



## Research Article

# STUDY OF GROWTH RATES AND INSTABILITY AMONG DIVERSE SUB-SECTORS OF AGRICULTURE AND THEIR IMPACT ON FARMERS INCOME IN INDIA

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**Abstract:** Agriculture is a vast sector comprising of diverse sub-segments. The changing food habits of people have led to a shift in the consumption pattern of food basket of the people in India. People today are more nutrition-centric than ever before and therefore horticulture crops like fruits, vegetables and other agri-commodities such as milk, egg, meat have been gaining importance. The present study was conducted to study the trends in area, production and yield of major crop groups and agri-commodities in India through growth rate and instability analysis for the last twenty years from 2001-02 to 2019-2020. The growth rates were calculated by fitting the exponential growth function and instability were analysed by generating Cuddy Della valle index for food grains, horticulture crops and other major agro-commodities such as egg, milk, meat at the national level. The results have shown a significant but low growth rate of 2.34 percent in food grain production during this period. Horticultural crops have seen a better growth rate than the food grains. Agri-commodities such as milk, egg, meat have also seen good growth in their production during the study period. The Cuddy Della Valle Index was computed to find the consistency in the growth these sub-sectors of agriculture. The diversification of agriculture towards high-value commodities (HVCs) like fruits, vegetables, dairy, poultry, meat and fish products, etc. is suggested as a potential solution to stabilize and raise farm income, enhance agricultural growth, increase employment opportunities by means of post-harvest processing and value addition.

**Keywords:** Food grains, Horticulture, Growth Rate, Exponential function, Instability, Cuddy Della Valle Index, Value addition

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## Introduction

Agriculture has been a vital component of Indian economy since times immemorial. India is a country with a huge population of 1.21 billion people [1]. Despite the developmental efforts taken over the last few decades have strengthened the industrial and service sector, still agriculture continues to remain the mainstay of our economy as more than 67 per cent of the population depends upon agriculture and allied activities for their livelihood directly or indirectly. Though the magnitude of contribution of agriculture to the overall Gross Domestic Product (GDP) of the country has fallen from about 30 percent in 1990-91 to less than 20 percent in 2020-21, this decrease in agriculture's contribution to GDP has not been accompanied by a harmonious shrink in the share of employment in agriculture, hence agriculture sector even today forms the crucial key for development of our country [2].

An average Indian spends almost half of his/her total expenditure on food. In the recent years, growing urbanization coupled with sustained economic growth has helped in rising per capita income, thus, leading to a shift in the consumption patterns of the people of our country. People are more health conscious and aware about what they are consuming. The per capita cereal consumption has been declining since the early 1970's despite a significant increase in per capita cereal production [3]. Within cereals, consumers have seemed to shift away from coarse cereals over time especially in rural India and this decline is compensated to a certain level by increased consumption of nutritious and high value food items such as milk, fruits, vegetables, meat, fish, eggs, etc. This dietary change is not confined to the higher income of the society only but is also visible to some extent in the lower income segment. Such a shift in consumption pattern in favour of high value food commodities depicts ongoing process of transformation that is, leading toward a silent wave of agricultural diversification.

The economy has also witnessed shifting of consumption pattern from traditional cereals to a more holistic diet consisting of fruit and vegetables, milk, fish, meat and poultry products. This shows there is a definitive shift from carbohydrate-centric to a balanced nutrition-centric approach in India. Hence, agricultural diversification towards high-value crops has been gaining great importance with the passage of time.

Agricultural diversification can be defined as a strategy of changing crops or adopting more than one crops as well as enterprise in accordance with the agro-climatic suitability of the region. It can also be defined as the transition from less profitable to more profitable crops or enterprises. Diversification in sub sectors of agriculture has been taking both across and within- crop, dairy, forestry and fishery sectors. In recent years, sectors such as horticulture, floriculture, mushroom production, and agro-food processing have seen a rising trend. Within agriculture, some of the sub-sectors are progressively occupying a more significant place than the crop production, and within the crop-mix, some superior cereals are progressing faster than the inferior cereals. However, the factors promoting diversification and the speed with which the changes occur vary under different situations [4]. Agricultural diversification in India is slowly picking up momentum in favour of high value food commodities primarily to enhance income rather than as a strategy of risk minimization. Keeping in view the shrinking agricultural land and operational holdings which are governed by the expansion of urban areas and, high growth rate of population, along with changes in consumer food habits, the farmers are slowly including or substituting additional high value crops in to their farming system [5].

Horticulture sector includes a wide range of crops like fruits, vegetables, flowers, spices, plantation crops like coconut, beverages like tea and coffee and medicinal and aromatic plants.

India is the second largest producer after China in both fruit and vegetable production [6]. In our country, horticulture sector contributes about 33 per cent to the agriculture Gross Value Added (GVA) making very significant contribution to the Indian economy. India is currently producing about 320.64 million tonnes of horticulture produce which has surpassed the food grain production of 296.65 million tonnes, that too from much less area of 26.45 million Ha. under horticulture against 127.59 million Ha. for food grains (2019-2020). The diverse agro-climatic conditions and rich diversity in crops of our country enable India to produce a wide range of horticultural crops round the year. The late 1980s saw diversification towards other crop groups like oilseeds, commercial crops like sugarcane and horticultural crops. Economic reforms and policies of 1990s further increased the speed of diversification in favour of horticulture crops [7]. In tune with the emerging demands, Horticulture is perhaps the most rising sector with great opportunities for employment generation and thus enhancing the income of farming community. This is because horticultural crops are good material for value addition also. Value addition helps to improve the profitability of farmers by empowering the farmers and other weaker sections of society especially women through gainful employment opportunities. Also, horticultural crops are highly perishable, so value addition and processing (secondary agriculture) help to ensure the year-round availability of the seasonal produce to the people. Thus, horticulture is one of the important sectors of agriculture which can greatly help to augment farmers' income by providing better prices, greater employment opportunities by encouraging growth of subsidiary industries. Livestock is also a very integral part of agrarian economy. India has the world's largest livestock population accounting for over 37.28 per cent of cattle, 21.23 per cent of buffalo, 26.40 per cent of goats and 12.17 per cent of sheep of the world's population. According to the 20th Livestock Census the total livestock population in the country has increase by 4.6 per cent as compared to 2012. Poultry sector has also observed a sharp rise of 16.8 per cent compared to the last livestock census [8]. There has been a sharp rise in the consumption of livestock products as the food habits are transformed over the period of time. Thus, the study was done with the purpose of assessing the growth rate as well as instability in the production of various sub sectors of agriculture- crops including major food grain crops, oilseeds crops, horticultural crops, milk, egg, meat, fisheries etc.

**Material and Methods**

The study was based on secondary data. The data related to the area, production and yield of different food grains crops and other agri-commodities at national level were compiled through the publications of Ministry of Agriculture and Farmer's Welfare -Agricultural Statistics at a Glance for the period 2001-02 to 2019-20 [9]. The present study was conducted for food grains, horticultural crops, milk, egg, and meat for the given time period.

**Growth rate analysis**

In the present study, Compound growth rates were calculated by exponentially fitting the time series data of area, production and yield of major agri-commodities at national level against time using the following formula-

$$Y_t = ab^t U_t \tag{1}$$

Where,

Y<sub>t</sub> = Dependent variable for which growth rate was estimate in year t

a = Intercept

b = Regression coefficient

t= Year which takes values 1, 2, ..., n.

U<sub>t</sub>= Disturbance term in year t.

The equation (1) was transformed into log-linear and written as -

$$\log Y_t = \log a + t \log b + \log U_t \tag{2}$$

Equation (2) was estimated by using Ordinary Least Square (OLS) technique.

Thereafter, compound growth rate (g) was then calculated by using formula given in equation (3)

$$g = (b-1) \times 100 \tag{3}$$

Where,

g = Estimated compound growth rate per annum in percentage.

b = Antilog of regression coefficient value

**Instability analysis**

An analysis of fluctuations in agricultural output, apart from growth, is important as wide fluctuations in agricultural output not only affect prices and bring about sharp fluctuation in them but also results in wide variations in disposable income of the farmers. The magnitude of fluctuations depends on the nature of crop production technology, agro-ecological conditions, economic environment, availability of material inputs and many other factors depending upon the enterprise chosen. High growth in production accompanied by low level of instability for any crop is desired for sustainable development of agriculture over the period of time. To measure the magnitude of variability in area, production and yield, the co-efficient of variation (%) was computed. The simple coefficient of variation (C.V.) often contains the trend component and thus overestimates the level of instability in time series data characterized by long term trend. To overcome this problem, a measure of instability is estimated by using Cuddy Della Valle Index (CDVI) which corrects the coefficient of variations and it is given by (4,5)-

$$\text{Instability index} = CV \cdot (1 - R^2)^{0.5} \tag{4}$$

Where,

R<sup>2</sup> is the coefficient of determination from a time trend regression adjusted by the number of degree of freedom.

The coefficient of variation (CV) can be calculated by using the formula -

$$CV = (\sigma/\bar{x}) \times 100 \tag{5}$$

Where,

σ = Standard deviation of variables concerned i.e., area/ production/yield

$\bar{x}$  = Mean value of the variable.

**Results and Discussion**

The food grain production was 212.85 million tonnes in 2001-02 and in 2019-20 it was recorded to 296.65 million tonnes. The area under horticultural crops increased from 16.47 million Ha. to 26.45 million Ha. but the horticultural production has seen a massive increase from 145.62 million tonnes to 320.64 million tonnes in the last twenty years period. Horticultural production has exceeded the food grain production in the recent years as shown in [Fig-1]. Horticulture has been gaining importance and farmers are substituting cereal crops with high value crops as they are more remunerative and export-oriented products beside providing ample employment opportunities to the farming community.

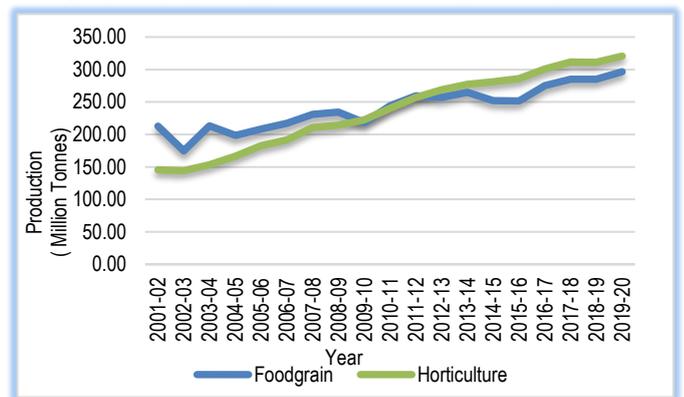


Fig-1 Comparison of Horticultural Production versus Food grain Production in India

The compound annual growth for food grain as well as horticultural crops were calculated by exponentially fitting the time series data of area, production and yield at national level against time. The growth rates estimated for area, production and yield of major crop groups are presented in [Table-2]. Food grain production has seen a growth of 2.34 per cent for the time period 2001-2020. The productivity has also seen a growth of 2.01 per cent. Area under food grains has almost remain stagnant thus CAGR was calculated to be mere 0.32 per cent. The overall horticultural production has seen a better rise of about 4.84 per cent than food grain production. The area growth and yield growth are found to be 2.66 and 2.12 per cent respectively. Among horticultural crops, production of all sub-categories such as fruits, vegetables and spices have seen a better rise as compared to area and yield. Flowers have seen the highest growth among all crops in terms of area and production of 14.65 per cent and 12.75 per cent

respectively, but productivity growth rate was computed to be negative with a value of -1.66 per cent. Spices and plantation crops have production growth rate of 5.55 and 3.51 per cent respectively. Horticulture sector has seen a good growth over the past twenty years. It has been adopted by farmers and also substituted traditional farming so as to enhance the income of farmer by use of secondary agriculture and value-addition. These crops are highly suitable for post-harvest processing which helps to get better prices to the farmers.

Table-1 Compound growth rate of area, production and productivity of Food grains and Horticulture

| SN   | Crops            | Area   | Production | Productivity |
|------|------------------|--------|------------|--------------|
| 1    | Food grains      | 0.32*  | 2.34*      | 2.01*        |
| 2    | Horticulture     | 2.66*  | 4.84*      | 2.12*        |
| i.   | Fruits           | 2.67*  | 5.05*      | 2.31*        |
| ii.  | Vegetables       | 3.28*  | 4.74*      | 1.43*        |
| iii. | Spices           | 1.37   | 5.55*      | 4.12*        |
| iv.  | Plantation Crops | 1.61*  | 3.51*      | 1.86*        |
| v.   | Flowers          | 14.65* | 12.75*     | -1.66        |

Note: \* Significant at 1% level of significance, \*\* Significant at 5% level of significance, \*\*\* Significant at 10% level of significance.

The growth rates help to show the time-series pattern of various crops over a period of time. It is necessary to study the instability index for different variable in order to assess the consistency of growth performance. [Table-2] indicates the Cuddy Vella index of instability of production and food grains and other agri-commodities in India during the last two decades from 2001-02 to 2019-2020. From the table it is observed that the instability in production under food grains was 7.62 per cent. As for the horticultural crops on a whole the instability was found to less than the food grains with a value of 4.80. Among the horticultural crops the instability was found to be high in all the sub-categories with maximum value among the spices followed by flowers. Fruits and vegetables which are the most important sector under horticulture crops had an instability index of 5.04 and 5.80 per cent respectively. The other dietary diversification products were also studied and it was found that compound annual growth rate for milk was calculated to be 4.81 per cent with instability index of about 2.87 per cent. Meat has seen a massive rise of 9.55 per cent followed by eggs and fisheries sector of 5.99 and 4.89 per cent respectively. A high growth rate along with low value of instability is considered to be a desirable criterion for the consistent and good performance of any crop group or sub-sector. Thus, it has been seen that for the growth of agriculture and its various sub-sectors CDVI is considered to be a very important criterion.

Table-2 Index of instability of agri-commodities in India during the period 2001-02 to 2019-2020

| SN   | Agri-commodities    | CAGR in Production | CDVI(in percentage) |
|------|---------------------|--------------------|---------------------|
| 1    | Food grains         | 2.34               | 7.62                |
| 2    | Horticultural Crops | 4.84               | 4.80                |
| i.   | Fruits              | 5.05               | 5.04                |
| ii.  | Vegetables          | 4.74               | 5.80                |
| iii. | Spices              | 5.55               | 13.86               |
| iv.  | Plantation Crops    | 3.51               | 10.30               |
| v.   | Flowers             | 12.75              | 12.96               |
| 3    | Milk                | 4.81               | 2.87                |
| 4    | Egg                 | 5.99               | 3.83                |
| 5    | Meat                | 9.55               | 11.32               |
| 6    | Fisheries           | 4.89               | 6.21                |

### Conclusion and Policy Implications

Horticulture is an immensely potential sector for the growth of agriculture in India. The gaining importance in terms of nutritious dietary intake has resulted in farmers taking up horticultural crops. Thus, the overall growth of horticulture sector is found to be better than the food grains. Better emphasis on good varieties, proper infrastructure for storage and good system for post harvest processing can greatly help in further enhancing the interest of farmers in this sector. Horticulture is rightly a sunrise sector in enhancing the farmers income by fetching remunerative prices and have a greater export-oriented potential. Livestock sector also has a tremendous growth potential in the recent years and the study also lays emphasis

that growth rate of almost every livestock product has seen a good rise. They will not only help to increase the income of farmer by providing additional means but also help to bring about a good balance by inducing dietary diversification. The overall indirect impact of agricultural diversification will lead to income diversification and a better position for the farmers by means of stabilized source of income. Diversification will provide more employment and income to reduce vulnerability of poor farmers and it will support the policy makers and planners who aim to double the farm income. The growth rates are positive and significant as well as CDVI is also low, thus it shows that government should emphasize on the specific sectors so as farmers opt for horticultural crops as well these enterprises such as poultry and livestock. The various schemes and establishment of infrastructure should be such that farmers take up these ventures at a larger scale. Research and policy support is needed to increase the acreage and yield under high value crops that will help to increase per capita availability of fruits, vegetables and other agri-product to the people and thus to some extent it will help stabilize the prices.

**Application of research:** Finding may be used by different stakeholder such as policy maker and administrator for further policy interventions looking into the potential of various sectors of agriculture.

**Research Category:** Growth and instability

**Abbreviations:** CDVI-Cuddy Della Valle Index  
CV-Coefficient of Variation, GVA-Gross Value Added

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**Cultivar / Variety / Breed name:** Nil

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Ethical Committee Approval Number: Nil

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