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Price Stabilization for Raw Jute in Bangladesh

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and
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The costs of the present system of price stabilization of raw jute by Bangladesn's public sector do not yield the expected benefits. Price stabilization could be better handled by the private sector. In any case, the loss of welfare to jute growers from price fluctuations is small.

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This paper — a product of the International Trade Division, International Economics Department — is part of a larger effort in the Department to address issues of price and income stabilization in primary commodities. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Dawn Gustafson, room S7-047, extension 33714 (49 pages). December 1991.

Fluctuating prices for raw jute have been viewed as contributing to economic problems in the jute subsector. Price fluctuations were thought to reduce the jute farmers' welfare and there has been concern about the costs of parastatals' stocking operations in attempts to stabilize jute prices and incomes.

Akiyama and Varangis examine the causes and consequences of these fluctations and analyze policies that might reduce them. They find that price fluctuations for raw jute reduce farmers' welfare only slightly because farmers' activities are typically diversified and jute's share in total income is small.

Although stocking operations by the parastatals contribute to stability in prices and real income, they have been extremely costly and have crowded out private stocking. Akiyama and Varangis contend that if the parastatals had refrained from ad hoc stocking and if the private sector had stocked efficiently, jute prices and incomes would have been just as stable — and at no cost.

They argue that the Bangladeshi jute market should be free of government intervention and that Bangladesh should establish a market-based credit system that allows efficient stockholding behavior by the private sector.

Akiyama and Varangis also found that improving the flow of market information to farmers and greater price responsiveness by jute mills to raw jute purchases would significantly improve the stability of raw jute prices and incomes. Having more information available would also make private stocking operations more efficient.

TABLE OF CONTENTS

PRICE STABILIZATION FOR RAW JUTE IN BANGLADESH

by: Takamasa Akiyama and Panos Varangis *

World raw jute prices historically have fluctuated widely. This has been a matter of great concern in Bangladesh and is believed to be an important contributor to a number of economic problems in the jute sub-sector. These perceived problems include a reduction in jute farmers' welfare, erosion of the international competitiveness of raw jute and of jute goods against synthetics, the huge costs associated with stocking operations of the parastatals, the Bangladesh Jute Mill Corporation (BJMC) and the Bangladesh Jute Corporation (BJC), and the large losses incurred by almost all the Bangladesh jute mills.

The focus of the present paper is an analysis of the causes of raw jute price fluctuations and policies that can be taken to reduce them. The first section gives a brief description of the jute market in Bangladesh. The second section examines the extent, causes and consequences of raw jute price instability. The third section describes the jute model used for the analysis. Section four uses the econometric model for the jute market to simulate several policies aiming at stabilizing jute prices. The final section concludes.

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I. STRUCTURE OF THE JUTE MARKET IN BANGLADESH

Detailed descriptions of the world jute market are given in several papers, including Thigpen and Akiyama (1986) and Thigpen, Marongiu and Lasker (1987), so only those comments specifically relevant to the Bangladesh jute sector are given here.

Jute is an important cash crop to farmers in Bangladesh and in the Northwestern states of India. According to the 1983/84 Bangladesh Census of Agriculture and Livestock, more than 3 million farm households receive cash income from jute which accounts for about 5-7% of their total income. Jute competes with rice for land at the growers' level and the price ratio of jute to rice is found to be the key factor affecting jute growers' decisions to allocate land to growing jute. Based on the agricultural calendar and statistical analysis, the boro rice is considered to be the more important competitor. All jute in Bangladesh is grown by smallholders who are diversified in jute, rice and vegetables. Jute does not compete with rice in some upland areas and in low areas. While jute yields are largely determined by weather events, they also respond to planting period fertilization, weeding, thinning, and post-emergence fertilization. Climatic effects of significance include lack of rain in the sowing period and flooding in the post-emergence period of June to September. There are two major types of jute growing in Bangladesh: white and tossa. Because tossa cannot survive flooding, and white jute is a less valuable crop, white jute is grown on low lands which are the more susceptible to flooding. Finally, adequate water supply for retting is essential for quality fiber production. Both jute types are grown throughout Bangladesh but the district-level mix varies considerably. Tossa retains its high quality during bumper years, while white jute quality declines as yield increases. This physical characteristic implies that tossa prices decline less than white jute prices in bumper years.

An important characteristic of the raw jute market in Bangladesh is its close relationship with that in India. Annex Table 1 shows raw jute prices, rice prices and their ratios in the two countries. For the period 1973/74-1988/89, the correlation coefficient for the ratios of raw jute prices to rice prices in the two countries is found to be 0.83; the correlation between raw jute prices (expressed in US dollars[1]) in the two countries is 0.90; while the correlation between production in Bangladesh and India is 0.85. These high correlation coefficients suggest that the raw jute markets of the two countries are integrated and that the extent of arbitrage is such that raw jute prices in the two countries are simultaneously determined and do not diverge much.

Two major components of raw jute demand in Bangladesh are exports and mill consumption (see Annex Table 2). Mill demand comes from BJMC, the Bangladesh Jute Mill Corporation (BJMC), the Bangladesh Jute Mill Association (BJMA) and the Bangladesh Jute Spinners' Association (BJSA). BJMC is a parastatal and constitutes about two-thirds of the weaving capacity. BJMA is an association of privately-owned mills. They were previously part of BJMC but were returned to their previous owners in 1982. BJSA mills are also privately-owned and mainly produce jute yarn for exports.

Jute mills process raw jute into jute goods. The main jute goods produced and exported are sacking, hessian and carpet backing (see Annex Table 3). About 90% of the jute goods produced are exported. Bangladesh's jute goods exports compete with those of India and other jute goods exporting countries and with synthetics. Bangladesh's jute goods prices usually have been lower than those of India and as a result Bangladesh has succeeded in capturing jute goods market shares from other countries, especially from India (see Section III for more details).

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[1] Discussions with jute traders in Bangladesh suggest that the black market exchange rates between the Bangladeshi Taka and Indian Rupee have been close to the official exchange rate.

II. CAUSES AND CONSEQUENCES OF RAW JUTE PRICE INSTABILITY

The extent, causes and consequences of raw jute price instability have been the subject of controversy and have been extensively analyzed.[2] These issues are examined here mainly by applying statistical and econometric techniques to recent data for jute and jute goods of Bangladesh, India and elsewhere.

II.1. Causes of Raw Jute Price Instability in Bangladesh

Although there are several methods for measuring instability the coefficient of variation (CV) around the time trend is used exclusively in this paper. Not only is the CV a widely used measure of instability but it is an important statistic that relates directly to the benefits or welfare gains from price stabilization schemes.

From the point of view of jute growers and jute supply in Bangladesh, the relevant measure of instability is the fluctuation of the ratio of jute to rice prices. This ratio has fluctuated much more widely (roughly twice) than raw jute export prices in US dollars. It was also found that tossa jute prices are significantly less volatile than white jute prices.

Wide fluctuations in agricultural commodity prices from year to year are usually due to fluctuations in supply caused by weather variations, which, given the low short-term elasticities of demand and supply, generate large price changes. Additional factors causing price fluctuations are wide fluctuations in demand and poor price expectations by farmers.

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[2] Some studies on the subject include Rahman (1981) and studies associated with the Integrated Program for Commodities of UNCTAD in the second half of the 1970s.

(i) Weather

Floods and droughts occur pericdically in Bangladesh and they cause substantial reductions in jute output. In recent years, abnormal weather reduced jute supply in a significant way in the 1984/85 and 1988/89 seasons. [3] These reductions in supply, in turn, caused both domestic and international prices to increase sharply. Statistical analysis shows that the damage caused by weather has been considerably more severe for white than for tossa jute. This is due to the fact that white jute is grown on lower land than tossa and thus is more prone to flood damage. The impact of weather on prices is aggravated by the fact that the same weather usually affects jute-growing regions in Bangladesh and in India in West Bengal which together produce about two-thirds of the world's output.

(ii) Farmers' price expectations

Statistical analysis shows that about 80% of the jute output variation can be attributed to harvested acreage fluctuations and the rest to yield fluctuations. A number of studies have shown that jute growers allocate land to grow jute based on their expectations of the price ratio of jute to rice.[4] These studies also suggest that the growers' expectations are based mainly on the previous years' price ratios. Statistical analysis shows that the previous year's price ratio does not predict the current year's ratio well. [5] Apparently because of these poor price expectations, jute production and prices behave in a "cob-web" manner. A typical example of this "cob-web" effect can be seen in the prices and production of 1984/85 and 1985/86. Mainly because of bad weather and panic (see below for more details), jute supplies in both Bangladesh and India declined and jute prices skyrocketed in 1984/85. Farmers expected

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[3] This was confirmed by taking the difference between actual supply and potential supply estimated by regression equations.

[4] See for example, Rahman (1981) and Akiyama (1985).

[5] Regressions were run on the current year's price ratio against the previous year's price ratio for the period 1973/74-1988/89. The adjusted R^2 value was -0.037 and the t-value for the previous year's price ratio was 0.68.

1984/85 prices to prevail in 1985/86 and as a result the 1985/86 season experienced a very large crop, which in turn caused prices to fall sharply in that year. Typically, jute prices stay low for 3 years followed by another 2-3 year period of higher prices.

(iii) Low short-term price elasticities of demand

Shocks in supply and/or demand do not cause prices to change greatly if short-run price elasticities of supply and demand are large. The same weather shock results in much greater price changes when supply and demand elasticities are high.

Estimated price elasticities of demand for stocks, exports and mill consumption in Bangladesh and India are given in Table 1. As shown in the table, price elasticities of export and mill consumption demand are very low. It is notable that jute mills in Bangladesh do not adjust to production levels to prevailing raw jute prices. Such behavior exacerbates raw jute price fluctuations. However, relatively high price elasticities of stocks in the two countries suggest that an important role has been played by stocks in stabilizing jute prices.

Table 1: PRICE ELASTICITIES OF DEMAND FOR RAW JUTE IN BANGLADESH AND INDIA

	Bangladesh	India
Stock	1.11	0.70
Exports	0.30	-
Mill Consumption	0.00 /a	0.17

/a The elasticity of lagged row jute prices is 0.15.

A number of studies (e.g. Mujeri (1978), Rahman (1981), Akiyama (1985), Rahman (1986)) found jute supply to be responsive to previous year's price ratio of jute to rice. The elasticity of jute acreage with respect to

changes in jute/rice prices and revenues differ depending on periods and specifications used to estimate them but fall between 0.3 and 0.5 in the short-run and between 0.7 and 0.9 in the long-run.

(iv) Market panic (the 1984/85 incident)

Raw jute and jute goods prices would have been much more stable in recent years if it were not for the 1984/85 incident. Thus it is of importance to examine the jute sub-sector in some detail in that year to determine what policies were taken and those which could have been taken to avoid the incident.

In nominal terms, raw jute prices were at their highest level ever in 1984/85, (average of almost $600/ton in terms of BWD, f.o.b. Chittagong/Chalna) although in real terms, i.e., deflated by the World Bank's measure of international inflation, they were lower than in the early 1970s. Production and carry-over stocks in Bangladesh and India that season do not show a very tight condition compared with 1977/78 and 1978/79. What seemed to have occurred was an exaggerated perception by the market of the flood damage. A raw jute export ban was imposed by the government from late 1984 through mid-1985 aimed at ensuring availability of raw jute to the mills. Bangladesh jute mills did not reduce their raw jute demand but increased jute goods prices in order to cover the high raw jute costs.[6] As a result 1984/85 ended with relatively high raw jute stocks (they were higher in 1984/85 than in the late 1970s), and the highest jute goods stocks ever, as goods could not be sold at the higher prices.

Commodity market panics do occur from time to time, especially for commodities with low short-term price elasticities of demand.[7] There are limited

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[6] According to BJMC data, the percentage share of raw jute in BJMC's total revenue was almost 70% in 1984-85 compared with 30-40% in normal years.

[7] Notable ones are coffee in 1977, sugar in 1974 and 1980, and fertilizer in 1975.

measures that can be taken to avoid such panics. The only meaningful measures would be to constantly provide the market with good estimates of production, stocks, demand and prices. Timely and accurate information on crop damage caused by floods and droughts would help to avoid creating panics.

(v) Fluctuating demand

The developing countries' share of raw jute and jute goods import demand has been increasing over the years.[8] Demand from these countries tends to fluctuate widely for several reasons, including; (a) jute and jute goods imported are used mainly to package various kinds of agricultural goods (e.g. grains, cocoa, coffee, cotton) for transport and storage. Hence jute demand varies with fluctuations in production of these commodities, (b) most of these countries suffer from severe shortage of foreign exchange, which also reduces their ability to import, including jute and jute goods, and (c) recently large quantities of jute bags have been used as sand bags, and hence, demand has fluctuated with military needs.

To summarize, the main factors that cause raw jute prices to fluctuate widely are:

a. Concentration of world jute production in Bangladesh and Northwest India (about two-thirds of world output) which experience similar weather patterns.

b. Inaccurate price expectations held by farmers, causing a "cob-web" effect on prices and production.

c. Very low price elasticities of demand, especially by the Bangladesh mills.

d. Inadequate information and estimates of production and demand, occasionally creating panic in the market, in great part the cause for the high prices in 1984-85.

e. Fluctuating import demand for jute and jute goods.

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[8] See World Bank (1990).

II.2. Consequences of Raw Jute Price Instability

It should be stated at the outset that raw jute price fluctuations should not necessarily be a cause of economic problems. Prices transmit and provide important information to market participants with regard to what is happening with the market and prices should fluctuate with dynamic market conditions. It is true that large price fluctuations can cause market participants to react in sub-optimal ways especially in the long-run and could cause welfare loss to producers. Producers would not incur welfare loss due to price fluctuations if producers have means to hedge income fluctuations or if they are risk-neutral. Jute mills should not suffer from raw jute price fluctuations per-se because they have means to minimize fluctuations of operating costs arising from raw jute price fluctuations, by adjusting jute goods production, jute goods prices, and operating their own income stabilization measures. Smallholder jute farmers have only limited means to stabilize their income from jute. Hence, a major concern as regards welfare loss due to raw jute price fluctuations is that of farmers. However, jute production makes up only a small part of smallholders' total income in Bangladesh.

The theoretical effects of price instability on producers' welfare have been developed by a number of economists including Newbery and Stiglitz (1981). Welfare analysis is based on income fluctuations and not on price fluctuations. In other words, jute farmers' welfare is not affected by price fluctuations if incomes do not fluctuate. Statistical analysis using the data for the period 1972/73-1988/89 shows that income from raw jute, i.e., average prices multiplied by production, is closely correlated with raw jute prices (correlation coefficient was found to be 0.90). The coefficient of variation for the same period is 40.23. Excluding the 1984/85 season the CV is 31.98. Because tossa and white jute prices behave differently, coefficients of variation were calculated for each type of jute. The estimated impact of price stabilization on jute growers' welfare is given in Table 2. These estimates are in terms of percentages of income from jute when the coefficient of relative risk aversion

as defined by Newbery and Stiglitz (1981) is 1 and 2. This coefficient is a measure of how risk-averse farmers are. Because jute farmers in Bangladesh have limited means to hedge and are poor, a coefficient of 2 may be appropriate. During the period 1972/73-1988/89, jute growers would have gained the equivalent of 16% of their income from jute if jute prices had been completely stable. This corresponds to about Taka 1 billion in 1985 constant Taka terms. This amount decreases substantially if 1984/85 is excluded. The figures also show that risk-benefit from price stabilization is smaller for the tossa jute growers compared with the white jute growers. The estimated benefit is based on achievement of complete price stabilization which is impossible and undesirable. If it is assumed that a typical jute grower obtains 10% of their incomes from jute and that a jute price stabilization program reduces instability by one-half, the risk-benefit of such a program would be, at most, 0.8% of their total income.

Table 2: ESTIMATES OF RISK-BENEFIT FROM RAW JUTE PRICE STABILIZATION AS SHARE OF INCOME FROM JUTE

	All Years		Excluding 1984-85	
	R = 1 /c	R = 2	R = 1	R = 2
All jute /a	8.1	16.2	5.1	10.2
Tossa /b	7.8	15.6	3.3	6.6
White /b	9.1	18.2	6.3	12.7

/a For the period 1972/73-1988/89.
/b For the period 1975/76-1988/89 due to lack of data.
/c R = Coefficient of relative risk aversion.
Source: IECIT, World Bank.

The effects of raw jute price fluctuations on jute goods prices are limited. Regression analysis of sacking and hessian prices on average jute mill wages and raw jute prices indicates that on average a 10% increase in raw jute prices increases sacking and hessian prices by 3.3% and 3.4% respectively in Bangladesh. Because of these relatively small effects, jute goods prices have been substantially more stable than raw jute prices. To the extent that raw jute prices affect jute goods prices, raw jute price fluctuations affect jute goods export revenues and quantities as well as profitability of the jute mills

In the private sector, the ratio of raw jute export prices to primary market prices is considerably higher than those in by BJMC (parastatal). Statistical analysis shows that this ratio for the private sector is high when the seasonal variation is high and low when domestic prices are high.[9] This suggests that the commission charged by raw jute traders in terms of the percentage of the price paid at the primary market is high when seasonal price fluctuations are large. This volatile part of the differential can be interpreted as the risk premium. If prices are stabilized, the margins should become smaller and hence increase growers' prices, ceteris paribus.

The analysis also suggests that raw jute exporters play a role in stabilizing export prices by the lowering the percentage profit margin when prices at the primary markets are high and vice versa, and hence keeping export prices more stable than the prices at the primary markets.

One important long-term effect of jute and jute goods price fluctuations is thought to be the loss of jute's market share to polypropylene. However, there are difficulties in substantiating this argument for several reasons, including:

(a) Reliable data are scarce, especially those on polypropylene goods prices and demand to undertake analysis of the competition.

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[9] Results of regression analysis for the period 1974/75-1988/89.

$$DPXPBGD = 37.56 + 6.64T - 0.0155\ JUPPBGD + 1.46\ SVJUPPBGD$$
$$(10.98)\quad (3.63)\quad (4.33)\qquad\qquad (2.54)$$

where

DPXPBGD = the ratio of export price to primary market price
T = time trend
JUPPBGD = price at the primary market
SVJUPPBGD = seasonal variation of prices at the primary market
R^2 = 0.57
D.W. = 2.29
Figures in brackets are t-statistics

(b) There are a number of other factors, such as introduction of bulk handling, introduction of new polypropylene products, and stagnacy in industry or agriculture that use jute goods, that are known to have caused a decline in jute goods demand. Thus, it would be extremely difficult to identify how much of the decline in jute goods demand was due to price fluctuations and to other factors even if reliable data were available.

(c) There could be confusion as to whether the levels of raw jute and jute goods prices or their price fluctuations were the main cause of decline in jute goods demand.

III. THE ANALYTICAL FRAMEWORK

To evaluate the impact of different policies aiming at stabilizing real jute prices and the real jute income of growers we developed an econometric model for raw jute and jute products. The analysis of Section II suggests that a major role in raw jute price stabilization has been played by the stockholding operations of the parastatals, however, at great cost. Hence, in Section III.2 we present the "optimal stocking rule" to be used for simulation exercises in Section IV. The advantage of the "optimal stocking rule" is that it achieves socially optimal levels of price stability.

III.1 Jute Econometric Model

The model consists of three markets: the combined raw jute market for India and Bangladesh and separate jute goods markets in Bangladesh and India. For each of these markets there is a market clearing equation which determines the corresponding price. The model includes India, Bangladesh and the rest of the world.[10] For the estimated equations used see Annex 1. Differences in the specification of equations between Bangladesh and India are mostly due to data availability.

The structure of the model is shown in Figures 1 and 2. The model determines raw jute and jute goods prices by simultaneoulsy equating raw jute and jute goods supply and demand. As shown in Figure 1, Bangladesh and India's raw jute markets are treated as an integrated market. Raw jute prices are determined by clearing total supply and demand originating from Bangladesh and India. Important components of demand are mill consumption in Bangladesh and India. These demands are demand components for the raw jute block but become supply components for the jute goods block in Figure 2.

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[10] India and Bangladesh account for around 90% of production and exports of raw jute and products (see Annex tables 3, 4 and 5).

Figure 2 shows India's hessian price determination mechanism. Although not shown, a similar mechanism exists for determining sacking prices in Bangladesh. The supply component is equivalent to demand for raw jute in this block and demand components are those of export and domestic demands. Again, prices are determined by equating total supply and demand for jute goods.

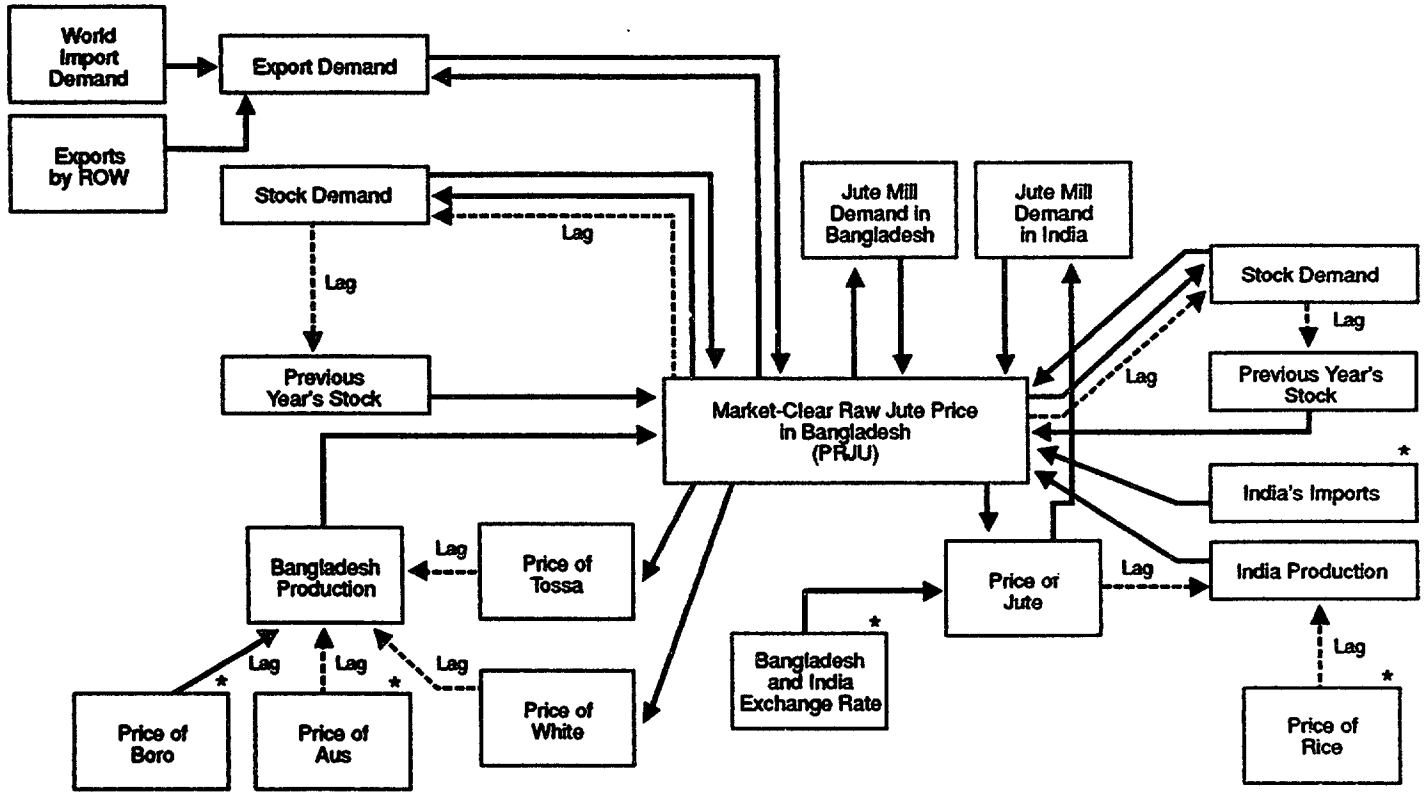
Statistical analysis shows that the price elasticities of demand for jute goods are low, but elasticities of market shares with regard to the differences between Bangladesh's and India's jute goods prices are relatively high. For example, the price elasticity for the market share for hessian of 2.3 in Table 3 implies that Bangladesh's hessian market share will increase by 2.3% if its price is reduced by 1% vis-a-vis India's hessian price. Bangladesh appears to have succeeded in increasing its shares of jute goods by pricing its jute goods lower than India. These elasticities are shown in Table 3. They imply a rather complicated relationship among key variables. For example, a bumper jute crop and low raw jute prices in Bangladesh and India do not necessarily imply higher profits for Bangladesh's jute mills. A bumper jute crop would enable the jute mills in India to produce substantial quantities of jute goods for export and, hence, would lower India's export price of jute goods. Bangladesh's mills, in order to keep their export market share, will also need to lower their jute goods prices. However, if they were to lower jute goods prices more than the gain from lower raw jute prices, their profitability would decline.

Table 3: ESTIMATED PRICE ELASTICITIES OF DEMAND AND MARKET SHARE FOR BANGLADESH'S HESSIAN AND SACKING

	Hessian	Sacking
World Imports	0.17	0.23
Market Share vis-a-vis India	2.30	0.68

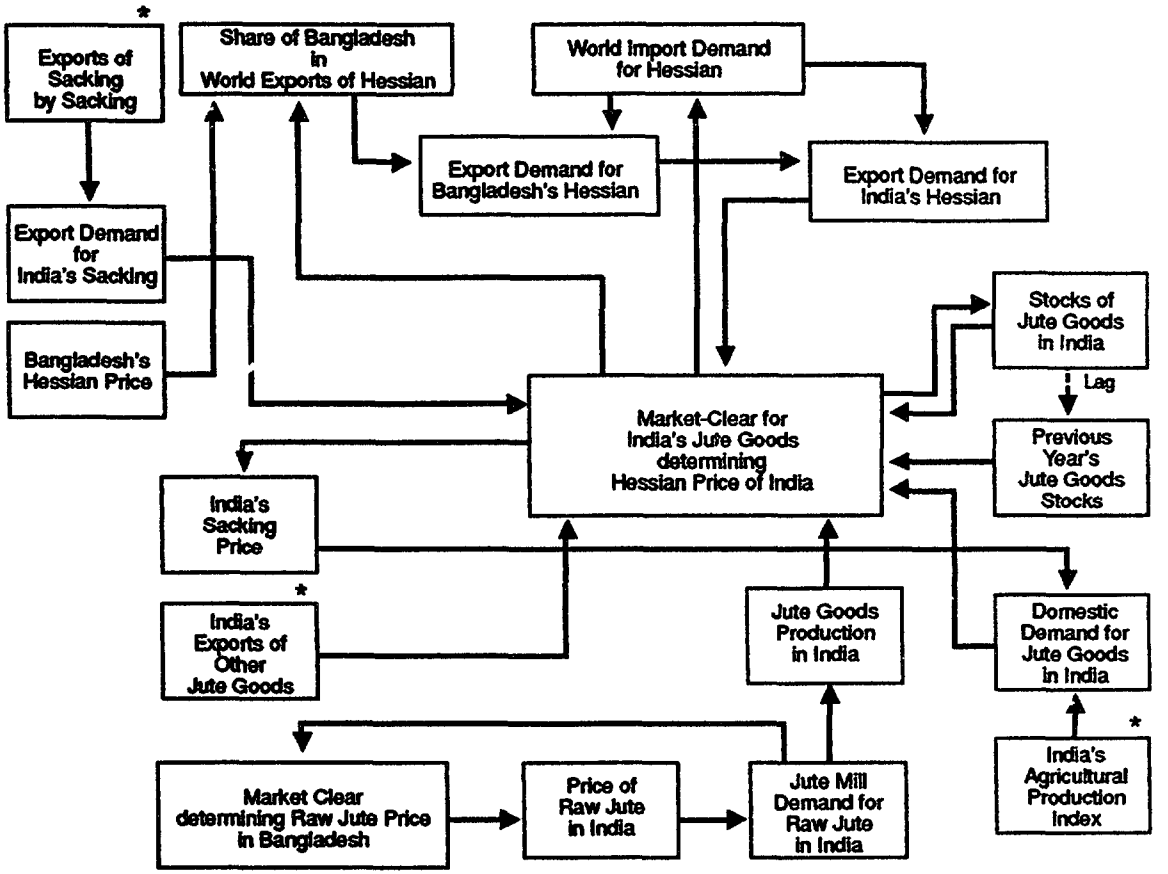
Source: IECIT, World Bank.

Figure 1: **Jute Model for Bangladesh and India: Raw Jute Block**



Note: "* " signifies exogenous variable

Figure 2: **Jute Model for Bangladesh and India: India Jute Goods Block**



Note: " * " signifies exogenous variable

III.2. Optimal Storage Rules

As discussed by Newbery and Stiglitz (1981), the optimal stocking rule is derived from the problem of optimizing the consumption flow from a serially uncorrelated sequence of supply (e.g., annual harvests in the case of agricultural commodities).

Mathematically, the objective function is:

$$Max\, E \sum_{t=0}^{T} \delta^t U(C_t, M_t - \gamma S_t) \qquad (1)$$

where

U_t = utility formation

C_t = consumption of the commodity

M_t = money expenditure on all other goods

γ = annual storage costs; γ per unit stored

S_t = stocks

δ = discount factor

The choice variables are the amounts carried over, S_t, and expenditure on other goods, M_t, subject to the constraints:

$$S_t \geq 0, \chi_o, S_T \text{ given}$$

$$\sum_{t=0}^{T} \beta^t M_t = W_o, \text{given}$$

where

$\beta = 1/(1+\delta)$

W_o = present value of wealth and future money income receipts

This maximization problem gives:

$$P_t + \gamma \geq \beta E_{pt+1}$$
$$S_t \geq 0 \qquad (2)$$

Equation (2) is often called the competitive storage rule. If the distribution of income between producers and consumers is of no concern, and if both are risk neutral, the competitive equilibrium achieves the optimum amount of price stabilization. Equation (2) implies that storage today continues until the present price, p_t, plus storage cost, γ per unit stored, has been driven up to equality with the present discounted value of the expected future price; or if present prices are high, stocks are sold now until the price plus storage costs have been driven down to this level, or until stocks, S_t, are exhausted.

If h_t is the harvest and x_t is total supply then

$$x_t = h_t + S_{t-1} = C_t + S_t \qquad (3)$$

We seek a function f(x) such that for all x_t

$$S_t = f(x_t) \geq 0 \qquad (4)$$

If demand is non-stochastic, this function must solve (2) and since

$$C_t = x_t - f(x_t)$$

this implies

$$p(x_t - f(x_t)) + \gamma \geq \beta E p[h_{t+1} + f(x_t) - f(h_{t+1} + f(x_t))] \qquad f(x_t) \geq 0 \tag{5}$$

Choose units so that the average harvest is unity and the elasticity of demand at the mean pre-shipment price $\bar{p}$, so the inverse demand schedule is:

$$p = \bar{p}\left(1 - \frac{1}{\epsilon}(C-1)\right) \qquad Eh = 1 \tag{6}$$

then (5) can be written

$$f(x) = \frac{1}{1+\beta}[x - a + \beta f(1 + f(x))], \quad x \geq x_o$$
$$= 0, \qquad x \geq 0 \tag{7}$$

where

$$a \equiv 1 + \epsilon(1 - \beta + \gamma/\bar{p}) \tag{8}$$

The "optimal storage rule" has the following key features:

(a) It is non-linear;

(b) The stock function f(x) is continuous and monotonically increasing;

(c) In a stationary world with bounded harvests, stocks are bounded; and

(d) The buffer stock breaks even on average if marginal storage costs are constant.

There are several methods of solving (7) but here the method developed by Gustafson (1959) is shown. His method consists of approximating the optimal rule by piecewise linear approximation as shown in the figure 3 below. The approximated equation is:

$$f(x) = \alpha_i (x - x_{i-1}) + f_{i-1}(x_{i-1}) \tag{9}$$

With subscription "i" demoting linear segments.

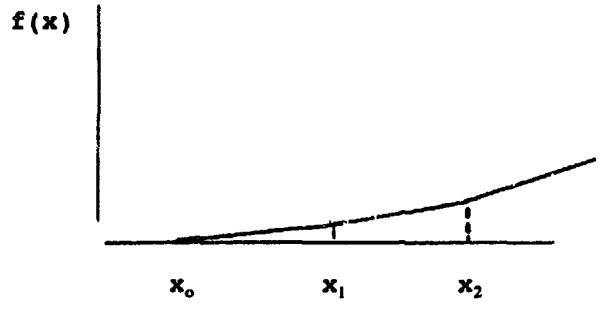


Figure 3: Linear approximation of the competitive stocking rule.

where:

$$\alpha_i = \frac{1-\beta^i}{1+\beta^{i+1}} \tag{10}$$

$$x_i - x_{i-1} = \frac{1-\beta^{i+1}}{1-\beta}(a-1) \tag{11}$$

Modified Rule

It was not possible to apply Gustafson's rule directly in the model simulations because inserting Gustafson's rule as a stock equation made the total demand for raw jute extremely inelastic. Since the model solves for raw jute prices by searching for the equilibrium points that equate total supply and demand, the model fails to converge when the total demand is very inelastic.

To avoid this problem, Gustafson's rule was transformed to a function of price. This was done by finding ps that correspond to the kink points in Gustafson's rule, x_o, x_1....., x_n by solving:

$$TSMBS_t = f(p) \tag{12}$$

$$f_t(x) = x_o, x_1, \ldots, x_n \tag{13}$$

$$TSMBS_t + f_t(x) = h_t + S_{t-1} \tag{14}$$

where:

TSMBS = Total supply of raw jute in Bangladesh and India

p = price of raw jute deflated by boro rice prices

Equation (12) is a demand equation for raw jute in Bangladesh and India excluding stocks held in Bangladesh and was estimated using OLS. [11] This gives:

$$f_i(p) = -\alpha_i (p - p_{i-1}) + f_{i-1}(p_{i-1}) \tag{15}$$

Graphically f_i (p) is shown in Figure 4.

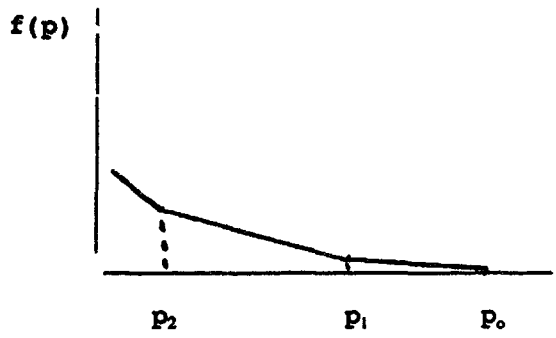


Figure 4: Modified Competitive storage rule.

[11] The estimated equation for the period 1975/76-1988/89 is:

$$\ln TSMBS = 5.11 - 0.24 \ln P_t + 0.322\ D85$$
$$(120.73)\quad (2.67)\qquad\quad (3.03)$$

Period estimated: 1976/77-1988/89 $R^2 = 0.565$ D.W. = 1.38

Because f_i (p) is non-linear and would not be accepted by the computer program for simulation using the Newton method, values for f_i's were calculated and regressed using p's for the period 1975/76-1988/89 to obtain an equation approximating (15).

We obtained:

$$\ln f = 3.703 - 6.794 \ln P + 4.819 D84 + 2.38 D77 + 1.197 D76$$

(2.93) (13.17) (8.81) (5.91) (3.44)

$R^2 = 0.944$ D.W. = 1.616 SER = 0.102

This equation was inserted into the model to evaluate the effects of the optimal stocking rule on the jute market. The estimated equation is basically a demand-for-stock equation with a high price elasticity. It is clear that such an equation if inserted in the model, would stabilize prices by increasing the price elasticity of total demand.

Practical Difficulties in Implementing the Optimal Storage Rule in Bangladesh for Raw Jute

A difficulty in implementing the original Gustafson's rule in the case of Bangladesh's raw jute is that it requires fairly accurate estimates of India's and Bangladesh's total supply and stocks held in India at the end of the season. Furthermore, if the optimal stocking is to be undertaken by one of the parastatals in Bangladesh, then estimates of end-season stocks held by the private sector in Bangladesh will be required. To the extent these estimates contain errors, estimated optimal stock levels to be held will deviate from the "true" optimal levels. The "modified" optimal rule, on the other hand, requires a good estimate of price to prevail during the current period and of stocks held by the private sector in Bangladesh. Another problem with both of the optimal rules is that many of the parameters are calculated based on historical data for

supply and demand. Hence if there is an abrupt structural change in these variables, the estimated optimal stocks levels would deviate from the "true" optimal levels.

IV. SIMULATIONS OF DIFFERENT POLICIES AIMED AT REDUCING RAW JUTE PRICE FLUCTUATIONS

This section reviews the causes of raw jute price instability that originate in Bangladesh, and examines factors to be taken into account in designing policies aimed at reducing raw jute price fluctuations and their adverse effect.

Section II discussed in some detail the main causes of jute price instability originating in Bangladesh: weather, inaccurate price expectations held by farmers, very low price elasticity of demand, inadequate dissemination of analysis and information, and demand fluctuations. An analysis of how the impact of these factors on price instability could be minimized is given below. Also, there is discussion and analysis of stockholding policy to stabilize prices in a socially optimal way.

(i) Weather. Obviously, strengthening flood control facilities would be one measure to reduce raw jute price fluctuations. This, however, is expensive and would not be justified if its only objective was to stabilize raw jute prices. However, efforts at flood control have already been made in Bangladesh as a means of strengthening its infrastructure and this will also help reduce jute price instability.

(ii) Inaccuracy of price expectations held by farmers and inadequate information dissemination. As discussed in Subsection II.2, farmers' price expectations about jute and rice prices have been inaccurate forecasts. Farmers' price expectations could be improved by providing them with more information and analysis of the jute market. Enhanced dissemination of analysis and up-to-date information would also be an effective measure to alleviate market panic at times of production shocks.

To evaluate the effects more accurate price expectations would have on jute prices, a simulation run was made on the jute econometric model assuming--that the farmers' expected jute prices depend on lagged level of ending stocks.[12] This assumption effectively increases the accuracy of price forecasts by 0.4 in terms of the R^2 of a regression with the lagged levels of stocks as the independent variable and the assumed expected prices as the dependent variable. The simulation results are shown in Table 4.

As shown in Table 4, improvement in farmers' price expectations reduces jute price variability (the C.V. of the deflated jute price is reduced from 38.9 to 32.4) and also reduces the fluctuations in farmers' real income (the CV declines from 39 to 29.9).

Table 4: SIMULATION RESULTS OF THE EFFECTS OF VARIOUS POLICIES ON PRICE AND INCOME FLUCTUATIONS

(Ex-Post Simulation 1975/76-1988/89)

	Nominal Jute Price	Jute Price Deflated by Boro Rice Price	Income from Jute Deflated by Boro Rice Price
	----------(CV, %)----------		
Without policy change	46.3	38.9	39.0
With improved farmers' price expectations	40.2	32.4	29.9
With higher price elasticity for mills	39.0	29.8	27.0
Without stock operations by the Parastatals	63.3	56.1	56.6
With "optimal" stocks	51.3	38.1	39.0

Source: IECIT, World Bank

[12]It is also assumed here that the coefficient for the expected price in the acreage equation does not change when farmers use stocks to form their expectations of the following years' price.

(iii) Inelastic jute demand by mills. Econometric analysis of raw jute demand by the mills suggests that they decide on the quantity of jute goods to produce based on the number of looms available, wages, and raw jute and jute goods' prices in preceding years. The inelastic nature of the mills' demand, as shown in Subsection II.1, exacerbates raw jute price fluctuations.

The situation in 1984/85 demonstrated the important impact that mills' raw jute purchases can have on raw jute prices and on the mills' profitability. Model simulations indicate that real raw jute prices and real farmers' incomes would have been substantially more stable if jute mills' purchases of raw jute had been more responsive to prevailing raw jute prices, as shown in Table 4.[13]

Raw jute prices would be more stable if mills' demand for raw jute were more responsive to current prices rather than lagged, and mills' jute goods production schedule were more responsive to prevailing jute goods market conditions. This would require the mills to be flexible in staff level adjustments and purchases of raw jute. For the simulation we assumed a price elasticity of mill demand for raw jute to be 0.3. The result indicated that a higher mill demand elasticity would have resulted in a significant reduction in both jute prices and real farmers' income from raw jute. In Table 4, the coefficients of variation declined by about a third for both prices and real income.

(iv) Stock operations by the parastatals

Although stock operations by the parastatals had some price stabilizing effect they were very costly (see Table 5). An important reason for their being so costly was that stock purchase and selling decisions were made in an ad-hoc manner and not based on sound analysis. However, it is estimated that raw jute prices would have been significantly more volatile had these operations not been

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[13] As noted earlier, the jute mills' price elasticity of raw jute demand was nil.

Table 5: ESTIMATED COSTS OF STOCK OPERATIONS BY THE PARASTATALS AND COUNTRY AS A WHOLE; 1977/78-1988/89

Parastatal Stock Operations /a

Years	Stocks (Lac BL)	Price of Jute (TK/KG)	Stocks in Excess /b (LAC BL)	Purchase Cost /c (Mill TK)	Revenue From Sale /c (Mill TK)	Storage Costs (Mill TK)	Current Cost /d (Mill TK)	Accumulative Cost /e (Mill TK)
1977/78	4.93	4.21	1.93	146.41			146.41	146.41
1978/79	8.35	3.79	5.35	364.70	131.56	7.32	240.45	410.29
1979/80	13.90	3.10	10.90	608.67	298.75	18.23	328.15	804.09
1980/81	11.27	3.10	8.27	461.65	608.46	30.43	-116.38	816.37
1981/82	8.79	3.73	5.79	388.44	554.44	23.08	-143.30	803.69
1982/83	4.88	4.14	1.88	140.15	431.63	19.42	-272.06	660.22
1983/84	5.71	6.76	2.71	329.53	228.60	7.01	107.93	873.79
1984/85	5.14	14.36	2.14	553.33	700.71	16.48	-130.91	882.69
1985/86	29.74	5.20	26.74	2501.90	200.23	27.67	2329.34	3353.26
1986/87	31.29	4.42	28.29	2250.86	2127.54	125.09	248.42	4138.20
1987/88	26.20	7.38	23.60	3136.72	3760.07	112.54	-510.81	4289.50
1988/89	18.21	6.73	15.21	1842.61	2859.01	156.84	-859.57	4116.25

Balance at the end of 1988/89: Loss - Take 2,274 Million /f

Table 5: ESTIMATED COSTS OF STOCK OPERATIONS BY THE PARASTATALS AND COUNTRY AS A WHOLE, 1977/78-1988/89 (Continued)

Country as a Whole

Years	Stocks (Lac BL)	Price of Jute (TK/KG)	Stocks in Excess /b (LAC BL)	Purchase Cost /c (Mill TK)	Revenue From Sale /c (Mill TK)	Storage Costs (Mill TK)	Current Cost /d (Mill TK)	Accumulative Cost /e (Mill TK)
1977/78	6.92	4.21	2.92	221.51			221.51	221.51
1978/79	23.32	3.79	19.32	1317.00	199.05	11.08	1129.03	1385.98
1979/80	42.20	3.10	38.20	2133.14	1078.85	65.85	1120.13	2727.87
1980/81	32.53	3.10	28.53	1592.60	2132.40	106.66	-433.14	2731.19
1981/82	18.52	3.73	14.52	974.11	1914.01	79.63	-860.27	2307.91
1982/83	13.50	4.14	9.50	708.21	1082.44	48.71	-325.53	2351.65
1983/84	10.10	6.76	6.10	741.75	1155.18	35.41	-378.02	2349.90
1984/85	9.76	14.36	5.76	1489.34	1577.25	37.09	-50.82	2675.05
1985/86	42.65	5.20	38.65	3616.25	538.93	74.47	3151.78	6254.85
1986/87	39.00	4.42	35.00	2784.73	3075.14	180.81	-109.60	7146.03
1987/88	32.08	7.38	28.08	3732.16	4651.91	139.24	-780.51	7508.88
1988/89	23.11	6.73	19.11	2315.07	3401.74	186.61	-900.06	7810.24

Balance at the end of 1988/89: Loss - Taka 5,445 Million /f

/a Stocks of the parastatals are those of BJMC and BJC given in Table 13.
/b Working stocks of 3 Lac bales and 4 Lac bales for the parastatal and total stocks are assumed.
/c Cost calculations are done by assuming that all stocks at the end of the season are bought at the average jute price of the current season and carried-over stocks are sold at the average jute price of the current season.
/d Purchase cost - Revenue from sale
/e It is the sum of current cost and previous years' accumulated costs plus interest costs on previous years' accumulated costs.
/f Calculated by subtracting "purchase costs" for 1988/89 from "accumulated cost" of 1988/89 as it is assumed that at the end of 1988/89, the operation is to liquidate itself. Both figures show negative numbers indicating loss.

Source: IECIT, World Bank.

implemented. This is also evident from the fact that stocks had significant and relatively large price elasticity.

We have estimated the costs of the stock operations by assuming that the nominal interest rate was 16%, the stock carrying cost as a percentage of the value of the stock was 5% a year, and that no parastatals other than BJMC kept stock before 1983/84.[14] Under these assumptions the total cost to the parastatal at the end of the period was more than Taka 3 billion for the period 1977/78-1988/89 (see Table 5). Estimated costs for holding total stocks in Bangladesh for the same period is about Taka 5.5 billion. Such high costs were unsustainable. As a result, these operations eventually become ineffective and a major problem of themselves.

Studies on buffer stocks suggests that the optimal stocking rule formulated by Gustafson (1958) and discussed by Newbery and Stiglitz (1981, 1982) is theoretically sound and efficient. The rule assumes that carry-over stocks would be at the socially optimal level, if consumers are price risk neutral. The rule also suggests that if the private sector has the necessary means and information it will hold stocks according to this rule. Whether the private sector actually performed according to this rule in the past for raw jute in Bangladesh is not possible to examine due to a lack of data and erratic government intervention.

Simulation of jute econometric model to test the performance of the modified version of the optimal stocking rule gives the results shown in Table 4 and the costs from applying such a rule in Table 6. The stocks and costs presented in Table 6 are estimates for the total stocks held in Bangladesh, i.e., stocks held both by the parastatals and the private sector. Under the rule, the more stocks held by the private sector the less are required to be held by the parastatals.

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[14] This assumption had to be made because no data on parastatals' stocks, other than BJMCs, exists before 1983/84.

Table 6: SIMULATED OPTIMAL STOCKS AND THEIR COSTS; 1977/78-1988/89

Year	Optimal Stock Levels	Price of Jute	Stocks in Excess	Purchase Cost /c	Revenue from Sales /c	Storage Costs	Current Costs /d	Accumulated Costs /e
	(Lac Bl)	(TK/KG)	(Lac Bl)	(Mill TK)	(Mill TK)	(Mill TK)	(Mill TK)	(Mill TK)
1977/78	5.66	3.84	2.66	183.86			183.86	183.86
1978/79	17.10	3.13	14.10	794.39	149.66	9.19	653.72	867.00
1979/80	27.89	2.83	24.89	1267.90	718.25	39.72	589.36	1595.08
1980/81	7.30	3.02	4.30	233.75	1353.02	63.39	-1055.88	794.42
1981/82	3.20	5.48	0.20	19.73	424.15	11.69	-392.74	528.79
1982/83	3.18	4.34	10.18	795.26	15.62	0.99	780.62	1394.02
1983/84	10.57	5.38	7.57	733.08	985.83	39.76	-212.99	1404.07
1984/85	4.19	13.61	1.19	292.81	1862.67	36.65	-1533.21	95.51
1985/86	33.00	4.18	30.00	2257.20	89.54	14.64	2182.30	2293.10
1986/87	21.02	5.34	18.02	1732.08	2883.60	112.86	-1038.66	1621.34
1987/88	12.14	5.19	9.14	969.02	1910.48	86.60	-854.85	1025.90
1988/89	3.00	9.90	0.00	0.00	1628.75	48.45	-1580.30	-390.25

Balance at the end of 1988/89: Profit Taka 390.25 Million /f

Note: Footnotes /b through /f see footnotes in Table 16.

An interesting result in Table 6 is that the balance of the total stock operation at the end of 1988/89 is a profit of Taka 390 million. This compares with the estimated losses of Taka 5,445 million for total stock operations and Taka 2,274 million for the parastatal stock operations for the same period (see Table 5). It is to be emphasized that these estimated costs apply only for the period 1977/78-1988/89 and compare the hypothetical results under the modified optimal rule with the actual ad-hoc behavior of the parastatals. The same result may not hold in the future. However, the optimal stocking rule is always expected to lead to a break-even result over the long-run. The simulated results for prices and income under the "modified" optimal stocking rule show that the degree of price stabilization achieved by this rule is almost exactly the same as that of the ad-hoc stocking undertaken by the parastatals. However, growers' income is significantly more stable. Thus, under the "modified" optimal stocking rule, growers' welfare is substantially higher than under ad-hoc stocking.

Implementation of the optimal storage rule by parastatals would be difficult, as discussed in Section III. It would be much preferable if storage were to be undertaken by the private sector. The private sector could be expected to carry out stocking operations according to the optimal storage rule if it had adequate information and means, such as credit. Seasonal variations of raw jute prices suggest, however, that the private sector has not held stocks according to the optimal storage rule.[15] Therefore, an examination of the availability of information and credit to private jute traders needs to be carried out.

The discussions above do not imply that special credit systems should be established for the purpose of encouraging stockholding by the private sector. Rather, there should be a market-based system which ensures financial discipline by the stockholders. This would be a precondition for efficient stockholding behavior.

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[15] It is possible to estimate optimal private sector stock levels in the presence of government interventions (See Wright and Williams (1991)).

V. CONCLUSION

The perceived problems in Bangladesh's jute sub-sector related to raw jute price fluctuations include:

(a) Reduction of jute growers' welfare,

(b) Large deficits incurred by the parastatals (BJC and BJMC) from ad-hoc stock operations aimed at stabilizing prices,

(c) Large deficits incurred by the mills when raw jute prices are high, and,

(d) Possible loss of competitiveness of raw jute and jute goods, mainly against synthetic substitutes, due to wide price fluctuations.

The paper argued that the reduction of jute growers' welfare due to raw jute price fluctuations is small, as the jute growers' activities are diversified and their share of income from raw jute in their total income is small.

Analysis in this paper indicates that the extent of raw jute price stabilization achieved by the parastatals could have been achieved by the private sector at no cost to the government provided that the private sector has access to relevant information and credit markets. Thus, parastatals should refrain from ad-hoc stock operations and allow the private sector to hold stocks. For the private sector to undertake efficient stocking operations, the credit system should be market-based instead of the current directed system.

Mill demand for raw jute in Bangladesh has been inelastic, implying that they purchased fixed quantitites of raw jute from year to year regardless of prices. This has not only hurt the mills' profitability but also magnified raw jute price fluctuations. Indeed, it has been a lack of concern with profit making which has led to this behavior. Making the mills more profit-conscious should improve their financial performance and also help stabilize raw jute prices.

Although some have considered raw jute price fluctuations to be one of the major reasons for jute's loss of fiber market share, it has not been possible to evaluate this argument because of the lack of data.

The analysis suggests that public raw jute price stabilization programs which can be expected to be costly would not be justified by the expected benefits. Government policies and actions should be such that they increase market transparency, reduce or eliminate market distortions, and enhance the proper functioning of the market.

Annex I. ESTIMATED EQUATIONS OF THE JUTE MODEL

RAW JUTE BLOCK

1) Bangladesh: White Jute Yield (1975-88)

YLDJUWH = 2.74 - 2.62 RWGBO1 + 0.09 FERTUJE 0.42 D84 - 0.82 D88
(0.18) (1.56) (4.53) (2.62) (4.18)

R^2 (adj) = 0.66 D.W. = 2.26 SER = 0.14

2) Bangladesh: Tossa Jute Yield (1975-88)

YLDJUTO = 2.89 - 0.56 RWGBO1 + 0.06 FERTUJE + 0.63 D31 - 0.57 D84
(0.20) (-1.28) (3.63) (3.56) (3.56)

R^2 (adj) = 0.76 D.W. = 1.99 SER = 0.15

3) Bangladesh: White Jute Area (1975-88)

ARJUWH = - 0.34 + 1368.37 WHBO(-1) - 632.96 RWGBO1 - 311.85 RWHBO2(-1)
(0.14) (4.42) (1.73) (3.48)

- 405.17 D88 - 270.84 D84
(3.71) (2.47)

R^2 (adj) = 0.80 D.W. 2.56 SER = 99.6

4) Bangladesh: Tossa Jute Area (1975-88)

ARJUTO = 143.24 + 189.38 RTOBO(-1) + 1191.46 RWGBO1 - 231.52 D77
(1.34) (4.73) (1.70) (2.75)

R^2 (adj) = 0.72 D.W. = 2.51 SER = 79.8

5) India: Supply of Raw Jute (1973-89)

JUQIND = 29.73 + 0.22 PRRTJURCIND(-1) + 0.05 PRRTJURCIND(-2)
(4.42) (7.38) (1.61)

R^2 (adj) = 0.79 D.W. = 1.45 SER = 7.19

6) Price Linkage of Farmgate Prices: India and Bangladesh (1975-89)

JUPPIND$ = 33.92 PRJU$ - 89.97 D77 + 57.27 D86
(35.83) (2.64) (1.73)

R^2 (adj) = 0.99 D.W. = 1.84 SER = 32.69

7) Bangladesh: Mill Demand for Raw Jute (1975-88)

CRJMILL = 4.96 - 0.50 RRJWG(-1) + 0.09 RSAWG(-1) + 0.01 TLOOMS
(0.49) (4.28) (2.06) (2.86)

R^2 (adj) = 0.78 D.W. = 1.52 SER = 1.118)

8) India: Mill Demand for Raw Jute (1975-88)

JUMIND = 3.85 + 0.05 JGPDIND + 9.37 D77 + 7.63 D76
(1.00) (18.26) (6.52) (6.51)

R^2 (adj) = 0.97 D.W. = 1.73 SER = 1.119)

9) Bangladesh: Raw Jute Demand for Stocks (1975-88)

ESRJ = -18.75 DERRJBO + 0.04 PDJUTE + 23.06 D84
(5.25) (11.36) (2.42)

R^2 (adj) = 0.94 D.W. = 2.23 SER = 6.46

10) India: Raw Jute demand for Stocks (1973-80)

ESJUIND = 12.27 + 0.20 JUQIND - 0.09 PRRTJURCINDD
(3.21) (4.27) (0.67)

- 12.78 D8283 - 16.62 D757677
(6.05) (9.21)

R^2 = 0.96 D.W. = 1.83 SER = 2.58

11) Bangladesh: Linkage of Price Paid by the Mills for Raw Jute and Raw Jute Farmgate Price (1974-89)

APRJU = -4.70 + 1.04 APRWHTO
(0.88) (43.85)

R^2 (adj) = 0.99 D.W. = 2.05 SER = 10.59

12) Raw Jute Export Demand (1975-88)

JUEXWOR = 970.68 - 20.97 T - 0.36 JUPRFYMUVD
(27.10) (13.60) (8.01)

+ 98.29 D86 - 51.33 D79 - 60.35 D75
(4.62) (2.48) (2.64)

R^2 (adj) = 0.95 D.W. = 2.51 SER = 19.32

13) Rest of the World: Raw Jute Exports (1975-88)

JUEXROW = 627.34 - 106.98 T + 0.10 JUPRFYMUV(-2)
(6.14) (6.02) (1.44)

- 64.27 D77 - 54.76 D82
(2.56) (2.26)

R^2 (adj) = 0.84 D.W. = 1.81 SER = 22.93

JUTE GOODS BLOCK

14) Bangladesh: Production of Jute Goods (1975-88)

JGBPDBGD = 9.56 + 1.05 CRJMILL - 2.84 SQRTT - 2.11 D76
(3.03) (9.84) (4.80) (2.45)

R^2 = 0.89 D.W. = 1.27 SER = 0.7615)

15) India: Production of Jute Goods (1976-88)

JGPDIND = 1557.39 - 0.39 PRRTJUBTIND - 291.78 D7677
(18.61) (2.48) (8.12)

- 287.36 D78 - 238.35 D83 - 143.38 D87
(6.53) (5.41) (3.25)

R^2 (adj) = 0.92 D.W. = 2.41 SER = 41.35

16) Bangladesh: Demand for Jute Goods Stocks (1973-88)

JGBESBGD = 6.62 + 0.14 DPRRTJUBTBGD3 - 3.52 D778 - 1.71 D81
(36.93) (5.27) (7.45) (2.66)

- 1.54 D76
(2.38)

R^2 (adj) = 0.84 D.W. = 1.00 SER = 0.62

17) India: Demand for Jute Goods Stocks (1974-88)

JGESIND = -33.85 + 0.05 DPRRTJUHIND3 + 1.90 JUMIIND
(0.66) (4.00) (2.67)

- 61.12 D84 - 36.6 D88
(3.29) (2.08)

R^2 (adj) = 0.58 D.W. = 1.65 SER = 16.39

18) India: Domestic Demand for Jute Goods (1975-88)

JGDCIND = -290.95 + 12.71 AGPIIND - 0.26 JBTPRDFIND
(1.45) (7.20) (1.73)

- 226.73 D77 + 178.46 D79
(2.66) (1.93)

R^2 (adj) = 0.84 D.W. = 1.36 SER = 79.0

19) World Import Demand for Sacking (1973-88)

JSEXBIT = 266.28 - 0.07 JBTPRBGDMUV + 4.94 PPHS10MUV
(5.97) (3.31) (2.60)

+ 66.51 D80 + 94.22 D81
(2.38) (3.38)

R^2 (adj) = 0.69 D.W. = 1.88 SER = 26.79

20) World Import Demand for Hessian (1969-80)

JHEXINDBGD = 525.04 - 3.17 T - 49.80 BURPPRT + 95.67 D80 - 83.15 D88
(8.54) (1.99) (1.27) (2.34) (1.97)

R^2 (adj) = 0.44 D.W. = 3.06 SER = 37.92

21) Bangladesh: Share in Total Hessian Exports (1974-88)

JHEXSHBGD = 149.39 - 59.42 RJHPR - 46.66 RJHPR(-1) + 9.61 D82 + 12.94 D83
(8.05) (3.04) (2.36) (2.84) (3.73)

R^2 (adj) = 0.77 D.W. = 1.50 SER = 3.21

22) Bangladesh: Share in Total Sacking Exports (1975-88)

JSEXSHBGD = 120.29 - 0.52 PRRTBTBGDIND$2 + 6.28 D8182 - 9.94 D84 + 5.95 D85
(10.12) (4.15) (3.16) (3.32) (2.18)

R^2 (adj) = 0.72 D.W. = 2.83 SER = 2.52

23) Price Linkage of N.Y. Burlap Price to Bangladeshi Hessian Price (1973-89)

BUR10NY = 1.40 + 0.45 JHPRBGD$ + 0.72 JHPRBDG$(-1)
(0.86) (5.68) (9.38)

R^2 (adj) = 0.92 D.W. = 2.11 SER = 1.36

Description of Variables

APRJV:	Average price for raw jute paid by the mills
APRWHTO:	Average farmgate price of white and tossa raw jute (=PRJU)
SQRTT:	Square root of the time trend
JUEXROW:	Raw jute exports by the rest of the world (i.e. excluding India and Bangladesh)
JUPRFYMUV:	Raw jute price in Bangladesh on fiscal year basis, converted into US$ and divided by the MUV
JUPRFYMUVD:	first difference of JUPRFYMUV
ESRJ:	Stocks of raw jute in Bangladesh
DERRJBO:	RRJBO-RRJBO3
RRJBO:	Real interest rate in Bangladesh
RRJBO3:	Three-year moving average
PDJUTE:	Production of raw jute in Bangladesh
CRJMILL:	Mill demand for raw jute in Bangladesh
RRJWG:	Raw jute by the mills in Bangladesh over wages paid by jute mills
RSAWG:	Sacking price over wages paid by jute mills
TLOOMS:	Total number of looms in Bangladeshi mills
JUQIND:	Production of raw jute in India
PRRTJURCIND:	Ratio of farmgate raw jute in India to farmgate price for rice.
PRRTJURCINDD:	PRRTJURCIND-PRRTJURCIND3(-1)
PRRTJURCIND3:	Three-year moving average
JUPPIND$:	Farmgate price in India in US$ terms
PRJU$:	Farmgate price in Bangladesh in U.S. $ terms
ESJUIND:	Ending stocks for raw jute in India
JGBPDBGD:	Jute goods production in Bangladesh
BUR10NY:	Burpal price in New York
JHPRBGD$:	Hessian price of Bangladesh in US$ terms

JSEXBIT:	Total world import demand for sacking equal to export supply of sacking by Bangladesh, India and Thailand.
JBTPRBGDMUV:	Export sacking price in Bangladesh divided by MUV
PPHS10MUV:	Polypropylene price in the U.S. divided by MUV.
JGBESBDG:	Jute goods stocks in Bangladesh
DPRRTJUBTBGD3:	PRRTJUBTBGD-PRRTJUBTBGD3
PRRTJUBTBGD:	Farmgate price of raw jute in Bangladesh divided by the export price cf sacking in Bangladesh
PRRTJUBTBGD3:	Three-year moving average
JUMIIND:	Mill demand for raw jute in India
JGPDIND:	Production of jute goods in India
PRRTJUBTIND:	Jute price in India divided by the hessian price in India
JGDCIND:	Domestic demand for jute goods in India
AGPIND:	Agricultural production index of India
JBTPRFIND:	Sacking price of India deflated by the wholesale price index
JGESIND:	Jute goods stock demand in India
DPRRTJUHIND3:	PRRTJUHIND-PRRTJUHIND3
PRRTJUHIND:	Price of raw jute in India deflated by the hessian price in India
PRRTJUHIND3:	Three-year moving average
JHEXSHBGD:	Bangladesh share in world hessian exports
RJHPR:	Hessian price in Bangladesh (in US$) divided by the Hessian price in India (in US$).
JHEXINDBGD:	World import demand for hessian
BURPPRT:	Burlap price in N.Y. divided by the polypropylene price in the U.S.
JSEXSHBGD:	Bangladesh share in world sacking exports
PRRTBTBGDIND$2:	[PRRTBTBGDIND$ + PRRTBTBGDIND$(-1)]/2
PRRTBTBGDIND$:	Ratio of sacking price of Bangladesh (in US$) over the sacking price of India (in US$)
ARJUWH:	Area of white jute in Bangladesh

RWHBO:	**Ratio of white jute price to rice boro price in Bangladesh**
RWHBO1:	**Ratio of current agriculture wage to lagged rice boro price in Bangladesh**
ARJUTO:	**Area of tossa jute in Bangladesh**
RTOBO:	**Ratio of tossa jute price to rice boro price in Bangladesh**
YLDJUTO:	**Yield of tossa jute in Bangladesh**
FERTUSE:	**Use of fertilizers in Bangladesh**
YLDJUWH:	**Yield of white jute in Bangladesh**

STATISTICAL ANNEX TABLES

Annex Table 1: PRODUCER PRICES FOR JUTE AND PADDY IN BANGLADESH AND INDIA

Season July-June	Bangladesh				India			
	Jute /a (TK/ton)	Paddy (TK/ton)	JU/PD (Ratio)	Jute Area ('000 HA)	Jute b/ (RS/Ton)	Paddy (RS/Ton)	JU/PD (Ratio)	(Jute Area) ('000 HA)
1970/71				890	1534	728	2.107	1,079
1971/72				678	1475	769	1.918	1,111
1972/73	1468	928	1.582	896	1685	884	1.906	993
1973/74	1502	1222	1.229	889	1398	1058	1.321	1,162
1974/75	2389	3170	0.754	583	1758	1400	1.256	983
1975/76	2292	2064	1.110	526	1879	1508	1.246	915
1976/77	2735	1547	1.768	659	2005	1241	1.616	1,089
1977/78	4282	2061	2.078	741	2229	1310	1.702	1,162
1978/79	3552	1966	1.807	842	2164	1274	1.699	1,264
1979/80	2682	2152	1.246	768	2124	1404	1.513	1,217
1980/81	3267	2557	1.278	642	2166	1615	1.341	1,300
1981/82	3555	2709	1.312	578	2413	1765	1.367	1,150
1982/83	5173	3535	1.463	584	2725	1860	1.465	1,020
1983/84	5443	3608	1.509	587	3848	1950	1.973	1,054
1984/85	11616	4904	2.369	608	8173	2104	3.885	1,129
1985/86	5646	4131	1.367	1,012	3140	2028	1.548	1,494
1986/87	3074	4888	0.629	664	3085	2323	1.328	1,075
1987/88	7100	5653	1.256	512	3416	2238	1.526	951
1988/89	6058	5724	1.058	544	4497	2300	1.955	941
1989/90					6120	2400	2.550	880

/a Average price of jute at growers level.
/b W5 at Calcutta.

Sources: Bangladesh Ministry of Jute and Bangladesh Bureau of Statistics:
Indian Jute Manufactures Development Council.

Annex Table 2: SUPPLY AND DISTRIBUTION OF JUTE IN BANGLADESH, 1964/65-1988/89 (TRADE ESTIMATE)

Period	Supply			Distribution					
	Carryover	Production	Total	Export Overseas	Mill Issue	Domestic Consumption	Shortfall	Total	Closing Stock
	Lakh bales								
1964-65	11.68	54.24	65.92	39.24	17.12	2.50	-	58.86	7.06
1965-66	7.06	71.58	+79.78	44.48	24.50	2.50	-	71.48	8.30
1966-67	8.30	77.51	35.40	24.10	24.10	2.50	-	62.00	15.51
1967-68	15.51	69.68	85.19	38.63	30.01	2.00	-	70.64	14.55
1968-69	14.55	58.16	72.71	32.49	29.93	2.50	-	64.42	8.29
1969-70	8.29	73.91	82.20	35.08	36.18	2.13	-	73.39	8.81
1970-71	8.81	68.01	76.82	21.98	27.39	2.00	3.98	55.35	21.47
1971-72	21.47	42.86	64.33	19.17	19.17	1.50	11.60	51.71	12.62
1972-73	12.62	66.24	78.86	28.28	24.91	1.50	2.06	55.75	22.11
1973-74	22.11	61.50	83.61	26.62	29.41	2.00	2.00	60.03	23.58
1974-75	23.58	39.67	63.25	15.49	25.46	1.00	2.00	43.95	19.30
1975-76	19.30	43.46	62.76	23.47	26.73	1.50	0.41	52.11	10.65
1976-77	10.65	47.00	57.65	22.76	28.91	3.00	0.53	55.20	2.45
1977-78	2.45	55.08	57.53	16.67	30.74	3.00	0.20	50.61	6.92
1978-79	6.92	67.21	74.13	19.68	28.09	3.00	0.05	51.81	23.32
1979-80	23.32	72.38	95.70	19.68	29.82	3.00	1.00	53.50	42.20
1980-81	42.20	47.83	90.03	19.44	33.56	4.00	0.50	57.50	32.53
1981-82	32.53	43.17	75.70	19.11	33.46	4.00	0.61	57.18	18.52
1982-83	18.52	55.14	73.66	22.46	33.20	4.00	0.50	60.16	13.50
1983-84	13.50	53.10	66.60	19.02	33.28	4.00	0.20	56.50	10.10
1984-85	10.10	49.39	59.49	14.08	32.50	3.00	0.15	49.73	9.76
1985-86	**9.76	86.58	96.34	23.01	28.45	2.00	0.23	53.69	42.65
1986-87	42.65	54.61	97.26	22.41	33.56	2.29	-	58.26	39.00
1987-88	39.00	43.38	82.38	13.45	32.24	4.00	0.61	49.69	32.08
1988-89	32.08	44.39	76.47	16.17	31.68	4.00	1.18	53.03	23.44

Source: BJMC.

Annex Table 3: PRODUCTION AND EXPORTS OF JUTE GOODS BY BANGLADESH: 1980/81-1989/90

Year	Production				Exports			
	Hessian	Sacking	Carpet Backing	Total/a	Hessian	Sacking	Carpet Backing	Total/a
	('000 tons)							
1980-81	205	310	71	591	183	238	76	501
1981-82	198	329	56	587	187	295	54	537
1982-83	228	242	94	570	225	195	91	514
1983-84	242	179	97	544	214	162	94	475
1984-85	210	219	81	524	185	177	73	443
1985-86	161	225	67	491	150	242	69	494
1986-87	205	249	81	597	208	198	73	533
1987-88	224	226	60	578	176	176	61	474
1988-89	190	238	71	558	146	218	56	508
1989-90	178	268	69	664	194	209	67	542

/a Total includes jute yarn and other minor jute products.

Source: FAO, Quarterly Review of Statistics.

Annex Table 4: BANGLADESH'S AND INDIA'S EXPORTS OF SACKING AND THEIR SHARES: 1972/73-1988/89 /a

Year	Bangladesh		India	
	Quantity	Share	Quantity	Share
	('000 tons)	(%)	('000 tons)	(%)
1972/73	172	59.8	73	25.4
1973/74	209	57.2	102	27.9
1974/75	184	51.0	128	35.5
1975/76	201	68.1	63	21.2
1976/77	212	71.2	65	22.0
1977/78	245	72.6	61	18.0
1978/79	202	70.4	37	13.0
1979/80	210	68.6	44	14.2
1980/81	238	65.5	66	18.0
1981/82	295	74.7	56	14.3
1982/83	195	76.8	32	12.5
1983/84	162	71.3	15	6.51
1984/85	177	66.9	35	13.3
1985/86	242	79.9	27	8.8
1986/87	198	73.2	20	7.3
1987/88	176	68.3	7	2.5
1988/89	218	81.3	8	3.0

/a Shares in combined exports of Bangladesh, India and Thailand.

Source: FAO.

Annex Table 5: BANGLADESH'S AND INDIA'S EXPORTS OF HESSIAN AND THEIR SHARES: 1972/73-1988/89 /a

Year	Bangladesh		India	
	Quantity	Share	Quantity	Share
1972/73	166	39.5	254	60.5
1973/74	147	39.9	221	60.1
1974/75	139	33.3	278	66.7
1975/76	162	41.4	229	58.6
1976/77	154	40.6	225	59.4
1977/78	187	40.0	281	60.0
1978/79	170	40.1	254	59.9
1979/80	183	38.7	290	61.3
1980/81	187	43.9	239	56.1
1981/82	225	51.3	214	48.7
1982/83	214	57.5	158	42.5
1983/84	185	48.1	200	51.9
1984/85	150	46.3	174	53.7
1985/86	20[illegible]	53.7	179	46.3
1986/87	176	50.4	173	49.6
1987/88	146	51.8	136	48.2

/a Shares in combined exports of Bangladesh, India and Thailand.

Source: FAO.

Annex Table 6: BANGLADESH AND INDIA JUTE GOODS EXPORT PRICES 1970-89

Countries	Bangladesh				India			
Product	Hessian		B-Twill Sacks		Hessian		B-Twill Sacks	
Currency Units	Taka 100 Yds	US$ 100 Yds	Taka 100 Bags	US$ 100 Bags	Rupee 100 Yds	US$ 100 Yds	Rupee 100 Bags	US$ 100 Bags
Seasons								
1970-71	55.3		111.4		88.8	11.8	265.1	35.1
1971-72	119.0		272.2		108.0	14.6	275.4	37.1
1972-73	107.2	13.8	262.5	33.7	100.9	13.0	258.3	33.2
1973-74	138.6	17.4	281.5	35.3	132.2	16.6	293.8	36.9
1974-75	156.8	17.7	416.6	46.9	133.2	16.6	372.1	46.4
1975-76	172.3	11.6	508.6	34.2	108.4	12.2	324.2	36.4
1976-77	189.7	12.3	493.3	31.9	109.2	12.0	316.1	35.6
1977-78	233.2	15.4	639.3	42.3	133.7	15.8	362.3	42.7
1978-79	305.7	20.1	771.2	50.7	162.6	20.0	426.9	52.5
1979-80	471.6	30.5	1,029.6	66.5	231.0	28.5	525.1	64.8
1980-81	348.8	21.3	929.4	56.9	161.0	20.1	457.0	57.0
1981-82	331.5	16.5	934.3	46.6	150.0	16.4	437.0	47.7
1982-83	416.8	17.7	1,117.3	47.4	169.0	17.3	497.0	50.8
1983-84	522.3	21.7	1,377.9	57.3	238.0	22.6	692.0	65.6
1984-85	716.8	27.5	1,834.1	70.3	353.0	28.8	1,095.0	89.5
1985-86	572.1	19.1	1,603.0	53.6	250.0	20.4	655.0	53.5
1986-87	513.1	16.7	1,415.2	6.2	238.0	18.5	594.0	46.2
1987-88	573.6	18.4	1,367.1	43.8	254.0	19.3	688.0	52.4
1988-89	627.0	19.5	1,369.0	42.6	321.0	21.2	875.0	57.8
1989-90	651.0	19.8	1,422.0	43.2	407.0	24.0	1,116.0	65.8

Sources: Prices - FAO Intergovernmental Group on Jute, Kenaf and Allied Fibers.
Exchange Rate - International Monetary Fund.

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