Ind. Jn. of Agri. Econ.
Vol.68, No.2, April-June 2013

Diversification of Cropping Pattern: Its Determinants and Role in Flood Affected Agriculture of Assam Plains

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ABSTRACT

Using farm level survey data, the paper examines the determinants of cropping pattern diversification, and evaluates the role of crop diversification in increasing farm income in flood affected agriculture in the plains of Assam. The results of censored regression on a cross section of 342 randomly selected farms suggest that crop diversification has been adopted as a mechanism to cope with limits imposed by flood. Moreover, the results of a linear regression led to the conclusion that crop diversification has an important role in enhancing farm income. The results reported in the study are quite interesting and useful, and offer important policy suggestions.

Keywords: Flood, Risk, Crop diversification, Farm income.

JEL: C13, C24, Q12, Q15, Q16

I

INTRODUCTION

The cropping pattern of a region has important implications for its agricultural growth in general and livelihood of millions of farmers. Apart from agro-ecological conditions and different socio-economic, infrastructure and institutional factors, the cropping pattern decision of the farmers is largely influenced by their exposure to risks arising out of various sources. The two main sources of risk to which a farmer is usually exposed while carrying out his agricultural operations are production risk and price risk. For farmers in the flood plains the production risk is further accentuated by the possibility of floods felling standing crops and damaging crop areas from prolonged water logging. As per risk theories, diversification helps to minimise the risk involved in an enterprise or activity. Accordingly a diversified cropping pattern may be resorted to by farmers as a strategy for coping with flood related risk.

Assam has remained more agrarian than the rest of the country in the sense of having higher share of agriculture in domestic product and a larger proportion of workforce being engaged in agriculture than the country average. While abundance of monsoon precipitations has enabled the farming communities in the fertile river valleys of the Brahmaputra and Barak[1] to depend on paddy cultivation as the principal source of livelihood, excessive precipitations in the wider region often result in damaging floods, especially for those who inhabit close to the rivers.

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There are visible signs of changes in the cropping pattern in the state away from *kharif* crops to *rabi* crops. The inducement of cropping pattern changes arises from the twin objectives of mitigation of risk associated with farm practices and maximisation of farm income. The present paper seeks to examine the determinants of cropping pattern diversification in flood affected agriculture in the plains of Assam using farm level survey data. It tries to explore specifically if flood induced limits[2] and production risk have any role in determining the level of crop diversification. It also examines the role of crop diversification in enhancement of farm income, if any, in the said area. Further, policy interventions for capacitating farmers for coping with flood risk and associated damage have also been explored.

The paper is organised in six sections. Section II provides a brief backdrop as regards cropping pattern choice as a strategy to cope with risk. Section III deals with data source and methodology used. Determinants of crop diversification and its contribution to farm income are sought to be explored with suitable econometric modeling in Section IV. Section V reports the estimated results and their discussion whereas Section VI sums up with conclusion and policy implications.

II

CROPPING PATTERN CHOICE AS A STRATEGY TO COPE WITH RISK:[3] A BRIEF BACKDROP

With a view to minimising risk with agricultural practices, especially in the absence of any crop insurance programme, farmers often tend to resort to self-insurance in their own capacities by way of adjustment in cropping pattern across crops and/or season. In a study on the drought hit state of Rajasthan, Rathore (2004) found how a correct crop mix and cropping pattern has been successfully adopted by the farmers as one of the few strategies to cope with risk of crop loss due to drought. The farmers were growing those crops which are highly drought resistant. They adopted a mixed cropping system which allowed them to follow a flexible production schedule in terms of their responses to varying rainfall patterns.

According to Mandal (2010) and Goyari (2005), to avoid crop losses due to frequent floods many farmers in the state of Assam have adopted a risk averse strategy as a result of which there has been a decline in the acreage of *kharif* food grains, which are grown in the rainy season and hence largely affected by flood, and an increase in the acreage share of *rabi* food grains and vegetables.

Moreover, a diversified cropping pattern is found as an important strategy to cope with risk and uncertainty associated with agriculture due to climatic and biological vagaries (Shiyani and Pandya, 1998). Gupta and Tewari (1985), in a study on Allahabad, found that the farmers who perceive greater risk resort to diversification of crops more as a means of risk aversion. Blade and Slinkard (2002) identified risk reduction as one of the factors promoting diversification of crops. According to them, diversification allows a producer to balance low price in one or two crops with reasonable prices in others. In another study on Kerala, Mahesh (1999) observed that in order to spread risk arising out of fluctuations in the prices of agricultural products the farmers diversified their cropping pattern which helped minimise risk due to crop failures and price fluctuations.

III

DATA AND METHODOLOGY

3.1 *Data Sources*

This paper is based on primary data collected from four non-contiguous districts of the Brahmaputra and the Barak valleys of Assam with the help of multi-stage random sampling. They are Dhubri, Morigaon, Dibrugarh and Cachar which fall in four different agro-climatic conditions of Lower Brahmaputra Valley Zone, Central Brahmaputra Valley Zone, Upper Brahmaputra Valley Zone and Barak Valley Zone respectively. In the first stage from each district three Agricultural Development Officer’s (ADO) circles have been selected of which one is chronically flood prone, one is occasionally flood prone and one is flood free. This selection in relation to flood proneness has been done after consultation with the officials of district agriculture offices and other informed sources. In the second stage from each ADO circle two villages have been selected purposively such that they fulfill the condition of flood proneness mentioned above.[4] In the final stage 10 per cent of the farm (cultivator) households have been selected at random from each village. A total of 342 farm households, thus selected, were surveyed using a pre-tested question schedule.

3.2 *Methodology*

Cropping pattern means the proportion of total cropped area under different crops at a point of time in a particular geographical area. The cropping pattern in a particular region is subject to changes which may lead to either concentration around a few crops or diversification of crops, depending on the nature of such changes.

Diversification of crop may be defined as reallocation of resources, mainly cultivable land, at the disposal of farmers to accommodate a more diverse cropping pattern. There are several measures of crop diversification being used in a number of empirical studies (Shiyani and Pandya, 1998; Gupta and Tewari, 1985). They are Herfindahl Index, Ogive Index, Entropy Index, Modified Entropy Index and Composite Entropy Index. Each of these measures has its merits and limitations. In the context of the present study the Composite Entropy Index (CEI)[5] appears to be most suitable. The index, indicated by Y has been computed using the following formula.

$$Y = -\left[\sum_{i=1}^{N} P_i \log_N P_i\right]\left[1-\left(\frac{1}{N}\right)\right] \qquad \dots. (1)$$

where, P_i represents acreage proportion of the ith crop in total cropped area and N stands for number of crops grown. The CEI increases with rise in diversification and vice versa. Its value ranges between zero and one. It takes into account the shares of each crop in total cropped area as well as number of crops grown.

To identify the determinants of cropping pattern diversification Tobit model (censoring on both sides) has been used whereas the role of cropping pattern diversification in farm income has been explored with the help of a multiple linear regression model. The details of the models have been spelt out in the following section.

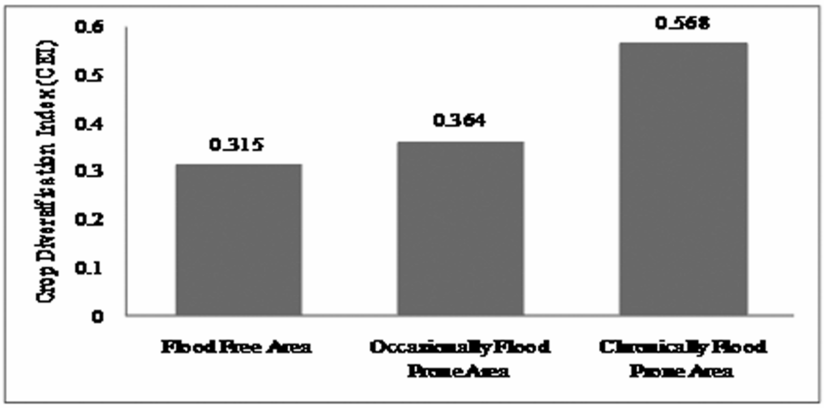
IV

ECONOMETRIC MODELING

4.1 Determinants of Crop Diversification: The Role of Flood Proneness

Since the focus of interest is whether crop diversification has been practiced for mitigating flood induced limits and risk, flood proneness naturally arises as the principal independent variable for regression analysis. To distinguish between different levels of exposure to flood risk dummies have been used to categorise the sample farms as located in chronically flood prone, occasionally prone and flood free areas.[6] Taking flood free areas as the reference category two dummies F_1 and F_2 have been taken, where $F_1 = 1$ for occasionally flood prone areas, 0 otherwise and $F_2 = 1$ for chronically flood prone areas, 0 otherwise. For reasons explained in Section 2 a priori the coefficients of F_1 and F_2 are expected to be positive and that of F_2 to be numerically larger than that of F_1. A preliminary investigation of sample data shows that average value of crop diversification index is the highest in chronically flood prone areas and lowest in the flood free areas (Figure 1).

The available theoretical and empirical literature also reflects some other factors such as farm size, share cropping, household size, experience of head of the farm household, irrigation, access to institutional credit, access to extension services etc. that influence the nature and extent of crop diversification (Joshi *et al.*, 2004; Vyas, 1996; Gupta and Tewari, 1985; Anosike and Coughenour, 1990; Pope and Prescott, 1980). To ascertain the relation between flood proneness and extent of crop diversification more rigorously, it is necessary to control these factors. Hence these factors have been inducted into the regression model in the form of control variables. Definitions of the explanatory variables (both independent and control) along with their expected impact on cropping pattern diversification are shown in Table 1.[7]



Source: Field survey.

Figure 1. Extent of Crop Diversification Across Categories of Flood Proneness

TABLE 1. DEFINITION OF EXPLANATORY VARIABLES AND THEIR LIKELY IMPACT ON CROP DIVERSIFICATION

Variable (1)	Definition (2)	Expected sign of coefficients (3)
Occasionally flood prone area (F_1)	= 1 for occasionally flood prone area, 0 otherwise	+
Chronically flood prone area (F_2)	= 1 for chronically flood prone area, 0 otherwise	+
Farm size (FS)	Size of farm in hectare	+/-
Share cropping (SC)	Area under share cropping without cost sharing as percentage of net sown area	-
Household size (HS)	Number of members in the farm household	+/-
Experience (AGE)	Age of the head of farm household in years	+
Irrigation (IR)	Gross irrigated area as percentage of total cropped area	+
Access to institutional credit (CR)	= 1 for farm households with access to institutional credit, 0 otherwise	+
Extension services (EXT)[9]	Total score on access to extension services	+
Morigaon (L_1)	=1 for Morigaon, 0 otherwise	+/-
Dibrugarh (L_2)	=1 for Dibrugarh, 0 otherwise	+/-
Cachar (L_3)	=1 for Cachar, 0 otherwise	+/-

For an elementary verification of relevance of these control variables in the present empirical context of Assam the scatter of each of these factors, except 'access to credit', against the extent of crop diversification were scrutinised. 'Access to credit' being a categorical variable, its relation with crop diversification has been seen by comparing the average values of the diversification index across categories. All these graphs show some relation of the dependent variable with each of these factors along the expected lines.

As the sample observations come from four different agro-climatic zones of the state, location dummies are also necessary to account for the interference of specific agro-climatic conditions in farmers' ability to diversify cropping patterns. Hence taking Dhubri as the base category, three location dummies, outlined as L_1, L_2 and L_3 in Table 1, have been included as the remaining explanatory variables.

Specification of the Model

To identify the determinants of crop diversification a multiple regression model has been used. Here the dependent variable crop diversification index being bounded between 0 and 1 a linear regression model is not suitable as the predicted value from a linear regression will not necessarily be contained within the interval of 0 and 1. In a similar context Pope and Prescott (1980), Mishra *et al*. (2004), Weiss and Briglauer (2002), Papke and Wooldridge (1996) have used logit transformation[8] to address the problem. Even a logit transformation may not be appropriate in the present context because in a cluster of observations the dependent variable takes the value 0. Hence a Tobit model with censoring on both sides has been formulated.

The model is formulated with the help of latent variable Y_j^* which can take any possible value but is not always observable. Incorporating the explanatory variables defined in Table 1, Y_j^* has been formulated as shown by Equation (2).

$$Y_j^* = \gamma_0 + \gamma_1 F_{1j} + \gamma_2 F_{2j} + \gamma_3 FS_j + \gamma_4 SC_j + \gamma_5 HS_j + \gamma_6 AGE_j + \gamma_7 IR_j + \gamma_8 CR_j + \gamma_9 EXT_j + \gamma_{10} L_{1j} + \gamma_{11} L_{2j} + \gamma_{12} L_{3j} + u_j \quad \text{.... (2)}$$

The observed dependent variable Y_j (i.e., value of crop diversification index for the j-th sample farm) is linked to the latent variable Y_j^* as per the following formulation.

$Y_j = 0$ for $Y_j^* \leq 0$

$Y_j = Y_j^*$ for $0 < Y_j^* \leq 1$

$Y_j = 1$ for $Y_j^* > 1$

The random disturbances u_js are assumed to be independently normally distributed with zero mean. Finally the Maximum Likelihood estimates of the parameters have been obtained using STATA II.

4.2 Crop Diversification and Farm Income

Apart from being a risk mitigation strategy a move towards diversifying the cropping pattern, especially to high value crops, may be conducive to enhancement of income generation in the farms. Thus it is quite pertinent to look into whether crop diversification contributes to generation of higher income in the farms in the study area.[10] Gross income generated in the farm has been captured by gross value added in the farm in the reference year. The costs of intermediate inputs have been subtracted from gross value of output produced to find out gross income generation. While calculating gross value of output and costs of intermediate inputs, the amount of non-marketed output and non-purchased intermediate inputs have been valued at their existing market prices. Gross income generated per hectare of net sown area (in thousand Rupees) has been used as the dependent variable (FI) while investigating the impact of crop diversification on farm income generation in a multiple regression framework. Apart from the independent variable crop diversification index (Y) other explanatory variables that appear as control variables are farm size (FS), irrigation (IR), share cropping (SC), access to extension services (EXT), access to institutional credit (CR) and location-specific characteristics captured by dummies (L_1, L_2, L_3).

Specification of the Model

The impact of crop diversification on farm income has been explored with the help of a multiple linear regression model of the form specified by Equation (3).

$$FI_j = \tau_0 + \tau_1 Y_j + \tau_2 FS_j + \tau_3 IR_j + \tau_4 SC_j + \tau_5 EXT_j + \tau_6 CR_j + \tau_7 L_{1j} + \tau_8 L_{2j} + \tau_9 L_{3j} + \varepsilon_j \quad \text{.... (3)}$$

Equation (3) has been estimated by ordinary least squares method assuming that the error term ε_j's are independently normally distributed with zero mean.

Moreover, since the models (Equations 2 and 3) specified above are based on cross-section data the presence of heteroscedasticity could not be ruled out. Running a White's test revealed presence of strong heteroscedasticity. Therefore, the final estimates were obtained after affecting White's heteroscedasticity correction procedure. The descriptive statistics of the variables (excluding dummies) are presented in Table 2.

TABLE 2. DESCRIPTIVE STATISTICS OF THE VARIABLES (NON-CATEGORICAL)

Variables (1)	Unit (2)	Minimum (3)	Maximum (4)	Mean (5)	Standard deviation (6)
Y	-	0	0.828	0.393	0.26
FI	Thousand Rupees	0.620	20.986	6.028	3.180
FS	Hectare	0.13	6.56	10.04	6.79
IR	Per cent	0	100	28.89	31.60
EXT	Score	0	5	0.31	0.81
AGE	Years	18	80	46.32	11.59
SC	Per cent	0	100	9.38	22.44
HS	Number	2	16	6	1.99

V

RESULTS AND DISCUSSION

The estimated results of the Tobit model are presented in Table 3. The prime focus of the study being the connection between crop diversification and flood proneness, it is of interest to note that the coefficient of the dummy F_1 has not turned out to be significant whereas the same for F_2 has been found to be positive and significant. This implies that the given values of the control variables crop diversification is significantly higher in chronically flood prone areas than in flood free areas. Thus our results suggest that farmers in areas where floods are regular have adopted a diverse and intense cropping pattern to extract the most out of their land resources during the period which is free from floods. It is quite possible that alluvial depositions as the floods recede replenish soil fertility to make such intensive use possible. Farmers of this category are affected by floods more in terms of reduced time availability for cropping than uncertainty. It is the farmers in occasionally flood prone areas who are critically exposed to the uncertainty arising from non-regular nature of flood. However, our results do not lead to a definite conclusion as to whether crop diversification has been adopted in such areas to cope with flood risk.

TABLE 3. RESULTS OF CENSORED REGRESSION (TOBIT) OF CROP DIVERSIFICATION

Explanatory Variables/Particulars	Estimated Coefficients/Values
(1)	(2)
Occasionally flood prone area (F_1)	0.017
	(0.031)
Chronically flood prone area (F_2)	0.21***
	(0.03)
Farm size (FS)	0.03***
	(0.01)
Share cropping (SC)	-0.0003
	(0.0004)
Household size (HS)	-0.008
	(0.006)
Experience (AGE)	0.0003
	(0.001)
Irrigation (IR)	0.002***
	(0.0005)
Access to institutional credit (CR)	0.061**
	(0.026)
Extension services (EXT)	0.006
	(0.01)
Morigaon (L_1)	-0.21***
	(0.03)
Dibrugarh (L_2)	-0.37***
	(0.03)
Cachar (L_3)	-0.36***
	(0.03)
Constant	0.49***
	(0.05)
$F(12, 329)$	29.05***
Pseudo R^2	0.97

Notes: (a) Figures in parentheses represent White's heteroscedasticity corrected standard errors.
(b) ** and *** Significant at 5 and 1 per cent level respectively.

Among the control variables the coefficients of farm size, irrigation, access to institutional credit and three location dummies have come out to be significant. Coefficient of farm size being significant and positive implies that farms with larger size are able to diversify their cropping pattern to a greater extent. Diversification, especially towards high value commodities requires more capital, improved technologies, quality inputs and better support services. Lack of access to these facilities may constrain diversification for small farms (Birthal *et al.*, 2006).

The coefficient of irrigation is statistically highly significant and expectedly positive implying that access to irrigation leads to a higher crop diversification. This is because provision of irrigation helps the farmers to do cultivation in the *rabi* season as well.

The coefficient of access to institutional credit being significant and positive implies that access to institutional credit capacitates farmers to practice crop diversification to a greater extent. Most of the farmers are poor and hence access to credit from institutional sources may enable them to carry on farming operations in a better way by providing them financial assistance to purchase the necessary inputs at a relatively lower rate of interest. This will reduce the liquidity constraints and may increase the capacity of the farmers to pursue a diverse cropping pattern.

Dummies for capturing variations in broad agro-climatic conditions have also been found to be statistically significant with negative coefficients. Thus crop diversification tends to be lower in other agro-climatic zones compared to control category of Lower Brahmaputra Valley Zone. Moreover, it is worth noting that the three coefficients are markedly different from one another which imply that within these three agro-climatic zones also, differences in the agro-climatic conditions have an impact on the farmers' ability to diversify their cropping pattern. High pseudo R^2 values accompanied by highly significant F statistic indicate that the estimated regression gives a good fit to the data.

The regression results of income generation in the farms (FI) have been reported in Table 4. The positive and significant coefficient of crop diversification index suggests that greater the level of crop diversification more is the farm income. Likewise access to irrigation is found to be positively impacting upon farm income. This is because access to irrigation not only facilitates farming in the *rabi* season but also use of high yielding varieties of seeds and chemical fertilisers, which in turn contributes towards increase in the productivity of crops.

On the other hand, the estimated results suggest that size of farm and share cropping without cost sharing (taken as a proxy for share cropping as mentioned earlier) negatively impacts upon farm income. This implies that controlling for other factors, smaller farms are able to generate more income per hectare of net sown area than the larger farms. The impact of share cropping without cost sharing on the income generation in farms is obvious because of the fact that the share cropper tenants are basically concerned with subsistence crops rather than high value crops. Moreover, since they have to share a part of output without cost being shared by the landlord, it may not provide sufficient incentive for them to put their best efforts.

The signs of the estimated coefficients of location-specific dummies and their levels of significance suggest that farm income is higher in Cachar than Dhubri. But no such comment can be made about Morigaon and Dibrugarh because of the coefficients of L_1 and L_2 being non-significant.

TABLE 4. REGRESSION RESULTS OF INCOME GENERATION IN FARMS

Variables/Particulars (1)	Estimated Coefficients/Values (2)
Crop diversification (Y)	6.29*** (0.75)
Farm size (FS)	-0.325* (0.175)
Irrigation (IR)	0.02*** (0.005)
Share cropping (SC)	-0.01* (0.006)
Extension services (EXT)	0.086 (0.165)
Access to institutional credit (CR)	-0.245 (0.34)
Morigaon (L_1)	-0.389 (0.373)
Dibrugarh (L_2)	-0.518 (0.376)
Cachar (L_3)	3.04*** (0.53)
Constant	2.32*** (0.60)
Adjusted R^2	0.44
F (9, 332)	29.51***

Notes: a) Figures in parentheses represent White's heteroscedasticity corrected standard errors.
b) ***, ** and * Significant at 1, 5 and 10 per cent level, respectively.

A reasonably good adjusted R^2 value coupled with highly significant F statistic indicate a good fit of the model.

VI

CONCLUSION AND POLICY IMPLICATIONS

Crop diversification has been adopted quite extensively by the farmers in chronically flood prone areas, where floods are rather certain but the annual cropping time available to the farmers is limited to flood free months. This diversified cropping pattern may be ascribed to their compulsion of extracting the maximum possible utilisation of land in the flood free period. Indeed regular replenishment of soil nutrients from alluvial deposition left behind by floods probably enables farmers to make intensive use of land with a diversified cropping pattern. On the other hand, cropping patterns in occasionally flood prone areas, where uncertainties arising from flood-proneness is greater, are not significantly more diverse than in flood free areas. Hence the findings of the study do not allow us to conclude that farmers in Assam plains have been diversifying their cropping patterns to cope with flood related production risks. Instead it can be said that farmers who are restrained by floods in a regular manner have gone for an intensive and diversified cropping pattern to counter the flood induced restrictions on them. Moreover, a diversified cropping pattern is found to contribute to farm income generation in the study area. Thus although cropping pattern diversification cannot be said as a risk minimisation strategy in the study area it clearly helps farmers raise their farm income. This has significant implications for making farming a remunerative profession in the state.

Since among the other factors access to irrigation and institutional credit favourably influence crop diversification policy interventions may be required for enhancing farmers' access to both these facilities. It is worth mentioning that in case of both irrigation coverage and credit dispersal to agriculture, Assam lags behind most of other states of India (CMIE, 2009). The Reserve Bank of India has initiated action plan for enhancing financial inclusion, and the northeast part of India including Assam finds special mention in that scheme (RBI, 2006). However, these initiatives are yet to make significant inroads into Assam's agriculture. As for irrigation, there is a need not just for investment in capacity expansion but also putting suitable institutions in place to ensure better utilisation of the installed capacity (Dutta and Bezbaruah, 2003). The geographical conditions in flood prone areas, especially chronically flood prone areas pose additional challenge in creating and maintaining irrigation facilities. In this regard innovation in agricultural engineering is needed.

Received March 2012. *Revision accepted May 2013.*

NOTES

1. Surrounded by the Eastern Himalayan Range and the Borail Range, Assam plains comprised of the Brahmaputra and the Barak Valleys named after the main rivers flowing through them.

2. Because of possibility of recurrent floods felling on the standing crops and damaging crop areas from water logging for a prolonged period during the *kharif* season the annual cropping season may be limited to flood-free months.

3. Here, the terms 'risk' and 'uncertainty' have been used interchangeably. The term 'risk' has been used more in *Neumann-Morgenstern* sense rather than that of *Knight*.

4. Villages are taken purposively because of the fact that an ADO being chronically flood prone, for example, does not imply each and every village under it is exposed to the same degree of flood proneness.

5. The CEI has its root in Entropy Index (EI) put forward by Theil (1971, p. 640) which is given by $EI = -\sum_{i=1}^{N} P_i \log P_i$, where P_i represents proportion of total cropped area under crop 'i' and N is total number of crops grown. The major limitation of EI is that it does not give standard scale for measuring the degree of diversification as the upper bound of EI depends on N and the base chosen for taking natural logarithm (Shiyani and Pandya, 1998). Although this shortcoming is sought to be overcome through some modification in EI by taking N as the base of the logarithm (also known as modified entropy index) it is not sensitive to changes in the number of crops. The usefulness of modified entropy index gets limited in comparing degrees of diversification when different number of crops is grown across time, space and households. Hence further adjustments have been made in EI with a product of (1 – 1/N) which yields the CEI as follows

$$CEI = -\left[\sum_{i=1}^{N} P_i \log_N P_i\right]\left[1-\left(\frac{1}{N}\right)\right]$$

The first use of this index for the study of Crop diversification has been traced by Shiyani and Pandya (1998). Subsequently this index has also been used by others (Palanisami *et al.*, 2011).

6. In chronically flood prone areas floods occur almost every year, even several times in a year with varying timing and intensity. Sometimes floods occur as early as in April or as late as in October. In occasionally flood prone areas floods do occur but not every year while the flood free areas are by and large free from floods.

7. Here a notable omission from the factors influencing a farmer's decision regarding crop diversification is the relative expected returns from different crop choices that may be available. The relative returns will be influenced, among other things, by the relative price movements of the crops. However, the present study being based on data from a cross section survey is not equipped to take account of the relative price movements, which are better observed in a time series or panel data set. Unfortunately time series data on the prices of all the crops investigated were not available.

8. Let $Y = \frac{1}{1 + e^{-(\alpha + \beta X)}}$, where Y is the diversification index and $0 \leq Y \leq 1$. Then Logit transformation may be done in the following manner ---

$$\log\left(\frac{Y}{1-Y}\right) = \alpha + \beta X$$

The dependent variable, which is now log of the odd ratio, can take any value between $-\infty$ to $+\infty$. Hence, ordinary least square can be used for estimation.

9. In the household schedule used for collecting primary data six questions related to the farmers' interaction with the extension agency were included. The farmers' responses to these queries were codified into scores. The total score for farming household on these questions could vary from 0 to 6, depending on the level of its interactions with the extension agencies. This total score is used as a measure of access to extension services.

10. The entire income generated in the farms, however, does not necessarily accrue to the farmers. It may entirely accrue to a farmer who cultivates own land using family labour without hiring any agricultural capital goods like tractor or power-tiller. But for a farmer using hired labour, hired capital and/or leased-in land apart from its own inputs of land and labour, income generated in the farm will partly go out in the form of wages and rents paid.

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