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ESTIMATION OF RESPONSIVENESS FACTORS OF PRODUCTIVITY IN MAJOR CROPS

Saira Banoo[1] and Archana Sharma[2]
[1]Research Scholar, Department of Economics, Govt. Atal Bihari Vajpayee Arts and Commerce College, Indore.
[2]Professor, Department of Economics, New Govt Degree College Khajrana.

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Abstract: This paper explores the estimation of responsiveness factors of productivity in major crops in Bhopal District. The study is based on primary- data (2021-22). The dependent variable is yield of crop (kg|ha), independent variables are labour use, machine use(whr.|ha), irrigation machine use(whr.|ha), Animal use(whr.|ha), seed use(kg\ha), Fertiliser use(kg\ha), farm yard manure use(Qtl.\ha),tractor dummy use, education of household head (year), age year The result of regression analysis show as the yield of cotton is 584 kg per hectare and standard error is (0.276), So it shows that the addition implementation of labour will not be helpful to increase the yield of cotton crop. Machine use had positive impact upon yield of cotton and is significant at 5 percent level of significance. On the other side there seems negative impact on yield if increase the working hours of irrigation machine use, animal use and seed use. Fertilizer use had positive impact on yield and is significant at 10 percent level of significance. Education of house hold had positive impact on yield but is not significant. The results of regression in gram cultivation shows that yield of gram had negative impact of labour use this means that gram is not labour intensive. While as results of regression shows that yield had positive impact of machine- use, tractor and education of house hold.

Keywords: Farm-Size, Productivity, crops

INTRODUCTION

Madhya-Pradesh is the only State who ranks first regarding production of Soyabean, gram, urad, tur, linseeds and second in the production of maize, sesame, moong and third in the production of wheat, sorghum,

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Barley. Agriculture is heart of indian Economy large number of population depends on agriculture. Before Independence the agricultural- production and productivity was very low because of the lower rate of return on factor of production which may be attributed to poor farm management practices, lower use of technology poor infrastructure. After Independence there seems to be increase in agricultural production and productivity it was because of the green – revolution the main aim of the green- revolution was to diminish poverty and malnutrition. Most of the Indian states take benefit from green-revolution Uttar- Pradesh, Punjab and West-Bengal but some of the States legged behind Madhya- Pradesh was among them. The State performed noteworthy growth during the last two decades but we have to take keen interest on the agricultural- production and productivity. Some crops lost its area due to low and unstable production. Inputs response positively to agricultural productivity enhancing in Bhopal District. The dependent variable is yield of crop (kg\ha), independent- variables are labour- use (whr.\ha), machine-use, irrigation- machine, Animal- use, seed-use, fertilizer-use, farm- yard-manure use, tractor, education of house hold head, age.

Kadaptti R. G. and S. T. Bagalkoti (2014) The small farms have been the main obstacle for food security and poverty allivation measures like providing modern technology, information and knowledge for better skills and extended credit have been suggested for higher productivity of small factors.

Savastano Sara and Pasquale L. Scandizzo they study that land productivity and farm –size are systematically related and the intensity of this relationship depend on one or more latent variables, directly related to total factor- productivity.

Assuncao J. Juliano and Maitreesh Ghatak (2003) explains the relationship between farm- Size and productivity interms of diminishing returns with respect to land and other inputs according to the Author there exists no credit market and heterogeneity in farmer skills. The result was that if there is a given level of income the skill full peasants are more likely to became farmers than that of unskill full peasants by raising their wages.

Ramesh Chand et al., (2011) The Authors put their serious attention on the income and livelihood of Small- holders, they under taken the

debates on farm- Size and agricultural productivity by suggesting policy measures in order to assemble both the problems of raising productivity and improvement of agriculture as well as income and livelihood of small holders, the results find that the small holders, the results find that the small farmers are superior in production process but there seems to be weakness interms of generating adequate income and sustaining levilihood.

Singh, et.al, 2013 the study finds that the existing form of Indian Agriculture came from the food shortage faced by the country during the 1960s. Our nation was struggling with food shortages since Independence, as part of India have been over populated and under developed due to the partition at the time of Independence most of the fertile area had gone to Pakistan territory, during 1960,s country import food grains from USA at that time the imported food grain was not edible due to poor quality.

DATA AND METHODOLOGY

The present study is based on primary data collected during the period of (2021-2022) in Madhya Pradesh of Bhopal District. The primary data collected for inputs and output of the agricultural production. The inputs data consists of dependent variable yield(kg\ha) and independent variables consists of labour- use, machine- use, seed- use, fertilizer- use, farm-yard manure use, fertilizer-use, farm- yard manure use, tractor, education of household head, age. Regression analysis has been used to determine the relationship between dependent and independent variables

Dependent Variables

- Yield of crop (kg\ha)

Independent Variables

- Labour use (whr\ha)
- Machine use(whr\ha)
- Irrigation Machine use(whr\ha)
- Animal use(whr\ha)
- Seed use(kg\ha)
- Fertilise use(kg\ha)

- Farm yard manure use(Qtl\ha)
- Tractor dummy(if yes=1 otherwise=0)
- Education of household head (year)
- Age year

To identify the relationship of exogenous variables with agricultural productivity in Madhya Pradesh, the working model of multiple log linear regression is used as below:

$$Y_i = \beta_0 + \beta_1 * LU_i + \beta_2 * MU_i + \beta_3 * IMU_i + \beta_4 * AU_i + \beta_5 * Fertuse_i + \beta_6 * FYM_i + \beta_7 * Tractor_i + \beta_8 + EduHH_i + \beta_9 * AgeHH_i + \mu_t$$

Where

Y_t = Crop Yield of i^{th} crop.

LU_i = Labour use (Whrs/ha) in i^{th} crop.

MU_i = Machine use (hrs/ha) in i^{th} crop.

IMU_i = Irrigation machine use (hrs/ha) in i^{th} crop.

AU_i = Animal use (hrs/ha) in i^{th} crop.

$Fertuse_i$ = Fertiliser use (Kg/ha) in i^{th} crop.

FYM_i = Farm Yard Manure use (Qtl\ ha)

$Tractor_i$ = Dummy variable for tractor ownership (if yes then=1 otherwise =0)

$EduHH_i$ = Education level of household head (Schooling Year)

$AgeHH_i$ = Age of household head (Years)

Here β_0 presenting intercept and β_1 to β_9 are coefficients (parameter for estimation) and μ presenting error term.

RESULTS AND DISCUSSION

As we know that agriculture is the predominant source of levlihood for the Indian Economy. The Government implemented various programmes for providing incentives to cultivators for augmenting crop production, the most important element in crop production is improving agricultural-technology in the form of high yield variety seeds.

Table 1: Determinants of yield in cotton cultivation (Regression results)

Particulars	*Parameter Estimate*	*Standard Error*	*t Value*	*Pr > |t|*
Dependent variable: Yield (Kg./ha)				
Intercept	2759.751	803.902	3.430	0.075
Labour use (Whr./ha)	0.584	0.276	2.120	0.169
Machine use (Whr./ha)	31.277	5.346	5.850	0.028
Irrigation machine use (Whr./ha)	-4.604	0.691	-6.660	0.022
Animal use (Whr./ha)	-3.541	0.855	-4.140	0.054
Seed use (Kg./ha)	-2314.268	601.162	-3.850	0.061
Fertiliser use (Kg./ha)	2.363	0.584	4.050	0.056
Farm Yard Manure use (Qtl./ha)	-4.609	2.005	-2.300	0.148
Tractor dummy (if yes=1 otherwise =0)	-141.718	67.521	-2.100	0.171
Education of household head (year)	10.272	3.884	2.640	0.118
Age Year	4.885	1.614	3.030	0.094
Family Size (No.)	63.254	12.067	5.240	0.035
R2	0.9977			
Adjusted R2	0.9849			
F Statistics	78.26***			

Source: Authors estimations based on primary survey data

The results of multiple regression analysis have been shown in the table 1Yield of the cotton was the dependent variable in the equation. The coefficient of labour use was founded 0.584 but not significant. So it shows that the addition implementation of labour will not helpful to increase the yield of cotton crop. The coefficient of machine use was founded 31.27 and it was significant at 5 level of significance which means with the additional apply of one workhour of machine the yield of cotton has been increased by 31.27 Kg/ha surely atleast 95 times out of 100 trials. In the same way, the positive coefficient of fertiliser use, age of household head, and size of family was founded 2.36, 4.88, and 63.25 respectively which was significant at different level of significance. That means the more use of respective determinant was helped to increase in yield of cotton in Bhopal district. It is a well establish fact that the cotton cultivation is a labour intensive crop, because the plucking of cotton has not been replaced with any machine and most of the activities have been through labour. The cotton grown in the kharif season and the dependency of cotton on artificial irrigation has been very low as a result the coefficients of irrigation machine use was founded

negative (-4.60), and significant at 5 per cent level of significance means the extra implementation of irrigation machine not helpful to increase in cotton yield.

Table 2: Determinants of yield in Gram cultivation (Regression results)

Particulars	*Parameter Estimate*	*Standard Error*	*t Value*	*Pr > |t|*
Dependent variable: Yield (Kg./ha)				
Intercept	1947.753	480.444	4.050	<.0001
Labour use (Whr./ha)	-0.666	0.654	-1.020	0.310
Machine use (Whr./ha)	43.827	16.520	2.650	0.009
Irrigation machine use (Whr./ha)	1.942	2.180	0.890	0.375
Animal use (Whr./ha)	-2.162	6.282	-0.340	0.731
Seed use (Kg./ha)	-6.046	3.820	-1.580	0.116
Fertiliser use (Kg./ha)	-3.367	2.803	-1.200	0.232
Tractor dummy (if yes=1 otherwise =0)	102.211	63.703	1.600	0.111
Education of household head (year)	3.250	6.947	0.470	0.641
Age Year	-4.149	2.285	-1.820	0.072
Family Size (No.)	-14.309	14.562	-0.980	0.328
R^2	**0.1663**			
Adjusted R^2	**0.1059**			
F Statistics	2.75**			

Source: Authors estimations based on primary survey data

The Table 2 shows determinants of yield in gram cultivation, it is clear from the table that regression analysis between dependent variable yield and labour is negative this means that gram is not labour intensive and level of significance is not significant. Regression results of machine use was founded positive and more (43.827) and was significant at 1% level of significance, regression results of irrigation machine use founded positive (1.942) but is non- significant. Regression results of animal-use, seed-use, fertilizer use was founded negative and non-significant at different levels of significance. Regression analysis of tractor was founded more and positive this means that tractors was used more in yield of gram. Regression results of education of house hold was founded positive (3.250) and level of significance was founded non- significant. Regression results of age was founded negative (-4.149) and level of significance was founded significant. The regression results of family size founded negative (-14.309) and level of significance was founded non-significant, the value of adjusted R^2 is 0.1059.

Table 3: Determinants of yield in maize cultivation (Regression results)

Particulars	*Parameter Estimate*	*Standard Error*	*t Value*	*Pr > |t|*
Dependent variable: Yield (Kg./ha)				
Intercept	4596.32	3153.20	1.46	0.1706
Labour use (Whr./ha)	-0.40	2.39	-0.17	0.8698
Machine use (Whr./ha)	212.55	128.78	1.65	0.1248
Animal use (Whr./ha)	48.82	14.97	3.26	0.0068
Seed use (Kg./ha)	-262.81	95.61	-2.75	0.0176
Fertiliser use (Kg./ha)	5.36	6.68	0.8	0.4382
Farm Yard Manure use (Qtl./ha)	-76.70	30.54	-2.51	0.0273
Tractor dummy (if yes=1 otherwise =0)	-246.78	229.18	-1.08	0.3027
Education of household head (year)	-4.95	29.73	-0.17	0.8707
Age Year	5.41	13.29	0.41	0.6911
Family Size (No.)	-123.93	75.53	-1.64	0.1268
R^2	**0.8547**			
Adjusted R^2	**0.7336**			
F Statistics	7.06***			

Source: Authors estimations based on primary survey data

The Table 3 above shows determinants of yield in maize cultivation, it is clear from the table that regression analysis between yield and labour is negative (-0.40) and level of significance is non-significant this means that maize is not labour intensive. Regression analysis of machine use is positive (212.55) more machines are used in maize cultivation and level of significance is not significant. Regression results of animal use is positive (48.82) and level of significance is 1%, regression results of seed use is negative (-262.81) and level of significance is 5%. Regression analysis of fertilizer use is positive (5.36) and level of significance is not significant. Regression analysis of farm yard manure use is negative (-76.70) and level of significance is 5%, regression analysis of tractor and education of household is negative (-246.78, -4.95) and level of significance is non-significant. Regression results of age is positive (5.41) and level of significance is non-significant. Regression results of family- size is negative and level of significance is non-significant. The summary statistics shows that the model was not appropriate and best fit. The value of adjusted R^2 is 0.7336 which shows 73% of total variance in the selected model, the value of F-statistics is significant at 1%.

Table 4: Determinants of yield in paddy cultivation (Regression results)

Particulars	*Parameter Estimate*	*Standard Error*	*t Value*	*Pr > |t|*
Dependent variable: Yield (Kg./ha)				
Intercept	1420.89	556.70	2.55	0.0148
Labour use (Whr./ha)	1.59	0.68	2.33	0.0251
Machine use (Whr./ha)	-29.77	16.70	-1.78	0.0827
Irrigation machine use (Whr./ha)	2.12	3.31	0.64	0.5258
Fertiliser use (Kg./ha)	-1.63	2.95	-0.55	0.5835
Farm Yard Manure use (Qtl./ha)	9.54	7.01	1.36	0.1819
Tractor dummy (if yes=1 otherwise =0)	-301.06	240.00	-1.25	0.2174
Education of household head (year)	32.47	16.03	2.03	0.0499
Age Year	20.42	11.59	1.76	0.0861
Family Size (No.)	-18.74	45.22	-0.41	0.6809
R^2	**0.3659**			
Adjusted R^2	0.2757			
F Statistics	2.44**			

Source: Authors estimations based on primary survey data

The Table 4 shows determinants of yield in paddy cultivation. It is clear from the table that regression results between yield and labour is positive (1.59) and level of significance is 5%, regression results of machine use is negative (-29.77), level of significance is 10%. Regression results of irrigation machine use is positive (2.12), level of significance is non-significant. Regression results of fertilizer-use is negative (-1.63) and level of significance is non-significant. Regression results of farm yard manure use is positive (9.54), but level of significance is non-significant. Regression results of education of house hold head is positive and level of significance is 5%. Regression results of age is positive (20.42) and level of significance is 10%. Regression coefficient of family size is negative (-18.74) and level of significance is non-significant.

Table 5 shows determinants of yield in soyabean cultivation. It is clear from the table that regression analysis between yield and labour is negative (-0.012), level of significance is also non-significant. Regression results of machine use is positive (26.258) and level of significance is 1% this means more machines are used in soyabean cultivation. Regression results of animal use is negative (-0.504), level of significance is non-significant. Regression results of seed use is negative (-3.518), level of significance is

Table 5: Determinants of yield in soyabean cultivation (Regression results)

Particulars	*Parameter Estimate*	*Standard Error*	*t Value*	*Pr > |t|*
Dependent variable: Yield (Kg./ha)				
Intercept	1506.649	241.197	6.25	<.0001
Labour use (Whr./ha)	-0.012	0.153	-0.08	0.9365
Machine use (Whr./ha)	26.258	7.886	3.33	0.001
Animal use (Whr./ha)	-0.504	1.452	-0.35	0.7289
Seed use (Kg./ha)	-3.518	2.274	-1.55	0.1227
Fertiliser use (Kg./ha)	0.402	0.893	0.45	0.6532
Farm Yard Manure use (Qtl./ha)	1.279	0.939	1.36	0.1742
Tractor dummy (if yes=1 otherwise =0)	10.122	27.015	0.37	0.7081
Education of household head (year)	-3.215	2.828	-1.14	0.2564
Age Year	0.352	0.951	0.37	0.7115
Family Size (No.)	-32.565	6.166	-5.28	<.0001
R^2	**0.2571**			
Adjusted R^2	**0.2329**			
F Statistics	6.49***			

Source: Authors estimations based on primary survey data

Table 6: Determinants of yield in wheat cultivation (Regression results)

Particulars	*Parameter Estimate*	*Standard Error*	*t Value*	*Pr > |t|*
Dependent variable: Yield (Kg./ha)				
Intercept	2828.910	841.569	3.36	0.0009
Labour use (Whr./ha)	0.422	0.371	1.14	0.2556
Machine use (Whr./ha)	5.571	12.756	0.44	0.6626
Irrigation machine use (Whr./ha)	2.109	0.779	2.71	0.0071
Animal use (Whr./ha)	-9.013	3.365	-2.68	0.0077
Seed use (Kg./ha)	2.444	6.076	0.4	0.6878
Fertiliser use (Kg./ha)	8.157	1.137	7.17	<.0001
Tractor dummy (if yes=1 otherwise =0)	178.102	65.934	2.7	0.0072
Education of household head (year)	-15.663	6.332	-2.47	0.0138
Age Year	-6.945	2.536	-2.74	0.0065
Family Size (No.)	-27.343	15.291	-1.79	0.0745
R^2	**9.43*** **			
Adjusted R^2	**0.2023**			
F Statistics	0.1808			

Source: Authors estimations based on primary survey data

non-significant. Regression results of fertilizer use is positive (0.402), level of significance is non-significant. Regression analysis of farm yard manure use is positive (1.279), level of significance is non-significant. Regression analysis of tractor is positive (10.122), level of significance is non-significant. Regression analysis of education of house hold head is negative (-3.215), level of significance is non-significant. Regression analysis of age is positive (0.352), level of significance is non-significant. Regression analysis of family-size is negative (-32.565), but level of significance is 1%. Value of R^2 is 0.2571, value of adjusted R^2 is 0.2329, value of F is 6.49

Table 6 shows determinants of yield in wheat cultivation, it is clear from the table that regression analysis between yield and labour was founded positive (0.422), level of significance was founded non-significant. Regression analysis of machine use was founded positive (5.571), level of significance was founded non-significant. Regression analysis of irrigation machine use was founded positive (2.109), level of significance was 1%. Regression analysis of animal use was founded negative (-9.013), level of significance was 1%. Regression analysis of seed use was founded positive (2.444), level of significance was non-significant. Regression analysis of fertilizer use was founded positive (8.157), level of significance was 1%. Regression analysis of tractor was founded positive (178.02), level of significance was founded 1%. Regression analysis of education of house hold was founded negative (-15.663), but level of significance was founded significant. Regression analysis of age was founded negative (-6.945), level of significance was founded 1%. Regression analysis of family size was founded negative (-27.34), level of significance was founded 10%. Value of R^2 is 9.43, value of adjusted R^2 0.2023, value of F 0.1808.

CONCLUSION

The responsiveness factors of productivity in major crops in Bhopal District. According to the results of the regression analysis the dependent variable yield of cotton crop was founded positive and significant with labour use, coefficient value of irrigation machine use, fertilizer use and farm yard manure use was founded positive. However, the association of machine use and animal use was founded inverse and significant. The coefficient of seed use was founded negative and non-significant, according to the results of multiple regression analysis the coefficient of labour use was founded positive and non-significant.

So it shows that the addition implementation of labour will not be helpful to increase the yield of cotton crop. The coefficient of machine use was founded positive and it was significant which means the additional apply of one work hour of machine the yield of cotton has been increased. In the same way, the positive coefficient of fertilizer use, age of house hold head and size of family was founded positive. That means the more use of respective determinant was helped to increase in yield of cotton in Bhopal district. It is a well establish fact that the cotton cultivation is a labour intensive crop, because the plucking of cotton has not been replaced with any machine and most of the activities have been through labour. Regression results of machine use, irrigation machine use, tractor, education of house hold was founded positive in gram, regression results of family size founded negative correlation coefficient between yield and labour of maize was founded positive.

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