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## **POLICY IMPLICATIONS OF INVESTMENT ON RICE RESEARCH AND DEVELOPMENT BY THE DEPARTMENT OF AGRICULTURE**

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### **ABSTRACT**

At present, new rice varieties cover over 98% of the cultivated area in the country and contribute towards achieving self-sufficiency in the staple diet. This was possible due to large-scale investment made by the government for rice research and development. This study examines the social welfare aspects of this public investment pertaining to equity and efficiency. The analysis of consumers' surplus as well as the producers' surplus indicates that the consumers are the major beneficiaries of rice research and development programmes. Low price elasticities of demand and supply have resulted in an increase in consumers' welfare at the loss of producers' benefit. The social benefit cost ratio was estimated to be 1.77. The external and internal rates of return were 404 and 28 percent, respectively. The high social rate of returns suggests that financing rice research and development programmes by channelling revenue obtained by imposing taxes is rationalized in terms of its contribution to the economic development. The analysis also provides evidence to inadequate resource allocation for agricultural research.

**KEYWORDS:** Rice Research and Development, Consumers' Surplus, Producers' Surplus, Social Rate of Returns.

### **INTRODUCTION**

Expenditure for agricultural research is necessarily a long-term investment with little or no possibility of gaining immediate benefits due to the time lag between development of technology and its adoption by farmers. However, such investments are not a matter of choice but a necessity, as seeking paths deviating from endogenous growth may threaten the food security of a country. Capital investments are considered to be of vital and timely importance for developing countries to achieve the increased productivity. Therefore, the opportunity cost of expenditure for agricultural research cannot be underestimated. It is in this context that this study focuses on evaluating the productivity and efficiency of funds allocated for rice research and development activities in Sri Lanka. The Department of Agriculture (DOA) is the major organization in the country responsible for research and development (R and D) pertaining to the food crop sector, and within this mandate area, R and D activities on rice research and development have been accorded very high priority owing to their political and socio economic importance. The DOA has several research stations in the different

agro-climatic zones, focusing mainly on R and D in rice. The rice research and development network of the DOA comprises Rice Research and Development Institute (RRDI), Batalagoda, Regional Agricultural Research and Development Centre, Bombuwela, Rice Research Stations at Labuduwa and Bentota and Agricultural Research Station at Ambalantota. All R and D activities are centrally coordinated by RRDI. While new varieties and production technologies are developed by these agencies technology transfer is vested with the Extension and Training Centre (ETC). Ensuring the availability of high quality seed to the farmer is the responsibility of Seed and Planting Material Development Centre (SPMDC) and the Seed Certification Service of the Seed Certification and Plant Protection Centre (SCPPC).

In the 1970s, investment by DOA on rice research and development was about Rs. 15 million and increased in nominal terms to about Rs. 481 million, in the year 2003. This enhanced investment is partly reflected in the increase in the national average yield, which recorded an increase from about 2.5 t/ha in the early 1970s to over 3.8 t/ha by the turn of the century (Department of Census and Statistics, 2002). However, little is known about the impact of this enhanced investment in rice R and D on the economic growth of the country.

Development of new varieties was the priority in most of the rice R and D programs in the past. At present, new rice varieties cover over 98% of the total cultivated area in the country. Major share of the investment was incurred towards varietal development. However, so far, no study has been conducted to evaluate the social welfare impact of such investment on rice R and D. Therefore, it is necessary to quantify the costs and benefits associated with rice R and D and its distributional effects.

The overall objective of this study is to evaluate the impact of rice R and D on social welfare and to suggest policy implications. The specific objectives of this study are to:

1. Analyze the distribution of social benefits;
2. Estimate the social benefit cost ratio and social returns of investment; and
3. Examine future direction of policy implications relevant to rice R and D programs.

## METHODOLOGY

### Model

The Marshallian concept of consumers' and producers' surplus can be applied to analyze cost and benefits associated with the investment on rice research and development. Figure 1, shows a shift in the aggregate supply

curve from S. to  $S_t$ . This shift is attributed to the adoption of improved technology developed through the rice R and D programmes.

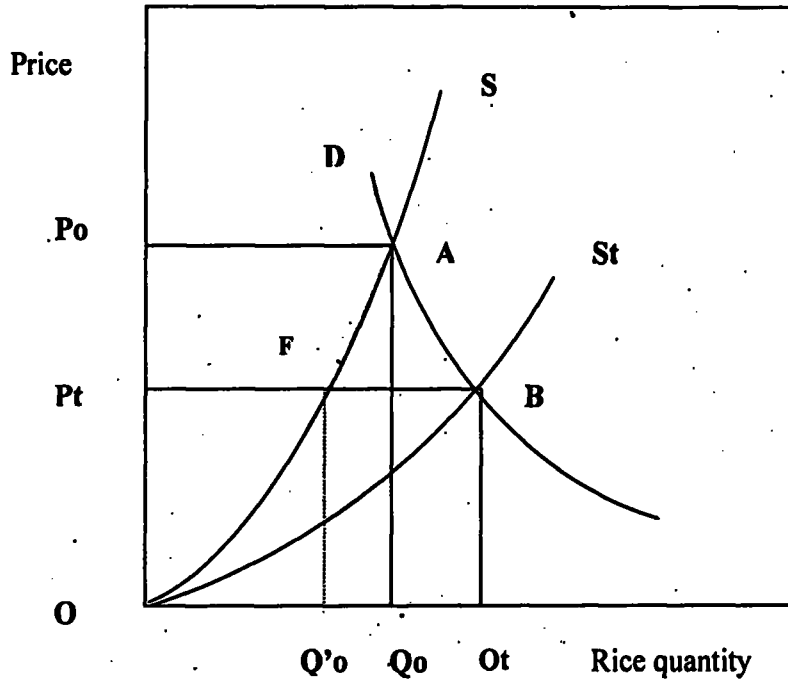


Figure. 1. Model for estimating social returns to rice research and development in Sri Lanka

The shift in the supply curve produces a change in the “consumers’ surplus” by the area  $ABF + AP_oP_tF$ . The same supply shift will produce a change in “producers’ surplus” by the area  $BFO - AP_oP_tF$ . The total change in economic surplus (Producer + Consumers) will be the area  $ABF + BFO = AOB$ .

This model provides a convenient organization of the concept behind the measurement of benefits from rice R and D programmes.

**Computing benefit streams**

The conversion of supply function shift estimates into welfare gains (or losses) require information about demand and supply elasticities. Multiplying the shift factors by the value of production effected provides approximate estimates of the total gains. Changes in price elasticities of demand and supply will have only a minor effect on the estimates of total welfare gains. However, it will have an important influence on the distribution of the gains between producers and consumers. A model developed by Akino and Hayami (1975) is

applied for the purpose of measuring the total welfare gain. Referring to figure 1, the relevant areas may be approximated as follows;

$$\text{Area AFB} \cong \frac{pq[k(1+\beta)]^2}{2(\beta+\eta)}$$

$$\text{Area BFO} \cong kpq$$

$$\text{Area AP}_0\text{P}_t\text{F} \cong \frac{kpq(1+\beta)}{\beta+\eta} \left[ \left\{ \frac{1 - 1/2 k(1+\beta)\eta}{(\beta+\eta)} \right\} - \left\{ \frac{k(1+\beta)}{2} \right\} \right]$$

$$\text{Area BFQ}'_0\text{Q}_t \cong k(1+\beta)pq$$

Where

- p - is the price of rice
- q - is the output of rice
- k - is the rate of shift in the rice production function
- $\beta$  - is the price elasticity of rice supply
- $\eta$  - is the price elasticity of rice demand

#### Data collection and analysis

The secondary data used in the analysis were gathered from several sources. Annual research and development expenditure data on rice were obtained from the annual budget of the DOA (for the period 1971 to 2003). These budget estimates provide the capital and recurrent costs in respect of all the institutions/ centers under the DOA. Total annual expenditure on rice R and D was estimated by adding the full budget allocation of RRDI to 50 percent budget allocation of the SPMDC, SCPPC, ETD and Administrative Division of DOA. In addition, about 10 percent of budget allocations of the Horticultural Crop Research and Development Institute (HORDI) and Field Crop Research and Development Institute (FCRDI) were also included on consideration of their contribution to varietal adaptability trials and other rice related programmes. National rice production data were collected from the Department of Census and Statistics. A deflator value of the Central Bank (based on 1996) was used to estimate the real values of all the prices and cost data. Own price elasticity of rice supply and shift in the production function due to research investment were assumed as 0.59 and 0.05, respectively (Niranjan *et al.*, 2000). The estimate of the price elasticity of demand for rice was taken as 0.515 (Samaratunga *et al.*, 2001).

The share of investment on rice R and D by different institutes and centers varied over the study period depending on the then prevalent government priorities and the structural changes of the DOA. However, due to unavailability of accurate information of relevance, approximate investment cost percentages were applied in this study to analyze the social benefit costs and distribution effects.

## RESULTS AND DISCUSSION

**Distribution of social benefits**

Consumers' surplus, producers' surplus and economic surplus of investment on rice research and development are presented in Annex 1. Positive values shown for the consumers' surplus indicate that they were the beneficiaries of the investment on R and D in rice. At the same time, negative values for producers' surplus show a worsening of the plight of the producers, indicating an inequitable allocation of resources. This is an outcome of the low price elasticity of demand and supply in the rice sector. The demand elasticity, in particular, plays a decisive role in the distribution of benefit among consumers and producers. However, a positive total economic surplus indicates that the society, on the whole, had benefited from the investment. Should the producers have the power of monopolistic pricing, they would be able to capture a major share of the welfare gain by taking advantage of the inelastic demand of rice in the country. However, such a possibility does not exist in the case of rice, characterized by near perfect competition among a multitude of small producers. This is identified as the main reason for the worsening of the plight of producers, with an accompanying gain by consumers.

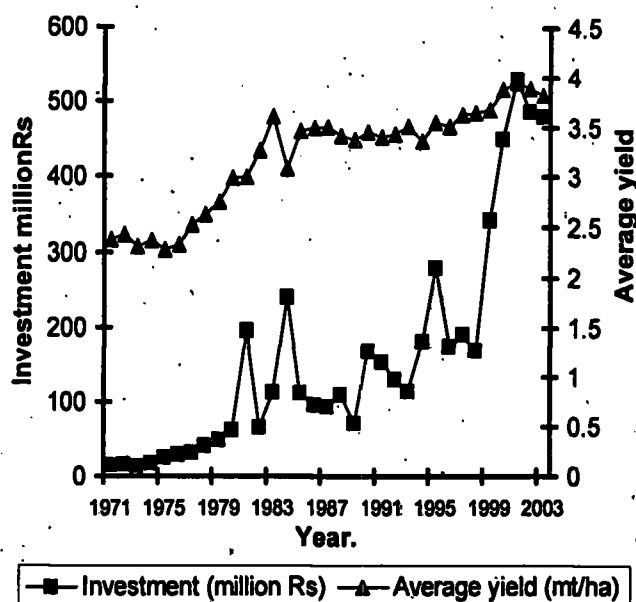
**Social benefit cost ratio**

The social benefit cost ratio of greater than one shows that the rate of return to rice R and D has resulted in positive social well being (table 1).

**Table 1. Social benefit cost ratio of investment on rice research and development.**

<i>Year</i>	<i>Ratio</i>
1971 - 2003	1.77
1971- 1980	2.21
1980- 1990	1.08
1990- 2000	3.68

At the same time, these investments have failed to make a pronounced effect on the yield, which appears to reach a plateau after 1985 (Figure 2). The ratio of social benefit cost ratio of more than 1, too, confirms that the society, as a whole, has benefited from investment on rice R and D.



**Figure 2. Research investment as related to the yield of rice.**  
 Source: Department of Agriculture and Department of Census and Statistics.

This analysis has revealed that the social benefit cost ratio varies from time to time. This is mainly linked to the change in government policies. From independence to 1977, paddy farming thrived under a protected and supportive trade environment showing a high social benefit cost ratio of 2.21 (table 1). Import and export restrictions were removed with the liberalization of rice trade in early 1980s. The demand and supply, as reflected in the market, are the principal factors determining the farm-gate price of paddy in competition with imports. The lowest social benefit cost ratio of 1.08 observed in 1980 - 1990 period is attributed to this open market policies. The period 1990-2000 recorded a better farm gate price compared with that of the preceding decade (Price ranged from Rs. 2.39 - 5.68 to Rs 7.32 - 12.31 in the period of 1980-1990 to 1990 - 2000) and had a relatively lower R and D investment, leading to a high social benefit cost ratio of 3.68.

#### Social rate of return

The estimates of External Rate of Return (ERR) for investment on rice R and D was 403.8% while the Internal Rate of Return (IRR) was 28%. Judging from this estimate, investment on research and development had been highly justifiable.

### Policy implications

The study indicates that the producers are worse off due to the low price elasticity of demand and supply for rice, a situation which could be improved through the production of high quality rice varieties and value added rice products that would fetch better prices. This will change the inelastic nature of rice demand and producers will start to gain from investment on rice research and development. Therefore, more investments are needed for the development of high quality rice varieties, improvement of milling industry and to develop and encourage consumption of rice-based products in the country.

Unfavorable government policies have affected the social benefit cost ratio as well the income of farmers engaged in rice production. Therefore, consistent government policies are needed in relation to input and output prices, trade and tariff, and investments on R and D in order to sustain the rice production as an economically viable sector in the country. Unfortunately, the percentage of GDP invested on rice research has declined from 0.3% in 1966 to 0.18% in 1996 (Fernando and Amaradasa, 1998; Ministry of Finance, 1999). This meager investment is quite inadequate considering the importance of the crop and food security concerns. The study points at the need to make policy changes that benefit the producers to a greater degree.

### CONCLUSION

Analysis has shown that the investment in rice research between 1970 and 2003 had yielded high returns to the society, with the consumer benefiting more than the producer. Making equitable benefits available to all stakeholders may be achieved by increasing the investment on R and D efforts in quality rice varieties, value addition and improving the milling industry. Consistent government policies on pricing, tariff and trade for the rice sector are needed for its further development.

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Annex 1

<b>Economic surplus of investment in rice research and development</b>			
<i>Year</i>	<i>Consumer surplus</i>	<i>Producer surplus</i>	<i>Economic surplus</i>
1971	1137213716	-333625899.5	803587816.4
1972	1100465449	-322845011.7	777620437.6
1973	1559235970	-457435129.3	1101800841
1974	1996731119	-585783662.5	1410947456
1975	1338040637	-392542760.2	945497876.5
1976	1370154233	-401963968.5	968190264.1
1977	1874026573	-549785666.9	1324240906
1978	1960372887	-575117199.6	1385255687
1979	1716722580	-503637185.3	1213085395
1980	2021522959	-593056877.7	1428466082
1981	2348588039	-689008394.9	1659579644
1982	2189030132	-642198679.6	1546831452
1983	2291149653	-672157619.3	1618992034
1984	1938438174	-568682183.9	1369755990
1985	2247602990	-659382276.9	1588220713
1986	2124701094	-623326384.2	1501374710
1987	1715411839	-503252651.3	1212159187
1988	1839507255	-539658688.7	1299848567
1989	1868191348	-548073779.2	1320117569
1990	2468021665	-724046796.5	1743974869
1991	2064453600	-605651496.8	1458802103
1992	2049310032	-601208808.1	1448101224
1993	2066016715	-606110069.9	1459906645
1994	1947018763	-571199482.7	1375819281
1995	1831025028	-537170246.3	1293854782
1996	1538651730	-451396303.2	1087255426
1997	1713882365	-502803947.5	1211078417
1998	1767798702	-518621455.2	1249177247
1999	2190433522	-642610393.9	1547823128
2000	2007651168	-588987291.8	1418663876
2001	1707593471	-500958966.5	1206634505
2002	1769235306	-519042913.4	1250192392
2003	1853765152	-543841546.9	1309923606
<b>Total</b>	<b>61611963867</b>	<b>-18075183738</b>	<b>43536780129</b>