Economic Affairs, Vol. 62, No. 3, pp. 555-562, September 2017
DOI: 10.5958/0976-4666.2017.00066.3

Influence of Allied and Non-farm activities on the Agricultural Transformation in Karnataka State: An Economic analysis

Gayathri Mohan* and B.V. Chinnappa Reddy

Department of Agricultural Economics, GKVK, UAS, Bengaluru, Karnataka, India

*Corresponding author: gaya3listens@gmail.com

ABSTRACT

The study was carried to analyse the influence of emergence of allied activities (AA) and non-farm activites (NFA) on agricultural transformation across the dryland and irrigated regions of Karnataka. The multi-stage random sampling technique was used to identify the respondents. Four districts namely Chitradurga, Kolar, Hassan and Mandya, corresponding to four different agroclimatic zones in Karnataka were used as the study area. Agricultural transformation index was developed using the Principal component Analysis for the study. This index was used as dependent variable for working out the multiple regression analysis to study the cause-effect relationship between agricultural transformation and the economic parameters associated with emergence of AA and NFA. The study showed that irrespective of the irrigation pattern existing, the dry land as well as the irrigated regions showed a positive agricultural transformation with the emergence of NFA.

Keywords: Agro-climatic zones, agriculture transformation index, allied activities, non-farm activities, principal component analysis, multiple regression analysis

Around 72% of the total working population in India was engaged in agriculture before independence, which confirms that India was an agricultural based economy. But even after 68 years of independence, though the share of agriculture in gross domestic product (GDP) has declined from 50% in 1950 to 16% in 2015, yet even today over 62% of the rural working population are engaged in agriculture as their primary source of livelihood. Emergence of alternate livelihood sources in the form of allied agricultural activities (AA) and non-farm activities (NFA) can be attributed as a coping strategy towards this overdependence. In rural India, typical regional contrast can be seen in the emergence of alternate sources of livelihood across all states. However, whether the emergence of allied and non-farm activities have brought in any transformation to the agriculture sector is a crucial question that needs to be pondered into.

Agricultural transformation broadly refers to the change taking place from the existing agricultural situation in the operational as well as socio–economic strategies of a farmer or farm household owing to certain push and pull factors. The transformation can be broadly analysed emphasising the following concepts:

(a) Subsistence - Commercial (Income concept)

(b) High labour intensive - low labour intensive cropping system (Employment concept)

(c) Traditional - Capital intensive and technology driven agriculture (Investment concept)

The transformation may focus towards the positive or negative side of agricultural development, that is, it may lead to higher income and employment generation or *vice-versa*.

Agriculture activities comprise of the crop cultivation activities carried out by cultivators and agricultural labourers. Allied agricultural activities (AA) refers to activities like livestock rearing, goat and sheep rearing, poultry, sericulture and piggery units which may or may not be related to

agriculture and make use of surplus agricultural resources such as farm labour, fodder grown on farm etc. Rural non-farm activities (RNFA/NFA) may be defined as all income generating activities taken up in rural areas other than agriculture and allied activities. Often the surplus generated from agriculture is inadequate to meet the livelihood requirements. Hence farm families diversify into non-farm activities which may fetch reasonable returns with moderate investment. Farm family members diversify into various non-farm activities to earn additional income to support the family. Common rural non-farm activities include wage labour, petty shop, small trade and business, repair of farm machinery etc which involve comparatively lower initial investment.

This study is a modest attempt to explore the influence of the rural allied and non-farm activities on agriculture. It aims at analysing whether there has been any change or transformation, positive or negative, on agriculture situation of the State

MATERIALS AND METHODS

Keeping in view the objectives of the study, a multi-stage random sampling procedure was adopted for the selection of the districts, taluks, villages and farmers. In the first stage, four districts of Karnataka, namely, Kolar, Mandya, Hassan and Chitradurga from four different agro-climatic zones of Karnataka were selected based on the diversity of the existing irrigation pattern in the regions. Among the four districts, Mandya district was taken as a representative of the Southern Dry Zone and represented the region with surface irrigation facility for crop productio. Hassan district was taken as a representative of Southern Transition Zone and represented the region with both rainfed as well as irrigated cropping system. Kolar district was taken as a representative of Eastern Dry Zone and represented borewell irrigated cropping system and Chitradurga district was considered as a representative of Central Dry Zone representing purely rainfed environment. In the second stage, considering the net sown area and the net irrigated area, three taluks from each district were selected. In the third stage from each sample taluk, one village was selected for the study after discussion with State Department of Agriculture, NGOs and local people regarding the diversity of non-farm activities and allied activities in the region. In the fourth stage, 25 farm households engaged in non-farm activities or allied activities or both non-farm and allied activities were selected using the snow ball sampling technique. Thus, 75 farmers were selected from each district to constitute a total of 300 respondents for the study.

The primary data pertaining to the year 2014-15 were collected from the sample respondents using a well-structured pre-tested schedule through personal interview. The analysis tools used for the study included Principal Component Analysis (PCA) and multiple regression analysis.

Principal Component Analysis

Agricultural transformation is a complex and dynamic process caused and propelled by a plethora of agricultural, economic and social parameters. It is often difficult to disentangle the transformation process in the familiar cause-effect framework unless causative factors are broadly identified to begin with. This reasoning stems from the fact that agricultural transformation is the result of complex interplay of various factors. Therefore, it calls for identification of broad thematic areas and from these broad areas, causative factors can be identified to analyse agricultural transformation in the cause and effect framework. The Principal Component Analysis (PCA) is one such approach which enables to identify broad dimensions through specific variables. This approach is often termed as data reduction process, which enables the researcher to identify the causative factors.

The use of PCA in forming socioeconomic index by combining socioeconomic indicators into a single index has been widely used (Antony and Rao, 2007; Fukuda *et al.*, 2007; Fotso and Kuate-defo, 2005; Havard *et al.*, 2008; Sekhar *et al.*, 1991). In a similar way to the socioeconomic index, an attempt was made to develop a single index for agricultural transformation. The approach of constructing indices built from weights derived from PCA has the ability to explain the inequality or variations across the regions (Krishnan, 2010). Using PCA, an agricultural transformation index was constructed by considering the variables that constitute to agricultural transformation like own land area, leased in area, total operational holding size, irrigated area, rainfed area, area under

cereals, pulses, food crops, fruit crops, vegetables, commercial crops, timber trees and plantation crops, mulberry, agriculture net income, agricultural labour days and agriculture investment. As the variables were not standardized, the correlation matrix was used as input to PCA to extract the components. These variables selected were broadly based on the idea given by FAO in 2012, in response to the "G8 call for a composite indicator on agriculture for food security". The components considered were grouped into four main headings – Food system structure, Institutional framework, Risk and Resilience and Productivity.

The STATA 11 software was used to perform the analysis. As a first step in the computation of a single index, the PCA was carried out and the components with Eigen value greater than one were taken as the contributing components. Following this, the component scores (factor scores) for each sample respondent was derived using STATA commands. The components selected showed different levels of contribution to the total variation and this was captured for calculation of a Non-standardized index (NSI) for each respondent across each district. The formula used was:

$$NSI = \sum_{i=1}^{n} \frac{\text{Percentage of variation explained by component } i}{\text{Total Percentage variation explained by } n \text{ components}} \times \text{Factor score of } i^{th} \text{ component} \quad \ldots(1)$$

Where, i = 1,2,3…n; n = number of components with Eigen value greater than 1.

This index measured the relative agricultural transformation status of each respondent on a linear scale. The value of the index may be positive or negative, which makes interpretation difficult. Hence a Standardized index (SI) was developed using the formula:

$$SI = \frac{(NSI \text{ of respondent } 1 - \text{minimum } NSI)}{(\text{Maximum } NSI - \text{Minimum } NSI)} \times 100 \quad \ldots(2)$$

The value of SI ranged from 0 to 100. The higher value of the index represents a higher transformation and lower value represents a lower level of transformation.

Multiple linear regression analysis

The multiple regression analysis was used to analyse the impact of allied and non-farm activities on agricultural transformation. The agricultural transformation index developed using the PCA for each respondent belonging to the four districts was regressed against the independent variables comprising of household net income from allied activities and household net income from non-farm activities, household net come from allied and non-farm activities, household person-days in allied activities, household person-days in non-farm activities and household person-days in allied and non-farm activities. The function used for the study was:

$$Y_i = a + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 + e \quad \ldots(3)$$

Where,

Y_i = Agricultural transformation index score of each household corresponding to i^{th} district

a = intercept; e = error term

X_1 = Net income per annum from allied activities

X_2 = Net annual income per annum from non-farm activities

X_3 = Net income per annum from allied + non-farm activities

X_4 = No. of person-days engaged in allied activities in the household per annum

X_5 = No. of person-days engaged in non-farm activities in the household per annum

X_6 =No. of person-days engaged in allied activities + non-farm activities in the household per annum

RESULTS AND DISCUSSION

Agricultural Transformation Index

PCA revealed that in Kolar district, 74.85% of the variation existing in agriculture system was explained by the six dimensions (Table 1). Diversity in farming system ranging from subsistence farming to capital intensive farming system was observed among the farmers of Kolar. Thus the agricultural transformation is brought about by capital intensive farming, diversified agriculture, commercial farming as well as rain fed farming

in Kolar district. An insight into the agricultural situation existing in Chitradurga district was given by the five dimensions which ranged from high value fruit crop farming to rainfed agriculture. The five dimensions together explained 78.24% variation in the existing agricultural scenario of Chitradurga.

Thus in Chitraduga, which represents the Central Dry Zone of Karnataka, the transformation in agriculture with respect to income, employment and investment exists but is not on par with the situation in Kolar. This is evident from the dimensional characteristic of the two regions.

In Kolar, four out of five dimensions showed positive agricultural transformation emphasizing higher income and investment aspects while in Chitradurga only two dimensions out of the five dimensions strongly depicted the positive agricultural transformation. This implies that within the dry zones of Karnataka itself, there exists differential transformation in agricultural situation.

In Mandya region, the dimensions ranged from commercial farming to allied enterprise promoting farming. The agricultural dynamics in Mandya displayed more of an established commercial set up where\transformation has taken place among majority of the farmers.

In Hassan district, the dimensions varied from leased in rainfed farming to irrigated farming systems. A predominance of agricultural transformation in the form of commercialization among the farmers of the study area was visible from the results.

Thus in the water abundant regions of Mandya and Hassan there existed agricultural transformation largely brought about by irrigated farming. In Mandya the level of agricultural transformation was not so conspicuous as already a larger proportion of change has taken place there. However in Hassan the level of transformation was noticeable among the seven dimensions explained. The detailed PCA results are given in Appendices 1,2,3 and 4.

Influence of allied and non-farm activities on agricultural transformation in dryland and irrigated regions

The Agriculture transformation index worked out using principal component analysis was used as the dependent variable and regressed against

Table 1: Dimensions of agricultural transformation existing in the study area

Dimensions	Kolar	Chitradurga	Mandya	Hassan
Dimension 1	**Labour and capital intensive farming (29.63)**	Rainfed farming (39.68)	**Irrigated commercial farming (35.32)**	**Irrigated farming (21.01)**
Dimension 2	**Diversified farming (15.16)**	**Irrigated High yielding crop farming (13.27)**	**Rain fed high value crop farming (14.27)**	Subsistence farming (12.81)
Dimension 3	Rain fed farming (15.16)	Less water intensive agriculture (10.27)	Subsistence farming (11.28)	**Diversified farming (10.12)**
Dimension 4	Commercial farming (9.43)	Leased in agriculture (8.43)	Leased in farming (7.22)	Leased in and High value crop farming (8.93)
Dimension 5	High value crop farming (6.90)	High value fruit cropfarming (6.29)	Capital intensive farming (6.67)	Commercial farming (8.08)
Dimension 6	Subsistence farming (6.41)		Allied enterprise promoting farming (6.09)	Plantation and tree crop cultivation (7.99)
Dimension 7				Leased in rain fed farming (5.90)

Note: *Figures in parentheses represent percentage of variation explained obtained through PCA.*
Bold marked dimensions indicate the dimensions showing positive agricultural transformation

the independent variables comprising of income, investment and employment in AA and NFA to analyse the influence of these on agricultural transformation. The results are depicted in Table 2.

In Chitradurga district, significant positive influence of NFA investment was seen on agricultural transformation. One-rupee increase in NFA investment increased the agricultural transformation index by 0.0002%. The NFA investment was thus observed to have a positive influence on agricultural transformation in Chitradurga district.

Both NFA income and AA income were showing a positive effect on agricultural transformation in Kolar district. For every unit increase in NFA income and AA income, the agricultural transformation increased by 0.00008 and 0.0001%, respectively.

In Hassan district, the NFA income and investment were significantly causing agricultural transformation. However, the relation between NFA investment and agricultural transformation showed a negative relationship, indicating that as the investment in non- farm activities increased, there was decline in agricultural transformation. As the investment in NFA increased, the agricultural transformation decreased by 0.0002 units.

But as the income in NFA increased there was an increase in the agricultural transformation index by 0.0005 units. This result indicated that the emergence on NFA activity initially has negative effect on agricultural transformation as capital meant for agriculture is diverted for development of non-farm activities. However, once, NFA activities start yielding returns, the agricultural transformation may pick up by way of increased investment on commercial agricultural enterprises.

However, the income generated from NFA activity influences positively agricultural transformation, thus indicating that surplus income from NFA is used for the positive transformation of agricultural sector in Hassan district. No significant influence of AA was noticed on agricultural transformation.

In the case of Mandya district, NFA investment was showing a positive transformation of 0.0002 percent for every unit increase in investment in NFA.

Table 2: Influence of AA and NFA on agricultural transformation across the study area (dependent variable: Agricultural transformation index)

Particulars	Chitradurga	Kolar	Hassan	Mandya
Intercept	7.37	17.91***	27.21***	14.41**
	(1.13)	(2.94)	(3.84)	(2.00)
NFA income	0.00003	0.000009**	0.00004***	0.000002
	(1.20)	(2.04)	(2.86)	(0.42)
NFA investment	0.00002*	0.00001	-0.00002**	0.00002**
	(1.71)	(1.34)	(-2.14)	(2.43)
NFA employment	-0.000006	-0.0036	0.0069	-0.0075
	(- 0.000)	(-0.46)	(0.48)	(-0.60)
AA income	0.0003	0. 00001*	-0.00002	-0.000007
	(1.37)	(1.92)	(-0.71)	(-0.16)
AA investment	-0.0003	0.0003	0.00004	0.000000007
	(-1.09)	(1.53)	(0.84)	(0.00)
AA employment	0.0514	0.00001	-0.004	0.0343
	(1.42)	(1.53)	(-0.15)	(1.65)
R2	0.24	0.20	0.18	0.14

Note 1: *Figures in parentheses indicate 't'value;*

**Indicate 10% level of significance of the estimates; **Indicate 5% level of significance of the estimates; **Indicate 1% level of significance of the estimates*

Note 2: $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon$

Where, Agricultural transformation index, value ranges from 0 to 100

X_1 *= NFA income (₹),* X_2 *= NFA investment (₹),* X_3 *= NFA employment (person days),* X_4 *= AA income (₹),* X_5 *= AA investment (₹) and* X_6 *= AA person days employment*

Thus it can be noted that in dry land region a positive agricultural transformation towards commercialization and capital intensity occurred with a unit increase in income from NFA in both Kolar and Chitradurga and from AA in Kolar. However, with increase in NFA investment, a negative effect was noticed on agriculture in Chitradurga district. The dry land districts thus witnessed a positive agricultural transformation from income generating low investment NFA. While in the case of irrigated regions, agricultural transformation resulted with increase in NFA income in Hassan district, however it decreased with NFA investment. It was seen that the relationship between agricultural transformation and NFA investment was positive in Mandya distict. This is because the level of agricultural transformation in Mandya district has already pervaded with commercial cultivation practices in place. While in Hassan, the effect of autonomous investment in NFA came as a multiplier effect on agricultural transformation only after the realization of NFA income, making the relationship initially negative.

CONCLUSION

Taking into consideration the importance of the agrarian sector, it is necessary to analyse and understand what impacts and influences the emergence of the agricultural allied activities and rural non-farm activities have on the agriculture sector in the rural economy. Whether these activities will have a positive/ negative/ lop-sided effect, with respect to the income, investment and employment?

Irrespective of the irrigation pattern existing, the dry land as well as the irrigated regions showed a positive agricultural transformation with the emergence of NFA. However the emergence of AA showed a positive agriculture transformation only in the case of Kolar district. Among the four districts, Chitradurga region representing the dry land region possessed a lower magnitude of agricultural transformation towards commercialisation. Thus optimum crop plan must be developed along with suitable NFA for regions like Chitradurga to make agriculture more profitable.

ACKNOWLEDGEMENTS

The first author is thankful to Department of Science and Technology, GOI for funding with INSPIRE Fellowship to support the PhD research work.

REFERENCES

Antony, G.M. and Rao, K.V. 2007. A composite index to explain variations in poverty, health, nutritional status and standard of living: Use of multivariate statistical methods. *Public Health,* **121**(8): 578-587.

Fotso, J. and Kuate-defo, B. 2005. Measuring socioeconomic status in health research in developing countries: Should we be focusing on households, communities, or both? *Social Indic Res*., **72**(2): 189-237.

Fukuda, Y., Nakamura, K. and Takano, T. 2007. Higher mortality in areas of lower socioeconomic position measured by a single index of deprivation in Japan. *Public Health,* **121**(3): 163-173.

Havard, S., Deguen, S., Bodin, J., Louis, K. and Laurent, O. 2008. A small-area index of socioeconomic deprivation to capture health inequalities in France. *Soc Sci Med*., **67**(12): 2007-2016.

Krishnan, V. 2010. Constructing an Area-Based Socioeconomic Status Index: A Principal Components Analysis Approach. Early Child Development Mapping Project (ECMap). University of Alberta, Edmonton, Alberta, Canada.

Sekhar, C.C., Indrayan, A. and Gupta, S.M. 1991. Development of an Index of Need for Health Resources for Indian States Using Factor Analysis. *Int J Epidemiol,* 20(1): 246-250.

Appendix

Appendix 1: Results of PCA for Kolar district: Varimax rotation factor matrix

Variable	Component 1	Component 2	Component 3	Component 4	Component 5	Component 6
Own land	0.3177		0.3433			
Leased in						
Total operational land holding size	0.3394		0.3590			
Total irrigated land	0.4628					
Total rainfed land			0.6913			
Area under cereals		0.6257				
Area under pulses						
Area under food crops		0.6257				0.6025
Area under fruit crops				0.6957		
Area under vegetables						
Area under commercial crops		0.4438				
Area under timber trees and plantations					0.3132	
Area under mulberry				0.6648		
Net income						-0.7571
Agricultural Labour days	0.4370				0.4665	
Investment	0.4251		-0.3246			
Percent of variance (74.85%)	29.63%	15.16%	10.50%	9.43%	6.90%	6.41%

Appendix 2: Results of PCA for Chitradurga district: Varimax rotation factor matrix

Variable	Component 1	Component 2	Component 3	Component 4	Component 5
Own land	0.34			-0.31	
Leased in				0.55	
Total operational land holding size	0.37				
Total irrigated land		0.45			
Total rainfed land	0.34				
Area under cereals	0.35				
Area under pulses			0.54	0.48	
Area under food crops	0.35				
Area under fruit crops					0.92
Area under vegetables			-0.36	0.36	
Area under commercial crops		-0.36			
Area under timber trees and plantations		0.51			
Area under oilseeds		-0.35	0.58		
Net income		0.32			
Agricultural labour days	0.37				
Investment					
Percent of variance (78.24 %)	39.98 %	13.27 %	10.27 %	8.43 %	6.29 %

Appendix 3: Results of PCA for Mandya district: Varimax rotation factor matrix

Variable	Component 1	Component 2	Component 3	Component 4	Component 5	Component 6
Own land	0.3169					
Leased in				0.6127		
Leased out			-0.3443		-0.3062	
Total operational land holding size	0.3128					
Total irrigated land	0.4344					
Total rainfed land		0.3593		0.3775		
Area under cereals			0.6090			
Area under pulses					0.7004	
Area under food crops			0.6090			
Area under fruit crops		0.5458				
Area under vegetables				0.6062		
Area under commercial crops	0.5116					
Area under timber trees and plantations		0.6150				
Area under mulberry						0.8888
Net income	0.3530					
Agricultural Labour days	0.3612					
Investment					0.5779	
Percent of variance (80.85%)	35.32%	14.27%	11.28%	7.22%	6.67%	6.09%

Appendix 4: Results of PCA for Hassan district: Varimax rotation factor matrix

Variable	Component 1	Component 2	Component 3	Component 4	Component 5	Component 6	Component 7
Own land	0.5287			-0.3127			
Leased in				0.5542			0.7313
Total operational land holding size	0.5220						
Total irrigated land	0.5759						
Total rainfed land				0.5297			0.3527
Area under cereals		0.6444					
Area under pulses			0.4504				
Area under food crops		0.6493					
Area under fruit crops				0.7016			
Area under vegetables					0.6747		
Area under commercial crops			0.4203			0.6784	
Area under timber trees and plantations			0.5353				
Area under mulberry					0.6343		
Net income						0.6518	
Agricultural Labour days			0.4061				
Investment			-0.3212				-0.4698
Percent of variance (74.85%)	21.01%	12.81%	10.12%	8.93%	8.08%	7.99%	5.90%