Tropical Agricultural Research Vol. 12: 249-254 (2000)

Impact of Rice Research on Rice Production in Sri Lanka

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ABSTRACT. This paper examines the impact of rice research investments on rice production in Sri Lanka. A supply function was estimated using time series data (1959–1999). Lagged research expenditure was included as one of the explanatory variables in the supply function. Results reveals that research investments have taken 8 years to show any positive change in rice production. This impact continued until the 12th year. Elasticity of supply with respect to rice research expenditure was 0.37. Elasticity of supply with respect to own price and price of seed paddy were 0.59 and −0.69 respectively. If research investment was increased by 10% over the period 1959–1999, domestic supply would have been increased by 3.56%.

INTRODUCTION

Numerous studies document high returns to investment in agricultural research. Rice is a sector of major importance in the economy of Sri Lanka and with the goal of self-sufficiency, successive governments have given priority to increasing production. Amongst other things, rice research and development has been actively promoted. Rice research is still a public activity and the Department of Agriculture (DOA) has established research stations in the different agro-climatic zones where rice research is a principal activity. Investment in rice research increased in real terms from about Rs. 2,400 in the early 1960s to about Rs. 17,000 in the late 1990s. However, they declined as a per cent of the gross domestic product (GDP), from 0.30% in 1966 to 0.18% in 1996 (Fernando and Amaradasa, 1998; Ministry of Finance, 1999). The research impact is in part reflected in the increase in yields, from about 1.5 mt ha^{-1} in the early fifties to over 3.5 mt ha^{-1} in the late nineties (Department of Census and Statistics, 1998 and 2000). There is increasing concern however that the rate of increase in yields appears to be slowing down. Questions arise as to how much should be spent on rice research and how it should be spent. Answers to such questions depend in part on an evaluation of the impact of rice research. *Ex-post* studies of this nature are also of importance in *ex-ante* research prioritisation exercises. The objective of this study is to estimate the impact of research investment on rice production in Sri Lanka.

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METHODOLOGY

The conceptual model

Economic theory suggests that product supply depends on the price of the commodity, the prices of other commodities which could be produced, the prices of inputs, and technology. The relationship can be expressed in the form of a supply function. Successful investment leads to increases in product supply and as such can be incorporated into the supply function. Research investment that results in a yield increasing or cost reduction technology leads to a shift in the supply curve as depicted in Fig. 1. The supply curve shifts from S_0 to S_1 and the quantity supplied increases from Q_0 to Q_1. The single equation supply response model has been widely used to estimate the returns to research (Alston *et al.*, 1995). It is well known that lags occur in research and its adoption. Assumptions have to be made about lag lengths and their duration, which then can be incorporated into the supply response model. Equally, price lags can also be taken into account.

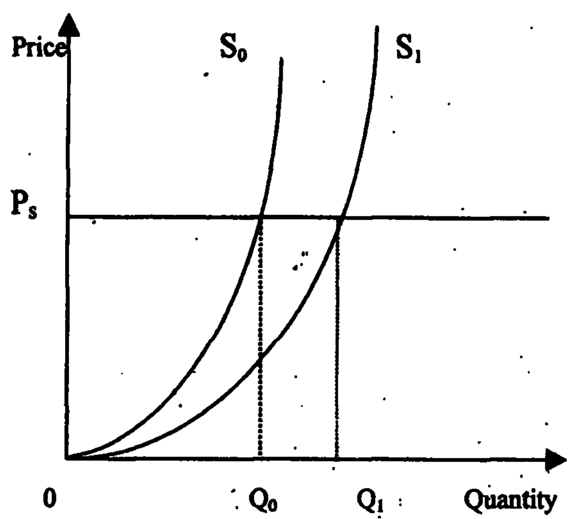

Fig. 1. Supply function shift.

A supply function of the form given below is used in this exercise:

$$Qs_t = g\ (Ps_{t-1}, Pi_t, R_{t-k}, \ldots, R_{t-k-r}, T_t)$$

where, at time t, Qs is quantity supplied, Ps_{t-1} is producer price at time $t-1$, Pi_t is price of inputs (i = 1,2,...,n) such as fertilizer, seeds and labour *etc.*, R_{t-k} is investment in research at time $t-k$, R_{t-k-r} is investment in research at time $t-k-r$ and T is a proxy for other types of technology. Parameter k represents the time after which benefits occur (duration of the research lag) and parameter r represents the duration over which benefits are retained.

Many reasons can be adduced to explain the research lag. There are intervals between the time that research activity commences and knowledge is generated, new technology innovated and the adoption of the new technology. In estimating a supply function as represented above, 4 important decisions have to be made. These relate to (a) the type of research expenditure that should be used, (b) the type of lag distribution that should be imposed (c) the duration of the research lag, and (d) the duration over which benefits are retained (Alston *et al.*, 1995).

(a) Research expenditure

The research expenditures utilized in research evaluation are of 2 types: One relates to expenditures in the location or country in which the research is carried out. The second takes into consideration research carried out in other locations or other countries, in short the spill-over benefits.

(b) The lag distribution

The impact of research expenditures have been studied using different lag models, such as polynomial lags, trapezoidal lags, geometric lags *etc.* These refer to the type of relationship after investment in research, the adoption of the new technology, and its obsolescence. This has been identified as consisting of a research lag, a development lag and an adoption lag (Alston *et al.*, 1995). Polynomial lag models with different degrees and end-point restrictions are used in this study.

(c) The duration of the research lag (parameter k)

The occurrence of research lags was referred to above. Parameter k refers to the time after which benefits begin to occur.

(d) The duration of benefits (parameter r)

The parameter r refers to the duration over which benefits are retained.

The supply equation can be used to estimate the shift in supply to calculate the change in economic surplus and the rates of return to research. This study focuses only on the impact on production.

The empirical model

The following supply function was estimated:

$$lQ_s = s_0 + s_1 lP_{t-1} + s_2 lRES + s_3 lS + s_4 W$$

where, lQ_s is the log of the quantity of paddy supplied (mt), lP_{t-1} is the log of the average real producer price of paddy lagged by one year (Rs kg^{-1}), *lRES* is the log of real research expenditure on rice lagged over different periods and distributed as a polynomial (Rs), *lS* is the log of real price of seed paddy (Rs bu^{-1}), *W* is the proxy for weather (the ratio of rice area harvested to total rice area cultivated), and s_0, s_1, s_2, s_3, and s_4 are parameters to be estimated.

Different durations of the research lag (k) and duration of the research benefits (r) were tried out and a research lag of 8 years and a benefit lag of 5 years, that is from 8[th] year to 12[th] year were the most appropriate according to the statistical estimation and used in the empirical model. Benefits before the 8[th] year and after the 12[th] year were found to be insignificant.

Data

The secondary data used in the analysis were gathered from several sources. Annual recurrent research expenditure data on rice from 1959–1999 were initially obtained from the vote ledgers of the Rice Research and Development Institute (RRDI). Recurrent expenditure includes personal emoluments of permanent researchers and other support staff members, and permanent and casual labourers; travelling expenses (domestic and foreign); supplies (stationery and office requisites, fuel and lubricants, uniforms, mechanical and electrical goods and other supplies); contractual services and research grants (local and foreign). Rice research is being carried out not only at RRDI but also at several research institutes/centres that belong to DOA. Hence, the following procedure is followed to calculate the total annual rice research expenditure for the whole country. The percentage budget allocations for each research institution/centre for the last 5 years for rice research were calculated using the INFORM (Information for Research Managers) database maintained at the Council for Agricultural Research Policy (CARP). The 5 year average as a percentage for rice research by each research institute/centre[2] was used to adjust the actual rice research expenditure at RRDI in order to obtain the total Sri Lankan rice research expenditure for each year. Farm gate price of paddy was obtained from the Statistical Abstracts of the Department of Census and Statistics (DCS). Seed paddy price was derived from the Guaranteed Price Scheme (GPS) obtained from the DOA. Proxy for weather (the ratio of rice area harvested to total rice area cultivated) was based on the data obtained from the DCS. All price and cost data were deflated by the Colombo Consumer Price Index (CCPI) for food to convert into real terms.

RESULTS

The supply function was estimated using the Ordinary Least Squares (OLSQ) and the Auto-regression (AR1) methods. The Polynomial Distributed Lag (PDL) research variable is considered as the most appropriate form as shown in the final model below. Several computations were checked for significance under both OLSQ and AR1

[2] Capital expenditure related to rice research is not included in the analysis.

procedures. The best fit final model was chosen after omitting non-significant variables. The best-fit model is given below:

$$lQ_s = 4.45 + 0.59\ lP_{t-1} + 0.37\ lRES - 0.69\ lS + 2.20\ W$$

The detailed results of the estimation are shown in Table 1.

Goodness of fit values for the supply function for rice was 0.97. As explained earlier, the research benefits are assumed to flow from the 8th year after commencement of research and are sustained till the 12th year. Results indicate that in each year from the 8th year to the 12th year, a 1% change in research expenditures results in 0.053, 0.080, 0.087, 0.080 and 0.065% changes in rice production respectively. Over the 5 year period from the 8th–12th year, the research impact on rice production is estimated at 0.37%. The price elasticity of supply is estimated at 0.59 while the price elasticity of seed paddy is estimated at -0.69. These elasticity coefficients are in line with results reported in other studies (Mangahas *et al.*, 1967; Bogahawatte, 1978; Bogahawatte, 1984; Tsakok, 1990). This study was not extended to estimate the rate of return to research. However, the sensitivity of domestic rice supply to changes in research investment over the entire period was examined. Increase in research investments by 10% and 20% for the period of simulation (1959–99) respectively would have had a 3.56% and 6.91% increase in the domestic supply of rice. Reduction in research investments by 10% and 20% respectively would have had a 3.79% and 7.85% decrease in the domestic supply of rice.

Table 1. Results of the estimation.

Explanatory variable		Coefficient	t-Statistics	Elasticity
Constant in the supply function		4.45***	5.73	0.59
One year lag producer price		0.59***	2.71	0.05
Research expenditure	(t - 8)	0.05*	1.80	0.08
	(t - 9)	0.08***	3.18	0.09
	(t - 10)	0.09***	3.49	0.08
	(t - 11)	0.08***	2.91	0.07
	(t - 12)	0.07*	1.72	0.37
	Sum of lag research	0.37***	5.33	-0.69
Seed paddy		-0.69**	2.37	
Weather proxy		2.20***	4.88	
$R^2 = 0.97$				
Durbin - Watson = 1.97				

* Significant at 10% level ** Significant at 5% level *** Significant at 1% level

CONCLUSIONS

Research investment in Sri Lanka has shown a statistically significant positive impact on rice production. Rice research impact was realized after 8th year of the investment. Production of rice increases gradually after 8th year up to 12th year and then decreases gradually. The research elasticity is estimated at 0.3

Certain caveats are in order in interpreting the results. Problems arise in terms of the data available, the assumptions made in terms of the functional form, the variables used, the lag periods and the lag structure imposed. Results of different formulations however, were very similar. It is felt that the results indicate general orders of magnitude. The general conclusion is that research investment had a positive impact on supply and that producers would have stood to benefit from rice research.

ACKNOWLEDGMENTS

This paper is part of a ongoing postgraduate study. Financial assistance by CARP for the postgraduate study is acknowledged.

REFERENCES

Alston, J.M., Norton, G.W. and Pardey, P.G. (1995). Science under scarcity, principles and practice for agricultural research evaluation and priority setting. Ithaca: Cornell University Press.

Bogahawatte, C. (1978). Some factors affecting yield of paddy in Mawathagama, Kurunegala district. J. National Agric. Society of Ceylon. 15: 63-68.

Bogahawatte, C. (1984). The demand for fertilizers in rice production in two selected villages of Sri Lanka: A cost function approach. Sri Lankan J. Agric. Sci. 21: 10-19.

Department of Census and Statistics. (1998). Paddy Statistics from 1952-1980.

Department of Census and Statistics. (2000). Paddy Statistics.

Fernando, C.M. and Amaradasa, W. (1998). National survey of research and development, 1996. NARESSA, Colombo.

Mangahas, M., Recto, A.E. and Ruttan, V.W. (1967). Production and market relationships for rice and corn in the Philippines. International Rice Research Institute, Technical Bulletin 9.

Ministry of Finance. (1999). Budgetary Estimates.

Tsakok, I. (1990). Agricultural price policy, a practitioners guide to partial equilibrium analysis. Ithaca: Cornell University Press.