# CHAPTER VIII

## SENSITIVITY ANALYSIS

The base period (2004) in this study is too short for general conclusion to be widely applicable because world price for commodities are unstable and yet they affect the PAM computations. It is also of utmost importance to find out the level of factors and investments that might result in more efficient market for the commodity systems. These concerns are addressed through a sensitivity analysis, a proxy for simulating different sets of policy. Therefore, to make full use of PAM analysis, sensitivity analysis was attempted for those variables, which are subject to great variability. The following cases were investigated.

### 8.1 Increase and decrease in the world price of rice

The world price of rice has its own ups and downs. During a period of 11 months in 2004, the Thai export price of rice fluctuated by about six percent. Based on this fluctuation, a sensitivity analysis has been carried out to see the likely effects it would have on the rice systems in Bhutan.

Table 8.1. Effect of increased and decreased f.o.b. price by location

| Parameters | 6 percent increase in fob price | | | 6 percent decrease in fob price | | |
|---|---|---|---|---|---|---|
| | Samtse | Lobesa | Paro | Samtse | Lobesa | Paro |
| Social Revenue | 26,083 | 60,161 | 57,958 | 24,253 | 56,288 | 54,194 |
| Social Profit | 1,584 | 23,307 | 22,168 | -246 | 19,434 | 18,405 |
| Output divergence | -3,203 | 4,389 | 4,767 | -1,373 | 8,262 | 8,531 |
| Net divergence | 756.4 | 4,956 | 4,946 | 2,587 | 8,829 | 8,710 |
| NPCO | 0.88 | 1.07 | 1.08 | 0.94 | 1.15 | 1.16 |
| EPC | 0.87 | 1.09 | 1.09 | 0.95 | 1.17 | 1.17 |
| DRC | 0.93 | 0.58 | 0.60 | 1.01 | 0.62 | 0.65 |
| SRP | 0.03 | 0.08 | 0.09 | 0.11 | 0.16 | 0.16 |

Results from Table 8.1 show that an increase in the world price would increase the social revenue thereby increasing the social profitability. However, in Samtse the negative output divergence would deteriorate further as a result of increased difference between the private and the social price. The difference between the private and the social prices of output would increase with the social prices higher by about 14 percent. Farmers therefore would feel more taxed on their rice output, as the domestically produced rice would fetch a lower price than the imported rice. However, the higher the import price gets, the more the consumers would switch to locally produced rice. Based on the example of Samtse, if Bhutan is to protect the domestic rice industry, an import tariff on imported rice can be imposed. With the six percent increase in the f.o.b. price, the DRC of rice in Samtse improves by about 4 percent. Therefore, the higher the social price the better would be the situation of comparative advantage. In such a situation, the NPCO would decrease meaning that the domestic price would be unprotected by the policy of protecting the domestic rice industry. The EPC would also show a decreasing trend indicating the negative effects of protecting the domestic rice industry. The increased fob price of rice would have a different effect on the output divergence in Lobesa and Paro. As the social price increases, the gap between the private and the social price is narrowed down thereby decreasing the output divergence. This decrease in output divergence also decreases the net transfers. The value of DRC decreases indicating an improvement in the comparative advantage but then the decrease in the NPCO shows that the policy of increasing the social price would be not be protecting the domestic or the private price and such policies would have a negative effect on the rice industry as revealed by the decreasing EPC.

In case the f.o.b. price of rice decreased by six percent, there would be a corresponding decrease in the import parity price. Social revenue in Samtse only would decrease thereby decreasing the social profit, the output divergence and the net transfer. As the gap between the private and the social price of the output becomes smaller, the EPC, DRC, and the SRP would increase. It is an indication of lower rate of protection and that Samtse would then not have any competitive advantage in the production of rice.

Whether the f.o.b. price increases or decreases by six percent there would still be divergences in the output and the net transfer. The question of what would be the break even import parity price for the NPCO to be equal to unity or the DRC be equal to unity then arises. A sensitivity analysis was again conducted to find the break even social prices. The results of it are as illustrated in Table 8.2.

Table 8.2. Break even f.o.b. price

| Social price | NPCO | EPC | DRC | SRP |
|---|---|---|---|---|
| Samtse | | | | |
| Nu.20/kg | 1.00 | 1.01 | 1.08 | 0.17 |
| Nu.21.5/kg | 0.93 | 0.93 | 1.00 | 0.09 |
| Lobesa | | | | |
| Nu25/kg | 1 | 1.01 | 0.54 | 0.01 |
| Nu.14.3/kg | 1.75 | 1.88 | 1 | 0.76 |
| Paro | | | | |
| Nu25/kg | 1 | 1 | 0.55 | 0.00 |
| Nu.14.3/kg | 1.75 | 1.80 | 1 | 0.75 |

Decreasing the social price to Nu.20/kg would bring the value of Nominal Protection Coefficient on Output (NPCO) and the Effective Protection Coefficient (EPC) value equal to one. This indicates no divergence in output revenue and a case of perfect competition or first best option. Such first best options are difficult to achieve and such decrease in social price in Samtse would result into comparative disadvantage in the production of rice. The Domestic Resources Cost (DRC) would break even only if the price decreased to Nu 21.5/kg. At this price, the NPCO would be lower than one indicating higher social price as compared to private prices. Further increase in the social price would improve the situation of comparative advantage, but then the rice systems would be neglected in terms of protection. In the case of Lobesa and Paro, the Nominal Protection Coefficient on Output (NPCO) would be equal to unity if the social price increased to Nu25/kg. At this price the situation of comparative advantage would also be strengthened for both the locations.

The Domestic Resources Cost (DRC) would break even if the social prices of the output decreased to Nu14.3/kg. This would only be possible only if the government protected the domestic rice system by subsidizing the import, thus entailing huge expenditure from the government's treasury. Providing subsidies on the imported rice would not be a wise move to protect the domestic rice industry.

## 8.2 Increase and decrease in yield

The yield as reported by the farmers varied by about 36 percent in Samtse and Lobesa while it varied by about 40 percent in Lobesa. However, the sensitivity analysis was carried out for 36 percent fluctuation in rice yield for all the three locations as it would provide a uniform comparison. The results from the sensitivity analysis are as shown in Table 8.3.

Table 8.3. PAM summary for increased and decreased yield

|  | 36 percent yield increase | | | | 36 percent yield decrease | | | |
|---|---|---|---|---|---|---|---|---|
|  | Revenue | Costs | | Profit | Revenue | Costs | | Profit |
|  |  | TI | DF |  |  | TI | DF |  |
| Samtse |  |  |  |  |  |  |  |  |
| PP | 31,117 | 2,740 | 17,799 | 10,578 | 14,643 | 2,740 | 17,799 | -5,896 |
| SP | 34,228 | 3,000 | 21,499 | 9,730 | 16,108 | 3,000 | 21,499 | -8,391 |
| Div | -3,112 | -260 | -3,700 | 848 | -1,464 | -260 | -3,700 | 2,495 |
| Lobesa |  |  |  |  |  |  |  |  |
| PP | 87,788 | 4,415 | 31,871 | 51,502 | 41,312 | 4,415 | 31,871 | 5,026 |
| SP | 79,009 | 4,982 | 31,871 | 42,156 | 37,181 | 4,982 | 31,871 | 328 |
| Div | 8,779 | -567 | 0 | 9,346 | 4,131 | -567 | 0 | 4,698 |
| Paro |  |  |  |  |  |  |  |  |
| PP | 85,306 | 2,122 | 33,489 | 49,696 | 40,144 | 2,122 | 33,489 | 4,534 |
| SP | 76,093 | 2,301 | 33,489 | 40,303 | 35,808 | 2,301 | 33,489 | 19 |
| Div | 9,213 | -179 | 0 | 9,392 | 4,336 | -179 | 0.00 | 4,515 |

TI= Tradable Inputs; DF = Domestic factor; PP=Private price; SP=Social price; Div = Divergence

In case the yield of the output increased by 36 percent the following would be observed.

- Increased private and social profitability
- Increased output divergence (increased negative divergence in Samtse)
- Net transfer decreased in Samtse while it increased for Lobesa and Paro.

When yield decreases by 36 percent, then rice production in Samtse would not be profitable privately as well as socially. Hanging on to rice production would be a waste of resources. It would be profitable for farmers to venture into the cultivation of other crops that are profitable. Social profit in Lobesa and Paro would also be low. The PAM ratios as illustrated in Table 8.4 gives a better explanation to the effects caused on the competitiveness, transfers and impacts of government policies.

Table 8.4. PAM ratios from change in yield

| Ratios | 36 percent yield increase | | | 36 percent yield decrease | | |
|--------|--------|--------|------|--------|--------|------|
| | Samtse | Lobesa | Paro | Samtse | Lobesa | Paro |
| DRC | 0.69 | 0.43 | 0.45 | 1.64 | 0.99 | 1.00 |
| SRP | 0.02 | 0.12 | 0.12 | 0.15 | 0.13 | 0.13 |
| PCR | 0.63 | 0.38 | 0.40 | 1.50 | 0.86 | 0.88 |
| PC | 0.92 | 0.82 | 0.81 | 1.42 | 0.07 | 0.00 |

With an increase in the yield by 36 percent, all the three locations would have a situation of strengthened comparative advantage. The decreased private cost ratio (PCR) also denotes a situation of improved profitability and increased competitiveness. The profitability coefficient (PC) also decreases indicating that the increase in the private profitability of the rice systems is not fully through the transfer of government policies.

**8.3 Rice import from India**

Of the total rice imports, almost 90 percent is from India. Till 1998, Bhutan through the FCB had been procuring rice from India based on their Central Issue Price (CIP), which was much below the market rate. The FCB is now currently importing at the Above Poverty Line (APL) rate, which in India is below the normal market rate but higher than the CIP (Agricultural Marketing Services, 2000). These two prices, the CIP and the APL are both subsidized rates and through bilateral trade agreements, Bhutan has been importing rice from India at a subsidized rate. The need to import rice from India at a cheaper rate is to ensure food security at prices affordable by the

majority of the people in the country. Therefore another situation using the above poverty line rate was created as a part of the sensitivity analysis and to see policy implications. Table 8.5 shows the summary of PAM with respect to the APL price of India. The freight and insurance cost, transportation cost, handling charges by the Food Corporation of Bhutan and the margin retained by the fair price shops have been added on to the APL to get the social import parity price. The analysis is purely based on the rice imported through Food Corporation of Bhutan (FCB) and does not in any way include the price at which private traders import and sell in the country.

Table 8.5. Rice PAM using the APL price of India

| | Revenue | Costs | | Profit |
| | | TI | DF | |
| | ------------------------Nu/ha------------------------- | | | |
| Samtse | | | | |
| Private prices | 22,880.0 | 2,748.3 | 17,799.2 | 2,332.5 |
| Social prices | 12,057.8 | 3,008.1 | 21,499.0 | -12,449.3 |
| Divergence | 10,822.2 | -259.8 | -3,699.8 | 14,781.8 |
| Lobesa | | | | |
| Private prices | 64,550.0 | 4,415.4 | 33,480.8 | 26,653.8 |
| Social prices | 28,686.0 | 4,982.4 | 33,480.8 | -9,777.2 |
| Divergence | 35,864.0 | -567.0 | 0 | 36,431.0 |
| Paro | | | | |
| Private prices | 62,725.0 | 2,121.8 | 35,066.8 | 25,536.5 |
| Social prices | 27,147.4 | 2,300.9 | 35,066.8 | -10,220.3 |
| Divergence | 35,577.6 | -179.1 | 0.00 | 35756.7 |

TI = Tradable inputs; DF = Domestic factors

Under the present scenario the rice systems in all the three locations yield positive profit. However, when the social price based on Indian rice is used the rice system suffers from negative social profitability in all the three locations. This indicates that rice farmers have been able to make positive private profit with the government's support through the provision of indirect subsidy in the use of tradable inputs and keeping the private prices of the output higher than the social prices. One

of the ways of keeping private prices of the output higher was through the support provided by the government in terms of transporting the imported rice to different parts of the country. The price of rice imported through the Food Corporation of Bhutan (FCB) and sold through the fair price shops therefore remained lower then the domestically produced rice. Another factor that resulted in the negative social profitability could be because of the fact that India has been aiding in supplying rice to Bhutan at the above poverty line (APL) rate, which is below the market rate in India. Therefore, the policy of the government in ensuring food security through lower social output prices creates huge divergence in output revenue. The divergence can be corrected either through the decrease in the private prices of the output or increase the social price. However under such circumstances of negative social profitability, it can be said that rice farmers may not find it enterprising enough to continue with paddy cultivation and could thus force them to venture into other crops that would yield higher returns as compared to rice. Without any support or intervention from the government, paddy cultivation when compared to the import price from India would not be viable in the study areas. The discussion gets clearer with the help of ratios. So based on the PAM summary of importing Indian rice, relevant ratios (Table 8.6) have been calculated to look into the efficiency and competitiveness of the rice system for these three locations.

Table 8.6. PAM ratios in relation to rice imports from India

| Ratios | Location | | |
|---|---|---|---|
| | Samtse | Lobesa | Paro |
| Nominal Protection Coefficient on Output (NPCO) | 1.90 | 2.25 | 2.31 |
| Nominal Protection Coefficient on Input (NPCI) | 0.91 | 0.89 | 0.92 |
| Effective Protection Coefficient (EPC) | 2.22 | 2.54 | 2.44 |
| Domestic Resources Cost (DRC) | 2.38 | 1.41 | 1.41 |

With respect to the import of Indian rice at the prevailing price, the nominal protection coefficient on output indicates that the policies of the government are geared to increasing the private prices of the output by as much as 90 percent in

Samtse, 2.25 times greater than social price in Lobesa and by about 2.31 times greater in Paro. It also indicates that the rice farmers are enjoying huge amount of subsidies from the society in terms of higher private prices. Consumers would prefer to consume imported Indian rice that is available in the market at a lower price.

The effective protection coefficient is greater than unity in all three locations indicating that private profits would be higher than they would be without commodity policies and that the rice system in all the three locations would have to be heavily protected by the government.

With low price of rice import from India, all the three locations would not have any comparative advantage in the production of rice as indicated by the domestic resources cost (DRC) that are much higher than unity. Even Lobesa, which has a DRC value of 0.60 when compared to the import parity price, would not have any competitive advantage.

The question then arises as to what should be the ideal social price so that the three locations would have comparative advantage in the production of rice. The domestic resources cost (DRC) would break even if the social prices for the outputs increased to Nu 21.5/kg (104 percent increase) in Samtse, Nu 14.3/kg (29 percent) in Lobesa and Nu 14.4/kg (33 percent) in Paro. Table 8.7 illustrates how the likely policy scenario would be in case the domestic resources cost breaks even with an increase in the social price of imported rice from India.

Private profitability does not change and still remains positive. The social profit would be positive and the output divergence would decrease in all the locations. The negative output divergence would indicate that Samtse would not be protected by government policy as the social price would now be above the private price of the output. The positive output divergence in Lobesa and Paro indicates that these places would still benefit from substantial protection from the government.

Table 8.7. PAM summary at break even social price

|  | Revenue | Cost | | Profit |
|  |  | TI | DF |  |
|  | ------------------------Nu/ha----------------------- | | | |
| Samtse |  |  |  |  |
| Private price | 22,880 | 2,740 | 17,799 | 2341 |
| Social price | 24,596 | 3000 | 2,1499 | 97.4 |
| Divergence | -1,716 | -260 | -3,700 | 2,244 |
| Lobesa |  |  |  |  |
| Private price | 64,550 | 44,15 | 31,871 | 28,263.84 |
| Social price | 36,923 | 4,982 | 31,871 | 69.40 |
| Divergence | 27,627 | -567 | 0 | 28,194 |
| Paro |  |  |  |  |
| Private price | 62,725 | 2,122 | 33,739 | 26,864 |
| Social price | 36,130 | 2,301 | 33,739 | 90 |
| Divergence | 26,595 | -179 | 0 | 26,775 |

The imputed ratios indicate that Samtse would lose protection from the government if the social price increased as the private price for the output would now be lower than the social price. Rice systems in Lobesa and Paro would still be protected by government policies where the private prices would remain higher than the social price.

Government policy would help in increasing the private revenue by as much as 75 percent in Lobesa and 74 percent in Paro. The domestic resources cost (DRC) would just break even if the social price for the Indian rice increased by the rate as mentioned above.

Table 8.8. PAM ratios at break even social price of output

| Ratios | Locations | | |
|---|---|---|---|
| | Samtse | Lobesa | Paro |
| Nominal Protection Coefficient on Output (NPCO) | 0.93 | 1.75 | 1.74 |
| Nominal Protection Coefficient on Input (NPCI) | 0.91 | 0.89 | 0.92 |
| Effective Protection Coefficient (EPC) | 0.93 | 1.88 | 1.79 |
| Domestic Resources Cost (DRC) | 1.00 | 1.00 | 1.00 |
| Private Cost Ratio (PCR) | 0.88 | 0.53 | 0.56 |
| Profitability Coefficient (PC) | 0.04 | 0.00 | 0.00 |

Based on the sensitivity analysis, increase in yield would greatly enhance the comparative advantage situation and make rice a more competitive crop in the country. However, if Bhutan were to continue importing Indian rice then the cultivation of paddy in the country would lead to inefficient use of resources. It would then more efficient and rewarding for farmers in all the three locations to venture into the cultivation of other crops that would provide higher returns.