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than those based on total labour. Probably, farmers base their decision on the basis of expenditure involved in hiring the farm labour. There was some upward shift in the productivity of labour during the period of investigation. However, the shift was not stable and it varied from year to year. During the period, wages rose by 130 per cent while the consumer prices increased approximately by 93 per cent. Some of the increase in wages might be attributed to the rise, though irregular in the productivity.

IMPACT OF GREEN REVOLUTION ON AGRICULTURAL WAGES IN THE PUNJAB

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Quite a large proportion of population in our country is below the poverty line. The Government has been endeavouring to narrow down inequalities in distribution of wealth and income with a view to ameliorating the conditions of the poorer sections of the population. The poverty problem is particularly severe among the landless classes in the rural areas. The agricultural labourers constitute a big majority of the weaker sections in the rural areas. A view is often expressed that fast rise in the prices of consumption goods is eroding the real earnings of labour class. It is important to probe this aspect.

An attempt has been made in this paper to examine the wage pattern of agricultural labour in the Punjab State—a premier State in experiencing the green revolution. Agricultural labour population is quite high in the State; the population was 7.86 lakhs in 1971 and constituted 32.09 per cent of the combined population of cultivators and agricultural labourers.

Hypothesis Tested and Source of Data

The main hypothesis sought to be tested in this paper is that technological break-through in agriculture has improved the real earnings of farm labour and increased the volume of employment. The empirical evidence to test this hypothesis was obtained from the Statistical Abstracts of Punjab issued by the Economic and Statistical Adviser, Government of Punjab and Farm Management reports for Punjab State published by the Economic and Statistical Adviser, Ministry of Agriculture, Government of India.

Trend in Wages

The money wage rates of agricultural labour obtaining in Punjab State during the period 1956 to 1972 are shown in Table I. The important operations of weeding, harvesting, and ploughing for which the farmers usually engage casual labour were studied. Along with the wage rates, the consumer price index for agricultural labourers is also presented in Table I. The period 1956 to 1972 was studied because the data on comparable basis were available only for this period. This period was considered large enough to represent the pre-and-post-green revolution era.

A look at the figures in Table I showed that there was a slight increase in the wage rates for all these operations from 1956 to 1963. From 1964 upto 1969, the increase in wages was relatively more compared to the earlier period. Thereafter, the rate of increase slowed down.

A perusal of the consumer price index revealed that the trend in the money wage rate was broadly correlated with movement of the consumer price index. The consumer price index indicated a steep rise of 81 points in the year 1969 compared to 1964. The wage rates also behaved in the same way and recorded an increase varying from Rs. 2.68 to Rs. 3.66 for different operations during the same period.

To have a better understanding of the real earning power of the labouring class, the money wage rates were deflated with the consumer price index. The real wages arrived at in this way were shown in Table II. *Prima facie*, the real wages indicated no trend except during the closing years of the period under study. A linear trend ($Y = a + bt$) was fitted to the data of real wages. The results are given below :

	Operation	Trend line
(a)	Ploughing	$Y = 2.4488 + 0.0287 t$ (0.0141)
(b)	Weeding	$Y = 2.2711 + 0.0543 t^{**}$ (0.0126)
(c)	Harvesting	$Y = 2.7552 + 0.0610 t$ (0.0885)

** Significant at 1 per cent level.

It is apparent that the increase in the real wages was not significant for the operations of ploughing and harvesting. The increase was, however, significant for weeding operation. Thus, on the whole, the real wage rates showed no increase during the period 1956 to 1972.

In order to see whether the rise in the wage rates during the period of green revolution was significant compared with earlier period, the analysis was repeated by using dummy variable for allowing changes in the intercept as

TABLE I—AGRICULTURAL WAGES AND CONSUMER PRICE INDEX (FOOD GROUP) FOR AGRICULTURAL LABOURERS IN PUNJAB : 1956 TO 1972

Year	Daily wages (Rs. per day) (day=8 hours)			Consumer price index
	Ploughing	Weeding	Harvesting	Food (Base 1950-51=100)
1956	2.15 (2.15)	1.75 (1.75)	2.62 (2.62)	97
1957	2.29 (2.22)	2.02 (1.96)	3.13 (3.04)	100
1958	2.40 (2.80)	2.03 (1.93)	2.51 (2.86)	102
1959	2.46 (2.16)	2.12 (1.87)	2.30 (2.02)	110
1960	2.46 (2.34)	2.37 (2.25)	2.40 (2.28)	102
1961	2.46 (2.31)	2.39 (2.25)	2.48 (2.33)	103
1962	2.62 (2.41)	2.60 (2.39)	2.80 (2.58)	105
1963	2.79 (2.57)	2.59 (2.38)	2.88 (2.65)	105
1964	3.38 (2.50)	3.15 (2.33)	4.07 (3.01)	131
1965	3.45 (2.28)	3.31 (2.18)	4.01 (2.65)	146
1966	3.82 (2.33)	3.66 (2.23)	3.94 (2.40)	158
1967	4.47 (1.97)	3.94 (1.73)	4.93 (2.17)	218
1968	4.70 (2.16)	4.59 (2.11)	6.14 (2.88)	213
1969	6.15 (2.83)	5.83 (2.68)	7.73 (3.42)	212
1970	6.46 (2.84)	6.32 (2.78)	7.71 (2.39)	217
1971	6.62 (3.04)	6.55 (3.04)	7.94 (3.65)	212
1972	6.64 (2.72)	6.72 (2.75)	8.24 (3.37)	239

Note : Figures in parentheses are real wages obtained by deflating the wages by the consumer price index.

Source : Statistical Abstracts of Punjab.

well as slope. The period 1967 to 1972 was taken to represent the green revolution era. A linear equation of the following type was fitted :

$$Y = a_1 + b_1t + a_2D + b_2Dt$$

where Y stands for real wages, t for time and D (dummy variable) = 0 for the pre-green revolution period and D = 1, for the green revolution period.

	Operation	Trend line
(a)	Ploughing	$Y = 2.4013 + 0.104t - 0.81431D + 0.1726Dt$ (0.0219) (0.3303) (0.0590)
(b)	Weeding	$Y = 2.2926 + 0.0514t - 1.0351D + 0.1771Dt$ (0.0187) (0.2816) (0.0503)
(c)	Harvesting	$Y = 2.5637 + 0.0073t - 0.7182D + 0.2293Dt$ (0.0314) (0.4736) (0.0846)

** Significant at 1 per cent level.

* Significant at 5 per cent level.

The analysis brought out that the increase in the real wages was not significant in the pre-green revolution period for the operations of ploughing and harvesting. It was significant for weeding operation only. On the other hand, the rise in the wage rates was highly significant during the period of the green revolution. From the behaviour of wage rates during the last two decades it could be observed that the real wages did not lag behind the cost of living index of the labouring class. The increase was commensurate with the rise in the cost of living index in the pre-green revolution era. The terms of trade improved somewhat in favour of the agricultural labouring class during the period of green revolution.

Factors Affecting Wage Rates

It is pertinent to examine the factors associated with the upward trend in the real wage rates during the recent few years. Wages are, primarily, a function of demand and supply of labour. It was hypothesized that this upward trend in the wage rates was the consequence of an increase in demand for labour in the wake of new technology. This hypothesis was tested by examining the demand for labour in the pre-green revolution (1954-55 to 1956-57) period as well as during the period when this process got fairly stabilised (1969-70). Comparable data were available only for these two points of time. Table II shows the estimated demand and supply of labour.

No direct estimates of demand and supply of labour for the State were available ; however, estimation of these variables was attempted. The total input of labour for the State was deemed to represent the demands of labour and it was worked out by multiplying the total cropped area in the State by the labour input per unit area during the corresponding period. The supply of

TABLE II—SUPPLY AND DEMAND OF AGRICULTURAL LABOUR IN PUNJAB

Period	Year	Labour input per cropped hectare per year (man-days)	Total cropped area (hectares)	Total estimated input of labour for the State (man-days)	Total supply of labour (cultivators and agricultural labourers—adult-man units)
(1)	(2)	(3)	(4)	(5)	(6)
Pre-green revolution	.. 1954-55 to 1956-57	50.51	46,60,000	23,53,76,600	17,33,107
Green revolution	.. 1969-70	63.24	54,99,000	34,77,56,760	23,96,733

Source : Col. (3) Studies in the Economics of Farm Management in the Punjab State, for 1954-55 to 1956-57, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India and 1967-68 to 1969-70, Punjab Agricultural University, Ludhiana.

Col. (4) Statistical Abstracts of Punjab.

Col. (6) Figures relating to 1954-55 to 1956-57 and 1969-70 were estimated from the figures of population of workers for the year 1961 and 1971 respectively by using the growth rate of population during the decade, 1961-1971.

labour was taken to consist of the total working population of cultivators and agricultural labourers in the State.¹ In the absence of availability of data on the participation rate of labour, these figures would give only a rough approximation of the estimates of supply of labour. Table II shows that during the period of 1954-55 to 1956-57, the total demand for labour was 23.54 crore man-days in the State as a whole and it went up to 34.78 crore man-days in 1969-70 (an increase of 47.74 per cent). Against this, the supply of labour increased from 17.33 lakh men to 23.97 lakh men during the corresponding period (an increase of 38.82 per cent). This indicated that the demand for labour increased relatively more than the supply of labour. It would be more meaningful to look at this problem from an another angle. In the absence of any estimates of the number of days for which a person worked in a year during 1954-55 to 1956-57, these estimates were derived by dividing the total labour input (23,53,76,600 man-days) by the available supply, during this period (17,33,107). This figure worked out at 136 man-days per worker per year.

Assuming the same participation rate for the year 1969-70 also, the supply of labour worked out to be 32.55 crore man-days against the demand of 34.78 crore man-days during this year.² This meant that there was a shortfall of 6.83 per cent in the supply of labour during 1969-70. This sup-

1. It is recognized that the labour supply should account for the labour force migrating to and out of the State but these estimates are not available.

2. (i) We have assumed the same participation rate of labour for the year 1969-70 as it was in 1954-55 to 1956-57. In fact this seems to have declined significantly during recent years because of the substitution of leisure for work by the farmers and the increased opportunities for off-farm work for labourers.

(ii) The supply of labour during 1969-70 worked out by multiplying the population of workers (23,96,733) with the participation rate (136 man-days.)

ports that available supply of labour within the State was less relative to the demand for it. This seems to have caused a rise in the wage rates.

Seasonality in Wage Rates

It was hypothesized that the wages depict a definite seasonal trend in accordance with the demand for labour at particular times during the year. This hypothesis was examined by analysing the data on monthly wages of casual labour. The wage rates during different months for the period 1954-55 to 1956-57 and 1967-68 to 1969-70 are shown in Table III.

TABLE III—WAGES OF AGRICULTURAL LABOURERS DURING DIFFERENT MONTHS IN PUNJAB

(day=eight hours)

Months	Pre-green revolution period				Green revolution period			
	1954-55 (Rs.)	1955-56 (Rs.)	1956-57 (Rs.)	Average (Rs.)	1967-68 (Rs.)	1968-69 (Rs.)	1969-70 (Rs.)	Average (Rs.)
July	2.35	2.25	2.40	2.30	6.60	6.14	5.32	6.02
August	2.38	2.32	2.78	2.49	4.25	5.70	5.28	5.08
September	2.36	2.26	2.63	2.42	4.37	5.58	6.65	5.20
October	2.34	2.39	2.60	2.44	4.48	5.01	6.41	5.30
November	2.32	2.44	2.75	2.50	4.64	5.43	6.33	5.47
December	2.28	2.40	2.50	2.39	5.30	5.28	5.48	5.35
January	2.28	2.25	2.63	2.39	5.05	5.37	5.23	5.22
February	2.21	2.58	2.75	2.51	5.05	5.36	5.71	5.34
March	2.30	2.90	2.63	2.61	6.22	5.94	5.87	6.01
April	3.25	3.37	3.71	3.44	7.47	6.73	8.02	7.41
May	3.20	3.25	3.68	3.38	7.13	6.46	9.71	7.77
June	2.20	2.34	2.37	2.30	6.47	7.65	8.11	7.41
Average	2.46	2.56	2.79	2.60	5.56	6.39	6.43	6.12

Source : (i) Studies in the Economics of Farm Management in the Punjab State, 1954-55 to 1956-57, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

(ii) Studies in the Economics of Farm Management in the Punjab State, 1967-68 to 1969-70 Punjab Agricultural University, Ludhiana.

The absolute figures of daily wage were converted into indices of seasonal variation. The figures arrived at were as follows :

Months	Index of seasonal variation of wages	
	1954-55 through 1956-57	1967-68 through 1969-70
July	90.22	95.61
August	97.85	91.27
September	93.39	93.26
October	94.88	94.59
November	97.70	99.90
December	92.05	87.12
January	90.52	90.36
February	95.12	90.35
March	102.49	104.67
April	130.47	120.88
May	126.72	114.24
June	88.59	117.75

A look at these figures shows that the wages follow a clear-cut seasonal pattern. There was a marked upward trend in the wage rates during the months of April and May during the two periods. This is the period when harvesting and threshing operations of wheat crop are performed. During the remaining months of the year, there were minor ups and downs in the seasonal index with no definite trend.

Green Revolution and Seasonal Pattern of Wages

The examination of indices revealed that during the pre-green revolution period (1954-55 to 1956-57), the seasonal fluctuations in wages were relatively more sharp with the index number reaching 130.47 in April and 126.72 in May. Against this, in the green revolution period, the seasonal index rose to 120.88 and 114.24 during the months of April and May respectively. Further, unlike the previous period, this index number did not decline during the month of June. It stayed at 117.75 during the month of June compared to 88.59 in the same month during the pre-green revolution period. During the month of July also the index number showed relatively less decline compared to the pre-green revolution period. The index for remaining months of the year behaved about the same way during the two periods. In a nutshell, it can be said that the new technology in agriculture has dampened the fluctuations in the seasonal pattern of wages and also lengthened the period of hike in the wage rates from April to May in the pre-green revolution period to April-May-June in the green revolution period.

Reasons behind Seasonality in Wage Rates

The seasonal hike in the wage rates during the months of April and May in the State of Punjab is the result of heavy demand for labour for harvesting and threshing operations of wheat crop. To avoid losses due to shattering of grains, the Mexican wheats have to be harvested within a very short span of time of about 15 days starting from the mid of April. However, the demand for labour at this time is much more compared to the available supply with the farmer.

The number of workers engaged in farming along with the attached servants worked out to 3.2 per farm in the State of Punjab.³ The average area under the wheat crop per farm was 6 hectares. On an average, one hectare needed 12.5 man-days (a day of ten hours) for harvesting operations.⁴ On this basis the total labour requirement on a farm worked out to 75 man-days. However, the supply with the farmer during these 15 days was estimated at 48 man-days (15×3.2). This meant that there was a shortfall of 27 man-days (36 per cent) in the supply of labour during this fortnight

3. Studies in the Economics of Farm Management in the Punjab State, 1969-70, Punjab Agricultural University, Ludhiana.

4. S. S. Grewal and H. S. Sandhu, "Comparative Economics of Harvesting Wheat with Combines and Other Methods," *Economic Affairs*, Vol. XIX, No. 8, August, 1974.

The farmers have, therefore to engage casual labour to complete this operation. In fact, the demand for labour would be more than this because of the fact that in a majority of the cases, the farmers did less labour themselves and preferred to get the harvesting operations completed on contract basis from the casual labour. This intensity of demand for casual labour pushes the wage rates significantly up and the same trend continued till the threshing operations are completed which are equally labour intensive and requires completion before the onset of rains to avoid losses to the produce.

Overall Economic Conditions of the Agricultural Labourers

Although the increase in the wage rates of agricultural labourers during the recent years gives an idea about the betterment of economic lot of the labouring class, yet this does not give the total picture. The duration of employment and the income from self-employment and off-farm sources also matter. There is no direct evidence available about the duration of employment of casual labourers over time, yet the facts presented in the earlier sections show that due to the relatively faster increase in the demand for labour in Punjab State, the yearly employment of casual agricultural workers, after the incoming of green revolution, has increased. This gets further support from the fact that the farmer's dependence on casual labour is greater now. The proportion of casual labour to total labour employment on a farm was 29.16 during 1954-55 to 1956-57 and it went up to 48.87 during 1967-68 to 1969-70.⁵ Since then, the proportion of casual labour is considered to have gone up further. This has happened because under the present day farming, the role of Punjabi farmer as manager, has increased and he finds less time to work as a labourer. Besides this, with the rising farm incomes, the farmer seems to have started substituting leisure for work. All this has resulted in increased dependence upon labour leading to increased employment of the labouring class.

Another allied aspect is the improvement in the working conditions that has occurred in Punjab after the break-through in the production technology. The labourers now work for lesser hours observing fixed timings, and preferred to work with the farmers having a larger degree of mechanization.

Besides, we have to take into account the income of farm labour from self-employment and other non-farm sources. In this connection, we would like to point out that invariably, the agricultural labour families are maintaining milch cattle and getting some income from the sale of milk. This was not true some two decades back when there was no milk market in the rural areas. Also, the opportunities for employment in non-farm work such as construction of roads, drains, buildings, etc., have increased adding to the incomes of the labouring class.

5. (i) Studies in the Economics of Farm Management in the Punjab State, 1954-55 to 1956-57, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

(ii) Studies in the Economics of Farm Management in the Punjab State, 1967-68 to 1969-70 Punjab Agricultural University, Ludhiana.