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Agricultural Wages and Employment

The introduction of technology has seen a steady decline in demand for human labour on Punjab farms, a process accelerated by the stagnation in overall agricultural growth. Increase in labour demand in the dairy sector has compensated for this fall, but in future the secondary and tertiary sectors will have to grow faster to absorb the state's growing labour force.

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Agricultural development in Punjab is closely associated with changes in the level and structure of agricultural employment. It reflects the composite effect of market forces and technical factors influencing demand for human labour in the state's farms. In the late 1960s and early 1970s, the introduction of modern production technology for wheat and rice unleashed the forces of change that influenced productivity, production and employment. Increase in production was accompanied by greater labour absorption in the production process through increase in cropping intensity and use of fertilisers, expansion in irrigated area and higher land productivity [Grewal and Kahlon 1974; Raj Krishna 1974; Raju 1976; Bisliah 1978]. However, the seed-irrigation-fertiliser technology necessitated mechanisation of farm operations through introduction of tractors and tractor-operated threshers in a big way in the late 1970s, in order to realise higher returns through precision farming and vertical expansion of land area. Tractorisation of farm operations led to a fall in labour intensity. Yet, total agricultural employment on mechanised farms did not decline, due to increase in cropping intensity, labour-intensive shifts in crop-mix and higher productivity, all of which had a direct relationship with labour use [NCAER 1980; Oberai and Ahmed 1981; Prihar and

Sidhu 1986; Sidhu and Grewal 1991]. The use of herbicides for wheat and paddy crops became widespread replacing human labour since the mid-1980s. Another development that also reduced demand for labour in Punjab agriculture was the introduction of combine harvesters on a large scale for harvesting and threshing operations in wheat and paddy. The agriculture sector has also witnessed a large influx of migrant labour from other states during this period. Due to changes in the demand-supply situation for labour, productivity of land and cost of living, agricultural wages have also changed significantly over the years. It is therefore pertinent to examine the shifts in the level and structure of agricultural employment, and estimate the impact of wages and other factors.

This paper analyses the pattern of agricultural employment for wheat and rice, covering 78 per cent of the cropped area and for the farming system as a whole encompassing the effect of changes in cropping pattern and cropped area. The study also includes the positive impact on employment of dairy development, which is more of a tradition than a commercial venture in the agrarian economy of the state. The paper focuses on the period of the 1990s, when the impact of labour-replacing factors is considered to have become more pronounced, whereas the effect of labour-enhancing factors like positive shifts in crop-mix and increase in cropped area and productivity receded. Analysis of this issue is essential for evolving future strategies of employment growth in rural areas. The paper has used the 'cost of cultivation' project data for estimating human labour demand for wheat and paddy and the 'economics of farming in Punjab' project data for overall farm employment analysis. Both these schemes collect data using the cost accounting method.

Demand for Labour

Wheat and paddy being the most important crops largely determine the level of agricultural employment in Punjab. These crops have experienced significant changes in their biological and mechanical technologies, influencing labour employment pattern.

The total human labour use for wheat increased in the mid-1980s, after which it started declining (Table 1). It decreased by 25.73 per cent from a per hectare average use of 52.35 mandays during 1985-88 to 38.9 mandays during 1998-2000. As a matter of fact, the demand for labour in the wheat crop remained stagnant at around 400 man-hours/ha during the 1980s but declined sharply afterwards due to the use of weedicides and combine harvesters, despite improvements in productivity. During 1985-97, there was not much change in the use of machinery for wheat crop, but widespread use of weedicides/ herbicides substituted for labour. In the late 1990s, use of machinery in the form of combine harvesters rose manifold, replacing human labour for harvesting and threshing.

The picture was no different in the labour-use pattern for the paddy crop. During 1981-88, the average use of total labour was 104 mandays/ha, and ranged between 99 mandays and 107 mandays except in 1984-85. The use of machinery and herbicides also did not show any major change (increase) during this period. However, in the 1990s, a significant decrease in the demand for human labour was observed due to higher machine use, especially combine harvesters. Productivity of paddy did not improve, which could otherwise have prevented this fall to some degree.

Keeping in view the impact of bad weather (rains) at the time of harvesting and threshing of paddy in September-October, farmers prefer to use mechanical means instead of manual harvesting and threshing. Human labour use in paddy fell by 45.6 per cent during 1981-99, while the use of machinery increased by 65.74 per cent. The fall in labour utilisation was the steepest during the early 1990s, corresponding to the largest proportionate increase in machine use.

The reasons for substitution of human labour with machinery and weedicides were both technical and economic. Due to cultivation of the same cultivars of wheat and paddy in large areas, their harvesting and threshing operations got accentuated in a short span of time. Farmers being risk averse, preferred to wind up harvesting and threshing operations as quickly as possible. Medium and large farmers opted for mechanical harvesting and threshing due to the bigger size of their harvestable areas. Further, mechanical harvesting and threshing is more economical than manual operation. Demand for labour peaks during harvesting and the wage rates tend to move higher. This happens despite the large-scale influx of migrant labour from other states into Punjab for these operations. Only the minimum area of wheat is harvested and threshed manually to meet dry fodder requirements of livestock. Of late, the harvesting and threshing operations for wheat by combines have been segregated and a tractor-driven combine harvester (reaper) has been developed which converts wheat straw into dry fodder, further curtailing demand for human labour. Harvesting and threshing are mostly done manually on marginal and small farms in order to utilise the available family labour and economise on costs. Even these farmers go for mechanical harvesting and threshing when the weather appears to play foul with the fully ripe crop at the time of harvesting.

Further, market influences on labour use can be expressed by the response of farmers to factor prices. Given the productivity of factors, farmers try to maximise profits by allocating their factor inputs in accordance with prices. Since the 1980s, the wage rate has tended to rise faster than

Table 1: Average Use of Human Labour, Machinery and Weedicides for Cropping in Punjab

Year/Crop	Human Labour (Mandays)	Machine Use (Rs at 1980-81 Prices)	Chemicals Use (Rs at 1980-81 Prices)	Yield (q/ha)
Wheat				
1981-84	49.44	495.34	57.31	30.33
1985-88	52.35	569.28	73.67	33.35
1991-94	43.89	540.19	102.21	37.21
1995-98	42.24	534.07	122.17	38.44
1998-2000	38.88	680.11	202.27	45.40
Paddy				
1981-84	103.60	379.55	113.69	53.93
1985-88	102.35	432.47	126.80	53.71
1991-94	70.60	546.66	188.24	52.42
1995-98	59.21	579.08	242.16	50.15
1998-99	56.32	629.06	267.75	46.45

Source: 'Comprehensive Scheme to Study Cost of Cultivation of Principal Crops in Punjab'.

Table 2: Index for Wage Rate and Prices of Other Input and Output

Year	Variable Input Price Index			Output Price Index	Relative Price Index		
	Labour	Machine Use	Chemicals		Lab/ Output	Lab/ Machine	Lab/ Chemicals
Wheat							
1981-82	100	100	100	100	100	100	100
1991-92	271.43	180.90	205.10	176.00	154.22	135.85	132.34
1998-99	648.05	340.00	317.86	366.90	176.63	191.57	203.88
Paddy							
1981-82	100	100	100	100	100	100	100
1991-92	239.57	199.80	158.30	203.68	117.62	132.43	151.34
1998-99	593.52	338.28	339.60	378.48	156.82	174.56	174.77

Source: Reports of the Commission for Agricultural Costs and Prices, various issues.

commodity prices, machine use prices and prices of herbicides, forcing substitution of labour by machine and herbicides (Table 2). The index for wage rate with respect to output price (base 1981-82) rose to 176.63 in 1998-99 for wheat, and to 156.82 for paddy. Correspondingly, the wage rate index with respect to price indices of machine use and chemicals use rose to 191.57 and 203.88 respectively for wheat, and 174.56 and 174.77 respectively for paddy. Therefore, factor-use adjustments in response to price changes resulted in a decrease in the use of labour and increase in the use of machinery and weedicides during the 1980s and 1990s. Wage rates rose more sharply despite the increase in the migration of labour from UP, Bihar, Rajasthan having a depressing effect on wage rate, due to increase in cost of living and skewed pattern of labour demand in harvesting season among other factors.

Employment elasticities to wage rate, machine use and herbicide use were also estimated to examine their impact on labour demand for wheat and paddy (Table 3). Increase in real wage rate (deflated with commodity prices) was an important variable in reducing the demand for labour for wheat and paddy crops in Punjab. Wage rate elasticity of labour demand was higher in case of paddy, as there was greater scope for substituting labour with harvesting combines when wage rates tended to go up. In case of wheat, the scope for substitution is relatively limited because wheat straw is used to make dry fodder to be used as livestock feed. The use of herbicides significantly reduced labour intensity in case of wheat. Herbicides are used on 70-80 per cent of wheat farms in Punjab to control weeds. Manual weeding and hoeing has been almost entirely replaced with chemical control due to the higher wage rate and effective control of weeds through herbicides. For the paddy crop, herbicides are used on 90-95 per cent farms. Manual weeding was never practised for paddy because it is transplanted and identification of weeds in the standing crop is difficult. The imact of productivity on employment was not significant for both crops and therefore this variable was excluded from the final estimation of equations.

Employment Structure

Though physical data on human labour use under family labour and hired labour categories were not available for wheat and rice, we have tried to examine the changes in the pattern of their use through changes in expenditure incurred on family labour use (estimated at attached labour wage rate) and hired labour (attached + casual). The wage rate for attached labour is generally lower than casual wage rate due to its contractual nature assuring regular work throughout the season/year.

Table 3: Elasticities of Demand for Labour
(In per cent)

Variable	Wheat (Linear)	Paddy (Log Linear)
Relative wage rate to output price	–0.35**	–1.048*
Machine use	–	–0.296**
Chemicals use	–0.915***	–
Adjusted R^2	0.667	0.87

Notes: * significant at 1 per cent level, ** at 5 per cent and *** at 10 per cent.

Table 4: Changes in Proportional Expenditure on Family Labour and Hired Labour
(In per cent)

Year/Crop	Family Labour	Hired Labour		
		Attached	Casual	Total Hired
Wheat				
1981-84	41.22	12.54	46.24	58.78
1985-88	39.51	8.95	51.54	60.49
1991-94	33.09	7.38	57.53	64.91
1995-98	32.13	11.08	56.79	67.87
1998-2000	31.25	8.78	59.97	68.75
Paddy				
1981-84	31.11	13.12	55.77	68.89
1985-88	31.76	7.20	61.04	68.24
1991-94	32.99	13.62	53.39	67.01
1995-98	39.99	20.53	39.48	60.01
1998-99	37.52	15.25	47.23	62.48

Source: Same as for Table 1.

Table 5: Changes in Share of Labour in Cost of Production and Value of Output
(In per cent)

Year	Wheat		Paddy	
	Share in Cost of Production	Share in Value of Output	Share in Cost of Production	Share in Value of Output
1981-84	14.68	12.34	20.15	16.82
1985-88	15.74	13.30	21.13	17.63
1991-94	16.04	12.56	18.21	14.94
1995-98	17.00	14.04	18.81	15.80
1998-2000	14.79	10.42	19.43*	16.96*

Note: * For paddy, the figures given for 1998-2000 refer to the year 1998-99.

Therefore, the proportional break-up of total labour use into its different components in physical units (mandays) on the basis of expenditure gets underestimated for family labour and attached labour and overestimated for casual labour. However, over time, relative changes in the structure may not be affected much as the ratio between attached wage rate and casual wage rate does not fluctuate widely over the years. There is a close association between the wage rates of attached labour and casual labour.

There has been a sizeable fall in the use of labour since the mid-1990s in paddy (Table 4). The use of harvesting combines replaced casual labour more than family labour. The trend of declining family labour use appeared to be waning during this period, and the proportional use of casual labour in paddy production decreased. Fragmentation of landholdings along with a squeeze in economic returns seemed to have reversed the earlier trend.

The share of hired labour in total labour rose and that of family labour decreased over the years in case of wheat. Yet, the share of family labour expenditure stabilised at 31-33 per cent and that of casual labour at 57-60 per cent during the 1990s. The major change in the structure of family and casual labour occurred in the 1980s, when the use of weedicides and harvesting combines expanded rapidly. Till the mid-1980s, it was the tractor and weedicides that were replacing human labour, but the labour-enhancing factors outweighed these negative employment effects and contributed to an increase in total labour employment. During the 1990s, higher use of harvesting combines and weedicides reduced agricultural employment in wheat, and the replacement largely occurred in family labour. Around the mid-1990s, dry fodder requirements for livestock restricted further expansion of harvesting combines especially on small and medium farms. Consequently, the demand for labour did not change much. However, lately, mechanical harvesting and threshing operations of the harvesting combines have been segregated and two combines,

Table 6: Average Annual Use of Human Labour in Mandays/Ha

Year(s)	Crops			Dairy			Crops+Dairy
	Family	Hired	Total	Family	Hired	Total	Total
1983-84	55.94	58.42	114.36	22.94@	na	22.94	137.30
1987-89	60.93	66.94	127.87	46.45@	na	46.45	174.32
1991-94	54.70	55.18	109.88	47.87	9.21	57.07	166.95
1995-98	49.63	57.27	106.89	59.05	9.63	68.68	175.57
1998-2001	43.30	57.16	100.46	60.11	14.84	74.95	175.41

Note: @ includes hired labour also.
Source: Research scheme, 'Economics of Farming in Punjab', Government of Punjab.

one threshing wheat grains and the other making dry fodder from wheat straw, are being used extensively in Punjab, reducing the share of family labour and increasing the share of casual labour in total labour use. Thus mechanical technology has replaced casual labour in paddy and in combination with biological technology replaced family labour in wheat since 1995.

Technological changes combined with changes in the prices of various factor inputs have led to shifts in factor shares over time in the production of wheat and rice. The use of human labour in the production process has declined since the 1980s, while use of capital inputs and intermediate production inputs such as fertilisers, insecticides/weedicides, has risen. In spite of this, the share of labour did not show significant decline, due to a greater increase in wage rates than the prices of output and other inputs (Table 5). In fact, technological changes for wheat and rice, and increase in cropped area, accentuated the peaks of labour demand in shorter intervals of time pushing up the wage rate. The share of labour in total cost of production remained at around 20 per cent for paddy and 15 per cent for wheat. Similarly, the share of wages in the total output did not show any substantial change over time for both crops. However, the share of labour in the value of wheat output in the late 1990s decreased due to a significant improvement in productivity, offsetting the impact of relative wage rate increase. This is a matter of great concern in labour-surplus economies like India, where growth in productivity and production is not leading to employment growth.

There has been a continuous decrease in the use of human labour since the mid-1980s, when the modern production technology of HYVs, irrigation and fertiliser stabilised and heavy farm machinery, that is, harvesting combines, started making significant inroads. Productivity of paddy stabilised, increases in cropped area became smaller and use of combine harvesters became normal practice. The positive impact of cropping intensity, productivity and irrigation on employment began diminishing and labour use began to fall (Table 6). The largest fall occurred in the early 1990s. Demand for labour in the crop sector increased by 11.81 per cent from 1983-84 to 1987-89 and thereafter decreased continuously. Labour use decreased by 21.4 per cent in 1998-2001 compared with 1987-89. Yet in the 1990s, the decline was small (8.57 per cent). Family labour use contracted by 20.84 per cent whereas hired labour use went up by 3.59 per cent. The use of combine harvesters decreased from 6.67 hours/farm in 1991-94 to 5.33 hours/farm in 1998-2001, but its coverage increased from 42.65 per cent of the farms using combines to 63.18 per cent.

The dairy sector gained importance over the years in generating employment. Average use of labour on a per cultivated ha basis increased from 22.94 mandays in 1983-84 to 74.95 mandays in 1998-2001, an increase of 226.7 per cent. There still exist significant opportunities for further growth of the dairy sector in Punjab. As a matter of fact, growth in employment in dairying has compensated for the fall in employment in the crop sector. On the whole, there was a marginal increase in agricultural employment in Punjab. The average annual share of the farm sector in agricultural employment declined from 73.35 per cent in 1987-89 to 57.3 per cent in 1998-2001 and that of the dairy sector improved from 26.65 per cent to 42.7 per cent.

Policy Implications

Due to increase in the use of farm machinery such as combine harvesters and weedicides, the demand for human labour in the farm sector in Punjab has decreased significantly since the late 1980s. Growth in employment-enhancing factors such as productivity, cropped area and irrigation have stagnated, thus failing to offset the labour-displacing effects of machinery and weedicides. The growth of the dairy sector boosted the demand for labour and fully compensated the falling demand in the crop sector. The fall in demand for crops was steeper in the early 1990s, but slowed down thereafter because further substitution of labour became technically and economically difficult. On the basis of per hectare labour use in the crop sector, demand for human labour is estimated to have fallen from 479.3 million mandays in 1983-84 to 421.93 million mandays in 2000-01. On the other hand, the number of agricultural workers in the state increased from 2.86 million in 1981 to 3.6 million in 2001 apart from the numbers of migrant labour increasing from 2.86 lakh in the lean period to 5.72 lakh in the peak period in 1983-84, and to 3.86 lakh and 7.74 lakh respectively in 1995-96 [Sidhu et al 1997]. Therefore, the farming sector in Punjab is beset by the problem of falling demand for labour in crop production and increasing real wage rates [Bhalla 1993]. Yet, further substitution of labour with machinery seems to be difficult due to techno-economic reasons. Any turnaround in labour intensity in farming is unlikely to happen in the near future. Diversification in cropping patterns from paddy and maybe wheat to oilseeds, pulses and maize may not push demand for labour significantly, as these crops are not labour-intensive. Cultivation of vegetables has the potential to increase employment, but the scope of their expansion in the state is limited due to their perishability and infrastructural bottlenecks in marketing. Development of dairying, which is considered to be a good option for increasing incomes of farmers, can lead to employment growth to some degree. The secondary and tertiary sectors shall therefore have to grow faster to provide gainful employment to the agricultural labour in the state. EPW

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