

Livelihood Security Determinants of the Organic Farm Household in Sikkim, India: Ordered Logistic Regression Approach

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Authors' contributions

This work was carried out in collaboration between both authors. Author SC designed the study, performed the statistical analysis and wrote the first draft of the manuscript. Author RS assisted in analysis and refined the manuscript. Both the authors read and approved the final manuscript.

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ABSTRACT

Aims: The study employed ordered logistic regression to assess the determinants of livelihood security of the organic farm households in Sikkim (India).

Place and Duration of Study: The study was conducted in three blocks of East Sikkim district (viz. *Martam, Nangdok* and *Ranka*) between January and December 2019.

Methodology: Multistage sampling technique was adopted for the study. Three blocks were selected and from each block 2 villages were selected at random. At the last stage 150 respondents were selected from 6 villages using random proportional sampling. Ordered logistic regression was applied to assess the determinants of the livelihood security.

Results: Landholding, distance to market and possession of livestock were the significant determinants of livelihood security for the organic farm households in Sikkim.

Conclusion: Livelihood security of the organic farm households in Sikkim was influenced significantly by the determinants like landholding, access to market and possession of livestock. Therefore, livestock rearing practices should be encouraged among the farmers and up to some

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extent livestock incentives must be given to the farmers of the region. Besides markets for organic products should be encouraged at block level respectively by the central or the state government so that farmer can access to their input and output easily.

Keywords: East Sikkim district; livelihood security; ordered logistic regression; organic farming.

1. INTRODUCTION

Organic farming (OF) is an agricultural production system that sustains the demands of production of healthy and safe food, without dependence on chemical fertilizers, using organic matter and bio-fertilizers, cultivating with reduced tillage, environmentally safe pest management and the adoption of integrated farming systems [1]. OF has the potential in contributing towards rural development and food production, enhancing productivity, farmer income and food quality [2,3]. It is an important agribusiness for farmers, owing to the premium returns from organic products [4]. It also has a significant advantage which encompasses environmental protection and a higher resilience to environmental changes, increasing farmers' income and reducing external input cost, enhancing social capacity, increasing employment opportunities and enhancing food security by increasing the purchasing power of the people [5]. Organic farming can substantially contribute to farmers' food security and improve farmers' livelihood [6]. Sustainable livelihoods of marginal farmers can be obtained by organic farming as it has high potential in fulfilling the livelihood indicators (economic security, food security, educational security, health security, habitat security and social network security). By adopting multi-cropping in one to two acres would improve food-security and safety, reduce the expenses of the household and might decrease health care expenditures for small farmers thus increasing the possibility to live self-sufficiently [7] as organic products are usually more expensive than conventional products [8] and is more profitable due to its higher price premiums [9]. Organic farmers often receive higher and more stable prices for their products [10] and incurred lower cost because of the cheaper organic inputs [11], which increases economic benefits such as saving money by reducing input cost [12]. In addition, the consumers exhibit higher willingness to pay for organic products [13]. Organic farming contributes in supporting livelihoods, sustained food security by improving nutrition intake, enhancing biodiversity, and also in reducing

vulnerability to climate change [14]. It also has higher bargaining power, better access to credits and markets, the chance to exchange knowledge and experiences, increase employment opportunities in rural areas and allow farmers to afford better education and health services due to higher incomes [15]. A number of factors influenced the livelihood security of the farm households including the age, education, gender, household size [16,17,18,19]. So, it is necessary to know the factors influencing the livelihood security of the organic adopters in Sikkim but hardly no such attempt has been made to evaluate it. so, the study has been made to evaluate the determinants affecting the same.

2. MATERIALS AND METHODS

2.1 Sampling

Multistage sampling technique was adopted for the study. East Sikkim district was selected randomly as all the districts in the state were practicing organic farming. Three blocks namely *Martam* and *Nangdok* and *Ranka* were selected randomly. From each block two villages were selected randomly, *Upper Marchak* and *Lower Marchak* from *Martam* block, *Upper Nangdok* and *Lower Nangdok* from *Nangdok* block and *Upper Lingdum* and *Lower Lingdum* from *Ranka* block respectively. From the selected blocks 2 villages were selected at random. At the last stage 150 respondents were selected from 6 villages using random proportional sampling.

2.2 Data Analysis

The livelihood security determinants were analysed using ordered logistic regression. In case of ordered logit we introduce a latent variable y_i^* which is not observed variable; however the properties of the variable are useful and intuitive.

- $y = 0$; if household's livelihood security level is low
- $y = 1$; if household's livelihood security level is moderate

- $y = 2$; if household's livelihood security level is high

Thus, the latent continuous variable model specification (including the logistic error term) is described as:

$$y_i^* = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \dots + \beta_n x_{ni} + \varepsilon_i$$

Whereas the observed ordered categorical variable y_i model specification is described as

$$\frac{pr(y_i > j)}{pr(y_i < j)} = \exp \{ - \gamma_j + \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \dots + \beta_n x_{ni} \}$$

Where,

- y_i = livelihood security
- x_{ni} = determinants
- β_0 = intercept
- β_n = coefficients to be estimated
- ε_i = error terms

However, the difference between the security level is unknown though the variables are inherently ordered resulting in low, moderate and high. By introducing threshold variables of γ_1 and γ_2 we will be able to formulate the formal relationship between the latent (y_i^*) and observed (y_i) model specification as:

$$y_i = 0 \text{ if } y_i^* \leq \gamma_1$$

$$y_i = 1 \text{ if } \gamma_1 \leq y_i^* \leq \gamma_2$$

$$y_i = 2 \text{ if } y_i^* > \gamma_2$$

Where γ is an unobserved parameter that is estimated jointly with β .

Independent variables used in the model

The dependent variables for the model were the livelihood security level coded by dummy variables '0' for low, '1' for moderate and '2' for highly secured. The explanatory variables were taken up by reviewing the earlier studies based on the determinants of the livelihood security. The measurement and expected sign of the explanatory variables included in the model are given in Table 1.

3. RESULTS AND DISCUSSION

Before running the Ordered Logistic Regression model, one has to check whether the assumptions hold true. Most common

assumptions were no multicollinearity and proportional odds. Multicollinearity occurs when the independent variables are highly correlated with each other. Applying the rule of thumb, if Variance inflation factor (VIF) of the variable exceeds 10, that variable is said to be highly collinear. One could use Tolerance (TOL) as a measure to detect multicollinearity. The closer TOL to zero, the greater the degree of collinearity of that variable with the other regressors. The TOL closer to 1, the greater the evidence that the variable is not collinear with the other regressors [20]. Ordered logistic regression cannot be applied if the multicollinearity problem is detected. The proportional odds assumptions assumed that the slope coefficient which describe the relationship between the low secured to moderately secured categories of the response variables are the same with the low secured to highly secured

Perusal of Table 2 depicts that the independent variables are free from the problem of multicollinearity as both the Tolerance (TOL) and Variance inflation factor (VIF) are within the range. TOL values are all closer to 1 signifying the greater evidence that the variables are not collinear with other variables. Similarly, all the VIF values are less than 10 denoting the absence of multicollinearity.

Perusal of Table 3 revealed that general model with Chi-Square value 12.03 with the p-value of 0.36 which was greater than 0.05 level of significance and we failed to reject the null hypothesis, thus concludes that the assumption holds true.

Perusal of Table 4 revealed that land holding, access to market and possession of livestock were the significant factors affecting the livelihood security of the organic farm adopter. With a unit increase in landholding the ordered log odds of being in higher level *i.e.* from low to moderate and low to highly secured level increase by 6.68 given all of the other variables are held constant. Larger farmers are associated with higher possibility to produce more food, with greater income which increases availability of capital that could increase the probability of investment in purchase of farm inputs which in turns increases food production and hence ensuring food security of farm households.

Table 1. Description of variables included in ordered logistic regression model

Variables	Description	Expected Outcomes
Age	Respondent's age in years	±
Family size	Number of Household member	±
Gender	1 if household head is male, 0 otherwise	±
Educational status of the household head	Literate =1, Illiterate =0	+
Total farm Income	Total farm income (INR)	+
Land holdings	Actual land holding in hectare	+
Farming experience	Number of years	+
Possession of livestock	1 if households owned livestock, 0 otherwise	+
Access to nearest market	Households access to the market (Km)	-
Access to credit	1 if the household has access to credit, 0 otherwise	±
Pest and disease	1 if food shortage is caused by pest and disease, 0 otherwise	-

Table 2. Multicollinearity test for organic adopter

Variables	TOL	VIF
Household size	0.67	1.48
Age of the Respondent	0.54	1.83
Gender	0.96	1.04
Education of the respondent	0.85	1.17
Total farm income	0.77	1.30
Land holding	0.92	1.08
Possession of livestock	0.94	1.06
Access to nearest market	0.95	1.04
Access to credit	0.95	1.05
Pest and disease	0.98	1.02
Farming experience	0.54	1.86

Table 3. Test of parallel lines

Model	-2 Log Likelihood	Chi-Square	df	p-value
Null Hypothesis	253.66			
General	241.63	12.03	11	.36

Also, as the distance to market increases the probability of being in a higher level of livelihood security decreases. This may be due to poor road conditions in the areas, the distance of the households to the market facilitates the buying of households needs and selling of their produce. The coefficient estimates indicate that with one km increase in distance access to market the ordered log odds of being in low from moderate and low to high level livelihood security decreases by 0.71 given that all of the other variables are held constant. Similar result was obtained by [21,22] who reporting that proximity to the road and market centre creates access to additional income through non-farm employment

opportunities, easy access to information for inputs [23] also reported that nearer the market distance, the level of crop diversification increases.

For the possession of livestock, dummy values have been assigned to households who possess livestock as 1 and households who do not possess livestock as 0. This is the ordered log-odds estimate of comparing households who do not possessed livestock to household who possessed livestock on expected livelihood security level when the other variables in the model held constant. The ordered log odds for household who do not possessed livestock being

Table 4. Summary of ordered logistic regression

	Predictors	Estimate	Std. Error	p-value
Threshold	[Livelihood security= .00]	-3.00	1.65	0.07
	[Livelihood security = 1.00]	-0.45	1.63	0.78
Location	Household size	0.01	0.16	0.97
	Age of the household head	-0.05	0.03	0.13
	Total farm income	0.00	0.00	0.88
	Landholding	6.90***	2.00	0.00
	Access to market distance	-0.71***	0.11	0.00
	Farming experience	0.01	0.05	0.81
	[Gender=.00]	-0.09	0.35	0.80
	[Gender=1.00]	0 ^a		
	[Education=.00]	-0.20	0.45	0.65
	[Education=1.00]	0 ^a		
	[Possession of livestock=.00]	-0.75**	0.36	0.04
	[Possession of livestock=1.00]	0 ^a		
	[Access to credit=.00]	0.45	0.36	0.21
	[Access to credit=1.00]	0 ^a		
	[Pest and disease=.00]	-0.22	0.34	0.52
[Pest and disease=1.00]	0 ^a			

Note*** and **indicate 1 per cent and 5 % level of significance

a. This parameter is set to zero because it is redundant

in a higher livelihood security level is 0.75 less than the household who possessed livestock when other variables in the model are held constant.

4. CONCLUSION

The study concluded that landholding, access to market distance and possession of livestock were significant determinants influencing the livelihood security of the organic farm households in Sikkim. From this findings it has been recommended that the livestock rearing practices should be encouraged among the farmers and up to some extent livestock incentives must be given to the farmers of the region besides markets for organic products should be encouraged at block level respectively by the central or the state government so that farmer can access for their input and output easily.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Pimentel D, Hepperly P, Hanson J, Douds D, Seidel R. Environmental, energetic, and economic comparisons of organic and conventional farming systems. *Bio Science*. 2005;55:573–582.
2. Tal A. Making conventional agriculture environmentally friendly: Moving beyond the glorification of organic agriculture and the demonization of conventional agriculture. *Sustainability*. 2018;10:1078.
3. Brzezina N, Biely K, Helot A, Kopainsky B, Vervoort J, Mathijs E. Development of organic farming in Europe at the crossroads: Looking for the way forward through system archetypes lenses. *Sustainability*. 2017;9:821.
4. Yadav DS, Sood P, Thakur SK, Choudhary AK. Assessing the training needs of agricultural extension workers about organic farming in the North-Western Himalayas. *J. of Organic Syst*. 2013;8:17–2.
5. Jouzi Z, Azadi H, Taheri F, Zarafshani K, Gebrehiwot K, Passel SV, Lebailly P. Organic farming and small-scale farmers: main opportunities and challenges. *Ecological Econ*. 2017;132:144-154.
6. IFAD. Organic agriculture and poverty reduction in Asia: China and India focus. Thematic evaluation, International Fund for Agricultural Development (IFAD). Report No. 1664;2005.
7. Udin N. Organic farming impact on sustainable livelihoods of marginal farmers in shimoga District of Karnataka. *American J. of Rural Dev*. 2014;2(4):81-88.

8. Katsarova I. Organic food: helping EU consumers make an informed choice. European Parliamentary Research Service Briefing; 2015.
9. Crowder DW, Reganold JP. Financial Competitiveness of Organic Agriculture on a Global Scale. Proceeding of the National Academy of Sciences. 2015;112(24):7611-7616.
10. Bolwig S, Gibbon P, Jones S. The economics of smallholder organic contract farming in tropical Africa. World Dev. 2009;37(6):1094-1104.
11. Valkila J. Fair trade organic coffee production in Nicaragua--Sustainable development or a poverty trap? Ecol. Econ. 2009;68(12):3018-3025.
12. Rundgren G, Parrott N. Organic agriculture and food security. IFOAM; 2006.
13. Stevens-Garmon J, Huang CL, Lin BH. Organic Demand: A Profile of Consumers in the Fresh Produce Market, Choices. The American Agricultural Economic Association. 2007;109-116.
14. Shukla UN, Mishra ML, Bairwa. Organic farming: current status in India. Popular Kheti. 2013;1(4):19-25.
15. Elzakker V, Eyhorn FB. The organic business guide. Developing sustainable value chains with small-holders, first ed. IFOAM; 2010.
16. Bashir MK, Schilizzi S, Pandit R. The determinants of rural household food security in the punjab, pakistan: an econometric analysis. Working Paper 1203. School of Agricultural and Resource Economics; 2012.
17. Birthal PS, Negi DS, Jha AK, Singh D. Income Sources of Farm Households in India: Determinants, Distributional Consequences and Policy Implications. Agric. Econ. Res. Rev. 2014;27(1):37-48.
18. Abdullah ZD, Ahmad W, Ali S, Din IU, Ilyas A, Shah T. Factors affecting household food security in rural northern hinterland of Pakistan. J. of the Saudi Society of Agric. Sci. 2017; 30:1-10.
19. Mohammed D, Bukar U, Umar J, Adulsalam B, Dahiru B. Analysis of food security among smallholder farming households in arid areas of borno state, Nigeria. Continental J. of Agric. Econ. 2014;8(1):1-8.
20. Gujarati DN, Porter DC, Gunasekar S. Basic Econometrics. McGraw Hills Education (India) private limited P-24, Green Park Extension, New Delhi; 2014.
21. Khatiwada SP, Deng W, Paudel B, Khatiwada JR, Zhang J, Su Y. Household livelihood strategies and implication for poverty reduction in rural areas of central Nepal. Sustainability. 2017;9(4),612:1-20. DOI:10.3390/su9040612
22. Haile F. Factors affecting women farmers' participation in agricultural extension services for improving the production in rural district of dendi west shoa zone, ethiopia. J. of Culture, Society and Dev. 2016;21:30-41. ISSN 2422-8400.
23. Aheibam M, Singh R, Feroze SM, Singh NU, Singh RJ, Singh AK. Identifying the determinants and extent of crop diversification at household level: An Evidence from Ukhrl District, Manipur. Econ. Affairs. 2017;62(1):89-95.

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