Farm Labour Productivity of Major Crops of Punjab

Arshdeep Singh[1*], Arjinder Kaur[2] and Poonam Kataria[2]

[1]National Institute of Agricultural Economics and Policy Research (NIAP), New Delhi
[2]Department of Economics and Sociology, Punjab Agricultural University, Ludhiana

Abstract

The present study examines the status of farm labour employment and its productivity in the major crops cultivated in Punjab state. The study is based on data derived from cost of cultivation survey data and various issues of Statistical Abstracts of Punjab from 1998-99 to 2018-19. Results highlight that the major crops (wheat, paddy and cotton) of Punjab were being cultivated on 80.80 per cent of gross cropped area in 1998-99 which has increased to 88.03 per cent in 2018-19. Also, the area under wheat and paddy has increased over the period whereas that of cotton has declined. Labour usage (hr./ha) has reduced in all crops both for hired and family labour except cotton. It is mainly because machinery has replaced both human and animal labour, while in case of cotton crop mechanization has not been adopted due to various reasons, so labour usage (hr./ha) in cotton has rather increased. It is due to increase in per hectare picking hours mainly because of manifolds increase in yield during the study period. Between 1998-99 to 2018-19, farm labour wage rate (Rs./ha) has also increased 6.07 times in paddy, while 5.07 times in wheat and 5.25 times in cotton. Labour productivity experiences a significant increase computed using labour man-hours as the denominator rather than the total labour cost incurred for crop cultivation. In other words, for the selected crops, both the value of output (Rs./ha) and yield (kg/ha) having experienced increase with each labour man-hour utilized in cultivation. However, the scenario shifts entirely when the estimates are based on the total labour cost (Rs./ha) incurred for crop cultivation as the denominator. In this case, the average labour productivity either declines or shows negligible improvement with an increase in the labour cost for the crops. It appears that the labour productivity is getting dampened because of slow growth in value of crop output as compared to the increasing labour cost required for cultivating different crops. This means that along with the improvement in production process, the need is to improve the supporting system that can help increasing the value of crop output.

Keywords: Family Labour, Hired Labour, Farm Labour Productivity, Punjab Agriculture

JEL codes: C43, J21, J43, Q10

Introduction

Punjab being principally an agrarian state has only 25% of the total workforce is dependent on the agriculture sector in the state. After the introduction of the green revolution in the middle of the 1960s, the Punjab agricultural sector underwent several changes (Narayanamoorthy *et al*., 2020). In addition to encouraging the use of yield-increasing inputs like chemical fertilizers and pesticides, the high-yielding varieties (HYVs) driven technology has also encouraged the use of agricultural machinery like tractors, harvesters, threshers, and winnowers, etc. (Bhalla and Singh, 2010). The growth of mechanization replacing human and animal labour is the major reason for the evolving crisis of agrarian employment in Punjab. Due to comparatively higher usage of

machinery in Punjab agriculture, human labour employment in crop production has come down. In an economy with a huge surplus of human labour, the prime concern lies in its employment. But after decades, the farm labour still stands at the same place, and it is noticed that there is no significant improvement in their lifestyle and upliftment in society. Various studies [such as Narayanamoorthy *et al*., (2020), Rudra and Sen (1980), Chattopadhyay (1984), Chand and Srivastava (2014)] linking farm labour with various factors have been conducted over the years since farm labour makes up the greatest portion of the nation's overall labour force and poverty rates are greater among farm labour households in rural areas. A declining growth in farm employment was experienced against an increasing growth rate of real agricultural output (Haque and Sharma, 2004). Chand and Srivastava (2014) have presented a detailed overview of the changes in the rural labour market and

Corresponding author email: arshdeep.singh.khosa1@gmail.com

their consequences for agriculture using NSSO data on employment and unemployment during the periods 1993–1994 and 2009–2010. Thus, it has been attempted to analyse the labour employment and earning in crop sector of Punjab, assessment of farm labour productivity and farm labour status in major crops (wheat, paddy and cotton) in Punjab state.

Data Sources and Methodology

The analysis in this study is based on the Cost of Cultivation Survey (COCS) data published by the Commission for Agricultural Costs and Prices (CACP) of the Ministry of Agriculture and Farmers' Welfare, Government of India, and Statistical Abstracts of Punjab. The Commission for Agricultural Costs and Prices (CACP) has been consistently publishing Cost of Cultivation Survey (CCS) data for selected crops, which encompasses all operations, including labour use. For this study, data has been collected and analysed from the period spanning 1998-99 to 2018-19. The primary focus of this study is to analyse labour productivity in various crops, the study has concentrated on a selection of three key crops, namely wheat, paddy and cotton. These crops collectively account for 80 percent of the gross cropped area in the state. This focused approach enables a thorough exploration of labour productivity in the region's most important crops. The methodology for assessing farm labour productivity in this study follows the approach outlined by Narayanamoorthy *et al.*, (2020). Four dimension of farm labour productivity are:

where, FLP = farm labour productivity; VOP = value of crop output in Rs./ha; LMH = labour man hours per ha; FLC = farm labour cost per ha; Yield = productivity of crops in kg/ha; whereas, V stands for value of output; H stands for labour man-hours; C stands for farm labour cost; Y stands for yield of crop.

$$FLP_{VH} = \frac{VOP}{LMH}$$

$$FLP_{VC} = \frac{VOP}{FLC}$$

$$FLP_{YH} = \frac{Yield}{LMH}$$

$$FLP_{YC} = \frac{Yield}{FLC}$$

In equation (1), the farm labour productivity (FLP$_{VH}$) is calculated by relating the value of crop output (v) to labour man-hours (h). This is determined by dividing the per-hectare value of crop output (VOP) in Rs./ha by human labour man-hours (LMH). In equation (2), the farm labour productivity (FLP$_{VC}$) is measured by relating the value of crop output to human labour cost (c). This is determined by dividing the per-hectare value of crop output by the cost incurred for

human labour in the cultivation of selected crops. In equation (3), the farm labour productivity (FLP$_{YH}$) is calculated by relating the yield (kg/ha) of the crop to labour man-hours (h). This is estimated by dividing the per-hectare yield of the crop by the human labour man-hours (LMH) used for cultivation. In equation (4), the farm labour productivity (FLP$_{YC}$) is determined by relating the yield of the crop (y) to human labour cost (c). This is calculated by dividing the per-hectare yield of the crop by the cost incurred on human labour for crop cultivation (Yield/HLC).

Results and Discussion

Cropping Pattern

Change of gross cropped area in Punjab over the years has been shown in Table 1. As the results indicate that the total cropped area of wheat, paddy and cotton is 80.80 per cent of gross cropped area in 1998-99 which has increased to 88.03 per cent in 2018-19. Over the two decades, wheat and paddy saw increased cultivation, while cotton witnessed a decline in its share of Punjab's cropping pattern.

### Labour Employed in Crop Sector of Punjab: Changes Over Time

In Figures 1 and 2 changes have been depicted in labour employed in the crop sector of Punjab over time. In case of wheat crop, the total human labour hours per hectare decreased significantly from 307 hours/ha in 1998-99 to 113 hours/ha in 2018-19. Similarly, hired human labour hours per hectare declined from 215 hr/ha to 52 hr/ha over the same period. Conversely, for paddy crops, the trend was different, with total labour employment increasing from 451 to 333 hr/ha. However, the trend for hired labour in paddy slightly declined from 282 to 208 hr/ha during the same period. The main reason for this decline in wheat and paddy crop was due to the adoption of mechanization, which substituted human labour with tractor-operated implements. In case of cotton crop, the trend was opposite to wheat and paddy. Total labour hours per hectare increased from 606 to 635 hr/ha, while hired labour hours per hectare increased significantly from 265 to 479 hr/ha, highlighting an increase of more than 80 per cent. Similar trend was reported by Reddy *et al.*, (2014) for India from TE 1999 to TE 2010. There is compelling evidence suggesting that certain technological factors, including cultivated area, cropping intensity, and increased input usage, have led to higher labour requirements. Conversely, mechanization and the use of herbicides have notably reduced employment (Reddy et al., 2014). The interaction of these variables has ultimately resulted in a net reduction in human labour demand (Singh and Singh, 2006).

Further, the proportion of family labour in total labour usage was highest in wheat (54.0%), followed by paddy (37.5%) and cotton (24.6%) during 2018-19 in the crop sector of Punjab (as shown in Figure 3). The rate of decline in family labour engagement was the highest in cotton (118.6%),

Table 1: Cropping pattern of Punjab state (%age of gross cropped area)

Year	Wheat	Paddy	Cotton	Area under major crops
1998-99	42.00	31.71	7.09	80.80
2008-09	44.57	34.57	6.66	85.80
2018-19	44.97	39.64	3.42	88.03
2021-22	45.06	40.17	3.21	88.44

Source: Authors' calculation from various issues of statistical abstract of Punjab
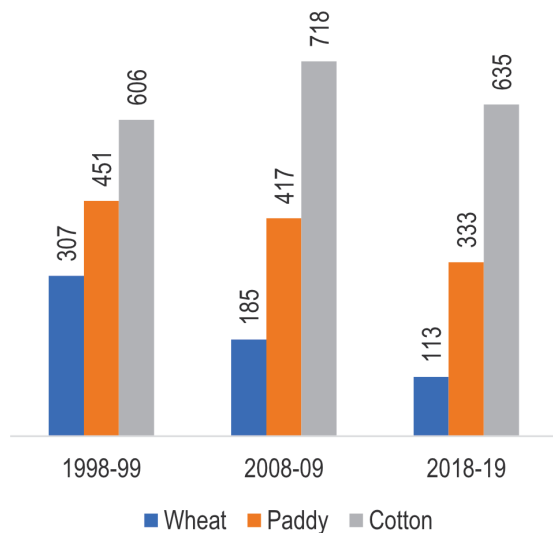
Fig 1: Total labour, hr/ha
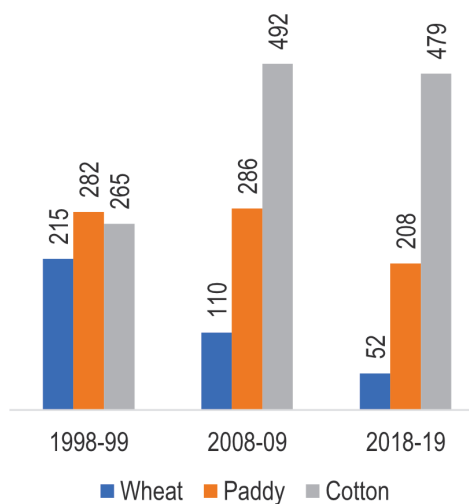
Fig 2: Hired Labour, hr/ha

followed by wheat (50.8%) and paddy (35.2%) from 1998-99 to 2018-19. Meanwhile, the rate of decline in hired labour was highest in wheat (313.5%), followed by paddy (35.6%). In case of cotton, hired labour showed an increase of 44.7 per cent from 1998-99 to 2018-19. Notably, the decline in wheat and paddy was more pronounced in hired labour, while in cotton, it was in family labour. In wheat, the proportion of family labour in total labour was 54.0 per cent, primarily due to the sharp decline in hired labour (313.5%), whereas family labour declined by 50.8 per cent from 1998-99 to 2018-19. Farm mechanization can effectively address the challenges of increasing farm wages and labour shortages, especially during the peak farming season by enabling farmers to complete agricultural tasks promptly, cover extensive areas within a short timeframe, and use resources, such as water, more efficiently (Singh *et al*., 2014).

Farm Labour Wage Rate: Changes Over Time

Figure 4 provides a better understanding of the wage rate of farm labour by highlighting the changes that have occurred in farm labour wage rate (Rs./hr) from the 1998–1999 to the 2018–2019. The agriculture industry in Punjab experienced a five to sixfold increase in the wage rate of farm labour. In addition, the compound annual growth rate of agricultural labour wage rate among the crops showed that the growth

rate was highest for paddy at 11.50 per cent, followed by cotton at 10.80 per cent, and wheat at 10.50 per cent from 1998 to 2018. The farm sector is facing significant challenges as a result of the growing wage rates (Chand and Srivastava, 2014). Non-agricultural factors, such as the presence of trade unions, non-farm employment, and per capita income, have been shown to have an impact on rural wage rates and variation in these (Vaidyanathan, 1986; Jose, 1988; Sen, 1996; Chand *et al*., 2009; Jose, 2013). In the scenario that the cost of human labour increases relative to the cost of using machines, farmers have the option to adopt mechanization for several farm operations (Srivastava *et al*., 2017).

Figure 5 depicts the index of agricultural labour wage rate using the base year of 1998-1999. The index of farm labour wage rate shows that for paddy it has climbed the most, by a factor of six times, followed by cotton and wheat, both of which noticed an increase of five times in the year 2018-19. In response to higher wage rates, there is increased farm mechanisation and shift in the cultivation pattern from work intensive to labour saving crops (Reddy *et al*., 2013).

Farm Labour Earnings

The labour cost incurred by farmers turns out to be earnings of the labour from labour point of view. The agricultural labourer earning per hectare of crop area for
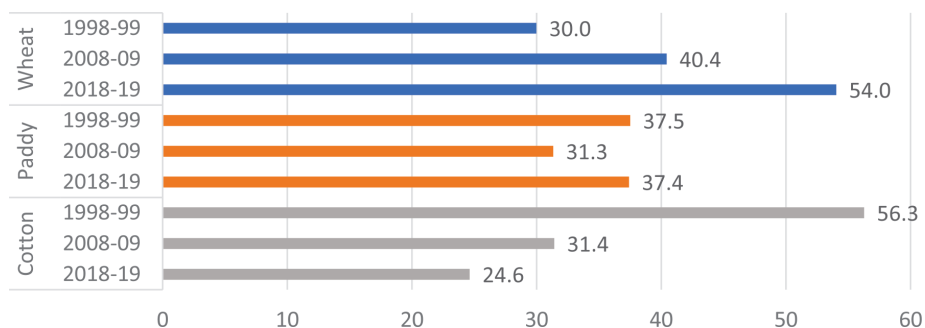
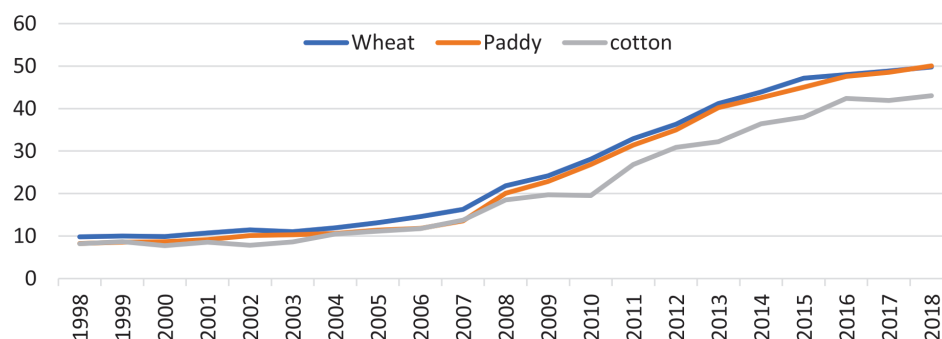**Fig 3: Share of family labour in total labour (%age)**

Fig 4: Farm labour wate rate (Rs./hr): Changes over time

the years 1989-1999 to 2018-19 was displayed in Figures 6 and 7. Over time, there has been a growth in terms of total and hired labour in all of the selected crops in terms of income. But it was found to be maximum in case of cotton crop, which increased from Rs. 4968/ha to Rs. 27322/ha from 1989-99 to 2018-19, whereas the increase in case of hired labour was from Rs. 2172/ha to Rs. 20111/ha during the same time period.

Earning Prospective of Farm Labour in Cost of Cultivation

Table 2 displays the proportion of remuneration received from the crop cultivation. It turned out that it was the highest in terms of cotton, which increased from 46 to 51 per cent from the period 1998 to 2018, in terms of operational cost. This was followed by paddy, which increased from 35 to 39 per cent for the period mentioned above, whereas it decreased in the case of wheat from 33 per cent to 19 per cent.

Indices of Crop Production and Farm Labour Usage

The parameters of crop production and labour utilisation on farms are being presented in Table 3. In terms of land use, the area used for cultivating wheat and paddy has remained relatively more or less same between 1998 to 2009, however the land used for cotton production has shrunk by a large extent. While there has been a modest shift in yield for wheat and paddy, there has been a significant gain in yield

for cotton throughout the course of the period, which is a 532 per cent increase. Labour usage rate shows a reduction in wheat, which is equal to 24 in 2018-2019 when compared to the base year 1998-1999. It also shows a decline in paddy, which is equal to 74 in 2018-2019, but it shows only positive and increasing trends in the case of cotton, which was 181 in 2018-19. The labour wage rate has seen a substantial increase, soaring from 100 in 1998-99 to 507 in 2018-19, indicating a fivefold rise in wheat. In contrast, paddy cultivation also experienced a substantial labour wage rate hike, going from 100 to 625 over the same period. However, cotton farming outshines them both, with a remarkable wage rate increase from 100 to 538.

In labour charges, the data reveals that wheat farming, while initially showing a modest increase from 100 in 1998-99 to 118 in 2008-09, attained a high of 125 in 2018-19. Paddy, on the other hand, experienced a substantial rise in earnings, going from 100 to 247, reflecting the profitability of paddy cultivation. Cotton stands out with a remarkable jump from 100 to 926, demonstrating the potential for high labour charges in cotton farming. Finally, when it comes to the value of the product, all three crops witnessed considerable growth. Wheat went from 100 to 398, paddy from 100 to 570, and cotton from 100 to an impressive 1380. This highlights that the value of output increased at larger extent than the labour charges, which indicated that the share of farmer
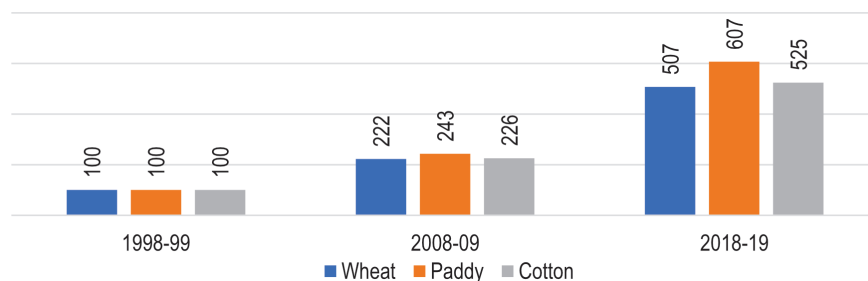
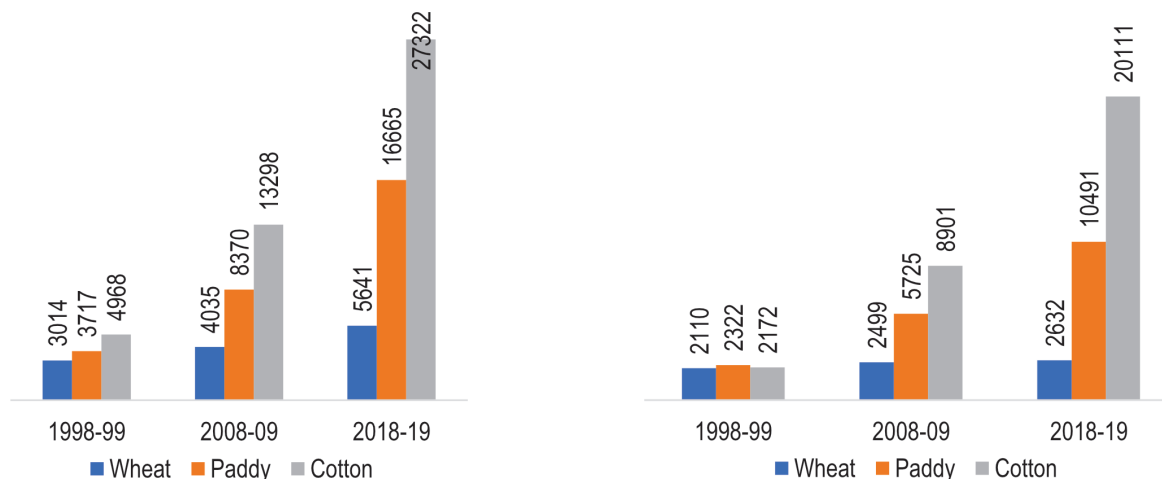**Fig 5: Index of farm labour wage rate (Base Year 1998-99)**

Fig 6: Total labour, (Rs./ha)

Fig 7: Hired labour (Rs./ha)

profit might being increased. These figures emphasize the economic viability of all three crops, albeit with cotton offering the highest potential returns. High wage rates and labour charges have seen notable shifts, all three crops have shown increased value in their products, with cotton being the most lucrative option in 2018-19.

Farm Labour Productivity

Farm labour productivity has been analysed in four dimensions and it is highlighted in Table 4. The significant increases in labour productivity has been observed when using labour man-hours as the denominator instead of the total

labour cost incurred for crop cultivation. This improvement is evident in both the value of output (measured in Rs./ha) and yield (measured in kg/ha) for each labour man-hour invested in cultivating selected crops. However, this scenario shifts when using total labour cost (Rs./ha) as the denominator. When labour cost becomes the denominator, average labour productivity either decreases or shows minimal improvement as labour costs rise. It suggests that labour productivity is negatively affected by the slow growth in the value of crop output compared to the increasing labour costs required for cultivating different crops. This highlights the need

Table 2: Earning prospective of farm labour in cost of cultivation

Particular	Wheat			Paddy			Cotton		
	1998	2008	2018	1998	2008	2018	1998	2008	2018
Cost (Rs./ha)									
Labour cost	3014	4035	5641	3717	8370	16665	4968	13298	27322
Operational cost	9161	15564	30197	10729	20971	42390	10798	27785	54028
Total cost	19479	35423	71103	19126	45291	84766	15459	50829	98076
Share of labour in									
Operational cost	33	26	19	35	40	39	46	48	51
Total cost	15	11	8	19	18	20	32	26	28

Table 3: Indices of crop production and farm labour usage

Farm labour	Wheat			Paddy			Cotton		
	1998-99	2008-09	2018-19	1998-99	2008-09	2018-19	1998-99	2008-09	2018-19
Area	100	106	105	100	109	123	100	94	48
Yield	100	94	122	100	145	146	100	535	532
Labour usage rate	100	51	24	100	102	74	100	186	181
Labour wage rate	100	222	507	100	250	625	100	238	538
Labour charges	100	118	125	100	247	425	100	410	926
Value of product	100	187	398	100	308	570	100	721	1380

for not only enhancing the production process but also for improving systems that can boost the value of crop output. Farm labour productivity in terms of value of product per unit of labour usage was the highest in case of wheat at Rs. 823.48/hr followed by paddy and cotton with 371 and 203 Rs./hr from the period 1998 to 2018 . Crop productivity per unit of labour usage (kg/hr) has shown an increasing trend over the period in wheat, paddy, and cotton. In case of farm labour productivity in terms of crop productivity per unit of labour usage was the highest in wheat followed by paddy and cotton with 45.97, 20.36 and 3.40 kg/hr in 2018-19. Crop productivity per unit of labour cost has also shown declining trend in all the crops. The compound annual growth rate of farm labour productivity has been given in Table 5. Growth rate for value of product per unit of labour usage was found to be the highest in wheat that is 12.77 per cent and the lowest in paddy 10.96 per cent. While the value of product

per unit of labour cost was the highest for wheat that is 2.03 per cent and the lowest for paddy (- 0.49 %). Growth rate for crop productivity per unit of labour usage was in the range of 3.05 per cent in case of paddy to 5.64 per cent in case of wheat, whereas the crop productivity per unit of labour cost is negative in all the crops.

Conclusion and Policy Implications

The findings of this study reveal that use of farm labour has declined in wheat and paddy but has increased slight for cotton during the span of study. The percentage of farm labour that was contributed by family members increased with time in the production of wheat and paddy but declined over time in the production of cotton mainly due to a reduction in hired labour. The most significant increase in labour productivity was shown in wheat, followed by cotton and then paddy. This trend was evident across the board. However, when

Table 4: Farm labour productivity in major crops from 1998 to 2018

Particulars	Wheat			Paddy			Cotton		
	1998	2008	2018	1998	2008	2018	1998	2008	2018
Value of product per unit of labour usage (FLP_{VH}), Rs./hr	76.09	235.94	823.48	48.13	160.18	371.26	15.45	94.05	203.46
Value of product per unit of Labour cost (FLP_{VC}), Rs.	7.75	10.82	16.50	5.84	7.98	7.42	1.88	5.08	4.73
Crop productivity per unit of labour usage (FLP_{YH}), Kg/hr	13.83	21.53	45.97	10.30	16.17	20.36	0.75	3.40	3.82
Crop productivity per unit of labour cost (FLP_{YC}), kg/Rs.	1.41	0.99	0.92	1.25	0.81	0.41	0.09	0.18	0.09

Table 5: Growth rate of farm labour productivity

Particulars	Wheat	Paddy	Cotton
Value of product per unit of labour usage (FLP_{VH}), Rs./hr	12.77*	10.96*	11.44*
Value of product per unit of Labour cost (FLP_{VC}), Rs.	2.03	-0.49	0.59
Crop productivity per unit of labour usage (FLP_{YH}), Kg/hr	5.64*	3.05*	4.89*
Crop productivity per unit of labour cost (FLP_{YC}), kg/Rs.	-4.43*	-7.58*	-5.24*

Significant at 1 % level of significance.

measured in terms of value per rupee spent on labour, farm labour productivity went down for wheat and paddy while remaining roughly unchanged for cotton. In general, there is a requirement to improve the production process in order to reverse the declining trend in the agricultural productivity per unit of labour cost that has been found across all crops. Promoting mechanization and providing financial incentives will help reduce labour dependency. Additionally, efforts should be made to develop and disseminate advanced agricultural practices and technologies that optimize labour usage and efficiency. Implementing training programs for family labour, enacting labour market reforms, and investing in cost-effective practices are essential to enhance productivity and reverse the declining trend in agricultural labour efficiency.

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