Pak. J. Agri. Sci., Vol. 42(3-4) 2005

EFFECT OF TRADE LIBERALIZATION ON THE MAIN CROPS OF THE MIXED CROP ZONE

Ishtiaq Hassan and Anjum Ali
Adaptive Research, Punjab

Linear Programming Model was applied to calculate the acreage and income of the farmers of mixed crop zone under the free trade regime. Eight crops were included in the model. The result showed that Sugarcane crop would be totally washed out from the mixed crop zone. Income of the farmers will decrease considerably under free trade regime.

INTRODUCTION

WTO is an international organization dealing with multilateral trade. Agriculture, like any other sector of the economy plays a dominant role in the economic development of any country by contributing to GDP, providing employment to people etc. However, its importance to developing countries is much more than to developed ones. As developing countries have very different economic, financial, technological and development circumstances as compared to developed countries (Shabir 2002).

The concept of trade liberalization in context of agriculture was first included in the international discussion at the eve of command changing from GATT to WTO. Pressure from major agricultural exporting countries in the Cairns group and the concerns of the two major developed trading blocks i.e. the USA and the EU put agriculture into the Uruguay Round. Both the USA and the EU over produced and needed to find markets to dispose off their surplus. Disagreements between them over agriculture nearly stalled negotiations in the GATT until they reached a compromise agreement on agriculture. These two major trading blocks largely thrashed out the AOA and selected the base year and detailed targets so as to benefit them most. Many, if not most, developing countries, including Pakistan, signed up the Uruguay Round without understanding the implications of the agreements for their farmers and food security (Ghafoor, 2003).

It is assumed that trade liberalization under WTO regime will increase the food security. Reduction of tariffs and opening of market will make it possible to supply food items at comparatively lower cost because commodities are assumed to be traded on the principle of comparative advantage i.e. commodities will move from lower cost point to higher cost point abandoning their production in the higher cost areas. In the existing scenario the agriculture of developing countries, like Pakistan, is characterized with high cost of production as compared to developed countries. Agriculture is the main stay of the economy of Pakistan but it is rather under developed. There will be more export from the developed countries into the market of the developing countries including, Pakistan, WTO, therefore will negatively effect 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 *et al* 2000).

Moreover, in the wake of the WTO agreement, many devices deployed in the past for productivity enhancement would be no longer tenable. Pricing of inputs and outputs and their subsidization, tariffs, duties etc. in particular would fall outside the purview of the Pakistan Government to steer agriculture to the desired goals, as has been the case in the past.

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. This 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 mixed crop zone with special reference to food security, supply of raw material to the local industries, volume of export of agricultural based goods and income of the farmers.

The province of the Punjab comprises four distinct crop zones. In the north lies the rain fed area, next to it is the rice zone, in the center is the mixed crop zone

where sugarcane and maize dominate, while the southern part houses the cotton zone (Ahmad, *et al* 1994). Objectives of the study are as under.

1. To estimate the acreage of the principal crops under WTO interventions and their comparison with the existing situation.
2. To assess the farmers income levels in the era of free trade regime and their comparison with the existing income levels.

METHODOLOGY

Province of the Punjab was divided into irrigated and non irrigated (rain-fed) regions. The irrigated area of the mixed crop zone was selected for the purpose of this study which spreads over 4850 thousand acres. All the crops, which covered over 2% of the cropped area in each crop region, were included in the model, except the fodder crops, which have been excluded irrespective of the acreage occupied by them. The area of fodder is more or less uniform over time. It fulfills the requirement of livestock sector.

The irrigated area of the Punjab was divided into 3-crop zones namely rice zone, mixed crop zone and cotton zone. These regions are located in seven civil administration divisions of the Punjab province. Further analysis was carried out on the basis of administration divisions because the civil administration division reports most of the data. The present study is conduced in mixed crop zone. Which consists of Faisalabad and Sargodha Divisions. In all eight different crops were included in the model namely wheat, Basmati rice, IRRI rice, cotton, sugarcane, maize, potato and gram.

MODEL

MATHEMATICAL PRESENTATION OF THE MODEL

The objective of the model was to maximize total net income (gross margin). Algebraically the model is summarized below:

1. **Basic Assumptions:**

   (a) All producers in a zone are having only the choice to produce certain product mixes.
   (b) All producers in a zone have identical input – output coefficients.
   (c) Total production of various commodities is limited by the resources availability in the zone.
   (d) An acre of production can be substituted for an acre of other type of production.
   (e) The economic objective of the producer is to maximize profit, i.e. gross margin.
   (f) The production period is agricultural calendar year.
   (g) Crops covering up to 2% or more of the total cropped area were included in the optimal solutions in the entire zone.
   (h) Farm labor supply does not pose limitation on crop production in the entire zone.
   (i) A crop failed to cover its variable cost; it was omitted from the model.

The Model

Linear programming model of the following form was used as an analytical tool to explore the possibilities of optimizing farm returns, considering only crop activities for the selected crop zone.

The objective function is to maximize profit, where

$$Y = \sum_{i=1}^{2} \sum_{J=1}^{8} \sum^{n} C_{ij} X_{ij}$$

Subject to the following constraints:

Kharif Land Availability:

$$\sum_{J=1}^{n} a_{ij} X_{ij} \leq SL_i \text{ for all } i$$

Rabi Land Availability:

$$\sum_{J=1}^{n} a_{ij} X_{iJ} \leq WL_i \text{ for all } i$$

Water Availability:

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

Capital Availability:

$$\sum_{J=1}^{n} k_{ij} X_{ij} \leq K_i \text{ for all } i$$

Maximum Acreage Constraint:

$$\sum_{i=1}^{m} a_{iJ} X_j \leq Max_j \quad \text{for all } i \text{ and } J$$

Minimum Acreage Constraint:

$$\sum_{i=1}^{m} a_{iJ} X_j \geq Min_j \quad \text{for all } i \text{ and } J$$

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 Division.
i = 1, Faisalabad Division
i = 2, Sargodha Division
J = 1, wheat
J = 2, Basmati Rice
J = 3, Irri Rice
J = 4, Cotton
J = 5, Sugarcane
J = 6, Maize
J = 7, Potato
J = 8, Gram
X_{ij} = Level of J-th activity in the i-th Division
a_{ij} = Amount of land needed per unit of J-th activity in the i-th Division
SL_i = Amount of land available during the kharif season in the i-th Division
WL_i = Amount of land available during the rabi season in the i-th Division
w_{ijg} = Quantity of water required per unit of j-th activities in the i-th Division
During the g-th month
g = 1, January
g = 2, February
g = 3, March
g = 4, April
g = 5, May
g = 6, June
g = 7, July
g = 8, August
g = 9, September
g = 10, October
g = 11, November
g = 12, December
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

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. The procedure adopted in establishing different constraints is discussed first. This is followed by the discussion of the cost of production of different crops. Finally, the method of yield and price estimation for different crop is given.

METHOD USED IN CONSTRAINT ESTIMATION

Land availability constraints

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. Sugarcane crop was assumed to occupy its land in both the seasons, not withstanding the fact that ratoon sugarcane crop may relinquish a part its acreage for the winter crops and a part of it may be reserved for the autumn and spring crops. Ratooning of sugarcane may extend beyond two years in certain cases.

Cost of production.

Cost of production of all crops included in the model was based on the study conducted by Department of Environmental and Resource Economics, University of Agriculture, Faisalabad. The items by which total cost of each crop has been estimated included are land and seed bed preparation, Sohagas (Planking) , Sowing Cost, Bund making (Bank), Irrigations, Farm yard manure, Fertilizers, Seed rate, Interculture, Weeding, Hoeing, Spray, Manual cost of application of fertilizer, irrigation , spray, farm yard manure, etc., Harvesting and threshing, picking cost. Land revenue., Taxes, Management charges, Mark up on investment.

YIELD ESTIMATION

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).

SELLING PRICES

Since at the time of making land allocation decisions, farmers do not know the prices at which the produce will be sold, they commonly used the preceding year prices as a basis to allocate acreage amongst crops. So average wholesale price for year 2002-03 for different commodities were taken and adjusted for freight and handling charges to arrive at the farm gate prices. These prices were used as a base year. International prices were also collected from the

Table 1. Comparison of National and International Prices (Farm gate prices, Rs/40Kg)

Crops	National support prices/average wholesale prices	International/farm gate prices
Wheat	300	262
Basmati rice	423	499
IRRI rice	205	176
Cotton	800	908
Sugarcane	42	21
Maize	460	410
Potato	196	145
Gram	670	800

reports and records of the Agricultural Prices Commission of Pakistan (Ministry of Agriculture, Government of Pakistan). These prices are the farm gate prices as worked out or visualized by the organization listed above. Their prices were therefore, used in the analysis.

GROSS MARGIN

Given the yield, prices and variable cost of production of various crops, farm income, i.e. gross margin (gross income - variable costs) were estimated and used in the analysis.

RESULTS AND DISCUSSIONS

Mixed crop zone

In the mixed crop zone wheat, cotton, Basmati rice, IRRI rice, potato and gram gained acreage by about 10% each as compare to the existing situation. While sugarcane crop was completely wiped out. Over all crop acreage decreased by about 6% as compare to the existing situation. Optimal cropping pattern under WTO situation resulting from the application of LP Model in comparison to the existing cropping patterns are presented in Table-2.

Income of the farmers of the mixed crop zone decreased from existing level of Rs: 14.259 (Billion) to Rs: 10.554 (Billion). Farmer's income was off about 26% in the mixed crop zone as compared to the existing situation. Details are given in the Table-3.

Table 3. Comparison of existing and WTO income level in mixed crop zone (RS billions)

Existing	Under WTO	Percentage change
14.259	10.554	-25.98

CONCLUSIONS:

1. The result showed that wheat, the staple food, increased its acreage.
2. 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.
3. Sugarcane will be in the extreme danger under the free trade regime.
4. Income of the farmers of mixed crop zone will suffer a serious set back.

Table 2. Comparison of existing and optimum cropping pattern under WTO in mixed crop zone (000 acres)

Crops	Existing	Under WTO	Percentage change
Wheat	2850	3133	+9.92
Basmati rice	350	406	+16.00
IRRI rice	38	42	+10.52
Cotton	416	463	+11.29
Sugarcane	691	-	–
Maize	71	79	+11.26
Potato	20	22	+10.00
Gram	90	101	+12.22
Total	4526	4246	–6.19

REFERENCES

Agriculture Prices Commission of Pakistan. 2003. Support Price Policies (various issues).

Ahmed, B., M.A. Chaudhry and S. Hassan. 1994. Cost of Producing Crops in the Punjab. Deptt. of Farm Management, Univ. of Agri., Faisalabad.

Ghaffor, A. 2003. Making people food secure or insecure, Economic and Bussiness Review, Daily Dawn, Karachi.

Govt. of Pakistan, Pakistan Census of Agriculture. 1999-2000. Province Report Punjab. Agriculture census organization.

Govt. of Punjab, Punjab Development Statistics. 2000. Bureau of Statistics, Lahore.

Mumtaz, M., A. Saeed, S. Zafar, M. Hakeem and F. Mirza. 2000. WTO and its impact on Pakistani Agriculture and Trade. Project assignment, NUST Institute of Management Sciences.

Mushtaq, K. 2000. Supply Response of Major Agriculture Commodities in Pakistan. Unpublished Ph.D., Thesis, Department of Agriculture Economics and Food Marketing, New Castle Upon Tyne, U.K.

Shabir, S. 2002. WTO Ruling on Agriculture Trade with Implications for Developing countries with special reference to Pakistan M.Sc. Thesis. Fatima Jinnah Women University, Rawalpindi, Pakistan.