Determinants of Crop Diversification and its Impact on Farm Income in a Coastal District of Andhra Pradesh

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ABSTRACT

The process of crop diversification involves a shift of the resources particularly cultivated area from cereals and low value crops to high value crops like fruits and vegetables. The paper aimed to recognise those determinants which influence the farmer's decision to crop diversification and further attempted to identify impact of crop diversification on farm income in East Godavari district of Andhra Pradesh. The study adopted regression analysis to estimate separately the determinants of crop diversification and impact of diversification on farm income. The results of the study found that the only education showed positive influence with determinants of crop diversification. In contrast, the farming experience and share of irrigated area were found to have positive influence with the impact of crop diversification. Size of the land has positively affected both the determinants of crop diversification as well as impact of crop diversification. Farmers who have owned and partially owned land are more likely to diversify crop compared to tenant farmers.

Keywords: *Crop diversification, Determinants, Impact and Regression analysis.*

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 (Monika et al, 2017). Diversification towards High Value Crops (HVC) including fruits and vegetables, compatible with the comparative advantage of the region, is suggested as a viable solution to stabilise and raise farm income (Joshi et al 2004; Brij Bala and Sharma, 2005), increase employment opportunities for small and marginal farmers, boost exports and conserve and enhance natural resource base. Several studies indicate that agricultural development (De Janvry and Sadoulet, 2010, Ravallion and Datt, 1996) and diversification in general and crop diversification in particular (Birthal et al., 2015; Michler 2017) can play role in poverty reduction. This is one way to address the problems of poverty and agrarian crisis. Literature shows that households which grow a diverse set of crops are less likely to be poor than households that specialize in their crop production (Michler 2017; Lathar 1996). Households diversifying towards HVCs are less likely to be poor, the biggest impact being for smallholders (Birthal 2015; Parthasarathy Rao 2006). In this regard it is important to note that doubling income of farmers by the 2022 has been one of the main objectives of the Government of India (Chandrasekhar and Mehrotra, 2016). Thus crop diversification towards high value crops can be one of the effective strategies to realise the objectives of raising farm income (Maila Lama, 2016).

Though several benefits are associated with crop-diversification, several constraints can limit the crop-diversification. These constraints can be agro-

climatic factors of a region, household level and other socio-economic constraints. Keeping this in view the study attempts to identify determinants of crop diversification in East Godavari district and evaluate the impact of crop diversification on farm income in East Godavari district.

MATERIAL AND METHODS

Andhra Pradesh (A.P.) state was selected purposively for the present study. From the A.P State, East Godavari, a coastal district was selected purposely, though the district stood at 4th rank in District wise and sub sector wise Gross Value Added (GVA) in agriculture in the state in 2014-15 & 2015-16, it participated in crop-holiday in 2011-12 year reflecting farmers dissatisfaction with their income. At the district level 79.66 % of area is under rice crop indicating low chance for diversification. Thus the district offers an interesting case study to study constraints and facilitators in crop diversification and effects of diversification on farm income.

Herfindahl Index (HI) was calculated for all the mandals of East Godavari district based on area under different crops in 2014-15. In the next step all the mandals were categorized under 3 groups i.e, high, medium and low diversified mandals based on Herfindahl Index. In the final stage Samalkota mandal from low diversified group, Amalapuram mandal from medium diversified group and Jaggampeta mandal from high diversified group were selected so as to represent mandals with different levels of crop diversification. These mandals also represented three different Zones of East Godavari district. In order to have representation from fourth Zone also i.e Agency area Zone of East Godavari, Rajavommangi mandal was selected (Table 1). This type of mandal selection ensured capturing the agro-climatic contextual diversity in crop cultivation. From each selected mandal, two villages were selected.

A sample of 20 farmers from each of the selected village were selected randomly. Thus a total 160 farmers constituted sample for primary data in present study. Primary data was collected using separate specifically designed and pretested questionnaires for farmers in the year 2015-16.

For measuring the diversification, Herfindahl index was computed at household level, using the formula.

Herfindahl index $(HI) = \Sigma P_i^2$

Where,

$P_i = A_i / \Sigma A_i$

A_i = Actual Area under ith Crop

ΣA_i = Total Cropped Area

HI is sum of squares of acreage proportion of each crop in the total cropped area. In the HI formula P_i represents area proportion of the ith crop in total cropped area. With the increase in diversification, the Herfindahl Index would decrease. Thus the index value ranges from 0 to 1

In order to identify determinants of crop diversification, linear regression analysis was carried out using primary data with the model.

$$Y1 = A + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + ... + b_{13} X_{13} + b_{14} X_{14}$$

Y1 is 1- Herfindahl index (1-HI) whereas A is the intercept. Farming experience, age of the farmer, number of family members participating in agriculture, education, total land in ha, market distance, share of irrigated area, land ownership dummies, credit dummies and mandal dummies were used as explanatory variables.

To know the impact of diversification on farm income, multiple linear regression analysis was carried out using primary data

$$Y2 = A + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + ... + b_{12} X_{12} + b_{13} X_{13}$$

Y2 is Gross returns/ ha whereas A is the intercept whereas explanatory variables used were 1-HI, farming experience, education, total land in ha, fertilizer consumption/ha, share of irrigated area, land ownership dummies, credit dummies and mandal dummies

RESULTS AND DISCUSSIONS

Based on insights drawn from review of literature, the following factors were considered as explanatory variables in identifying the determinants of diversification in the present study, viz. farming experience, age, education, total land of farmer, number of family members participating in agriculture, market distance from village, and share of irrigated area. The expected relation between farming experience and diversification is empirical; similarly the expected relation between age and diversification, education and diversification is also empirical. Some studies indicated that farm size influenced diversification (Joshi et al, 2006 and Monika et al, 2017). To analyze the effect of farm size on diversification in the present study, total land in ha was considered as an explanatory variable. Some studies indicated that higher labour availability in terms of more family labour participation leads to more diversification towards crops like vegetables i.e, labour intensive crops (Joshi et al, 2006). Some studies indicated lower is the market distance higher is the diversification towards fruits and vegetables as there is more demand for these commodities in urban centres and also quick transferability (Ashfaq et.al., 2008 and Monika et al, 2017). Many studies indicated irrigation as a significant determinant of diversification hence share of irrigated area in total cropped area was considered as explanatory variable in the current study (Birthal et.al., 2006 and Monika et al, 2017). To capture the effect of agro ecological diversity on diversification, mandal dummies (MD1, MD2, MD3)

were used. Murali and Vijay (2017) reported that tenancy is constraining diversification. Keeping this in view in the present study effect of tenancy on diversification was analyzed using dummy variables. An attempt has been made in the present study to examine the influence of credit on diversification using dummies. Further the farmers who have taken credit were categorized into farmers taking credit from institutional sources and non institutional sources. Accordingly dummies were introduced in the model, one is for taking loans from institutions, other is for taking loans from private sources.

Among the variables considered in the study five variables were influencing diversification negatively they are farming experience, share of irrigated area, non institutional credit, institutional credit and one mandal dummy. Total land was positively influencing diversification and was significant. Education showed a positive influence on crop diversification but it was not significant. This is in line with expectation that education helps the farmers in taking conscientious decisions and enables them in accessing several facilities which are required for crop diversification. Number of family members participating in agriculture, which represents the assured labour availability, was positively influencing overall crop diversification. This indicates that availability of more family labour induces the farmers to diversify.

It is observed that ownership of land both complete and partial were having positive influence on diversification compared to pure tenants. Non institutional credit was influencing diversification negatively compared to farmers who have not taken any loan. Among dummy variables, only in case of Jaggampeta (MD2) and Rajavommangi mandal (MD3), the mandal dummy effect positive and significant. Age and market distance influenced crop diversification positively but both the variables observed to be non significant. In contrast farming

Table 1. Selection of mandals and villages

Name of the Zone	No. of mandals	Selected mandal	Selected villages
Central Delta Zone (Zone 1)	17	Amalapuram	Palagummi
			Nadipudi
Eastern Delta Zone (Zone 2)	18	Samalkota	Pedabrahmadevam
			Unduru
Upland Area Zone (Zone 3)	18	Jaggampeta	J.Kothuru
			Ramavaram
Agency Area Zone (Zone 4)	11	Rajavommangi	Jaddangi
			Aminabada
East Godavari District	64		

Table 2. Determinants of crop diversification (2015-16).

Herfindahl Index (HI)			
Variables	Coefficients	Standard Error	P-value
Intercept	-0.020	0.153	0.896
Farming experience (years)	-0.001	0.003	0.852
Age (years)	0.001	0.003	0.867
Participation in agriculture (years)	0.044	0.036	0.232
Education(years)	0.001	0.003	0.815
Total land in ha	0.029	0.012	0.015
market distance (km)	0.000	0.005	0.936
Share of irrigated area (%)	-0.001	0.000	0.145
Partially owned (dummy)	0.214	0.043	0.000
Owned (dummy)	0.081	0.035	0.021
Institutional credit (dummy)	-0.031	0.036	0.401
Non-Institutional credit (dummy)	-0.052	0.032	0.098
Mandal D1 (dummy)	-0.037	0.067	0.577
MD2 (dummy)	0.193	0.090	0.034
MD3 (dummy)	0.135	0.055	0.015
Observations	160		
R Square	0.5		
Adjusted R Square	0.45		
Standard Error	0.16		

Table 3. Impact of crop diversification on farm income (2015-16).

Dependent variable : Gross returns/ha			
Variables	Coefficients	Standard Error	P-value
Intercept	-29598.15	8463.08	0.00
1-HI	16226.82	9606.23	0.09
Total land (ha)	2361.11	1408.64	0.10
Share of irrigated area (%)	216.41	59.13	0.00
Fertilizer (kg/ha)	232.59	9.61	0.00
Farming experience (years)	182.92	126.69	0.15
Education(in years)	-19.94	374.28	0.96
Partially owned (dummy)	-3798.87	5380.12	0.48
Owned (dummy)	2631.76	4103.26	0.52
Institutional credit (dummy)	-2937.82	4212.32	0.49
Non-Institutional credit (dummy)	5357.44	3683.09	0.15
MD1 (dummy)	833.75	4278.31	0.85
MD2 (dummy)	-6212.54	5079.89	0.22
MD3 (dummy)	11367.23	5201.83	0.03
Observations	160		
R Square	0.84		
Adjusted R Square	0.82		
Standard Error	18060.68		

experience and share of irrigated area negatively influenced crop diversification. Overall the model was able to explain 50% of variation in crop diversification.

Impact of crop diversification on farm income

For this analysis, gross returns were computed from all the crops grown by each farmer. Analysis clearly showed that gross returns per hectare increased with increase in crop diversification (1-HI). Crop diversification was observed to be statistically significant. These observed results corroborate with expected hypothesis that diversification increases income from crops (Mandal and Bezbaruah, 2013). Gross income per ha was inversely related to education of the farmer but was not statistically significant. Total land in ha, share of irrigated area, fertilizer consumption/ha, farming experience positively influenced gross returns/ha. Out of all these variables

except farming experience, remaining were statistically significant. Among dummy variables, only in case of Samalkota (MD1) and Rajavommangi (MD3) mandal, the mandal dummy effect is positive. In the case of Jaggampeta mandal (MD2), the effect of dummy was negative. Among mandal dummies only MD3 was statistically significant. Among credit dummies, institutional credit dummy influence was negative and credit from non institutional sources was positive on gross returns compared to farmers who have not taken loan. Partial ownership of land negatively influenced gross returns whereas complete ownership of land positively influenced gross returns. The values of R-square and adjusted R-square were found to be 0.84 and 0.82 respectively which are fairly high indicating good explanatory power of the variables included in the model.

CONCLUSION

The study results indicate that crop gross returns as well as crop-diversification varied in different mandals. Diversification showed positive influence on farm income, however due to the constraints, farmers were not able to diversify. In irrigated areas, diversification is less. Soil suitability and tenancy were restricting diversification. Land size showed positive influence on diversification and also on gross returns, hence pooling of land is recommended. And also it is better to promote optimum use of resources in existing cropping pattern for maintaining sustainability of resources as well as income.

LITERATURE CITED

Ashfaq Muhammad, Sarfraz Hassan, Muhammad Zeeshan Naseer, Irfan Ahmad Baig and Javeria Asma 2008 Factors Affecting Farm Diversification in Rice-Wheat. Pak.J. Agri.Sci., 45(3): 91-94

Birthal P S, Jha A K, Joshi P K and Singh D K 2006 Agricultural diversification in north eastern region of India: Implications for growth and equity. Indian Journal of Agricultural Economics, 61(3): 328-339.

Birthal P S, Roy D, Negi, D S 2015 Assessing the impact of crop diversification on farm poverty in India. World Development, 72: 70–92.

Brij Bala and Sharma S D 2005 Effect on income and employment of diversification and commercialization of agriculture in kullu district of Himachal Pradesh. Agricultural Economics Research Review, 18: 261-269.

Chandrasekhar S and Mehrotra N 2016 Doubling Farmers Incomes by 2022: What would it take? Economic and Political Weekly, 51(18): 10-13.

De Janvry, Alain and Elisabeth Sadoulet 2010 Agricultural growth and poverty reduction: Additional evidence. World Bank Research Observer, 251: 1-20.

Joshi P K, Ashok Gulati, Birthal PS and Laxmi Tewari 2004 Agricultural diversification in South Asia, pattern, determinants and policy implications. Economic and Political weekly, 39(24): 2457-2467.

Joshi P K, Laxmi Joshi and Birthal S Pratap 2006 Diversification and its impact on smallholders: Evidence from a study on vegetable production. Agricultural Economics Research Review, 19: 219-236.

Lathar R K, Pandey R N, and Goyal S K 1996 Diversification for enhancing the income on marginal and small farms in Harayana. Indian Journal of Agricultural Economics, 51(4): 691.

Maila Lama 2016 Crop diversification and farm income in the hills of north east India: a case of Arunachal Pradesh. International Journal of Food, Agriculture and Veterinary Sciences, 6(2): 15-21.

Mandal R and Bezbaruah M P 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.

Michler Jeffrey D and Josephson A L 2017 To specialize or diversify: Agricultural diversity and poverty dynamics in Ethiopia. Elsevier Ltd, 89: 214–226.

Monika Aheibam, Ram Singh, Feroze S M, Uttam Singh N, Singh R J and Singh A K 2017 Identifying the determinants and extent of crop diversification at household level: an evidence from Ukhrul district, Manipur Economic Affairs, 62(1): 89-95.

Murali D and Vijay R 2017 Revival of agriculture sector and increasing tenancy in India. Economic and political weekly, 52(31): 18-21.

Parthasarathy Rao P, Birthal P S and Joshi P K 2006 Diversification towards high value agriculture: Role of urbanization and infrastructure. Economic and Political Weekly, 41(26): 2747–2753.

Ravallion, Martin and Datt Gaurav 1996 How important to India's poor is the sectoral composition of economic growth? The World Bank economic review, 10(1): 1-25.

Shiyani R L and Pandya H R 1998 Diversification of agricultural in Gujarat: A spatio-temporal analysis. Indian Journal of Agricultural Economics, 53(4): 627-639.