



Trade Policy Reforms and Agribusiness Outcomes: Evidence from Pakistan's Basmati Rice Markets

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ABSTRACT

Rice is one of Pakistan's most important agricultural commodities, contributing significantly to farm income, employment, export earnings, and national food security. Among rice varieties, basmati occupies a unique position because of its premium quality and strong demand in international markets. Over the past four decades, Pakistan's rice sector has experienced substantial trade policy reforms, shifting from a highly regulated marketing system to a more market-oriented trade regime following the implementation of agricultural liberalization measures under the World Trade Organization (WTO). To evaluate the agribusiness implications of these reforms, this study analyzes the welfare effects of trade policy changes during two distinct policy regimes: the pre-trade liberalization period (1981–1995), characterized by extensive government intervention in rice marketing and exports, and the trade liberalization period (1996–2015), during which government controls were substantially reduced and private sector participation expanded. A Simultaneous-Equation Recursive Model was employed to estimate domestic supply, domestic demand, export demand, and export supply relationships for Pakistan's basmati rice market. Using the estimated structural equations, free-trade equilibrium prices were simulated under the large-country assumption for Pakistan in the global basmati rice market to evaluate changes in producer surplus, consumer surplus, export tax revenue, and overall social welfare resulting from trade liberalization.

The findings indicate that Pakistan's trade policy reforms generated positive agribusiness outcomes under both policy regimes, although the magnitude differed considerably. The estimated forgone net social welfare gain was approximately USD 113.35 million per annum during the pre-trade liberalization period compared with USD 19.66 million per annum during the trade liberalization period. The results suggest that progressive reductions in market distortions improved allocative efficiency while reducing welfare losses associated with government intervention. These findings highlight the importance of transparent, market-oriented trade policies that enhance the competitiveness of Pakistan's basmati rice sector while supporting sustainable agribusiness development under evolving global trade conditions.

Introduction

Agriculture remains a central pillar of Pakistan's economy, contributing approximately 22–23 percent to the Gross Domestic Product (GDP), employing around 37–38 percent of the labor force, and supplying essential raw materials to the industrial sector (Government of Pakistan, 2024). Among major crops, rice holds a prominent position as the second most important staple after wheat in terms of area and production. In recent years, rice has been cultivated on about 3.0 million hectares with production exceeding 9 million tonnes, reflecting its growing economic significance. Moreover, rice is a key export commodity, contributing substantially to foreign exchange earnings (Pakistan Bureau of Statistics, 2024; Food and Agriculture Organization, 2024). Globally, rice remains a dominant staple food, particularly in developing countries, with nearly 90 percent of production and consumption concentrated in Asia. Pakistan ranks among the leading rice exporters, contributing approximately 7–8 percent to global rice trade, with a strong comparative advantage in premium basmati rice exports.

In Pakistan, rice production is geographically concentrated, with Punjab accounting for nearly 70 percent of total output, followed by Sindh, while Khyber Pakhtunkhwa and Balochistan contribute relatively smaller shares. Major basmati varieties include Super Basmati, Basmati 385, and Kernel Basmati, whereas non-basmati varieties such as IRRI-6, IRRI-9, and KS-282 dominate the coarse rice segment. Over time, the private sector has assumed a leading role in both domestic marketing and international trade of rice, while the government's role has increasingly shifted toward regulation, facilitation, and policy support (Government of Pakistan, 2023; International Rice Research Institute, 2022).

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Basmati rice has attracted considerable attention among farmers and traders due to its strong export demand and price premium, often fetching significantly higher prices compared to non-basmati varieties in both domestic and international markets. Agro-climatic conditions in Punjab are particularly favorable for basmati cultivation, which explains farmers' preference for basmati production despite shifting global demand trends that increasingly favor non-basmati rice varieties, especially in bulk-importing countries (FAO, 2023). The international rice market exhibits unique structural characteristics that distinguish it from other agricultural commodity markets. It is highly segmented based on grain type, quality, processing level, and consumer preferences, resulting in limited substitutability across different rice categories. Additionally, the global rice market is relatively thin, with only about 9–10 percent of total production entering international trade, making it more susceptible to shocks and price fluctuations. Market thinness, combined with product heterogeneity, remains a key driver of price volatility in the global rice economy (Timmer, 2010; Jamora and von Cramon-Taubadel, 2016; Bellemare et al., 2020; Tahir et al. 2024).

Trade liberalization has become one of the most influential policy reforms affecting agricultural markets worldwide. Since the establishment of the World Trade Organization (WTO) and the implementation of the Agreement on Agriculture (AoA), many developing countries have gradually reduced trade distortions by lowering tariffs, eliminating export restrictions, reducing government intervention in commodity marketing, and encouraging greater private-sector participation. Such reforms are expected to improve market efficiency, resource allocation, and international competitiveness, although their welfare effects depend on the structure of domestic markets, comparative advantage, and the nature of government interventions (Feenstra, 2015; Anderson et al., 2020; WTO, 2023). Pakistan's rice sector has undergone substantial policy reforms during the past four decades. During the pre-trade liberalization period (1981–1995), the government exercised considerable control over rice marketing and exports through institutions such as the Rice Export Corporation of Pakistan (RECP), together with various pricing, procurement, and export policy measures. Following the implementation of the WTO Agreement on Agriculture and broader economic reforms, the trade liberalization period (1996–2015) witnessed a gradual reduction in direct government intervention, increased private-sector participation in rice exports, and greater integration with international markets. These policy changes substantially altered market incentives, price transmission mechanisms, and the distribution of welfare among producers, consumers, exporters, and the government.

A substantial body of literature has examined the effects of agricultural trade liberalization on production, trade competitiveness, market efficiency, and economic welfare. Earlier studies on Pakistan's rice sector primarily focused on estimating the welfare effects of trade liberalization and domestic protection policies (Akhtar, 1999; Qayyum et al., 2006; Sharif et al., 2008; Zulfiqar, 2008; Zulfiqar et al., 2012). More recent international studies have emphasized the implications of agricultural trade reforms for market integration, value chains, export competitiveness, and agribusiness development under changing global market conditions (Anderson et al., 2020; WTO, 2023; FAO, 2024). However, relatively limited empirical evidence exists on the comparative welfare effects of Pakistan's transition from a highly regulated rice market to a more liberalized trade regime over an extended period. Furthermore, most previous studies do not explicitly compare welfare outcomes across distinct policy regimes using a consistent structural modelling framework.

This study addresses this gap by evaluating the agribusiness outcomes of Pakistan's trade policy reforms in the basmati rice sector over the period 1981–2015. Unlike previous studies that primarily examined a single policy environment or relied on assumed price scenarios, the present study estimates domestic supply, domestic demand, export demand, and export supply relationships using a Simultaneous-Equation Recursive Model and employs the estimated structural relationships to simulate free-trade equilibrium prices under alternative policy regimes. The analysis provides a comparative assessment of producer surplus, consumer surplus, export tax revenue, and net social welfare during both the pre-trade liberalization and trade liberalization periods. The findings contribute to the literature on agricultural trade policy by providing empirical evidence on the long-term welfare implications of market-oriented reforms in one of Pakistan's most important export-oriented agribusiness sectors. The results also provide useful insights for policymakers seeking to design trade policies that improve market efficiency, strengthen export competitiveness, and promote sustainable growth in Pakistan's basmati rice industry.

Accordingly, the specific objectives of this study are:

1. To estimate the domestic supply, domestic demand, export demand, and export supply functions for Pakistan's basmati rice market using a Simultaneous-Equation Recursive Model.
2. To estimate free-trade equilibrium prices and evaluate the effects of trade policy reforms on producer surplus, consumer surplus, export tax revenue, and overall social welfare under the pre-trade liberalization and trade liberalization policy regimes.
3. To assess the agribusiness implications of trade policy reforms and provide evidence-based policy recommendations for enhancing the competitiveness of Pakistan's basmati rice sector.

Review of Literature

Time series data of thirty-five years (1981–2015) were taken to analyze the pricing and protection policies of basmati rice. This time period was divided into two phases named as pre-trade liberalization period (1981–1995) and trade liberalizing period (1996–2015). The first period named as pre-trade liberalization where Government was intervening on pricing and trading of basmati rice while the other period named as trade liberalizing period where most protection policies were abolished and private sector got involved in trading of rice. Domestic wholesale prices were compared with export price of basmati rice to estimate free trade price for identifying the protection policies and type of intervention levied during 35 years from 1981 to 2015.

Linear approximation equations (Abdelmalek and Malek 2008) were used for the estimation of producer surplus, consumer surplus and net welfare gains/losses.

$$\Delta PS = +/ - \int_{\frac{pd}{pf}}^{\frac{pd}{pf}} S(P) dp \quad (3.1a)$$

$$\Delta CS = +/ - \int_{\frac{pf}{pd}}^{\frac{pf}{pd}} D(P) dp \quad (3.1b)$$

$$ET/ES = (P_e - P_d)S_e \quad (3.1c)$$

$$SWG/C = \Delta PS + \Delta CS + ET \text{ or } ES \quad (3.1d)$$

$S(P)$ and $D(P)$ are estimated supply and demand functions while P_d and P_f are domestic price and estimated free trade price. If domestic price (P_d) is higher than free trade price (P_f) then producers are gaining as shown by the (+) sign and if estimated free trade price (P_f) is higher than domestic price (P_d) then consumers are gaining shown by the (+) sign and vice versa. P_f is estimated by equating export supply (S_e) and export demand (D_e). ET or ES is export tax or export subsidy which also adjusted to get net social welfare gain or loss. After this demand and supply equations were estimated using different specifications based on econometric theories. Zulifiqar *et al* (2012), Zulifiqar (2008) used such specification for the estimation of simultaneous equations.

$$A = \alpha_0 + \alpha_1 A_{t-1} + \alpha_2 TR \quad (3.2a)$$

$$S_d = \beta_0 + \beta_1 \hat{A} + \beta_2 P_d + \beta_3 FNT \quad (3.2b)$$

$$D_d = \gamma_0 + \gamma_1 P_d + \gamma_2 PCI_p \quad (3.2c)$$

$$S_e = S_d - D_d \quad (3.2d)$$

$$D_e = \delta_0 + \delta_1 P_e + \delta_2 P_w + \delta_3 PCI_w \quad (3.2e)$$

Where

- A = Area under basmati rice in '000' hectares
- At-1 = Lagged area under basmati rice in '000' hectares
- $\hat{A}$ = Estimated area under basmati rice in '000' hectares
- S_d = Supply of basmati rice in Pakistan in '000' tonnes
- D_d = Demand of basmati rice in Pakistan in '000' tonnes
- D_e = Export demand of basmati rice in Pakistan in '000' tonnes
- S_e = Export supply of basmati rice in Pakistan in '000' tonnes
- P_d = Domestic Price of basmati rice per tonne in USD
- P_e = Export Price of basmati rice per tonne in USD
- P_w = World Price of basmati rice per tonne in USD
- FNT = Nutrient-fertilizers used for rice in '000' tonne
- PCI_p = Per capita income of Pakistan in USD
- PCI_w = Per capita income of world in USD
- TR = Trends

This supply and demand equations-based model is Simultaneous Equations Recursive Model (Gujarati 2003, pp.764-766; Maddala 2002, p.373). The above specifications are selected on the basis of statistical diagnostics by using R^2 , F-test, Normality test, Durbin Watson test and Durbin h test. This simultaneous equation models required some adjustment/modification to get final specifications of model. The first one was that we used lagged area in equation 1 which give short elasticity which needs to be adjusted to get long run version. We used following method to convert into long run version of equation.

$$1 - \lambda = \alpha_1$$

Solving for λ

$$\lambda = 1 - \alpha_1$$

Where λ is coefficient of adjustment and to divide all the coefficients of independent variables and constant in the equation, omit lagged variable and then the equation was converted into long version which gave long run elasticity (Gujarati 2003, pp.673-78). The second adjustment was in equation 3.2b where area predicted was included as one of its explanatory variables which was calculated in equation 1. So, the $\hat{A}$ was replaced with estimated values of area in equation 1. Export demand function was estimated but export supply function was not estimated and computed by using identity equation

$$S_e = S_d - D_d.$$

Material and Method

Supply and Demand Functions:

Following supply and demand functions of basmati rice were estimated with particular specifications based on economic theory and statistical diagnostics. Values in round brackets are t-ratios and values in square brackets are P-values.

$$A = 335.007 + 0.687A_{t-1} + 0.0945P_d \quad (3.3a)$$

(3.95) (8.93) (0.80)

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$$\begin{matrix} [0.000] & [0.000] & [0.431] \\ R^2 = 0.77 & F = 54.01 & DW = 1.228 \\ & & DH = 2.277 & JB = 0.0316 & N = 35 \end{matrix}$$

$$\begin{matrix} S_d = -608.676 & + 0.988 \hat{A} + & 9.890 \text{ FNT} - & 20.982 \text{ TR} & (3.3b) \\ (-2.70) & (3.49) (2.41) & (-0.95) & & \\ [0.011] & [0.001] [0.022] & [0.349] & & \\ R^2 = 0.904 & F = 97.26 & DW = 1.194 & JB = 0.3628 & N = 35 \end{matrix}$$

$$\begin{matrix} D_d = -1195.034 - 0.746 P_d + 3.129 \text{ PCI}_p & (3.3c) \\ (-4.02) & (-1.99) (6.21) \\ [0.000] & [0.055] [0.000] \\ R^2 = 0.700 & F = 37.29 & DW = 1.107 & JB = 0.5224 & N = 35 \end{matrix}$$

$$\begin{matrix} D_e = -1179.228 - 0.354 P_e + 1.303 P_w + 0.186 \text{ PCI}_w & (3.3d) \\ (-6.06) & (-2.95) (4.38) (6.97) \\ [0.000] & [0.006] [0.000] [0.000] \\ R^2 = 0.801 & F = 41.60 & DW = 1.114 & JB = 0.1137 & N = 35 \end{matrix}$$

The model specifications used in estimated model behaved in accordance with economic theory as its explanatory variables had correct signs. The estimated basmati rice behavioral functions also fulfilled the statistical and econometric diagnostics requirements. The values of R^2 were found 0.770, 0.904, 0.700, 0.801 for the above equations (3.3a, b, c, d) which were reasonable to accept these functions. The F statistics value was also statistically significant suggesting that data series showed a good fit. Regarding the DW statistic of equation 3.3a, the value was not valid because lagged area was included as one of its explanatory variables and so Durbin-h test was conducted which yielded the value of 2.23. The DW statistic of equation 3.3b is 1.194 which was in the accepted range of at 0.05 level of significance ($dL=1.143$ and $dU=1.739$). In equation 3.3c, DW statistics was 1.107 which did not fall in accepted range ($dL=1.284$ and $dU=1.567$) at 0.05 level of significance but at 0.01 level of significance it seemed to be in inconclusive zone ($dL=1.070$ and $dU=1.339$). Similarly, DW statistic of equation 3.3d is 1.114 which was not in the range of no-decisive zone at 0.05 significance level ($dL=1.214$ and $dU=1.650$) while it was in the range of no-autocorrelation zone ($dL=1.006$ and $dU=1.421$). As per normality of residual was concerned, the JB test was conducted and the values were found in acceptance range.

The estimated model from equation (3.3a to 3.3d) required some modification. In the equation 3.3a, lagged area was included as one of its explanatory variables which gave short run elasticity. To convert it into long run version, equation $\lambda = \alpha_1 - 1$ was used and divided the entire explanatory variable in equation 3.3a including intercept by λ and then removed the lagged area variable. The equation 3.4a is the long run version of area predicted.

$$A = 335.007 + 0.687 A_{t-1} + 0.0945 P_d$$

$$\lambda = 1 - 0.687$$

$$\lambda = 0.313$$

$$A = 1070.31 + 0.302 P_d \quad (3.4a)$$

In equation 3.3b, area predicted ($\hat{A}$) was included as one of explanatory variables of domestic supply function of basmati rice. Replacing ($\hat{A}$) by the value of 3.4a ($A = 1070.31 + 0.302 P_d$) in equation 3.3b as well as putting the mean values of other explanatory variable except domestic price of basmati rice in Pakistan was the shorten version of domestic supply function shown in equation 3.4b.

$$\begin{matrix} S_d = -608.676 & + 0.988 \hat{A} + & 9.890 \text{ FNT} - & 20.982 \text{ TR} \\ S_d = -608.676 & + 0.988 (1070.31 + 0.302 P_d) + & 9.890 \text{ FNT} - & 20.982 \text{ TR} \\ S_d = -608.676 & + 0.988 (1070.31 + 0.302 P_d) + & 9.890 (158.315) - & 20.982 (18) \\ S_d = 1636.85 + 0.302 P_d & & & (3.4b) \end{matrix}$$

Similarly, the domestic demand and export demand function were also shortened as follow.

$$\begin{matrix} D_d = -1195.034 - 0.746 P_d + 3.129 \text{ PCI}_p \\ D_d = -1195.034 - 0.746 P_d + 3.129 (879.292) \\ D_d = 1556.271 - 0.746 P_d & (3.4c) \end{matrix}$$

$$\begin{matrix} D_e = -1179.228 - 0.354 P_e + 1.303 P_w + 0.186 \text{ PCI}_w \\ D_e = -1179.228 - 0.354 P_e + 1.303 (322.322) + 0.186 (8382.14) \\ D_e = 799.836 - 0.354 P_e & (3.4d) \end{matrix}$$

$$\begin{matrix} D_e = -1179.228 - 0.354 (643.618) + 1.303 P_w + 0.186 (8382.14) \\ D_e = 152.009 + 1.303 P_w & (3.4e) \end{matrix}$$

The 3rd adjustment was to use identity equation (difference between domestic supply and demand functions) to calculate export supply function of rice.

$$\begin{matrix} S_e = S_d - D_d \\ S_e = (1636.85 + 0.302 P_d) - (1556.271 - 0.746 P_d) \\ S_e = 1636.85 + 0.302 P_d - 1556.271 + 0.746 P_d \\ S_e = 80.579 + 1.048 P_d & (3.4f) \end{matrix}$$

So, after these three adjustments, final model of demand and supply function of basmati rice of Pakistan is presented as;

$$S_d = 1636.85 + 0.302 P_d \quad (3.4b)$$

$$D_d = 1556.271 - 0.746 P_d \quad (3.4c)$$

$$D_e = 799.836 - 0.354 P_e \quad (3.4d)$$

$$D_e = 152.009 + 1.303 P_w \quad (3.4e)$$

$$S_e = 80.579 + 1.048 P_d \quad (3.4f)$$

Protection Status and Welfare Effect:

The descriptions of various prices used in following calculations are as follow;

P_d = Domestic wholesale price of basmati at Lahore market

P_e = Export price of basmati rice at Karachi port

P_w = World price taken as price of 5% Thai broken rice

P_{df} = Domestic free trade price estimated by equating export demand and export supply functions

P_{wf} = World free trade price estimated by equating export demand and export supply functions

Table 1: Prices of basmati rice from fiscal year 1981-2015(USD per Tonne)

Years	Domestic Price	Export price	World Prices	Free Trade Price
1981	476.010	727.00	458.990	328.03
1982	486.010	677.00	272.480	336.08
1983	438.629	600.00	256.800	297.97
1984	394.855	616.00	232.500	262.76
1985	422.865	651.00	196.930	285.29
1986	365.333	714.00	186.250	239.02
1987	405.706	744.00	214.610	271.49
1988	417.615	716.00	277.470	281.07
1989	424.903	684.00	299.160	286.93
1990	369.705	564.00	270.850	242.53
1991	386.239	487.00	293.280	255.83
1992	424.107	446.00	268.220	286.29
1993	392.693	310.37	235.410	261.02
1994	410.779	245.38	267.590	275.57
1995	440.244	249.88	320.960	299.27
Averages	417.046	562.109	270.100	343.984
1996	456.637	415.00	338.880	312.45
1997	388.602	458.00	303.510	257.73
1998	400.894	492.00	304.160	267.62
1999	370.189	486.00	248.420	242.92
2000	418.298	418.00	202.400	281.62
2001	428.947	332.00	172.840	290.18
2002	368.739	366.00	191.870	241.76
2003	414.434	357.00	197.620	278.51
2004	514.069	468.00	237.670	358.65
2005	517.259	473.00	286.270	361.21
2006	546.127	516.00	304.880	384.43
2007	559.980	677.00	326.430	395.57
2008	621.213	1077.00	650.190	444.82
2009	800.597	937.00	554.990	589.10
2010	956.444	881.00	488.910	714.45
2011	827.439	1060.00	543.030	610.69
2012	858.646	1137.00	562.980	635.79
2013	899.192	1372.00	505.890	668.40
2014	1033.160	1324.00	422.830	776.15
2015	1211.672	849.00	386.000	919.73
Average	629.627	704.750	361.488	682.506

Source: Agricultural Statistics of Pakistan (various issues).

From the table 1, it is clear that Pakistan export price of basmati rice remained higher than domestic wholesale price which showed that Pakistan had been adopting

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export tax policies for basmati rice. For the analysis of welfare effects of trade liberalization, the study period was divided into two phases categorized as pre-trade liberalization period (1981-1995); this period was characterized by multiple interventions by Government in basmati rice trade, and the second phase of trade liberalizing period (1996-2015) characterized by gradual removal of multiple interventions by Government. In the Pre-trade liberalization period where Government adopted protection policies and Rice Export Corporation of Pakistan (RECP) was the sole Government agency to control the rice trade but, 1995 to onward, private sector started playing active role in rice trade. Rice Exporters Association of Pakistan (REAP), a representative body of rice exporters was formed to manage the trade and export activities of rice in Pakistan.

The comparison of basmati prices in both periods are given below;

	Pre- Liberalizing Period	Liberalizing Period
Pakistan's Domestic Price	417.046USD	629.627USD
Estimated Free Trade Price	343.984USD	682.506USD
Pakistan's Export Price	562.109 USD	704.750 USD

As the $P_d=417.046$ USD was lower than $P_e=562.109$ USD in pre-liberalizing period, which showed that Pakistan was taxing on export of basmati rice which remained similar in liberalizing period, where the $P_d=629.627$ was also less than $P_e=704.750$. Pakistan had been declining export tax during trade liberalization period. After this, changes in producer surplus and consumer surplus in both pre-liberalizing period and liberalizing period in Pakistan were estimated.

Pre-Liberalization Period (1981-1995):

As mentioned earlier, welfare analysis was conducted for two periods i.e. Pre-Liberalization and Liberalizing period. The supply and demand functions, estimated in the previous part were not valid because mean values of thirty-five years were taken. For this period supply and demand functions were adjusted according to fifteen years data from 1981 to 1995. The final model according to this time period is as follow;

$$S_d = 1253.319 + 0.302P_d \quad (3.5a)$$

$$D_d = 1114.353 - 0.746P_d \quad (3.5b)$$

$$D_e = 546.789 - 0.354P_e \quad (3.5c)$$

$$D_e = -4.138 + 1.303P_w \quad (3.5d)$$

$$S_e = 138.966 + 1.048P_d \quad (3.5e)$$

Free trade price is estimated by equating export supply and export demand function as follow;

$$S_e = D_e$$

$$138.966 + 1.048P_d = 546.789 - 0.354P_e$$

$$138.966 + 1.048P_d = 546.789 - 0.354(562.109)$$

$$P_d = \{546.789 - 0.354(562.109) - 138.966\} / 1.048$$

$$P_{wff} = 198.317 \quad (3.5f)$$

P_{wff} is world free trade price. Now putting the value of P_{wff} in export demand function, D_e is computed as follow

$$D_e = 546.789 - 0.354(198.317)$$

$$D_e = 476.585$$

After measuring D_e this is equal to S_e and then P_{df} is estimated as follow;

$$S_e = D_e = 491.268$$

$$138.966 + 1.048P_d = 476.585$$

$$P_d = 476.585 - 138.966 / 1.048$$

$$P_{df} = 343.984 \quad (3.5g)$$

After estimating demand and supply functions and free trade export price, welfare effects were estimated by using following method.

$$\Delta PS = \int_{378.311}^{417.781} (1253.319 + 0.302P_d) dp$$

$$\Delta PS = 100772.00 \text{ thousand US \$} \quad (3.5h)$$

$$\Delta CS = - \int_{578.311}^{471.781} (1114.354 - 0.746P_d) dp$$

$$\Delta CS = -58686.15 \text{ thousand US \$} \quad (3.5i)$$

$$ET = (P_e - P_d)S_e$$

$$ET = (562.109 - 417.046)491.268$$

$$ET = 71264.55 \text{ thousand US \$} \quad (3.5j)$$

$$SWG/C = \Delta PS + \Delta CS + ET$$

$$SWG/C = 100772.00 - 58686.15 + 71264.55$$

$$SWG/C = 113350.40 \text{ thousand US \$ or 113.305 million US \$} \quad (3.5k)$$

The estimated results showed that Government of Pakistan adopted "Price support-cum-export tax" policy which means that producers were getting support in the form of subsidy and the same time heavy export tax were levied resulted higher export price of basmati rice. It was also revealed that during the study period of pre-trade liberalization, producers gained by 101 million US \$ annually due to higher prices while consumers lost by 59 million US \$ annually. The export tax collection

was worth 71 million US \$. The value of forgone net social welfare recalculated during the pre-liberalization period was 113 million US \$ annually on an average.

Trade Liberalizing Period (1996-2015):

As mentioned earlier that time period from 1996 to 2015 is categorized as liberalizing period where most of protection and distortion policies were withdrawn by the Government and compliance to WTO-Agreement on Agriculture started appearing. For the calculation of welfare effect, demand and supply functions were adjusted according to the period of 1996 to 2015 as;

$$S_d = 1924.475 + 0.302P_d \quad (3.6a)$$

$$D_d = 1887.711 - 0.746P_d \quad (3.6b)$$

$$S_e = 36.764 + 1.048P_d \quad (3.6c)$$

$$D_e = 989.621 - 0.354P_e \quad (3.6d)$$

$$D_e = 269.119 + 1.303P_w \quad (3.6e)$$

After the estimation of demand and supply equations, model for trade liberalization period, P_{df} is estimated by taking following steps.

$$S_e = D_e$$

$$36.764 + 1.048P_d = 989.621 - 0.354P_e$$

$$36.764 + 1.048P_d = 989.621 - 0.354(704.750)$$

$$P_{wf} = 671.160 \quad (3.6f)$$

By putting the value of P_{wf} (world free trade price) in export demand function, export demand is obtained and then equating it with export supply function, we got the value of P_{df} .

$$D_e = 989.621 - 0.354P_e$$

$$D_e = 989.621 - 0.354(671.160)$$

$$D_e = 752.030$$

$$S_e = D_e$$

$$36.764 + 1.048P_d = 752.030$$

$$P_{df} = 682.506 \quad (3.6g)$$

So, after the estimation of demand and supply function and free trade export price, the welfare gains is estimated by using following method.

$$\Delta PS = - \int_{629.627}^{682.506} (1924.475 + 0.302P_d) dp$$

$$\Delta PS = -111819.12 \text{ thousand US \$} \quad (3.6h)$$

$$\Delta CS = \int_{629.627}^{682.506} (1887.711 - 0.746P_d) dp$$

$$\Delta CS = 74982.91 \text{ thousand US \$} \quad (3.6i)$$

$$ET = (P_e - P_d)S_e$$

$$ET = (704.750 - 629.627)752.030$$

$$ET = 56494.94 \text{ thousand US \$} \quad (3.6j)$$

$$SWG/C = \Delta PS + \Delta CS + ET$$

$$SWG/C = -111819.12 + 74982.91 + 56494.94$$

$$SWG/C = 19658.74 \text{ thousand US \$} \quad \text{or } 19.659 \text{ million US \$} \quad (3.6k)$$

The results revealed that as the Government of Pakistan had been applying "Price tax-cum-export tax" policy, the estimated free trade price and export price of basmati rice were both higher than average domestic price during the trade liberalization period. As a result, the estimated value of forgone social welfare gain was about USD20 million per year and where producers were losing around USD112million annually due to lower prices and consumers were getting benefits around USD75 million. The estimated export tax collection was worth 56 million US \$ annually for this period.

Conclusions and Implications

Rice is considered as one of the protected crops in both developing and developed countries. About 8 percent of rice was traded in world rice market with average level of protection around 70 percent (Wails, 2004). Pakistan is one of the major rice producing and exporting countries which had been intervening in rice markets by providing support and protection. Even though, rice sector in Pakistan faced many challenges like difficulties in compliance to stringent requirements of importing countries, competing with heavily subsidized rice sector of developed countries and intellectual property related issues especially in basmati rice. In this study, an effort was made to quantify the social welfare gains of above-mentioned policy measures assuming Pakistan as a large country in the world basmati market. In this regard, supply and demand functions were estimated assuming different regressed variables and by adhering to suitable functional forms based on economics theory and statistical diagnostic test. Simultaneous-equation recursive model was used for the estimation of demand and supply function by using time series data of thirty-five years from 1981 to 2015. The final version of demand and supply equations of basmati rice model is as follow.

$$S_d = 1636.85 + 0.302P_d \quad (3.4b)$$

Trade Policy and Agribusiness Outcome

$$D_d = 1556.271 - 0.746P_d \quad (3.4c)$$

$$D_e = 799.836 - 0.354P_e \quad (3.4d)$$

$$D_e = 152.009 + 1.336P_w \quad (3.4e)$$

$$S_e = 80.579 + 1.048P_d \quad (3.4f)$$

Though Pakistan was trying to change its policies in accordance WTO requirements but major paradigm shift was observed after the implementation of Agreement on Agriculture in 1995. After this Government in 1997 allowed private sector to export rice by replacing RECP which was the sole agency to export rice in early periods. Meanwhile the system of domestic procurement and support prices were also abolished for rice. Considering this background, welfare analysis was divided into two periods *i.e.* Pre-liberalizing period (1981-1995) and liberalizing period (1996-2015). Demand and supply functions were adjusted according to these time periods as follow.

Demand and Supply Function (Pre-liberalizing Period):

$$S_d = 1253.319 + 0.302P_d \quad (3.5a)$$

$$D_d = 1114.353 - 0.746P_d \quad (3.5b)$$

$$D_e = 546.789 - 0.354P_e \quad (3.5c)$$

$$D_e = -4.138 + 1.303P_w \quad (3.5d)$$

$$S_e = 138.966 + 1.048P_d \quad (3.5e)$$

Demand and Supply Function (Liberalizing Period):

$$S_d = 1924.475 + 0.302P_d \quad (3.6a)$$

$$D_d = 1887.711 - 0.746P_d \quad (3.6b)$$

$$S_e = 36.764 + 1.048P_d \quad (3.6c)$$

$$D_e = 989.621 - 0.354P_e \quad (3.6d)$$

$$D_e = 269.119 + 1.303P_w \quad (3.6e)$$

Welfare analysis was conducted in the form of change in producer's surplus, consumer's surplus as well as Government interventions in the form of export tax. For this purpose, domestic free trade price and world free trade price of basmati rice were estimated through export demand function and export supply function. Since the export price of basmati rice was higher than the domestic wholesale price, it implied that Pakistan had been imposing export taxes in both periods. Summary results of welfare analysis for both periods are shown in Table 3.2. The results of welfare analysis of basmati rice in Pakistan revealed that if trade liberalization would have happened properly during pre-trade liberalization, then Pakistan could gain USD 113million and USD20 million during liberalizing period as an average annual social welfare gain. It is worth mentioning here that during pre-liberalization period, the possible net welfare gain (which Pakistan could get if complied properly to trade liberalization process) was around six times greater than liberalizing period. This might also be because, Pakistan had imposed export tax much higher (more than double) in pre-liberalizing period than liberalizing period.

Table 2 Welfare Analysis for Pakistan (Million U.S dollars annually)

Social welfare Gains	Δ Producer Surplus	Δ Consumer Surplus	Export Tax	Net Social Welfare Gains
Pre-Trade Liberalization	100.772	-58.686	71.265	113.350
Trade liberalization	-111.819	74.983	56.495	19.659

Producers could get benefit/loss in the form of change in producer surplus whereas consumers could get benefit/loss in the form of change consumer surplus. Results implied that gain of producer surplus was much higher than the loss of consumer surplus during pre-liberalizing period. In the liberalizing period, contrast to pre-trade liberalization period, producers faced losses in the form of negative producer surplus while consumers got benefits in the form of positive consumer surplus. The overall welfare analysis suggested that Pakistan has been losing social welfare gain due to protection and distortion policies imposed on the country's rice sector. So it is recommended that Pakistan should abolish intervention and distortion policies, if any to enhance benefits from trade liberalization.

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