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Economic analysis of different sowing methods of cotton crop in Punjab Province-Pakistan

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Abstract

After proper seedbed, crop stand mainly depends upon proper seeding depth as too shallow seed is prone to bird's attack while too deep seed may not germinate well due to heavy load of soil on the seeds. For proper yield of any crop, plant population and row to row distance plays an important role which can only be achieved if appropriate sowing machines are used. But which planting method is most suitable depends upon economic outcomes. In this backdrop, present study was planned to try in exploring most efficient and economically viable option of sowing particularly among three planting methods viz. Ridge planting (dibbling method), Drill (flat planting) and Planter (bed cum planting method) with the purpose of guiding farmers to improve outcomes along with increasing the productivity of cotton under challenges of labor and water shortages. According to survey results, planter technology was the most economical venture vis-a-vis ridge and drill sowing methods on account of lowest total cultivation costs, highest yield and accordingly highest revenue per acre. Time saving at sowing was inspiring attribute of cotton seed planter while lack of finances and lack of timely availability of the planter for sowing seed cotton were among reported barriers in order of importance for wider adoption. Findings suggest that this is high time for the government to win confidence of the farmers by introducing bed-cum-planter on cost sharing basis.

1. Background

After a proper seedbed, the crop stand mainly depends on proper seeding depth, as too shallow a seed is prone to bird attack, while too deep a seed may not germinate due to a heavy load of soil on the seeds. For proper yield of any crop, plant population and row to row distance plays an important role which can only be achieved if appropriate sowing machines are used. Inappropriate sowing techniques neither provide desired plant population nor results in proper yield. Under a high-density planting system supported by cotton mechanization, yields increase by 25-40% compared to farmer practice. Khan *et al.* (2005) concluded that plant spacing of 23 cm gave better yield than 30 cm spacing in cotton. Many scientists recommend a 30 cm plant spacing as the optimal spacing for a cotton crop to achieve a plant population of 18,000 plants per acre for maximum seed cotton yield (Shah *et al.*, 2005). Among three planting methods viz. flat planting, ridge planting and bed planting in 75 cm apart rows, bed planting gave significantly higher seed cotton yield as ridges and raised beds ensure adequate plant population due to better seed germination and emergence of seedlings ever during unusual rainfalls (Ali *et al.*, 2010). On the contrary, Bridge *et al.* (1973) observed no significant influence of planting methods on seed cotton yield.

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Kamal (2017) in his article "Mechanized Cotton Sowing Catches on" published in the Times of India reports that the farmers will get 20 to 30 percent more yield from cotton sown through pneumatic Planter as well as cotton sown through pneumatic Planter does not get damaged despite rains lashing the area. Yield increase is attributed to higher plant density per acre compared to conventional practice and this increase provides a strong basis for adoption of cotton mechanization. Therefore, cotton Planter might be an appropriate response to the high cost of land preparation and sowing of cotton as well as the labor scarcity associated with low farm wages. The high costs of certain improved inputs and low yields characterize cotton production in Pakistan. The price of agricultural inputs, especially fertilizers, agro-chemicals and seed has more than doubled since 2007, thus becoming a major constraint, especially to smallholder farmers. Yet, access and appropriate use of improved inputs and technologies will make a significant yield difference to farmers.

In Pakistan, the adoption of machinery in farm operations is lagging because of various factors like unavailability of credit to purchase expensive machinery, small size holdings of farmers and lack of technical knowledge and skills to operate complex farm machinery. According to annual plan 2015-16 regarding food security and agricultural development, land holdings, cropping patterns, market price of crops including minimum support price, availability of labor and labor cost are the major factors determining the agricultural mechanization. Looking at the cotton productivity data; it is clear that a lot has to be done to improve productivity in the country. Apart from Bt-technology and hybrid seeds, we now need to look at mechanization coupled with high-density planting to further increase productivity and reduce costs. Certain private agro-industries like Faizan Traders Lahore have developed multi-crop seed Planters for sowing of row crops like cotton, maize, sunflower, groundnut and vegetables, which don't place seeds at one place; rather seed is more or less dropped in a continuous fashion, which requires thinning of plants to maintain desired plant population. Use of such Planters also requires more than the recommended seed rate. In order to overcome this problem, pneumatic Planters, inclined/vertical seed plate Planters are being used in Punjab on a very limited scale owing to various barriers in adoption. Before taking any public action in this dimension, empirical studies on modern planter technology are also required. It has come to notice that planter machine is put to work in cotton fields of District Multan. Therefore, present study was planned with ultimate aim to make an attempt to explore the possibilities of employing mechanized sowing to achieve cost effectiveness and to help farmers to improve outcomes along with increasing the productivity of cotton despite forthcoming labor and water shortages. Specific objectives were:

1. To study the socioeconomic characteristics of cotton growers.
2. To compare the cost of production among cotton sowing technologies in the research area.
3. To devise policy recommendations based on research findings.

2. Research Methodology

2.1. Sampling and Sample Size

The present primary data-based study was aimed to estimate the cost of production of cotton in the cotton-wheat cropping system of the irrigated Punjab. Considering financial and time constraints, study was confined to only Multan district where certain farmers were observed sowing cotton through bed-cum-planter machine in addition to Ridger (manual dibbling method) and Drill technology. Planter machine opens small trenches (of a predefined depth) for the seeds, drop the seeds inside at certain distances between them and then cover lightly with soil. In most cases, planter machine also drops a predefined quantity of fertilizer granules between the seeds. Overall, 45 cotton growers (15 farmers from each method of Dibbling, Drill and tractor-mounted cotton Planter techniques) were selected for data collection during April, 2024. In first two methods of cotton sowing, random selection of farmers was practiced while in planter method; purposive sampling was adopted because planter adopters were scanty and difficult to locate in desired number. Descriptive statistics were run to interpret survey results.

2.2. Analytical Tools

2.2.1. Budget Analysis

Budget analysis is essential both for long- and short-term planning. It helps policymakers to understand the costs and returns paid and received by the growers (Harrington, 1992). Production is the process of combining inputs in the creation of goods and services. This varies in systematically with the

quantity of inputs used (Colman & Young, 1992). This can be shown in the form of a production function.

$$Y = f(X_1, X_2, X_3, X_4 \ldots X_n)$$

The equation indicates that output is a function of various inputs and is symbolized as 'Y' whereas X_1, X_2, X_3, X_4 and X_n are the variables indicating various inputs applied for cotton production.

2.2.2. Gross Margin Analysis

The gross margins of cotton were estimated as enterprise output value fewer variable costs. The variable costs for cotton consisted of land preparation, seed & sowing cost, fertilizer, hoeing/inter-culturing, plant protection measures, picking and transportation. For land preparation practices, the prevalent village hiring rates of tractor as paid by the individual farmer was used irrespective of the ownership of tractors. Actual prices paid by the farmers on seed, fertilizer and chemicals including transportation and application cost were used, irrespective of the declared market prices. Water rates (aabiana) as prescribed for cotton crop were used for canal irrigation. Rate at which tube-well water was being purchased/sold in the village was used irrespective of the tube-well ownership. Actual prices received by the growers for disposing cotton was used for computing the gross revenue of the output produced. The formula used to estimate the gross margin is as under

$$GM = TR - VC$$

Where 'GM' stands for gross margin, 'TR' indicates total revenue and 'VC' shows the variable costs.

2.2.3. Net Return

Net Return is known as the net income received from an investment after deducting all expenses from the gross income generated by the investment. The net return for producing seed cotton from an acre was calculated as follows:

$$NR = TR - TC$$

Where 'NR' stands for net return, 'TR' indicates total revenue and 'TC' shows the total cost.

2.2.4. Benefit Cost Ratio

For a feasible project benefit-cost ratio should be greater than one. The benefit cost ratio was computed using the following formula.

$$BCR = {}^{TR}/_{TC}$$

Where 'BCR' stands for benefit cost ratio, 'TR' indicates total revenue and 'TC' shows the total cost.

3. Materials and Methods

3.1. Socio-Economic Characteristics of Farmer and the Farm

Social indicators are health, education and shelter while economic characteristics of households mean employment, income, consumption, spending and household property and assets. According to human capital models, education is an important dimension of people behavior. High educational attainment may imply better awareness of full potential of new technologies and best agricultural management practices (Chaudhry *et al.*, 2009). Study results reveal that average age of cotton growers was 39 years having minimum age of 21 to maximum age of 60 years. Saeed *et al.*, (2017) observed almost the same patronage of farming by the elder ones while studying citrus growers in cotton growing district of Muzaffargarh, a nearby district of Multan. Table 1 reveals education of primary level was not satisfactory as per human capital models.

Average operational land holding was higher at 29 acres whereas minimum land size was 5 and maximum land holding was 100. Land holding results imply that there were landlords in the study area. Average annual land rent had been reported to Rs.25190 per acre with a range of Rs.13000 to Rs.35000. Out of operational holding of 29 acres, cotton crop was sown on area of 27 acres which depicts that despite arrival of competing crops like rice, maize and sugarcane, cotton is still important cash crop in the study area. The use of Planter technology was not common as evident from availability of Planter within average radius of more than 13 Km. According to Costa and Melgarejo (2000), the modernization of technology is often difficult because of small land holdings; hence the necessary progress in acquisition of knowledge and adoption of new techniques is slow.

3.2. Characteristics of Different Cotton Sown Fields

Selection of an appropriate technology depends on factors, such as the size and shape of seeds, soil characteristics, total area to be seeded and personal preferences of the grower (Daum and Orzolek, 2004). Results

Table 1. Farmer and the Farm's Characteristics

Characteristics	Minimum	Maximum	Mean	S.D
Age (years)	22.00	60.00	39.6000	9.785
Education (years)	0	16	5.34	4.937
Land operational (acres)	5.00	100.00	29.2444	21.970
Land rent (Rs./annum)	13000	35000	25189.7	6518.399
Cotton sown area (acres)	5.00	100.00	27.1333	22.105
Access to Planter from distance (Km)	4.0	21.0	13.3	6.200

Source: Author's Survey

in table 2 are based on the primary survey conducted for Ridger, Drill and Planter sown crops. Cotton is labor intensive crop wherein there is huge scope of introducing modern machinery like planter technologies in the wake of ever increasing shortage of labor particularly at the sowing and picking times when every farmer was in competition with fellow farmers in the pursuit of labor. In the present study, tractor-drawn planter which performs seed-bed preparation along with planting functions is the primary focus of research. In this scenario, some characteristics of three sowing fields of cotton crop were studied to evaluate performance of technologies in the target area. In established crop of cotton, average plant to plant distance was the same (12 inches) among three technologies whereas row to row distance was same (21 inches) in both the Ridger and Drill fields while it was slightly less in Planter field (20 inches). In other words, design of the cotton fields with respect to plant to plant and row to row dimensions was almost similar in three fields.

Applied seed rate was 10 Kg per acre for Ridger while it was slightly higher (11 Kg) for Drill field. Least quantity of seed (7 Kg) was required in Planter sown fields which imply that planter sown field saves money without compromising on yield at the end of season. Proper plant population is equally important in cotton crop. After thinning of over-crowded plants, higher population (39980 plants per acre) was maintained in Planter fields as compared to Ridger and Drill for which it was 31266 plants and 39233 plants respectively. Wiki farmer (an online farming library) reported that cotton seed rate @10.11 Kg/acre produced on average 90000-100000 plants per hectare (40,000 plants/acre) during year 2017. However, there are cases in which plants up to 70000 per acre can easily be achieved but selecting specific varieties.

Table 2. Characteristics of Different Cotton Sown Fields

Characteristics	Ridger			Drill			Planter		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
P*P distance (inches)	12	10	14	12	10	14	12	10	14
R*R distance (inches)	21	18	26	21	18	24	20	18	22
Seed rate (Kg)	10	7	12	11	8	13	7	5	9
After thinning, final plant population (Nos./acre)	31266	24000	40000	39233	33000	48000	39980	33000	50000
Labor used at sowing (No.)	4	2	8	3	2	6	2	1	4
Germination time (days)	6	5	7	6	5	7	6.5	5	8
Time taken for sowing (min)	137	100	190	132	100	200	76.9	35	90
Daily sown area (No. of acres)	6.9	4	11	8.1	5	11	18.2	9	44
Cost of sowing (Rs./acre)	8988.0			8698.6			7213.3		

Source: Author's Survey

Least personnel (only 2 persons) were required during sowing of cotton seed with Drill machine. Labor requirement was highest in Ridger (manual sowing) farms mainly due to cumbersome dibbling of cotton seed. Germination of cotton seeds almost took same period of 1 week to come out of the surface of earth. It was noted that planter worked more efficiently in sowing of cotton seed as it took only 77 minutes for complete sowing of seeds with more than 18 acres daily sowing efficiency. Dinesh kumar and Pandia (2014) reported that the average time requirement by manually operated single row cotton planter was 3.06 hour (183.6 minutes) per acre while manually sowing around 4.50 hour (270 minutes) per acre in Gujrat district of India. Survey results further reveal that manual labor was able to sow on average 7 acres in a day. Cost of operation with Ridger was estimated as Rs.8988 per acre while costs of operation in Drill and Planter were relatively lower than Ridger and these were Rs.8698 and Rs.7213 respectively. Cost of operation with Planter was highly cheap. Raghavendra *et al.* (2013) developed a Ridger planter for cotton. The researcher found that the cost of operation of Ridge planter for sowing cotton was estimated as Rs.433/ha compared to Rs.1013/ha in conventional method.

3.3. Labor Profile during Cotton Season

Cotton sowing and picking activities are mainly labor intensive. Now a days, there is scarcity of labor at right time and at desired price. Even if one can get it, there is no guarantee to timeliness in operation and plant to plant distance. On the contrary, appropriate technologies can save the resources of resource-poor farmers. According to results in table 3, almost 5 persons within range of 2 to 9 persons were required and involved in cotton sowing. Similarly, more persons were required for picking of cotton bolls. On average, more than 5 persons while minimum and maximum strength of 2 to 10 persons were performing picking activity. Labor for picking purposes was mostly female labor and their average wage rates for performing agricultural activities were nearly Rs.300/day with minimum and maximum wages of Rs.230 to Rs.350. Agriculture wages to females are usually less than wages offered to male labor irrespective of their location within the country. In their study on vegetable picking in districts of Nankana Sahib and Faisalabad, Saeed *et al.* (2015), mostly females were involved in picking activities just like cotton picking. Vegetable pickers were earning a minimum of Rs.50 to a maximum of Rs.375 per day with an average of Rs.196.5 per day depending upon experience and working hours.

Cotton picking, which is highly labor-intensive activity, is an important source of employment for rural women, providing supplementary income to rural farm and nonfarm households. However, cotton picking charges were different than normal agricultural works. There was labor shortage in the study area since last two years. Some farmers had managed it by hiring permanent labor at their farms with average offer of Rs.50579/annum including incentives. On average, permanent hired personnel were 2.7 with minimum and maximum labor as 1 and 6 respectively. Farmers had to manage temporary labor at the time of sowing and harvesting from up to 1.8 Kilometers. At certain times, they had to provide pick and drop facility to labor and farmers had to face additional burden of Rs.255/day to have their services.

3.4. Comparing Irrigation Scheduling among Different Sowing Methods

Irrigation plays an important role in crop development. Irrigation scheduling among Ridger, Drill and Planter sown

Table 3. Labor Profile during Cotton Season

Characteristics	Mean	Min	Max	S.D
Working persons at sowing (No./acre)	4.9	2.0	9.0	2.3
Picking persons (No./acre)	5.4	2.0	10.0	1.7
Wage rate for females (Rs. /day)	302.4	230.0	350.0	21.8
Labor shortage since (years)	2.0	1.0	4.0	1.0
Permanent labor hired (No.)	2.7	1.0	6.0	1.4
Salary including incentives for farm labor (Rs. /year)	50579.2	21000	120000	23945.4
Charges for labor pick & drop (Rs. /day)	255.6	0.0	500.0	137.3
Availability of labor (Km)	1.8	0.0	5.0	1.4

Source: Author's Survey

fields was studied to plan irrigations in the wake of water scarcity (Table 4). After germination, 5 watering schedules were studied. There was a gap of 6.9 days (one week), 18.5 days (more than two weeks) and 17.5 days (more than two weeks) between germination and first water application in Ridger, Drill and Planter cotton crops respectively. This implies that after germination, Ridger field needs first water early as compared to other two technologies. Overall, there is less water requirement in drill sown cotton in the study area as contrast to Bakhsh *et al.* (2012) who found that bed/ridge sowing cotton fields need frequent irrigations but, in less quantity, than drill sowing methods

cotton crop in cotton-wheat belt of Punjab Province was Rs.64665 per acre when average yield of seed cotton was 1360 Kg/acre, with sale price of Rs.2874/40 Kg, net benefits were Rs.33051 (PARC, 2015).

Results imply that Drill sown field gave lowest yield and hence lowest total revenue of Rs.71501 per acre. Highest yield and resultantly highest total revenue from Planter technology proved sufficiently that Planter was a good technology for the farmers from income point of view. BCR (without land rent) of 1.93 and BCR (with land rent) of 1.27 also suggest that Planter is a profitable venture in the study area. These findings are in line with (Ali *et al.*, 2010) who

Table 4. Comparing Irrigation Scheduling among Different Sowing Methods

Attributes	Ridger field	Drill field	Planter field
first irrigation and germination Interval (Days)	6.9	18.5	17.5
Time to 1st Irrigation After Germination (min)	280.0	300.0	240.0
Fourth interval (Days)	14.1	19.9	17.1
Third interval (Days)	15.3	20.1	16.9
Fourth interval (Days)	15.9	19.5	18.4
Fifth irrigation interval (Days)	20.6	21.4	20.7

Source: Author's survey

3.5. Comparing Cost of Seed Cotton Production under Different Sowing Technologies

Costs of productions were estimated separately for Ridger, Drill and Planter sown cotton crops. Total cost of production of seed cotton in the area was Rs.68604 per acre in the case of Ridger sown field and it was the highest total cost of production as compared to both the Drill and Planter sown fields mainly due to costly manual dibbling of seeds and earthing-up around established plants. Similarly, manual method has two-fold problems i.e. labor intensive as well as labor does not establish required plant population and accordingly low yield is obtained. The total cost of production per acre of seed cotton for Drill sown field was Rs.66045 whereas lowest total costs of productions (Rs.64406) were estimated for Planter sown field. Dineshkumar and Pandia (2014) in their study on evaluation of single row cotton planter in India found that the cost of planting cotton by manually method was Rs.209/ha whereas cost by single row planter was Rs.168/ha which means that planter of any dimension has advantage over conventional methods of cotton sowing. According to Pakistan Agricultural Research Council, average cost of production of

studied three planting methods namely flat, ridge and bed methods of cotton sowing at Adaptive Research Farm, District Vehari and advised cotton growers to adopt bed planting for maximum yields. In a study on evaluation of cotton planters, the planting operation with Ridger seeder, pneumatic planter and cultivator seeder resulted in 44.0, 42.85 and 41.64 % savings in cost respectively when compared with traditional method of cotton sowing (Kathirvel et al, 2005). However, Ehsanullah *et al.* (2017) examined opposite trend in B.C.R of cotton sown fields in Pit, Flat and Bed sowing methods suggesting Flat method of cotton sowing as most favorable on account of comparatively highest yield and highest B.C.R of 1.52. Although less than current study results, Chaudhry *et al.* (2009) calculated overall B.C.R of 1.31 in district Multan and Bashir *et al.* (2016) calculated B.C.R (with land rent) of 1.45 and without land rent as 1.99 in pure cotton belts of Punjab province. Anyhow, in present study, the economic returns as evident from higher B.C. Rs across three methods are suggesting enough profitability in growing cotton crop.

According to table 5, the inputs were cost intensive and major costly items were land rent, harvesting, fertilizers,

Table 5. Comparing Cost of Seed Cotton Production in Sowing Technologies (Rs./Acre)

Inputs	Ridger	Drill	Planter
Land preparation	4844.3 (10.8)	4663.5 (11.0)*	4450.0 (10.5)
Seed and sowing	10413.0 (23.2)	10266.7 (24.2)	8211.2 (19.4)
Thinning charges	815.0 (1.8)	946.4 (2.2)	939.1 (2.2)
Earthing up around plants	4700.0 (10.5)	4214.3 (10.0)	4240.0 (10.0)
Fertilizer including FYM cost	6818.0 (15.2)	6818.0 (16.0)	6763.0 (16.0)
Irrigation cost	5000.0 (11.1)	4000.0 (9.41)	5000.0 (11.8)
Pesticides & Weedicides cost	4175.0 (9.3)	4175.0 (9.8)	4175.0 (9.8)
Picking cost	8069.3 (18.0)	7406.7 (17.4)	8452.1 (20.0)
Total Variable Cost	44834.6 (100)	42490.7 (100)	42230.4 (100)
Land rent	23770.0	23555.0	22176.0
Total Cost	68604.6	66045.7	64406.4
Yield (Kg/acre)	1096	1008	1148
Price (Rs./40 Kg)	2843.0	2843.0	2843.0
Total revenue (Yield*Price)	77898.0	71501.0	81594.0
Net income (with Land rent)	9293.3	5455.3	17187.6
Net income (without rent)	33063.4	29010.3	39363.6
BCR (with land rent)	1.13	1.08	1.27
BCR (without land rent)	1.74	1.68	1.93

Source: Author's estimations *Figures in parenthesis are percent shares

irrigations and land preparation. Ali *et al.* (anonymous) in their study on input trend in cotton production reported that major costly item was land rent and the lowest was on cotton seed. Land preparation costs were least in Planter sown fields as compared to Ridger and Drill fields. Yield of seed cotton was highest with Planter technology (1148 Kg per acre) as compared to Ridger (1096 Kg per acre) and drill sown fields (1008 Kg per acre). Results on average yield were close to Bashir *et al.* (2016) who reported average seed cotton yield of 1120 Kg per acre in districts of Bahawalpur and Rahim Yar Khan. According to Arain (anonymous), these average yields across all farming methods are far less than 1600-1800 Kg seed cotton per acre obtained at Valley Irrigation Pakistan (Private Ltd) farms. Pakistan needs more efforts to increase average seed cotton yield from 2.19 tons/hectare (i.e. 880 Kg/acre) as there is 2.2 times yield gap than world's highest yield of 4 tons/hectare (Khan, 2015). The trio variable costly inputs in Ridger and Drill methods were seed & sowing, picking and fertilizers respectively but in case of planter the trio variable costly inputs were picking, seed & sowing and fertilizers respectively implying that planter saves seed & sowing costs considerably vis-à-vis Ridger and Drill methods, but irrigation cost was highest in planter as compared to other methods. In the nutshell, planter technology was suitable technology for the cotton growers due to lowest total costs of cultivation and highest yield generating highest profitable per acre.

3.6. Convincing Factors and Barriers in Wider Adoption of Cotton Planter Technology

As the main inspiration behind this study was introduction of planter technology in the study area; therefore, advantages and barriers impeding its spread were explored for the information of all concerned stakeholders. Literature suggests that seed placement and establishment is probably the most crucial phase in the life of a crop, therefore, the role of the planter or seeder is of vital importance. According to responses of farmers, cotton planter had its merits as well as barriers in wider adoption. According to majority, main benefit of planter technology was precious time saving of both the parties i.e. farmer and the machine supplier at the time of sowing. According to Kathirvel *et al.* (2005), there was a savings of 96.4, 96.3 and 96.2% of time in Ridger, Planter and Cultivator respectively. Water saving

Table 6. Convincing Factors and Barriers in Wider Adoption of Cotton Planter Technology

Closed-Ended Questions	Frequency	Percent
Time saving	8	17.4
Yield increase	3	6.5
Water saving	3	6.5
Sub-total	14	30.4
No response	32	69.6
Total	45	100.0
Barriers in wider adoption of Planter technology		
Lack of finances	9	19.6
Lack of timely availability of Planter	5	10.9
Poor performance of Planter machine	2	4.3
Lack of awareness	30	65.2
Total	45	100.0

and more cotton yield as a result of planter technology were other reported benefits. Whereas major barriers in its wider adoption were lack of finances, lack of timely availability and less satisfactory performance of the planter respectively as evident from table 6. Majority of the farmers did not respond to queries about planter success due to lack of knowledge and results of the newly emerging technology. Dineshkumar and Pandia (2014) reported that planters have more accuracy in sowing, time saving and cost effective as compared to conventional manual dibbling methods. The researchers further reported that tiller planter resulted in 23.65, 90.09 and 18.25 % saving in cost, time and energy respectively. According to Ahmad (2012), trio factors i.e. water & time saving and yield increase were main convincing factors in adoption of cotton planter technology as reported by 95%, 80% and 65% respondents respectively while 80% respondents opined non-availability of planter machine followed by high cost of machine and lack of information as barriers in wider adoption of planter technology in cotton crop of Punjab Province.

4. Conclusion

The present study was planned to see the profitability or other favorable attributes associated with planter technology while studying other methods of cotton cultivation. The cotton growers were allocating 27 acres out of their farm size of 39 acres to cotton crop during kharif season to earn more income. Planter technology was suitable technology for the cotton growers due to lowest total costs of cultivation and highest yield per acre generating highest profitable. BCR (without land rent) of 1.93 and BCR (with land rent) of 1.27 also suggest that Bed-cum-planter is a profitable venture in the study area. According to perceptions of farmers, major benefit of planter technology was precious time saving of both the parties i.e. farmer and the machine supplier at the time of sowing in addition to other benefits like water saving and more cotton yield. Whereas major barriers in its wider adoption were lack of finances, lack of timely availability and poor performance of the planter respectively. It is, therefore, recommended that extension efforts may be strengthened for motivating farmers for adoption of Planter technology. Keeping in view the interest and difficulties faced by the farmers for arranging cotton planter, government may introduce it on cost sharing basis (subsidy). It is also recommended that such type of feasibility study may be extended to other cotton growing districts to have more reliable information on planter technology.

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7. Conflict of Interest

The authors declare that they have no conflict of interest.

8. Authors' Contribution

Rashid Saeed conceived the idea. Waqas Manzoor and Irfan Mahmood wrote the manuscript, Angarag Enkhbayar critically reviewed the article.

9. SDGs Addressed

This study contributes to SDG 1 (No Poverty) and SDG 8 (Decent Work and Economic Growth) by identifying cost-effective sowing methods that enhance farmers' income. It also supports SDG 12 (Responsible Consumption and Production) by promoting efficient resource use in cotton cultivation.

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