

# DIVERSIFICATION OF INDIAN AGRICULTURE: A PRE AND POST REFORM ANALYSIS

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## **Abstract**

Diversification is an integral part of structural transformation of an economy. In brief it is the shift of work force either from one sector to another sector (Macro level diversification) or from one branch to other branch of a particular sector (Micro level diversification). So far as diversification within the agricultural sector is concerned it may be in terms of less profitable crop to high profitable crop i.e. crop to crop diversification or may be in terms of crop production to animal husbandry, fishing etc. i.e. crop to non-crop diversification.

The present study mainly concentrates on crop-to-crop diversification in India for the period of 1980-81 to 2000-2001. Both food and nonfood crops have been considered here. The total period of discussion is subdivided into two sub-periods viz. pre reform period (1980-81 to 1989-90) and post reform period (1990-91 to 2000-2001).

To measure the extent of diversification Herfindahl-Hirschman Index (HHI) has been used. HHI is a simple yet sophisticated way of measuring the nature of diversification not only in the agriculture sector but also in any other sector of an economy. The value of HHI varies from zero to one. It takes a value of one when there is complete specialization and approaches to zero with the increase in the extent of diversification. Zero value of HHI indicates perfect diversification.

Besides studying the nature and extent of diversification, attempt has also been made to study the sub period growth rates of the different crops and crop groups using best fitted kinked model, the year of reform being the year of kink. Kinked models that impose linear restriction, so as to eliminate discontinuity between sub-periods, provide a superior basis for comparisons of sub-periods growth rates.

As the literatures depict, with the advent of modern seed-fertilizer-water technology specially since the Green Revolution, there was a continuous surge for crop diversification in India primarily on the economic consideration. The present study also observed a clear diversification towards high value commodities during the last two decades. But, the pace has been accelerated during the post reform era. The nature

of post reform diversification was also observed quite different from that of Green Revolutionary diversification. Besides modern seed-fertilizer technology, resource related factors like rainfall, soil fertility; price related factors like input and output prices, institutional factors like tenancy reforms, government regulatory policies etc. are the important causes of crop diversification in India. Change in food habit, lifestyle are also to a great extent responsible for the crop diversification in the country during the post reform era.

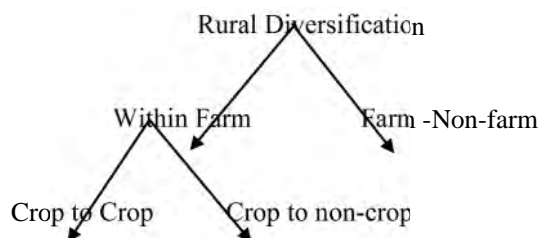
As a concluding remark it can be said that crop diversification is no doubt a healthy picture of an agro-based country like India towards its modernization. However, as compared to the other developing countries the process of crop diversification in this country is lagging far behind. To make the crop diversification more beneficial proper government attention, research support, proper water management, enhancement of credit and input supply etc. are very much necessary in the present competitive environment of globalization and liberalization.

**Key Words:** Diversification, Herfindahl- Hirschman Index, Kinked model, Linear restriction, Discontinuity.

## **INTRODUCTION**

Diversification of agriculture in favour of high value crops is reckoned as a spontaneous response to counter the emerging challenges. Diversification is gradually becoming popular either may be because of economic reforms or may be because of the change in the consumers test and preferences. Now diversification, what does it actually mean? Diversification is an integral part of structural transformation of an economy. However, it is varying in nature in terms of the factors that influences it or speed up its momentum. At the macro level occupational shift from primary to secondary and tertiary sector denotes diversification. The shift within the different branches of one sector can be termed as a micro level diversification. So far as rural economy in India is concerned broadly the nature of diversification can be divided into two groups viz. i. Diversification within the farm sector and ii. Diversification from farm to non-farm sector. The

first type of rural diversification can again be subdivided into two groups. One is shift from less profitable crop to high profitable crop that mean Crop to crop diversification and the other is the shifting in terms of crop production to animal husbandry, forestry etc. that means crop to non crop. Crop to crop shift is very much price elastic. The commercialization of market is the driving force behind this. To some extent the change in food habit is also influencing the diversification within the farm sector. Crop diversification is intended to give a wider choice of production of variety of crops in a given area so as to expand production depending upon the demand in the changing environment.



The second type of diversification is essentially the diversification of rural economics, which shows the shifting from primary rural activities to secondary and tertiary rural activities.

The present study mainly concentrates on crop-to-crop diversification in India for the period of 1980-81 to 2000-2001. Both food and nonfood crops have been considered here. The total period of discussion is subdivided into two sub-periods viz. pre reform period (1980-81 to 1989-90) and post reform period (1990-91 to 2000-2001).

The planning of the paper is as follows. After the introduction of present section (Section I), section II briefly overviews the literatures. Design of the study has been discussed in section III. Section IV deals with the results and discussions of the paper and finally the paper ends with the concluding remarks of section V.

**OVERVIEW OF LITERATURE**

Diversification can take place in the form of shift from farm to non-farm activities, shift from less profitable crop to more profitable crop that means diversification within different crops and lastly use of resources in diverse but complimentary activities (Vyas, 1994). However, here we are basically interested in the second type of diversification. Overview of literature reveals the use of different diversification index in the context of the measurement of diversification.

Pope and Prescott (1980) considered four different measures of diversification as the following

Index of maximum proportion  $M_1 = \max_i p_i$

Number of enterprises  $M_2 = \sum_{i=1}^N I(p_i)$ , I is the zero-one indicator

i.e. when  $p_i$  exists I takes a value one and if  $p_i$  does not, I takes a value zero.

Herfindahl Index  $M_3 = \sum_{i=1}^N p_i^2$

Entropy Index  $M_4 = \sum_{i=1}^N p_i \log \frac{1}{p_i}$

where  $p_i = \frac{A_i}{\sum_{i=1}^N A_i}$ , the proportion of ith crop.

In case of acreage proportion  $A_i$  is the area under ith crop and  $\sum A_i$  the total cropped area and  $p_i$  in case of income proportion these two terms represents net income from the ith crop and net income from all crops respectively. The values of all the indexes, except  $M_2$ , vary between zero and one.  $M_2$  may take a value more than one. For increasing diversification,  $M_1$  and  $M_3$  are decreasing,  $M_2$  and  $M_4$  are increasing.

In the subsequent years these measures were used by different authors like Gupta and Tewari (1985), Singh et. al (1985) for diversification measurement. While Gupta and Tewari took both the acreage and income proportion measure, Singh et. al.(1985) applied it only taking the income proportion. Later Pope and Prescott (1980) related the indexes with farm size, wealth and experience by the following equation

$$M_{jt} = a_0^j Z_t + a_1^j D_t + a_2^j S_t + a_3^j W_t + a_4^j E_t + \epsilon_t$$

where  $M_{jt}$  is the jth diversification measure on the tth farm,  $Z_t$  is the vector representing organizational forms,  $D_t$  is a vector of locational dummies,  $S_t$  is acres cropped,  $W_t$  is net worth per acres cropped and  $E$  is the year of the farmer started farming. Their findings indicate that the larger farms are more diversified and wealthier and less experienced farms are more specialized.

Chand and Chauhan (2002) measured the extent of diversification in terms of change in level of resource allotted to different production activities as a proportion total resource used using the following measure:

$$DI_{mk} = 1/2 \sum_i |A_{im} - A_{ik}| / TCA$$

where,  $DI_{mk}$  refers to diversification crop pattern between year m and k.  $A_{im}$  and  $A_{ik}$  are area under ith crop in mth and kth year respectively. TCA is the

total crop area.

To characterize spatial crop shift Kurosaki (2003) used two-diversification indexes. The first index is defined as

$$D_{it} = 1 - H_{it} = 1 - \sum (A_{hit} / \sum_k A_{kit})^2$$

A small  $D_{it}$  implies the concentration of the crop in a few districts.

The second index that measures the diversification within a particular district is as follows

$$D_{hit} = 1 - H_{hit} = 1 - \sum (A_{hit} / \sum_k A_{hit})^2$$

## STUDY DESIGN

### Objectives:

The main objectives of this study are

- i. to study the nature of crop diversification in India for the pre and post reform periods.
- ii. to examine the growth trends of different crop(group/single) output valued at constant prices for the sub-periods under study.

### Data Sources:

The data used for this study are of secondary type. The basic sources are CMIE for various years. The values of the output for each crop have been estimated at constant prices for the year 1990-93 and the prices have been taken from the notable study of Bhalla and Singh (2001).

As already mention the whole period (1980-81 to 2000-2001) has been sub divided into two sub-periods viz. pre reform period (1980-81 to 1989-90) and post reform period (1990-91 to 2000-2001).

### Selected crop Groups

Both food and non-food crops have been considered in the present study. Among the food crops, from cereals rice, wheat, jowar, bajra, maize, Ragi, small millet and barley, from pulses gram, arhar and other pulses as one group are considered. Non-food crops are subdivided into three groups viz. oilseeds, fibres and miscellaneous crop. Oilseeds comprises of mustered, linseed, castor, safflower, nigrerseed, soyabeans and sunflower. Cotton, jute and mesta are in the fibers group and lastly in the miscellaneous group there are tea, coffee, potato, sugarcane and tobacco.

### Diversification Index

To measure the extent of diversification the following model has been used for the present study

$$DI_{mk} = 1/2 \sum |(A_{im} - A_{ik})| / TCA$$

Where;  $DI_{mk}$  is the diversification index between the year m and k,  $A_{im}$  refers to the area under ith crop in the mth year,  $A_{ik}$  refers to the area under ith crop in

kth year and TCA is the total crop area (average of the total crop area of the first and end year of a period). Chand and Chauhan (2002) used this model to measure the nature of diversification of Indian agriculture at the aggregate level. In the present case the same model has been used for the measurement of diversification among the different crop groups and also the agriculture as a whole at the country level. Here the diversification is measured in terms of changes in level of land allocated to different crops as a proportion of total land use.

### Models for Trend Selection:

In case of growth measurement the most important point is the identification of the appropriate trend equation. The present study is a sub-period study. The sub-period growth rates can be measured either by estimating them separately or by fitting a single equation. However, in case of independent estimation the trend line are likely to be discontinuous and because of that some time disparity may arise in between the sub-period and whole period growth rates [Boyce, 1987]. Kinked models that impose linear restrictions, so as to eliminate discontinuity between sub-periods, provide a superior basis for comparisons of sub-periods growth rates. Basically here our intention is to study the change in agricultural production that may have occurred due to liberalization. Because of that the year 1991-92 has been selected as the year of trend break or year of kink. To the best of our knowledge, introduction of kink in the exponential framework was found first in the work of Boyce (1987) in the context of sub-period growth study of West Bengal. The introduction of kink in the linear, parabolic and also in log-quadratic framework is the new attempt by the present author. The models are as follows:

*Kink Linear (KL):*

$$V_t = a + b_1 D_1 t + b_2 D_2 t + u_t \quad (1)$$

*Kink Parabola (KP):*

$$V_t = a + b_1 D_1 t + b_2 D_2 t + c_1 D_1 t^2 + c_2 D_2 t^2 + u_t \quad (2)$$

*Kink Exponential (KE):*

$$\ln V_t = a + b_1 D_1 t + b_2 D_2 t + u_t \quad (3)$$

*Kink Log Quadratic (KLQ):*

$$\ln V_t = a + b_1 D_1 t + b_2 D_2 t + c_1 D_1 t^2 + c_2 D_2 t^2 + u_t \quad (4)$$

where  $V_t$  is the total agricultural production in value terms.  $a$ ,  $b_1$ ,  $c_1$  are the parameters estimated on the basis of observed data,  $t$  is the time period,  $D_j$ s are the dummy variables and

$$D_j = 1 \text{ for the } j\text{th sub-period, } i, j = 1, 2$$

= 0 otherwise.

$u_t$  is the disturbance term. Here the sub-periods are 1981-82 to 1990-91 and 1991-92 to 2000-2001. Significance of the trend breaks has been calculated by replacing the value of  $b_2$  by  $(b_1 + b)$  and  $c_2$  by  $(c_1 + c)$  in the regression of the trend equations. Significance of  $b$  and  $c$  values will indicate the significance of the trend break.

## Results and Discussion

### Nature of diversification

In India significant level of diversification has been started since the green revolution. As the index shows (Table-1) in the post reform period total agriculture witnessed higher level of diversification in India. 11.2% of the total crop area experienced some sort of diversification. The main reason of this is the diversification within the foodgrains specifically from cereals to non-cereals crops. In this sub-period lowest diversification is found in the food-nonfood group only 1.2%. However the diversification levels are quite high in the cases of nonfoodgrains (11.7%), oilseeds (26.5%), miscellaneous crops (7.3%) during the pre reform period.

Table-2 gives the shares of various crop groups in total cropped area for the two different time periods. The share of foodgrains decreased from 82.26% in the triennium ending (TE) 1990-91 to 79.44% in TE 2000-2001, resulting in increase of share of nonfoodgrains in the area (from 17.74% to 20.57%). Among foodgrains, cereals have lost area share (from 66.39% to 60.19%) whereas the pulses have gained (from 15.87% to 19.24%).

### Selected Growth Trends:

For the cereals and total foodgrains kink exponential model (KE) gives the best fit (Table-3) indicating a sharp change in the relative rate of growth. Kink parabola (KP) is giving good fit for the miscellaneous and total agriculture. Kink in parabolic form implies a jump in the rate of change of rate of absolute growth. For the rest crop groups namely pulses, oilseeds, fibers, and nonfoodgrains kink log-quadratic (KLQ) model is the best-fitted model, which indicates a sharp change in the rate of acceleration and deceleration. All the trend breaks are found negative though very few of them are at significant level. Only in case of oilseeds, nonfoodgrains and total agriculture the quadratic breaks are significant. That means the new reforms do not bring any remarkable change in the crop production of India.

### Growth rates

Growth rates, calculated from the different functional form, are not comparable. Though not best fit in all

the cases, but on an average the KE model is at the acceptable position for all the cases. Because of that to maintain the uniformity KE model has been uniformly used in the present study for the growth rate measurement. In the exponential frame work, the coefficients bis(equation-3) give the relative growth rates for the sub-periods.

Table-3 shows that the growth rates of the crop groups during sub-period II are lower than that of sub-period I only with the exception in the miscellaneous group. It indicates adverse impact of globalization on Indian agriculture. Pulses ushers negative growth rate in the second sub-period (-.7%). Fall in total agriculture is from 3.5 % to 1.9%. During the pre-reform period the maximum growth rate is found in the oilseeds group. Foodgrains growth comes down 2.9% to 1.6%. This post reform foodgrains production was below the population growth of that period. Since 1975, it was the first time when the foodgrains growth was below the population growth rate. The exponential growth rates of the important single crops are in Table -5.

### Interpretation

Crop wise analysis shows during post reform period area growth was in favour of pulses, fibers and miscellaneous crops. This means the area shift was in favour of exportable crops during this period. The export thrust of the reform policies had accelerated the cropping pattern change. However, export agriculture is capital intensive and beyond the reach of small farmers who lack not only the access to the productive assets but also the infrastructure to take advantage of market openings. Therefore the benefits of export-oriented policies of 1990s do not seem reach to the poor section of the farming community. Basically it helped the rich farmers, for example in the case of cotton production in Andhra Pradesh, Karnataka, oilseeds production in Rajasthan [Reddy, 1996] etc.

The reform policy some time showed wrong direction to the farmers also. For example, the exports of superior cereals like wheat and rice in which the country has comparative advantage continue to be restricted, on the other hand the oilseeds in which the country has no comparative advantage, are still protected [Gulaity and Sharma, 1997b]. This factor is causing a shift of resources from foodgrains to oilseeds.

The crop shift within the foodgrains was basically an outcome of the nature of new technology. The superior cereals got more importance. The high yielding varieties of wheat and rice made significant

impact on the cropping pattern in the different states and because of this technological support, though the non-food crops gained an edge over the foodgrains in terms of area, the percapita availability of foodgrains was not affected adversely.

Change in lifestyle, consumption pattern etc are also very much influencing the crop production structure of India [Dyson & Hanchate, 2000]. The food basket in the country has become considerably diversified with much greater share being occupied now by non-foodgrains such as milk, meat, eggs, vegetables, fruits etc. Demand for processed, ready to cook and fast food is quite high in the recent times. For the urban people now-a-days less time is available for food preparation [Hanumantha Rao, 1999] In the rural area the physical labour has been reducing gradually which has resulted in the revolution of biological requirement of grains for energy. In this connection it is interesting to note that decline in percapita consumption of foodgrains has taken place basically in the developed region. Even if with the decrease in the price of foodgrains, the percapita consumption declined in those areas in the 1990s. The share of cereals and pulses in the real consumption expenditure on food has fallen from 34% in 1990 to 27% in 2000 [Bansil, 2002]. This change in food habit is also partly because of the influence of the media. Now the people have wide section of food and nonfood items to purchase.

### **Conclusion**

From the foregoing analysis it is quite clear that a significant level of crop diversification has been found in India during the period of liberalization. It is mainly characterized by the growth in the share of nonfood crops. In case of foodgrains, cereals are replaced by pulses. More thrust on export oriented production, change in life style and consumption pattern etc. are some of the leading factors behind the recent trends of Indian agriculture. However, liberalization did not made any significant dent in the agricultural growth scenario in India. Significant levels of fall in the growth rates of production have been noticed in all the crop groups except the miscellaneous group and in all the single crops except jute and coffee from the pre to post reform period.

In this present situation rethinking about the reform policies are very much in urgent for the future development of Indian agriculture. Finally it can be said that crop diversification is no doubt a healthy picture of an agro-based country like India towards its modernization. However, as compared to the other developing countries the process of crop diversification in this country is lagging far behind.

To make the crop diversification more beneficial proper government attention, protective technology, proper infrastructure research support, proper water management, enhancement of credit and input supply etc. are very much necessary in the present competitive environment of globalization and liberalization to enter into the world market on equal footing with the developed countries.

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**Table-1**  
**Extent of Diversification of different crop groups in India**  
**(Percentage)**

Crop Group	Diversification Index	
	Pre-reform Period	Post-reform Period
<b>Total Agriculture</b>	<b>6.2</b>	<b>11.2</b>
Within Foodgrains	4.5	10.3
Within Pulses	3.1	15.23
Within Cereals	4.8	8.9
Cereals to Non cereals	1.1	6.2
Within Non foodgrains	11.7	2.7
Within fibers	4.5	5.3
Within Oilseeds	26.5	23.9
Within Miscellaneous	7.3	6.9
Foodgrains to Nonfoodgrains	1.8	1.2

**Table-2**  
**Share of various crop groups in total cropped area**  
**(Percentage)**

Crop Groups	1990-91	2000-2001
Cereals	66.39	60.19
Pulses	15.87	19.24
Oilseeds	8.57	9.79
Fibers	5.49	6.42
Miscellaneous	3.68	4.35
Total Foodgrains	82.26	79.44
Total Non Foodgrains	17.74	20.57
Total Agriculture	100	100

**Table-3**  
**Selected trend lines and the level of significance of the trend breaks**

Crop Groups	Trend Equation	Trend break of the linear term	Trend break of the quadratic term	$\bar{R}^2$
Cereals	KE	-.012(-1.70)		.91
Pulses	KLQ		-.0053(-1.36)	.12
Oilseeds	KLQ		-.015(-3.4)*	.94
Fibers	KLQ		-.009(-.34)	.46
Miscellaneous	KP		-910.89(-.79)	.91
Total Foodgrains	KE	-.0125(-1.59)		.89
Total Non Foodgrains	KLQ		-.086(-2.06)**	.79
Total Agriculture	KP		-6045.1(-1.86)***	.88

Notes: (1) KE → Kink Exponential, KL→ Kink Linear,  
 KLQ→ Kink Log Quadratic, KP→ Kink Parabola.  
 (2) \*, \*\*, \*\*\* Indicate Significant at 1%, 5% and 10% level respectively.  
 (3) Figures in the parentheses are the t values.

**Table-4**  
**Sub-Period wise Exponential Growth Rates of Output, Area and Productivity of the Crop Groups (Percent per annum)**

Crop Groups	Pre-reform Period		
	Exponential Growth rates		
	Output	Area	Productivity
Cereals	3	-.3(-10)	3.3(110)
Pulses	1.3	-.5(-38.46)	1.8(138.46)
Oilseeds	9	5.9(65.56)	3.1(34.44)
Fibers	3.6	-.6(-16.67)	4.2(116.67)
Miscellaneous	3.2	1.4(43.75)	1.8(56.25)
Total Foodgrains	2.9	-.3(-10.34)	3.2(110.34)
Total Non Foodgrains	4.1	2.8(68.29)	1.3(31.71)
Total Agriculture	3.5	.17(4.86)	3.33(95.14)
Post-reform Period			
Cereals	1.9	-.45(-23.68)	2.35(123.68)
Pulses	-.7	.8(-50)	-1.5(150)
Oilseeds	3.6	1.8(50)	1.8(50)
Fibers	1.3	2.4(184.62)	-1.1(-84.62)
Miscellaneous	3.3	2.2(66.67)	1.1(33.33)
Total Foodgrains	1.6	-.17(-10.63)	1.77(110.63)
Total Non Foodgrains	2.2	2.1(95.45)	.1(4.55)
Total Agriculture	1.9	.28(14.74)	1.62(85.26)

Note: Figures in the parentheses are the percentage contributions.

**Table-5**  
**Exponential Growth rates of some of the important Crops (Percent per annum)**

Crops	Pre-reform period	Post reform Period
Rice	3.9	1.7
Wheat	3.5	3.1
Gram	.0006	1.6
Mustard	9.7	-.37
Cotton	.76	-1.8
Jute	1.6	2.5
Tea	2.7	1.5
Coffee	1.9	6.5
Potato	4.6	4.5
Sugarcane	3.3	3.2
Tobacco	1.2	1.6