	17.68	0.03	14.69	20.67
1986	18.35	18.34	0.01	14.86	21.83
1987	19.01	19.02	-0.01	15.05	22.99
1988	19.69	19.72	-0.03	15.26	24.18
1989	20.40	20.43	-0.03	15.49	25.36
1990	22.43	21.14	1.29	15.73	26.56
1991	23.34	21.87	1.47	15.99	27.75
1992	24.28	22.61	1.67	16.28	28.94
1993	25.27	23.36	1.91	16.58	30.14
1994	27.26	24.11	3.15	16.89	31.32
1995	28.25	24.87	3.38	17.22	32.51
1996	29.44	25.63	3.81	17.57	33.69
1997	30.69	26.40	4.29	17.93	34.87
1998	31.98	27.17	4.81	18.30	36.04
1999	32.54	27.95	4.59	18.69	37.21
2000		28.73		19.09	38.37
2001		29.51		19.50	39.52
2002		30.29		19.92	40.67
2003		31.08		20.35	41.81
2004		31.87		20.79	42.95
2005		32.66		21.24	44.08
2006		33.45		21.70	45.20
2007		34.24		22.17	46.32
2008		35.04		22.64	47.44
2009		35.84		23.12	48.55

Note: Forecasts and Confidence Intervals are rounded to two decimal places.
Actual = Formula 1 values in Table 3.8.

Figures are in million tons.



STAR DENOTES FORECASTS
DASHED LINES DENOTE CONFIDENCE BANDS
FIGURE C.3.

tude.

Appendix D

ANALYSIS OF THE MARKET DEMAND FOR FOOD IN BANGLADESH

The structural demand equation (4.8) was estimated through the reduced form equation (4.7). Both equations (4.8) and (4.7) were statistically unsatisfactory for the reasons outlined in the text, notably that the parameters had large standard errors compared to the coefficient value because of the presence of multi-collinearity among the regressor variables. Nevertheless, demand forecasts based on equation (4.8) can still be made and this is shown in Table D.1.

TABLE D.1

Foodgrain Demand Forecasts under Alternative Price Regimes

EAR	Y GROWTH			FOODGRAIN DEMAND				
		P = 0	P = 10	P = 20	P = 30	P = 40	P = 50	P = 100
976	0.00	10.55	10.05	9.55	9.05	8.56	8.06	5.57
977	4.00	11.52	11.01	10.50	9.90	9.48	8.97	6.43
978	3.50	11.70	11.18	10.66	10.13	9.61	9.09	6.49
979	3.50	11.97	11.44	10.90	10.37	9.84	9.30	6.64
980	3.60	12.27	11.73	11.18	10.63	10.09	9.54	6.81
981	3.60	12.54	11.98	11.43	10.87	10.31	9.75	6.96
982	3.60	12.82	12.25	11.68	11.11	10.54	9.97	7.12
983	4.08	13.20	12.62	12.03	11.45	10.87	10.28	7.37
984	4.08	13.49	12.89	12.30	11.70	11.10	10.51	7.53
985	4.69	13.80	13.20	12.60	11.99	11.39	10.76	7.77
986	4.69	14.16	13.54	12.92	12.31	11.69	11.07	7.97
987	4.69	14.44	13.81	13.17	12.54	11.91	11.28	8.12
988	4.69	14.72	14.07	13.43	12.78	12.14	11.50	8.28
989	4.96	15.06	14.40	13.75	13.09	12.43	11.78	8.50
990	4.96	15.34	14.67	14.01	13.34	12.67	12.00	8.66
991	4.96	15.62	14.94	14.26	13.58	12.90	12.22	8.82
992	4.96	15.89	15.20	14.51	13.82	13.12	12.43	8.97
993	4.96	16.18	15.47	14.77	14.06	13.36	12.65	9.13
994	4.83	16.42	15.70	14.99	14.27	13.55	12.84	9.25
995	4.83	16.69	15.96	15.24	14.51	13.78	13.05	9.41
996	4.83	16.96	16.22	15.48	14.74	14.00	13.26	9.56
997	4.83	17.21	16.46	15.71	14.96	14.21	13.46	9.70
998	4.83	17.49	16.73	15.96	15.20	14.44	13.67	9.86
999	4.83	17.77	16.99	16.22	15.44	14.67	13.89	10.01

ote: Y Growth = Per Capita Real Income Growth (per cent).
P = (.) denotes price level change per annum (per cent).
Foodgrain Demand (million tons).

ource: Calculated from Equation (4.8) [Model using time series only].

BIBLIOGRAPHY

Abdullah, A.A. *et al*. (1976) "Agrarian Structure and IRDP: Preliminary Considerations," *Bangladesh Development Studies*, Vol.IV(2) pp.209-266.

Abdullah, M. *et al*. (1978) "Prevalence of Dietary Inadequacy in Energy and Protein in Rural Bangladesh," *Bangladesh Development Studies*, Vol.VI(3) pp.323-330.

Agricultural Development Council (ADC) (1981) *Food Aid and Development*. New York.

Ahluwalia, I.J. (1979) "An Analysis of Price and Output Behaviour in the Indian Economy: 1951-1973," *Journal of Development Economics*, Vol.6 pp.363-390.

Ahmed, E. (1981) "Strategy of Growth and Rural Development in Bangladesh," *Asian Studies*, Vol.3(1) pp.11-36.

Ahmed, R. (1979) "Foodgrain Supply, Distribution and Consumption Policies with a Dual Pricing System: A Case Study of Bangladesh," *IFPRI Research Report No.8*. Washington D.C.

Ahmed, R.(1978) "Public Foodgrain Distribution and Poverty in Bangladesh," *The Bangladesh Journal of Agricultural Economics*, Vol.1(2) pp.1-19.

Ahmed, S. (1979) "Self-sufficiency in Foodgrain," *Political Economy*, Vol.4(1) pp.221-224.

Alamgir, M. (1980) *Famine in South Asia: Political Economy of Mass Starvation*. Oelgeschlager, Gunn & Hain, Publishers, Inc. Cambridge, Massachusetts.

Alamgir, M. (1978) *Bangladesh: A Case of Below Poverty Level Equilibrium Trap*. Dacca: BIDS.

Alamgir, M. (1975) "Some Aspects of Bangladesh Agriculture: Review of Performance and Evaluation of Policies," *Bangladesh Development Studies*, Vol.III(3) pp.261-300.

Alamgir, M. and Berlage, L.J.J.B. (1973a) "Foodgrain (Rice & Wheat) Demand, Import and Price Policy for Bangladesh," *Bangladesh Economic Review*, Vol.I(1) pp.25-28.

Alamgir, M. and Berlage, L.J.J.B. (1973b) "Estimation of Income Elasticity of Demand for Foodgrain in Bangladesh from Cross-section Data: A Skeptical View," Bangladesh Economic Review, Vol.I(4) pp.387-408.

Asian Development Bank (ADB) (1977) Rural Asia: Challenge and Opportunities. Federal Publication, Singapore.

Beringer, C. and Ahmad, I. (1964) The Use of Agricultural Surplus Commodities for Economic Development in Pakistan. Karachi: Institute of Development Economics.

Bose, S.R. (1972) "Foodgrain Availability and Possibility of Famine in Bangladesh," Economic and Political Weekly, Annual No. pp.293-306.

Boserup, E. (1965) The Conditions of Agricultural Growth. George, Allen and Unwin, London.

Box, G.E.P. and Jenkins, G.M. (1976) Time Series Analysis: Forecasting and Control, Second Edition. San Francisco: Holden-Day.

Brundin, H. (1978) Food for Work Saturation and Constraints to Expansion Study. USAID: Dacca.

Burki, S.J. et al. (1976) Public Works in Developing Countries: A Comparative Analysis. IBRD Staff Working Papers, No.224.

Cramer, J.S. (1971) Empirical Econometrics. North-Holland Publishing Company, Amsterdam.

Chen, L.C. (1975) "An Analysis of Per Capita Foodgrain Availability, Consumption and Requirements in Bangladesh: A Systematic Approach to Food Planning," Bangladesh Development Studies, Vol.III(2) pp.93-126.

Chen, L.C. and Chaudhury, R.H. (1975) "Demographic Change and Food Production in Bangladesh, 1960-74," Population and Development Review, Vol.1(2) pp.201-227.

Chowdhry, M.K.A. (1981) Demand for Labour in Bangladesh Agriculture. Unpublished M.Ec. Dissertation. University of New England, Armidale, Australia.

Clay, E.J. (1979) Food Aid and Economic Development of Bangladesh. Discussion Paper no.147, IDS, U of Sussex.

Clay, E.J. (1978) "Food Aid and Food Policy in Bangladesh," The Bangladesh Journal of Agricultural Economics, Vol.1(2) pp.107-20.

Clay, E.J. and Khan, M.S. (1977) Agricultural Employment and Underemployment in Bangladesh: The Next Decade. Bangladesh Agricultural Research Council, Dacca.

Clay, E.J. and Pryer, J. (1982) Food Aid Issues and Policies. Discussion Paper No. 183, IDS, U of Sussex.

Clay, E.J. et al. (1981) Food Policy Issues in Low Income Countries. World Bank Staff Working Paper No. 473, Washington D.C.

Coale, A.J. and Hoover, E.M. (1958) Population Growth and Economic Development in Low Income Countries. Princeton, N.J.: Princeton University Press.

Durbin, J. (1953) "A Note on Regression When There is Extraneous Information About One of the Coefficients," American Statistical Association Journal, Vol.48 pp.799-808.

Eberstadt, N. (1980) "Recent Declines in Fertility in LDC's and What Population Planners Can Learn From Them," World Development, Vol.8(1) pp.37-60.

El Ghonemy, M.R. et al. (1984) Studies on Agrarian Reform and Rural Poverty. FAO Economic and Social Development Series No. 27. FAO, Rome.

ESCAP (1981) Population of Bangladesh: Country Monograph Series No. 8. United Nations: New York.

Faaland, J. (ed) (1981) Aid and Influence: The Case of Bangladesh. Macmillan Press Ltd., London.

Faaland, J. and Parkinson, J.R. (1978) Bangladesh: The Test Case of Development. Dacca: University Press Ltd.

FAO/UN (1964) The linking of Food Aid with Other Aid. Rome: FAO.

FAO/UN (1966) Use of Agricultural Surpluses to Finance Economic Development in Under-developed Countries. Rome: FAO

FAO (1983) FAO Trade Year Book. Vol.37. FAO: Rome.

Fisher, F.M. (1963) "A Theoretical Analysis of the Impact of Food Surplus Disposal on Agricultural Production in Recipient Countries," Journal of Farm Economics, Vol.45 pp.863-75.

Fox, K. (1968) Intermediate Economic Statistics. John Wiley and Sons, New York.

Frank, A.G. (1966) "The Development of Underdevelopment," _Monthly Review_, Vol.18(4) pp.17-31.

Geary, R.C. (1963) "Some Results about Relations between Stochastic Variables: A discussion Document," _Review of International Statistical Institute_, Vol.31 pp.163-81.

Girshick, M.A. and Haavelmo, T. (1947) "Statistical Analysis of the Demand for Food: Examples of Simultaneous Estimation of Structural Equation," _Econometrica_, Vol.15 pp.79-110.

Goldberger, A.S. (1964) _Econometric Theory_. John Wiley and Sons, New York.

Goreux, L.M. (1960) "Income and Food Consumption," _FAO Monthly Bulletin_, No.9.

Government of Bangladesh (GOB) _Statistical Year Book, 1982_. Dhaka, Bangladesh.

Government of Bangladesh (GOB) _Statistical Year Book, 1980_. Dhaka, Bangladesh.

Government of Bangladesh (GOB) _Statistical Year Book, 1979_. Dhaka, Bangladesh.

Gupta, D.A. and Roy, S.G. (1976) "Population Estimates for Bangladesh: The Use of Specific Transitional Population Model," _Population Studies_, Vol.30(1) pp.15-34.

Hamid, M.A. (1980) "Foodgrain Demand Supply Projections: Bangladesh 1978-2000," _The Bangladesh Development Studies_, Vol.VIII(1,2) pp.169-185.

Hoff, J.C. (1983) _A Practical Guide to Box-Jenkins Forecasting_. Lifetime Learning Publications. Belmont, California.

Hossain, M. (1980) "Foodgrain Production in Bangladesh: Performance, Potential and Constraints," _Bangladesh Development Studies_, Vol.VIII(1,2) pp.39-70.

Huq, S. (1968) _Demand for Food in Pakistan 1965-85_. United Bank Limited, Research Monographs, No.1.

International Food Policy Research Institute (IFPRI) (1980) _Food Needs of Developing Countries: Projections of Production and Consumption to 1990_. Research Report No.3, Washington D.C.

International Monetary Fund (IMF) (1984) _Government Finance Statistics Year Book_. Vol.VIII. IMF, Washington D.C.

Isenman, P.J. and Singer, H. (1977) "Food Aid: Disincentive Effects and their Policy Implications," Economic Development and Cultural Change, Vol.25(2) pp.205-237.

Islam, A.M. and Ahsan, E. (1976) Population Food Imbalance and Food Self-Sufficiency Strategy for Bangladesh for 2000 A.D. (Part I) Agricutural Economics and Social Science Paper No.7, Dacca: BARC.

Islam, N. (1978) Development Strategy of Bangladesh, Pergamon Press, London.

Islam, N. (1977) Development Planning in Bangladesh: A Study in Political Economy. C. Hurst and Company, London.

Islam, R.(1979) "What Has Been Happening to Rural Income Distribution in Bangladesh," Development and Change, Vol.10 pp.385-401.

Islam, R. (1980) "Foodgrain Procurement, Input Subsidy and Public Food Distribution System in Bangladesh: An Analysis of Policy Packages," The Bangladesh Development Studies, Vol.VIII(1,2) pp.89-120.

Johnston, B.F. and Mellor, J.W. (1961) "The Role of Agriculture in Economic Development," American Economic Review, Vol.51 p.566-593.

Johnston, B.F. and Southworth, H.M. (1967) "Agricultural Development: Problems and Issue," Johnston, B.F. and Southworth, H.M. (ed) Agricultural Development and Economic Growth. Cornell University Press, Ithaca, New York.

Jones, D.B. and Tulloch, P. (1974) "Introduction: Is Food Aid Good Aid," ODI Review, Vol.(2) pp.1-6.

Khan, A.R. (1972) The Economy of Bangladesh. Macmillan, London.

Khan, A.R. (1977) "Poverty, and Inequality in Bangladesh," in Griffin et al.(eds) Poverty and Landlessness in Rural Asia. Geneva: ILO.

Khan, M.I. (1970) "Demand for Food in Pakistan in 1975," Pakistan Development Review, Vol.10(3) pp.310-333.

Khatkhate, D.R. (1962) "Some Notes on the Real Effects of Foreign Surplus Disposal in Under-developed Economies, Quarterly Journal of Economics, Vol.76 pp.186-196.

Khusro, A.M. (1967) "The Price of Food in India," Quarterly Journal of Economics, Vol.81 pp.271-85.

Klein, L.R. and Nakamura, M. (1962) "Singularity in the Equation Systems of Econometrics: Some Aspects of the Problem of Multicollinearity," International Economic Review, Vol.3(3) pp.274-99.

Lancaster, K. (1966) "A New Approach to Consumer Theory," Journal of Political Economy, Vol.84 pp.132-57.

Lappe, F.M. & Collins, J. (1977) Food First: Beyond the Myth of Scarcity. Boston: Houghton Mifflin Co.

Levenson, R. et al. (1979) "A Missing Dimension of Food and Nutrition Policy in Bangladesh," The Bangladesh Development Studies, Vol.VII(1) pp.99-106.

Lewis, W.A. (1954) "Economic Development with Unlimited Supplies of Labour," The Manchester School, Vol.22(155) pp.139-191.

Ljung, G.M. and Box, G.E.P. (1978) "On a Measure of Lack of Fit in Time Series Models, Biometrika, Vol.65 p297.

Malinvaud, E. (1970) Statistical Methods of Econometrics. Second Edition. North-Holland Publishing Company, Amsterdam.

Mann, J.S. (1967) "The Impact of PL 480 Imports on Prices and Domestic Supply of Cereals in India," Journal of Farm Economics, Vol.49 pp.131-46.

Maxwell, S. and Singer, H . (1979) "Food Aid to Developing Countries: A Survey," World Development, Vol.7 pp.225-247.

McHenry, D.F. and Bird, K. (1977) "Food Bungle in Bangladesh," Foreign Policy, Summer, pp.72-88.

Mahmud, W. (1979) "Foodgrain Demand Elasticities of Rural Households in Bangladesh--- An Analysis of Pooled Cross Section Data," The Bangladesh Development Studies, Vol.VII(1) pp.59-70.

Mellor, J.W. (1980) "Food Aid and Nutrition," American Journal of Agricultural Economics, Vol.62(5).

Mellor, J.W. (1978) "Food Price Policy and Income Distribution in Low Income Countries," Economic Development and Cultural Change, Vol.27 pp.1-26.

Mellor, J.W. (1966) The Economics of Agricultural Development. Ithaca: Cornell University Press.

Muqtada, M. (1981) "Poverty and Famines," Bangladesh Development Studies, Vol.9(1) pp.1-34.

National Council of Applied Economic Research (1967) All India Consumer Expenditure Survey. New Delhi, India.

Nelson, G.O. (1983) "Food Aid and Agricultural Production in Bangladesh" IDS Bulletin, Vol.14(2).

Nelson, G.O. (1981) "Macroeconomic Dimension of Food Aid," in Food Aid and Development. ADC, New York.

Newman, B. (1981) "Bangladesh Food for Work Drive is Good on Paper, not in Practice," Asian Wall Street Journal, April 28, pp.1-7.

Newman, B. (1981) "Touted Food Glut in Bangladesh is Just an Illusion, Asian Wall Street Journal, April 27, pp.1-5.

Pak, K.H. and Hau, K.C. (1969) An Analysis of Food Consumption in the Republic of Korea. Seoul: Honsei University.

Parkinson, J. (1981) "Food Aid" in Faaland, J.(ed) Aid and Influence. London: Macmillan Press Ltd.

Pankratz, A. (1983) Forecasting with Univariate Box-Jenkins Models: Concepts and Cases. John Wiley and Sons, New York.

Pindyck, R.S. and Rubinfeld, D.L. (1981) Econometric Models and Economic Forecasts. Second Edition. McGraw Hill, New York.

Pray, C.E. (1980) "An Assessment of the Accuracy of the Official Agricultural Statistics of Bangladesh," Bangladesh Development Studies, Vol.VIII(1,2) pp.1-38.

Rempel, H. (1985) "Food Security Options for Sub-Saharan Africa," Departmental Staff Seminar Paper. University of Manitoba.

Reutlinger, S. and Selowsky, M. (1976) Malnutrition and Poverty. World Bank Occasional Staff Paper No. 23, World Bank, Washington D.C.

Reutlinger, S. (1977) "Malnutrition: A Poverty or a Food Problem," World Development, Vol.5(8) pp.715-724.

Reutlinger, S. (1978) "Food Insecurity: Magnitudes and Remedies." World Development, Vol. 6(6) pp.797-811.

Rogers, K.D. et al. (1972) "Modified Price, Production and Income Impacts of Food Aid under Market Differentiated Distribution," American Journal of Agricultural Economics, Vol.54 pp.201-8.

Rothschild, E. (1976) "Food Politics," Foreign Affairs, Vol.54(2) pp.285-307.

Ray, S.K. (1971) "Foodgrain Demand and Supply --- Projection of Regional Imbalances," Economic and Political Weekly, June 26 pp.A59-A74.

SAS Institute Inc. (1982) SAS/ETS USER'S GUIDE. Cary, NC.

Schneider, H. (1975) The Effect of Food Aid on Agricultural Production in Recipient Countries --- An Annotated Select Bibliography. OECD, Paris.

Schuh, G.E. (1981) "Food Aid and Human Capital Formation," in Food Aid and Development, ADC, New York.

Sen, A.K. (1977) Issues in the Measurement of Poverty. Working Paper, ILO, Geneva.

Sen, A.K. (1980) "Famines," World Development, Vol.8(9) pp.613-621.

Sen, A.K. (1981a) "Ingredients of Famine Analysis: Availability and Entitlements," Quarterly Journal of Economics, Vol.96 pp.433-464.

Sen, A.K. (1981b) Poverty and Famines: An Essay on Entitlement and Deprivation. Oxford University Press, New York.

Sen, S.R. (1971) "Whither Aid." American Journal of Agricultural Economics, Vol. 53(5) pp.768-776.

Sen, S.R. (1960) "Impact and Implication of Foreign Surplus Disposal on Under-Developed Economies --- The Indian Perspective," Journal of Farm Economics, Vol.42(5) pp.1031-1042.

Shenoy, B.R. (1974) PL 480 Aid and India's Food Problem. Affiliated East-West Press Pvt. Limited, New Delhi.

Shupack, M. (1962) "The Predictive Accuracy of Empirical Demand Analysis," Economic Journal, Vol.72(287) pp.550-575.

Shultz, T.W. (1960) "Value of US Farm Surpluses to Under-Developed Countries," Journal of Farm Economics, Vol.42 pp.1019-1030.

Siamwalla, A. and Valdes, A (1980) "Food Insecurity in Developing Countries," Food Policy, Vol.5(4) pp.258-272.

Sinha, R. (1984) Landlessness: A Growing Problem. FAO Economic and Social Development Series No.28. FAO, Rome.

Sobhan, R. (1979) "Politics of Food and Famine in Bangladesh," Economic and Political Weekly, Vol.14(48) pp.1975-1980.

Srivastava, U. et al. (1975) Food Aid and International Economic Growth. Iowa State University Press.

Stepanek, J.E. (1978) Bangladesh --- Equitable Growth? Pergamon Press, London.

Stevens, C. (1979) Food Aid and the Developing World: 4 African Case Studies. Croom Helm, London.

Stevens, R.D. (1965) Elasticity of Food Consumption Associated with Changes in Income in Developing Countries. Foreign Agricultural Economic Report 23. Washington: USDA.

Stone, R. (1945) "The Analysis of Market Demand," Journal of the Royal Statistical Society, Vol.108 pp.286-382.

Stone, R. (1948) "The Analysis of Market Demand: An Outline of Methods and Results," Review of the International Statistical Institute, Vol.16(1) pp.23-34.

Tagle, M.A. (1980) "Operational Conflicts of Food Aid at the Recipient Level: Those who know don't Plan and Those who Plan don't Know," Food and Nutrition Bulletin, Vol.2(3) pp.5-15.

Taylor, L. (1975) "The Misconstrued Crisis: Lester Brown and World Food," World Development, Vol.3(11,12) pp.827-837.

Thomas, V. (1980) "Regional Differences in Foodgrain Production and Distribution in Bangladesh," Bangladesh Development Studies, Vol.VIII(4) pp.93-105.

Timmer, C.P. et al. (1983) Food Policy Analysis. The Johns Hopkins University Publication, Baltimore.

Tobin, J. (1950) "A Statistical Demand Function for Food in the USA," Journal of the Royal Statistical Society, Vol.113 pp.113-140.

UNESCO (1975) Population: Quality of Life Themes, Population Education in Asia: A Source Book. No.4, Bangkok.

Valdes, A. (ed.) (1981) Food Security for Developing Countries. Westview Press, Boulder, Co.

Vylder, S.D. (1982) Agriculture in Chains: Bangladesh, A Case Study in Contradiction and Constraints. Vikas, New Delhi.

Wold, H. (1953) Demand Analysis. John Wiley and Sons, New York.

World Bank (1979) Bangladesh Food Policy Issues. Report No.2761-BD, Washington D.C. South Asia Program Department.

World Bank (1981) Commodity Trade and Price Trends. Johns Hopkins University Press, Baltimore.

World Bank (1983) World Tables. Vol. I and II. Johns Hopkins University Press, Baltimore.