Research Paper

Socio-economic Impact on Livelihood of Black Rice Growers in Manipur: Heckman Selection Model Approach

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ABSTRACT

The present study was carried to examine the influence of socio-economic factors on earning of black rice growers in Manipur. A sample of 120 black rice growers was collected from two selected districts of the Manipur state *viz*., Imphal West and Imphal East. Heckman selection two stage model was employed to analyse the result of the study. The study was revealed that factors like education, gender, organic farming motive of production and land area employed under black rice cultivation has found to be significant and responsible to change the income of the farmers. In second stage of the model, number of earners of household and organic farming motive of production were found to be significant to change the income of farmers. Moreover, it was also found that more educated farmers had secured more income from black rice production. If farmers are produced black rice with business motive can be emerged as major source of income and ultimately would be helpful to reduce the unemployment and strengthen the economy of the state.

HIGHLIGHTS

◉ Organic farming of black rice production was identified profitable.

◉ Educated farmers were secured more from black rice production.

◉ Large area of black rice production was responsible to enhance the income.

Keywords: Black rice, Socio-economic factors, Heckman selection model and Income

Agriculture is the major employment activity for the rural households of Manipur. The sector has engaged 52.81% of the population as a cultivator and agriculture labour in the State (Aheibam and Singh, 2017). Majority of the population (70.79%) lives in rural areas (Census, 2011). In order to enhance the life standard of economically weaker section of the society of Manipur, some programmes have been implemented such as *Mahatma Gandhi National Rural Employment Guarantee Scheme* (MGNREGS), *Sampoorna Grameen Rozgar Yojana* (SGRY), *Swarnjayanti Gram Swarozgar Yojana* (SGSY), *Pradhan MantriGram Sadak Yojana* (PMGSY) and *Pradhan Mantri Gramodaya Yojana* (PMGY) (GoM, 2022).

According to the 68th round of the National Sample Survey (2011-12), in the state of Manipur, 38.8

percent and 32.5 percent of the population living in rural and urban areas were below the poverty line (BPL) (GoI, 2015). The overall literacy rate of the state was (76.94%), while the male and female literacy rates were recorded at (83.58%) and (70.26%) respectively. As per Population Census 2011, the sex ratio of the state was recorded at 985 females per 1000 males (GoI, 2022). Agriculture is a major source, as most of the population is engaged in agriculture and allied activities (Singh and Bera, 2017). Rice is one of the main food crops of India as well as the state of Manipur. Rice based agriculture and allied activities are the major source of livelihood for the majority of the rural population which helps in strengthening the economy of the state (Singh *et al.* 2016). In total foodgrain production of the State, the rice contributed 43 per cent and total cereal production 46 per cent shows dominancy of rice in Manipur. (Yumnam, 2016; Devi and Singh, 2014). Although, the rice productivity is still low which can be enhanced by research, infrastructural facilities and extension activities by taking public investment decision (Roy *et al*. 2014).

Black scented rice also known as '*Chak-hao*' is an aromatic variety of the rice of Manipur which originated from North-East Region of India (Banerjee *et al*. 2019). Black scented rice requires a warm climatic condition and cultivated in *Kharif* season comprising long growing period of around 3-6 months and made available in market during the period of May to December (Mainuddin *et al*. 2022). The black scented rice possesses with high nutritional value and have played a prominent role in socio-cultural practices of various communities of the State. Mostly farmers are followed natural and organic farming of black rice production resulted less productivity. On the other hand, farmers are experienced low production cost of black rice as compare to normal rice which may be due to less requirement of labour effort and input materials like fertilizers and manures, plant protection chemicals (herbicides and pesticides), shallow ploughing and less water requirement of the crop. However, the black rice is highly associated with state's cultural value and adoption of natural motive of farming revealed that the black rice productivity is highly affected by socio-economic attributes of farmers but sufficient studies have not been conducted. All above backdrops, motivated to carried out to the study on assess the influence of socio-economic factors of household on the livelihood of black rice producers in Manipur.

RESEARCH METHODOLOGY

Sources of data

The present study was conducted on black rice producers of Manipur, by using primary data which was collected through pre-tested interview schedule. A sample of 120 black rice growers was interviewed during data collection from Imphal West and Imphal East district. Both districts are having maximum area and production of rice therefore selected for study purpose (Table 1). Total number of six villages were selected purposively from each selected district and total 60 black rice producers were interviewed from each selected district during data collection. The data were collected for *Kharif* season of the crop during the year 2022.

Table 1: District wise area, production and productivity of rice in Manipur (2020-21)

Name of district	Area (000' ha)	Production (000' Mt)	Productivity (MT/ha)
Imphal West	39.83	127.88	3.21
Imphal East	37.61	136.00	3.62
Thoubal	30.15	118.75	3.94
Bishnupur	29.36	103.10	3.51
Churachand	29.12	38.00	1.30
Tamenglong	27.45	35.85	1.31
Senapati	12.10	16.18	1.34
Ukhrul	10.12	13.10	1.29
Chandel	10.03	13.35	1.33
Total	225.77	602.21	2.67

Source: GoM, 2021.

Heckman selection two stage model

The Heckman two stage selection model was applied to assess the influence of the socio-economic factors of black rice producers on their income. In first stage of the model, probit model was estimated to determine whether the income of black rice growers is changing or not and in second stage, the OLS model was estimated to determine the extent of changing in the income of black rice producers.

Probit model equation

$$Y_i(0,1) = \alpha_1 + \alpha_2 X_{1i} + \alpha_3 X_{2i} + \alpha_4 X_{3i} + \ldots\ldots + \alpha_{10} X_{9i} + \varepsilon_i$$

Where, Y_i indicates dichotomous value as the change in the income-1; otherwise-0. α_1 is the constant term, α_2 to α_{10} are the coefficients of the variable, X_1 assigned for education, X_2 indicates age, X_3 indicates gender, X_4 represents farming experience, X_5 indicates family size, X_6 indicates number of earners, X_7 indicates hiring labour, X_8 indicates sources of income and X_9 assigned for organic farming. The normality was tested by using Jarque-bera test and multicollinearity tested by applying Variance Inflection Factor (VIF) test. In second stage of model, the OLS was applied with one additional variable (λ_i) *i.e.*, inverse meals ratio which estimated by using formula:

$$\lambda_i = \frac{(\beta_0 + \beta_n X_n)\phi}{(\beta_0 + \beta_n X_n)\phi}$$

Where, λ_i is the value of inverse meals ratio, ϕ and φ are the standard normal density and cumulative density functions, respectively. The OLS model is defined as;

$$Y_i = \beta_1 + \beta_2 X_1 + \beta_3 X_2 + \beta_4 X_3 + \ldots\ldots + \beta_{10} X_9 + \beta_\lambda \lambda_i + \varepsilon_i$$

Where, Y_i indicates the extent of change in the income of black rice producers, β_1 is constant term, β_2 to β_{10} are the coefficients of the variable, X_1 to X_9 are the variables which incorporated in the model, λ_i indicates the value of inverse meals ratio and ε_i indicates disturbance terms of model.

RESULTS AND DISCUSSION

Occupational status of black rice producers

The agricultural activities were observed as a major source of income of black rice producers. In Manipur, the agriculture sector had engaged 34.63 per cent of the male and 25.92 per cent of the female households, whereas, 37.45 per cent of the male and 27.08 per cent of the female of a household were enrolled for the education. Rest members of the household were engaged in business, service sector and household activities (Table 2). The agriculture sector had provided employment to most of population of Manipur state.

Land holding size of black rice producers

Operational size of land holding of black rice growers presented in Table 3. In Imphal East district, black rice was cultivated relatively in larger area (0.32 ha) than the Imphal West district *i.e.*, (0.14 ha). Although, maximum area under the black rice cultivation was observed (1.10 ha) in Imphal East district. Overall, black rice growers had possessed the operational land of 0.23 ha and own land of 0.21 ha in Manipur. The black rice producers had possessed the maximum area of own land (1.21

Table 2: Occupational status of household

Occupation	Imphal East				Imphal West				Overall			
	Male	%	Female	%	Male	%	Female	%	Male	%	Female	%
Agriculture	76	40.21	37	25.34	57	30.98	43	26.87	196	34.63	112	25.92
Business	19	10.05	10	6.85	18	9.78	10	6.25	48	8.48	32	7.41
Service	9	4.76	3	2.05	12	6.52	3	1.87	35	6.18	8	1.85
Household	26	13.75	57	39.04	21	11.41	55	34.37	75	13.25	163	37.73
Education	59	31.21	39	26.71	76	41.30	49	30.62	212	37.45	117	27.08

Source: Household survey, 2021-23.

Table 3: Land holding size of sample household in study area (n=120)

Land tenancy	Imphal East			Imphal West			Overall Average
	Mean	Min	Max	Mean	Min	Max	
Operational land (ha)	0.32	0.02	1.10	0.14	0.01	0.9	0.23
Own land (ha)	0.23	0.06	1.21	0.19	0.08	1.15	0.21
Leased-in land (ha)	0.10	0.03	0.8	0.11	0.05	0.87	0.10
Leased-out land (ha)	0.03	0.10	0.6	0.04	0.16	1.24	0.03

Source: Household survey, 2021-23.

ha) and (1.15 ha), respectively in Imphal East and Imphal West district. Whereas, the producers were leased-in and leased-out the area of land (0.10 ha) and (0.03 ha), respectively in Manipur.

Personal characteristics of black rice growers

The factors such as education, gender, farming experience, family size, number of earners, sharing labour, sources of income, organic farming and area of cultivated land were incorporated as explanatory variable in Heckman selection model (Table 4). Most of the producers were having primary and secondary level of education, whereas, other producers had possessed with the higher secondary and higher education. The black rice producers were found to be 54.07 years old and 53.33 per cent of total farmers were male. The black rice growers were having 9.42 years of farming experience and grown black rice since previous generation. Average household size of black rice growers was found to be of 5.56 members out of which 2.41 members of household were earner. In Manipur, there was a tradition to work with sharing labour since 88.33 per cent of black rice growers had shared the labour for agricultural operations. Non-agricultural enterprise like business, daily wage labour, government services *etc.* were the subsidiary sources of the income for 71.67 per cent of black rice growers. The black rice was cultivated in average area (0.24 ha)

and 55 per cent of total growers were organically grown the black rice in relatively small area.

Factors identified to change the income

The factors like education, gender, organic motive of production and land size were found to be significant and responsible to changing in the income of black rice producers. The result found that negative value (-0.077) of inverse mills ratio revealed the negative influence of disturbance terms on the income of black rice producers. Value of the marginal effect showed that increase in level of education was responsible to enhance the income by 2.73 per cent since it was helpful for learning technical skills of production. Gender of farmers showed negative influence on the income as if male farmer producing the black rice decrease their income by 7.07 per cent. Generally, black rice production is having less requirement of labour and input materials since female farmers were effectively produced black rice at low cost of production. The organic farming of black rice production was found to be positive and significant revealed that enhance the income (9.76%) of organic producers of black rice. Although, organic farming was intended to enhance the productivity of black rice ultimately can increase the income of the producers. Area under black rice cultivation was found to be positive and significant revealed that addition of one ha area of

Table 4: Descriptive statistics (explanatory variables) of respondents applied in Heckman selection model (n=120)

Explanatory variables	Types	Parameters	Frequency/ average	Parameter's sign
Education	Dummy	Illiterate-0, primary-1, secondary-2, higher education-3, higher education-4	Illiterate-7, primary-37, secondry-37, higher secondary-35 and Higher education-32	+
Age	Continuous	Age of households (years)	54.07	+
Gender	Continuous	Male-0; female-1	64(53.33)	+/-
Farming experience	Continuous	Farming experience of black rice (years)	9.42	+
Family size	Continuous	Family size of black rice growers (Numbers)	5.56	+
Number of earners	Continuous	Numbers of earners in household	2.41	+
Sharing labour	Dummy	Yes-0, no-1	106 (88.33)	+
Sources of income	Dummy	Farming-0; farming + others-1	86(71.67)	+
Organic farming	Dummy	Yes-0; no-1	66(55)	+
Land (ha)	Continuous	Area of land under black rice cultivation	0.24	+

Source: Author's calculations; Figure in parentheses indicates the percentage of total respondents.

land can enhance the income (9.32%) of black rice producers.

Moreover, larger area under cultivation increases the internal economies of scale thereby can be reduced the cost of cultivation ultimately enhance income of black rice producers (Table 5).

Table 5: Probit model estimates of Heckman selection model (n=120)

Variable	Coefficient	Std. error	Marginal effect
Constant	0.106	0.194	0.1934
Education	0.058**	0.027	0.0273
Age	0.000	0.002	0.0000
Gender	−0.117*	0.070	-0.0707
Farming experience	0.000	0.004	0.0000
Family size	0.000	0.028	0.0000
Number of earners	−0.012	0.053	-0.0515
Hiring labour	−0.079	0.103	-0.1022
Sources of income	−0.003	0.080	-0.0732
Organic farming	0.251**	0.097	0.0976
Land (ha)	0.699***	0.093	0.0932
Lamda	−0.077	0.431	-0.4278

*Source: Author's calculations; ***,**,* indicates significance level at 1%, 5% and 10%, respectively.*

Extent of changing the income

In order to examine the extent of change in the income, the OLS method was applied in second stage of the model. The result showed that number of earners of a household were found to be positive and significant which intended to enhance the income (53.70%) of black rice producers. However, it was reflected negative impact in first stage of model. Income of non-agricultural enterprises was found to be helpful to timely application of agricultural practices, increase the yield and ultimately enhance the income of farmers. The non-agricultural sector provides the employment throughout the year so farmers were engaged in off season of farming. Organic black rice production was also found to be positive and significant since those farmers who had organically produced the black rice increase their income with 4.60 per cent. Even similar view urged by farmers that black rice is produced high yield in organic farming condition than the inorganic production. Yield of black rice is reduced with application of inorganic fertilizers due to the incidence of disease and pest on crop. Black

rice possesses the anthocyanin help to reduce the incidence pest and disease of crop while inorganic application increases the incidence thereby reduce the yield ultimately income of farmers (Table 6).

Table 6: OLS estimates of Heckman selection model (n=120)

Variable	Coefficient	Std. error	z
Constant	1.558	1.419	1.098
Education	−0.064	0.183	−0.350
Age	−0.019	0.016	−1.236
Gender	0.358	0.442	0.811
Farming experience	0.003	0.031	0.108
Family size	−0.045	0.161	−0.283
Number of earners	0.537*	0.280	1.913
Sources of income	−0.297	0.440	−0.675
Organic farming	0.046**	0.525	1.994
Land (ha)	−0.284	0.341	−0.832
sigma	0.352		
rho	−0.221		
Censored observations	9 (7.5%)		

*Source: Author's calculations; **,* indicates significance level at 5% and 10%, respectively.*

CONCLUSION

The black rice production in Manipur is associated with the state's cultural value. It uses as for name sake at various cultural festival and traditional ceremonies of the state. Majority of farmers were found be cultivating black rice in small area while others were produced the same in business motive in relatively large area. The education, gender, organic farming and land were identified as factors showing positive and significant impact on income of black rice producers. More educated farmers can be secured more income from black rice production should be engaged in black rice production. Black rice farming can be emerged as a major source of income for state youth and will be helpful for reducing the unemployment of the state. Organic production of black rice can be encouraged, which has high potential in enhancing the yield, profit and ultimately income of the farmers. The farmers should produce black rice in relatively larger area which would help in reducing the cost of cultivation and thereby increase their profits in black rice cultivation.

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