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Trends in Paddy Production in Sri Lanka

A. Mohamed Razmy*
A. Naseer Ahmed**

Abstract

In recent years viability of the paddy production sector in Sri Lanka has been a question because of lack of net profit to the paddy-producing farmers. It has been well proved by the attitude of the young generation who diverge from the paddy cultivation. Even though the country could able to reach the self-sufficiency due to increased average yield and extent of cultivation it failed to satisfy the poor farmers. In this study an attempt is made to understand the past trends in paddy production in order to find out the reasons for the above discussed problems and to forecast the future requirements. Paddy production related variables such as extent sown, extent sown under different water sources, crop failure percentage, production, average yield, cost of production, standard of living of the farmers, rice consumption and imports of rice over the time have been analyzed using simple and complex time series analysis techniques and other statistical techniques. Future situations have been forecasted from the result of the analysis.

During the last three decades cost of production increase is significantly higher than the increase of the selling price of paddy, which affected the standard of living of the farmers. At present in the farmer's point of view, still they are cultivating paddy because of return to their own labor, lack of better alternative jobs and the lowest investment for paddy. Therefore to uplift and keep viable the paddy production in Sri Lanka, the cost of production, scale of cultivation and the market price have to be kept in control while keep on increasing the average yield. Results indicate that, a farmer to have a reasonable standard of living in 2006, at least 2.81 hectares to be cultivated by one farmer and the profit margin should be Rs. 2.32 per Kg paddy produced.

Keywords: paddy production, extent sown, extent sown under different water sources, crop failure

Introduction

Unmistakable signs of environmental stress in Sri Lanka at present cause serious concern. One cause for this is lower productivity and lower income to the people. Sri Lanka is an agricultural country where one third of the land is used for agriculture and it contributes Rs. million 237,411 to the GDP, which is 15.2 % of the total GDP of Sri Lanka (2003). In addition, this sector provides 37 % of the total employment to the nation. These figures would be even higher if agriculture raw materials dependent industries are included.

Paddy production sector is a main sector, which gives lower productivity and lower income to the people. This sector provides 7% of the total employment to the nation but contributes only 2.6% to the total GDP (2003). In terms of Sri Lankan's diet also it is an important sector because it accounts for about 45% of the per capita calorie and 45% of per capita protein requirements.

During the past and present significant new laws and programs have been implemented to gain self-sufficiency in paddy production and to uplift farmers' income. Very recently Sri Lanka could able to approach the self-sufficiency but failed to meet the satisfaction of the poor farmers where their standard of living has deteriorated. The actual results of these new laws and programs depend in part on how well planners, decision makers and citizens understand the past and present situations and problems of paddy production

***A. Mohamed Razmy**, is a Lecturer in the Department of Mathematical Sciences, South Eastern University of Sri Lanka.
****A. Naseer Ahmed**, Senior Lecture in the Department of Biological Sciences, South Eastern University of Sri Lanka.

and how well they forecast the future in each sector. Wrong understanding of the paddy production sector will lead to unrecoverable problems. This profile provides that the best available information on significant sectors and its trends are vitally very important. It should help to the government and private sector institutions to identify and rank natural priorities for action when starting development programs and facing a dauntingly vast number of problems, demands and choices.

For practical reasons trend assessments has to be done in discrete sectors but true perspective and sound policy require understanding of complete interactions among the paddy production sectors over time. Unfortunately most of these assessments on paddy production in Sri Lanka are not done properly and therefore policy planing is done blindly. Therefore in this paper the trends of the extent sown, extent sown under different water sources, extent harvested, crop failure, production, average yield, cost of production, standard of living of the farmers, rice consumption and imports of rice over the years are investigated. Finally forecasts of the future demands have been estimated.

Objectives

1. To analyze the past trends in paddy production.
2. To organize the available data related to paddy production.
3. To forecast the future demands in paddy production.

Methodology

As the important part of this study is explaining the trends in paddy productions and related variables over time, the trends have been analyzed for the two distinct seasons Maha and Yala. For the analysis secular trend models and cyclical movement models have been used. Under secular trend analysis simple linear regression, non-linear regression and multiple linear regression analysis have been used. Only for crop failure cyclical movement model has been fitted. In certain instances where models could not be fitted due to irregular fluctuations, only graphical analysis was performed. For comparisons depend on the situations one sample t test, pooled t test, paired t test, randomized complete block designs were used. To compare the standard of living of the farmers over the years the following ratio index has been used.

Ratio index = net profit in Rs. Per hectare/ Colombo consumer price index for the year (CCPI) *100

Results and Discussion

Extent sown

The extent sown in each year and season fluctuate due to inclusion of new land, not cultivating the land, seawater intrusions into the land and diversification of the lands for other purposes. It is shown in Figure 1 that from 1950 to 1984 the total extent sown increased at a rate of 13,794 hectares per year in which Maha accounts for 9,840 hectares per year and Yala accounts for 3,943 hectares per year. That is from 431,455 hectares to the peak of 990,199 hectares (130% increase in 35 years) with negligible drops in some particular years (1956, 1959, 1973, 1975, 1979, 1982 & 1983). This increase is mainly due to large lands area being opened up for peasant colonization and settlements in the dry zone in both seasons Maha and Yala.

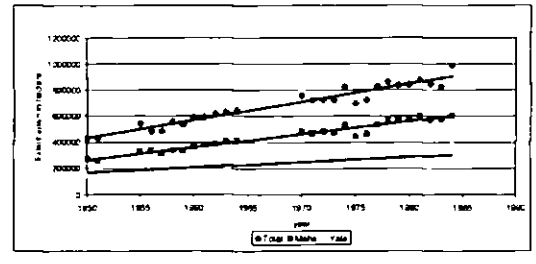

Figure 1 Extent Sown (1950-1984)

From 1984 to 2004 period the extent sown is vastly influenced by the ethnic conflict in the dry zone. From 1984 to 1992 the total extent sown (two years moving average) dropped at a rate of 23,642 hectares per year (adj R^2=88.1%). That is from 990,199 hectares to 741.843 hectares (25 % drop in 9 years). It could be observed during the no war period the extent sown has been increased (1994, 1995, 2002 and 2003) and it is a good example to show that how the production is correlated with the ethnic conflict. In 2003 the total extent

sown approached the ever-maximum extent shown in 1984, which is 990,199 hectares.

Both seasons Maha and Yala follow the same pattern in extent sown over the years as expressed in the total extent sown except during the period 1984 to 1992 the drop in Yala is not significant and it was maintained 309,730± 31370 hectares (P=0.05). The rate of drop for Maha from 1984 to 1992 is 8,769 hectares per year (adj R^2=97.2%). The peak extents sown 606,441 and 383,758 hectares in Maha and Yala respectively were observed in 1984. The extent sown in Maha is 1.81 times of extent sown in Yala. (1.81±0.07, P=0.05).

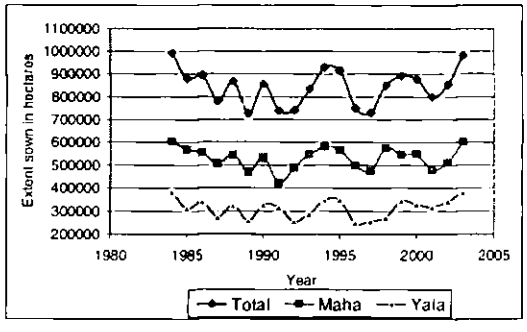

Figure 2 Extent Sown (1984-2003)

Extent Sown under Different Water Sources

In Sri Lanka depending on water source used, the paddy cultivation system varies. Three main water sources are used and those are major irrigation system, minor irrigation system and rain fed. The extent under minor irrigation system has changed proportionately to the total extent change and over the years, 22.06 % of total extent has been cultivated under minor irrigation system (22.06 ± 0.65, P=0.05). The extent cultivated under Major irrigation system has been 23.41 % of total extent up to 1970 and after 1970 it increased according to the following log model:

$\ln Y = 3.00 + 0.279 \ln X$ adj. $R^2 = 95.3\%$

Where,

Y = The percentage of extent under Major irrigation system X = Year

Like the Major irrigation system the percentage of extent cultivated under rain fed system has been 55.53 % up to 1970. But after 1970 as it decreased according to the following semi log model Y= 59.9 - 9.31 Ln X (adj. R^2 = 94.8%). The overall trends in different systems are shown in Figure 3 and Table 1 shows the differences in percentage of extent cultivated under different systems between Maha and Yala seasons.

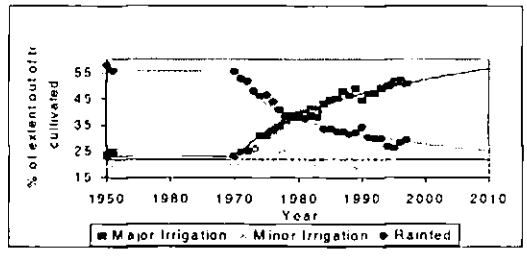

Figure 3 Overall trends under major and minor irrigation and rain fed systems.

Table 1: Confidence ranges for Maha -Yala extents for the three different schemes

System	Difference in % (Maha-Yala) (P=0.05)
Major Irrigation	-7.23 ± 1.18
Minor Irrigation	4.48 ± 1.35
Rain Fed	2.75 ± 1.78

Crop Failure

Figure 4 shows the total crop failures over the years. In average 6.17% of total crop failure has been observed over the years (6.17% ± 1.22%, P=0.05). But an eight-year cyclic movement has been identified using time series plot with origin in 1970 and seasonal indices were calculated for all eight years in the cycle. The fluctuation in percentage of crop failure within the eight-year cycle compared with the average crop failure was calculated and is illustrated in Figure 5. Deseasonallized values (seasonally adjusted values) were calculated to express the trends.

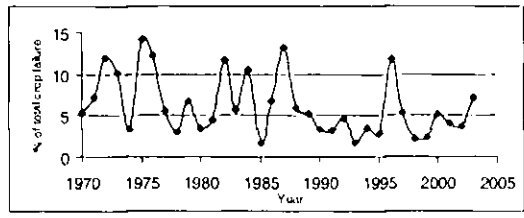

Figure 4 Percentage of total crop failure (1970-2003)

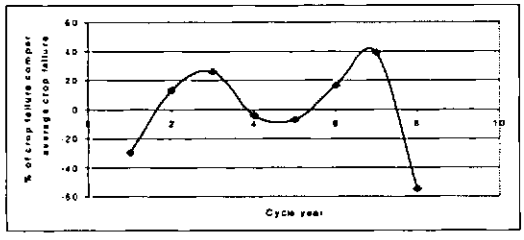

Figure 5 Crop failure cycle

However there were no regular trends. No significant difference in crop failure was observed between the seasons Maha and Yala (Maha 7.58%±1.55%, Yala 5.43%± 1.55%, P=0.05). Also in crop failure, no significant difference was observed between the Major, Minor and Rain fed systems (Major 4.68%±2.38%, Minor 8.43%± 2.38%, Rain fed 8.69%± 2.38%, P=0.05).

Production

The paddy production in each year and season fluctuates due to changes in extent sown, extent harvested and average yield. Theses changes are shown Figure 06. Extent and average yield changes are affected by many physical and environmental factors such as weather, pest attack, government policies etc. In 2003 the production reached an all time high level of 3,071 thousand metric tons super passing the previous peak out put in 2000 by 7 percent. Production 2003 in the Maha season super passed the previous best Maha production in 2000 by 6.4 percent and Production 2003 in the Yala season super passed the previous best Yala production in 1999 by 4.9 percent. Favorable climate as well as the cessation of war contributed to the overall improvement. The productions models for separatelyboth seasons and for the total production are given below.

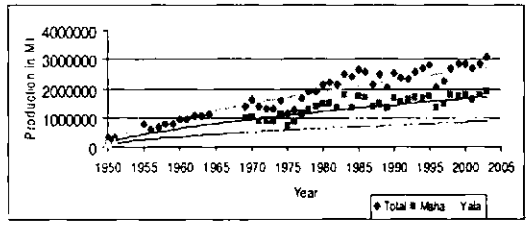

Figure 6 Paddy production over the years (1950-2003)

Total: Ln Y = 12.26 + 0.65 Ln X (adjR^2 93.02%)
Production

Maha: Ln Y = 11.90 + 0.62 Ln X (adj R^2 85.5%)

Yala: Ln Y = 11.40 + 0.57 Ln X (adj R^2 84.3%)

It could be observed that increasing rate of production decreases with years. These rates in metric tons per year are for total production $0.65e^{12.26} * X^{-0.35}$, for Maha $0.62\ e^{11.90} * X^{-0.38}$, and for Yala $0.57\ e^{11.40} * X^{-0.43}$. The production in Maha is 1.9423 times greater than the Yala (1.9423± 0.11, P=0.05). Figure 7 shows the decreasing rate of increase in production.

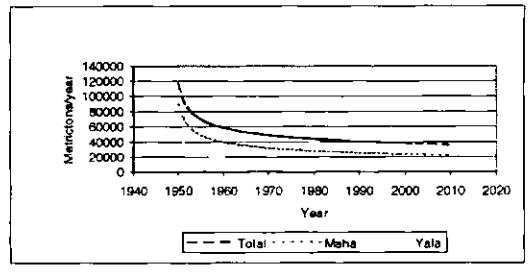

Figure 7 Decreasing rate of increase in production.

Average Yield

From 1955 to 1970 Average yield per harvested extent (Kg/hectare) smoothly increased from 1763 kg/hectare to 2247 kg/ hectare (27.5% increase) at a rate of 39.2 kg per hectare per year. (adj R^2 =91.3%). From 1971 to 1975 the average yield decreased at a rate of 32.2 kg per hectare per year. (adj R^2 =86.3%). From 1976, it started to increase according to the semi log model Y = 538 Ln X + 1871 (adj.R^2 = 91.2%) where Y = Two years moving average of yield per harvested extent (Kg/hectare) and X = Year. The average yield-changing pattern is same for both seasons but the average yield in Maha is 5% greater than in the Yala over the years (5% ± 2.2%, P=0.05). The peak average yield 3954.3 Kg/ha was obtained in 2001 and decline in average yield was observed in the years 2002 and 2003 because of some marginal lands came under cultivation.

There is a room for further increasing the average yield in Sri Lanka. The paddy yield in Sri Lanka on a region wise basis indicates that already we have about four paddy

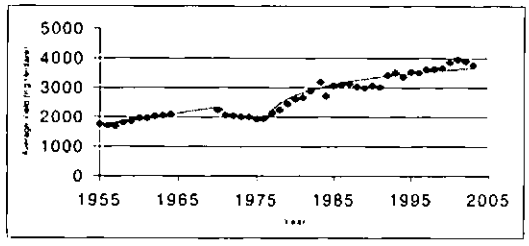

Figure 8 Trend of average yield

cultivating regions, which give yield of over 4200 Kg per hectare. These areas are Udawalawa (5035 Kg/ha), Mahawali H (4756 Kg/ha) and Polannaruwa (4468 Kg/ha) Ampara (4416 Kg/ha). How ever the average yield in Sri Lanka is much higher than in most of the countries in this region (See Table 02). For instance, yields in Sri Lanka are higher than in several major rice exporting countries such as Thailand, Myanmar and Pakistan. There is a claim that Sri Lanka's paddy yield should not be compared with yields in countries like Japan or Korea because these countries have temperate climates and long day lengths, which results in more photosynthetic activity.

Table 2 Yields in major Rice Producing Countries in the Tropical Region

Country	Year (Kg/Hectares)			
	1999	**2000**	**2001**	**2002**
India	3236	2852	2131	2839
Indonesia	4252	4405	4388	4473
Madagascar	2128	2051	2195	2196
Myanmar	3240	3383	3417	3674
Pakistan	3074	3031	2754	3018
Philippines	2947	3068	3187	3280
Sri Lanka	3672	3856	3954	3895
Thailand	2424	2613	2619	2564

Source: Central Bank Annual Report 2003

Cost of Production

The cost of production for paddy is increasing exponentially over the years and it is shown in Figure 09. Prices of the inputs such as fertilizer, agro chemicals, seed paddy, machinery and labour have been growing steadily. Labour constitutes that largest share accounting for over 50 percent of the total cost and fertilizer accounts for 12-15 percent. Further increased small scale of production due to the fragmentation of holdings had increased the cost of production. Cost of production model can be fitted as $C = 0.00768 X^2 + 0.141 X - 0.018$ (Adj $R^2 = 94.2$ %) Where C = Cost of production (Rs/Kg paddy produced) and X= Year. Therefore the increasing rate of cost has been increasing at a rate 0.01536 X+0.141 rupees per year.

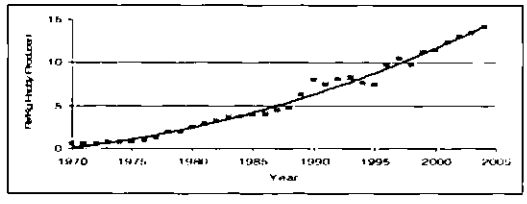

Figure 9 Cost of production for paddy

Paddy production –Farmers point of view

The guaranteed price scheme (GPS) price lost it's importance after 1979 due to the open economy. After 1979 farm gate price also become a selling price because it was greater than the GPS price. The percentage return to the investment before introducing the open economy (1970-1977) ranged from 17 to 120 where farmers had been received better return to their investment. But from 1980, after the introduction of open economy, farmers were badly affected due to no return to their investment or even some time negative return. (0.41% ± 2.2%, P=0.05). The behavior of cost of production, output price, GPS price and profit are shown in Figure 10.

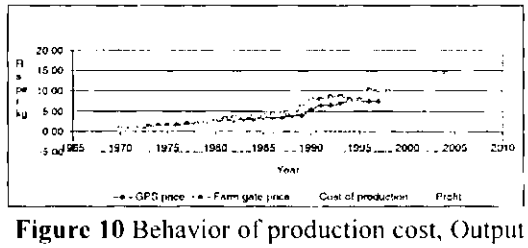

Figure 10 Behavior of production cost, Output price, GPS price and profit

Standard of living of the farmers

Increasing cost of living and low average net income has significantly lowered the standard of living of the farmers. Low average net income is the result of the increased cost of

cultivation and the small scale of production. The cultivation units have declined steadily because of fragmentation of holdings, which denies benefits of economics of scale and raises the cost of production. Using the index discussed in the methodology it could be said that the standard of living of the farmers at present (Open Economy period) is 5.08 times worse than the standard of living before 1978 (508 ± 256, P= 0.05) assuming that an average farmer's filed size remains constant. The comparison is shown in Figure 11.

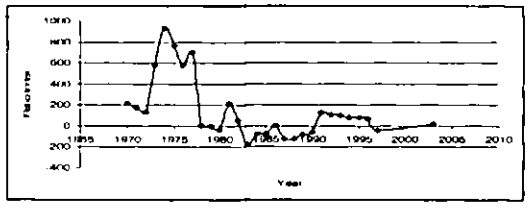

Figure 11 Comparison of standard of living (1970-2003)

Consumption of Rice per Capita

From 1964 to 1970, average rice consumption had been more or less a constant value of 136 Kg per year. During the period of 1970 to 1972 a sudden decrease of 41 Kg in rice consumption was observed due to the short supply of rice (136 Kg to 95Kg). From 1972 to 1986, the average per capita rice consumption again increased at a rate of 2.33 Kg per year because of freely availability of rice at open market. (adj.R^2=94.14%). Between 1986 and 1987 per capita rice consumption suddenly decreased from 132 kg/ year due to the introduction of other cereals and from 1987 it has been maintained at 111.5 kg per year. (111.5 ± 4.8 Kg/year, P=0.05). Figure 12 shows the pattern of consumption.

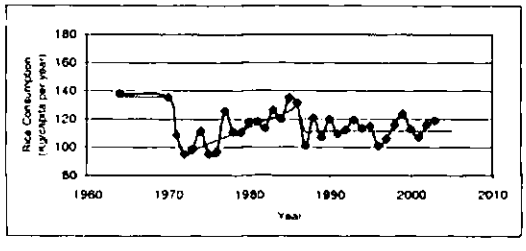

Figure 12 Consumption of rice per capita

Rice Imports

Rice imports reduced over the years and we are in the edge of self-sufficiency (See Figure 13). However to have a stable self-sufficiency we should have surplus production in some years so that that the surplus amount could be stored as buffer stock. As because of the extra value rice varieties such as Basmathi are not much produced to meet the demand, those are still being imported.

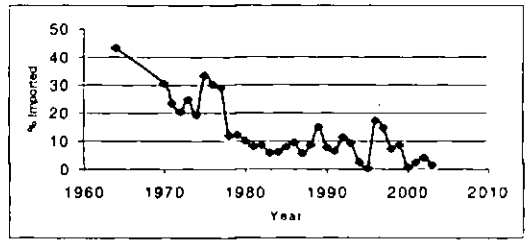

Figure 13 Rice imports over the years

Future Requirements

The future situation in paddy production has been calculated assuming these trends will be continued except the per capita consumption and cultivating extent. It is reasonable to assume the per capita consumption of rice and cultivating extent will be stable at 140 kg and 990,199 hectares respectively. Table 03 gives the present status and future prediction for the paddy production sector.

Conclusions

During the last 33 years (1970-2003) the cost of production of paddy had increased by 2400%, which is greater than the increase due to inflation of 2344%, while the selling price had increased only by 1919%. Production and average yield had increased by only 90% and 113% respectively.

Currently farmers get the profit margin of Rs. 0.20±0.27 per Kg paddy produced (P=0.05). Therefore, the standard of living of the farmers is 39 times worse in terms of standard of living ratio index when compared to 1970. At present, from the farmer's point of view, they still cultivate paddy because of return to their own labor, lowest investment and lack of better alternative jobs. Therefore to uplift and to keep viable the paddy production in Sri Lanka it could be suggested to increase the average yield with less cost of production and to increase the scale of cultivation.

Table 3 Present status and future prediction for paddy sector

	1997	2000	2005	2010
Extent cultivated (hectare)	730,000	878,000	990,199	990,199
Extent harvested (hectare)	681,287	832,000	928,807	928,807
Average yield (kg)/hectare	3,245	3,856	3,900	3,925
Total production (M.T)	2,239,000	2,860,000	3,223,888	3,244,554
Population	18,452,363	19,359,000	20,360,000	21,460,000
Per capita consumption in terms of paddy (kg/yr)	134	140	140	140
Total requirement for consumption (M.T.)	2,742,617	2,710,260	2,850,400	3,004,400
For seed requirement (M.T.)	152,315	181,307	204,476	204,476
Total requirement (M.T.)	2,624,932	2,891,567	3,054,876	3,208,876
Deficit paddy (M.T.)	385,932	31,567	-169,012	-35,678
% Import (M.T. rice)	14.7	1.1	-5.5	-1.1

To bring the standard of living of the farmers back to the 1970 situation the profit margin in year 2006 should be Rs. 2.32 per Kg paddy produced or Rs.9061 per hectare. (Assuming the inflation rate is going to be 8%). It is easily achievable because if the farmers continue with the same inputs that they are using now then the cost of production in year 2006 would be Rs.17.01 per Kg paddy produced. If the average yield is 3900 Kg per hectare and the selling price is Rs. 19.33 per Kg then the standard of living of the farmers can be brought back to the 1970 situation. How ever farmers expect a better life comparable with the urban population and in order to achieve it in average a farmer should cultivate 2.81 hectares.

Therefore the success depends on how well Sri Lanka can control the cost of production, scale of cultivation and the market price and keep on increasing the average yield. In fact there are some farmers in Sri Lanka who obtain yields ranging from 5300 Kg per hectare to 8150Kg per hectare by using these identical techniques adopted naturally to local circumstances but with higher cost of production. Careful selection and use of good seed, transplanting or row seeding, the use of chemical and organic fertilizer according to recommended dosages and integrated pest control and management techniques can increase the yield of farmers. Therefore, high yield can be obtained by resorting to improved cultivation practices and in particular to the use of good seed, fertilizer and control of weeds, which latter practice is greatly facilitated by transplanting or row sowing. The use of chemicals, on a prophylactic basis, for pest and disease control is still generally unknown to most cultivators in Sri Lanka. This brings us immediately to the question why, in our country most farmers do not adopt these practices. The reason is, in Sri Lanka farmers do not have proper recommended practices and extension networks. It is the farmer who decides on their own practices without considering the present recommendations. Therefore, our success in paddy production in future mainly depends on changing our policy for developing recommendation area wise for different cultural practices to ensure a better profit margin. It should be concentrated on areas where the average yields are low. Areas, which give more than the national average, do not have the same potential as the low yielding areas for improvement.

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