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Factors Affecting Productivity, Adoption of Modern Technology and Cost in Paddy Cultivation

Dr. Sanjib Kumar Hota

Faculty Member, Madhusudan Institute of Cooperative Management, Bhubaneswar, Odisha, India
skhota001[at]yahoo.co.in

Abstract: ***The study deals with the different factors affecting productivity of rice, adoption of modern technology (MT) and cost of cultivation undertaken by different sizes of farms and villages considered for this study with varied irrigation status. There are various factors found affecting different farm sizes and villages significantly vary but small farm size and irrigated villages are found relatively advantageous in many aspects.***

Keywords: Productivity, Modern Technology, HYV technology, Cost of Cultivation, Farm size

1. Introduction

The productivity of rice (paddy) is mainly affected by farm size besides other factors as evident from plethora of literature. The adoption of modern technology is a pre - requisite for the improvement in productivity. However, the level and degree of adoption of modern technology depends on mostly on the creditworthiness of farms besides other factors as observed from the literature. Hence, it is also important to discuss the factors influencing the cost of production as it is mostly affected by farm size besides other factors.

1.1 Objectives of the Study

- To find out the factors significantly influencing the productivity
- To assess the factors significantly affecting the adoption of Modern Technology
- To estimate the of factors influencing Cost of Cultivation

1.2 Data base and Methodology

The Primary sources of data constitute the data base for the study. Three villages with different canal irrigation status located in different blocks of Bargarh district of Odisha have been consider for the study during 2016 - 17. All together 474 farm households considered for the study. There are 192, 139 and 143 farmers consisting different farm sizes such as Small, Medium and Big considered from the three villages such as Village (V) - I (head - end of canal irrigation), Village (V) - II (tail - end of canal irrigation) and Village (V) - III (rain - fed area - enjoys only one crop i. e. Kharif) respectively. The selected farm sizes were classified on the basis of operated area such as Up to 5.00 acres – Small farm size, 5.01 acres to 10 acres - Medium farm size and 10.01 acres and above - Big farm size.

The cropping pattern in the area under study is dominated by Rice (Paddy). So paddy crop is only taken into consideration for the study. The tools suitable for analyzing the various aspects of the study have been us as discussed subsequently.

1.3 Factors Influencing Productivity of Rice (paddy)

There are various factors influencing the productivity of rice. Among the factors there are certain common factors besides the technology and use of critical inputs, which are affecting the productivity significantly. Thus the effect of various common explanatory variables on the productivity of rice has been estimated.

In order to estimate relationship of these variables with Paddy productivity, regression analysis (OLS method) has been undertaken as shown below.

$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots + \beta_{13} X_{13} + \beta_{14} X_{14} + ui$

Where α = intercept

and $\beta_1 \ldots. \beta_{14}$ = regression coefficients.

u_i = stochastic disturbance terms

Y = Paddy Productivity (Rs. / acre)

X_1 = Expenses on Bullock/Mech. Labour (Rs. / acre)

X_2 = Expenses human labour (Rs. / acre)

X_3 = Expenses of seeds (Rs. /acre)

X_4= Expense of Fertilizer & FYM (Rs. / acre)

X_5= Farm yard manure - FYM (RS/acre)

X_6= Fertilizer (Rs/acre)

X_7 = Expenses on Pesticide (Rs. /acre)

X_8 = Irrigation charges (Rs. /acre)

X_9 = Gross Cropped Area (in acre)

X_{10} = Ratio of workers to family size

X_{11} = Proportion of area under HYV (%)

X_{12} = Cropping Intensity (%)

X_{13} = Formal credit (Rs/acre)

X_{14}= Informal credit (Rs/acre)

The regression equations were estimated across the farm sizes and villages and the significant difference was tested by using “Chow test” (‘F’ value).

Given the procedural assumptions of **Chow test** procedure, the F Value is estimated as shown below:

$$F = \frac{S_6/K}{S_5/(N_1+N_2+N_3-3K)}$$

‘F’ with df = (K, $N_1+N_2+N_3$ - 3K).

Where, K = number of parameter estimated

N_1, N_2 & N_3 = No. of observations for farm sizes viz. small, medium and Big respectively.

$S_6 = S_1 - S_5$, where S_1 = RSS for pooled data, S_2 = RSS for small farm size, $S_{3=}$ RSS for medium farm size and $S_{4\,=}$ RSS for Big farm size.

The calculated 'F' of Chow test is compared to critical F value at the chosen level of α to test significance difference in the regression lines of different farm sizes. Similarly, in the same process the test is conducted for the Villages.

The results of regression model as depicted in table - 1.4 shows that the factors like expenses of bullock/machine labour, expenses of human labour, expenses of seeds (Rs. /acre), expense of Fertilizer & FYM, Irrigation charges, Gross Cropped Area and Cropping Intensity have positive and significant effect on the productivity of rice in V - I (i. e. irrigated village). On the contrary, the factors like Proportion of area under HYV and Formal credit have significantly negative impact on productivity. In other ward, productivity of rice decreases with the increase in Proportion of area under HYV and Formal credit which may be attributed to the improper (either less or more than recommended quantity) use of seeds and misutilization of credit or diversion of credit to non - productive purpose.

Similarly, in V - II, the factors like Expenses of Bullock/Mech. Labour (Rs. / acre), Expense of Fertilizer & FYM (Rs. / acre), Expenses on Pesticide (Rs. /acre) and Irrigation charges (Rs. /acre) have positive and significant effect on the productivity of rice. On the contrary, the factor like Expenses of human labour (Rs. / acre) has significantly negative effect on productivity. In other ward, the productivity of rice decreases with the increase in Expenses on human labour which may be attributed to the shortage of labour for agricultural operation.

In V - III (rain - fed area), the factors like Expenses on Bullock/Mech. Labour (Rs. / acre), Irrigation charges (Rs. /acre) and Gross Cropped Area (in acre) have positive and significant effect on the productivity of rice. On the contrary, the factor like Ratio of workers to family size has significantly negative effect on productivity. In other ward, productivity of rice decreases with the increase in Ratio of workers to family size which may be attributed to the problem of disguised unemployment in agricultural operations.

In the case of overall sample (All - V), the factors like Expenses on Bullock/Machine. Labour (Rs. / acre), Expenses on Fertilizer & FYM (Rs. /acre), Expenses on pesticide (Rs. /Acre), Gross Cropped Area (in acre) and Cropping Intensity (%) have positive and significant effect on the productivity of rice. On the contrary, the factors like Expenses on seeds (Rs. /acre), Expenses on Fertilizer (Rs/acre) and Formal credit (Rs/acre) have negative and significant impact on the productivity, which may be attributed to the improper (either less or more than recommended quantity) use of seeds and chemical fertilizer as well as misutilization of credit or diversion of credit to non - productive purpose.

The analysis pertaining to farm sizes reveals that in case of Small farms the factors like Expenses on Fertilizer & FYM (Rs. /acre). Expenses on pesticide (Rs. /Acre) Irrigation charges (Rs. /acre) Cropping Intensity (%) and Informal credit (Rs/acre) have positive and significant effect on the productivity of rice. On the contrary, the factors like Expenses on seeds (Rs. /acre), Farm yard manure - FYM (RS/acre), Fertilizer (Rs/acre) and Formal credit (Rs/acre) have negative and significant impact on the productivity, which may be attributed to the improper (either less or more than recommended quantity) use of seeds, farm yard manure and chemical fertilizer as well as misutilization of credit or diversion of credit to non - productive purpose.

Similarly, in the case of Medium farms, expenses on Bullock/Machine Labour (Rs. / acre), expenses on human labour (Rs. / acre), expenses on Fertilizer & FYM (Rs. /acre), Expenses on pesticide (Rs. /Acre), Gross Cropped Area (in acre) and Cropping Intensity (%) have positive and significant effect on the productivity of rice. On the contrary, the factors like Expenses on seeds (Rs. /acre), Irrigation charges (Rs. /acre) and proportion of area under HYV (%) have negative and significant impact on the productivity, which may be attributed to the improper (either less or more than recommended quantity) use of seeds, higher expenses on alternative sources of irrigation (other than canal irrigation) for certain percentage of area, low quality of HYV seeds or low pace of technological adoption relative to the requirement of HYV.

In the case of big farms, expenses on bullock / machine Labour (Rs. / acre), expenses on human labour (Rs. / acre), expenses on pesticide (Rs. /acre), Gross Cropped Area (in acre) have positive and significant effect on the productivity of rice. On the contrary, Expenses on Chemical Fertilizer (Rs/acre) and Cropping Intensity (%) have negative and significant impact on the productivity, which may be attributed to excessive use of Chemical Fertilizer and lesser percentage of net area sown relative to the gross cropped area.

Further, it is found from the Chow test (F value) result as depicted in the table - 1.4 that there exist significance difference in the estimated regression lines for different farm sizes and villages.

1.4 Effect of factors on MT adoption

The adoption of MT means adoption of Modern / High Yielding variety of seeds (for Paddy cultivation). It is observed that the importance of adopting this technology is still lagging behind even decades after the green revolution. The adoption of this technology is water - intensive, but its advancement made available certain varieties for the dry area also but still the farmers are not in a position to adopt it fully being affected by several factors (Mohammad Alaudin *et al.*, 1991). There are several literature available arguing its adoption rate across different farm sizes emphasizing adoption rate of small and large farms (Mohammad Alauddin, *et al*, 1991). However, the adoption of modern technology has a significant impact in increasing the productivity of rice in the study area. The crude rate of adoption and intensity of adoption defined following Ahmed (1981) and Lipton (1978) in the study area (both irrigated and dry area) found comparatively lower than the desired level. In dry area it ranges from 50 to 60 per cent respectively for crude rate and intensity of adoption. Even in irrigated area (head - end of the canal irrigation) on an average for all types of crop including paddy the intensity of adoption is yet to reach to 100% (i. e.75 to 80 percent). Here, the percentage of cultivators cultivating HYV paddy of the total cultivators is termed as Crude Rate of adoption and the percentage of area of the total cultivated area under the HY paddy is termed as Intensity of adoption. However, in this study the impact of different factors on the intensity of adoption has been analyzed for understanding the causes of its non - adoption by the farmers. Irrigation is no doubt one of the major restrictive factors behind non - adoption. But in the irrigated area also it is found that the intensity of adoption is comparatively below the desired level. Thus, in this study an attempt has been made to find out the reasons (other than irrigation) which are affecting the intensity of adoption of HYV Rice technology.

For the estimation purpose the OLS estimate of simple linear multiple regression methodology has been adopted and regression equations have been estimated for three different villages and entire sample as a whole. The regression equation and explanatory variables are mentioned below and regression result is shown in the Table - 1.5

The multiple regression model is as follows:

$Y = \alpha + \beta_1 D_1 + \beta_2 X_1 + \beta_3 X_2 + \beta_4 X_3 + \beta_5 X_4 + \beta_6 X_5 + u_i$

Here, Y= dependent variable

X_1 to X_5 = the independent variables.

α = intercept

β_1 to β_6 = regression coefficient

u_i = stochastic disturbance terms.

D_1 is the dummy variable and

D_1 = 1 if the head of the farm household is educate

= 0 otherwise.

Y = Intensity of adoption of HYV Paddy

X_1 = Farm size (operated in acres)

X_2 = Tenancy (in acres)

X_3 = Total Credit from all sources (in Rs.)

X_4 = Labour - Land ratio

X_5 = ratio of agricultural workers (family workers) to total family members (or, subsistence pressure)

D_1 = Dummy variable introduced for education of the Head of the farm household.

It is observed from the Table - 1.5 that in V - I, credit (very low correlation), and labour - land ratio are positive and significantly related to the intensity of adoption of HYV - Rice technology. It implies that in the irrigated area the positive impact of credit is significantly marginal but the shortage of family labour is stood one of the major problems behind the intensity of adoption. On the other hand, the farm size is negative and significantly related to the intensity of adoption. It implies that there exists an inverse relationship between intensity of adoption and farm size. It can be inferred from this analysis that the intensity of adoption is found relatively higher for small farm size in the area under study.

Similarly, for V - II, credit is also found positive and significantly related to the intensity of adoption. But the farm size and ratio of family agricultural workers to operated land are negative and significantly related to the intensity of adoption. Another noteworthy finding is that in tailed - irrigated area also the negative effect of land - labour ratio on the intensity of adoption is observed as revealed by regression coefficient shown in Table - 1.5.

In the case of V - III (rain - fed area) also credit is positive (very low correlation) and significantly related the intensity of adoption of HYV rice technology. Further, there exists an inverse relationship between the labour - land ratio and adoption of HYV technology. But as like other cases the farm size shows a negative and significant relationship with the adoption of HYV technology. Further, like tailed - irrigated (V - II) area, in V - III also inverse relationship between land - labour ratio and adoption of MT is observed. But the tenancy variable in this area is found significant and directly related to HYV adoption.

In overall case (i. e. All - V) the credit has a direct and significant relationship with HYV adoption. Besides this tenancy and education in the overall sample are found to be positive and significant even though the education variable had not found significant in any of the three villages. But in this case also the farm size and labour - land ratio are found significant and inverse relationship with HYV adoption, which is treated as modern technology for the present study.

Thus, from the above analysis some of the hypotheses can be tested such as one of the hypotheses was credit (from both formal and informal sources) is positively related to adoption of new technology. The null hypothesis in this case is accepted as per the evidence of Table - 1.5. Another hypothesis i.e. the adoption of modern technology is positively related to farm size. The null hypothesis is here rejected as significant and inverse relationship between farm sizes and HYV adoption found in all cases irrespective of irrigation status of the area under study.

1.5 Cost and Returns of Rice

An attempt has been made in the present study to examine the costs and returns in the rice cultivation across the farm sizes in the study area. Further an attempt has also been made to see the impact of various components on the total cost. This was estimated with the help of OLS estimate of the Cobb - Douglas type cost function. The study on costs and returns is highly desired to understand profitability aspect of various farm sizes in rice production in both the irrigated and dry area. The concepts of costs and returns applied here have resemblance with the concepts popularly used farm management studies of India. The cost per unit of production (i. e. cost per quintal of rice production) is also calculated to understand the effectiveness of the farm business in rice production. The concepts of cost viz. A_1, A_2, B and C are computed. The average productivity of rice and its gross and net returns were also computed. Further, certain income measures associated with the cost concepts were also computed in order to understand the cost concepts were computed in order to understand the cost and income relationship in the rice production of the study area. For assessing the costs and returns of rice (paddy) four cost concepts viz. A_1, A_2, B and C are computed here. The items included in the computation are presented as follows:

Cost A_1 = Cost of human labour (hired and attached)

+ bullock labour (value of owned)
+ bullock labour (value of hired)
+ machine charges (value of owned)
+ machine charges (value of hired)
+ cost of manure, fertilizers, pesticides, plant nutrients and insecticides.
+ depreciation/repairs/maintenance of farm implements and buildings
+ value of seeds
+ irrigation charges (canal water charges and charges from other sources both own & hired)
+ land revenue /cesses /other taxes
+ interest on working capital
+ misc. expenses
Cost $A_2 = A_1$ + rent paid (for leased - in land).
Cost B = Cost A_2 + imputed rental value of own land (less land revenue paid thereupon) + imputed interest on owned fixed capital (excluding land)
Cost C = B + imputed value of family labour.

The cost concept, returns and certain income measures in relation to cost concept such as farm business income (i. e. Gross income - Cost A_1) and family business income (Gross income - Cost B) were computed across farm sizes in all the villages under study.

The cost concepts, returns and certain income measures are shown in table - 1.6. The table shows that the average yield (in quintal) per acre is showing a direct relationship with farm sizes in all the villages under study irrespective of their irrigation status.

Similarly, the gross income of rice (gross income of main product is considered as most of the farms in the sample have no income from the by product), the cost of production at various level viz. A_1, A_2, B and their percentage share in total cost of production (i. e. cost C) per acre have been increasing with the increase in the farm sizes. But the farm business income and family labour per acre decreases sharply with the increase in farm sizes in all the villages under study irrespective of their irrigation status as evident from table - 1.6. Because the net income per acre (i. e. Gross income - Cost C) shows an inverse proportional relationship with the farm sizes in both the irrigated and dry area under study. The net income per acre even is showing negative (i. e. loss) for the large farms in irrigated areas (i. e. V - I & V - II) and in case of entire sample. But the net income per acre for all the farm sizes shows negative (i. e. loss) in the case of rain fed area (i. e. in V - III). This indicates that most of the farms (mainly large farms) in irrigated area and all farms in the dry area operating in loss. However, the small farms are proved to be profitable (even though the profit is meager) in irrigated area and All - V. It is also found that the. cost C per acre and per quintal showed a direct proportional relationship with the farm sizes. In other words the unit cost of production (cost of production of paddy per acre) has a direct relationship with farm sizes. The ‘F’ value found out with the help of two way ANOVA (Analysis of Variance) to test the hypothesis i. e. there exists a direct relationship between cost of production per acre and farm size shows that the value of $F_{2, 4} = 13.90$ (where 2 & 4 indicate degree of freedom) which tested against the tabulated value and found significant (at 5% level). Thus, it is accepted. This proposition is true across villages as F value found in the same method shows $F_{2, 4} = 8.58$ (significant at 5% level). Thus the cost of production per acre varies across farm sizes direct and proportionally in both irrigated and dry area under study. Similarly, the second proposition or, hypothesis in the study regarding unit cost of production (i. e. the cost of production per quintal) has direct relationship with farm size is also tested with the help of two way ANOVA test where the value of F found across farm sizes and villages are $F_{2, 4} = 5.44$ (significant at 10% level of significance) and $F_{2, 4} = 4.10$ (not significant) respectively. This hypothesis is also accepted i. e. cost of production per quintal (unit cost) has a direct relationship with farm size. But here it is noteworthy that the variation of unit cost of production of rice across the villages is not found significant.

Further, in order to understand the contribution or effect of various components of cost on the total cost per acre in different villages (such as in irrigated area i. e. V - I & V - II and dry area i. e. V - III) a Cobb - Douglas type cost function has been estimated with the help of OLS method.

1.5.1 Cost Function

To understand the contribution of different cost component on the total cost of production per acre in rice cultivation the elasticity coefficient of various cost components with respect to total cost has been estimated. The Cobb - Douglas type cost function has been specified as functional form for estimating the coefficient with the help of OLS estimation.
The Cobb - Douglas type cost function can be specified as follows:

$$C = a\, X_1^{\beta_1}\, X_2^{\beta_2}\, X_3^{\beta_3}\, X_4^{\beta_4}\, X_5^{\beta_5}\, X_6^{\beta_6}\, X_7^{\beta_7}$$

The logarithmic transformation of the function
$C = l_n a + \beta_1 l_n X_1 + \beta_2 l_n X_2 + \ldots .\ \beta_7 l_n X_7 + u_i$
$= A + \beta_1 \log X_1 + \ldots\ldots. + \beta_7 l_n X_7 + u_i$
where C = Total Cost of production (i. e. cost - C) per acre (in Rs.)
X_1 = Cost of Bullock/mech. Labour (per acre in Rs.)
X_2 = Cost of Human labour (per acre in Rs.)
X_3 = Cost of Plant nutrients & plant protection measures per acre in (Rs.)
X_4 = Cost of seed per acre (in Rs.)
X_5 = Land cost per acre (in Rs.) (land cost includes rental value of own land and rent paid for leased - in land)
X_6 = Cost of land revenue and irrigation per acre (in Rs.)
X_7 = Other cost per acre (Other cost includes miscellaneous cost, value of depreciation, interest paid on borrowing and interest on own capital assets).
u_i = Stochastic disturbance term.
ln_a = A i.e. constant

The result of the cost function is shown in table - 1.6.1. The table shows that in V - I, the cost incurred on bullock/machine. labour, human labour, plant nutrients and plant protection measures, seeds and other cost per acre shows positive and significant contribution to total cost. This implied that the total cost of production of rice per acre would be possibly increased by 0.078, 0.243, 0.107, 0.069, 0.482 and 0.069 per cent respectively by an one per cent increase in each of the above said variables. It is observed here that the land cost has highly significant effect on the increase of total cost of production per acre followed by cost of human labour per acre and so on in V - 1. Similarly, in V - II also the same variables as it was in the case of V - 1 shows positive and highly significant effect on the total cost of production implying the same fact that here also there exists the dominating effect of land cost. But in this case (i. e. V - II) it is followed by the cost of manure, plant nutrient and plant protection measures per acre and so on. In case of V - III, also the same type of effect of the land cost on the total cost of production per acre has been found out followed by the cost of human labour used per acre and so on. In All - V case also it is found that the land cost has a similar type of effect on the total cost per acre followed by the cost of manure, plant nutrients and plant protection measures per acre, cost of human labour per acre and so on. It can thus be observed from the analysis that the total cost of production per acre is much affected by land cost (as the rental value of own land is a major component of the total cost of production). The other factors influencing the total cost per acre are cost of manure, plant nutrient (i. e. fertilizer) and plant protection measures per acre, human labour and other cost (where the major component like interest on borrowings are also included) etc. as evident from the table - 1.6.1in the present study.

2. Conclusion

It is found from the analysis that the expenses on seeds (Rs. /acre), expenses on Fertilizer (Rs/acre) and Formal credit (Rs/acre) have negative and significant impact on the productivity, which may be attributed to the improper (either less or more than recommended quantity) use of seeds and chemical fertilizer as well as misutilization of credit or diversion of credit to non - productive purpose. Further, it is found that in all the cases the farm size has an inverse and significant relationship with adoption of modern technology (i. e. HYV adoption). Similarly, the cost of production at various level such as A_1, A_2, B and their percentage share in total cost of production (i. e. cost C) per acre have been increasing with the increase in the farm sizes. But the farm business income and family labour per acre decreases sharply with the increase in farm sizes in all the villages. It is also observed from the analysis that the total cost of production per acre is much affected by land cost (as the rental value of own land is a major component of the total cost of production). The other factors influencing the total cost per acre are cost of manure, plant nutrient (i. e. fertilizer) and plant protection measures per acre, human labour and other cost (where the major component like interest on borrowings are also included) etc. in the present study.

The findings of the study may pave the way for suggesting judicious use of significant inputs for productivity improvement, minimization of cost and maximization returns by taking care of the significant factors influencing the adoption of modern technology. The policy makers may thrust upon the strategies of increasing the pace of intensive use of modern technology, crop diversification, and remunerative price for agricultural produce, infrastructure and extension services etc. to minimize the cost of production and maximize the gains or income of the farming community as a whole in an agrarian economy like India.

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Table 1.4: Factors Affecting Rice (Paddy) Productivity

Dependent Variable: Production of Rice (paddy) per acre (in Rs.)

	Village - I	Village - II	Village - III	ALL - Village	SML	MED	BIG
Independent Variables	*Coefficients*	*Coefficients*	*Coefficients*	*Coefficients*	*Coefficients*	*Coefficients*	*Coefficients*
Intercept	2215.5* (4.6)	3506.8* (6.3)	3373.7* (3.8)	3456.5* (8.4)	4095.2* (8.1)	2246.5* (2.7)	5089.4* (3.3)
Expenses on Bullock/Mech. Labour (Rs. / acre)	1.80* (4.69)	1.853* (4.4)	1.91** (2.30)	2.77* (8.61)	- 0.34 (- 0.70)	1.99** (2.52)	1.97** (2.58)
Expenses on human labour (Rs. / acre)	0.18*** (1.84)	- 0.134*** (- 1.68)	- 0.30 (- 0.63)	0.00 (0.02)	0.04 (0.33)	0.38** (2.04)	0.85* (3.96)
Expenses on of seeds (Rs. /acre)	4.61* (5.61)	0.316 (0.27)	- 0.53 (- 0.22)	- 6.54* (- 8.76)	- 5.47* (- 5.30)	- 2.31*** (- 1.80)	0.66 (0.28)
Expenses on Fertilizer & FYM (Rs. /acre).	1.15** (2.34)	0.473*** (1.64)	0.33 (0.67)	1.11* (5.06)	2.64* (6.91)	1.05 *** (1.86)	- 0.11 (- 0.16)
Farm yard manure - FYM (RS/acre)	- 0.60 (- 1.05)	0.011 (0.007)	0.40 (0.74)	- 0.32 (- 0.59)	- 1.46** (- 2.22)	1.09 (1.54)	0.16 (0.07)
Fertilizer (Rs/acre) - Total	0.08 (0.37)	- 0.228 (- 0.44)	0.36 (1.14)	- 0.95* (- 4.82)	- 1.38* (- 3.63)	- 0.08 (- 0.19)	- 0.72 *** (- 1.87)

Expenses on pesticide (Rs. /Acre)	- 0.26 (- 0.40)	2.491* (5.91)	- 8.24* (- 2.66)	5.08* (15.9)	2.08* (3.81)	4.24* (8.22)	3.91* (4.71)
Irrigation charges (Rs. /acre)	2.01** (1.96)	4.315* (4.51)	4.62* (4.87)	1.86 (2.61)	5.33* (4.81)	- 1.51*** (- 1.79)	- 1.17 (- 0.86)
Gross Cropped Area (in acre)	24.28* (7.77)	- 2.210 (- 0.25)	85.78*** (1.92)	32.19* (8.41)	196.51* (8.85)	84.12* (5.60)	29.43* (6.41)
Ratio of workers to family size	14.76 (0.12)	- 154.652 (- 1.157)	- 363.38** (- 2.42)	- 103.18 (- 0.84)	- 228.62 (- 1.41)	- 44.30 (- 0.33)	35.71 (0.14)
Proportion of area under HYV (%)	- 5.44* (- 2.83)	5.446 (1.091)	- 1.93 (- 1.05)	0.85 (0.44)	0.88 (0.33)	- 3.49*** (- 1.87)	- 2.07 (- 0.36)
Cropping Intensity (%)	12.59* (9.55)	- 0.014 (- 0.007)	0.99 (0.68)	10.09* (9.11)	8.15* (5.62)	4.05*** (1.74)	- 29.77* (- 2.51)
Formal credit (Rs/acre)	- 0.04 (- 0.76)	0.005 (0.071)	- 0.01 (- 0.70)	- 0.05* (- 2.88)	- 0.03*** (- 1.76)	0.01 (0.15)	0.17 (1.26)
Informal credit (Rs/acre)	- 0.37* (- 3.14)	0.001 (0.004)	0.12 (1.12)	- 0.04 (- 0.41)	0.21** (1.99)	0.07 (0.43)	- 0.25 (- 1.03)
R Square	0.65	0.76	0.49	0.82	0.85	0.92	0.86
F	23.86*	27'.84*	8.68*	151.72*	99.03*	113.95*	39.23*
No. of Observations	192	139	143	474	252	129	93
No. of variables	15	15	15	15	15	15	15
Chow Test (F value)	53.54*				18.88*		

Note: The Figure in the parentheses indicate‘t’ value and *, ** and *** indicate 1%, 5% and 10% level of significance respectively.

Table 1.5: Factors Affecting the Adoption of Modern Technology

Variables	Village - I Coefficient	Village - II Coefficient	Village - III Coefficient	All - Village Coefficient
Constant	92.253* (50.70)	89.269* (11.61)	57.58* (14.33)	81.908* (28.83)
X_1	- 0.389** (2.29)	- 1.215** (1.92)	- 0.1163 (0.18)	- 0.835* (3.15)
X_2	0.0002 (0.07)	0.027 (1.25)	0.045* (2.50)	0.017* (2.38)
X_3	0.0001* (3.67)	0.0004** (1.92)	0.001* (2.55)	0.0004* (5.70)
X_4	2.234*** (1.38)	- 3.672* (3.62)	- 12.58* (3.16)	- 3.040* (5.25)
X_5	1.485 (0.63)	- 3.79 (0.43)	21.764* (4.25)	1.972 (0.62)
D_1	0.844 (0.69)	3.269 (0.68)	2.189 (1.08)	4.751* (2.67)
R^2	0.58	0.51	0.55	0.64
DF	185	132	136	467

Note: 1) Values in the parenthesis are‘t’ values
2) Here D_1 is the dummy variable for education & introduced only for intercept
3) *, ** and *** indicate 1%, 5% and 10% level of significance respectively

Table 1.6: Cost and Returns of Rice per acre (in Rupees)

	Village - I				Village - II				Village - III				All - Village			
	Small	Medium	Large	All	Small	Medium	Large	All	Small	Medium	Large	All	Small	Medium	Large	All
Average yield (in quintal)	18.6	19.0	19.6	19.3	15.3	16.3	15.9	15.9	11.5	12.7	13.2	12.4	16.0	16.7	18.6	17.5
Gross income of rice	21424.4	21964.4	22697.2	22300.4	17045.1	18319.7	17830.2	17774.3	12088.8	13469.9	14155.5	13090.9	17999.5	18857.0	21362.6	19927.4
Gross exp. (cost C)	12040.1	14459.5	15569.7	14677.1	10770.6	10918.5	12295.1	11609.9	8581.6	9747.6	12541.2	9637.6	10821.7	13663.8	14778.0	13226.4
Cost A_1	4959.4	6986.6	8537.3	7536.6	4572.1	6386.8	7186.7	6398.3	3672.2	4421.8	6316.7	4363.2	4522.8	6138.0	8172.7	6800.2
Cost A_2	5520.3	7195.7	9835.9	8495.3	4572.1	7382.7	8506.8	7340.1	4154.6	5430.5	7161.0	5147.2	4950.5	6719.0	9457.8	7703.4
Cost B	10182.2	12879.2	14612.8	13415.7	8556.3	10217.0	11572.8	10556.0	7066.1	8118.1	11019.6	8065.6	8988.8	11026.6	13847.1	11991.8
Cost A_1 as a percentage of Cost C	41.2	48.3	54.8	51.3	42.4	58.5	58.5	55.1	42.8	45.4	50.4	45.3	41.8	44.9	55.3	51.4
Cost A_2 as a percentage of Cost C	45.8	49.8	63.2	57.9	42.4	67.6	69.2	63.2	48.4	55.7	57.1	53.4	45.7	49.2	64.0	58.2
Cost B as a percentage of Cost C	84.6	89.1	93.9	91.4	79.4	93.6	94.1	90.9	82.3	83.3	87.9	83.7	83.1	80.7	93.7	90.7

Farm Business income (G. I. - Cost A_1)	16465.1	14977.8	14159.9	14763.8	12473.0	11933.0	10643.5	11375.9	8416.5	9048.1	7838.9	8727.6	13476.7	12719.1	13189.8	13127.2
Family labour income (G. I. - Cost B)	11242.2	9085.3	8084.4	8884.7	8488.9	8102.7	6257.4	7218.3	5022.6	5351.8	3136.0	5025.3	9010.7	7830.4	7515.5	7935.6
Net Income (Profit or loss) at cost C (i. e. G. I. - Cost C)	9384.3	7505.0	7127.5	7623.3	6274.5	7401.2	5535.1	6164.3	3507.2	3722.3	1614.3	3453.3	7177.8	5193.2	6584.6	6701.0
Cost of Production per quintal	648.0	761.0	795.6	762.0	703.0	669.4	771.8	730.6	748.2	768.1	947.9	777.8	675.5	818.2	795.8	756.2

Table 1.6.1: Result of OLS Estimate of the Cobb - Douglas Type Cost Function

Variables	Village - I Coefficient	Village - II Coefficient	Village - III Coefficient	All - Village Coefficient
Constant	1.1704* (10.281)	3.054 (9.2332)	1.3245* (3.0462)	2.2185* (15.522)
X_1	0.078* (7.576)	0.0668* (2.3587)	0.13875* (4.3263)	0.0430* (3.77)
X_2	0.243* (31.816)	0.0854* (11.091)	0.16248* (5.0861)	0.1093* (19.35)
X_3	0.107* (9.059)	0.232* (91.1345)	0.15650* (10.907)	0.1985* (24.141)
X_4	0.069* (5.961)	0.059 (1.184)	0.12006** (1.8298)	0.0301** (1.7943)
X_5	0.482* (54.656)	0.267* (8.1685)	0.3394* (16.605)	0.4199* (36.006)
X_6	- 0.0009 (0.435)	- 0.000049 (0.00884)	0.0103* (3.0838)	- 0.0003 (- 0.1395)
X_7	0.069* (16.116)	0.105* (11.786)	0.16081* (202.34)	0.11 (22.047)
R^2	0.89	0.85	0.88	0.86
Df	184	131	135	466