AJES
ASIAN JOURNAL OF ENVIRONMENTAL SCIENCE ■ VOLUME 8 | ISSUE 2 | DECEMBER, 2013 | 77-80

RESEARCH ARTICLE

Intensive farming and its implications on crop diversification in Tamil Nadu

■ V. KAVITHA AND K. CHANDRAN

Article Chronicle :
***Received* :**
20.06.2013;
***Revised* :**
19.10.2013;
***Accepted* :**
06.11.2013

SUMMARY : In India as a result of green revolution, increase in area under cultivation and productivity was noticed in almost all the crops. Intensive use of inorganic fertilizers and pesticides and extension of area under irrigation has been an important tool in the drive for increased crop production. It has been of late recognized that the efforts to increase agriculture production through intensive farming resulted in monocropping and thereby decline in area of certain principal crops over the years. In order to assess the implications of intensive farming on cropping pattern and thereby on crop diversification, the study was undertaken in South Arcot district of Tamil Nadu, for the period of 1980 - 2010. The results indicated that co-efficient of variation was higher for non-food crops (41 %) than that of food crops (9 %) and the analysis of crop diversification showed that, during last three decades, the average Herfindahl Index value for crop diversification was found to be 0.20, which showed, the district was diversified in cropping pattern and intensive farming did not create the mono-cropping in the district.

HOW TO CITE THIS ARTICLE : Kavitha, V. and Chandran, K. (2013). Intensive farming and its implications on crop diversification in Tamil Nadu. *Asian J. Environ. Sci.*, **8**(2): 77-80.

Key Words :
Composite Index, Herfindahl index, Co-efficient of variation

Author for correspondence :
V. KAVITHA
Department of Agriculutral Economics, Tamil Nadu Agricultural University, COIMBATORE (T.N.) INDIA
Email:kavi_economics@rediffmail.com

See end of the article for **Coopted authors'**

Crop diversification in India is viewed as a shift from traditionally grown less remunerative crops to more commercial crops. The crop shift takes place due to governmental policies and thrust on some crops over a given time, for example creation of the Technology Mission on Oilseeds (TMO) to give importance on oilseeds cultivation and improve production so as to reduce imports. Higher profitability in production also induces crop diversification. Crop substitution and shift are also taking place in the areas with distinct soil problems. Consumer preference towards high value crops also reduces the area under traditional food grains. Crop diversification also changes within the state level due to climatic conditions.

Tamil Nadu, one of the important agrarian state in India has attained rapid rate of growth in the agricultural sector. It is one among the leading states in the production of principal crops like paddy and sugarcane. With the limited gross area sown, higher productivity of many crops has been achieved by practicing intensive farming. But the state has witnessed deceleration from 1990's onwards since the growth in agriculture faced major constraints such as growing water scarcity, urbanization, land degradation, declining farm sizes, rise in cost of labour and transition from traditional crops to commercial crops. Thus, the present study has aimed at studying the implications of this intensive farming on crop diversification of the farmers over the years in the most intensive farming district of Tamil Nadu.

EXPERIMENTAL METHODOLOGY

For identifying the districts in Tamil Nadu, which are practicing intensive farming, composite index was used. Intensive farming can be well represented by composite indices which are used as yardsticks to compare a district performance in relation to other districts. There are many methods of classification based on multivariate data and among them, one method which is statistically

sound is that developed by Iyengar and Sudarshan (1982). In this method, for each district a 'Composite index' was constructed. The index lies between 0 and 1 with 1 representing 100 per cent intensive farming and 0 representing no intensive farming at all. It is assumed that there are 'n' districts and 'm' intensive farming indicators and X id is the observed value of i th intensive farming indicator for the district (i = 1,2,3 … m, d = 1,2,3…n). First these values of indicators for each district are to be standardized by using the formula :

$$\text{Index value (Yid)} = \frac{(X_{id} - \text{Min } X_{id})}{(\text{Max } X_{id} - \text{Min } X_{id})}$$

where, Min X_{id} and Max X_{id} are the minimum and maximum of (X_{i1}, X_{i2},……X_{in}), respectively. The index lies between 0 and 1 with 1 representing good performance in intensive farming and 0 representing poor performance.

The composite index is the simple average of all the indices. It comprised of the indicators such as net irrigated area by tube wells, area irrigated per tube well, area under high yielding varieties of rice and sugarcane, fertilizer consumption per hectare of net area sown and number of tractors used per net area sown. The data have been collected from Season and Crop Report (2010-11) of Tamil Nadu (Anonymous, 2011) and Statistical Hand Book of Tamil Nadu Anonymous (2012). The composite index was framed for all the districts of Tamil Nadu except Ariyalur, Thirupur and Nilgiris where the data for certain intensive parameters during the study period were not available. Based on the index, the districts which were placed under first two ranks for the intensive agriculture were identified *i.e.*, Cuddalore and Villupuram. Since Villupuram district has been bifurcated from Cuddalore district only during 1994, else while South Arcot district which comprised both the Cuddalore and Villupuram district were taken for the study.

The following tools were used for the analysis :

Compound growth rate :

To analyse the changes in area under cultivation over the years, compound growth rate was estimated using the following formula :

$$Y = e^{a+bt}$$

$$\ln Y = \ln a + b \ln t$$

where,

Y= Area under the crop in hectare, b = Slope, a = Intercept and t = Time trend in years.

Instability analysis :

In order to compute the instability in area, co-efficient of variation (CV) was computed. The form of equation to compute the CV is as follows :

$$CV = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

Herfindahl index :

Crop diversification minimizes the risk of crop failure that might result from the unforeseen climate change and also help farmers to increase their incomes. In this study for measuring the crop diversification, Herfindahl index was used. In South Arcot district, food crops such as paddy, cholam, cumbu, ragi, pulses, banana, vegetables and cashew were grown traditionally. The district is also famous for the production of non-food crops especially sugarcane, cotton, gingelly and groundnut. Among the major crops, paddy and sugarcane are the two important crops and occupied 55 per cent of the gross sown area during 2010-11. The area under various crops over the years was analysed for the last three decades and on the basis of these data, Herfindahl index for measuring crop

Table 1 : Temporal change in area composition of major crops **(hectares)**

Crops	1980-81 to 1990-91	1991-92 to 2000-01	2001-02 to 2010-11	1980-81 to 2010-11	Growth rate (1980-81 to 2010-11)
Paddy	242729	251427	246596	246782	0.25
Cholam	20805	7186	3294	10763	-8.48
Cumbu	83786	70630	26089	60930	-6.24
Ragi	10361	4818	1544	5729	-9.33
Pulses	45257	49639	59058	51122	1.76
Banana	1649	4758	5328	3839	6.72
Coconut	1975	3507	4411	3255	3.79
Cotton	8974	27109	8152	14559	-0.74
Gingelly	24205	21009	9791	18524	-4.94
Groundnut	125028	100387	57695	95359	-4.51
Sugarcane	43274	66439	83700	63787	3.62
Tapioca	11344	15505	16359	14304	2.06
Vegetable	13680	18911	19116	17121	1.70
Cashew	22714	26195	34300	27574	2.06

diversification was worked out as under :

where,

$$HI = \sum_{i=1}^{n} Pi \log (1/Pi)$$

HI is the Herfindahl index, Pi is the proportion of area under ith crop to total area under the crop; and n is the number of crops raised. H varies from 0 to log n. The value of HI is bounded by zero (Perfect diversification) and one (Complete specification). The value of HI approaches to zero as N becomes large and assumes value one when single crop is cultivated.

EXPERIMENTAL FINDINGS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Crop pattern changes : A temporal analysis :

Temporal analyses of major crops grown in the district

Table 2 : Co-efficient of variation in area under major crops in South Arcot district (%)

Crops	1980-81 to 1990-91	1991-92 to 2000-01	2001-02 to 2009-10	1980-81 to 2010-11
Paddy	18.93	19.03	14.68	17.18
Cholam	27.08	40.85	32.12	79.56
Cumbu	10.15	21.59	73.59	47.34
Ragi	30.82	46.49	54.63	76.29
Maize	71.42	186.52	63.40	180.65
Samai	33.90	10.25	25.52	42.86
Thenai	54.20	24.74	198.49	83.45
Bengal gram	89.57	166.31	127.53	128.31
Red gram	56.05	38.61	85.04	90.07
Black gram	53.53	9.58	18.27	36.96
Green gram	73.98	40.19	40.43	83.03
Horse gram	28.79	51.44	59.25	76.39
Banana	52.62	15.29	9.69	47.09
Mango	13.76	12.56	20.12	35.16
Sugarcane	36.88	14.99	15.35	33.37
Sunflower	141.50	57.59	76.34	166.30
Tapioca	39.38	20.91	21.11	30.06
Vegetables	27.92	20.77	20.19	26.57
Cashew	9.40	12.45	3.23	19.68
Major food crops	12.56	8.17	34.75	9.68
Castor	58.60	60.49	119.41	121.05
Coconut	16.77	20.62	50.61	37.52
Cotton	30.45	187.60	190.12	201.34
Gingelly	17.74	32.74	53.70	44.47
Groundnut	28.16	40.12	55.15	47.33
Major non food crops	22.00	34.53	50.73	41.27

Table 3 : Average herfindahl index value for crop diversification

Decades	Average annual rainfall (mm)	Average Herfindal index value
1980-81 to 1990-91	1004	0.18
1991-92 to 2000-01	1124	0.25
2001-02 to 2009-10	1248	0.19
1980-81 to 2010-11	1144	0.20

are detailed in Table 1. It is observed that during the period 1980-81 to 2010-11, paddy occupied the maximum area (2.46 lakh ha), followed by groundnut (95359 ha), sugarcane (63787 ha), cumbu (60930 ha) and pulses (51122 ha). Except paddy, area under all other coarse grains has been reduced in all the three decades due to changes in income level and consumer preference.

The analysis of compound annual growth rate (Table 1) indicated that the area of pulses, banana, coconut, sugarcane, tapioca and cashew increased in the three decades. Due to the implication of technology mission on oilseeds in 1987, area under gingelly and groundnut was high during first two periods under study and later fell drastically in the last decade and registered a negative growth rate of above 4 per cent.

Instability analysis in Table 2 shows that the co-efficient of variation in area under food crops during 1980-2011 was 9.68 per cent and for non- food crops it was 41.27 per cent.

From the calculated co-efficient of variation values (Table 2) it is followed that the area cultivated under non-food crops showed greater variation than the area under food crops. This is because food crops need more and continuous irrigation than non- food crops. Scanty rainfall in some years resulted in lesser area under food crop cultivation and more area has been diverted for non-food crops. In the district, the average annual rainfall received during the last two decades was higher than the state average and the growth rate of rainfall in the last decade has reached a positive rate. Thus, because of the sufficient rain and thereby the ground water availability, more area has been diverted for food crops than the non-food crops. In order to analyse the implications of this cropping pattern on crop diversification, Herfindahl index was used.

Measurement of crop diversification using herfindahl index:

To relate the diversification index with that of the rainfall, the average annual rainfall of the district is also included in the Table 3.

It could be observed from Table 3 that the average Herfindahl index value for the district during the given time period was 0.20 and it ranged from 0.06 to 0.2 which indicated that the district has experienced crop diversification during the above mentioned period and mono-cropping was not followed. It can be observed that the low average annual rainfall during 1980-81 to 1990-91 coincided with the very low Herfindahl index value. This shows that less rainfall induces the farmers for more crop diversification. The present results are in accordance with the findings of Palanisamy *et al.* (2009).

Conclusion :

- Based on the composite index, the study has identified South Arcot district as the most intensive farming district in Tamil Nadu.
- Instability analysis showed that the co-efficient of variation in area under cultivation was found to be higher for non-food crops than that of food crops, which means area under non-food crops are subject to change frequently, due to variation in annual rainfall.
- The analysis of annual growth rate indicated that the area of pulses, banana, coconut, sugarcane, tapioca and cashew had increased in the three decades. Except paddy, growth rate of all other food grains and oilseeds had recorded a negative growth rate.
- Analysis of crop diversification using Herfindahl index showed that, during the last three decades, the average Herfindahl index value for crop diversification was found to be 0.20, which showed that the district was diversified in cropping pattern and intensive farming did not create mono-cropping in the district. Of all the three decades, the value of Herfindahl index was very low during the period wherein the annual rainfall was very scanty. Thus, the study concludes that during scanty rainfall period, farmers practicing intensive farming were diversified to less water requirement crops and hence crop diversification is considered as one of the resilient mechanisms, when climate is not conducive.

Coopted Authors' :

K. CHANDRAN, Department of Agricultural Economics, Tamil Nadu Agricultural University, COIMBATORE (T.N.) INDIA

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