International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-4, November 2019

Estimating the Impact of Crop Diversification on Economic Growth in India: A Quantitative Assessment

Pratiti Singha, Anup Sinha

Abstract*: Though agriculture is the mainstay in India, it accounts only 14 percent sectoral share in GDP. This is mainly because of low productivity and income generation capacity of agriculture. In this regard, crop diversification can act as a mechanism to eliminate this dilemma. It not only will increase the agricultural productivity but also will accelerate the income generation capacity. In this study we have investigated the impact of crop diversification on economic growth in India since 1988. The study is completely based on secondary data. In order to investigate the impact of crop diversification on economic growth, we have estimated Granger causality test based on vector error correction model setting. The results reveal that in India, there is no causality running from crop diversification to economic growth in the short-run. However, in the long-run crop diversification causes economic growth in India and the nature of cause is positive. Finally, the study concludes that suitable policies should be adopted to encourage the farmer to adopt the crop diversification mechanism. This will ultimately accelerate economic growth of the nation through increased income and employment in agriculture and reduction in poverty of the nation.

***Keywords* : Crop diversification, economic growth, VECM, and India.**

I. INTRODUCTION

In the developing countries like India, agriculture plays an important role in economic progress. Though industry and service sectors are the dominant sectors in India, agriculture still provides 50 percent employment to its population (Madhusudan, 2015). But compared to its employability, it accounts only 14.39 percent in sectoral share to GDP of the nation at constant prices in 2018-19. This is mainly due to poor profitability of agricultural sector through increasing risk of falling prices of crops, inefficiencies of minimum support price system, rural indebtedness, lack of storage, warehousing, etc. (Bhoi and Dadhich, 2019). In this regard, diversification of agriculture can be considered as a useful mechanism to overcome from such distressed situation of agriculture in India (Bhoi and Dadhich, 2019; Rahman, 2009).

At present, diversification is considered as one of the important measures for agricultural development. Traditionally, however, it was mostly used in subsistence agricultural farming. In the recent times, it is increasingly used to describe increase in area under high value crops (Jha et al., 2009). In this connection, crop diversification is one of the important measures of diversification which plays significant role in agricultural development. This is because crop diversification towards higher remunerative crops (for example, fruits and vegetables, oilseeds, fibre, etc) is of immense importance for generating higher income in the agricultural sector (Mandal and Bezbaruah, 2013) of the nation which in turn will contribute more to the GDP of India (Mukharjee, 2015).

Generally, crop diversification refers to the changing proportion of area from lesser value crops to higher value crops (Mandal, 2011). In India, it is commonly viewed as shifting from lower remunerative crops towards higher remunerative crops (Hazra, 2004). It intended to give extensive options in the production of variety of crops which help to expand the production (Hazra, 2004). More precisely, it is considered as a risk aversion strategy towards the risks associated with price and production to which the farmers are always exposed to (Mandal, 2014, Vyas, 1996, Haque, 1995). This is very true for the poor farmers who have lesser scope to cover or eradicate any price drop or production failure. For them, crop diversification is the most feasible and cost effective ex-ante coping mechanism to eliminate such risks of farming (Mandal, 2014). This, in turn, leads to a stabilization of income in the agricultural sector.

Studies show that, crop diversification not only accounts higher relative return to cultivators (Mukherjee and Chattopadhyay 2017; Mandal and Bezbaruah 2013), but also considered as a means for rural development (Haque, 1995; Joshi et al., 2006). At the same time crop diversification towards vegetables enhances income of smallholders and also generates occupation opportunities in rural areas. Further, it helps to engage the farmers as well as agricultural labourers across different seasons and also in the same season (Vyas, 1996). In this sense, Joshi et al (2004) found that an efficient and sincere cropping pattern diversification can be proved as a useful strategy to enlarged farm income, employment opportunities, conserve soil and water resources and most importantly can alleviate poverty.

Manuscript published on November 30, 2019.
* Correspondence Author
Pratiti Singha*, Department of Economics, Assam University, Silchar, India. Email: spratiti123@gmail.com.
Anup Sinha, Department of Economics, Assam University, Silchar, India. Email: anupsinha015@ gmail.com.

Moreover, crop diversification towards higher value crops are very much labour intensive and they have low gestation periods and thus generates fast returns which in turn reduces poverty (Birthal, 2007). It also encouraged to conserve natural resource base (Vyas, 1996) and improves soil fertility.

As found by Ali et al (2012) that cropping pattern towards green manuring and leguminous crops not only increases the production of paddy compared to the traditional cropping pattern associated with rice and wheat, but also improves soil fertility. In fact, Singh (2007) found that after green revolution in India, the agricultural sector faced decreased soil fertility and serious imbalances in agro-ecosystem because of too much concentration of cropping pattern around crops like rice and wheat and continuous application of chemical fertilizers.

In aggregate a number of studies have been conducted to explore the different issues related to crop diversification and its importance in agricultural growth in India (Mukherjee and Chattopadhyay 2017; Mandal and Bezbaruah 2013; Mandal, 2014, Vyas, 1996, Haque, 1995; Joshi et al 2006). Crop diversification not only leads to agricultural development but also makes agricultural sector sustainable. This in turn increases the sectoral share of agriculture to GDP leading to augmented economic growth. More precisely, economic growth as a result of agricultural development can be realised in two ways. Firstly, it will boost economic growth of the nation directly through increase in sectoral share. Secondly, through the interlinkages among different sectors of the economy specially between agriculture and industry (Hirschman, 1958). But, the specific issue of the impact of crop diversification on economic growth is not properly addressed in India. Since, the economy of India is dominated by agriculture sector, the knowledge of impact of crop diversification on economic growth, can be helpful for the policy makers to make appropriate policies for the development of agriculture and the nation as a whole. This study is first of its kind to examine the impact of crop diversification on economic growth in India.

The rest of this study is organised as follows. Section 2 deals with the details discussion data source and methodologies of this study. Section 3 presents the Analysis of the results and section 4 concludes the study and suggests the policy measures.

II. METHODOLOGY

2.1 Data

This study exclusively relies on secondary data sources from 1988 to 2016. The data related to real GDP (constant) and various control variables, viz., Urbanisation, export and import (for calculating Openness index) are compiled from the World Bank. Data on social expenditure are collected from the Reserve Bank of India (RBI). Finally, data on area under different crops (to calculate crop diversification index) are compiled from "Ministry of Agriculture, Government of India and Ministry of Agriculture & Farmers Welfare, Government of India".

2.1.1 Variables

In this study we have investigated the impact of crop diversification on economic growth of India. We have used real GDP (constant US $) as a proxy for economic growth. And a diversification index is calculated to capture the crop diversification.

There are a number of measures of diversification available which are used in empirical studies such as Herfindahl Index, Simpson Index, Entropy Index, Modified Entropy Index and Composite Entropy Index. Each of these has its own advantages and disadvantages, and hence applicable under different circumstances which is discussed at length by Mandal (2011). We have used Simpson Index to measure crop diversification. The advantage of using this index is that it is easy to compute and simple to understand. Also it provides a clear dispersion of crops over a geographical area (Joshi et al, 2004; Shiyani and Pandya, 1998). The formula of calculating Simpson Index is given as follows:

$$SI = 1 - \sum_{i=1}^{N} P_i^2 \quad \text{..... (1)}$$

Where, P_i= Proportion of total cropped area under crop i (i=1,2,…,N). SI lies between 0 and 1. It increases with the increase in the level of diversification and it approaches zero when there is perfect concentration. The details of the variables included in the model are given in Table-1.

Table-1: List of variables

Variables	Definition	Variable Type
Real GDP (RGDP)	GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2010 U.S. dollars.	Effect
Simpson Index *(SI)*	Simpson Index is an index to measure diversification. It ranges between 0 and 1. As diversification increases, it approaches 1 and vice versa.	Cause
Openness Index (OI)	It refers the degree of trade openness and can be defined as: Export + Import / Real GDP.	Control
Per capita social expenditure (PSE)	Percentage share of GDP which is spent on different social sectors like health, education, etc divided by total population.	Control
Urbanisation (URBA)	Proportion of population live in urban regions.	Control
Dummy 2005	1 for crop diversification after 2005 0 otherwise	Control

Source: Authors' own specification based on World Bank data and RBI data.

2.2 Methods

Granger causality test (Granger 1969) has been generally used to find the causality relationship between variables. This test tells us that, "if the past values of a variable (say y) significantly contribute to forecast the future value of another variable (say x) then y is said to Granger-cause x. Conversely, if past values of x statistically improve the prediction of y, then we can conclude that x Granger causes y (Granger 1969)".

2.2.1 Co-integration and Vector error correction model (VECM)

Engle and Granger (1987) suggest that "if two variables (say X and Y) are individually non-stationary at levels but stationary after first difference i.e. integrated of order one I(1) and co-integrated then there would be at least one directional relationship in the long run".

However the presence of such long-run relationship among the variables only shows the degree of association and not the causality. Granger causality tests with co-integrated variables may utilise the I(1) data with an error correction term. The equations are:

$$\Delta Y_t = \alpha + \sum_{i=1}^{n} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{m} \gamma_j \Delta X_{t-j} + \vartheta ECT_{t-1} + Z' + u_t \text{.....(2)}$$

$$\Delta X_t = \alpha + \sum_{i=1}^{n} \beta_i \Delta X_{t-i} + \sum_{j=1}^{m} \gamma_j \Delta Y_{t-j} + \vartheta ECT_{t-1} + V' + e_t \text{.....(3)}$$

Where, Y is dependent variable, X is independent, ECT is error component term and Z and V are the vectors of control variables. and are white noise error component.

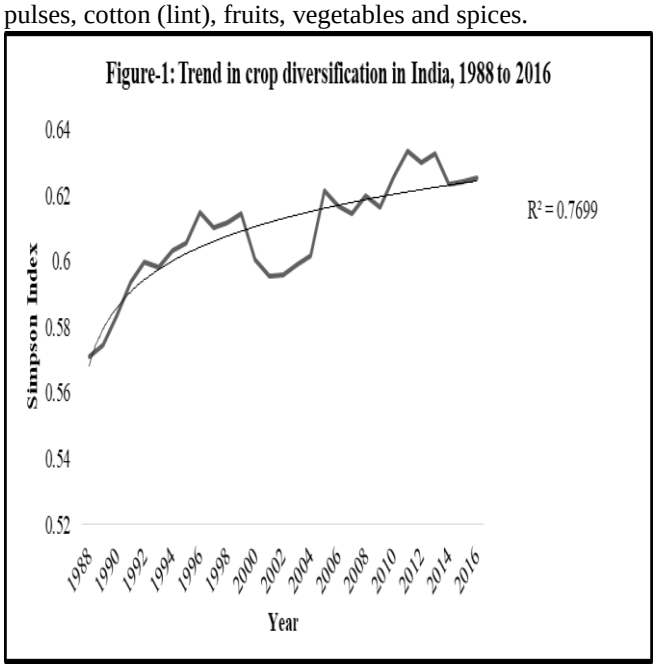
Akaike's Information Criterion (AIC) and/or Schwarz Bayesian Criterion (SBC) and/or log-likelihood ratio test (LR) are used to select the optimum lag length of n, m, q and r.

III. RESULTS

3.1. Trend of crop diversification in India and its changing cropping patterns

Crop diversification, as explained earlier, has got tremendous importance in agricultural development and economic growth in any nation. Thus before estimating the impact of crop diversification on economic growth in India, we have first examined the nature and trend of crop diversification in the country. In this study we have taken only the non-perennial crops to calculate crop diversification because the gestation period between sowing and harvesting is relatively longer for perennial crops compared to non-perennial ones. Therefore the crops included in this study are cereals, pulses, fibres, oilseeds, fruits and vegetables, and spices and condiments. Figure-1 is used to show the trend of crop diversification in India since 1988 till 2016. From this figure it is observed that crop diversification (SI) has shown an increasing trend over the years. However it is still not identified that which crops are getting greater area allocation over years. For that we have used Table-2 to show towards which crops, the crop diversification is proceeding.

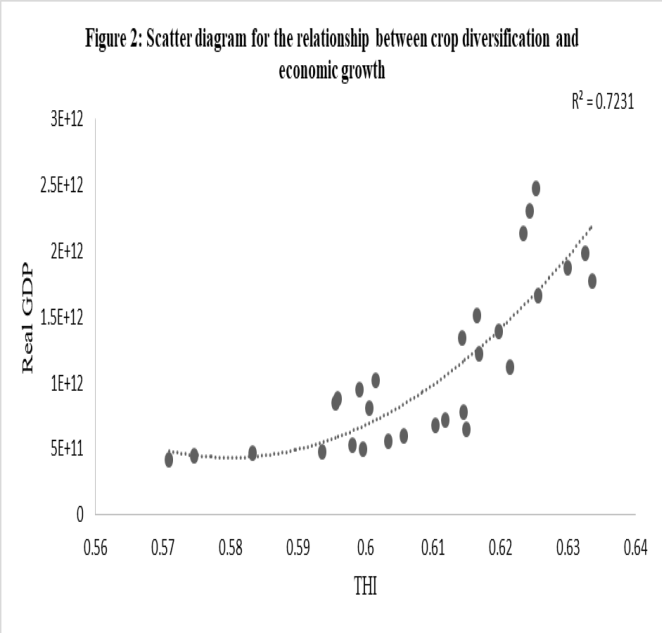
Table-2 shows the change in cropping pattern[1] of the major crops in India over the time span of 1991-92 to 2016-17. Here the percentage share of each crop to the gross cropped area[2] of major crops in India are shown over the same period of time. From this table it is seen that, the percentage shares of the crops like wheat, pulses, cotton (lint), fruits, vegetables and spices are found to be increasing from 1991-92 to 2016-17 while the shares of rice, coarse cereals, oilseeds, and raw jute and mesta are found to be decreasing during the same time period. The share of sugarcane remained more or less stable over the same time period. Thus it is clearly perceived that the cropping pattern in India is diversifying towards the higher remunerative crops like pulses, cotton (lint), fruits, vegetables and spices.



Source: Ministry of Agriculture, Government of India.
Authors' own calculation from the data on area under crops in India.

3.2 Impact of crop diversification on economic growth in India

We now report an analysis which shows the relationship between crop diversification and economic growth in India. We begin with the analysis of this relationship with simple scatter diagram shown in Figure-2:



Source: Authors' own calculation

[1] Cropping pattern of a particular region shows proportion of total cropped area under different crops for a particular geographical area in a particular point of time (Mandal, 2011).

[2] Gross cropped area is the total area under the major crops (rice, wheat, coarse cereals, pulses, oilseeds, sugarcane, cotton (lint), raw jute and mesta, fruits and vegetables) in India.

Table-2: Cropping pattern changes across the major crops in India, 1991-92 to 2012-13

Year	Rice	Wheat	Coarse Cereals	Pulses	Oilseeds	Sugarcane	Cotton (Lint)	Raw Jute & Mesta	fruits	vegetables	Spices
1991-92	32.23	17.58	25.25	17.03	19.56	2.90	5.79	0.84	2.17	4.23	1.52
2001-02	32.98	19.35	21.68	16.17	16.63	3.24	6.71	0.77	2.95	4.52	2.36
2006-07	31.45	20.10	20.61	16.65	19.03	3.70	6.56	0.67	3.99	5.44	1.76
2011-12	30.64	20.79	18.39	17.03	18.31	3.51	8.48	0.63	4.67	6.26	2.24
2016-17	29.42	20.59	16.73	19.66	17.51	2.97	7.24	0.51	4.33	6.88	2.36

Source: Authors' own calculation from the data of area under major crops in India, Ministry of Agriculture & Farmers Welfare, Government of India and Horticulture at a glance, 2017.
Note: Values are given as percentage share of each crop to the gross cropped area.

The result from the scatter diagram (Figure-2) indicates that, there is a strong and positive relationship between crop diversification and economic growth in India. This is true from the fact that, the slope of the line is increasing and the value of R square (0.72) is also very high. However, the phenomenon economic growth is not only influenced by crop diversification but also by several other factors. Hence, we have considered all those variables which are supposed to influence economic growth and which are also supported by literature. We then examined the associations between each of these variables with the dependent variables and the variables that are found to be insignificant and redundant are excluded from the models. The final equation for VECM model is as follows:

$$\Delta lnRGDP_t = \alpha + \sum_{i=1}^{n} \beta_i \Delta lnRGDP_{t-i} + \sum_{j=1}^{m} \gamma_j \Delta lnSI_{t-j} + +\vartheta ECT_{t-1} + lnPCSE + \ln URBA + lnOI + u_t .....(4)$$

Where, RGDP represents real per capita GDP and SI represents crop diversification. The control variables OI, PCSE, URBA, represents Openness Index, per capita social expenditure, and urbanization respectively. The summary statistics of the variables used in the study is presented in Table-3:

Table-3 : Summary statistics

Variable	Mean	S.D	Min.	Max.	Obs.
RGDP	1.1E+12	6.16E+11	4.17E+11	2.46E+12	29
SI	0.60	0.01	0.57	0.63	29
OI	0.34	0.13	0.14	0.57	29
PCSE	4.54	3.03	1.43	11.02	29
URBA	28.63	2.44	25.06	33.13	29

Source: Authors' own calculation

Before estimating any time series model, it is essential to check the "stationarity" of the time series variables. This is because if the variables are non-stationary then the estimated model will provide misleading results. Further, the knowledge of stationarity helps to understand the order of integration and selection of appropriate method. The test of stationarity is also required to understand the order of integration and model selection as well. The "Phillips-Perron" (PP) unit root tests is used to check the stationarity of the variables. This is because PP test is more powerful than the Augmented Dickey and Fuller (ADF) test (Banerjee et al., 1993). Moreover PP tests are "robust to general forms of heteroskedasticity in the error term compared to ADF" (Phillips and Perron, 1988). The results of PP unit root test are presented in Table-4 after taking natural logarithms of SI and real GDP.

Table-4: Phillips-Perron Unit Root Test

Variables	Level	First difference
lnRGDP	-1.87	-4.56***
lnSI	-2.56	-5.04***

Source: Authors' own calculation
Note: ***; **; and * represent 1; 5; and 10 percent level of significance respectively.

From Table-4 it is clearly observed that both GDP and SI are non-stationary at level (the null hypothesis of unit root is not rejected) but after taking the first differences, they are found to be stationary. This means that the variables are I(1). Hence it is necessary to test the co-integration between the variables. As even if the variables are I(1), they may not be co-integrated.

Thus, to investigate the co-integration relationship between real GDP and crop diversification, we have performed Johansen Co-integration test. This test is based on Trace Statistic and Max-Eigen Statistic. The result of Johansen Co-integration Test is presented in Table-5.

Table-5: Johansen Co-integration Test

Null Hypothesis	Trace Statistic	Max-Eigen Statistic
None (r = 0)	15.38**	13.55*
At most 1 (r ≤ 1)	1.83	1.83

Source: Authors' own calculation. Note: "r" indicates number of Co-integration

Table-5 reveals that there is no co-integration between GDP and SI. This is true from the fact that the null hypothesis of no co-integration is rejected at significant level for rank 0. This implies that even if real GDP and SI are individually non-stationary but their joined effect is stationary that is they are co-integrated. Further, it is also implied that there is at least *one direction* of the relationship between real GDP and crop diversification in the long run.

Nonetheless, the long-run connection between the variables merely displays the degree of relationship. But we cannot say anything about the direction of the relationship. This implies this test is not able to tell us about the *direction of the causal relation*, that is, we can't say whether real GDP causes crop diversification or crop diversification causes real GDP. So, we have used *Granger causality tests* to ex

amine the causality between the GDP and SI. However, if the variables are I(1) and co-integrated, we must conduct *Granger causality test* based on VECM setting" (Greene, 2008).

Further, this approach helps us to discriminate between "*short-run*" and "*long-run*" relationship other than causality. Finally, the result of VECM is presented in Table-6:

Table-6: Result of Granger causality test with VECM

Variables	Co-efficient (t Statistic)
ECT	-0.67*** [-3.88]
D(lnRGDP(-1))	0.28* [1.59]
D(lnRGDP(-2))	0.007 [0.03]
D(lnSI(-1))	-0.12 [-0.41]
D(lnSI(-2))	0.20 [0.73]
lnOI	-0.11*** [-2.71]
lnPCSE	0.01* [1.37]
LnURBA	3.28*** [2.73]
D05	0.03* [1.60]
C	-11.33*** [-2.81]
R square	0.73
Adj. R square	0.62
F-statistic	5.15***
	Granger causality Wald test
Null hypothesis	Chi squ.
Non-causality from lnSI to lnRGDP	0.98 (prob.=0.61)
Non-causality from lnRGDP to lnSI	0.72 (prob.=0.69)

Source: Authors' own calculation
Note: (1)***; **; and * represent 1; 5; and 10 percent level of significance respectively. (2) According AIC and SIC optimum lag length is 2.

In the above Table-6, we started with the analysis of short-run relationship between GDP and SI. The result of Granger causality test based on VECM suggests that, there is no causality running from crop diversification to real GDP. This is because of the fact that, Chi- square statistics (0.98) with 2 degrees of freedom is not statistically significant. Similarly, the null hypothesis of non-causality from real GDP to crop diversification is clearly not rejected.

Among the control variables, the coefficient of openness index is found to be significant and negative which implies that it influences economic growth in India adversely. This might be because of greater specialisation in the production of low quality products in India than high quality products (Hausmann, et al., 2007). Conversely, the coefficient of urbanisation is positive and significant coefficient. This implies that urbanisation affects economic growth positively as it opens up various business activities and employment opportunities and hence eventually accelerates income growth (Nguyen and Nguyen, 2018).

Similarly, the coefficient of public sector expenditures is found to be positive and significant. This may be due to fact that the increase in public expenditure on health and education helps to accumulate human capital which eventually boosts economic growth (Furceri, and Zdzienicka, 2011).

Moreover, the long-run relationship can be traced from the coefficient of error component term. It is noted from Table-5 that, the coefficient of error component (-0.67) is found to be negative and significant. This implies that, there is significant causality relationship running from crop diversification to economic growth in India. Further, it also implies that, the disequilibrium in economic growth will be corrected with the speed of 67 percent in the long-run. Finally the nature and extend of long-run relationship between crop diversification and economic growth in India can be explained with the following equation:

$$lnRGDP = 27.86 + 0.52lnSI\ (t=1.49^{*})\ldots\ldots\ldots\ldots(5)$$

The above equation suggests that, crop diversification impacts real GDP positively and significantly in the long-run. The coefficient of crop diversification index (SI) is 0.52, and which suggest that, if crop diversification increases by 1 unit, then economic growth will increase by 0.52 unit in the long-run. The result clearly depicts the importance of crop diversification in economic growth in India. Crop diversification benefits the farmers to mitigate the risks associated with price and production in agriculture. This in turn stabilises farm income and increases the same as the farmers diversify their cropping pattern towards higher remunerative crops. This is how in long run with increased farm income; GDP of the nation is expected to increase. Moreover, crop diversification also helps to create occupation opportunities because diversification towards higher value crops in the same season or across seasons requires more and more labour (Vyas, 1996). Thus the problem of seasonal unemployment present in agricultural sector is reduced and the surplus labour in rural areas is also expected to be absorbed due to crop diversification. Diversification of cropping pattern also has poverty reducing affect (Birthal, 2007; Joshi et al, 2004). Furthermore, Crop diversification towards the crops having global demand also helps the farmers to increase income through increased export. Thus all these elements ultimately boost economic growth of the nation in the long run.

IV. CONCLUSION

In India agriculture is the main source of livelihood and it provides employment to 50 percent of its population. However, compared to its employability, it accounts only 14 percent sectoral share in GDP. This is mainly because of low productivity and income generation capacity of the agriculture. In this regards crop diversification can act as coping mechanism to eliminate this dilemma. It will not only increase the agricultural productivity but also accelerate the income generation capacity. In this study we made an investigation regarding the impact of crop diversification on economic growth in India. The result of PP units root test shows that, both the variables are not stationary at levels. But they are found stationary after taking first difference. As the variables are I(1), we have conducted Johansen Co-integration test to understand the co-integration relationship. Since, variables are I(1) and co-integrated, we have estimated Granger causality test based on VEC model setting. The result reveals that, there is no causality running from crop diversification to economic growth in the short-run.

However, in the long-run crop diversification causes economic growth in India and the nature of cause is positive.

Thus crop diversification from low remunerative crops to higher remunerative crops is strongly needed in India.

This will not only help to increase GDP of the nation but also will be helpful for rural development through reduction of poverty and rural unemployment problem in the nation. Furthermore, crop diversification will help to solve different environmental issues like loss of soil fertility, soil hardening, and imbalances in agro biodiversity particularly occurred after green revolution in India.

However in India, the adoption of crop diversification by farmers is not free from challenges. This is mainly because most of the farmers in India are poor and small landholders and hence often fail to purchase required inputs due to shortage of money. Thus these small farmers should be encouraged first to diversify their cropping pattern. Government should take initiative to do so. Firstly, the different inputs required to produce higher value crops should be provided to the farmers at affordable prices. Secondly, credit facility should be provided to all section of farmers. This will help the poor farmers to diversify towards high remunerative crops. Thirdly, agricultural extension services should be provided for educating the farmers to use proper proportion of inputs to get maximum productivity. Finally, government should look after the regional diversity in India and meet the local needs of the farmers and their areas of specialisation. This will help the country as a whole to reap benefit of crop diversification which will in long-run increase economic growth of India.

REFERENCES

1. Ali, R. I., Awan, T. H., Ahmad, M., Saleem, M. U., & Akhtar, M., (2012). Diversification of Rice-Based Cropping Systems to Improve Soil Fertility, Sustainable Productivity and Economics. Journal of Animal and Plant Sciences, 22(1), 108-12.
2. Banerjee, A., Dolado, J., Galbraith, J. H., and Hendry, D. F., (1993). Co-Integration, Error-Correction, and the Econometric Analysis of Non-Stationary Data: Advanced Texts in Econometrics (Oxford: Oxford University Press).
3. Bhoi, B. K., & Dadhich, C. L. (2019). Agrarian distress in India: Possible solutions (No. 2019-017). Indira Gandhi Institute of Development Research, Mumbai, India.
4. Birthal, P. S., Joshi, P. K., Roy, D., & Thorat, A., (2007). Diversification in Indian Agriculture Towards High-value Crops. International Food Policy Research Institute, IFPRI Discussion Paper 00727.
5. Census of India (2011). Census of India, Office of Registrar General, India, Retrieved from: http://censusindia.gov.in (accessed 12/11/2016).
6. Desai, BM, D'souza M., Sharma, T. (2011). Agricultural policy strategy instruments and implementations: a review and road ahead. Economic and Political Weekly. 56(53). 42–50.
7. Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. Econometrica: journal of the Econometric Society, 251-276.
8. Furceri, D., & Zdzienicka, A., (2011). The Effects of Social Spending on Economic Activity: Empirical Evidence from a Panel of OECD Countries.
9. Granger, C. W. J., (1969). Investigating Causal Relations by Econometric Models and Cross Spectral Methods", Econometrica, 37, 428-438.
10. Greene, W. H., (2008). Econometric Analysis (New Delhi: Pearson Education).
11. Haque, T., (1995). Diversification of Small Farms in India: Problems and Prospects (Theme Paper). In Proceedings of National Workshop on Small Farm Diversification: Prospects & Problems, May, 22-23.
12. Hausmann, R., Hwang, J., & Rodrik, D. (2007). What you export matters. Journal of economic growth, 12(1), 1-25.
13. Hazra, C. R.,(2004).Crop diversification in India. (http://www.fao.org/3/x6906e/x6906e06.htm).
14. Hirschman, A.O., (1958). A Strategy for Economic Development. Yale University Press, New Haven.
15. Joshi, P. K., Gulati, A., Birthal, P. S., & Tewari, L., (2004). Agriculture Diversification in South Asia: Patterns, Determinants and Policy Implications. Economic and Political Weekly, 39(24), 2457-2467.
16. Madhusudhan L., (2015). Agriculture role on Indian Economy. Business and Economic Journal, 6(4).
17. Mandal, R., (2011). Cropping Patterns and Crop Diversification in Flood-Prone and Flood-Free Agro-Economic Environments in Assam. Unpublished PhD Dissertation submitted to Guwahati University.
18. Mandal, R., (2014). Flood, Cropping Pattern Choice and Returns in Agriculture: A Study of Assam Plains, India. Economic Analysis and Policy, 44(3), 333-344.
19. Mukherjee, S., & Chattopadhyay, S. (2017). Crop diversification in West Bengal: a district level analysis for the period 1980-81 to 2011-12. Journal of Rural Development, 36(4), 501-529.
20. Nguyen, H. M., & Nguyen, L. D. (2018). The relationship between urbanization and economic growth: An empirical study on ASEAN countries. International Journal of Social Economics, 45(2), 316-339.
21. Phillips, P.C. and Perron, P., (1988). Testing for a unit root in time series regression. Biometrika, 75(2), pp.335-346.
22. Pope, R. D., & Prescott, R., (1980). Diversification in Relation to Farm Size and other Socioeconomic Characteristics. American Journal of Agricultural Economics, 62(3), 554-559.
23. Rahman, S. (2009). Whether crop diversification is a desired strategy for agricultural growth in Bangladesh?. Food Policy, 34(4), 340-349.
24. Singh, T. (2007). Green Revolution, food security and agricultural sustainability in India: the Conflicts and Solutions. Fifty Years of Indian Agriculture. 2(1). 1-15.
25. Vyas, V. S. (1996). Diversification in agriculture: Concept, rationale and approaches. Indian Journal of Agricultural Economics, 51(4), 636-643.

AUTHORS PROFILE

Dr. Pratiti Singha did her Ph.D. from the Department of Economics of Assam University, Silchar in 2019. Presently she is working as a Guest faculty in the same department. Her area of interest is agricultural economics, environmental economics, and development economics. She has published many papers in different reputed journals and edited books..

Anup Sinha did his MPhil from the Department of Economics of Assam University, Silchar in 2017. Presently, he is the Registered Ph.D Scholar of the Economics Department of Assam University. He is also working as a Guest faculty in the same department. His area of interest is population ageing, economics of crime and development economics. He published many papers in different journals and edited books.