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Research Note

**ECONOMIC AND FINANCIAL PROFITABILITY OF AROMATIC AND FINE RICE PRODUCTION IN BANGLADESH**

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**ABSTRACT**

The study was undertaken to evaluate the economic and financial profitability of aromatic and fine rice production, using both primary and secondary data. Forty farmers who cultivated both *Kataribhog* and *Chinigura*, and fifteen farmers each producing *Pajam* and *Nizershail* were selected from Dinajpur district. For the *Kalijira* variety, thirty farmers were selected from Sherpur district. Among the aromatic and fine rice varieties *Pajam* had the maximum per hectare yield. But net returns per hectare for the aromatic varieties were higher due to the higher market prices and less production cost of the varieties. Domestic Resource Cost (DRC) ratios showed that Bangladesh had comparative advantage in the production of aromatic and fine rice both from the point of view of export and import substitution, except the *Nizershail* variety which was marginally unprofitable under export proposition. The study also identified some problems faced by the farmers in producing aromatic and fine rice. Finally, some policy guidelines were suggested.

**I. INTRODUCTION**

Rice is the staple food of about half of the world's population. Of the three most important cereals produced in the world -rice, wheat and maize- almost all of rice is used for human consumption. Bangladesh, producing about 26 million tons of milled rice annually, is the 4<sup>th</sup> largest rice producer in the world. About 10 million hectares, consisting of very small farms, are used annually to produce this rice. The rice sector contributes about 18% to the national GDP and offers more than 50% of employment. For income generation, the rural poor spend up to 60% of their time on rice production and processing activities (BRF 2002).

Bangladesh produces many fine aromatic and non/aromatic rice varieties with excellent eating quality for regular consumption as steamed rice as well as for *polao* and *biryani* type preparations. For regular consumption, local varieties such as *Kataribhog*, *Kaktara*, *Banshful*, *Bau-pagal*, and *Nizershail* are among the fine varieties that are currently grown. BRRI-developed BR-6, BR-16 (shahibalam), BR-36, BR-38, and BR-39 are the fine, slender grains that have attractive qualities in the export market. Some of them have slightly pleasing aroma. For *polao* and *biryani* type preparations, *Kalijira*, *Chinigura*, *Dolhabhog* (BR-5), BR34 and BR-38 are among varieties that are considered excellent, with small-to-medium sized grains and fine aroma. BR-26 rice is slender and long and has soft and slightly sticky consistency-qualities that should have demand in the East Asian markets (Japan and Korea).

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There are other varieties with the desirable qualities that are grown in various locations in Bangladesh but not well known outside those areas. In western and middle-eastern countries, where Bangladeshi communities constitute a significant proportion of population, a major 'consumer bank' is already in existence that could be successfully exploited through proper promotion and marketing incentives. As a food, rice and rice-based preparations are becoming increasingly popular with the non-Asian populations all over the world, including Europeans, Americans and affluent Africans. With proper promotion and marketing support, Bangladeshi fine quality and aromatic rice could find significant markets both at home and abroad.

While so many prospects are in sight, achievement of the goal is fraught with a number of production, marketing and trade related problems. It would therefore be pertinent to examine the relevant issues for assessing the prospect of production and export of aromatic and fine rice in Bangladesh. Some works have been done on production and marketing of aromatic fine rice, including determination of financial costs and returns or profitability of aromatic fine rice. However, little works have been done on determination of economic profitability of these varieties of rice. This paper examines the profitability of aromatic and fine rice production, from the point of view of both farmers and the country as a whole.

## II. METHODOLOGY

### **Determination of Financial Profitability**

The information that were needed to determine the financial profitability of aromatic and fine rice were collected through structured interview schedule by directly interviewing the farmers who cultivated aromatic and fine rice. The survey was conducted during the period February to April 2003 to get the information of production of Aman season of the year 2002. A list of farmers growing aromatic and fine rice was collected from the Thana Agriculture Office of Chirirbandar and Sadar thana of Dinajpur and Sadar thana of Sherpur district. Forty farmers who cultivated both *Kataribhog* and *Chinigura*, 30 farmers producing *Kalijira* and 15 farmers each producing *Nizershail* and *Pajam* were selected randomly from the list. In total, 100 farmers were chosen from the selected areas. The costs and returns were calculated by enterprise costing method.

### **Determination of Economic Profitability**

The main sources of the data were various publications of the Bangladesh Bureau of Statistics (BBS), Bangladesh Bank, World Bank and Food and Agricultural Organization (FAO) of the United Nations. The f.o.b. price Bangkok was collected from the website of Food [market.com](http://market.com). The variety White Fragrant Rice of Class A 100% was considered as the representative variety for the varieties *Kataribhog*, *Chinigura* and *Kalijira* and the variety White 15% milled rice was used for pricing *Pajam* and *Nizershail* varieties. Some of the specific documents used were Huda (2001) and Hossain (1999) and a report by Rahman (1993).

Domestic Resource Cost (DRC) was calculated by using the following formula (Bruno 1972):

$$\text{DRC} = \frac{\text{Cost of domestic resources and nontraded inputs for producing per unit of output}}{\text{Value of tradeable output} - \text{Value of tradeable input}}$$

$$\text{or, DRC} = \frac{\sum f_{ij} P_j^d}{U_i - \sum a_{ik} P_k^b} \quad (j=1\text{-----}m, k=1\text{-----}n)$$

Where,

$f_{ij}$  = Domestic resource and non-traded inputs  $j$  used for producing per unit commodity  $i$

$P_j^d$  = Price of non-traded intermediate inputs and domestic resource

$U_i$  = Border price per input of output  $i$

$a_{ik}$  = Amount of traded intermediate inputs for unit production of  $i$

$P_k^b$  = Border price of traded intermediate input

Among the aromatic and fine rice varieties, only *Basmati* is imported and Bangladesh exports a number of other varieties. Thus Bangladesh produces fine and aromatic rice varieties both as an export and import substitution proposition. Therefore, both import and export parity prices were used for estimating DRC. Inputs were divided into 'tradable' and 'non-tradable' inputs. Tradable intermediate inputs are those which are either exported or imported. In the context of Bangladesh, it would be plausible to consider chemical fertilizers viz., Urea, TSP and MP as tradable intermediate inputs. Since Urea is both exported and imported, both export and import parity price was calculated and in case of TSP and MP only import parity price was considered. Some other inputs such as irrigation equipment and pesticides are also imported. But since detailed cost of production figures for irrigation equipment were not available and since pesticides constituted a small portion of the total cost of production, these two items were not considered. The costs of fertilizers were measured in terms of border price at farmers' level. The resources that have the mobility within the country and not used as a commodity in the international market are considered as non-tradable intermediate inputs and domestic resources. In Bangladesh, unskilled agricultural labour, animal power, land, seed, manure, irrigation charge, interest on operating capital generally belong to this category. Necessary costs on these items were obtained from the field survey.

#### **Border Price at Farmgate (Import Parity)**

The c.i.f. price Chittagong was obtained by adding freight from Chittagong to Bangkok with the f.o.b. price Bangkok. The c.i.f. price Chittagong plus transportation cost from Chittagong to Dinajpur and domestic trading cost less cost from mill gate to wholesale and the cost from mill gate to farmgate represented the border price at farmgate. From this, milling cost was subtracted by adjusting the milling rate. Interest cost of three months was also subtracted. The transportation cost from Chittagong to Dinajpur was used for the variety

*Kataribhog, Chinigura, Pajam and Nizershail* and the transportation cost from Chittagong to Sherpur was added for the variety *Kalijira*.

### **Border price at farmgate (Export Parity)**

World price (f.o.b. Chittagong) equals f.o.b. Bangkok price minus the freight from Bangkok to Chittagong. Freight rate and f.o.b. Bangkok were the same as in the case of import parity. Border price measured at farmgate equals world price times official exchange rate less export handling and transportation cost less domestic trading costs less cost from mill gate to wholesale. The milling cost was then subtracted. Then the costs from farmgate to mill gate were subtracted to yield border price at farmgate. Export handling cost was collected from Rahman (1993) and was extended to 2003 by using Wholesale Price Index.

## **III. FINANCIAL AND ECONOMIC PROFITABILITY OF AROMATIC AND FINE RICE PRODUCTION**

### **Issues and Earlier Evidence**

From farmers' point of view, rice production will have to be financially rewarding compared to financial returns from other crop and non-crop enterprises. There are already signs of replacement of rice lands by other high value crops such as fruits and vegetables, and fish culture. From national point of view, whether or not a particular crop will be promoted for production will depend to a large extent on its comparative advantage in the export or import substitution proposition. It would therefore be worthwhile to perform some analysis on the financial and economic profitability of production of different rice varieties, particularly aromatic and fine rice varieties.

Earlier analysis showed that net economic returns of the special type of rice such as *Kalijira* and *Kataribhog* were substantially positive and thus the varieties had fair chance of finding good export market (World bank, 1995). While economic returns per hectare for *Kalijira* were similar to returns from other High Yielding Variety (HYV) *Aman* rice, those for *Kataribhog* were considerably higher than the return from other HYV *Aman* rice varieties. Although yields of the aromatic varieties were much lower compared to other non-aromatic varieties, lower cost of production and higher prices made the varieties fairly remunerative compared to the other rice varieties. Table 1 shows financial and economic profitability of selected aromatic rice vis-a-vis profitability of other rice varieties.

**Table 1. Financial and economic profitability of selected rice varieties**

Type of Rice	Yield (tons/ha)	Net Financial Return (Tk/ha)	Net Economic Return (Tk/ha)
Boro (HYV)	4.4	77000	13000
Aus (HYV)	3.3	6500	8900
T. Aman (HYV)	3.5	9600	12700
Kalijira	1.9	4500	12700
Kataribhog	2.8	10600	18200

Source: World Bank, 1995.

### Results of the Current Investigation

#### Results of Financial Profitability Analysis

Table 2 shows that per hectare production cost of *Kataribhog*, *Chinigura*, *Kalijira*, *Pajam* and *Nizershail* varieties were Tk. 22223.34, Tk. 26434.02, Tk. 28419.18, Tk. 26877.40 and Tk. 29588.90 respectively. The production cost was highest in the case of *Nizershail* variety. It is evident from the table that cost of human labour constituted the maximum portion of production cost. Costs of fertilizers and insecticides were very low. These low costs kept the production cost at low level. Per hectare yield of *Kataribhog*, *Chinigura*, *Kalijira*, *Pajam* and *Nizershail* rice was 2199.50 Kg, 2252.83 Kg, 2521.46 Kg, 3565.55 Kg and 4418.70 Kg respectively (Table 3). The value of straw was Tk. 26394, Tk. 2556.61, Tk. 1976.75, Tk. 1672.40 and Tk. 1535.24 for *Kataribhog*, *Chinigura*, *Kalijira*, *Pajam* and *Nizershail* rice respectively (Table 3).

Per hectare average value of *Kataribhog*, *Chinigura*, *Kalijira*, *Pajam* and *Nizershail* rice were Tk. 25194.00, Tk. 29286.76, Tk. 37821.87, Tk. 2852.98 and Tk. 32187.05 respectively. Thus the average per hectare gross return of *Kataribhog*, *Chinigura*, *Kalijira*, *Pajam* and *Nizershail* rice were Tk. 27466.01, Tk. 31843.36, Tk. 39798.62, Tk. 30196.80 and Tk. 33722.29 respectively. Per hectare net returns of *Kataribhog*, *Chinigura*, *Kalijira*, *Pajam* and *Nizershail* were Tk. 5242.66, Tk. 5409.34, Tk. 11379.44, Tk. 3319.40 and Tk. 4133.39 respectively (Table 3).

Per hectare gross margin of *Kataribhog*, *Chinigura*, *Kalijira*, *Pajam* and *Nizershail* were Tk. 13984.23, Tk. 16968.53, Tk. 23128.24, Tk. 12448.02 and Tk. 15734.08 respectively. Cash margins of *Kataribhog*, *Chinigura*, *Kalijira*, *Pajam* and *Nizershail* were calculated at Tk. 14236.87, Tk. 17551.44, Tk. 23747.10, Tk. 13456.98 and Tk. 16342.80 respectively (Table 3).

Output was defined in terms of kilograms of paddy per hectare. In case of *Kataribhog* rice, cost per unit (Kg) output were Tk. 6.13 on variable cost basis, Tk. 6.01 on cash cost basis and Tk. 10.10 on total cost basis. In the case of *Chinigura* rice, cost per unit (Kg) output were Tk. 6.60 on variable cost basis, Tk. 6.34 on cash cost basis and Tk. 11.73 on total cost basis. Cost of per unit of output of *Kalijira* rice were Tk. 6.61 on variable cost basis, Tk. 6.37 on cash cost basis and Tk. 11.27 on total cost basis. Tk. 3.35, Tk. 3.16 and Tk. 5.08 were the cost

of per unit of output of *Pajam* rice on the basis of variable cost, cash cost and total cost respectively. Cost of per unit of output of *Nizershail* rice were Tk. 4.07 on variable cost basis, Tk. 3.93 on cash cost basis and Tk. 6.07 on total cost basis (Table 3).

Undiscounted Benefit Cost Ratio (BCR) was calculated on total cost, variable costs and cash cost bases. The BCRs for the sample farmers were found to be 2.04, 2.08 and 1.24 on variable, cash and total cost bases in the case of *Kataribhog* rice. For *Chinigura* rice, BCRs were 2.14, 2.23 and 1.20 on variable, cash and total cost bases. In the case of *Kalijira*, BCRs were 2.39, 2.48 and 1.40 on variable, cash and total cost bases. The BCRs, for *Pajam* rice were calculated at 1.70, 1.80 and 1.12 on variable, cash and total cost bases. In case of *Nizershail* the BCRs were 1.87, 1.94 and 1.14 on variable, cash and total cost bases respectively (Table 3)..

**Table 2. Per hectare total cost of aromatic and fine rice production**

Sl. No.	Items	Kataribhog		Chinigura		Kalijira		Pajam		Nizershail	
		Cost (Tk.)	Percent of total cost (Tk.)	Cost (Tk.)	Percent of total cost (Tk.)	Cost (Tk.)	Percent of total Cost (Tk.)	Cost (Tk.)	Percent of total cost (Tk.)	Cost (Tk.)	Percent of total cost (Tk.)
Variable cost											
1	Human labour	9093.57	40.92	9565.43	36.19	12763.61	44.91	11828.85	44.01	12292.17	41.54
2	Animal labour	272.70	1.23	358.27	1.36	260.62	0.92	314.07	1.17	304.28	1.03
3	Power tiller	1849.01	8.32	2058.33	7.79	1576.94	5.55	2159.48	8.03	1879.35	6.35
4	Seed	1029.20	4.63	1256.68	4.75	1004.84	3.54	918.44	3.42	942.79	3.19
5	Fertilizer										
	Urea	216.65	0.97	267.20	1.01	150.28	0.53	747.92	2.78	693.57	2.34
	TSP	123.85	0.56	189.43	0.72	205.62	0.72	399.25	1.49	353.50	1.19
	MP	55.73	0.25	88.79	0.34	44.93	0.16	26.35	237.15	181.89	0.61
	Total cost of fertilizer	396.23	1.78	545.42	2.06	400.84	1.41	1384.32	5.15	1228.96	4.15
6	Cowdung	575.64	2.59	721.96	2.73	359.84	1.27	758.57	2.82	932.22	3.15
7	Insecticides	152.05	0.68	283.60	1.07	235.66	0.83	154.38	0.57	124.54	0.42
8	Irrigation	113.38	0.51	85.12	0.32	68.03	0.24	230.68	0.86	283.91	0.96
A.	Total variable costs	13481.78	60.66	14874.83	56.27	16670.38	58.66	17748.78	66.04	17988.21	60.79
Fixed cost											
1	Interest on Operating capital	179.76	0.81	198.33	0.75	222.25	0.78	236.63	0.88	239.82	0.81
2	Land use costs	8561.81	38.53	11360.86	42.98	11526.55	40.56	8892.00	33.08	11360.86	38.40
B.	Total fixed costs	8741.57	39.34	11559.19	43.73	11748.80	41.34	9128.63	33.96	11600.68	39.21
C.	Total cost (A+B)	22223.34	100.00	26434.02	100.00	28419.18	100.00	26877.40	100.00	29588.90	100.00

Source: Field survey 2003

**Table 3. Summary results of per hectare cost and return of aromatic and fine rice**

Sl. No.	Particulars	Variety				
		Kataribhog	Chinigura	Kalijira	Pajam	Nizershail
1	Yield(kg)	2099.5	2252.83	2521.46	3565.55	4418.70
2	Value of output (Tk.)	25194	29286.76	37821.87	28524.4	32187.05
3	Value of by-product (Tk.)	2272.01	2556.61	1976.75	1672.40	1535.24
4	Gross return (Tk.)	27466.01	31843.36	39798.62	30196.80	33722.29
5	Gross costs (Tk.)	22223.35	26434.02	28419.18	26877.40	29588.90
6	Variable costs (Tk.)	13481.78	14874.83	16670.38	17748.78	17988.21
7	Cash cost (Tk.)	13229.14	14291.92	16051.52	16739.82	17379.49
8	Net return (Tk.)	5242.66	5409.34	11379.44	3319.40	4133.39
9	Gross margin (Tk.)	13984.227	16968.53	23128.24	12448.02	15734.08
10	Cash margin (Tk.)	14236.87	17551.44	23747.10	13456.98	16342.80
11	Benefit-cost ratio (Variable cost basis)	2.04	2.14	2.39	1.70	1.87
12	Benefit-cost ratio (Cash cost basis)	2.08	2.23	2.48	1.80	1.94
13	Benefit-cost ratio (Total cost basis)	1.24	1.20	1.40	1.12	1.14
14	Cost per unit output (Variable cost basis)	6.13	6.60	6.61	3.35	4.07
15	Cost per unit output (Cash cost basis)	6.01	6.34	6.37	3.16	3.93
16	Cost per unit output (Total cost basis)	10.10	11.73	11.27	5.08	6.70

Source: Field survey 2003

**Results of Economic Profitability Analysis**

So far profitability of aromatic and fine rice production has been considered from private point of view. But this profitability may diverge from the society's opportunity costs of inputs and outputs because of many distortions in the product and factor markets.

In the DRC measure, domestic value added represents the actual payments to factors of production (cost of domestic resource and non-traded inputs for producing per unit of output e.g. wage, rent, water charge, seed, interest on operating capital etc.) in local currency units. The denominator, value added at world prices, is the difference between the world price of the competing imports or exports and the cost of imported inputs used to produce that commodity. Thus DRC becomes a measure of domestic cost of earning or saving foreign exchange and is an explicit expression of comparative cost principle in the international trade.

If the DRC is greater than one, it implies that the economy loses foreign exchange through domestic production of the crop (in the sense it consume more domestic resources than it generates net value added to tradable goods and services), while a DRC less than one



implies that the production is efficient and makes a positive contribution to domestic value added. It should be noted that a country may have a number of efficient production opportunities, but in order to maximize economic growth, it should pursue production of those for which it exhibits the strongest comparative advantage (i.e. the lowest DRC).

Tables 4 and 5 show the values of inputs and outputs divided into traded and nontraded inputs and domestic resource items. Traded inputs were valued at their world price equivalent at farm level. The prices of three types of fertilizers Urea, TSP and MP were collected from Huda (2001) and were extended up to 2002 by extrapolation. Values of all non-traded inputs were collected from primary survey. Table 4 shows DRC at import parity price. The DRC (import parity) for the period of investigation were estimated at 0.53, 0.61, 0.60, 0.57 and 0.76 for the varieties *Kataribhog*, *Chinigura*, *Kalijira*, *Pajam* and *Nizershail* respectively. Table 5 shows that the DRC (export parity) for the year 2002 were 0.60, 0.69, 0.80, 0.76 and 1.01 for the varieties *Kataribhog*, *Chinigura*, *Kalijira*, *Pajam* and *Nizershail* respectively.

Table 6 shows DRC (import and export parity) for the varieties *Kataribhog*, *Chinigura*, *Kalijira*, *Pajam* and *Nizershail* on the basis of Taka per dollar. DRC (import parity) of the varieties *Kataribhog*, *Chinigura*, *Kalijira*, *Pajam* and *Nizershail* were 30.69, 35.32, 34.74, 33.00 and 44.00 respectively, which were lower than official exchange rate in all cases. DRC (export parity), on the basis of Taka per dollar criteria were 34.74, 39.95, 46.32, 44.00 and 58.48 for the varieties *Kataribhog*, *Chinigura*, *Kalijira*, *Pajam* and *Nizershail* respectively. Thus the results of the study implied that production of the varieties *Kataribhog*, *Chinigura*, *Kalijira* and *Pajam* would be highly efficient for import substitution and export, the case being stronger for import substitution than for export.

**Table 4. Calculation of DRC (import parity) of aromatic and fine rice varieties in Bangladesh**

Item	Kataribhog	Chinigura	Kalijira	Pajam	Nizershail
A. Value of Tradable inputs (Tk/ton)	219.24	298.35	200.93	318.64	337.15
B. Value of non-tradable inputs (Tk/ton)	10047.70	11532.11	11188.45	4865.26	6487.42
Human labour	4134.38	4245.97	5062.00	2234.39	2781.85
Animal labour	123.98	159.03	103.36	59.33	68.86
Tilling cost	840.65	913.67	625.41	407.91	425.32
Seed	467.92	557.83	398.52	173.49	213.36
Cowdung	261.71	320.47	142.71	143.29	210.97
Irrigation	51.55	37.78	26.98	43.57	64.25
Interest on operating capital	274.88	254.43	258.10	123.65	151.71
Land use costs	3892.62	5042.94	4571.38	1679.64	2571.09
C. Output price (Tk/ton)	19350.86	19350.86	18734.34	8928.86	8928.86
D. Value added (Tradable) (C-A) (Tk/ton)	19131.62	19052.51	18533.41	8610.22	8591.71
E. DRC (B/D)	0.53	0.61	0.60	0.57	0.76

Source: Anik 2003

**Table 5. Calculation of DRC (export parity) of aromatic and fine rice varieties in Bangladesh**

Item	Kataribhog	Chinigura	Kalijira	Pajam	Nizershail
A. Value of Tradable inputs (Tk/ton)	219.24	298.35	200.93	318.64	337.15
B. Value of non-tradable inputs (Tk/ton)	10116.83	11657.99	11281.92	4894.42	6515.60
Human labour	4134.38	4245.97	5062.00	2234.39	2781.85
Animal labour	123.98	159.03	103.36	59.33	68.86
Tilling cost	840.65	913.67	625.41	407.91	425.32
Seed	467.92	557.83	398.52	173.49	213.36
Cowdung	261.71	320.47	142.71	143.29	210.97
Irrigation	51.55	37.78	26.98	43.57	64.25
Interest on operating capital	274.88	254.43	258.10	123.65	151.71
Land use costs	3892.62	5042.94	4571.38	1679.64	2571.09
C. Output price (Tk/ton)	17195.21	17195.21	14242.84	6773.21	6773.21
D. Value added (Tradable) (C-A) (Tk/ton)	16975.96	16896.86	14041.91	6454.57	6436.06
E. DRC (B/D)	0.60	0.69	0.80	0.76	1.01

Source: Anik 2003

**Table 6. DRC (import and export parity) of aromatic and fine rice varieties in terms of Taka per dollar**

Variety	DRC (Tk/dollar)		Official exchange rate (OER)	Direction	
	Import Parity	Export parity		Import parity	Export parity
Kataribhog	30.69	34.74	57.9	DRC<OER	DRC<OER
Chinigura	35.32	39.95	57.9	DRC<OER	DRC<OER
Kalijira	34.74	46.32	57.9	DRC<OER	DRC<OER
Pajam	33.00	44.00	57.9	DRC<OER	DRC<OER
Nizershail	44.00	58.48	57.9	DRC<OER	DRC>OER

Source: Anik 2003; Economic Trends, Bangladesh Bank (2002)

**Constraints to Production**

Use of quality seed is a prerequisite for good yield of a crop. For production of aromatic and fine rice, the seed issue is more critical because a substantial proportion of investment is anticipated to be exported after proper milling and processing of the crop. Farmers generally use their home-produced seeds, a large proportion of which are not processed and stored

under ideal conditions. There seems to be lack of organized efforts for scientific processing and storing of seeds of aromatic and fine rice varieties.

The traditional aromatic and fine rice varieties have relatively lower yields. Although the new varieties released by the BRRI have promising yields, they are yet to be extensively adopted across the country. Farmers generally feel skeptic in adopting the new varieties, particularly in replacing the old varieties by the new ones, because of the fear of losing some of the traits of the old varieties.

The aromatic rice varieties are very sensitive to the cultural practices followed in the production. Farmers complained that they had been observing gradual loss of aroma and fineness of the rice varieties, possibly because of imbalanced use of manures, fertilizers and cultural practices.

The other problem is the frequent lodging of rice plants which seriously affect grain qualities. The lodging of plants is also attributed to imbalanced use of inputs and improper cultural practices.

Since aromatic and fine rice varieties are grown during the T. Aman season, they are generally produced under rainfed condition. Shortage of rainfall often affect production of the rice varieties. Provision should be made for supplementary irrigation to protect the crop from any possible drought during the Kharif II season.

Fluctuation of price seriously affect production of the aromatic and fine rice varieties. Since the aromatic varieties have relatively thinner domestic market, and export of rice is constrained by many trade and non-trade related barriers, lack of proper combination of domestic demand and export avenues causes wide range of price fluctuation from year to year. This situation calls for concerted efforts towards establishing an organized production, marketing and trade channels. Thus there is a need for establishing some form of vertical integration comprising production, marketing and trade in which farmers would be protected from any major fluctuation of prices of the rice varieties.

#### **IV. CONCLUSIONS AND POLICY IMPLICATIONS**

Results of the analyses showed that production of aromatic and fine rice was profitable both from financial and economic point of view. Except for Nizershail, all the selected aromatic and fine rice varieties had comparative advantage of production both for import substitution and export. Although Nizershail did not have comparative advantage in the export market, production of the variety had sufficient merit as an import substitution proportion. Thus aromatic and fine rice production would be amply justified both from private and social point of view.

The study identified some constraints which need to be addressed for improving the production environment of aromatic and fine rice. Research work need to be strengthened to address the issues of low yield, lodging of plants and loss of aroma of the aromatic rice

varieties. Measures should also be taken to make provision of supplementary irrigation for production of the rice varieties. In order to ensure a dependable target of production every year, farmers need to be protected from major fluctuation of prices of the rice varieties.

In order to improve economic profitability of the aromatic and fine rice varieties, policies need to address two major issues: reducing domestic cost of production and minimizing marketing and trade related costs and barriers.

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