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Short Communication

Estimating the Effects of WTO on Cropping Pattern and Farm Income

ISHTIAQ HASSAN, KHUDA BAKHSH† AND ASIF MAQBOOL[1]
Adaptive Research, Government of Punjab, Lahore–Pakistan
†*Faculty of Agricultural Economics and Rural Sociology, University of Agriculture, Faisalabad–38040, Pakistan*
[1]Corresponding author's e-mail: asif_maqbool2002@yahoo.com

ABSTRACT

This paper analyzes the impacts of trade liberalization on the cropping pattern and farm income with special reference to the irrigated areas of Pakistani Punjab. For this purpose, three divisions were selected i.e. Lahore, Faisalabad and Multan. The study in hand employs Linear Programming (LP) model to determine cropping pattern, and farm income in these divisions. To visualize the effects of trade liberalization, national farm gate prices and the World Bank farm gate prices of 2003 are used. Results of the study indicate that farm income would increase Lahore division by 45.98%. Sugarcane, potato, cotton and maize are the crops that would not compete. In case of Faisalabad division, the increase in farm income was recorded as 81.33% and that of Multan division 62.13%. Results depict that trade liberalization could increase farm income in all three divisions due to increased in production of those crops in which Pakistan has comparative advantages given that other factors remain constant.

Key Words: Linear programming; Cropping pattern; Farm income; Farm gate prices; Punjab

INTRODUCTION

Globalization and trade liberalization is not meant that they will bring equal distribution of income within or between countries. Liberalization policies have had both positive and negative consequences (Huang *et al*., 2003). Un-employment, inequality and alienation are rising partly because of globalizations process. Like other developing countries, Pakistan has not made necessary arrangements to face the challenges and avail the opportunities offered by the WTO. Agriculture is the one of the largest sectors of the economy of Pakistan. It contributes 23.3% to Gross Domestic Product (GDP) and engages 42.1% of country work force. Agriculture is subsistence in nature, land holdings are small, and production is labour intensive with relatively low intensity of farm inputs, irrigation decedent on the vagaries of nature so, the farm productivity is low.

In the existing scenario the agriculture of developing countries, like Pakistan, is characterized with high cost of production as compared to developed countries. There will be more export from the developed countries in to the market of the developing countries including, Pakistan, WTO, therefore will negatively affect Pakistan agriculture export (Shabir, 2002). Sugar from the West Indies, Brazil and Hawaii will be in our market at half of the price of Pakistan sugar (Mumtaz, 2000).

What can be done under the new situation, when most of the Pakistan agricultural products would face cut throat competition from abroad? The most decisive option would comprise selection of optimum cropping patterns as a pre-requisite to efficient utilization of available resources of land, water and capital. Farmer's profit cannot be maximized without optimum cropping patterns, which ensure efficient utilization of available resources in the scenario of WTO. Secondly, international price options foreseeable in the times ahead should be used to see their effects on acreage allocation to crops, land use intensities, water and capital utilization in various crop zones. It would be seen how a given crop behaves to new price situations. Such exercise would yield information by which a particular commodity would be made to stay in the field under the conditions of WTO where the most fitted would survive.

Under such a grim situation present study was designed to see the impact of WTO on the principal crops of the irrigated areas of the Punjab province. The province of the Punjab accounts for about 73.4% of Pakistan's Agriculture both in terms of cropped acreage and income originating from the crop sector. Over 95% of agriculture income comes from the irrigated areas of Pakistan, of which 73% is contributed by the irrigated areas of the Punjab (Agriculture census, 2000; Agriculture Statistics, 2000). The specific objectives of the study include estimating the acreage of the principal crops under WTO interventions and their comparison with the existing situation, assessing the farmers' income levels in the era of free trade regime and their comparison with the existing income levels. For this purpose, two types of farm gate prices were used a) local farm gate prices b) World Bank farm gate prices.

METHODOLOGY

Analytical framework. In order to find out the optimal organization of crops in the irrigated Punjab, a static deterministic linear programming model was used. It was assumed that farmers' aim was to maximize their profit,

perfect marketing system was operating in the economy, there were constant returns to scale or that the production function for each enterprise was linear, out-put could be produced and input could be used in fractional units, and it was assumed that total acreage in each region is limited by the availability of land and by the maximum and minimum limits set for crops. The objective of the model was to maximize total net income (gross margin). Linear programming model of the following form was used as an analytical tool to explore the possibilities of optimizing cropping pattern, farm returns, considering only crop activities for the selected divisions.

The objective function is to maximize profit,

Where

$$Y = \sum_{i=1}^{3} \sum_{j=4}^{7} C^{n}{}_{ij} X_{ij}$$

Subject to the following constraints Kharif Land Availability

$$\sum_{j=1}^{n} a_{ij} X_{ij} \leq SL_i \quad \text{For all i}$$

Rabi Land Availability

$$\sum_{j=1}^{n} a_{ij} X_{ij} \leq WL_i \quad \text{For all i}$$

Water Availability

$$\sum_{j=1}^{n} W_{ijg} X_{ijg} \leq W_{ig} \quad \text{For all i and g}$$

Capital Availability

$$\sum_{j=1}^{n} K_{ij} X_{ij} \leq K_i \quad \text{For all i}$$

Maximum Acreage Constraint

$$\sum_{i=1}^{m} a_{ij} X_j \leq Max_j \quad \text{For all i and j}$$

Minimum Acreage Constraint

$$\sum_{i=1}^{m} a_{ij} X_j \geq Min_j \quad \text{For all i and j}$$

Non-negativity Constraints

$X_{IJ} \geq 0$

Where

Y = Gross margin i.e. gross income - variable cost.

C_{ij} = Gross margin from J-th activity in the i-th region.

Where

i = 1, wheat-rice cropping pattern region, i = 2, wheat-sugarcane cropping pattern region, i = 3, wheat-cotton cropping pattern region, J = 1, wheat, J = 2, Basmati Rice, J = 3, Irri Rice, J = 4, Cotton, J = 5, Sugarcane, J = 6, Maize, J = 7, Potato

X_{ij} = Level of J-th activity in the i-th region

a_{ij} = Amount of land needed per unit of J-th activity in the i-th region

SL_i = Amount of land available during the kharif season in the i-th region

WL_i = Amount of land available during the rabi season in the i-th region

W_{ijg} = Quantity of water required per unit of j-th activities in the i-th region during the g-th month

g = Months ranges from 1, 2, 3, 12

X_{ijg} = Level of J-th activity in the i-th division during the g-th month

W_{ig} = Total amount of water available in the i-th division during the g-th month.

k_{ij} = Amount of capital required for the J-th activity in the i-th division

K_i = Total amount of capital available in the i-th division

X_J = Level of j-th activity

Max_J = Maximum level of j-th activity

Min_i = Minimum level of j-th activity

The data. In order to determine the optimal organization of the crops, the province of the Punjab was divided into irrigated and non-irrigated (rain-fed) regions. The irrigated area was selected for the purpose of this study, which spreads around 12 million acres. Out of this, three divisions namely Multan, Lahore and Faisalabad were selected for the purpose of this study. And seven different crops were included in the model namely wheat, Basmati rice, IRRI rice, cotton, sugarcane, maize and potato.

Most of the data requirement was fulfilled by making specific adjustments to the data available in various studies, government reports etc. The constraint levels were determined by collecting data for various years. Total land that would be available for the production of crops in each of the crop regions was collected from the Agricultural Census, 1999 - 2000. From this, the share of the minor crops occupying less than 2% of the cropped area was deducted, the balance was assumed to be available for the crops included in the model. Because of the double cropping practiced in the irrigated Punjab, land was estimated for each season i.e. Kharif (summer) and Rabi (winter) crops.

Cost of production of all crops included in the model was based on the study conducted by Department of Farm Management, University of Agriculture, Faisalabad (Ahmad *et al*., 1992; 1994). The average crop yield estimated by the government agencies as published in agricultural statistical books, were used in the study. Since higher or lower prices than the average existing price of the commodities were adopted, their effects on acreage and yield were adjusted according to the results reported by Mushtaq (2000).

RESULTS AND DISCUSSION

Linear programming model was used to determine optimum cropping pattern and farm income for each division separately. Use of two types of farm gate prices was made for the purpose of this study. At first, local farm gate prices were used to determine the optimum cropping pattern and farm income and in the second step, the World Bank farm gate prices were used to evaluate the effect of free trade regime on acreage and farm income. Results are described as under:

Multan division. Multan division is an important division from agricultural point of view. Mostly, cotton and wheat are grown in this division and Pakistan's economy mainly depends on these two crops. Results of study indicate that acreage under cotton would increase when World Bank farm gate prices were utilized to determine optimum cropping pattern. Area under cotton increased from 2187 thousand acre to 2463 thousand acres. This increase could be due to the fact that the cotton growing farmers are getting selling prices for cotton lint according to the world market, so, the effect was positive as area under other crops such as

sugarcane, maize, IRRI rice and potato crops decreased because these crops could not compete cotton crops in terms of use of available inputs and their prices in the scenario of World Bank farm gate prices. The crops, which suffered from huge reduction in area under cultivation, were basmati rice, sugarcane, maize and potato as their area decreased by 13.94, 12.5, 11.21 and 9.61%, respectively. One important reason is that basmati rice and sugarcane need more use of irrigation water as compared to cotton crop and therefore, their area decreased, while that of cotton crop increased. Wheat is the most staple crop of Pakistan and it was found that its area decreased by 3.08%. Overall, area in Multan Division increased from 5620 thousand acres to 5747 thousand acres recording a 2.25% increase in cropped area when the World Bank farm gate prices were used for determining optimum cropping pattern. Due to increased area under cultivation in the scenario of World Bank prices, an increase in farm income was estimated. The farm income rose from Rs. 35.084 billion to Rs. 56.884 billion recording an increase of 62.13% (Table I). This increase in farm income came from more area under cotton crop and cotton crop is an important cash crop in Pakistan and fetch huge foreign earnings every year.

Faisalabad division. Faisalabad division is famous for the production of wheat, sugarcane and cotton as these crops occupy most of the cultivated area of this division. Under national farm gate prices, wheat was the most important crop occupying 1600 thousand acreage of total cultivated area in Faisalabad division. Sugarcane, cotton and basmati rice were other important crops in terms of area under these crops. In the scenario of the World Bank farm gate prices, area under all crops except potato increased. The highest increase in the descending order was estimated for IRRI rice, cotton and wheat crops. The highest increase in acreage under IRRI rice was due to favorable climatic conditions for this crop in Faisalabad division. Overall, cropped area increased from 2702 thousand acres to 2742 thousand acres showing an increase of 1.48%. While considering the farm income, it increased substantially when the World Bank farm gate prices were used to determine optimum cropping pattern and farm income. Because more area was brought under IRRI rice cultivation and Pakistan is enjoying comparative advantage in the production of this crop, therefore, farm income increased by 81.33% (Table II).

Lahore division. Lahore division is one of the important irrigated divisions of Punjab province of Pakistan. It contributes substantially in agricultural production and foreign earning. Wheat is the most important crop in this division also because it is the staple crop and meets food requirements of the rural as well as urban population. Other important crops in this division are basmati rice, sugarcane and IRRI rice. Under national farm gate prices, wheat, basmati rice, sugarcane and IRRI rice were the most important crops occupying major portion of cultivated area in Lahore division. When the World Bank farm gate prices were introduced in the linear programming model, the results showed that area under IRRI rice crop increased substantially from 170 thousand acres to 194 thousand acres recording an increase of 14.11%, while that of wheat rose from 1789 thousand acres to 1980 thousand acres showing a rise of 10.68%. However, area under basmati rice, sugarcane, cotton, potato and maize decreased substantially as these crops could not compete in the scenario of free trade regime. However, a 1.60% increase in cropped area was recorded whereas the farm income increased from Rs. 14.703 billions to Rs. 21.463 billions indicating an increase of 45.98% (Table III).

Table I. Comparison of Existing and Optimum Cropping Pattern under WTO in Multan Division (000 acres)

Crops	National farm gate prices	World Bank Prices	Percentage change
Wheat	2917	2827	-3.08
Basmati rice	165	142	-13.94
IRRI rice	80	75	-6.25
Cotton	2187	2463	+12.62
Sugarcane	112	98	-12.50
Maize	107	95	-11.21
Potato	52	47	-9.61
Total	5620	5747	+2.25
Income (Rs. Billion)	35.084	56.884	+62.13

Table II. Comparison of Existing and Optimum Cropping Pattern under WTO in Faisalabad Division (000 acres)

Crops	National farm gate prices	World prices	Bank Percentage change
Wheat	1600	1763	+10.18
Basmati rice	208	0	0
IRRI rice	20	23	+15.00
Cotton	321	364	+13.40
Sugarcane	462	496	+7.36
Maize	71	78	+9.85
Potato	20	18	-10.00
Total	2702	2742	+1.48
Income (Rs. Billion)	8.973	16.271	+81.33

Table III. Comparison of Existing and Optimum Cropping Pattern under WTO in Lahore Division (000 acres)

Crops	Existing	Under WTO	Percentage change
Wheat	1789	1980	+10.68
Basmati rice	954	832	-12.78
IRRI rice	170	194	+14.11
Cotton	63	59	-6.35
Sugarcane	185	163	-11.89
Maize	61	55	-9.83
Potato	76	68	-10.52
Total	3298	3351	+1.60
Income (Rs. Billion)	14.703	21.463	+45.98

CONCLUSIONS

The result showed that there appears no substantial change to the prevailing situation of food security because wheat, the staple food, maintained its position in all the divisions. Pakistan's agriculture exports will be increased in free trade regime because the acreage of two main

exportable crops namely cotton and Basmati rice will increase under WTO situation. Sugarcane, Basmati rice and potato will be in the extreme danger under the free trade regime. Income of the farmers of cotton and rice zone will get benefit from the free trade regime, while the income of the farmers of mixed crop zone will suffer a serious set back. The results showed that food crops and exportable crop will be able to remain in the field; the WTO as such would not be a major threat to Pakistan's agriculture exception being sugar cane economy, which would be totally wiped out.

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