

PRODUCTION ECONOMICS AND PERCEPTION ANALYSIS USING LOGISTIC REGRESSION OF PADDY FARMERS IN LAMJUNG, NEPAL

Ajit Khanal, Sabin Dawadi, Thaneshwar Bhandari,
Prayash Pathak Chalise, Sudip Poudel

Department of Social Science, IAAS, Lamjung, Tribhuvan University

ABSTRACT

A survey research was conducted with randomly selected 168 paddy growing households in Lamjung district, Nepal. Information on cost of seed, labor and inorganic fertilizers along with paddy income and other socio-economic variables were obtained. Result showed that paddy growers used NRs 154,379, total variable cost per hectare and benefit cost ratio was 1.34. The average cost per hectare for seed, labor and inorganic fertilizer were Rs 6,934, Rs 139,347 and Rs 8,097 respectively, where other costs like fixed cost, management cost and manure cost were considered implicit expenses. Average area under paddy cultivation was 0.39 ha and gross margin per hectare was Rs 40, 895 Results of logistic regression analysis on adoption behavior of stress tolerant paddy varieties with various regressors showed maximum likelihood estimator and pseudo R^2 value 83.663 and 0.586 respectively. Farmers joined in farm association, upland paddy grower, male-headed farm household and education level of household head had likelihood of positive relationship with adoption of stress tolerant paddy varieties. Probability of one unit of change in above said variables, likelihood of adoption could increase by 4.52, 71.38, 5.345 and 2.34 units respectively, *ceteris paribus*. However, paddy income and occupation of household head showed no significant difference. In the stressed condition of the climate, this study suggested the farmers for rapid adoption of stress tolerant varieties in order to increase both income and livelihood.

Keywords: Logit, Odds ratio, Pseudo R^2 , Stress tolerant

INTRODUCTION

Nepal, an agricultural country, has long been contingent upon agriculture for increasing its economy. The government has focused on agriculture by implementing programs and appropriating a lot of budget: it contributes about 30% to the national GDP and about two-thirds of the population is engaged in agriculture¹. Of the different crops produced, rice is the most cultivated one; the total land area under rice production is 1,552,469 ha with production of 5,230,327 MT² It is cultivated throughout the nation. In Lamjung district, which has an area of

1692 km² and population of about 167,724, paddy is cultivated in 14,930 ha land area with the production of 43,830 MT².

Despite the primacy of rice production and persistent effort of the government, Nepal has been facing many challenges. The country which once exported rice till 1984/85 has been importing it; the fiscal year 2016/17 witnessed an import of rice worth Rs. 23.85 billion which is a huge amount for a developing nation³. Moreover, the land under rice production has decreased by five percent from the fiscal year 2016/17 to 2017/18 for the country at large which is accompanied by about one and half percent decrease in total rice production. Not only import but average cost of rice production per hectare has also soared up from about Rs.14000 to Rs.71132.3 from 1993/94 to 2013/14, 408% increase⁴.The major cause for the problems has been the country's dependency on rain and lack of irrigation facility; about two-third of rice area in Nepal is rain fed and most of them are stress-prone. Other contributing factors are uncertain weather conditions, erratic rainfall, drought and inundation during monsoon, insects and pests. In response to these causes, the government of Nepal has released eleven stress tolerant rice varieties (STRVs). However, the perception of farmers towards these varieties is still unknown. Are they adopting them? Have they heard about them?

It has been realized that there is a need to know the costs and benefits of paddy production and also the perception of farmers towards the adoption of stress tolerant rice varieties. Production economics of paddy would gather information on the costs incurred and benefits gained. This information would help to know which input is the major contributor to the total cost and how much profit is there in producing paddy. Thus, output of this research could be helpful for farmers, researchers and policy makers to work on minimizing the cost, acquaint on local problems and increasing the profit so that paddy production can become a profitable occupation and contribute more to the agricultural GDP. Distribution and dissemination of stress tolerant rice varieties can manage the climatic uncertainty in paddy production and prevent against yield loss due to insects and pests. This study would help to know the areas which effect the adoption of these varieties. Government can work on these areas and increase the adoption of stress tolerant rice varieties.

MATERIALS AND METHODS:

1.1 Data

Primary data was collected by using a pre-tested questionnaire; questions were asked to that member of the household who was knowledgeable about paddy production in that household. Out of eight municipalities of Lamjung district four municipalities were chosen randomly: Dordi, Rainas, Sundarbazar and Madhya Nepal. From each municipality three villages were selected randomly. List of farmers who were involved in paddy production in 2018 monsoon season was

prepared for each village with the help of local leaders. From each list 14 households were selected randomly to obtain a sample size of 168. Household survey was carried out during the month of November and December 2018. Microsoft Excel 2013 and Statistical Package for Social Science (SPSS 20) were used for data tabulation and analysis. Descriptive test like frequency estimation, percentage estimation and graph were performed. Calculation of costs, income, gross margin, B/C ratio and productivity was done through Ms. Excel and binary logistic analysis was performed using SPSS 20.

1.2 Data analysis methods:

Cost of production (Y):

The cost of production(Y) was calculated by taking cost of labor (LC), cost of inorganic fertilizer (IC) and cost of seed (SC) where other costs like fixed cost, management cost and manure cost were considered as implicit expenses while labor cost includes the cost of paid, unpaid and household labors.

$$Y = SC + IC + LC$$

Cost of seed (SC):

The respondents were asked how many varieties they grew in 2018 monsoon season, the amount of seed used for each variety (V) and price per kg (p) of each variety. In case the farmers didn't purchase the seed, they were asked what price they would get if they sold the seed in the local market.

$$SC = \sum_{n=1}^n p_n V_n$$

Cost of inorganic fertilizer(IC):

The respondents were asked how many types of inorganic fertilizer they used in paddy production in 2018 monsoon season, their individual amount in kg (I) and price per kg (p) for each inorganic fertilizer.

$$IC = \sum_{n=1}^n p_n I_n$$

Cost of labor (LC):

For the calculation of LC, the production period of paddy was divided into 4 phases namely nursery, land preparation and planting (P), weeding(R), harvesting (H) and threshing (T). The respondents were asked how many person days of male (M) and female labors (F) were used in each production phase and their respective wage per person days (W). In case, different wage

amounts were given to the labors in the same production phase average wage per person days was used to calculate labor cost.

$$LC = W_1M_P + W_2F_P + W_3M_R + W_4F_R + W_5M_H + W_6F_H + W_7F_T + W_8F_T$$

Paddy Income (PI):

The respondents were asked the amount (kg) of paddy harvested for each variety(X) and their respective selling price per unit (p).

$$PI = \sum_{n=1}^n p_n X_n$$

Benefit cost ratio and gross margin:

B/C ratio was calculated as⁵

$$B/C = \sum_{t=0}^T \frac{\frac{B_t}{(1+d)^t}}{\frac{C_t}{(1+d)^t}} = \frac{PADDY INCOME(PI)}{COST OF PRODUCTION(Y)}$$

Where,

B_t= Benefit stream

C_t = Cost stream

d= discount rate

t= number of years

Gross margin is simply the difference between the amount you sell a product for and the direct cost (costs that occur only when you buy sell, create and provide your products and services) of that product or service⁶.

$$\text{Gross margin} = \text{Sales Price} - \text{Cost of goods} = \text{Paddy Income (PI)} - \text{Cost of Production (Y)}$$

Binary logistic regression model

Binary logistic is a non- linear regression model where the probability of an event to occur can be predicted based on the value of the explanatory variable which bears a significant relationship with the dependent variable. In this model the dependent variable is dichotomous i.e. it has two categories⁷.

The variable, adoption of stress tolerant paddy varieties has two categories i.e. 0 for those households who have not adopted stress tolerant paddy varieties and 1 for those households who have adopted stress tolerant paddy varieties.

The probability is given by,

$$p_i = 1 / (1 + e^{-z_i})$$

Where,

p_i = probability of adoption of stress tolerant paddy varieties.

$$z_i = \hat{Y} = \log(odds) = \hat{\beta}_0 + \hat{\beta}_1 x_1 + \hat{\beta}_2 x_2 \dots \dots \dots + \hat{\beta}_n x_n$$

Where, $\hat{\beta}_0$ is the constant term, $\hat{\beta}_1, \hat{\beta}_2, \dots, \hat{\beta}_n$ are the coefficients of explanatory variables and x_1, x_2, \dots, x_n are explanatory variables.

Odds

Odds is simply the ratio of the probability of adopting stress tolerant paddy varieties (p_i) to the probability of not adopting stress tolerant paddy varieties⁷ ($1 - p_i$).

I.e. $Odds = \frac{p_i}{1 - p_i}$

Wald test

Wald test measures the significance of given coefficients of the explanatory variables⁷

$$= (B / S.E.)^2$$

Where,

B = coefficient of explanatory variables

S.E. = estimate of the standard error of the coefficient

The description of the variables used in logistic model is shown by Table: 2

Based on the regressand and the regressors, the binary logistic analysis was specified by using the following equation:

$$\hat{Y} = \log(odds) = \hat{\beta}_0 + \hat{\beta}_1 X_1 + \hat{\beta}_2 X_2 + \hat{\beta}_3 X_3 + \hat{\beta}_4 X_4 + \hat{\beta}_5 X_5 + \hat{\beta}_6 X_6$$

Where,

\hat{Y} = Estimator of adoption of stress tolerant paddy varieties.

X_1 = Gender_HH = Gender of household head

X_2 = Upland = Cultivated in upland or not

X₃= Education_HH = Education level of Household Head

X₄= Farmerassociation = Involvement in farmer association

X₅= Paddy income = Paddy income in the year 2018

X₆= Occupation_HH = Primary occupation of household head

$\hat{\beta}_0$ is a constant term and $\hat{\beta}_1, \hat{\beta}_2, \hat{\beta}_3, \hat{\beta}_4, \hat{\beta}_5, \hat{\beta}_6$ are coefficient of explanatory variables.

RESULTS

Socioeconomic characteristics of the household

Out of the total households, 65.5% had male household heads while the remaining 34.5% had female household heads. Furthermore, 42.9%, 37.5%, 17.3% and 2.4% of the household heads had education level up to primary, secondary, intermediate and bachelors and above respectively. Talking about the primary occupation of the household head, 70.4% were farmers, 20.7% had private salary jobs, 7.7% were engaged in government job and 1.2% were self-employed. Result also showed that 61.3% of the households were in farm association whereas the remaining 38.7% were not. Out of 168 households, 53% of households were small land holders with land holdings less than 0.5 ha, 30% were medium land holders with land holding between 0.5 to ha and 17% households had land holding greater than 1 ha. 74% households cultivated paddy in less than 0.5 ha, 23% cultivated in between 0.5 and 1 ha while the remaining 3% cultivated paddy in area greater than 1 ha. Average land holding and average area under paddy cultivation was 0.59 ha and 0.39 ha respectively. Moreover, 58.3% households cultivated paddy in upland while the remaining 41.7% did not.

Cost of production of paddy growers

Keeping fixed cost, manure cost and management cost constant, result showed that farmers used Rs. 154,378 total variable cost while cultivating paddy in one hectare. Furthermore, the cost of seed per hectare (SC/ha) was Rs. 6,934, labor cost per hectare (LC/ha) was Rs. 139,347 and cost of inorganic fertilizer per hectare (IC/ha) was Rs 8,097.

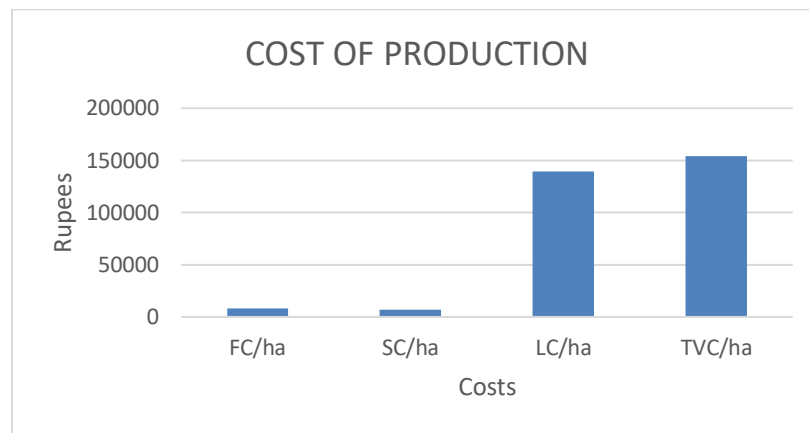


Fig 1: Bar diagram showing cost of production of paddy growers

Paddy income of the households

The paddy income from 2018 monsoon season of the respondents were divided into seven categories. The frequency of households falling under each category is in Table 4.

Table 1: Paddy Income of the households

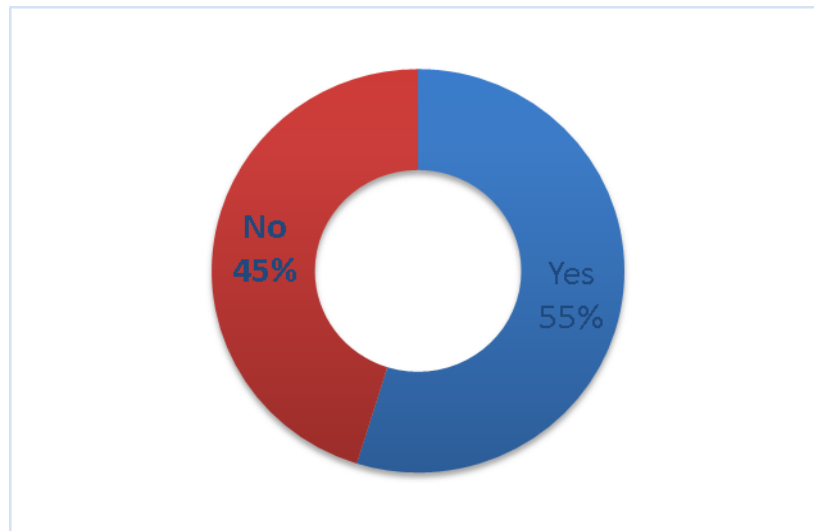
Paddy Income(Rs.)	10,000 to 50,000	50,000 to 1 lakh	1 lakh to 1.5 lakhs	1.5 lakhs to 2 lakhs	2 to 2.5 lakhs	2.5 lakhs to 3 lakhs	3 lakhs to 3.5 lakhs
Frequency	54(32%)	76(45%)	28(17%)	6(4%)	2(1%)	1(0.5%)	1(0.5%)

Source: Household survey 2018

Gross margin per hectare was Rs. 40,895 and Benefit cost ratio was 1.34.

Adoption of stress tolerant paddy varieties

Figure 2 shows that 54.8% had adopted stress tolerant paddy varieties at least once in their paddy cultivating period whereas the remaining 45.2% had never adopted a stress tolerant paddy varieties.



Marginal effect of adoption of stress tolerant paddy varieties

Table 2 explains Maximum Likelihood Estimator (MLE) to be 83.663^a and pseudo R² shows 58.5% of variability in dependent variable is explained by the explanatory variables

Table 2: Effect of different variables on adoption of STRVs

	B	S.E.	Wald	Df	Sig.	Exp(B)
Gender_HH	1.676	.658	6.489	1	.011	5.345
Education_HH	.850	.429	3.925	1	.048	2.340
Occupation_HH	-.715	.519	1.901	1	.168	.489
Step 1 ^a farmer_association	1.509	.611	6.093	1	.014	4.520
Paddyincome	.000	.000	.089	1	.766	1.000
Upland	4.275	.654	42.710	1	.000	71.888
Constant	-4.966	1.013	24.039	1	.000	.007

Table 2 depicts the effect of different explanatory variables namely gender of household head, education of household head, occupation of household head, involvement in farmer's association, paddy income and cultivation on upland likely effect on the dichotomous dependent variable adoption of stress tolerant paddy varieties.

Significant results were obtained with the variables gender of household head, education of household head, involvement in farmer's association and cultivation in upland.

Gender of household head was found significant at 5% level of significance ($0.01 < 0.05$) Result shows that probability of gender of household head when changes from female to male the likelihood of the odds of adopting stress tolerant paddy varieties increases by 5.345 units, *ceteris paribus*. In terms of logarithm of the odds, the result can be interpreted as keeping other variables in the model constant, probability of gender of household head when changes from female to male, the likelihood of adopting stress tolerant paddy varieties increases by 1.676 units

Education level of the household head also showed significant relationship with the dependent variable at 5% level of significance ($0.048 < 0.05$). Result showed that keeping other variables in the model constant, as the probability of education level of the household head changes from primary to secondary or from secondary to intermediate or from intermediate to bachelors, the odds and logarithm of odds of adopting stress tolerant paddy varieties increases by 2.340 units and 0.850 units respectively..

Occupation of the household head showed no likely significant relationship with the dependent variable. The regressor, farmer's association showed significant relationship with the regressand at 5% level of significance, ($0.014 < 0.05$) This meant that probability of farmers to join in a farmer's association, increases the likelihood of adoption of stress tolerant paddy variety by 4.52 units keeping other variables in the model constant.

The scale variable, paddy income showed no significant relationship with the dependent variable.

The explanatory variable upland showed highly significant positive relationship with the dependent variable at 1% level of significance ($0.00 < 0.01$). The probability of movement from lowland to upland increases the likelihood of adoption of stress tolerant paddy variety by 71.88 units, *ceteris paribus*.

CONCLUSION

From the study, we conclude that major decision-makers in the farm households were male and most of them fell in the lowest category of the education level. The productivity of paddy is high and B/C ratio higher than 1 suggests that investment in paddy cultivation is worthwhile. In spite of these optimistic comments, the gross margin is fairly low which is explained by high cost of labors in the production process. And if the cost of labors can be minimized, good profit can be earned from paddy. Study also revealed that investment of Rs. 154,378 in paddy cultivation would give a profit of Rs. 40,895 from one hectare keeping fixed cost, management cost and manure cost constant.

The study also revealed that still most of the farmers have never adopted stress tolerant rice varieties despite the risks of climate, drought or any other uncertain severities. Furthermore, gender and education level of household head, involvement of household in farmer's organization and cultivation in upland are important variables that effect the adoption of stress tolerant paddy varieties.

REFERENCES

1. Ministry of Finance (2018).Economic survey. Government of Nepal.
2. Agriculture Communication and Information Center (2018). Krishi Diary 2075. Ministry of Agricultural Development. Government of Nepal
3. Kafle, L. (2019 ,June 26).Rice Import Increases by 21 percent. *The Rising Nepal*.
4. Market Research and Statistics Management Program (2015). Cost, production and price spread of cereal crops in Nepal: A time series analysis. Ministry of Agriculture Development. Government of Nepal.
5. Fugitt, D., & S. Wilcox (1999). Cost-benefit Analysis for Public Sector Decision Makers. The USA: Greenwood Publishing Group, Inc.
6. Wilkinghoff, S (2009). Found Money: Simple strategies for uncovering the hidden profit and cash flow in your business. The USA: John Wiley and Sons, Inc.
7. Gujarati, D. N., & D.C. Porter (2009).Basic Econometrics (5th ed). New York: The McGraw-Hill Companies, Inc.