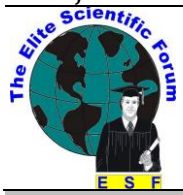
Pak. j. life soc. Sci. (2020), 18(1): 51-57 E-ISSN: 2221-7630; P-ISSN: 1727-4915



Pakistan Journal of Life and Social Sciences
www.pjlss.edu.pk

RESEARCH ARTICLE

Where Farmers Stand in Terms of Trade of Cotton Production? The Case of District Vehari (Punjab), Pakistan

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ARTICLE INFO
Received: Jul 01, 2019
Accepted: May 01, 2020

Keywords
Economics of Production
benefit-cost ratio
Small Farmers
Cotton Trade
Vehari, Pakistan

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ABSTRACT

Historically, the agriculture sector served as the fundamental engine of growth. In Pakistan, the agricultural sector contributes about 19% of the gross domestic product (GDP). There are nine agro-climatic zones in Pakistan. The cotton-wheat zone is the poorest among them. Cotton is an important cash crop, yet the largest producing zone ranks amongst the poorest zones of the country. This study aimed to calculate the economics of cotton production. The specific objectives were to a) estimate the cost of production of the cotton crop in the study area, b) measure the profitability of farmers, c) estimate domestic terms of trade and d) suggest policy implications. Primary data from 200 cotton farmers of district Vehari of province Punjab, Pakistan were collected. Profitability was calculated using the most common economic analytical techniques i.e., profit, benefit-cost ratio (BCR), and input-output ratios. Results showed that there was a slight difference in cost of production and profit margins and benefit-cost ratios of the small, medium and large farmers that were not statistically significant. Overall, the BCR remained 1.136 which showed a decline over the time when compared to the previous studies. The results of domestic terms of trade analyses confirmed these results and explained that the domestic terms of trade have deteriorated over time. This underlines the importance of correcting imbalances in the prices (received and paid). Hence, there is a dire need to correct the imperfections in both input and output markets.

INTRODUCTION

Historically, the agriculture sector served as the fundamental engine of growth (Diao et al., 2005). It serves as one of the most important strategic components of economic growth (Katircioglu, 2006). It helps in increasing the income of rural masses that in turn reduces hunger and improves wellbeing (Birkhaeuser et al., 1991; Owens et al., 2003). A reasonably high growth rate is required for this purpose. For rapid agricultural growth, the role of small agricultural farms is very important (Deller et al., 2003). The performance of such farms is praiseworthy, and they remained efficient throughout the world with some exceptions (Diao et al., 2005).

Pakistan is not an exception. The agricultural sector is one of the major contributors towards the national GDP i.e., 19.2%. To meet the growing food and fiber requirements of high population growth (1.80%), it is important that agriculture sector grows at a faster pace. During the past year, it grew by 2.77% as against the target of 2.8%. The crops sector performed well and grew by 4.65% as compared to the previous year's growth. This was the result of availability of certified seeds, quality pesticides, fertilizers and timely availability of credit. Furthermore, attractive output prices and supportive public policies acted as a catalyst (Anonymous, 2020).

Pakistan is categorized into nine agro-climatic zones based on cropping seasons (i.e., Kharif and Rabi). These zones include rice- wheat zone (Punjab), mixed zone (Punjab), cotton-wheat zone (Punjab), barani zone (Punjab), low-intensity zone (Punjab), cotton-wheat zone (Sindh), rice-other crops (Sindh), Khyber Pakhtunkhwa (former NWFP) except DI Khan, and Balochistan except Nasirabad (Amjad et al., 2008). Cotton-wheat zone of the Punjab province ranks amongst the poorest zones in terms of head count poverty index (Irfan, 2007; Fatima, 2015). Cotton is one of the five major crops of Pakistan which is the 5th

largest producer and 3rd largest consumer of cotton in the world (Anonymous, 2020). It is most cultivated crop in Kharif season. It generates the largest export revenues in the form of lint, textile products, seed cotton for oil and meal. The cotton seed oil contributes 80% of the national oilseed production. It is a major source of livelihood for the farming community (Rehman et al., 2017).

Despite the above-mentioned facts about the economic importance of the cotton crop, yet the largest cotton producing agro-climatic zone i.e. cotton-wheat (Punjab) ranks amongst the poorer zones in Pakistan. To identify the reasons of this, an economic assessment of cotton production is the need of the time in order to uplift the livelihoods of the farming community. This study aimed to calculate the economics of cotton production. The specific objectives were to: estimate the cost of production of the cotton crop in the study area; measure profitability of farmers; identify yields gaps between potential, small, medium and large farmers' yields; estimate domestic terms of trade; and suggest policy implications.

MATERIALS AND METHODS

Data Collection

The cotton-wheat zone of the Punjab was selected being the poorest agro-climatic zones of Pakistan in terms of head count poverty calculations (Irfan, 2007; Fatima, 2015). The Zone consists of nine districts (Sahiwal, Pakpattan, Multan, Lodhran, Khanewal, Vehari, Bahawalnagar, Bahawalpur and Rahim Yar Khan) of three divisions named Sahiwal, Multan and Bahawalpur (Amjad et al., 2008). Multan division was selected based on the highest yield per hectare i.e., 66.3KG/Hectare (Anonymous, 2018). Out of the four districts, Vehari was selected randomly. A stratified random sampling technique was adopted to select 200 farmers. The district is comprised of three Tehsils i.e., Burewala, Vehari and Malsi which were considered as three strata. Out of each stratum, five villages were randomly selected i.e., 15 villages in total (Table 1). A total of 200 farmers were interviewed using a well-structured questionnaire.

Based on the final selection of the farmers, they were categorized into small (up to 5 acres of land), medium (from 5 to 12.5 acres of land) and large (above 12.5 acres of land) farmers. Majority of the famers (40.5%) were small followed by medium (32%) and large (27.5%).

Estimation of the economics of cotton production

A comprehensive information on field operations at every step of production in order to calculate the total cost of cotton production in the study area. Total income / revenue was estimated by multiplying the yield per acre with average market price. Profit was calculated by subtracting total costs from gross income (Olukosi and Erhabor, 1998; Alam et al., 2013; Sehto et al., 2018) and the benefit-cost ratio was estimated by dividing total revenue by total cost (Khan et al., 2011; Wei et al., 2020):

$\pi = GI - TC$ (1)

$BCR = GI / TC$ (2)

Where:

π = Profit

GI = Gross Income = Yield * average market price

TC = sum of all the costs incurred

BCR = Benefit-cost ratio

Comparison of means

Comparison of mean technique was applied in order to differentiate between the profitability of small, medium and large farmers. This technique is widely used in comparative analysis see for example (Baba et al., 2014; Hyblova and Skalicky, 2018; Mugula and Mishili, 2018; Arru et al., 2019).

Yield Gaps

Yield gaps were estimated by subtracting the actual yields of small, medium and large farmers from the potential yields of different varieties. Farmers reported different variety names during the interviews, a rapid appraisal method was applied to get information on the potential yields of these verities from research stations. Help was also taken from existing literature.

Domestic Terms of Trade

In order to estimate domestic terms of trade, ploughing (traction), fertilizers (urea and DAP) and farm labor were considered. Being the principal constituents of production process, these inputs cover majority (> 50%) of the cost of production. Fluctuations in their prices can significantly impact gross margins, net farm income and profitability of the farmers. A time series secondary data on their prices were also obtained from APCOM /API policy reports, Economic Surveys for relevant years and Agricultural Marketing Information System (AMIS) of the Punjab government.

Table 1: Selection of respondents.

Sr. No.	Strata	Villages	Respondents	
1	Burewala	5	From one village 15 and rest of four 13 farmers	67
2	Vehari	5	From one village 15 and rest of four 13 farmers	67
3	Mailsi	5	From one village 14 and rest of four 13 farmers	66
Total	3	15		200

RESULTS AND DISCUSSION

Cost of Production, Profit and BCR

The result of average cost, gross income and net income according to famers' categories are presented in Table 3. The average land preparation costs were the highest by the small farmers (PKR 4308) followed by medium (PKR 3708) and large (PKR 3237) farmers. This is because of the difference in hiring costs and own technical machinery (Hassan et al., 2005). Overall, for the data set an amount of PKR 3749 were spent on land preparation. In terms of expenditures on seed, small farmers spent the least i.e., PKR 2407 as compared to medium and large farmers who spent PKR2587 and 2769, respectively. This is because of the scale and credit availability that the small farmers compromised on the seed quality and seed rate (Abedullah et al., 2006; and Iqbal, 2015). In terms of irrigation expenditures, small farmers spent the most (PKR 3210) as compared to medium and large farmers who spent PKR 2540 and 2320, respectively. Due to hiring of water (tube well hours) the cost of irrigation may be higher for small farmers.

Small farmers spent the least on weeding, plant protection and fertilization i.e., PKR 18,970 while medium and large farmers spent PKR 20,975 and 22,787, respectively. Due to financial crunch, small farmers spent less on these activities compared to the medium and large famers (Abedullah et al., 2006; and Iqbal, 2015). Total cost of cotton production of small farmers was PKR 57,597 while of medium and large farmers was PKR 59,160 and 61,115, respectively. The comparison of means test showed no difference in the costs of small, medium and large farmers. The average yield of small farmers was lower than that of medium and large farmers i.e., 19.98, 21.70 and 23.52 maunds, respectively. The average market price was observed to be PKR 3,100 for the season. Hence the gross income of small, medium and large farmers was PKR 61,938, 67,270 and 72,912, respectively. That provided a profit (from an acre) of PKR 4,341, 8,110 and 11,797 to small, medium and large farmers, respectively. In terms of per maund (40KG) the profit was PKR 217, 374 and 502 for small, medium and large farmers, respectively. A BCR of 1.075, 1.137 and 1.193 to small, medium and larger farmers was calculated, respectively.

Table 2: Distribution of the farmers according to their landholdings

	Frequency	Percentage
Small Farmers (< 5 Acres)	81	40.5%
Medium Farmers (5 to 12.5)	64	32.0%
Large Farmers (>12.5 Acres)	55	27.5%
Total	200	100%

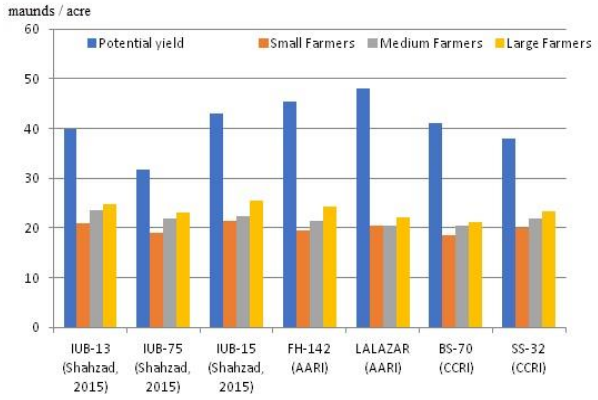

Figure 1. Yield gaps.

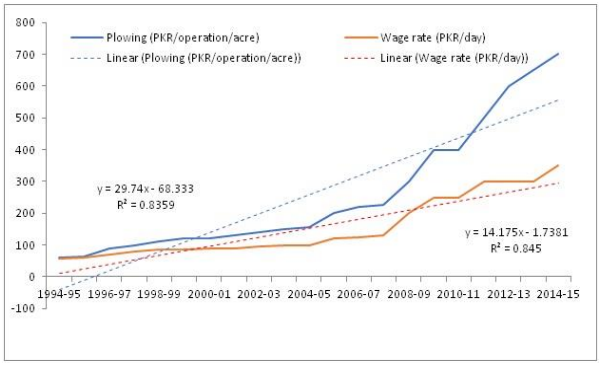

Fig. 2: Average annual expenditures on Ploughing and Labor.

Data Sources: APCOM /API policy reports, Economic Surveys for relevant years and Agricultural Marketing; Information System (Anonymous, 2018) of the Punjab government. Similarly, a rising trend was observed in Urea and DAP prices. The DAP's price rose sharply than that of Urea, over the years. The fitted trend line explains this difference.

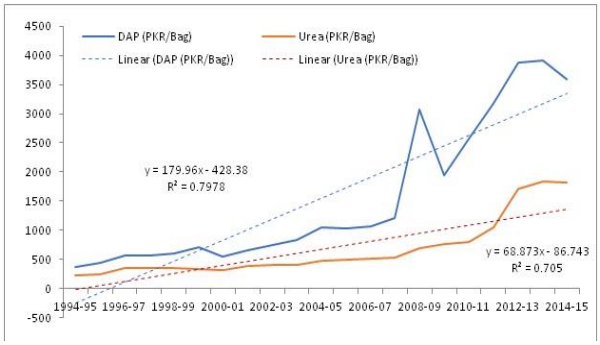

Fig. 3: Average annual prices of Urea and DAP.

Data Sources: APCOM /API policy reports, Economic Surveys for relevant years and Agricultural Marketing Information System (AMIS) of the Punjab government.

Same trend was observed in cotton's market price (per 40 KG). The fitted trend line explains a steady rise in output price of raw cotton.

Table 3: Cost of Production, Gross Income, Profit and Benefit-Cost Ratio

Activity	Small (n=81)	Medium (n= 64)	Large (n = 55)	Total sample (n = 200)
	PKR	PKR	PKR	PKR
Land preparation				
Deep Ploughing	754	743	568	688
Planking	973	682	597	750
Rotavator	1,800	1,274	1,089	1,387
Laser land leveling	781	1,009	983	924
Subtotal-1	4,308	3,708	3,237	3,749
Seed				
Seed rate + de-linting cost	1,695	1,804	1,949	1,816
Seed treatment	35	35	35	35
Drilling + Ridge Sowing	592	654	690	654
Manual labor	85	90	95	90
Subtotal-2	2,407	2,583	2,769	2,595
Irrigation				
Canal water / Abiana	90	90	90	90
Tube well Water	2,690	2,100	1,900	2,230
Mixed (tube well + canal)	430	350	330	370
Subtotal-3	3,210	2,540	2,320	2,690
Manual Thinning	1,500	1,800	2,000	1,766
Inter culture with tractor	1,800	2,100	2,300	2,066
Water course cleaning	1,600	1,650	1,670	1,640
Subtotal-4	4,900	5,550	5,970	5,472
Weedicide spray	4,580	4,890	5,380	4,950
Farmyard manure + transport	400	450	480	443
Subtotal-5	4,980	5,340	5,860	5,393
Fertilization				
DAP	3,309	3,432	3,693	3,478
Urea	2,981	3,653	4,064	3,566
Potash / others	2,800	3,000	3,200	3,000
Subtotal-6	9,090	10,085	10,957	10,044
Markup @ 12%	1,740	1,740	1,740	1,740
Land rent	19,000	19,000	19,000	19,000
Payment to pickers	7,962	8,614	9,262	8,612
Subtotal-7	28,702	29,354	30,002	29,352
Total Cost	57,597	59,160	61,115	59,295
Yield per acre (maunds (40 KG))	19.98	21.70	23.52	21.73
Total Cost / 40KG	2883	2726	2598	2729
Market price / 40KG	3,100*	3,100*	3,100*	3,100*
Gross income	61,938	67,270	72,912	67,373
Net gains/Net profit	4,341	8,110	11,797	8,078
Net gains / profit per 40KG	217	374	502	371
BCR	1.075	1.137	1.193	1.136

* Average market price.

Table 4: Comparison of BCR results with previous studies

Reference	Study Area	Total observation	BCR			Overall
			Small	Medium	Large	
Current Study	Vehari	200	1.075	1.137	1.193	1.136
Wei et al., 2020			1.020	1.270	1.120	1.130
Imran et al., 2018	Sahiwal and Kahnewal	198	X	X	X	1.24
Ahmad and Afzal, 2018	Bahawalpur	240	X	X	X	1.25
Ahmad et al., 2016	Muzafergarh	100	X	X	X	1.479
Noonari et al., 2015	Khairpur	60	X	X	X	1.30
Khan et al., 2011	Multan	155	1.22	1.24	1.41	1.30
Khan et al., 2011	Bahawalpur	155	1.34	1.36	1.48	1.35

Yield Gaps

There was a significant gap in potential and farmers' yield levels. Farmers were able to get between 40 percent to73 percent of the potential yields. This shows an inefficiency at the farming level.

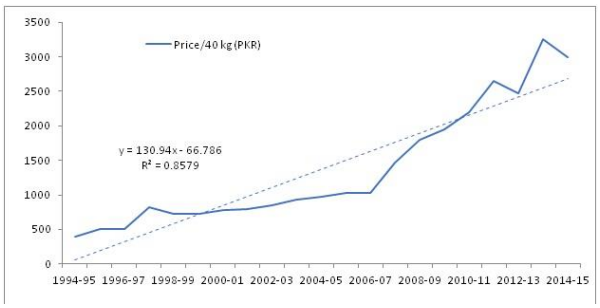

Fig. 4: Average output price of cotton (per 40KG).
Data Sources: APCOM /API policy reports, Economic Surveys for relevant years and Agricultural Marketing. Information System (AMIS) of the Punjab government.

The requirement of cotton (KGs) to buy inputs has gone up for DAP and slightly reduced for Urea. For the current data (primary / cross sectional) 35 KG cotton was required to buy a bag of DAP and 18 KG to buy a bag of Urea.

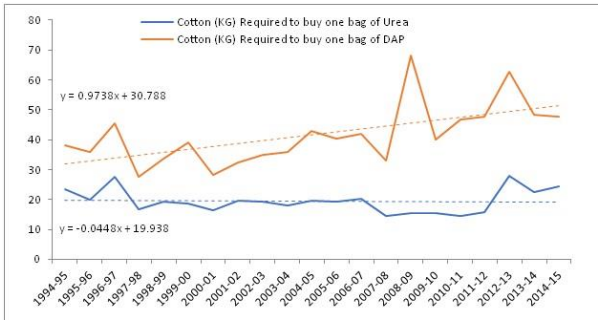

Fig. 5: Terms of Trade of Cotton (KGs) for Urea and DAP per bag.
Data Sources: APCOM /API policy reports, Economic Surveys for relevant years and Agricultural Marketing. Information System (AMIS) of the Punjab government

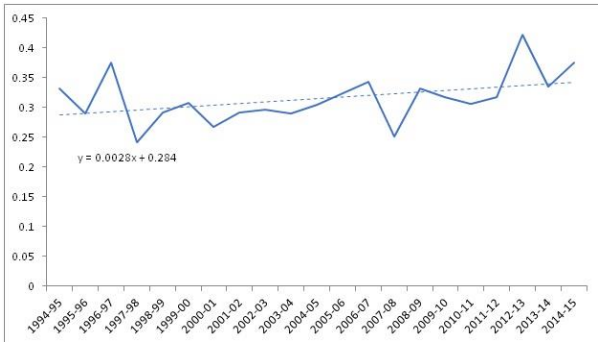

Fig. 6: Terms of Trade of Cotton (PKR) in terms of Geometric mean of Expenditure.
Data Sources: APCOM /API policy reports, Economic Surveys for relevant years and Agricultural Marketing. Information System (AMIS) of the Punjab government.

Terms of Trade

The analysis of the terms of trade with respect to plowing (traction), farm labor and fertilizers (Urea and DAP) is presented in Figures 2 - 6. The costs of plowing and wage rate has gone up over the years as evident from Figure 2. The trend lines explain a steady rise in these costs. The cost of plowing operation is steeper because of the rise in petroleum prices.

There were a few years where the domestic terms of trade for cotton showed improvement i.e., 1997-98, 2000-01, 2007-08. But the overall trend shows a deterioration. The fitted trend line in Figure 6 reflects a smaller but steady deterioration in domestic terms of trade of cotton production for major expenditures. On an average, the geometric mean of the expenditures increased by 9.60 percent while the output prices increased by 8.46 percent.

Concluding remarks

This study aimed to investigate the profitability of cotton production in Vehari District, Punjab, Pakistan. The results showed that farmers were spending on an average PKR 59,295 on cotton production. There was a slight difference in the expenditures of small, medium and large farmers i.e., PKR 57,597, 59,160 and 61,115, respectively. Similarly, there was a slight difference in their yields i.e., 19.98, 21.70 and 23.52 maunds, respectively. Same trend was observed in the BCRs. However, the comparison of means test showed that there was no significant difference in the costs, profits and BCRs of small, medium and large farmers. In comparison to previous studies, it was noted that the BCRs have reduced slightly, over the years. There was a significant gap observed in the yields of farmers and potential yields of different varieties.

The results of domestic terms of trade conforms the above-mentioned results as the terms of trade have deteriorated over the years. Explaining a significant reduction in farmers' profits. This deterioration in terms of trade and profit margins underline the need to correct the imbalances in the prices (received and paid). There is a strong need to correct the imperfections in both input and output markets. Furthermore, research on profitability, market failure and yield gaps should be conducted on a regular interval.

Acknowledgements

The authors wish to acknowledge USAID, US-Pakistan Center for Advanced Studies in Agriculture and Food Security (USPCAS-AFS); and Punjab Agricultural Research Board (PARB) for funding the project-PARB-970. The authors further acknowledge the support of ORIC and UAF in order to complete the research.

Authors' Contributions

MKB conceived the idea, designed the project and wrote the paper. SH performed the economic and statistical analysis. AA helped in designing the study and write up of the paper. MUF collected data, performed data entry and cleaning along with helping in economic and statistical analysis. All authors read and approve the final manuscript.

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