Drivers of Choosing Crop Diversification Practice: Empirical Evidence from Jammu and Kashmir

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Abstract:

Crop diversification is the most important risk management strategy. It reduces the risk of total crop failure and provides the alternate means of improving the living standard by generating income. Moreover, it enables the farmers' to grow surplus products for sale at market. Increased production from varied cropping pattern and increased production stability are the probable explanation for improved income as a result of crop diversification technique. The present study employed Tobit model to identify the factors that drive households' decision to diversify crops and the level of crop diversification stimulated by the decision to diversify in the state of Jammu and Kashmir. The study revealed that education, experience of household head, availability of irrigation are played a positive and significant role to diversify cropping pattern, while distance of market and age of household head are negatively impacted.

Key Words: Risk, Management, Diversification, Agriculture, Tobit model.

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Introduction

Agriculture is the primary sector of economy and hence basis of supply of food for the human population. It is one of the most important human occupations, its origin dating back to the Neolithic Revolution. In fact, engagement in farming activities is considered the beginning of human civilization and an experience in group living. It has held a crucial place in the economy and culture of Jammu and Kashmir State. It plays very important role for the development of state's economy. It is vital for food and nutritional security. It can contribute to spurring of growth,

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reducing poverty and sustaining the environment. State is endowed with varied agro-climatic conditions or geo-features thus different regions has its own cropping pattern, growing a variety of horticulture crops like fruits, vegetables, plantation crops, floriculture etc which determine their productivity profits. Apart from this, well known spices like saffron and black Zeera are also cultivated in some pockets of the state (**Majid Hussain, 2003**). Though climate change and variability is major threat to agricultural development and extensively it influences the agriculture at large. The improved agricultural technologies are not alone a measure research success rather deteriorating crop yields, increased agricultural risks, diminishing soil fertility and environmental degradation are the main challenges that must be held for yielding good research results. This continues to threaten societal goals of improving food, income and nutrition security which are the foundation elements of sustainable and productive farming system. Moreover, owing to its peculiar topography, rugged terrain, extreme weather conditions etc, the state has suffered a lot on account of agriculture development. Agricultural risks are exacerbated by a variety of factors, ranging from climate change and variability, frequent natural disasters, uncertainties in yields and prices, weak rural infrastructure, imperfect markets and lack of financial services including limited span and design of risk mitigation instruments such as crop diversification technique, credit and insurance. Therefore, significant agriculture transformation in the state is essential to hold out for the emerging challenges.

The introduction of crop diversification is not a new agricultural practice but climate change has made it popular as it significantly reduces its risks associated with agriculture and hence improves soil fertility, generates sufficient employment and increase farm income etc. Crop diversification can be introduced through rotation, inter-cropping and is the technological approach of climate supported smart agricultural practice that help the households to overcome these challenges.

Crop diversification is a risk management strategy for the farming community and an important step for poverty alleviation and transition from subsistence to commercial agriculture. It is also observed as one of the most environmentally viable, cost effective and balanced way of reducing uncertainties' in agriculture. Crop diversification as a best strategy has achieved important societal goals like immense crop productivity, farm income etc. It plays vital role in fighting against diseases, pests and also suppresses the weeds, volunteer crops and more importantly it reduces probability of total crop failure. Crop diversification besides increasing production,

improving crop yield and increasing income has direct influence on food availability and nutrition. Moreover, crop diversification allows more efficient utilization of agro-ecological processes, increase farm income which in turn improves the purchasing power of the households **(Chand Ramesh, 1999).**

Crop diversification is considered as important agriculture practice which on the one hand, helps the cultivators to improve farm income, reduce risks associated with agriculture, improves food security and on the other hand, provides more diversified food items to the consumers (**Deshpande, et al., 2007**). The prominent arguments in favour of diversification are to increase farm income, generate additional employment, and stabilize farm income overtime and to conserve natural resources (**Sharma, 2007**). The overall benefits of crop diversification mostly in agricultural ridden areas is to tackle the problems of unemployment which is becoming the burden for every society and that too becomes a hurdle for the most countries to develop.

Against this back drop, the focus of this study is on an agriculturally developed and advanced region, Jammu and Kashmir, with an aim to help farmers to have more income by reducing their dependence on outside sources instead helping them for adopting the new measures of diversification which will help in promoting the export alternative.

Research Methodology

Research methodology is the procedure to systematically solve the research issue. It is a way, structure, method for examination conceived so as to get replies to the research inquiries. The present study utilizes primary sources of data for evaluation and analysis. Moreover, present study is purely empirical in nature and is mainly concerned with in-depth investigation of farmers' decision- making process relating to determinants that force the farmers to diversify their crops. In this regard, this study has analysed the factors which determine the probability of farmer's decision to diversify in Jammu and Kashmir.

For the present study, multi-stage cluster sampling method was adopted to select final units of population. Anantnag, Shopian, Kulgam, Reasi, Rajouri and Udhampur were purposively selected on the basis of maximum cultivator population. Before collecting the formal survey, the structured interview schedule was pre-tested by interviewing 30 farmers to generate clarity, validity and also sequence.

Moreover, in order to obtain a proper sample size Krijcie-Morgan formula is used. A sample size of 380 was obtained through this method. This Sample size has been distributed among different districts (*Anantnag, Shopian, Kulgam, Reasi, Rajouri and Udhampur*) for survey on the basis of their proportion of cultivators from these zones.

However, Tobit regression was applied to analyse covariates of crop diversification and its intensity. The variable used to measure crop diversification is a modification of the Simpsons index that lies strictly between zero and one. The diversity index is censored because some of its values cluster at the limit (i.e, 0 for complete specialization or 1 for perfect diversification). Thus for this reason, it is not appropriate to use a classical regression model for this purpose. Hence, opting for other econometric model- censored regression model.

Censored regression model refers to a model in which we observe the dependent variable only if it is above some cut off level. Tobit model is a special case of censored regression models that arise when the dependent variable is limited (or censored) from above and/or below. It is a non-linear model which employed maximum likelihood estimation technique which estimates the likelihood of crop diversification and its intensity. This model is appropriate since the dependent variable is an index which takes values between 0 and 1 inclusive. The dependent variable of the model can be either left-censored, right censored, or both left censored and right censored, where the lower and/or upper limit of the dependent variable can be any number. The standard Tobit model can be defined as follows for observation (farmer) that is:

$$Y_i^* = X_i\beta + \mu_i$$

$$Y_i = \begin{cases} Y^* \ if \ Y^* > T \\ T_y \ if \ Y^* \leq T \end{cases}$$

In this Tobit model we assumed T= 0 (zero) i.e. the data are censored at 0. Thus, we have

$$Y_i = \begin{cases} Y^* \ if \ Y^* > 0 \\ 0 \ if \ Y^* \leq 0 \end{cases}$$

Where, **u ~ N (0,Σ2), X** and **β** are vectors of explanatory variables and unknown parameters, respectively. The **y*** is a latent variable and **y** is the debit amount. In the present study we use the functional form of the censored tobit model as below:

$$SID = \beta_0 + \beta_1 AEG + \beta_2 SEX + \beta_3 EDU + \beta_4 EXP + \beta_5 MRTD$$
$$+ \beta_6 FARMSIZE + \beta_7 IRRI + \beta_8 MACH + \mu_i$$

Where

SID= Value of Simpson Diversification Index

AGE = Age of household head (year)

SEX = Sex of household head (male-1, female-2)

EDU = Education of household head (Level)

EXP = Experience in cropping of household head (Year)

MRTD = Distance of market (Km)

FARMSIZE = Farm Size (cultivated area in Kanal)

IRRI = Dummy for irrigation (if yes=1 otherwise=0)

MACH = Dummy for Own Machinery (if yes=1 otherwise=0)

β_0, β_{1-7} and μ_i are constant, regression coefficients and error terms respectively.

Results and Discussion

Agriculture is the most important industry of the people in the State of Jammu and Kashmir. It plays a very prominent role in its economic development and in removing rural poverty. Agriculture has always been one of the key occupations that serve mankind, both in terms of livelihood and employment.

Table 1: Cropping pattern of Jammu and Kashmir

Crop	Area (Hectares)	Share (%)
Rice	283443	24.1
Bajra	13869	1.2
Maize	295174	25.1
Wheat	290301	24.7
Barley	6760	0.6
Millets/other Cereals	9102	0.8
Pulses	18893	1.6
Sugarcane	45	0.0
Condiments and Spices	2399	0.2
Fruits & Vegetables	132071	11.2
Other food crops incl. Ragi	8723	0.7
Oilseeds	54714	4.6
Dyes & Tanning Materials	3688	0.3
Fodder crops	45870	3.9
Other non-food crops incl. oats	11974	1.0
Gross cropped area	**1177026**	**100.0**

Source: Land use statistics 2016-17, Directorate of Economics & Statistics, Govt; of J & K.

Crop diversification in any particular geographical area is based on the changing social, economic, technological, geographical and institutional structure of that region. Major underlying factors which are conceived to be of great importance in determining the allocation of land resources among competing crops are prices and yields of different crops, level of irrigation, availability and variation of other agricultural inputs (pattern of agricultural implements, varieties of seeds, synthetic fertilizer etc.) and geographical characteristics of the respective region. Moreover, we can say that Crop diversification is impacted by various variables such as age, occupation, gender, family size, experience, educational qualification, farm size, irrigation, farm machinery, access to fertilizer, soil fertility, seed quality, road length etc.
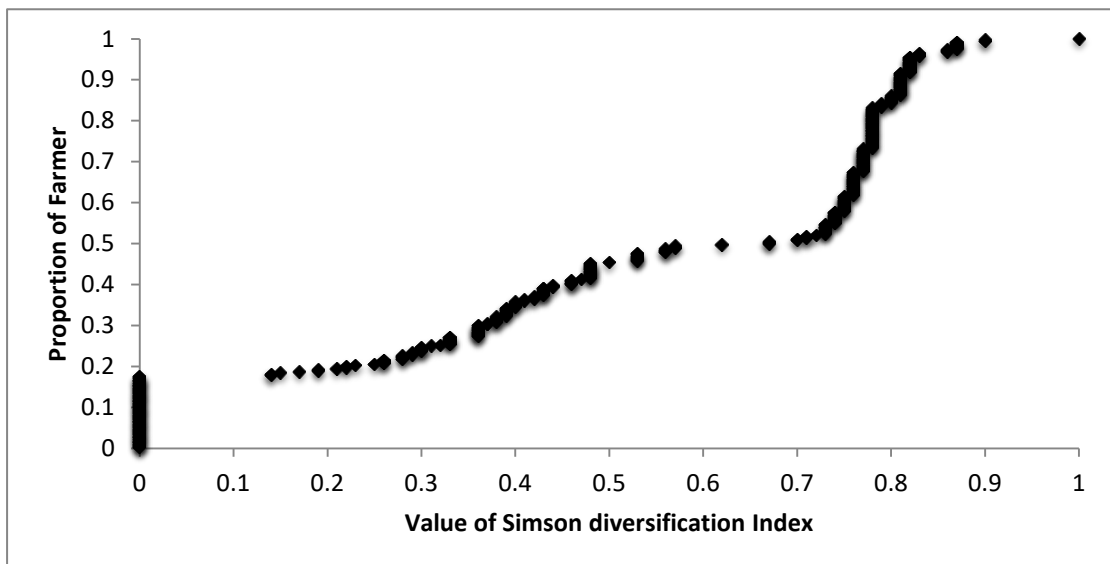
Fig. 1- Cumulative distribution of farmers according to diversification index

Crop diversification depends on various quantitative and qualitative factors; some of them might be difficult to measure. Having the advantage of primary information from the household data, the list of variables used in the analysis and their impact on crop diversification is discussed below. The magnitude of diversification is measured by statistical tool- Simpson's index to know the factors influencing the likelihood of farmer's decision to diversify. Using Simpson's Index the crop diversification index has been calculated.

Table No. 2: Summary Statistics of Sample Households

Sample Statistics					
Variable	**N**	**Mean**	**Std. Dev**	**Minimum**	**Maximum**
SDI	380	0.51808	0.30277	0	1.0
Age	380	48.81316	9.33823	19.0	76.0
Gender	380	1.04474	0.20700	1.0	2.0
Education	380	2.31842	0.86025	1.0	4.0
Experience	380	23.38684	7.64312	4.0	40.0
Market Distance	380	6.43289	2.88662	1.0	18.0
Machinery	380	0.69737	0.46000	0	1.0
Farm Size	380	15.54868	12.53132	2.0	120.0
Irrigation	380	0.80526	0.39652	0	1.0

The magnitude and the determinants of diversification at the district level have been carried out using farm level information collected through the interview schedule. The researcher has tested the variables that are considered important for diversification towards the high value crops. The table presents that variables like education, farming experience, farm size, irrigation, have positive association with crop diversification whereas negative association with age, market distance and farm machinery. These factors lead to the intensification of crops and rapid changes in the existing cropping pattern.

Table No.3: Tobit Regression Results for Determinants of Crop Diversification

Particulars	Estimate	Standard Error	t Value	Probability Pr> |t|
Dependent Variable	Crop Diversification Index			
Intercept	1.2608	0.5123	2.46	0.014
Age of Household head (Year)	-0.0383	0.0153	-2.50	0.012**
Gender of household head	0.2480	0.2626	0.94	0.345
Education Level of Household head	0.1593	0.0800	1.99	0.046**
Cropping Experience of Household head	0.0431	0.0179	2.41	0.016**
Distance of Market (Km)	-0.0775	0.0307	-2.53	0.012**
Farm Size (Kanal)	0.0143	0.0062	2.32	0.021**
Dummy for Irrigation (If yes=1,otherwise= 0)	0.6812	0.2490	2.74	0.006*
Dummy for Machinery (If yes=1 otherwise= 0)	-1.0142	0.3380	-3.00	0.003*
Sigma	0.4658***			
Log Likelihood	101.72009			
AIC	-183.44018			

Source: Author's estimation

Note: Significance level- (p≤0.01) *; (p≤0.05) *

As already highlighted that Cropping pattern of any particular region is dependent to a great extent on various natural, demographic, socioeconomic, institutional and technological structure like physiography, climate, irrigation, soil, capital, machinery, workforce etc that determines the agricultural land use, cropping pattern and agricultural processes of that region. The availability of socio-economic infrastructure is solely not meant for the development until and unless it is adequately available on minimum need based criteria in a particular region. Infrastructure plays a strategic role in producing large multiplier effects in the economy with growth in agriculture (**Mellor, 1976**). It is the key for economic growth and plays noteworthy role in setting an enabling platform for sustainable economic development (**Demurger, 2001**). Inadequate infrastructure also represents a major cause for loss of quality of life, illness and death (**Doeksen et al., 1998**). Economic infrastructure promotes economic activities that make business activity possible such as communication, transportation and distribution networks, financial institutions and markets.

Agriculture is important industry of the people in the State of Jammu and Kashmir. It plays a very prominent role in its economic development and in removing rural poverty. Agriculture has always been one of the key occupations that serve mankind, both in terms of livelihood and employment. It needs effective utilization of technology to accelerate the production and employability of people. Technology has substantial impact on agriculture. Adoption of modern agricultural technologies has the potential to contribute to the sustainable farming system. Usage of modern technology and innovative techniques and methods will prove to be the beneficial for the improvement in the living standard of people and in eradicating the problem of poverty.

Moreover, the development of institutional factors like credit and market access plays an important role in encouraging diversification. Credit can influence diversification indices in a different way. Credit is believed to increase the risk bearing ability of farmers, therefore one can expect a positive effect of institutional credit on agricultural diversification provided increase in diversification fulfils the objective of rational farmers. Credit reflects farmers' dependence on market purchased input, which in turn highlights the commercialization of agriculture in region. Similarly, market infrastructure and agricultural diversification has a direct

link in order to have maximum profit and price response with institutional and infrastructural arrangements.

Tobit model has been applied to investigate the relationship between these factors and crop diversification technique. The results are summarized and presented in table above.

The empirical results of the censored regression model highlighted the factors affecting the crop diversification practice. It is depicted that age of the household is significantly and negatively affecting the crop diversification technique. It means as the age of the household head increases, his/her physical strength tends to decline and this adversely affects the cultivation of additional crops. Older farmers' have less expertise in the market risk management and hence rely on traditional methods. Besides, older farmers' may see farming as a way of life, whereas young farmers' may see more it as a business opportunity. Male headed households have significantly and positively affected the likelihood of crop diversification at 5 per cent level of significance. This is due to the fact that access of resources like land is an important indicator for the welfare of farmers'. Women rarely own or have control over land and other assets. Thus, the inequality that exists between male and female in accessing and having resources determine that male household will respond to diversification positively.

Education as an asset in human capital has been regarded as a development factor as it is expected to increase labour productivity and reduce income inequality and poverty. The above results revealed that the effect of education was found to have significant and positive bearing on the probability of crop diversification. This finding is due to the fact that educated household's decision for sowing a particular crop would be governed by sound economic estimates of costs and benefits of that crop. Educated households are more progressive about the existing options of demand and supply and also are more familiar to innovative techniques than the illiterate households. As number of years of education of household head increases so does his work related skills and his ability to acquire new skills will increase.

The farming experience of the farmers' is positively related to the likelihood of household's decision to adopt crop diversification practice as shown in table above. This is due to the fact that experienced households have more knowledge about new techniques of farming and also profitable crops and it may influence to diversify crops.

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It is also evident from the results that the size of farm is positively related to diversification implies that an increase in farm size, increases the diversification to a greater extent and it is significant at 5 per cent of significance. It shows that diversification is more common among large farmers as compared to small farmers, because large farmers have more land resources to divide among various crops and pay more attention to farming than any other off-farm activities.

Innovative infrastructure especially road connectivity provides better opportunity to farmers to market their produce, receive better price for their produce and minimizes the role of middlemen. Road facility reduces the transport costs of inputs and outputs, thereby increasing profit margin of farmers. Access to infrastructural variables like Roads and markets were observed to be multi-collinear and therefore only distance to market was kept among independent variables. From the results, it is found that market distance influences the crop diversification decision of farmers significantly and negatively. Therefore, the farmers' having their farms near to market are more likely to diversify as compared to those having their farms far-away from the market.

Modern agricultural technology has been another essential factor for raising agricultural productivity of food and other crops. Important technological factor which influences the practice of crop diversification is farm assets. Farm assets (Bullocks, Tractors, Water Pumps, storage house etc) are important factor determining the probability of farmer's decision to diversify. Households who possess their own farm assets and equipment enable them to perform more diversified activities (both horizontal and vertical diversification). It is evident from the results; the coefficient of Farm machinery is negative and statistically significant. It implying that own farm machinery leads to lower crop diversification. The farmers' who own their farm machinery, the probability of farmers' decision to diversify decreases, while as who are using hired farm assets, the probability increases.

Another technological component- access to irrigation facility plays vital role in scripting the spectacular success story of agriculture. The progress in growth rate of agriculture is made possible by adequate irrigation facilities. Nature and availability of irrigation facility is one of the most important technological change which has remarkable impact on cropping pattern of any region, wherever assured irrigation facility is available, farmers' not only grow different crops, but avoids uncertainty of the output and thus reduces risk. From the results, it is evident that the coefficient of

access to irrigation is statistically and expectedly positive implying that access to irrigation leads to higher crop diversification. The probability of crop diversification increases by 5 per cent in presence of adequate irrigation facility. This finding could be explained by the fact that the decision to diversify need support in terms of irrigation development.

Apart from these factors that determine the extent and pace of diversification, agro-climatic conditions are an important determinant of diversification. In fact, these conditions are basic in determining economic rationality of expansion and diversification (**Gupta and Tiwari, 1985**). The soil and climatic conditions for diverse regions are such that help distinctly to cropping pattern. Agriculture and climate change are inter-related processes. Climate change may bring benefits in agriculture production but there will also be a range of adverse impacts due to reduced water availability and extreme weather conditions. The recent problems of climate change prevailed in Jammu and Kashmir witnessing in the form of floods, droughts and snow storms were quite feasible for the diversification of the crops in terms of high value crops. The unseasonal rainfall during the year 2004 was the hall mark as far as farming community of Jammu division is concerned. However, the farmers of Kashmir valley faced drastic situation in September 2014 when Kashmir region was hit by the severe floods of the history. During the survey, it was found that the farmers are converting paddy fields into orchards as this is economically more beneficial.

Conclusion

Crop diversification is regarded as one of the most important risk management tool which enhances farmers' income and ensures food diversity across the globe. It envisages changes in the production activities of farm sector and adjusts the changes in the appropriate economic environment and to face the problems of determined unemployment and degradation of natural resources. This approach is mainly related to increase economic growth in farm and non-form sectors for the productive employment. It is also concerned to stand out the lucrative and advantageous in overcoming the burden of farmers' for preparing them to develop such crops which has both demand and supply in the long run. Besides, crop diversification is helpful to mitigate risks arising from climate changes. Thus, considering the multi-dimensional importance of crop diversification as a risk mitigating tool and an engine for ensuring food security, the present study was conducted to assess the factors that determine the crop diversification at farm level. The results indicate that the different factors of crop

diversification have different effect on propensity to diversify and intensity of diversification at household level.

References

Ashfaq, M., Hassan, S., Naseer, Z. M., Baig, A., &Asma, J. (2008). Factors Affecting Farm Diversification in Rice-Wheat: *Pakistan Journal of Agricultural Sciences*, 45 (3), 45-47.

Birthal, P.S., A.K. Jha, P.K. Joshi and D.K. Singh (2006), "Agricultural Diversification in North Eastern Region of India: Implications for Growth and Equity", *Indian Journal of Agricultural Economics*, Vol.61, No.3 July-September, pp. 328-340.

Chand Ramesh (1999), "Agricultural Diversification in India," *Mittal Publications, New Delhi*

Demurger, Sylvie, 2001. "Infrastructure Development and Economic Growth: An Explanation for Regional Disparities in China?" Journal of Comparative Economics, Elsevier, vol. 29(1), pages 95117, March.

Desai, B.M. and Namboodiri, N.V. (1997) Determinants of total factor productivity in Indian agriculture, *Economic and Political Weekly*, **37**(53): A165-171.

Doeksen G A., Johnson T, Biard-Holmes D and Schott V (1998) A healthy health sector is crucial for community economic development, The Journal for Rural Health, Winter 1998, Vol. 14, No.1 pp. 6672

Gupta, R.P. and Tewari, S.K., (1985), "Factors Affecting Crop Diversification: An Empirical Analysis". Indian J. Agric. Econ., 40 (2): 304-309.

Hazell, P. 1987. Sustainability Issues in Agricultural Development: *Proceedings of Seventh Agriculture Sector Symposium*, World Bank, Washington DC

Majid Hussain, 2003. Majid Hussain, *Geography of Jammu and Kashmir* (New Delhi: Rawat Publications, 2003), p. 137.

Mandal R and Bezbaruah MP (2013) Diversification of Cropping Pattern: Its Determinants and Role in   Flood affected Agriculture of Assam Plains. *Indian Journal of Agricultural Economics* 68(2)169-181.

Mellor, J.W. (1976). The New Economics of Growth: A Strategy for India and Developing World, A Twentieth Century Food Study. Cornell University Press.-Ithaca, N.Y.

Pope, R. D. and Prescott, R., (1980), "Diversification in relation to farm size and other socio-economic characteristics": *Amer. J .Agr. Econ.*, 62: 555-559.

Samuelson, P. (1967) A General Proof that Diversification Pays. *Journal of Financial Quantitative Analysis*.2 (1):1-13.

Sichoongwe, K, L Mapemba, D Ng'ong'ola, and G Tembo (2014) The determinants and extent of crop diversification among smallholder farmers. A case study of Southern Province, Zambia, *IFPRI working paper* 05

Singh, J. (1976). An Agricultural Geography of Haryana, *Vishal Publication, Kurukshetra,* pp. 253- 290)

Xu, Z., Guan, Z., Jayne, T. S., & Black, R. (2009) Factors Influencing the Profitability of Fertilizer Use on Maize in Zambia: *Policy Synthesis Food Security Research Project – Zambia.*