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Research Paper

Factors Determining Labour Absorption in Agriculture in Different Agro-Climatic Regions of Rajasthan

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ABSTRACT

This present study was carried out to examine and analyse the factors determining the labour absorption in agriculture in different agro-climatic regions of Rajasthan with state as a whole. Both primary and secondary data were used for this study. 200 respondents from 10 villages were collected for primary data during year of 2018-2019 and secondary data were used of published data from different reports and publications. The findings were showed that farm size has a significant negative relationship with total labour absorption in all agro-climatic regions at the state level except the transitional plain region. The cropping intensity showed a positive association with the total labour utilization in arid western and northern region, transitional plain regions, semi-arid and flood-prone eastern plain and humid south and eastern plain region. The per hectare absorption of tractor hours was displayed a significant negative relationship with the total labour utilization in all the agro-climatic regions with the state level. Expenditure on animal feeds showed a significant positive association with the total human labour utilization in all the agro-climatic regions with the state level except semi-arid and flood-prone eastern plain region. It was observed that the total labour utilization showed a significantly positive relationship with irrigation intensity in arid western and northern region and humid south and eastern plain region. Unemployment of agricultural labourers has negative impact on their income, consumption expenditure and savings. So, there is need to create additional income opportunities for agricultural labourers.

HIGHLIGHTS

- The results showed that the farm size has a significant negative relationship with total labour absorption in all agro-climatic regions as well as at the state level also except transitional plain region.

Keywords: Agro-climatic regions, labour absorption, coefficient of determination, regression

The social and economic point of view, labour is the most significant and important factor of production in any activity. The most exploited and oppressed class is the agriculture labour in rural hierarchy. Accordingly, as per the census of India, workers who are employed in any productive economic activity with or without indemnity, wage or profit. One year before the date of enumeration serves as the reference period for classifying individuals as workers or non-workers. The primary employees were divided into four groups based on their industrial classification: cultivators, agricultural labourers, domestic industry workers, and other workers (Singh and Singh, 2016).

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From 2001 to 2011, over 8.9 million farmers out of the entire labour force switched from self-cultivation. It was also noted that, between 2001 and 2011, 1.5 million farmers in the marginal worker group joined the 7.4 million farmers in the main worker category in leaving the agricultural/farming industry. As a result, there was a reduction of 8.9 million farmers overall between 2001 and 2011 (Hazarika, 2015). Farmers are leaving agriculture and engaging in non-agricultural pursuits, which is the reason of the fall in the absolute number of cultivators seen during the previous two census periods. Concretely, we are observing a movement in the agricultural labour force in India over time from agricultural activity to non-agricultural activity, such as industrial and service sector.

Since the decade of 2001 to 2011, there has been a significant decrease in the number of cultivators and a significant rise in the number of agricultural labourers. The major causes of this sort of circumstance are decreasing average operating holding sizes, rising agricultural salaries, widespread land sales, farming being unprofitable, and a shift in employment from the agricultural to non-agricultural sectors.

As the time passed awayagriculture has become infeasible and less profitable because size of land holdings decreases, rise in agricultural labourers, small and marginal farmers are selling their land and shifting to non-farming work. Therefore, due to decline in the cultivated areaand continuously increasing population, the land-to-man ratio has been declined over the time period.

In addition, a few other recent events may have caused people to switch from agricultural to non-agricultural occupations. Increasing cultivation costs and declining farming sector profitability are only two examples of difficulties. Second, the real estate boom and growing urbanisation are luring rural farmers in search of higher-paying jobs in metropolitan areas. Third, in the name of the real estate industry, rapid urbanisation, and industrial development, or SEZ, the government and private businesses are seizing farmland and forcing farmers off their land and out of farming by offering them a pitiful recompense. All of the aforementioned elements may have contributed quickly to such outcomes.

Keeping these facts in this backdrop and in the wake of renewed emphasis on employment in the present situation in India, it has become a matter of extreme importance to conduct studies about determinants of labour utilization in agriculture in various agro-climatic regions in Rajasthan. The study would generate much needed data set on labour use coefficients at district/zonal/regional and state levels for academic purposes.

METHODOLOGY

From each agro-climatic region,two districts were selected randomly. Total 10 districts from five agro-climatic regions, were selected randomly for the study. One tehsil from each district was selected randomly. Thus, from 10 districts, 10 tehsils were selected randomly for the study. From each selected tehsil, one village was selected randomly. 10 villages were selected randomly from the selected 10 tehsils for the study. According to five standard size classes i.e. marginal (<1 ha), small (1-2 ha), semi-medium (2-4 ha), medium (4-6 ha) and large (>6 ha) 20 farmers from each village were selected randomly. Therefore, for the present study, 200 farmers were selected from five agro-climatic regions of Rajasthan. Both primary and secondary data were used for the analysis. For primary data, a comprehensive schedule prepared while for secondary data, various administrative reports, govt. reports, publications, surveys, records, articles and official documents were used.

Factors determining labour absorption in crop production

Multiple regression analysis was done in order to identify the determinants which effect the labour utilization and providing the largest employment to workers in the agriculture sector of the state of Rajasthan. The regression equations were tried on cross-sectional data, region wise for the period 2018-2019.

(a) Step-wise regression analysis

The following form of multiple log linear function was estimated for each region as well as state as a whole, using step-wise regression method (Sankhayan, 1988).

Multiple log-linear (Cobb-Douglas) functional form

$$Y = a\, X_1^{b1}\, X_2^{b2}\, X_3^{b3} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots X_{17}^{b17} U$$

which on log transformation takes the following form:

$$Log\ Y = Log\ a + b_1\ Log\ X_1 + b_2 Log\ X_2 + \ldots\ldots\ldots\ldots\ldots + b_{17}\ Log\ X_{17} + U$$

Y = Labour absorption per hectare

X_1 = farm size (Hectares) – is the total operated area of the farm including owned land plus leased in land minus leased out land during the reference year (2018-19).

X_2 = Cropping intensity (%),

X_3 = Tractor use (Hours per hectare) – is the total use of tractor (owned, hired or gifted in).

X_4 = Average wage for crop operations (Rupee per day),

X_5 = Number of Adult family worker per hectare – includes family labour as well as attached labour

X_6 = Value of crop output (Rupees per hectare) – includes the value of main product as well as by-product

X_7 =Animal output value (Rupees per animal) – includes milk, curd, butter, dung etc.

X_8 = Expenditure on crop inputs (Rupees per hectare) – is the sum value of seeds (both farm produced and purchased), manures, fertilizers and insecticides used in crop cultivation during the reference period

X_9 = Expenditure on animal feeds (Rupees per animal) – includes green fodder, dry fodder, mixed feed and concentrates.

X_{10} = Irrigation intensity (%),

X_{11} = Area under HVY in hectare,

X_{12} = Area under labour-intensive crops in hectare,

X_{13} = Literacy level of the farm family workers (Score) – is the sum total of educational scores of adult male and female workers of the farm family.

X_{14} = Gross family income (Rupees) – includes farm as well as non-farm income.

X_{15} = Number of animal per head (Numbers),

X_{16} = Bullock labour use (Pair hours per hectare) – is the actual bullock labour (owned, hired and gifted in) used on the farm in the crop cultivation during the reference period, and

X_{17} = Family size (Number).

Based on the magnitude of R^2 (coefficient of determination), Adjusted coefficient of determination ($\overline{R}^2$) and significance of the estimated regression coefficients the significant variables were worked out separately for each region and state as a whole.

With the step-wise regression approach, the computer programme runs a sequence of multiple regressions, beginning with the variable that has the biggest influence and progressively adding more variables until the goodness of fit is improved to the desired level.

The per cent contribution of each variable in the total variation explained jointly by the finally retained variables in the regression was worked out to determine the relative importance of the retained variables. This becomes possible directly in step-wise regression as the degree of improvement in the coefficient of multiple determination (R^2) due to the inclusion of each new variable can be examined by taking difference between R^2 of two successive step in the regression.

(b) Multiple regression analysis

In many research areas in which controlled experiments are not practicable, multiple regression analysis was mostly used in gesture to sort out and measures the effects of different 'X' variables on some outcome Y for the purpose of explanation and not prediction. Under such circumstances it may be useful not to converge to few variables and rather discover as many variables as possible which are related with the dependent variable. Therefore, multiple regression was also attempted along with step-wise regression. Multiple log-linear (Cobb-Douglas) function was tried separately for each region in the present study and the state as a whole with the same set of dependent and independent variable as discussed above.

RESULTS AND DISCUSSION

Regression coefficients for Arid Western and Northern Region

The regression results revealed that out of ten explanatory variables only six explanatory variables namely; farm size (X_1), cropping intensity (X_2), tractor use (X_3), expenditure on crop inputs (X_8), expenditure on animal feeds (X_9) and irrigation intensity (X_{10}) were significantly affecting the per hectare labour absorption (Table 1).

The results showed that farm size (X_1) displayed a significantly negative relationship with the total human labour absorption. As the farm size increases, per hectare total human labour requirement should be more but it is not feasible because it is very time-consuming in certain operations/activities and costly. Therefore, a part of human labour was replaced by machine labour as farm size increased.

The utilization of tractor hours per hectare (X_3) increased as farm size increased that replaced human labour. In this region the tractor was more frequently used in most of the activities such as preparatory tillage, sowing, inter-culture, plant protection measures, harvesting, threshing and transportation that saved human labour. Therefore, it showed negative relationship with labour absorption at 1 per cent level of significance.

Irrigation intensity (X_{10}) bears a significantly positive relationship with labour absorption at 1 per cent level of significance. In this region, the availability of irrigation water was more due to which the irrigated area under crop cultivation was more and this condition favourd more utilization of human labour and provided more employment in agriculture.

Regression coefficients for Transitional Plain Region

The regression results showed that out of ten explanatory variables only four explanatory variables namely; cropping intensity (X_2), tractor use (X_3), average wage rate (X_4) and expenditure on animal feeds (X_9) were significantly affecting the per hectare labour absorption (Table 2).

The Cropping intensity (X_2) showed positive relationship with labour absorption at 5 per cent level of significance. In this region, the irrigated area under crop cultivation was less but it showed average labour absorption due to which it gives positive response with labour absorption.

The tractor use (X_3) was showed negative relationship with labour absorption at 1 per cent level of significance. The utilization of tractor increases, it replaced total human labour.

The result indicated that average wages (X_4) carry significant negative effect at 5 per cent level of significanceon total labour absorption. Due to migration of agricultural labourer to off-farm activities like MGNREGA, industries etc., the negative effect of wage on labour absorption was seen in this areas.

Table 1: Regression Statistics of Arid Western and Northern Region (Observations = 40)

Particulars	Coefficients (b_i)	Standard Error (SE)	P-value
Intercept (a)	0.274	0.386	0.482
X_1 = Farm Size	-0.259*	0.026	0.000
X_2 = Cropping Intensity	0.486*	0.107	0.000
X_3 = Tractor use	-0.169*	0.032	0.000
X_4 = Avg. Wage	-0.117	0.164	0.481
X_5 = No. of adult Family Workers	0.045	0.051	0.387
X_6 = Value of crop output	0.019	0.102	0.856
X_7 = Animal output value	-0.061	0.060	0.320
X_8 = Expenditure on crop inputs	0.236**	0.110	0.024
X_9 = Expenditure on animal feed	0.122***	0.066	0.059
X_{10} = Irrigation Intensity	0.416*	0.107	0.008
(R^2) = 0.84, $(\overline{R}^2)$ = 0.79 & Standard Error = 0.047			

**Significant at 1 per cent level of significance; ** Significant at 5 per cent level of significance; ***Significant at 10 per cent level of significance.*

Table 2: Regression Statistics of Transitional Plain Region (Observations = 40)

Particulars	Coefficients (b_i)	Standard Error (SE)	P-value
Intercept (a)	2.952	1.131	0.014
X_1 = Farm Size	-0.036	0.084	0.670
X_2 = Cropping Intensity	0.159**	0.062	0.016
X_3 = Tractor use	-0.147*	0.042	0.001
X_4 = Avg. Wage	-0.630**	0.273	0.028
X_5 = No. of Adult Family Worker	0.065	0.085	0.447
X_6 = Value of crop output	0.011	0.107	0.915
X_7 = Animal output value	0.059	0.061	0.337
X_8 = Expenditure on crop inputs	-0.211	0.240	0.386
X_9 = Expenditure on animal feed	0.354*	0.084	0.003
X_{10} = Irrigation Intensity	0.056	0.065	0.465
(R^2) = 0.56, ($\overline{R}^2$) = 0.42 & Standard Error = 0.06			

**Significant at 1 per cent level of significance; ** Significant at 5 per cent level of significance; ***Significant at 10 per cent level of significance.*

Table 3: Regression Statistics of Semi-Arid and Flood Prone Eastern Plain Region (Observations = 40)

Particulars	Coefficients (b_i)	Standard Error (SE)	P-value
Intercept (a)	1.333	0.796	0.105
X_1 = Farm Size	-0.111**	0.047	0.024
X_2 = Cropping Intensity	0.254**	0.062	0.025
X_3 = Tractor use	-0.288*	0.076	0.015
X_4 = Avg. Wage	-0.031	0.094	0.748
X_5 = No. of adult Family Worker	0.059	0.056	0.302
X_6 = Value of crop output	0.155**	0.062	0.018
X_7 = Animal output value	0.014	0.033	0.677
X_8 = Expenditure on crop inputs	-0.028	0.131	0.829
X_9 = Expenditure on animal feed	-0.026	0.050	0.606
X_{10} = Irrigation Intensity	0.022	0.065	0.465
(R^2) = 0.78, ($\overline{R}^2$) = 0.72 & Standard Error = 0.03			

**Significant at 1 per cent level of significance; ** Significant at 5 per cent level of significance; ***Significant at 10 per cent level of significance.*

Regression coefficients for Semi-Arid and Flood Prone Eastern Plain Region

The regression results showed only four explanatory variables namely; farm size (X_1), cropping intensity (X_2), tractor use (X_3) and value of crop output (X_6) were significantly affected the labour absorption per hectare from out of ten explanatory variables (Table 3).

The result showed that farm size (X_1) represented significantly negative relationship with the total human labour absorption at 5 per cent level of significance. As the farm size increased, total human labour absorption decreased. Because on the large size farm the use of human labour was decreased due to utilization of a significant part of machine labour and reducing the cost of cultivation effectively.

The Cropping intensity (X_2) showed positive relationship with labour absorption at 5 per cent level of significance. In this region, the availability of resources and advanced technology in agriculture was average that enhanced the labour utilization in agriculture.

The tractor use (X_3) was showed negative relationship with labour absorption at 1 per cent level of significance. It is mostly seen that the utilization of more machine in crop cultivation less use of human labour in agriculture field activities.

The value of crop output (X_6) is also postulated to have a direct relationship with the labour utilization

and showed 5 per cent level of significance. In this region, it was observed that the farmers used new high-yielding varieties and modern techniques when they getting more value of crop output and spend a considerable part of their income which was earned from crop output.

Regression coefficients for Sub Humid and Humid Southern Plain Region

The regression results showed only four explanatory variables namely; farm size (X_1), tractor use (X_3), expenditure on crop inputs (X_8) and expenditure on animal feeds (X_9) were significantly affected the labour absorption per hectare from out of ten explanatory variables (Table 4).

Table 4: Regression Statistics of Sub Humid and Humid Southern Plain Region (Observations = 40)

Particulars	Coefficients (b_i)	Standard Error (SE)	P-value
Intercept (a)	-2.620	1.255	0.045
X_1 = Farm Size	-0.094**	0.040	0.026
X_2 = Cropping Intensity	0.012	0.056	0.830
X_3 = Tractor use	-0.434***	0.228	0.052
X_4 = Avg. Wage	0.375	0.296	0.214
X_5 = No. adult Family Worker	0.013	0.041	0.750
X_6 = Value of crop output	0.077	0.103	0.457
X_7 =Animal output value	0.016	0.052	0.758
X_8 = Expenditure on crop inputs	0.475**	0.219	0.038
X_9 =Expenditure on animal feed	0.186**	0.081	0.048
X_{10} = Irrigation intensity	0.003	0.080	0.848
(R^2) = 0.78, ($\overline{R}^2$) = 0.72 & Standard Error = 0.05			

** Significant at 1 per cent level of significance; ** Significant at 5 per cent level of significance; *** Significant at 10 per cent level of significance.*

The result showed that farm size (X_1) represented significantly negative relationship with the 5 per cent level of significance of total human labour used. As the farm size increased, total human labour used decreased.

The expenditure on animal feeds (X_9) showed positively significant relationship with labour absorption at 5 per cent level of significance. As the number of animal increased the expenditure on animal feed and fodder was also increased that encouraged the farmer to cultivate more fodder crops for animal feeding and this increased the human labour absorption.

Regression coefficients for Humid South and Eastern Plain Region

The regression results revealed that out of ten explanatory variables only five explanatory variables namely; farm size (X_1), cropping intensity (X_2), tractor use (X_3), expenditure on animal feeds (X_9) and irrigation intensity (X_{10}) were significantly affecting the per hectare labour absorption (Table 5).

Table 5: Regression Statistics of Humid South and Eastern Plain Region (Observations = 40)

Particulars	Coefficients (b_i)	Standard Error (SE)	P-value
Intercept (a)	3.179	0.858	0.001
X_1 = Farm Size	-0.081*	0.023	0.002
X_2 = Cropping Intensity	0.147**	0.060	0.021
X_3 = Tractor use	-0.557*	0.110	0.000
X_4 = Avg. Wage	-0.170	0.182	0.359
X_5 = No. of adult Family Worker	0.027	0.026	0.314
X_6 = Value of crop output	0.039	0.050	0.446
X_7 = Animal output value	-0.004	0.034	0.897
X_8 = Expenditure on crop inputs	-0.149	0.130	0.261
X_9 = Expenditure on animal feed	0.181**	0.049	0.023
X_{10} = Irrigation Intensity	0.231*	0.049	0.007
(R^2) = 0.74, ($\overline{R}^2$) = 0.66 & Standard Error = 0.03			

**Significant at 1 % level of significance; ** Significant at 5 % level of significance; ***Significant at 10 % level of significance.*

Out of five explanatory variables, farm size (X_1) and tractor use (X_3) were negatively significant at 1 per cent level of significance, irrigation intensity (X_{10}) was positively significant at 1 per cent level of significance and cropping intensity (X_2) and expenditure on animal feeds (X_9) were positively significant at 5 per cent level of significance.

The results showed that farm size (X_1) showed significantly negative relationship with the total human labour utilization. As the farm size increases, total human labour absorption per hectare should be

more but it is not an economics to scale because it increased cost of cultivation considerably. Therefore, a part of human labour was replaced by machine labour as farm size increased.

Cropping intensity (X_2) showed positive association with labour absorption at 5 % level of significance. In this region, the cropping pattern use and availability of resources was very good that encourage intensive crop cultivation and this condition increased the labour absorption in agriculture.

Irrigation intensity (X_{10}) bears a significantly positive relationship with labour absorption at 1 per cent level of significance. In this region, the availability of irrigation water was through canal system due to which the irrigated area under crop cultivation was more and this condition favoured more utilization of human labour and provided more employment in agriculture.

Regression coefficients for the State of Rajasthan

The regression results showed only six explanatory variables namely; farm size (X_1), tractor use (X_3), average wage (X_4), number of adult family workers (X_5), expenditure on crop inputs (X_8) and expenditure on animal feeds (X_9) were significantly affecting the per hectare labour absorption from out of ten explanatory variables (Table 6).

The result revealed that farm size (X_1) represented significantly negative relationship with the total human labour absorption at 1 per cent level of significance. As the farm size increased, total human labour absorption decreased. The another reason for decreasing human labour as farm size increase was the working efficiency of human labour, operational cost for labour and underutilization of human labour. All these parameters indicate that the farmers on large farms replace the human labour by machine labour for improving the production level. Savings of time, reduce the cost of cultivation etc.

Tractor use (X_3) showed negative relationship with labour absorption at 1 per cent level of significance. It is the fact that the use of higher tractor hours per hectare leads to less use of human labour in agriculture. In general, tractor was used in preparatory tillage, sowing, threshing and transportation activities in almost all crops in the state. Another important thing was that the tractor utilization overcome diseconomies of scale. Therefore, Tractorisation is displacing human labour from agriculture at significantly.

Table 6: Regression Statistics for the State of Rajasthan (Observations = 40)

Particulars	Coefficients (b_i)	Standard Error (SE)	P-value
Intercept (a)	0.525	0.392	0.182
X_1 = Farm Size	-0.248*	0.026	0.000
X_2 = Cropping Intensity	0.021	0.045	0.647
X_3 = Tractor use	-0.243*	0.025	0.000
X_4 = Avg. Wage	-0.297***	0.138	0.056
X_5 = No. adult Family Worker	-0.108***	0.060	0.058
X_6 = Value of crop output	-0.016	0.057	0.771
X_7 = Animal output value	0.021	0.036	0.569
X_8 = Expenditure on crop inputs	0.175**	0.081	0.032
X_9 = Expenditure on animal feed	0.124*	0.046	0.007
X_{10} = Irrigation Intensity	0.022	0.036	0.658
(R^2) = 0.54, ($\overline{R}^2$) = 0.52 & Standard Error = 0.09			

**Significant at 1 per cent level of significance; ** Significant at 5 per cent level of significance; ***Significant at 10 per cent level of significance.*

The result showed that average wages (X_4) carry a significant negative effect at 10 per cent level of significance on total labour absorption. Due to migration of agricultural labourer to off-farm activities like MGNREGA, industries, mines, textiles industries, cottage industries, construction of road & buildings etc., the negative effect of wage on labour absorption was seen in these areas. Therefore, as the average wage rate in off-farm activities increased the agricultural labourer shift/migrate from agriculture to non-agriculture sector. This circumstances decreased the labour utilization in agriculture sector in the state of Rajasthan.

The expenditure on animal feeds (X_9) showed at 1% level of significance positively significant with thelabour absorption. It is mostly seen that the number of animal increased as the expenditure on feed and fodder also increases so that this action pushes for more labour absorption. There was an another relation between crop and livestock enterprise i.e. complimentary effect due to which

both enterprise increased the labour used in crop cultivation along with cattle tending.

CONCLUSION

The results revealed that the farm size has a significant negative relationship with total labour used in all agro-climatic regions and state level also except transitional plain region. It was implying that small farms utilize more labour per hectare as compared to large farms. The cropping intensity showed the positive association with the total labour utilization in almost all regions. Because, level of significance was depending upon the cropping pattern use and availability of resources that favours intensive cultivation and this condition enhanced the labour used in agriculture sector. The utilization of tractor hours per hectare was displayed a significant negative relationship with the total labour used in all the agro-climatic regions. As the utilization of tractor increased, it replaced a part of human labour in agriculture sector.

Adult family workers showed a significantly positive association only at the state level. It means, when the availability of adult family workers in a family was more there will be a chances for more labour absorption in agriculture. There is a scope in Rajasthan agriculture for additional labour used in crop production through increased use of material inputs, HVY's, irrigation and high commercial crops which are labour intensive in nature.

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