Comparative Advantage in Rice Production

Policy Options Facing Sri Lanka

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Sri Lanka and a number of developing countries in monsoon Asia, who traditionally exported estate crops and imported rice have, in recent decades, pursued a policy of self-sufficiency in rice with considerable success. Massive public investments in constructing irrigation infrastructure and the diffusion of the green revolution technology since the late 1960s have been the major driving forces in achieving this goal. The rapid increase in rice production in several Asian countries led to a sharp drop in world and domestic rice prices in the 1980s (Fig. 1). A question often asked is whether the country has achieved the goal of national self-sufficiency in rice at a high cost? It is also argued that over the years Sri Lanka has lost its comparative advantage in rice production. This paper examines the level and trend in comparative advantage of rice production in Sri Lanka over three decades, measures the contribution of irrigation to the change in comparative advantage and identifies the factors contributing to the change in comparative advantage. We highlight the apparent change in comparative advantage in rice production among Asian countries and discuss the policy options for Sri Lanka to maintain a comparative advantage in the future.

Estimations of the Comparative Advantage in Rice Production

A well-established method of presenting comparative advantage is to measure domestic resource cost (DRC). DRC compares the opportunity cost of the domestic resources used in production with the value added that it generates. That is:

$$DRC = \frac{\text{Domestic Resources and non-traded inputs required to produce one unit of the good, valued at shadow prices}}{\text{Net foreign exchange earned or saved by producing one unit of the good domestically}}$$

A country has a comparative advantage in the production of a commodity if the social opportunity cost of producing an incremental is less than the border price (import cost) of the commodity. The shadow price for non-tradable inputs and domestic resources (such as labor) is the opportunity cost assuming the highest value use of these resources other than for rice production. Tradable inputs and rice (in the denominator) are valued at their import cost. This definition of comparative advantage or social profitability is essentially a benefit-cost analysis and is equivalent to identifying a countries' potential capability for either export or (as in the case of rice in Sri Lanka) import substitution.

To bring the numerator and the denominator of the DRC to the same numeraire we divide numerator by the shadow exchange rate SER (i.e. exchange rate adjusted for over-valuation) and define it as the resource cost ratio (RCR). RCR less than 1 indicates a comparative advantage; RCR greater than 1 indicates a comparative disadvantage.

Table 1 - Domestic resource cost (DRC), shadow exchange rate (SER) and resource cost ratio (RCR) of rice production by irrigation regime, Sri Lanka, 1968-95[a]

	Domestic resource Cost (DRC) (1)	Shadow exchange Rate (SER)[b] (2)	Resource cost Ratio (RCR) (1) / (2)
Major Irrigation[c]:			
1968	7.4	6.4	1.15
1980	11.9	20.4	0.58
1985	26.2	31.0	0.85
1990	41.3	42.5	0.97
1995	56.0	57.9	0.97
Rainfed:			
1980	12.0	20.4	0.59
1985	30.7	31.0	0.99
1990	44.7	42.5	1.05
1995	55.7	57.9	0.96
All country[d]:			
1980	11.9	20.4	0.59
1985	28.1	31.0	0.91
1990	42.6	42.5	1.00
1995	55.9	57.9	0.97

[a] Most related variables are in terms of five-year averages centering on the years shown. Average of Maha and Yala seasons.
[b] Assume 16% over-valuation in the exchange rate in the 1980s and earlier, and 10% over-valuation in the exchange rate in the 1990s.
[c] The ideal level of O&M expenditure is included as cost (Rs. 1828/ha/year in 1995 prices).
[d] Aggregated using the rice production in each regime as weights', while assuming the average of the two regimes for the minor irrigation regime.

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The results of our analysis for major irrigation schemes, for rainfed rice production, and for the country as a whole are shown in Table 1. The data and assumptions used in this study can be found in Kikuchi, et al., (2000). For rice production in the major irrigation schemes, the estimation of irrigation costs takes only O&M into account. However, we assume here the level of O&M needed to sustain the operation of major irrigation schemes for the designed usable life span of 50 years.

Our DRC estimates being subject to an unknown degree of statistical errors, we have to be careful in drawing conclusions from our results. However, for the period in and after 1980 for which data are relatively more reliable, it would be safe to conclude that rice production in Sri Lanka definitely had a comparative advantage around 1980. The comparative advantage has eroded in the last two decades, but the rice sector does not face an overt comparative disadvantage at present.

Table 2 - RCR of rice production under the major irrigation regime by type of irrigation investment, Sri Lanka, 1968-95[a]

	O&M alone[b]	New construction[c]	Rehabilitation[d]	
			Minor[e]	Major[f]
1968	1.15	1.79		
1980	0.58	1.11	0.59	0.62
1985	0.85	2.53	0.87	0.94
1990	0.97	3.46	1.00	1.07
1995	0.97	4.99	1.00	1.08

[a] Assume over-valuation in the exchange rate of 16%, 16% and 10% for 1968, the 1980s and the 1990s, respectively. Five-year averages centering on the years shown.
[b] The ideal level of O&M expenditure (Rs. 1828/ha/year in 1995 prices).
[c] The cost of constructing new irrigation systems in addition to O&M.
[d] The cost of rehabilitating irrigation systems in addition to O&M.
[e] Water-management improvement with minor rehabilitation.
[f] Major rehabilitation project (represented by the unit cost of the ISMP).

Impact of Irrigation Costs on Comparative Advantage

How are the conclusions for the major irrigation schemes modified if other costs of irrigation are taken into account in addition to O&M costs? Table 2 presents RCR estimations that incorporate the cost of new construction and the cost of rehabilitation for major irrigation schemes.

The cost of new construction refers to the investment cost for constructing new irrigation schemes. New irrigation projects in Sri Lanka began just after independence from relatively easier sites and moved to more difficult ones. The cost escalation of new construction is reflected in our estimates. The inclusion of new construction costs raises the RCR for rice production dramatically (Table 2). Except in 1980, when it was close to unity, the RCR has far exceeded the break-even level.

Figure 2 shows how the combination of rising costs and falling rice prices have affected the benefit/cost ratio for new irrigation. Using the construction costs of the 1970s we estimated the 1980 RCR to be 0.88. Thus, at the time the decision to move forward with the Accelerated Mahaweli Project the RCR for new construction was favourable. However, it rose sharply in the 1980s well before the Mahaweli was completed.

As mentioned earlier, a newly constructed irrigation scheme, if properly maintained, is expected to continue in operation for several decades. As in other developing countries, however, the O&M of these irrigation schemes have rarely been adequate resulting in rapid deterioration in their performance after their construction. Irrigation rehabilitation often aims at not just restoring but modernizing systems to a level higher than their original design. Rehabilitation projects can be grouped into two depending on the emphasis of the projects: (i) major rehabilitation if the emphasis is on improving the physical structure of irrigation and (ii) minor rehabilitation if the emphasis is on improving management or institutional aspects requiring lower unit project costs. Table 2 shows that the RCR for major rehabilitation is slightly above the breakeven and the RCR for minor rehabilitation (emphasis on management and institutions) differs little from the estimate with O&M alone, both being about at the breakeven point.

Factors that have Brought about Change in Comparative Advantage

When we express RCR in unit value it becomes net social profitability (NSP). NSP is more convenient when we want to analyze causes of change in social profitability. A comparative advantage in rice production exists if RCR is less than 1 or NSP is positive.

The NSP for major irrigation systems in Sri Lanka is shown

Table 3 Net social profitability (NSP) of rice production for major irrigation regime, Sri Lanka, 1968-95[a]

		1968 (Rs/mt)	(%)	1980 (Rs/mt)	(%)	1985 (Rs/mt)	(%)	1990 (Rs/mt)	(%)	1995 (Rs/mt)	(%)
Rice price[b]	(1)	611	100	4,302	100	4,173	100	6,657	100	9,082	100
Tradable inputs (fertilizer and other)											
Total	(2)	118	19	804	19	863	21	1,656	25	2,264	25
Domestic factors (labor, land and other)											
Total	(3)	568	93	2,039	47	2,802	67	4,856	73	6,590	73
Grand Total	(4) = (2)+(3)	686	112	2,843	66	3,665	88	6,512	98	8,854	97
NSP	(1)-(4)	-76	-12	1,460	34	508	12	145	2	227	3

[a] Corresponds to the RCR of the second column of Table 2 – major irrigation, with O&M cost alone. Five-year averages centering on the years shown.
[b] Farm-gate equivalent border price of rice (in terms of paddy) converted to rupee by SER.

in Table 3. Costs for domestic production exceeded the import cost of rice in 1968, but was much higher than the import cost of rice in 1980. After 1980 the NSP fell sharply reaching almost the breakeven point in the 1990s.

Table 4 shows the factors that have contributed to the change in NSP between the five time periods. The most significant contributing factor to the improvement in comparative advantage has been the depreciation of the exchange rate followed by the increase in world rice price brought about by the food crisis in the 1970s. The impact of the technological change is observed in the fact that the share of domestic resources in a unit of rice fell from 93 to 43 percent between 1968 and 1980 (Table 3).

From 1980 to 1985 the NSP showed a large decline due mainly to the decline of the world rice price as a result of the very success of the green revolution and irrigation development in the preceding decades in many developing countries in Asia including Sri Lanka. From 1985 onward the continued depreciation of the exchange rate helped to sustain comparative advantage but increases in the social cost have counter-balanced this movement. Increasing wage rates have been the major factor bringing down the comparative advantage in recent years. The adoption of labor saving technology has therefore become increasingly important.

Comparative Advantage in other Asian Countries

What has been the experience of other Asian countries and how does it compare with Sri Lanka? The nominal protection rate for rice provides a rough indication of the change in comparative advantage among Asian countries. The nominal protection rate is estimated as the percentage difference between the domestic and border (import) price of rice. Table 5 shows the nominal protection rate for rice for Sri Lanka and eight other Asian countries.

Table 4 - Sources of change in net social profitability of rice production (Rs/mt), by irrigation regime, Sri Lanka, 1968-95[a]

	1968-80	1980-85	1985-90	1990-95
Major irrigation				
Change in NSP	1,535	-952	-363	82
Social value added:				
Exchange rate	1,787	1,355	1,290	1,816
Rice price	1,488	-1,811	810	6
Input prices[b]	-290	248	-341	49
Input coefficients	22	20	-67	-55
Total	3,006	-189	1,691	1,817
Social costs (deduct):				
Labor coefficient	-113	-171	-131	-552
Wage rate	616	606	984	1,712
Land coefficient	-434	-75	-66	-89
Land rent	1,132	164	790	128
Others	271	239	476	536
Total	1,471	763	2,054	1,735

[a] Based on five-year averages shown in Table 3.
[b] All tradable inputs combined.

As countries lose comparative advantage they are faced with the decision of whether to protect their rice producers by maintaining domestic prices above international prices and restricting imports. The East Asian countries as they have become more developed have chosen to protect their domestic producers maintaining domestic rice prices as much as 2 to 5 times above the international market in the 1988-95 period (Table 5).

Until the change in government in 1978, Sri Lanka had a policy that protected domestic rice producers, but since then Sri Lanka's domestic rice price has been very much in line with the international price. But now, due in large part to steadily rising wage rates and other costs, Sri Lanka and a number of other Asian countries are beginning to lose their comparative advantage. For example, a study conducted recently in the Philippines (Estudillo, et al., 1999) concludes that "the country appears to have slowly lost its comparative advantage due to the decline in rice prices, stagnation in rice yield, and rising cost of domestic factors." This situation is similar to what has been experienced in Sri Lanka.

The comparative advantage in Asia as a whole is shifting to the large river deltas many of which historically (from the opening of the Suez Canal to World War II) were the source of Asia's rice exports. Initially these delta areas lacked the water control needed to adopt the green revolution technologies. But with improved water management and pumping technologies and low labor costs, rice production in areas such as Eastern India, Bangladesh, and Vietnam is increasing more rapidly than in areas which were initial beneficiaries of the new technology. With appropriate domestic policies, Cambodia and Myanmar also have the potential to once again become major rice exporters.

Conclusions and Policy Options

Through massive investments in infrastructure and adoption of new

Table 5 - Nominal protection rate for rice in nine Asian countries[a]

Country	1960-70	1970-80	1980-88	1988-95
Japan	70	148	443	496
South Korea	17	65	243	431
Taiwan	-12	6	101	246
Philippines	31	-3	6	39
Bangladesh	68	51	32	18
Indonesia		3	27	18
Sri Lanka	36	42	-4	8
Thailand	-28	-28	11	5
India	19	-5	-3	-17

Source: IRRI World Rice Statistics

[a] Estimated as the percentage difference between the domestic and border (import) price of rice.

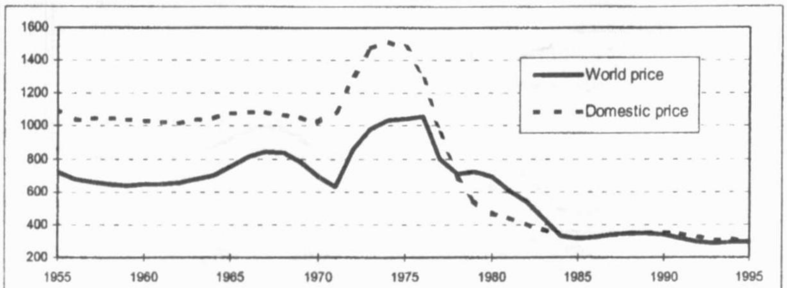


Fig. 1. World rice price (Thai 25% broken; Colombo CIF) and domestic rice price (farm-gate price of rough rice in milled rice equivalent at Colombo port), 1958-97, deflated by the world export price index (1995=100), five-year moving averages

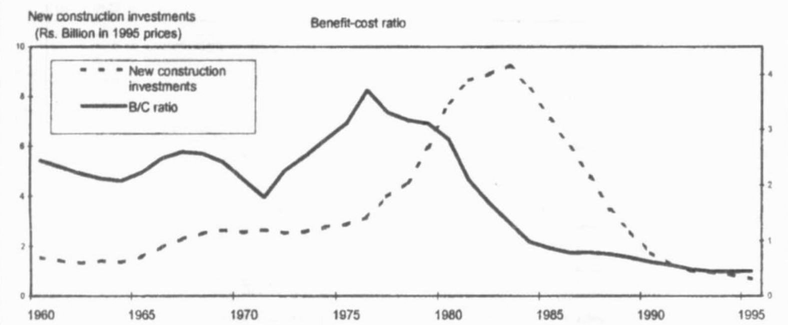
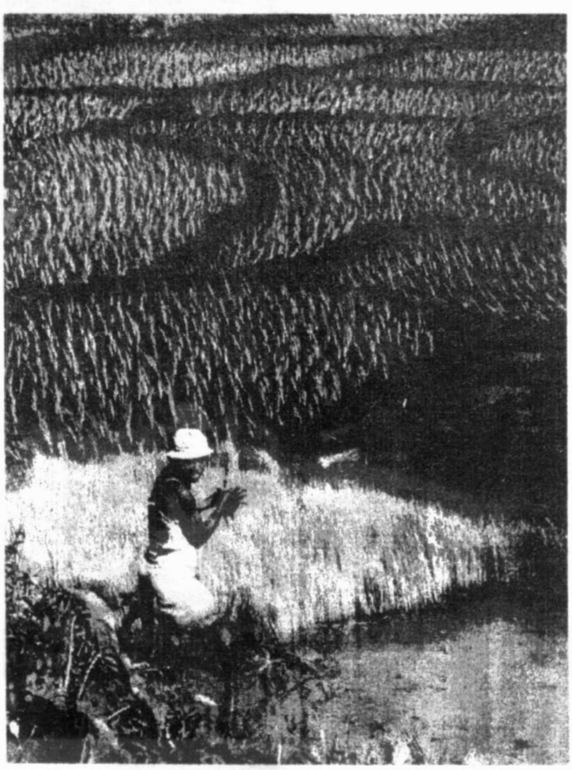


Fig. 2. Changes in benefit-cost ratio of new irrigation construction investments evaluated at current world prices and total new irrigation construction investments in 1995 constant prices, five-year moving averages, 1960-1995

technology, rice production and productivity grew rapidly in the 1970s and '80s allowing the Government to achieve its goal of rice self-sufficiency. However, the comparative advantage in rice production has been eroding over the past several years.



Now a more modest growth rate can meet future growth in demand as the population growth rate has slowed and per capita consumption of rice is declining. Can this more modest growth rate be achieved without further loss in comparative advantage, avoiding the need to either increase rice imports or subsidize rice producers? This is the question faced not just by Sri Lanka but by a number of other Asian rice importing countries.

The answer to this question is yes if we can increase the productivity of land, labor, and water resources. A strong investment in rice research and extension must be coupled with continued strong ties with international research agencies to obtain the benefits of research in areas such as biotechnology. But equally important are well working land and labor markets aided by well defined land and water rights

What is the potential for increasing yields with existing technology? The national level yield of rice in Sri Lanka has been fairly constant at around 3 tons per hectare since the mid 1980s, and this yield level is in line with countries such as the Philippines and Malaysia. Yields in Indonesia and Vietnam on the other hand are approximately 4 tons per hectare, which is the level achieved on major irrigation schemes in Sri Lanka. Yields for minor irrigation are 3 tons and for rainfed rice just over 2 tons. A national average goal of reaching 4 tons per hectare over the next decade would seem reasonable.

As labor moves out of agriculture, adoption of labor saving technology will raise the productivity of agricultural labor. Institutional reforms will be needed to insure that increasingly scarce water resources are allocated equitably among sectors and to encourage water saving practices in agriculture at both irrigation system and farm level.

The most important implication of this study is that the rice sector of Sri Lanka has already entered a difficult stage of economic development. There will be a temptation for governments of developing countries like Sri Lanka to follow the path of the developed countries and subsidize rice production. They may resort to the argument of multi-functional values of agriculture, now advanced primarily by the industrialized countries in East Asia and the EU in the face of negotiations with the World Trade Organization. We suggest that with appropriate domestic policies the current level of self-sufficiency in rice can be maintained without resort to subsidies. The benefits from a more productive rice sector will accrue to both producers and consumers.