



Economic Analysis of Agricultural Growth and Crop Diversification in Tamil Nadu

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Tamil Nadu is one of the largest state with an area of 130.33 lakh ha and with the population of 6 percent of nation. Agriculture sector contributes 13 percent of state income. Nearly 56 percent of people depends on agriculture for their livelihood. In this scenario, the present study has been undertaken to analyse the agriculture growth as it determines the trend in terms of production, area and productivity. In this study, compound growth rate is used to measure the agricultural growth. The study was conducted based on secondary data. The data is analysed for the period of 50 years (1967-68 to 2017-18) for the important crops such as Rice, Maize, Cotton, Banana, Groundnut, Sorghum, Sugarcane, Oilseeds, Pulses, Vegetables, Fruits and Spices. The growth rates of the production of the major crops revealed that rice, maize, banana, pulses, vegetables and fruits were showing a positive growth rate. In contrast, crops such as cotton, groundnut, sorghum, oilseeds, and spices were showing negative trend. In recent decades, there is a vast change in the climate and other environmental factors which makes farmers to shift in their cropping pattern. Hence to analyse the changes crop diversification is calculated using the indices such as Herfindal Index and Modified Entropy Index (MEI). The estimates of indexes revealed that crop diversification is increased in over years.

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1. INTRODUCTION

Diversification is an integral part of the process of structural transformation of an economy. A move away from agriculture to industries and services denotes diversification at the macro level. But there is a lack of clarity when it comes to diversification within agriculture [1]. Diversification of agriculture in favour of more competitive and high-value commodities is reckoned an important strategy to overcome many of the challenges emerging in agriculture sector. Diversification is used as a tool to augment farm income, generate employment, alleviate poverty and conserve precious soil and water resources [2].

Cropping pattern at state level is transforming from foodgrains to high-value crops but the transformation is not uniform across the states/regions. The agricultural economy has diversified in all the states with some fluctuations in case of food crops and non-food crops [3].

Tamil Nadu is the most important state in the southern peninsular India. Agriculture is an overriding sector in the state economy. The climate nature of the state is tropical. The state is covered with bountiful natural resources and better climate which makes the people to engage in agricultural activities all round the year. The two important monsoons are south west monsoon and north east monsoon which gives adequate precipitation to the state, among these north east monsoon showers huge precipitation. The main source of irrigation are canal and well. The soil resource of the state is wider range with different soil types. Nearly 93% of the farmers are small and marginal farmers. 56% of the state population depends on agriculture (Tamil Nadu Agriculture census, 2015-16). Hence, the welfare and well-being of the State's population mainly depend either directly or indirectly on agricultural sector. Agriculture is undergoing perceptible changes as it gets transformed from traditional to a modern economy, which is an essential step towards economic growth and development. The state has total area of 4.7 million hectare under cultivation. The major cultivated crops are rice, cotton, groundnut, mung bean, urdbean and sugarcane (Tamil Nadu Agriculture census, 2015-16). During past two decades agriculture sector has faced major challenges such as water scarcity, unseasonal rainfall, scarcity of labour and unhealthy prices for agriculture produces in

the market. All these factors collectively enforce the farmers to shift from monocropping to multiplecropping. Thus a broader perspective of crop diversification is willingly practiced by the farmers of the state. Tamil Nadu is moving towards crop diversification rather than specialisation. In Tamil Nadu the share of major crops like paddy, groundnut and jowar has decreased over the years and the share of minor crops like maize, black gram, green gram, coconut and fruits and vegetable increased over the years [4]. The diversification of agriculture in coastal districts of Tamil Nadu also exists widely with spatio temporal disparity [5]. Amirithalingam [6] study also found that in Villupuram district crop intensification is very less. The study also revealed that the compound growth rate of area under major crops like cereals and millets were negative whereas it was positive for pulses, oilseeds, vegetables and fruits, sugar, tapioca. In this background, the present study examines the growth rate in terms of area, production, productivity and to estimate the diversification index.

2. DATA

The present study was carried out for a period of five decades (1970-2016). The study is based on the secondary data which was collected from the sources by the Government of Tamil Nadu. To analyse the agriculture growth as it determines the trend in terms of production, area and productivity, compound growth rate is used to measure the agricultural growth. To analyse the changes crop diversification is calculated using the indices such as Herfindal Index and Modified Entropy Index (MEI). Area, production and productivity of the following crops such as rice, maize, banana, cotton, groundnut, sorghum, sugarcane, total oilseeds, total pulses, total fruits, total pulses has been collected from official website of Indiatat for the period of 1967 to 2018.

3. METHODOLOGY

3.1 Compound Growth Rate Analysis

Compound growth rates of area, Production, productivity under major crops were estimated to capture agriculture growth in Tamil Nadu. The major crops considered for the analysis were rice, maize, banana, total pulses, total oilseeds, total fruits, total vegetables, total spices,

sugarcane, cotton, groundnut, sorghum. Exponential function of following form was used to estimate the growth rate for the area under major crops [7-9].

$$Y_{it} = A_i (1+r_i)^t \quad (1)$$

Where

Y_{it} = Area, production and productivity of i^{th} crops at time t (ha)

r = Compound growth rate

A_i - Initial year of area, production and productivity of i^{th} crops in time t (years)

By taking natural logarithm of (1),

$$\ln Y_{it} = \ln A_i + t \ln (1+r_i) \quad (2)$$

Now letting

$$a_i = \ln A_i$$

$$b_i = \ln (1+r_i)$$

Equation (2) can be written as

$$\ln Y_{it} = a_i + \beta_{it} \quad (3)$$

Adding the disturbance term to (3), it can be written as

$$\ln Y_{it} = a_i + \beta_{it} + U_t$$

Y_{it} = Area, production and productivity of i^{th} crops at time t (ha)

t = time in years

a_i = constant term

b_i = regression co-efficient

This log linear function was fitted by using ordinary least square (OLS) method. The compound growth rate (r) was obtained using the formula [10-12].

$$r_i = (\text{Antilog } \beta_i - 1) \times 100$$

3.2 Crop Diversification

3.2.1 Herfindal index

Herfindal Index is the sum of the squares of the acreage proportion of each crop in the total cropped area [13,14].

$$HI = \sum_{i=1}^{i=N} P_i^2$$

Where,

N is the total number of crops

P_i represents area proportion of the i^{th} crop in total cropped area

3.2.2 Modified Entropy Index (MEI)

The Modified Entropy index shifting the base of the logarithm to the number of crops.

$$MEI = - \sum_{i=1}^{i=N} P_i * \log_N(P_i)$$

4. RESULTS AND DISCUSSION

4.1 Estimation of Compound Growth Rate for Major Crops

The main aim of this analysis is to know the agricultural growth in Tamil Nadu. This analysis helps us to know how much the agricultural growth are in par and its economic status in our country. For estimating agriculture growth, analysed the compound growth rate of area, production, productivity of the past fifty years i.e. from 1968-69 to 2017-18 has been analyzed and has been given in Table 1.

In terms of area, the crops such as maize, banana, sugarcane, pulses, vegetables, and fruits have registered a positive growth rate between 1967-68 to 2017-18. However, crops such as rice, cotton, groundnut, sorghum, oilseeds, and spices have recorded a negative growth rate during the same period. The study by Sanjeev Kumar and Sakshi Gupta [3] also found that total food crops some of the states including Tamil Nadu have recorded negative compound average growth rates for area under total food grains.

As far as production is concerned the following growth rate, is obtained. The crops such as rice, maize, banana, pulses, vegetables and fruits where showing a positive growth rate. In contrast, crops such as cotton, groundnut, sorghum, oilseeds, and spices were showing negative trend. This negative trend is may be due to the fact that the crop profitability of those crops is comparatively lesser.

In productivity, except banana, sugarcane, fruits, and vegetables, the rest of the crops were registered positive growth rate during the period of 1969-70 to 2017-18. Further, it was observed

that maize had registered the highest growth (9.91) in crop productivity, and it was followed by spices (7.77), groundnut (5.55), sorghum (4.58), oilseeds (4.29), pulses (2.33), and rice (1.03).

The analysis reveals that though the growth rate of paddy area is decreasing, the production growth rate is increasing. It acknowledges the findings of Velavan and Balaji [4] found that the share of paddy, groundnut, jowar has increased.

The Compound growth rate of production for major crops in Tamil Nadu has been shown in Fig. 1. The analysis was carried out by splitting the entire period into two parts viz., 1970 to 2000 and 2000 to 2018.

The figure reveals that the growth rate of production for the crops such as maize,

sorghum, cotton, oilseeds has been increased enormously in the period from 2000 to 2018 compare to 1970 to 2000. It may be due to increased research and technology in agriculture. Joshi et al. [15] also confirms that research contributed 48% to the TFP growth. And, the production of Agricultural research investment on SAUs had considerable impact on release of crop varieties and other technologies. During the period 2009-14, 20.1 crop varieties, 2.4 animal/fish breeds and lines and 20 technologies/ non-crop products were developed and released by SAUs [16] and horticulture crops like banana, fruits and vegetables has been decreased after 2000. Production of rice also decreased after 2000. The growth rate of production of other crops such as pulses, groundnut is equally distributed in the both periods.

Table 1. CGR of Major crops from the period 1967-68 TO 2017 -18

Crops	Area	Production	Productivity
Rice	-0.88	0.35	1.03
Maize	8.08	11.60	9.91
Banana	2.11	4.48	-0.07
Cotton	-2.10	-0.32	5.55
Groundnut	-2.27	-0.38	2.01
Sorghum	-2.44	-1.91	4.58
Sugarcane	2.00	2.41	-0.04
Oilseeds	-2.13	-0.01	4.29
Pulses	0.86	2.12	2.33
Vegetables	1.80	4.06	-1.59
Fruits	2.84	3.47	-3.31

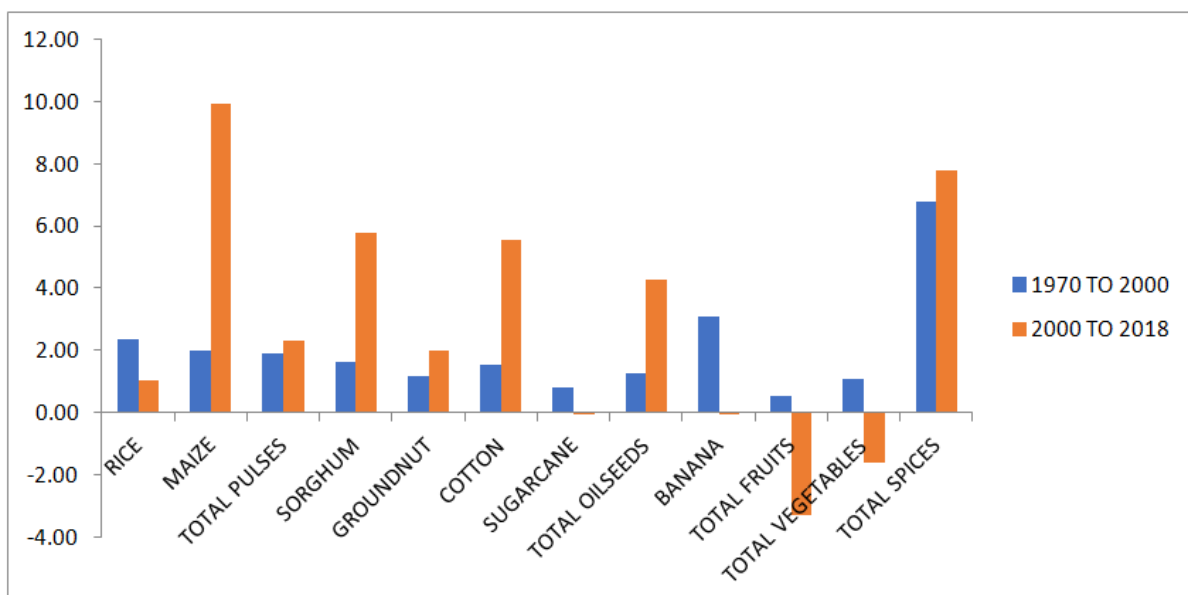


Fig. 1. CGR of production for the major crops in Tamil Nadu (1970 to 2000) & (2000 to 2018)

Table 2. Herfindahl index and Modified entropy index for Tamil Nadu

Period	Herfindahl index (HI)	Modified entropy index (MEI)
1970-71	0.19	0.70
1975-76	0.18	0.72
1980-81	0.17	0.74
1985-86	0.18	0.79
1990-91	0.16	0.79
1995-96	0.17	0.80
2000-01	0.16	0.78
2005-06	0.16	0.80
2010-11	0.15	0.79
2015-16	0.15	0.78

4.2 Crop Diversification

The crop diversification indices viz., herfindahl index, and modified entropy index for Tamil Nadu were estimated and presented in below Table 2. It could be seen from the table that the estimates of the herfindahl index were declined from 0.19 to 0.15 during 1970-71 to 2015-16, which implies that crop diversification of Tamil Nadu has increased over the years. Similar results were observed while considering modified entropy index, ranging from 0.70 to 0.78 from 1970-71 to 2010-11. These results revealed that moving towards diversification of crops has been considered a resilience mechanism followed by farmers in different regions of the state to mitigate effect of climate change [17,18], drought and other natural calamities [19-21].

Presently, diversification in agriculture is leading to agribusiness, and the focus on vertical integration between farmer and retailer is increasingly becoming common [22] and therefore public and private investments, especially in the areas of R&D, extension services delivery and technology development need to be enhanced. It is imperative to take steps towards reinforcement of link across production, processing, marketing and crop management.

5. CONCLUSION

The study has analyzed the growth rate of area, production and productivity of major crops such as Rice, Maize, Cotton, Banana, Groundnut, Sorghum, Sugarcane, Oilseeds, Pulses, Vegetables, Fruits and Spices for 50 years period (1967-68 to 2017-18).

It is concluded from the study that the share of major crops like paddy, sugarcane and sorghum has increased to little extent over the years in the state as compared to minor crops such as maize,

banana, total oilseeds, total vegetables, groundnut and total spices.

The study also estimated the crop diversification indices viz.,herfindahl index, and modified entropy index for Tamil Nadu were estimated. The results indicate that the estimates of the herfindahl index were declined from 0.19 to 0.15 during 1970-71 to 2015-16, which implies that crop diversification of Tamil Nadu has increased over the years. Similar results were observed while considering modified entropy index, ranging from 0.70 to 0.78 from 1970-71 to 2010-11.This shows that state is moving towards crop diversification rather than specialization. Based on the compound annual growth rate of area of crops, it is evident that major crops like paddy, sugarcane and sorghum have grown negatively and least share crops like maize, total fruits, banana and sugarcane have grown positively over the years. Hence, it is concluded from the study that crop diversification has been taking place in the state over the years. Thus, the technology has a dominant role to play and as such adequate measures should be taken for propagating their innovative technologies in agriculture to the farmers. Govt. should initiate the steps for expansion in irrigation facilities, availability of production technology especially for small farms. The transport, communication, market infrastructure and processing facility for high value, crops should be strengthened in the state. Besides, diversification of enterprises should also be encouraged as a measure of minimizing the risk via resilience mechanism which will help to minimize the crop failure and income loss including employment to the rural people.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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