Pakistan Journal of Applied Economics, (1984), Vol. III No. 2, (139 – 156).

# SOCIAL PROFITABILITY OF ALTERNATIVE RICE VARIETIES IN PAKISTAN: Basmati vs. IRRI

Rauf A. AZHAR and Fakhre MAHMUD*

Pakistan's rice export earnings have increased remarkably since the early 70's. Of the two major varieties grown and exported, it is the traditional variety, Basmati, which has shown an enormous potential for export earnings. The other variety, namely IRRI, was introduced in the midst of the green revolution. Although IRRI's yield has been higher as compared to Basmati, the latter has fetched a very high price in the international market. This paper attempts to estimate the social profitability of the two varieties and shows that Basmati enjoys a much higher profitability viz-a-viz IRRI. The policy implication is that the cultivation of Basmati needs to be encouraged by direct price incentives and other means.

## I. Introduction

The decade of the seventies has witnessed an unprecedented increase in the export of rice from Pakistan. Cotton has traditionally been the leading foreign exchange earning crop. However, it is now overshadowed by an enormous increase in the foreign exchange earnings of rice. Since 1973-74, when rice overtook cotton as the leading foreign exchange earner, the export earnings of rice have increased steadily over time while those of cotton have fluctuated widely [see Appendix (Table 1)]. In 1980-81 the export earnings from rice stood at Rs.5 billion as compared to Rs.173 million in 1970-71 – an almost thirtyfold increase.

* Assistant Professor, Wilfrid Laurier University, and Graduate student, McMaster University, respectively. This paper is a condensed version of "Domestic Resource Cost of Alternative Rice Varieties in Pakistan", Discussion Paper No. 51, December 1981, Applied Economics Research Centre, University of Karachi, which was completed while both the authors were working at the Applied Economics Research Centre. The study was supported by a grant from Pakistan Agricultural Research Council. We are thankful to Professor O. Kyn of Boston University for his help with the computer programming and the Food Research Institute, Stanford University for allowing the use of their DRC computer package. We are also thankful to an anonymous referee of this journal for his helpful comments.

Although a number of rice varieties are grown in Pakistan, two of these – Basmati and IRRI-6[1] – constitute more than four-fifths of total rice production and dominate exports.[2] IRRI-6 (henceforth IRRI) competes with other IRRI varieties grown in the Southeast Asian countries. Basmati, due to its peculiar flavour and aroma, does not face much competition in the international market except from Basmati from India which is predominantly grown in the Indian part of the Punjab. Export of Basmati has increased tremendously in the 1970's. In 1980-81 it alone accounted for more than 50 per cent of Pakistan's rice export earnings.[3]

Basmati has fetched a very high price in the international market. In recent years its price has been more than double the price of IRRI. Consequently, casual empiricism would suggest a comparative advantage (higher social profitability) for Pakistan in the production of Basmati. It should, however, be noted that: (1) IRRI's yield is higher than Basmati's (by about 30 per cent in our sample), and (2) the inputs package for the two varieties is somewhat different. This makes it difficult to draw any concrete inference about the relative social profitability of these two varieties on the basis of price statistics alone.

In the present paper we have pursued the question of relative social profitability of these varieties by using the Domestic Resource Cost (DRC) methodology. Our results indicate that Basmati does indeed enjoy a much higher social profitability viz-a-viz IRRI. However, any policy inference from these results regarding a higher future potential of Basmati export must take into account:

1. The possibility and potential of increasing the output of Basmati through inter- and, specifically, intra-crop substitution (that is, substitution of Basmati for IRRI).
2. The possibility of decrease in the price of Basmati and hence export earnings, as a result of increased export if the demand is inelastic.

We have elaborated on the first question in the next section while the second could be the subject of a separate paper.

[1] IRRI stands for "International Rice Research Institute", Manila, Philippines, a source of HYV's of rice.

[2] In 1979-80, these two varieties accounted for 89 per cent of total rice production in Pakistan. See, "Agricultural Statistics of Pakistan, 1980-81", Ministry of Agriculture and Food, Islamabad.

[3] The major sources of export demand for Basmati are the expatriate workers in the Middle East and immigrants in the West from the Indian sub-continent. It was these groups who, to a large extent, introduced Basmati in the overseas markets and are therefore responsible for the creation of any additional overseas demand.

## II. Basmati vs. IRRI

IRRI was introduced in the wake of the "green revolution" in 1967 on the presumption that it would replace the traditional rice varieties, including Basmati, because of its relatively higher yield potential. Consequently, cultivation of IRRI was encouraged by the government while Basmati, along with the other traditional varieties, was ignored, quite understandably because its subsequent export potential could not be perceived at the time. The adoption response by the farmers was quite impressive,[4] at least up to 1971. In those four short years 50 per cent of the rice crop area came under the cultivation of HYV's of rice.[5] However, this trend was reversed after 1971 as a result of the increased export demand for Basmati. By 1974 the cropped area under HYV's of rice had dropped to below 40 per cent.[6]

Yet the readoption response for Basmati has not been as impressive as one might have thought. In 1979, the production of Basmati accounted for just 27 per cent of Pakistan's total rice production and 49 per cent of the rice production of Punjab – the home province of Basmati [see Appendix (Table 3)]. The reasons for this seem to be, *inter alia,* (1) an absence of any significant price incentive and (2) difficulties of crop substitution due to agro-climatic reasons.

1. The export of rice from Pakistan is a government monopoly. All the rice export trade is handled by the Rice Export Corporation of Pakistan (RECP) – a public sector corporation. Export rice is procured by the government agencies after the harvest. Inter-district mobility of all rice as well as any private sale of Basmati by the farmer is prohibited. The procurement price of Basmati has been kept much lower than the export price as shown in Table 1. In certain years, the procurement price has been less than even half the export price. It should not cause any surprise then if the farmers have responded less than enthusiastically.
2. As far as the inter- or intra-crop substitution possibilities of increasing the output of Basmati are concerned, it should be noted that any such possibilities are necessarily restricted to the province of Punjab. Due to agro-climatic reasons, none of the other provinces including Sind, which is the other major rice producing province, grow any Basmati except for

[4] The adoption rate for IRRI was as high as for Mexipak wheat – a HYV of wheat introduced at the same time.

[5] HYV's of rice included IRRI-6 and a relatively coarse variety IRRI-8. IRRI-6, however, is the dominant variety.

[6] See, Johnson, [(1979) Chapter 20]. The adoption of Mexipak wheat continued unabated and by 1974-75, 63 per cent of the wheat cropped area was under its cultivation.

a miniscule amount produced in the Frontier province (NWFP). Furthermore, within Punjab inter-crop substitution is considerably constrained, again due to agro-climatic reasons. Rice is a *kharif* crop.[7] The other major kharif crop is cotton. Different regions of Punjab are relatively more suitable for either rice or cotton cultivation. For example, Lahore and Rawalpindi divisions[8] do not grow much cotton while Bahawalpur and Multan divisions do not grow much rice [see Appendix (Table 2)]. Therefore, inter-crop substitution between rice and cotton would seem to be restricted to Sargodha (the remaining division) and, to some extent, Multan division.

## TABLE 1

Export and procurement prices of Basmati rice, 1974-81

| Year | Export Price | | Procurement Price[f] |
|---|---|---|---|
| | $/md.[e] | Rs./md.[c] | Rs./md. |
| 1974-75 | 29.02[a] | 287.27 | 90.00 |
| 1975-76 | 19.58[a] | 193.89 | 90.00 |
| 1976-77 | 12.89[a] | 127.58 | 52.00[d] |
| 1977-78 | 13.69[b] | 135.52 | 95.00 |
| 1978-79 | 27.86[b] | 275.80 | 110.00 |
| 1979-80 | 26.81[b] | 265.41 | 110.00 |
| 1980-81 | 27.22[a] | 269.51 | 127.84 |

Source and Notes:

[a]Rice Export Corporation of Pakistan.

[b]Pakistan Economic Survey, 1979-80.

cA conversion factor of Rs.9.90 is used to convert dollar into rupee prices.

[d]Price of Paddy.

[e]md. stands for maund, a local weight unit, which is roughly equal to 37 kgs.

[f]Agricultural Sratistics of Pakistan, 1980.

[7] *Kharif* is one of the cropping seasons. It starts in April-May and ends in October-November. The other cropping season is *Rabi*, and it covers the rest of the period.

[8] A division is an administrative unit.

There does appear to be more room for intra-crop substitution – that is between Basmati and IRRI – since Basmati has accounted for about 40 to 50 per cent of the total rice production in Punjab over the past decade.

## III. Methodology

The Domestic Resource Cost (DRC) methodology has been extensively used for the purpose of estimating comparative advantage and can be derived from the following definition of the net social profitability (NSP):[9]

$$NSP_j = (U_j - \bar{m}_j - r_j)V_1 - \sum_{s=2}^{m} \bar{f}_{sj} V_s + E_j \qquad (1)$$

where

$U_j$ = total value at world prices (in foreign currency) of the output of the jth activity,
$\bar{m}_j$ = total value (in foreign currency) of tradable materials used by the jth activity,
$r_j$ = total value (in foreign currency) of repatriated earnings of foreign-owned factors of production employed by the jth industry,
$V_1$ = shadow price of foreign exchange,
$\bar{f}_{sj}$ = total quantity of the sth primary domestic factor employed by the jth industry,
$V_s$ = shadow price (in domestic currency) of the sth primary factor of production, and
$E_j$ = net external benefits associated with the jth activity.

Setting (1) equal to zero and solving for $V_1$ yields what Bruno (1972), defines as the Domestic Resource Cost (DRC) of foreign exchange earned or saved by the industry under consideration. Therefore;

$$DRC_j = \frac{\sum_{s=2}^{m} \bar{f}_{sj} V_s - E_j}{U_j - \bar{m}_j - r_j} \qquad (2)$$

In equation (2) the numerator is expressed in local currency while the denominator is expressed in foreign currency. Multiplying the denominator by official exchange rate of the currency in point, $V^*$ gives,

$$DRC_j^* = \frac{\sum_{s=2}^{m} \bar{f}_{sj} V_s - E_j}{(U_J - \bar{m}_j - r_j)V^*} = \frac{DRC_j}{V^*} \qquad (3)$$

[9] See Pearson, et. al. (1976).

In equation (3) both numerator and the denominator are expressed in the same currency. Comparative advantage is implied by $DRC_j^*$ being less than the ratio of shadow price of foreign exchange to the official exchange rate i.e., $DRC_j^* < (V_1/V^*)$. If the shadow price of foreign exchange, $V_1$ is not known with reasonable certainty, an equivalent but convenient way of evaluating the results would be to present $DRC_j^* \cdot V^*$ values, to be compared with any plausible value of the shadow price of foreign exchange. In that case comparative advantage implies $DRC_j^* \cdot V^* < V_1$. Both the pure DRC coefficient, $DRC_j^*$ and the values of $DRC_j^* \cdot V^*$ will be reported in this paper. The smaller the $DRC_j^*$, the greater the comparative advantage and the higher the social profitability.

## IV. Data and Results

The most important component of cost of rice production is the farm level cost. The others being processing and transportation costs. For the farm level cost, apart from the market prices of certain inputs and outputs which were readily available from the secondary sources, we have used data from a major water course survey conducted jointly by the World Bank and WAPDA (Water and Power Development Authority), Pakistan in 1976-77. The survey covered 2002 farms on 400 selected watercourses through the entire irrigated region of Pakistan. Per acre input and output coefficients for both Basmati and IRRI were obtained from this survey. Our sample for IRRI consisted of 711 farms. Unfortunately the sample size for Basmati was rather small. It included only 77 farms. Consequently, the results for Basmati may not be as robust as one would like. This limitation, however, must be evaluated in light of the fact that no other data base as comprehensive as that required for the present study was available.

The principal source of information on transportation costs and processing costs were the published records of the Rice Export Corporation of Pakistan (RECP). RECP also operates public sector rice processing facilities. These facilities, however, process only a small proportion of the total rice exported. In 1979-80 public sector processing accounted for only 10 per cent of the rice processed for export. The remaining 90 per cent was done by the private sector. Furthermore, the processing technology employed by the two sectors is rather different. Whereas the public sector operates large rice mills, using relatively capital intensive technology, the private sector uses small *shellers* which have smaller capacity and are relatively labour intensive.[10]

[10] A typical *sheller* would have the capacity to husk about 40 to 50 kg. of paddy per hour while public sector mills at Dhaunkal and Shikarpur would have from four to five times as much capacity. The drying process also differs. Public sector mills have drying units that take only a few hours to dry the paddy while *shellers* disperse it on fields which may take four to five days, depending on weather.

Therefore, RECP data could not be considered as representative of the true processing costs. Unfortunately, no secondary data source provided the required information on processing costs for *shellers*. A small random survey was conducted in the rice growing region of Punjab to arrive at the comparable processing cost estimate for the *shellers*. Our estimate of these costs is Rs.275.38 per ton as compared to Rs.221.96 per ton for the public sector. The difference between these two estimates may represent economies of scale in the large scale (public sector) processing or an upward bias in the private sector estimates – a possibility that could not be ruled out.[11] Instead of selecting either one of these estimates as representative, we have reported results for both large and small scale processing in the following analysis.

Lastly, for shadow prices Squire, Little, and Durdag (1979) estimates were particularly suitable for our purpose because of the rural-urban breakdown for the shadow price of unskilled labour.[12] Therefore, for capital, skilled, and unskilled labour we have used their short-run estimates.

The DRC methodology assumes fixed coefficients in production implying a unique prevalent technology. That, however, is not the case in Pakistan agriculture. In Pakistan both mechanical (mechanical land preparation) and traditional (bullocks land preparation) technologies are currently in use; the exact prevailing mix between the two remains uncertain.[13] Casual empiricism suggests that traditional technology is still the predominant technology. Since the results are expected to be sensitive to on-farm technology, we have assumed a prevailing technology mix of 70:30 in favour of the traditional technology to provide, what we believe, is a reasonable measure of ex post social profitability. However, in order to avoid the hazards of this assumption we have also calculated two additional DRC coefficients, one for completely mechanical and the other for completely traditional technology. These would define two extreme values between which the actual DRC coefficient, whatever the true technology mix, must lie. This also has the added advantage of showing the direction in which DRC coefficient may move as a result of a change in technology.

Consequently, for each processing technology (Public sector large scale mills vs. Private sector small *shellers*), we have presented three different estimates of DRC coefficients. Therefore, for each variety of rice there are altogether six estimates of DRC coefficients as presented in Table 2. Besides

[11] Private sector has a tendency to overstate cost figures due to the apprehension that the figures may be used by the taxation authorities. On the other hand, an upward bias in public sector processing costs could not be ruled out either.

[12] The issue of shadow prices in Pakistan has also been discussed by Guisinger (1979); Khan (1979); Weiss (1979); and Tsakok (1979).

[13] We were unable to find any information on the prevailing technology mix from the existing sources including the World Bank – WAPDA survey.

**TABLE 2**

Social profitability of Basmati and IRRI rice varieties in Pakistan, 1979-80

| Processing | On-farm Technology | DRC* Coefficients | | DRC*·V* Values | |
|---|---|---|---|---|---|
| | | (Basmati) | (IRRI) | (Basmati) | (IRRI) |
| Small Scale (Private Shellers) | 1) Mixed Technology | 0.677 | 1.287 | 6.70 | 12.74 |
| | 2) Mechanical Technology | 0.581 | 1.150 | 5.75 | 11.38 |
| | 3) Traditional Technology | 0.688 | 1.300 | 6.81 | 12.87 |
| Large Scale (Public Mills) | 1) Mixed Technology | 0.617 | 1.148 | 6.11 | 11.36 |
| | 2) Mechanical Technology | 0.530 | 1.029 | 5.25 | 10.19 |
| | 3) Traditional Technology | 0.626 | 1.160 | 6.19 | 11.48 |

V* = Rs.9.90 for one U.S. dollar (the official exchange rate).

pure DRC coefficient, DRC*, the modified measure of social profitability, i.e., DRC*·V* is also presented in the table. Social profitability (and comparative advantage) is implied by DRC* $< (V_1/V^*)$ or DRC*·V* $< V_1$ where $V_1$ is the shadow price of foreign exchange and V* is the official exchange rate.

As far as the relative social profitability of the two varieties under consideration is concerned, we do not even need to know the shadow price of foreign exchange. A comparison of pure DRC coefficients suffices for this purpose. A look at Table 2 reveals that DRC* coefficients for Basmati range from 0.530 to 0.688 while those for IRRI range from 1.029 to 1.3, and are almost twice as large as for Basmati. At the outset it is clear that Basmati has a very high social profitability viz-a-viz IRRI. The DRC* coefficients for large scale processing are lower than small scale processing, presumably due to economies of scale although we would not like to place any bets on that. There may be an upward bias in the estimates of *sheller* processing costs as already pointed out.

A second general feature of the results relates to the on-farm technology. Mechanical technology is evidently more cost efficient than the traditional technology. The DRC* coefficients for the latter technology are consistently larger than the respective coefficients for the mechanical technology. This should not occasion any surprise. However, one need not jump to any conclusions from these partial results about the appropriateness of mechanical technology. It should be pointed out that in our estimation we have assumed net external effect [see equation (1)] to be zero. If mechanical technology displaces labour, especially in a labour abundant economy like Pakistan, one must be willing to concede that the net external effects may not be zero, and any conclusion about appropriate technology must take these into consideration.

At this juncture it may be worthwhile to compare the findings of the present study with those of another study, that uses a different data base, conducted by Gotsch and Brown (1980).[14] Their DRC coefficients estimates for Basmati and IRRI for both mechanical and traditional technology are reported in Table 3.

Apart from certain differences in details, their findings, in general, are much the same as ours. Basmati shows a much higher social profitability as compared to IRRI. The differences are worth noting too. In their results, although mechanical technology is more cost efficient in the case of Basmati, for IRRI the traditional technology turns out to be superior! Its DRC coefficient is relatively small. More importantly, however, the absolute difference between the DRC coefficients for the two technologies is much larger than what our results suggest. The coefficient for Basmati goes down from 1.01 to 0.67 while the coefficient for IRRI goes up from 1.54 to 1.88.

[14] Gotsch and Brown (1980), used data for leading farmers in Punjab for the year 1975-76.

**TABLE 3**

DRC coefficients for Basmati and IRRI
for Punjab, Pakistan, 1975-76

| Technology | Basmati | IRRI |
|---|---|---|
| Traditional | 1.01 | 1.54 |
| Mechanical | 0.67 | 1.88 |

Source: Gotsch and Brown, [(1980), p.74, Table 18].

To sum up the discussion so far we see that Basmati has a relatively higher social profitability. In other words Pakistan seems to have a comparative advantage in the production of Basmati as compared to IRRI. The next question is about the social profitability of these rice varieties from the standpoint of the entire economy. An answer to that question requires a knowledge about the shadow price of foreign exchange. Social profitability in that context is implied by $DRC^* < (V_1/V^*)$ or equivalently $DRC^* \cdot V^* < V_1$.

In the absence of any reliable estimates for the shadow price of foreign exchange, $V_1$, we have presented $DRC^* \cdot V^*$ estimates in Table 2 where $V^*$ is assumed to be Rs.9.90 to one U.S. dollar (the official exchange rate). These estimates can be compared with any plausible value of the shadow price of foreign exchange. If the postulated shadow price of foreign exchange is higher than the value of $DRC^* \cdot V^*$, the activity is indicated to be socially profitable from the entire economy's viewpoint and vice-versa if the reverse is true.

It can be seen from the table that the highest value of $DRC^* \cdot V^*$ for Basmati is 6.81 (with the combination of small scale processing and traditional technology). Basmati, consequently, will be socially profitable for any value of shadow price of foreign exchange greater than Rs.6.81 to one U.S. dollar. On the other hand, IRRI does not become profitable until the shadow price exceeds Rs.10.19 to a dollar, and even that under the most favourable assumptions about the processing and on-farm technology (large scale processing and mechanical technology combination). A more realistic assumption would be small scale processing in combination with mixed on-farm technology which shows that it would be socially unprofitable for any value of the shadow price of foreign exchange less than Rs.12.74 to a dollar.

If, following a World Bank estimate, we assume the shadow price of foreign exchange to be Rs.10.87,[15] IRRI would be socially profitable only

[15] Third Highway Project, 1979, World Bank– Ministry of Communications, Government of Pakistan, Islamabad.

under the most favourable assumptions about the processing and on-farm technology as pointed out earlier and would be unprofitable for all the remaining assumptions about the processing and on-farm technology.

## V. Sensitivity Analysis

Table 4 reports the results of sensitivity analysis with respect to the world price of rice and prices of the inputs including skilled labour, unskilled labour, and capital. We have reported the results for only mixed on-farm technology to give an idea of the magnitude of change in the DRC coefficient when one of these prices is changed. The table reports the revised values of DRC* coefficients and shows the percentage change in the coefficients with reference to the original DRC* coefficient (reported on top of each column). In the end we have reported estimates of the elasticity of DRC coefficients with respect to yield and evaluated the sensitivity of coefficients for changes in yield per acre.

The DRC* coefficients are most sensitive to the world price of rice. In 1979-80 these prices were US$718.28/MT and $249.18/MT for Basmati and IRRI respectively.[16] A 90 per cent increase in the world price of either variety leads to an approximately 50 per cent decrease in the DRC* coefficients, (a considerable improvement in the social profitability). On the other hand, if the world prices are reduced to one-half of their present values, DRC* coefficients for Basmati register an increase of around 120 per cent, while for IRRI the deterioration is even larger than that, more than 180 per cent increase in one case. It is interesting to note that the comparative advantage of Basmati can be attributed, more or less, to its higher world price. For example, if IRRI's world price is assumed to be twice as much as its present price, its DRC* coefficients become comparable and even better[17] than those for Basmati. A similar conclusion emerges when we look at the DRC* coefficients for Basmati with its international price reduced to one-half its present value. The results also indicate that DRC* coefficients are not very sensitive to changes in the opportunity cost of other inputs. They are least sensitive to the price of skilled labour simply because skilled labour accounts for an insignificant proportion of the total costs. Even then, we find that DRC* coefficients are relatively more sensitive for large scale processing because skilled labour constitutes a relatively higher proportion of the large scale processing costs.

It can be seen in the table that doubling or reducing to one-half the

[16] Pakistan Economic Survey [(1979-80), p.135]; Government of Pakistan, Economic Affairs Wing, Islamabad.

[17] This is to be expected because IRRI has a higher yield per acre as compared to Basmati. A higher yield per acre, *ceteris paribus*, implies a lower DRC coefficient.

**TABLE 4**

DRC sensitivity analysis for Basmati and IRRI, 1979-80

| | | Small Scale Processing | | | | Large Scale Processing | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Basmati | | IRRI | | Basmati | | IRRI | |
| | | Revised DRC* | % change in DRC* | Revised DRC* | % change in DRC* | Revised DRC* | % change in DRC* | Revised DRC* | % change in DRC* |
| Original DRC* | | 0.677 | | 1.287 | | 0.617 | | 1.148 | |
| Sensitivity w.r.t. | magnitude of change in price | | | | | | | | |
| World Price | double (90%) | 0.341 | −50.0 | 0.594 | −54.0 | 0.312 | −49.4 | 0.541 | −52.9 |
| | half | 1.510 | +121.5 | 3.650 | +183.6 | 1.345 | +118.0 | 3.051 | +165.8 |
| Capital Price Ratio | double | 0.813 | +20.0 | 1.498 | +16.4 | 0.743 | +20.0 | 1.346 | +17.2 |
| | half | 0.607 | −10.0 | 1.175 | −8.7 | 0.550 | −10.8 | 1.050 | −8.5 |
| Skilled Labour Price Ratio | double | 0.679 | +0.2 | 1.292 | +0.4 | 0.629 | +1.9 | 1.187 | +3.4 |
| | half | 0.677 | 0.0 | 1.284 | −0.2 | 0.610 | −1.1 | 1.128 | −1.7 |
| Unskilled Labour Price Ratio | half | 0.577 | −14.8 | 1.049 | −18.5 | 0.531 | −13.9 | 0.954 | −16.9 |

ratios of shadow to market prices for any input in no case effects a more than 20 per cent change in the DRC* coefficient, not an impressive change considering the magnitude of change in the prices. Nevertheless, it is worthwhile noting that DRC* coefficients are most sensitive to the opportunity cost of capital followed by the opportunity cost of unskilled labour.

Finally, the elasticity of the DRC coefficient with respect to yield provides an indication of the change in social profitability when yield per acre is changed. The estimates of this elasticity for Basmati and IRRI are remarkably similar; −0.926 for Basmati and −0.929 for IRRI. This means that a one percentage point increase (decrease) in yield in either case leads to approximately 0.93 per cent decrease (increase) in the respective DRC coefficients. Since the absolute value of DRC coefficients for IRRI is larger than those for Basmati, a similar proportional increase in yield per acre will lead to a greater improvement in social profitability in the case of IRRI.[18]

To evaluate the preceding results, we have utilized the official per acre yield estimates which are higher than the ones used in the present study. The official estimates of per acre yield were 1138 kgs. for Basmati and 2031 kgs. for IRRI[19] as compared to 949 kgs. and 1810 kgs. as used in the present study, representing a difference of 19.91 per cent and 12.21 per cent for Basmati and IRRI respectively.[20] If the official yield estimates are used, the DRC* coefficient for Basmati goes down from 0.677 to 0.552 while the corresponding reduction for IRRI is from 1.287 to 1.141. In both the cases, the social profitability is considerably enhanced though IRRI still remains unprofitable if the shadow price of foreign exchange is assumed to be Rs.10.87 to a U.S. dollar.[21]

## VI. Conclusion

In this paper we have explored the question of social profitability of rice production in Pakistan. Domestic resource cost methodology has been used

[18] However, it must be noted that since IRRI's yield per acre is higher than Basmati's, similar proportional increase in the case of IRRI implies a higher absolute increase in per acre output. Per acre output estimates are reported in the analysis that immediately follows.

[19] The official estimates are derived from the "Agricultural Statistics of Pakistan, (various years)". It should be mentioned that official estimates for the year 1976-77 were not much different than for 1979-80.

[20] The difference between the two sets of estimates is particularly large for Basmati. We opted for the survey estimates to evaluate social profitability under relatively unfavourable assumptions about yield per acre and to provide an idea for the magnitude of change in social profitability under relatively favourable assumptions about yield only at this point. In case of Basmati, however, since the sample size was not very large, we feel that official estimates are more close to reality.

[21] It should be pointed out that since January 1982, the rupee has been floated and its value has fluctuated between Rs.11 and 14 to a U.S. dollar.

to evaluate social profitability and comparative advantage in the production of alternative rice varieties, i.e., Basmati and IRRI. These varieties constitute more than four-fifths of the total rice production in Pakistan. The results can be interpreted at two levels. First, it seems fairly clear that Basmati has a significantly higher social profitability as compared to IRRI. Its DRC coefficients are about one-half the size of the corresponding coefficients for IRRI (0.677 vs. 1.287 for the small scale processing and mixed on-farm technology). The evidence suggests that it becomes socially profitable for any value of the shadow price of foreign exchange above Rs.6.81 per U.S. dollar whatever the on-farm and processing technology, even though the yield estimates used in the study are quite conservative. These estimates were considerably lower than the official yield estimates particularly in the case of Basmati. For Basmati the estimate used was almost 20 per cent lower than the official estimate (for IRRI this difference is about 12 per cent). If official estimates were used instead, the social profitability will improve by almost 20 per cent since the elasticity of DRC coefficients with respect to yield is almost minus unity.

The results of the sensitivity analysis show that Basmati's comparative advantage is, more or less, the result of its higher international price. For example, IRRI's DRC coefficients become comparable to those for Basmati if its world price is doubled and an allowance is made for its higher yield per acre (implying a lower DRC coefficient). Consequently, as long as the current discrepancy in their world prices prevails – Basmati's world price has remained more than twice the price of IRRI in the last four years – Basmati will maintain its comparative edge even though its yield per acre is lower.

Second, the results indicate that, given its present yield per acre, IRRI may in fact be socially unprofitable for any value of the shadow price of foreign exchange less than Rs.11.00 to a U.S. dollar except for the most favourable assumption about production technology (i.e., mechanical on-farm and large scale processing technology combination), an unrealistic assumption. At best, it breaks even if the shadow price of foreign exchange is postulated to be in the range of Rs.11.00 to Rs.13.00 per dollar depending on the assumptions about on-farm and processing technology. This is partly due to the fact that in Pakistan IRRI's yield potential, as compared to other Southeast Asian countries, has not materialized.[22]

*Wilfrid Laurier University*
*McMaster University*

[22] Azhar (1984), has explored this question.

## APPENDIX

### TABLE 1

Export earnings of rice and cotton, 1970-71 to 1978-79
(Million Rupees)

| Year | Cotton | Rice |
|---|---|---|
| 1970-71 | 270.00 | 173.00 |
| 1971-72 | 934.70 | 241.10 |
| 1972-73 | 1167.00 | 1136.10 |
| 1973-74 | 376.10 | 2098.40 |
| 1974-75 | 1411.30 | 2304.00 |
| 1975-76 | 908.50 | 2479.00 |
| 1976-77 | 292.00 | 2478.00 |
| 1977-78 | 1093.60 | 2408.50 |
| 1978-79 | 655.20 | 3380.01 |

Source: Agricultural Statistics of Pakistan, Government of Pakistan, Islamabad,(annual).

TABLE 2

Regional production of cotton and rice, 1976-77

| Province | Division | Production | | |
|---|---|---|---|---|
| | | Cotton (thousand bales) | Rice (thousand tons) | |
| | | | Total | Basmati |
| Punjab | Rawalpindi | 7.5 | 81.5 | 33.4 |
| | Sargodha | 185.3 | 134.2 | 50.0 |
| | Lahore | 45.8 | 786.1 | 466.5 |
| | Multan | 861.0 | 248.2 | 67.5 |
| | Bahawalpur | 457.6 | 61.0 | 21.1 |
| Sind | Sukkur | 329.4 | 740.5 | – |
| | Hyderabad | 556.1 | 531.1 | – |
| NWFP (North West Frontier Province) | Peshawar | 1.0 | 18.8 | 0.9 |
| | Malakand | – | 54.0 | 9.9 |
| | D.I. Khan | 2.3 | 11.2 | 0.1 |
| Baluchistan | – | 0.4 | 27.6 | – |
| TOTAL | | 2446.4 | 2694.2 | 649.4 |

Source: Agricultural Statistics of Pakistan, Government of Pakistan, Islamabad, (various).

**TABLE 3**

Provincial and National production of Basmati rice, 1971-72 to 1978-79

| | PUNJAB | | SIND | | N.W.F.P. | | BALUCHISTAN | | PAKISTAN | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Production | as a percentage of total provincial rice production | Production | as a percentage of total provincial rice production | Production | as a percentage of total provincial rice production | Production | as a percentage of total provincial rice production | Production | as a percentage of total national rice production |
| 1971-72 | 384.0 | 39 | — | — | — | — | — | — | 384.0 | 17 |
| 1972-73 | 399.8 | 40 | — | — | — | — | — | — | 399.8 | 17 |
| 1973-74 | 476.1 | 43 | — | — | 9.7 | 13 | — | — | 485.8 | 20 |
| 1974-75 | 594.1 | 51 | — | — | 7.9 | 10 | — | — | 602.0 | 26 |
| 1975-76 | 632.3 | 53 | — | — | 10.0 | 12 | — | — | 642.3 | 25 |
| 1976-77 | 648.7 | 49 | — | — | 11.1 | 13 | — | — | 659.8 | 24 |
| 1977-78 | 551.8 | 37 | — | — | 8.1 | 9 | 0.2 | * | 560.1 | 19 |
| 1978-79 | 865.4 | 49 | — | — | 12.0 | 11 | * | — | 877.4 | 27 |

Source: Agricultural Statistics of Pakistan, Government of Pakistan, Islamabad, (various).
* Nominal

## References

Agricultural statistics of Pakistan, 1980-81, Government of Pakistan, Ministry of Agriculture and Food, Islamabad.

Azhar, R., 1984, Schooling and agricultural productivity in Pakistan: A test of the insufficient education level hypothesis, mimeograph.

Bruno, M., 1972, DRC and effective protection, Journal of Political Economy, January-February: 20.

Gotsch, C., and G. Brown, 1980, Prices, taxes, and subsidies in Pakistan agriculture, 1969-1976, Washington, D.C.: World Bank Staff Working Paper No.387, April.

Government of Pakistan, 1977, Cost of production of major crops under irrigated and unirrigated (Barani) conditions, Planning Division, Agricultural and Food Section, July.

Government of Pakistan, Agricultural statistics of Pakistan, various, (1976-77, 1979-80, and 1980-81), Ministry of Agriculture and Food, Islamabad.

Government of Pakistan, Pakistan economic survey, (annual), Finance Division, Economic Affairs Wing, Islamabad.

Guisinger, S., 1979, Calculating shadow prices in Pakistan: Reflections on the paper by Squire, Little and Durdag, Pakistan Development Review, 18(2).

Johnson, B.L.C., 1979, Pakistan, technology and institutional change in agriculture, London: Heinemann.

Khan, M.Z., 1979, Estimation of shadow prices for project evaluation in Pakistan, Pakistan Development Review, 18(2).

Pearson, S.R., N. Akrasanee, and G. Nelson, 1976, Comparative advantage in rice production: A methodological introduction, Food Research Institute Studies, 15(2).

Squire, L., I.M.D. Little, and M. Durdag, 1979, Shadow pricing and macroeconomic analysis: Some illustrations from Pakistan, Pakistan Development Review, 18(2).

Tsakok, I., 1979, Shadow prices for Pakistan: An assessment of alternative estimates, Pakistan Development Review, 18(3).

Weiss, J., 1979, Project selection and the equity objective: The use of social analysis, Pakistan Development Review, 18(2).