

**COMPARATIVE ECONOMICS OF BANANA  
CULTIVATION AND ITS COMPETING CROPS IN  
HILLY ZONE OF KARNATAKA**

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**DEPARTMENT OF AGRICULTURAL ECONOMICS  
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HILLY ZONE OF KARNATAKA**

**RANGEGOWDA, R.**

**PALB 4004**

*Thesis submitted to the*

**University of Agricultural Sciences, Bengaluru**

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*for the award of the degree of*

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in

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*Affectionately  
Dedicated to My  
Beloved Parents,  
Srĭ Ranganath, S.N.  
Smt Lalĭtha, R.  
My Sister  
Nivedĭtha, R.*

**DEPARTMENT OF AGRICULTURAL ECONOMICS  
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**CERTIFICATE**

This is to certify that the thesis entitled “**COMPARATIVE ECONOMICS OF BANANA CULTIVATION AND ITS COMPETING CROPS IN HILLY ZONE OF KARNATAKA**” submitted by **Mr. RANGEGOWDA, R. ID No. PALB 4004** in partial fulfillment of the requirements for the degree of **DOCTOR OF PHILOSOPHY** in **AGRICULTURAL ECONOMICS** to the University of Agricultural Sciences, GKVK, Bengaluru is a record of *bona-fide* research work done by him during the period of his study in this University under my guidance and supervision and the thesis has not previously formed the basis for the award of any other degree, diploma, associateship, fellowship or other similar titles.

Bengaluru  
August, 2017


  
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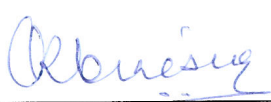
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August, 2017*

*(Rangegowda, R.)*

# **COMPARATIVE ECONOMICS OF BANANA CULTIVATION AND ITS COMPETING CROPS IN HILLY ZONE OF KARNATAKA**

**RANGEGOWDA R**

## **ABSTRACT**

The study was undertaken in Hilly Zone of Karnataka to analyse the dynamics of banana area, production and prices along with cost and returns, resources use efficiency and profitability of banana and its competing crops. Multistage random sampling technique was employed to select the respondents. In total 200 banana growing farmers and 100 consumer household were selected and required field data pertaining to the year 2015-16 was collected through personal interview. The secondary data was collected from various published sources. The data were analysed using compound growth rate, instability index, Cobb-Douglas production function, partial budgeting technique, Garrett ranking technique and descriptive statistics. The results revealed that, growth in area, production and productivity of banana in India, Karnataka and in the study area showed significant positive growth for the period 2001-02 to 2015-16. Further, horticultural crops showed positive trend compared to agricultural crops. The results of cost and returns of banana and its competing crops revealed that, banana cultivation was profitable with per ha net returns of Rs. 3,04,475 compared to its competing crops (Rs. 3,829 in paddy and Rs. 1,18,598 in ginger). Resource use efficiency in banana production indicated that sucker, FYM, chemical fertilizer and irrigation were the most productive inputs. The study also showed that, there is a scope for reorganizing inputs usage of these were departed from optimality as indicated by MVP:MFC ratio. Skin colour, price and taste were the major factors that contributed for consumer preference for banana. Year round availability, Price of banana, taste, religious festivals, health concern and nutritional quality were the major factors influenced households to consume banana. Less labour requirement, high profitability, regular demand and low pest and disease compared to its competing crops were the major factors responsible for sustained banana production in the study area.

August, 2017

Department of Agricultural Economics  
UAS, GKVK, Bengaluru

**K. B. Umesh**  
Major Advisor

ಕರ್ನಾಟಕದ ಮಲೆನಾಡು ಕೃಷಿ ವಲಯದಲ್ಲಿನ ಬಾಳೆ ಬೇಸಾಯದ ಮತ್ತು ಅದರ ಸ್ಪರ್ಧಾತ್ಮಕ ಬೆಳೆಗಳ  
ತುಲನಾತ್ಮಕ ಆರ್ಥಿಕ ಅಧ್ಯಯನ

ರಂಗೇಗೌಡ, ಆರ್.

ಸಾರಾಂಶ

ಪ್ರಸ್ತುತ ಅಧ್ಯಯನವನ್ನು ಕರ್ನಾಟಕದ ಮಲೆನಾಡು ಕೃಷಿ ವಲಯದಲ್ಲಿನ ಬಾಳೆ ಮತ್ತು ಅದಕ್ಕೆ ಸ್ಪರ್ಧಿಸುವ ಬೆಳೆಗಳ ವಿಸ್ತೀರ್ಣದ ಬದಲಾವಣೆಗಳ ವಿದ್ಯಮಾನಗಳು, ಉತ್ಪಾದನೆ, ಬೆಲೆ, ಖರ್ಚು ಮತ್ತು ವೆಚ್ಚ, ಸಂಪನ್ಮೂಲಗಳ ಬಳಕೆಯ ದಕ್ಷತೆ ಹಾಗೂ ಲಾಭದ ಕುರಿತು ವಿಶ್ಲೇಷಿಸಲಾಯಿತು. ಪ್ರತಿವಾದಿಗಳನ್ನು ಆಯ್ಕೆ ಮಾಡಲು ಬಹು ಹಂತದ ಯಾದೃಚ್ಛಕ ಮಾದರಿ ತಂತ್ರವನ್ನು ಬಳಸಲಾಯಿತು. ಒಟ್ಟಾರೆಯಾಗಿ ೨೦೦ ಬಾಳೆ ಬೆಳೆಗಾರರು ಹಾಗೂ ೧೦೦ ಮನೆಮಂದಿಯಿಂದ ೨೦೧೫-೧೬ನೇ ಕೃಷಿ ವರ್ಷಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ಮಾಹಿತಿಯನ್ನು ವೈಯಕ್ತಿಕ ಸಂದರ್ಶನದ ಮೂಲಕ ಸಂಗ್ರಹಿಸಲಾಯಿತು. ದ್ವಿತೀಯ ಅಂಕಿ ಅಂಶಗಳನ್ನು ವಿವಿಧ ಪ್ರಕಟಿತ ಮೂಲಗಳಿಂದ ಸಂಗ್ರಹಿಸಲಾಯಿತು. ಪ್ರಾಥಮಿಕ ಹಾಗೂ ದ್ವಿತೀಯ ಅಂಕಿ ಅಂಶಗಳನ್ನು ಬೆಳವಣಿಗೆ ದರ ವಿಶ್ಲೇಷಣೆ, ಅಸ್ಥಿರತೆ ಸೂಚ್ಯಂಕ, ಕಾಬ್-ಡಾಗ್ಲಾಸ್ ಪ್ರೊಡಕ್ಷನ್ ಫಂಕ್ಷನ್, ಪಾರ್ಶಿಯಲ್ ಬಜೆಟ್ ತಂತ್ರ, ಗ್ಯಾರೆಟ್ ರ್ಯಾಂಕಿಂಗ್ ತಂತ್ರ ಮತ್ತು ವಿವರಣಾತ್ಮಕ ಸಂಖ್ಯಾಶಾಸ್ತ್ರದ ಮುಖೇನ ವಿಶ್ಲೇಷಿಸಲಾಯಿತು. ೨೦೦೧-೦೨ ರಿಂದ ೨೦೧೫-೧೬ರ ವರೆಗೆ ಭಾರತ ಮತ್ತು ಕರ್ನಾಟಕದಲ್ಲಿ ಬಾಳೆಯ ವಿಸ್ತೀರ್ಣ, ಉತ್ಪಾದನೆ ಮತ್ತು ಉತ್ಪಾದಕತೆಯ ಬೆಳವಣಿಗೆ ಸಕಾರಾತ್ಮಕ ಹಾಗೂ ಮಹತ್ವವಾಗಿರುವುದು ಕಂಡುಬಂದಿದೆ. ಕೃಷಿ ಬೆಳೆಗಳನ್ನು ತೋಟಗಾರಿಕೆ ಬೆಳೆಗಳಿಗೆ ಹೋಲಿಸಿದಾಗ, ತೋಟಗಾರಿಕಾ ಬೆಳೆಗಳು ಧನಾತ್ಮಕ ಪ್ರವೃತ್ತಿ ತೋರಿವೆ. ಬಾಳೆಯಲ್ಲಿ ಪ್ರತಿ ಹೆಕ್ಟೇರಿಗೆ ನಿವ್ವಳ ಆದಾಯ ರೂ. ೩೦೪೪೭೫ ಬಂದಿದೆ, ಅದಕ್ಕೆ ಸ್ಪರ್ಧಿಸುವ ಬೆಳೆಗಳಾದ ಭತ್ತ ಮತ್ತು ಶುಂಠಿ ಬೇಸಾಯದಿಂದ ನಿವ್ವಳ ಆದಾಯ ರೂ. ೭೬೫೯ ಮತ್ತು ರೂ. ೧೧೮೫೯೮ ಬಂದಿದೆ. ಕಂದುಗಳು, ಕೊಟ್ಟಿಗೆ ಗೊಬ್ಬರ, ರಾಸಾಯನಿಕ ಗೊಬ್ಬರ ಮತ್ತು ನೀರಾವರಿ ಒಳಸುರಿಗಳು ಬಹಳ ಉತ್ಪಾದಿತ ಒಳಸುರಿಗಳಾಗಿವೆಯೆಂಬುದನ್ನು ಸಂಪನ್ಮೂಲ ಬಳಕೆ ದಕ್ಷತೆ ವಿಶ್ಲೇಷಣೆಯಿಂದ ತಿಳಿದುಬಂದಿದೆ. ಎಂವಿಪಿ:ಎಂಎಫ್‌ಸಿ ಅನುಪಾತದ ಪ್ರಕಾರ, ಪ್ರಸ್ತುತ ಬಳಸಿರುವ ಸಂಪನ್ಮೂಲಗಳನ್ನು ಪುನಃ ಸಂಘಟಿಸಲು ಅವಕಾಶವಿದೆ. ಗ್ರಾಹಕರು ಬಾಳೆಗೆ ಆದ್ಯತೆ ನೀಡಲು ಸಿಪ್ಪೆಯ ಬಣ್ಣ, ಬೆಲೆ ಮತ್ತು ರುಚಿ ಹೆಚ್ಚಿತ್ತು ಪ್ರಭಾವ ಬೀರಿವೆ. ಮನೆಮಂದಿ ಬಾಳೆ ಸೇವಿಸಲು ವರ್ಷಪೂರ್ತಿ ಲಭಿಸುವಿಕೆ, ಬೆಲೆ, ರುಚಿ, ಧಾರ್ಮಿಕ ಹಬ್ಬಗಳು, ಆರೋಗ್ಯದಡೆಗಿನ ಕಾಳಜಿ ಮತ್ತು ಪೌಷ್ಟಿಕಾಂಶಗಳ ಗುಣಮಟ್ಟ, ಈ ಅಂಶಗಳು ಪ್ರಮುಖ ಪಾತ್ರವಹಿಸಿವೆ. ಸುಸ್ಥಿರ ಬಾಳೆ ಉತ್ಪಾದನೆಗೆ, ಇದಕ್ಕೆ ಸ್ಪರ್ಧಿಸುವ ಬೆಳೆಗಳಿಗೆ ಹೋಲಿಸಿದಾಗ ಕಡಿಮೆ ಕೂಲಿಗಳ ಅವಶ್ಯಕತೆ, ಹೆಚ್ಚು ಲಾಭ, ನಿರಂತರ ಬೇಡಿಕೆ ಮತ್ತು ಕಡಿಮೆ ಕೀಟ ಹಾಗೂ ರೋಗಬಾಧೆ ಅಂಶಗಳು ಪ್ರಮುಖ ಅಂಶಗಳಾಗಿವೆ.

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ಪ್ರಧಾನ ಸಲಹೆಗಾರರು

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# I INTRODUCTION

India has been predominantly an agrarian economy since the times immemorial. Agriculture occupies the central place in rural life. The contribution of agriculture towards national income was about 16 per cent in 2015-16 although 52 per cent of population depended on it. Therefore, it is rightly said that agriculture is the backbone of Indian economy.

Indian agriculture has undergone a radical transition from traditional to high-value horticultural crops during recent years. The economy has also witnessed shifting of consumption pattern from traditional cereals to a more holistic and nutritious diet of fruit and vegetables, milk, fish, meat and poultry products. Thus agricultural diversification towards high-value horticulture crops has been instituted within Indian agriculture.

## **Importance of Horticultural sector in Indian economy**

Horticulture is the fastest growing sector within agriculture, presently contributes 30 per cent of agricultural gross domestic product (Agarwal *et al.*, 2016). The horticultural sector has also received considerable attention in recent years as it is recognized as a potentially important source of growth, employment generation and foreign exchange earnings (Singh, 2015). The horticulture sector encompasses a wide range of crops viz., fruits, vegetables, plantations, ornamental crops, etc. India, with its wide variability of climate and soil, is highly favorable for growing a large number of horticultural crops. Horticulture has emerged as the key instrument of the Indian agricultural development strategy for reduction of poverty, unemployment and malnourishment. The horticultural-based agricultural diversification in India has been most prominent in the southern states of India (Saraswati *et al.*, 2012).

During the last decade horticulture sector in India has registered a phenomenal growth. This is evident from the fact that India is the largest producer of fruits and vegetables after China. Horticulture has emerged as a bright spot of Indian agriculture. In India, horticulture production grew at a phenomenal pace where, our farmers produced more than double the quantity of fruits and vegetables compared to early 2000-01 period.

Horticulture production rose from 146 mt in 2001-02 to 295 mt in 2016-17 (Anonymous, 2016a). It clearly represents the importance of horticulture crops in India agricultural economy.

According to the second estimate of horticulture crops released by Ministry of Agriculture in 2017, the total area under horticulture crops has increased from 245 lakh ha to 249 lakh ha in 2016-17 which is an increase of 1.9 per cent from 2015-16. The total fruits production is estimated to be 93 mt in 2016-17, which was 2.9 per cent higher than the previous year. Production of vegetables is estimated to be around 175mt, 3.5 per cent more than the previous year.

Karnataka state finds a prominent position on the horticultural map of India where state has potential for growing various kinds of fruits and vegetables as soil and climatic conditions are congenial. Horticultural crops are being grown on 19.4 lakh hectares which account for eleven per cent of total net cultivated area of the state.

## **Banana**

Banana (*Musa* sp.) is the second most important commercial fruit crop in India. The botanical names of banana are *Musa Cavendish* and *Musa paradisiacal* which belongs to the family *Musaceae*. Banana was originally found in South East Asia, including India. In Indian more than 20 varieties are being cultivated in India. Those varieties list is furnished in Appendix-I. Unique feature of banana fruit is year round availability. Banana is a rich source of carbohydrate and is rich in vitamins particularly vitamin B. It is also a good source of potassium, phosphorus, calcium and magnesium. The fruit is easy to digest, free from fat and cholesterol.

Banana is the major staple food crop for millions of people in the developing countries of tropics, have an antiquity of over 4000 years dating back to 2020 BC. Banana serves as an ideal and low cost food source for developing country where population rely mostly on banana for food and dietary purpose (Kumar, *et al.*, 2011). Banana plants are used as insecticide, antioxidant and colour absorber.

Banana fiber is used to make items like bags, pots and wall hangers, rope and good quality paper can also be prepared from banana waste. Banana leaves are used as healthy and hygienic eating plates. The various products like Banana puree, powder, flour, chips, vinegar, jam, jelly, wine, alcohol, biogas, cattle feed can be prepared. Hence it is referred as “Kalpatharu” (plant of virtues) and “Apple of Paradise” because of multifaceted uses. Thus, banana is one of the important fruit crops with its easy reach by common man.

### **Banana scenario in India and Karnataka**

Banana is the fifth largest agricultural commodity in world trade after cereals, sugar, coffee and cocoa. India, Ecuador, Brazil and China produce half of total bananas of the world. Banana is reported to be grown in 130 countries around the world with an annual production of 103.63 million tonnes (Anonymous, 2015). The major banana exporting countries are India, Ecuador, Colombia, Costa Rica and Philippines and the major importing countries are USA, Belgium, Germany and United Kingdom. According to FAO estimates in 2016, India occupied the highest area under banana in the world. It may be noted that 23 per cent of the total global area under banana belongs to India. India ranks first in banana production, contributing highest in world pool of banana production. Thus India leads the world in banana production (29 %) with an annual output of about 29163 tonne. Banana ranks first in production (39 %) and second in area (13 %) after mango in the country. In India, Tamil Nadu leads in production (5650 ‘000 t) and area (118.04 ‘000 ha). Karnataka stands fifth in area (102.71 ‘000 ha) as well as in production (2675.63 ‘000 t) of Banana (Anonymous, 2016a). Chamrajnagar, Chikkamagaluru, Shivamogga and Hassan are the major banana growing districts in Karnataka.

### **Need for the present study**

Karnataka is one of the progressive states of India with great potential for development of fruit crops. The state is blessed with ten Agro-Climatic Zones suitable for growing a variety of fruits all-round the year. Of the ten Agro-Climatic Zones, Hilly Zone contribute maximum chunk to fruit production in Karnataka especially in banana. The resources use efficiency and profitability of banana and its competing crops depends

upon the income generating capacity and cost structure of the enterprises. However, much information is not available on the economic aspect of banana cultivation at micro level. So far, no detailed studies have been conducted on the economics of banana by considering its competing crops in Hilly Zone of Karnataka. Hence, a study encompassing the above mentioned issues is a felt need and it is quite justified in taking up such a study. Thus, the study makes an attempt to assess comparative economics of banana cultivation and its competing crops in Hilly Zone of Karnataka in terms of growth and instability of banana and its competing crops (paddy and ginger), resource use efficiency, profitability, externalities and factor responsible for consumer preference towards banana consumption.

Keeping all these aspects in view, the present study entitled “Comparative economics of banana and its competing crop in hilly zone of Karnataka” is taken up with the following specific objectives.

### **Objectives**

1. To assess the dynamics of area, production and prices of banana and competing crops
2. To assess and compare the resource use efficiency and profitability of banana and competing crops
3. To identify the factors influencing sustained production and profitability of banana
4. To assess the externalities associated with banana and competing crops; and
5. To analyze the consumption behaviour of banana and factors influencing it.

### **Hypotheses**

1. There is an increasing trend in area in relation to other competing crops.
2. Banana production is more stable compared to competing crops
3. Resources are efficiently used in banana compared to other competing crops
4. Per unit profitability is higher in banana compared to competing crops
5. Price and productivity are the driving factors for sustained production of banana.

6. Externalities (negative) associated with banana cultivation is relatively less compared to other competing crops (paddy and ginger).

### **Limitations of the Study**

Though the study tries to be comprehensive in its scope, there are a few limitations inherent to it. Due to the limitation of time and other resources, the study was conducted only in three districts of Hilly Zone of Karnataka. Further, the expressed opinion of the respondents with regard to the various issues of the study may not be totally free from personal bias and prejudice. Hence, the results of the study cannot be generalized beyond the limits of the study area.

### **Presentation of the study:**

The entire study has been presented in six chapters,

- Introduction: The nature and importance of research problem, specific objectives and hypotheses of the study have been presented in this chapter.
- Review of Literature: It deals with the review of the relevant concepts and past studies useful for the present study.
- Methodology: This chapter highlights overview of the study area, the nature and sources from where relevant data have been collected, the analytical tools employed for evaluating objectives of the study.
- Results and Discussion: The results of the study and their analysis have been presented in the form of tables, figures and graphs and interpretation of the results and attempts to establish relationships between certain variables and their outcomes.
- Summary and Conclusion: Brief summary of the major findings of the study along with policy recommendations drawn from the findings have been presented.
- References: The list of literature referred during the course of research is presented in this chapter.

## II REVIEW OF LITERATURE

Review of literature helps the researcher not only in understanding the issues involved but also in planning and execution of the experiences of others. Further, the knowledge of possible gap of empirical research provides indication to plug those gaps to the extent possible which in turn helps in making empirical research socially more meaningful. Keeping in view the objectives of the study, this chapter provides a brief review of the relevant studies under the below mentioned headings. However, it is of course, not possible to refer and comment in detail on all the studies conducted but a brief review of recent and the selected studies is given below.

- 2.1 Dynamics of area, production and price of banana
- 2.2 Resource use efficiency and profitability of banana
- 2.3 Factors influencing sustained production and profitability of banana
- 2.4 Externalities associated with banana
- 2.5 Consumption behaviour of banana and factors influencing it

### **2.1 Dynamics of area, production and price of banana**

Considering the importance of vegetable sector in the Indian economy, Chand and Sharma (2007) made an attempt to know the growth in area, production and productivity of vegetable crops in different agro-climatic Zones of Rajasthan for a period 1980-81 to 2002-03. The estimated growth results showed a wider variability in productivity of vegetable crops compared to other fruits crops. They also showed that, performance of Zone III-B has found best in production of vegetable in Rajasthan.

Chengappa *et al.* (2007) made an attempt to study the growth in area, productivity and production for the state as well as at the district level in Andhra Pradesh for the period 1998-99 to 2005-06. Compound annual growth rates have been estimated for different sub-sectors like fruits, vegetables, spices, flowers and nuts in Andhra Pradesh. The study showed area under nuts and palms occupied major share in horticultural sector in the TE 2001, have paved way to the fruits by 2005-06. The study also showed that,

significant growth in the area of banana, orange and mango in the state without gains in productivity, whereas area under spices showed negative trend.

Shivanand (2011) assessed the performance of banana plantation in north Karnataka. The study revealed that there was significant and positive growth in area, production and productivity of banana in North Karnataka. Further, the results highlighted that, area under banana showed significant growth (6.69 %) in Karnataka state during 1980 to 2010.

Saraswati *et al.* (2012) estimated the growth in area, production and productivity of different crops in Karnataka using compound growth function for a period from 1990 to 2010. The results showed that, significant positive growth in area under pulses, vegetables and spices and fruits and nuts, while cereals showed significant negative growth. The growth in area under oilseeds and commercial crops showed negative growth. Similarly the production of cereals, pulses, vegetables and fruits showed a significant positive growth. The productivity of different crops recorded significant growth in case of cereals, pulses, oilseeds and fruits.

Kumar and Jain (2013) analyzed growth and instability in Indian agriculture at the district level based on the secondary data for the period 1990-91 to 2007-08. Results revealed that use of fertilizers has turned out to be the most important input in increasing the agricultural production. Along with fertilizer-use, rainfall, irrigation, source of irrigation, better human resources and road connectivity have emerged as the other critical determinants of growth and variation in agricultural productivity.

Sattigeri and Vijay (2013) studied trends of banana production in India. The study showed that banana and plantain, are continuously exhibiting a spectacular growth worldwide. India alone produced 27.01mt from an area of 0.765 million ha (2011). India was the largest producer of banana in the world and also in Asia, and contributed 22.15 percent to global production from 7.4 per cent area (2009) followed by China and Philippines. The study concluded that, growth in banana production is more significant in

India and China due the technological interventions and adoption, while production in Ecuador, Columbia and Costa Rica has shown a declining trend during 2001 to 2009.

Singha *et al.* (2014) examined the growth and diversification of horticulture crops in Karnataka with the help of secondary data by employing Simpson's Diversification Index. The results showed that area under horticulture cultivation in the state between TE 2004-2005 and TE 2009-2010 was found highest, estimated at 15 per cent compared with 5.6 per cent of cereal crops during the same period. Where, growth trends of area under pulses and oilseeds were found negative, estimated at 1 per cent and -10 per cent, respectively. The study also found that, Gulbarga, Raichur, Bijapur, Bidar, Koppal, Bagalkot, and Bellary districts showed a complete diversification toward horticulture crops, whereas the Kolar, Udupi, and Dakshina Kannada districts were found least diversified.

Vinayaka *et al.* (2014) conducted a study on trends in area, production and productivity of fruit crops in the India. The study was based on secondary data from 2000-01 to 2010-11 by applying compound growth rate, coefficient of variation and instability index. The result found that, positive growth and moderate degree of instability in area, production and productivity of fruits crops in India. They also documented the average of area, production and productivity of fruits crops during this period were 50.84 (lakh ha), 55.36 (lakh million tonnes) and 10.83 (tonne/ha).

Ali and Jabbar (2015) studied the growth and variability in area production and yield of major selected horticultural crops including apple, peach, pear, and plum in Khyber Pakhtunkhwa. The study was based on secondary data from 1975-76 to 2011-12 which was further bifurcated into three periods; period-I (from 1975-76 to 1990-91), period-II (from 1991-92 to 2011-12), and period-III (from 1975-76 to 2011-12). The findings of the study revealed that growth in area of selected fruit crops showed positive during period-II compared to Period-I. They also concluded that variability in fruit production was higher in period-II as compared to period-I.

Ramappa *et al.* (2015) analyzed the growth of horticulture sector in Karnataka during the post reform period from 1992-93 to 2010-11 by using Herfindahl Diversification Index. Empirical results showed that, the rate of change in area under horticulture crops moved in positive direction during the selected period as compared to food crops viz., pulses, cereals and oil seeds. Further, district level analysis results showed that significant growth in area under horticultural crops in Tumkur district followed by Hassan and Kolar.

Agarwal *et al.* (2016) conducted a study to know the growth and instability of horticultural crops in India by using exponential function and instability index for a period 2001-02 to 2014-15. The results showed that instability index in area, production and productivity was observed highest in flowers compared to fruit crops. Further, the results of instability in production of flowers showed high degree of variation compared to fruits production. Finally they concluded that, high instability in flower production might be due the reason that there was no specific market available for flowers, as it was not directly consumed compared to fruits and vegetables.

It can be summarized that, over the years there is significant positive trend in area, production of banana in India. Technological interventions by institutions led to spectacular changes in banana as well as fruits. Banana was observed relatively high share in area, production and productivity compared to other horticultural crops in India.

## **2.2 Resource use efficiency and profitability of banana**

Bastine and Radhakrishnan (1988) analyzed the economics of plantain cultivation in Kerala. The results found that, the cost of cultivation per hectare was ₹ 36,249. The net return was ₹ 45,068 per hectare and the main share of expenditure was cost of the family labour, followed by hired labour and manure. The study illustrated that the contribution of family labour was 30.50 percent of the total expenditure. They also observed that the contribution of family labour decreasing trend as the size of holding increased.

Guledgudda *et al.* (2002) reported that the average variable cost incurred by producers was ₹ 54,502.81 per hectare of banana in Haveri district which was accounted

for 65 per cent of total cost. Among variable costs, the human labour was the major item of cost, which accounted for 18 per cent. On an average, farmers got 175 quintals of banana yield per ha as main product valued at ₹ 1,54,375 and farmers have realized ₹ 30,000 per hectare by selling suckers. The gross return from banana cultivation was ₹ 1,84,375 per hectare. The net return realized by farmers was ₹ 1,00,545.96 with a BC ratio of 2.19.

Shivanand (2002) studied the cost and return structure of banana cultivation in North Karnataka. The results showed that cultivation of banana in the study area was highly profitable and on an average banana growers obtained net returns of ₹ 85,260 per hectare per year which was about ₹ 2,61,726 for a cycle of three years period.

Maurya *et al.* (2006) worked out the cost of cultivation of banana in Kerala. The results showed that cost of cultivation was ₹ 2,01,607 per hectare. The cost of human labour had major share in total expenditure (37.40 %), followed by cost on manures and fertilizers (32.37 %), overhead cost (7.41 %), bullock labour (6.63 %), suckers (6.20 %), rental value of land (4.96 %) plant protection (2.80 %) and irrigation (2.23 %).

Yadav *et al.* (2006) studied resource productivities and resource use efficiencies of traditional and tissue culture banana cultivation in Parbhani district of Maharashtra State. The results showed that, with respect to traditional banana cultivation, regression coefficients of area, FYM and potash were positive and significant at 10 per cent level. Elasticities of production was equal to unity indicating constant returns to scale in traditional banana cultivation. In tissue culture banana, the functional analysis showed that the regression coefficient of plantlet was highly significant thereby indicating scope to increase the level of plantlet so as to step up productivity. The sum of elasticities of production was equal to unity showing constant returns to scale. MVP/MC ratio for the inputs namely sucker, nitrogen and bullock labour was greater than unity there by exhibiting their efficient use in tissue culture banana production.

Kathirvel (2007) estimated the cost and returns of banana cultivation in Karur district of Tamil Nadu. The study was completely on primary data of 500 selected

respondents of Karur District by using Cobb-Duggles (CD) production function. The results showed that, multiple correlation co-efficient was 0.984 which was significant at 1 per cent level. The CD function result showed that, the effect of fixed cost and variable cost on banana production was significant at 1 per cent level.

Shashidhara *et al.* (2007) conducted study on economics of drip irrigation in arecanut and banana in Shimoga and Davanagere districts of Karnataka. Drip irrigation increased returns by 5.92 per cent and 3.54 per cent in coconut and arecanut with a BC ratio (1:3.36) as compared to surface irrigation (1:2.81). Quality parameters of banana (Yelakki bale) crop grown under drip system had shown more number of hands per bunch (12), fingers per bunch (103), length of fruit (4.73 inches) and fruit thickness (2.53 inches). The drip irrigation had minimized the days for harvesting (to 398 days) and also increased shelf-life (15 days) in banana.

Hile *et al.* (2008) studied economics of organic banana production in Sangli. The study showed that per hectare total cost was ₹ 103279.09 and interest on working capital, irrigation, manure, hired human labour and planting material were the major items of cost. There was significant increase in all the items of cost as well as at the level of cost A, B and C. They reported that, proportion of cost 'A' in the total cost 'C' was 68.55 per cent and the production of Cost 'B' in the total cost was 96.01 per cent.

Hanumantharaya *et al.* (2010) conducted a study on comparative economic analysis of tissue culture banana and sucker propagated banana production in Karnataka. Study was based on primary data collected from 80 farmers in 12 villages of two taluks in Tungabhadra and Malaprabha command areas of Karnataka. Results of the study showed that, in crop-I, per ha production cost of sucker banana was ₹ 82,298 and tissue culture banana was ₹ 1,17,563. The gross returns obtained were ₹ 1,60,113.81 and ₹ 1,97,295.94, respectively. The net returns obtained were ₹ 77,815.81 and ₹ 79,732.94, respectively. In crop-II, production cost of sucker banana was ₹ 55,073 and tissue culture banana was ₹ 57,561.30. The gross returns realized were ₹ 1,70,596.56 and ₹ 1,85,953.07, respectively and the net returns were ₹ 1,15,523.56 and ₹ 1,28,391.77, respectively.

Kumudha (2015) analysed the resource use efficiency in banana production. Resource use efficiency was calculated by using the production function analysis and marginal value productivity analysis. The results showed that, the ratios of marginal value products to the factor costs were 3.37, 1.04, 1.13, 25.98 and 3.13 for suckers ( $X_1$ ), human labour ( $X_2$ ), fertilizer ( $X_3$ ), plant protection chemicals ( $X_4$ ) and expenditure on irrigation ( $X_5$ ) respectively. The analysis of the marginal value product of banana showed a one rupee increase in the cost of suckers, human labour and fertilizer would increase the income by ₹ 3.37 ₹ 1.04 and ₹ 1.13 respectively to the farmers. Similarly a one rupee increase in the expenditure on plant protection chemicals and irrigation would fetch an additional income of ₹ 25.98 and ₹ 3.13 respectively to the banana growers. The study concluded that there was ample scope for increasing the income through exploitation of all the five resources particularly through increases in dose of plant protection chemicals.

Noor *et al.* (2015) studied on economic efficiency of banana production under contract farming in Sindh district of Pakistan. The study showed that, total cost of banana production was ₹ 1,58,581 which included ₹ 88,300, ₹ 20,100, ₹ 28,847 and ₹ 21,334 on fixed cost, labour costs, capital inputs and marketing costs, respectively. The net returns per acre earned was ₹ 91,669 with a total expenditure of ₹ 1,58,581.

It can be inferred from the review that, banana cultivation is highly profitable. Human labour cost is detrimental in influencing more to cost of banana cultivation. Investing about one more rupee on cost of suckers, human labour and fertilizer would increase the income more than additional one rupee invested.

### **2.3 Factors influencing sustained production and profitability of banana**

Alagumani (2005) conducted a study on economic aspects of tissue-cultured banana (TCB) and sucker-propagated banana (SPB) in Theni district of Tamil Nadu. Primary data was collected from tissue-cultured banana and sucker-propagated banana growers (60 and 30 respondents, respectively). Gross income and bunch weight were the major factors influencing the adoption of tissue-cultured banana. Study concluded that the profitability of TCB was better than SPB.

Rohile *et al.* (2006) analyzed the resource use efficiency in banana production in Sindhudurg district with a sample of 90 banana growers from Dodamarg and Sawantwaditahsils using CD production function. The results showed that, average area under banana was 0.40ha in mixed cropping and 1.08ha in sole cropping systems. In mixed cropping, planting material and fertilizers were significant variables, while in sole cropping, planting material, male labour, fertilizers and irrigation charges were statistically significant in increasing yield of banana. Similarly, in case of sole cropping planting material and plant protection were over used.

Biswas and Kumar (2010) reported that high density planting would lead to more profitability among banana growers in the country. They identified less price fluctuation in banana due to multiple uses was the driving force for farmers to opt for banana as they experience less price fluctuation.

Datta (2013) stressed the need for developing horticultural crops that withstand stress conditions in climatic change era. He concluded that development of new cultivars of horticultural crops tolerant to high temperature, resistant to pests and diseases, short duration and producing good yield under stress conditions help to maintain consistency in production of horticulture crops.

Ebiowei (2013) studied on budgetary analysis of banana and plantain production enterprises in Bayelsa State of Nigeria. The data was analyzed using mean and budgetary models. The results showed that, farm holding was on an average 0.12 and 0.89 ha for Banana and plantain enterprises respectively. Net annual returns for Banana and plantain enterprises were ₹ 47,461.11 and ₹ 242,690.53, respectively. Further the study concluded that net returns associated with banana and plantain production enterprises can be enhanced by the provision of credit/loan, farm inputs, farm equipment, good rural roads with improved varieties of suckers as well as ensuring access to extension services and improved farming technologies by Government, Non-Governmental Organizations (NGOs) and institutions alike through genuine political will.

Mugo *et al.* (2014) identified factors influencing tissue culture banana output and its impact on income in Nyamusi district by employing Cobb-Douglas production analysis. The study revealed that, tissue culture banana growers had relatively higher income compared to conventional banana growers. The results showed that land size under tissue culture banana, manure applied, extension services and age of household head were the significant determinants of production with elasticities of 1.861, 0.0716, 0.017 and 0.341 respectively. They also identified gender and level of education of household head had no influence on banana production in both the cases.

Anik *et al.* (2017) estimated the major drivers for onion production and efficiency in major onion growing districts of Bangladesh. Results revealed that, land was the most important driver factors of onion production (elasticity value 0.33) followed by labour (0.24) and seed (0.18). Use of modern seed significantly improved production. Further the study showed extension services, use of recommended dose of fertilizers and non-agricultural income significantly improved technical efficiency of the onion growing farmers.

Johnson *et al.* (2017) studied factors influencing ginger productivity among smallholders growers in Tanzania by drawing primary data from 251 sample respondents. The study used both quantitative and qualitative methods for data analysis. The study reported that, farmer's education level, use of fertilizer, land size under ginger production and frequency of contacting extension services had significant contribution to ginger productivity. They also showed that, extension services, high-yielding ginger seed varieties, improved farm inputs, storage and marketing facilities would encourage ginger farmers to cover more area under ginger cultivation.

In relation to banana gross income and bunch weight were crucial attributed leading to sustained profitability. For future sustainability there is a need to develop cultivars for high temperature compatible, resistant to pests and diseases to increase yield in climate change era. In general extension services, high-yielding ginger seed varieties, improved farm inputs, storage factors lead to profitability in crop cultivation.

## 2.4 Externalities associated with Banana

Joseph (2004) made a study on economic analysis of externalities in coastal mariculture. The study was undertaken in 208 farms practicing different types of aquaculture selected from Kollam, Alappuzha, Ernakulam and Kasargod districts of Kerala state during the period 2001 to 2003 by using Contingent Valuation Method (CVM) and Hedonic method. The results of CVM revealed that the stake holders were willing to pay for the development of compensatory mechanism for polluted areas of coastal district of Kerala. The results from Hedonic method revealed that, the influence of water quality was characterized by land value. The study also projected that, the annual economic loss due to the wide spread occurrence of white spot virus for the country as a whole during 2001-02 as ₹ 1,742.4 crores.

Chang and Ying (2005) analyzed the external benefits of preserving paddy rice fields in Taiwan by using Contingent Valuation Method (CVM). The results revealed that majority of people in Taiwan recognize the externalities of paddy rice fields. Each household is willing to pay on average about \$ 1777.92 NT annually to sustain the rice fields for water preservation and land protection functions. This payment which was willing to pay a equal to 3.57 per cent more than the intrinsic economic value of rice. Thus, authors concluded that, rising opportunity costs of retaining land in agricultural production is not yet sufficient to justify a reallocation of this resource from agriculture to other uses.

Sabur and Molla (2006) assessed the pesticide usage awareness among integrated pest management technologies (IPM) practicing banana farmers in Bangladesh. 360 farmers were interviewed for the study. The study inferred that IPM farmers were well aware of the fact that pesticide application pollutes air as well as crop. Further, concluded that training on IPM encourages farmers to adopt non-traditional pest control methods.

Singh and Sidhu (2006) analyzed the use of certain resources and its impact on the cost of production in Punjab by using both primary and secondary sources of data. They concluded that, the fast increase in area under rice and wheat leads to unsustainable and showed significantly decline in water table. Therefore, the cost of pumping out water

with electricity has been going up, shortage of electric power has resulted in increase in the number of electric and diesel tube wells, further escalating the cost of production. Thus the study states that, the cost on account of these factors together has gone up by ₹ 63/t in wheat and ₹ 189/t in rice. The varietal diversity of wheat has decreased and that of rice crop has increased during the past two and a half decades.

Kiatpathomchai (2008) elicited farmers' opinion on negative externalities due to rice production in Songkhla Lake Basin in southern Thailand. The identified externalities according to farmers were methane gas emission, nitrous oxide gas emission, nitrogen leaching, water contamination from excessive use of chemical fertilizers and pesticides.

Shetty *et al.* (2011) reported that there is a need for agricultural production models or policies that internalize the external costs of pesticide use and incorporate prevention of ill health and environmental contamination, and promote the conservation of biological capital into production processes and markets.

Dikshita and BIRTHALB (2013) analyzed the positive environmental externalities associated with livestock production in India's mixed farming systems. The results revealed that, synergic effect was observed from the livestock production and mixed farming system. Positive effects were land saving from livestock production system due to recycling of crop by-products as animal feed and use of dung as domestic fuel has been estimated as 42 Mha. The use of dung as manure saved 1.2 Mt of soil nutrients. Likewise, use of animal energy as a substitute for mechanical energy had potential to save diesel consumption to the extent of 13 Mt and prevents greenhouse gas emission due to burning of diesel.

The above reviews revealed that, the use of pesticide causes air pollution in crop cultivation. Proper training on IPM could lead to less use of chemicals for pest control. More coverage of area in paddy would lead to more depletion of ground water table. Rearing of livestock would lead to positive externality to some extent. However, its role in creating negative externality can't be ruled out accordingly.

## 2.5 Consumption behaviour of banana and factors influencing it

Bhuvaneshwari (2007) made a comparative study of different markets for selected cut flowers in Bangalore. Conjoint analysis was conducted to determine the consumer's preference for the flowers and its attributes. Five important attributes were considered for this purpose, viz., colour of the flower, size of the flower, floral arrangement of the flower, stem length of the flower and the price of the flower. The results showed that the most important attribute was colour. The average importance attached to the colour was 33.4 per cent. Among the various colours available, red colour was preferred the most. This was reflected by the higher utility value attached to it.

Varun *et al.* (2009) studied the factors influencing the consumption behaviour of coffee and tea in four districts (namely Bengaluru Urban, Kodagu, Dharwad and Belagavi) of Karnataka using the primary data from 240 sample households. The results revealed that, the urban households purchased on an average about 1.25 kgs of coffee and tea powder together every month, while the rural ones purchased 1.16 kgs. Urban households spent relatively more at ₹ 235.13 and the rural households spent about ₹ 160. The factors like family size and total family income had a positive influence on the demand for coffee in the urban areas. In the rural areas, family size had a positive influence on the demand for coffee, while the price per unit of coffee had a negative influence on the coffee demanded. In the case of tea, total family income turned out to be highly significant in the urban areas. The study also found that education was the only factor that was highly significant with respect to the demand for coffee by the urban respondents.

Steven *et al.* (2011) assessed the factor responsible for consumption of fruits and vegetables in Malaysia. As indicated that socio-demographic factors such as education, age, ethnicity, income, location of residence, as well as smoking status and health conditions significantly affect fruit and vegetables (F&V) consumption. Specifically, education affects on consumption patterns of F&V as those with at least high school education consume significantly more servings compared with primary school educated

individuals. Individuals between 41 and 58 years of age consumed more F&V than those below 30 years of age.

Maksuda and Uddin (2012) examined the food security among maize growing rural households of Bogra district. The results of the study revealed that almost all rural households food secured. It was checked by using recommended minimum calorie requirement (i.e., 2122 kcal). Based on these results, 33.33 percent households were found to be food insecure while the rest 66.67 percent households were food secured households. The results of logit model showed that, the age of household head, household size, monthly agricultural income and food expenditure were found significant in influencing household food security.

Nurul *et al.* (2012) carried out research on patterns of fruits and vegetable consumption among adults of different ethnics in Selangor, Malaysia. Study concluded that most frequently consumed leafy, leguminous, root, brassica and fruits vegetables were long beans, french beans, carrot, potato, round cabbage, cauliflower, chilies, tomato, cucumber and okra. The most preferred fruits were banana and apples. A total consumption of fruits and vegetables among adults in Selangor was 173 g/day and the consumption among Malays (202 g/day) was significantly higher ( $P < 0.001$ ) compared to the Indians. Individually, vegetables were consumed 133 g/day while fruits were 179 g/day. No significant differences ( $P < 0.05$ ) were shown for consumption of different vegetable categories among different ethnic groups.

Othman *et al.* (2012) identified the factors influencing fruits and vegetables consumption behaviour among adults in Malaysia. Data was analysed using multiple linear regressions. Based on the findings, attitude ( $p = .001$ ), habit ( $p = .002$ ), social influences ( $p = .001$ ) and availability ( $p = .001$ ) were found important towards fruits and vegetables consumption behaviour. The study also found age and marital status were significant factors in fruits consumption behaviour whereas age, race, marital status and household income were found to have significant influence in vegetables consumption behaviour.

Atnan *et al.* (2014) analyzed the impact of social and economic factors on vegetable consumption in Turkey. The study found a positive relationship between the money spent on vegetables and income. In low-income populations, affordability was the most important inhibitory factor preventing fruit and vegetable consumption. However, the price paid for fruits and vegetables increased in higher income groups. In terms of the maximum price that can be paid for one kilo of vegetables, there was a difference of 62.34 per cent between the lowest and the highest income groups. The study concluded that, increase in purchasing power is positively associated with the increase in the monthly budget of vegetables and variety of places vegetables are bought. People with higher income tend to shop from greengrocer shops and supermarkets rather than local street markets. The high level of attention paid to cleanliness and freshness of vegetables indicates that individuals care a lot about what goes into their body and how it tastes.

Gupta and Mishra (2014) attempted to know the food consumption pattern in rural India using NSSO data for period 2009-10 which included 142 food items. The results revealed that consumption of different food items varies among socio-economic groups and regions. Persons with better incomes, belonging to 'higher' social class, having small families and working as self-employed showed significant higher intake of almost all food items and also exhibited diet diversity which made them nutritionally more secure and healthy whereas other socio-economic groups such as those with lower Monthly Per-capita Consumer Expenditure (MPCE), large households, belong to Scheduled Tribe, Scheduled Caste, Muslims, agricultural labour and other labourers had a poorer diet in comparison with national average and even to the other groups. The study also identified the major determinates for quantum of food intakes which included food culture, taste and preferences, local availability, market and income.

Shukla *et al.* (2014) studied the consumer behavior and preference for mango pulp in south Gujarat in India by using Garrett's ranking technique for seven factors. Consumers were asked to rank the various factors from 1 to 7 in order of their importance in affecting purchase decision of mango pulp. The results revealed that, highest rank was given to taste (6.05) followed by quality (5.74), variety of mango pulp (4.68), packing size (3.21), brand (3.1), price (2.85) and freshness (2.78) in that order, respectively.

Consumption of fruits and vegetables are influenced by mainly by income of family. Higher the family income more they spend for this food. Even social factors, taste, variety would influence banana consumption. Local factors like easy availability, market, food culture occupy detrimental role while consuming fruits and vegetables.

### III METHODOLOGY

This chapter deals with the brief description of the study area, methods and techniques used in selection of samples, nature and sources of data and the various tools and techniques employed in analysing the data and evaluating the problems. The methodology adopted is discussed under the following section

- 3.1 Description of the Study Area
- 3.2 Sampling Procedure
- 3.3 Nature and Sources of Data
- 3.4 Analytical Tools Employed
- 3.5 Terms and Concepts Used in the Study

#### **3.1 Description of the Study Area**

Karnataka is the eighth largest state in India with a geographical area of 190 lakh ha. It is situated between 11°5' and 18°45' North Latitude and between 74°12' and 78°40' East Longitude in the Southern Plateau. The state receives an average rainfall of about 1139 mm both from South-West and North-East monsoons. The temperature ranges from 14°C to 40°C. The important field crops grown in the state are Ragi, Jowar, Paddy, Maize, Bajra and Wheat among cereals; Red Gram, Green Gram, Tur and Bengal gram among pulses; Groundnut, Sunflower and Safflower among oilseed crops; Cotton, Sugarcane and Tobacco among commercial crops. In addition, predominantly growing fruit crops in the state are Mango, Banana, Sapota, Grape, Guava and Pomegranate. Similarly, Onion, Brinjal, Cabbage, Potato and Tomato among vegetable crops; Coconut, Arecanut and Coffee among plantation crops are being widely cultivated in the state. Karnataka state comprises 30 districts which are classified under 10 Agro Climatic Zones. The present study was undertaken in Hilly Zone of Karnataka covering Hassan, Chikmagalur and Shivamogga districts.

### **3.1.1 Location of the Study Area**

The Malnad or Hilly Zone of Karnataka represents unique agro-climatic features with varied topography of mountains and deep valleys. The zone consists of parts of as many as seven districts. They are Uttar Kannada, Belgaum, Shivamogga, Chikkamagaluru, Dharwad, Kodagu and Hassan. The rainfall varies from 1200 to 3700 mm. The soils are red clay loamy in major areas and important crops grown are paddy, ginger, coffee, areacanut, banana, spices and other plantation crops.

### **3.1.2 Geographic and Demographic Features**

Geographic and demographic features of Chikkamagaluru, Shivamogga and Hassan district are presented in Table 3.1. The total geographical area of Chikkamagaluru district is 7,202 Sq. km accounting for 6.74 per cent of the total geographical area of the state. Mudigere and N. R. Pura taluks have an area of 162 and 779 sq.km. The district consists of 1117 villages, while, Mudigere and N. R. Pura taluks consist of 140 and 58 villages, respectively. The total population of Chikkamagaluru district as per 2011 census was 11,37,961 and those of Mudigere and N. R. Pura taluks were 1,28,134 and 66,090, respectively. The density of population in Chikkamagaluru district was 207 per sq km and that in Mudigere and N. R. Pura taluks was 194 and 182 per Sq. km, respectively.

The total geographical area of Shivamogga district is 8,477 sq km accounting for 5.82 per cent of the total geographical area of the state. Sagar and Thirthahalli taluks have an area of 1,940 and 1,254 Sq. km, respectively. The district consists of 1,530 villages, while, Sagar and Thirthahalli taluks consist of 238 and 247 villages, respectively. The total population of Shivamogga district as per 2011 census was 17,52,753 and those of Sagar and Thirthahalli taluks were 2,06,319 and 1,42,006, respectively. The density of population in Shivamogga district was 253 per sq km and that in Sagar and Thirthahalli taluks was 257 and 217 per Sq.km, respectively.

The total geographical area of Hassan district is 6814 Sq. km accounting for 4.22 per cent of the total geographical area of the state. Sakleshpura taluk has an area of 1026 sq km. The district consists of 2586 villages, while, Sakleshpura taluk consist of 227 villages.

**Table 3.1: General features of the study area (2015-16)**

Sl. No.	Particulars	Chikkamagaluru District			Shivamogga District			Hassan District	
		Mudigere Taluk	N. R. Pura Taluk	District Total	Sagar Taluk	Thirthahalli Taluk	District Total	Sakleshpura Taluk	District Total
1	Population (Nos.) (2011 census)								
	a) Total: Persons	128134	66090	1137961	206319	142006	1752753	128633	1776421
	b) Total: Male	63102	324498	566622	102273	69882	877415	65507	892754
	c) Total: Female	65032	33641	571339	104046	72124	875338	63126	883667
2	Decennial Population growth rate (%)	-3.05	0.05	0.26	7.36	-1.86	18.60	4.25	3.18
3	Area (sq.km)	162	779	7202	1940	1254	8477	1026	6814
4	Density of population (persons/sq.km)	194	182	207	257	217	253	182	251
5	Sex ratio (no.of females/1000 males)	1020	1019	1008	1017	1032	998	1038	1010
6	Literacy rate (%) a) Total	77.34	83.29	79.25	81.01	83.06	80.46	79.55	76.07
	b) Male	83.80	88.02	85.41	87.64	88.80	86.07	86.13	83.64
	c) Female	71.09	78.77	73.16	74.54	77.54	74.84	73.24	68.60
7	Percentage of scheduled Castes	24.30	15.10	22.29	9.65	9.92	17.58	29.75	19.42
8	Percentage of scheduled Tribes	11.67	3.17	3.95	2.14	1.91	3.73	1.48	1.82
9	Number of villages	140	58	1117	238	247	1530	227	2586
10	Number of towns	2	1	9	2	1	9	1	8
11	Average rainfall (mm)	3339	2054	1977	2225	3331	2247	2667	1199

**Source:** Anonymous, 2016b

The total population of Hassan district as per 2011 census was 17,76,421 and that of Sakleshpura taluk was 1,28,633. The density of population in Hassan district was 251 per sq km and that in Sakleshpura taluk was 182 per sq.km.

The Chikkamagalur, Shivamogga and Hassan districts as well as the taluks under study are having a good network of roads, communication facilities, markets, etc. which is an indicative of good infrastructural facilities.

### **3.1.3 Climate, Rainfall and Soil type**

The Chikkamagaluru district gets an annual average rainfall of 1,977 mm, as against 3,339 mm and 2,054 mm, respectively for Mudigere and N. R. Pura taluks, which falls under Hilly Zone. The soils of the district are mostly red sandy loam. Similar types of soil are found in Mudigere and N. R. Pura taluks, which comprise of red and medium sandy soils. The Shivamogga district receives an annual average rainfall of 2,247 mm, as against 2,225 mm and 3,331 mm, respectively for Sagar and Thirthahalli taluks. The soils of the district are mostly sandy loam, and red sandy loam. Hassan district gets an annual average rainfall of 1,199 mm, as against 2667 mm for Sakleshpura taluks. The soils of the district are mostly red sandy loam and medium black soil. In case of Sakleshpura taluk red and medium sandy soils was found. Hilly zone as whole, the annual rainfall received ranges from 1,200 to 3,700 mm. About 75 per cent of it is received in Kharif season. The average temperature in Hilly zone range from 18-28°C and soils are red clay and sandy loam in major areas.

### **3.1.4 Land utilization pattern**

Land utilization pattern of the districts and the selected taluks for the year 2011-12 is presented in Table 3.2. The net cultivable land in Chikkamagaluru district was 2,98,545 ha and that of Mudigere and N. R. Pura taluks was 42,418 and 14,277 ha, respectively. The area under forest was 2,02,028 ha in Chikkamagaluru district, while it was 30,604 and 31,944 ha correspondingly in Mudigere and N. R. Pura taluks. The fallow land accounted for 22,078 ha in the district out of which correspondingly 3,906 and 765 ha was in Mudigere and N. R. Pura taluks, respectively. The land not available

**Table 3.2: Land utilization in the study area during 2015-16**

(Area in ha)

Sl. No.	Particulars	Chikkamagaluru District			Shivamogga District			Hassan District	
		Mudigere Taluk	N. R. Pura Taluk	District Total	Sagar Taluk	Thirthahalli Taluk	District Total	Sakleshpura Taluk	District Total
1	Geographical area	115495	80448	722075	194009	125377	847784	102889	662602
2	Forest area	30604	31944	202028	66125	47732	276855	26169	58775
3	Land not available for cultivation	9579	9464	43421	29486	10052	88708	4029	79843
4	Other uncultivable land	2396	4708	28322	930	1659	13312	2771	30365
5	Fallow land	3906	765	22078	3713	7943	33857	11410	71618
6	Net cultivable land	42418	14277	298545	26103	23334	228410	42826	367953
7	Gross cultivable area	45498	15185	357636	28202	25494	264077	46317	449430
8	Net irrigated area	1777	6539	59912	12989	12235	143639	981	104128
9	Gross Irrigated area	1840	6600	62113	15062	13847	174515	1378	116564

**Source:** Anonymous, 2016b

for cultivation was 43,421 ha in Chikkamagaluru district with 9,579 and 9,464 ha in sample taluks in that order.

The net cultivable land in Shivamogga district was 2,28,410 ha and that of Sagar and Thirthahalli taluks was 26,103 and 23,334 ha, respectively. The area under forest was 2,76,855 ha in Shivamogga district, while it was 66,125 and 47,732 ha correspondingly in Sagar and Thirthahalli taluks. The fallow land accounted for 33,857 ha in the district out of which correspondingly 3,713 and 7,943 ha was in Sagar and Thirthahalli taluks, respectively. The land not available for cultivation was 88,708 ha in Shivamogga district with 29,486 and 10,052 ha in sample taluks in that order.

The net cultivated land in Hassan district was 3,67,953 ha and that of Sakleshpura taluk was 42,826 ha. The area under forest was 58,775 ha in Hassan district, while it was 26,169 ha in Sakleshpura taluk. The fallow land accounted for 71,618 ha in the district out of which 11,410 ha was in Sakleshpura taluk. The land not available for cultivation was 79,843 ha in Hassan district with 4,029 ha in Sakleshpura taluk.

### **3.2 Sampling Procedure**

The selection of study area and the sampling procedure adopted is described below.

#### **3.2.1 Selection of District and Taluks**

The present study pertains to three districts of Hilly Zone of Karnataka, viz Chikkamagaluru, Shivamogga and Hassan, which were purposively selected based on banana area and production share from Hilly Zone of Karnataka (Appendix-2). Owing to manpower, cost and time constraints, all the districts of the state could not be included in the domain of data collection. Hence, three districts from Hilly Zone of Karnataka were purposively selected to represent the hilly zone of State. Further, two taluks from each Chikkamagaluru and Shivamogga district, namely, Mudigere and N. R. Pura from Chikkamagaluru District (Fig. 3.1), Sagar and Thirthahalli taluks from Shivamogga district (Fig. 3.2) and one taluk from Hassan district, i.e, Sakleshpura (Fig. 3.3) were selected based on the area and production under banana.

### **3.2.2 Selection of Villages and Respondents**

Multistage random sampling technique was adopted for the selection of study area and sample respondents. The list of villages in each taluk of three districts was obtained from the concerned Taluk Panchayat offices. From each taluk, five villages were randomly selected by using random number table. Thus, in all, twenty five villages spread across five taluks in three districts were finally selected (Appendix-3). From each village, five to ten banana growing farmers were selected to meet the required sample size.

Chikkamagaluru, Shivamogga and Hassan districts (Fig. 3.1, 3.2 and 3.3.) of Karnataka were selected for producer's survey as they are the major banana growing districts in Hilly Zone of Karnataka. For consumer survey, again the same three districts were selected as these are the banana consuming areas. Simple random sampling technique was employed for the selection of sample households.

The primary data required for the study were collected from 200 sample farmers spread across three selected districts in Hilly Zone of Karnataka (40 banana growing farmers from each taluk) (Fig. 3.4). One hundred consumers were selected for the study (20 consumers in each taluk town were selected to analyze the consumption behavior) (Fig. 3.5).

### **3.3 Nature and Sources of Data**

For achieving the objectives of the study, the secondary data were collected from various published sources of Government of Karnataka and Government of India. The data on area, production and productivity of banana for the country and Karnataka for two time periods *viz.*, Period-I (1995-96 to 2004-05) and Period -II (2005-06 to 2014-15) were drawn purposefully to know the impact of introduction of National Horticultural Mission (NHM 2005-06) and this data was drawn from [indiastat.com](http://indiastat.com) and various issues of the Horticultural Statistics at a Glance. Taluk-wise area under major cereals, pulses, oilseeds, vegetables, spices, fruit crops, and other major commercial crops of Chikkamagaluru, Shivamogga and Hassan district which comes under Hilly Zone for

2001-02 to 2014-15 were collected from the Directorate of Economics and Statistics, Bengaluru.

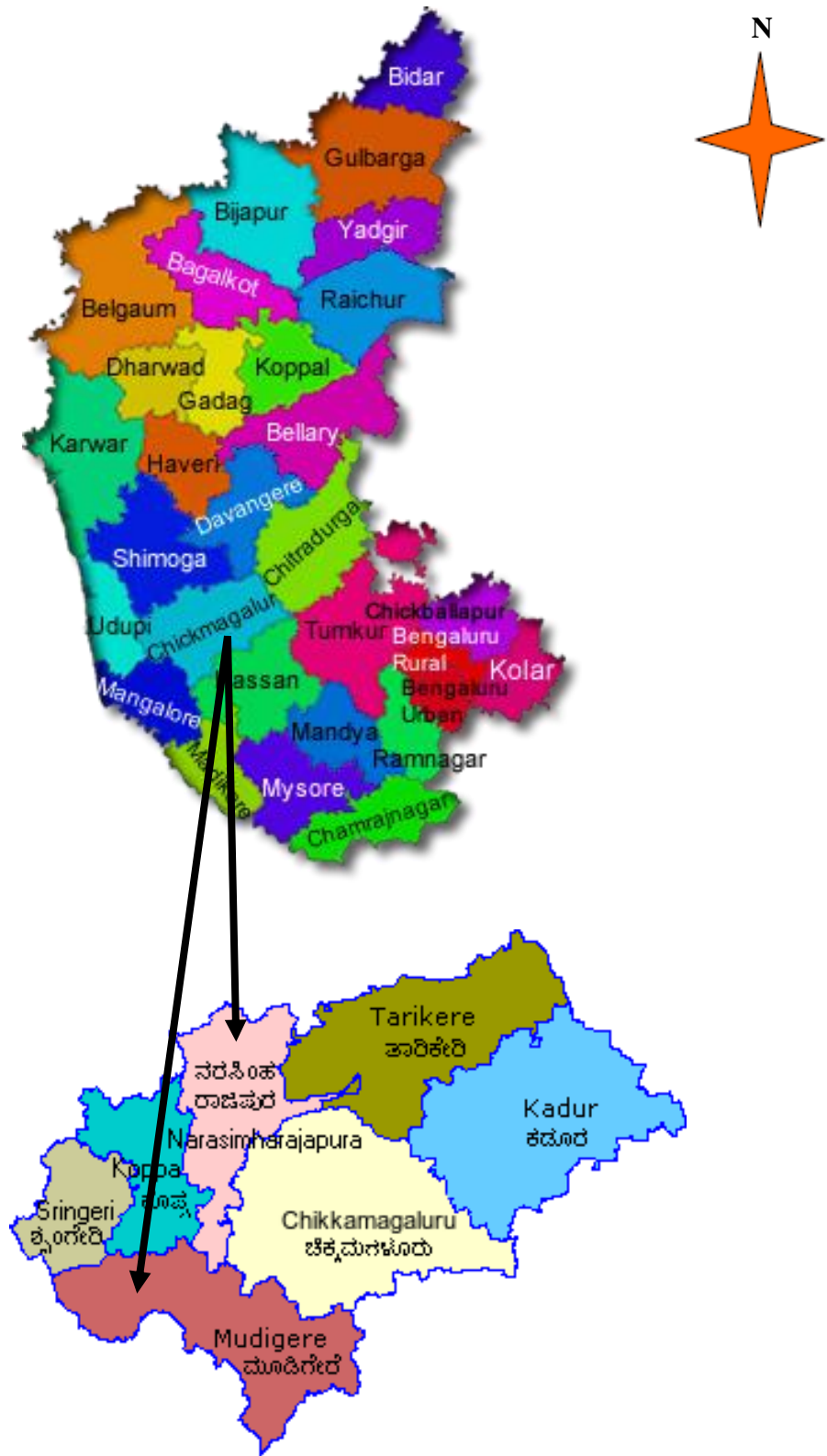
In order to assess the dynamics of banana and its competing crops in Hilly Zone of Karnataka, area, production, productivity and monthly prices of banana, paddy and ginger for Shivamogga and Chikkamagaluru districts of Karnataka for 2001-02 to 2015-16 were collected from the Directorate of Economics and Statistics, Bengaluru. Here, among three districts, Shivamogga and Chikkamagaluru districts were chosen for this study as more than 50 per cent geographical area of these districts comes under “Hilly Zone of Karnataka”. Paddy and ginger were purposefully selected as competing crops for banana based on the area share.

The primary data pertaining to the year 2015-16 were collected by using a well structured and pre-tested schedule (Appendix-IV and V) through a survey of sample respondents. Based on preliminary survey, majority of area under banana cultivation was preceded by paddy and ginger. Thereby paddy and ginger was considered as competing crops for banana. The data relating to the general information about the respondents, family size, age, education, land holding, asset position, cost and returns of banana and its competing crops, factor responsible for banana consumption in household consumers and such other details were obtained from them. Personal interview was used to elicit the data from the respondents, and it was ensured that the data made available by the respondents were relevant, comprehensive and reasonably correct and precise.

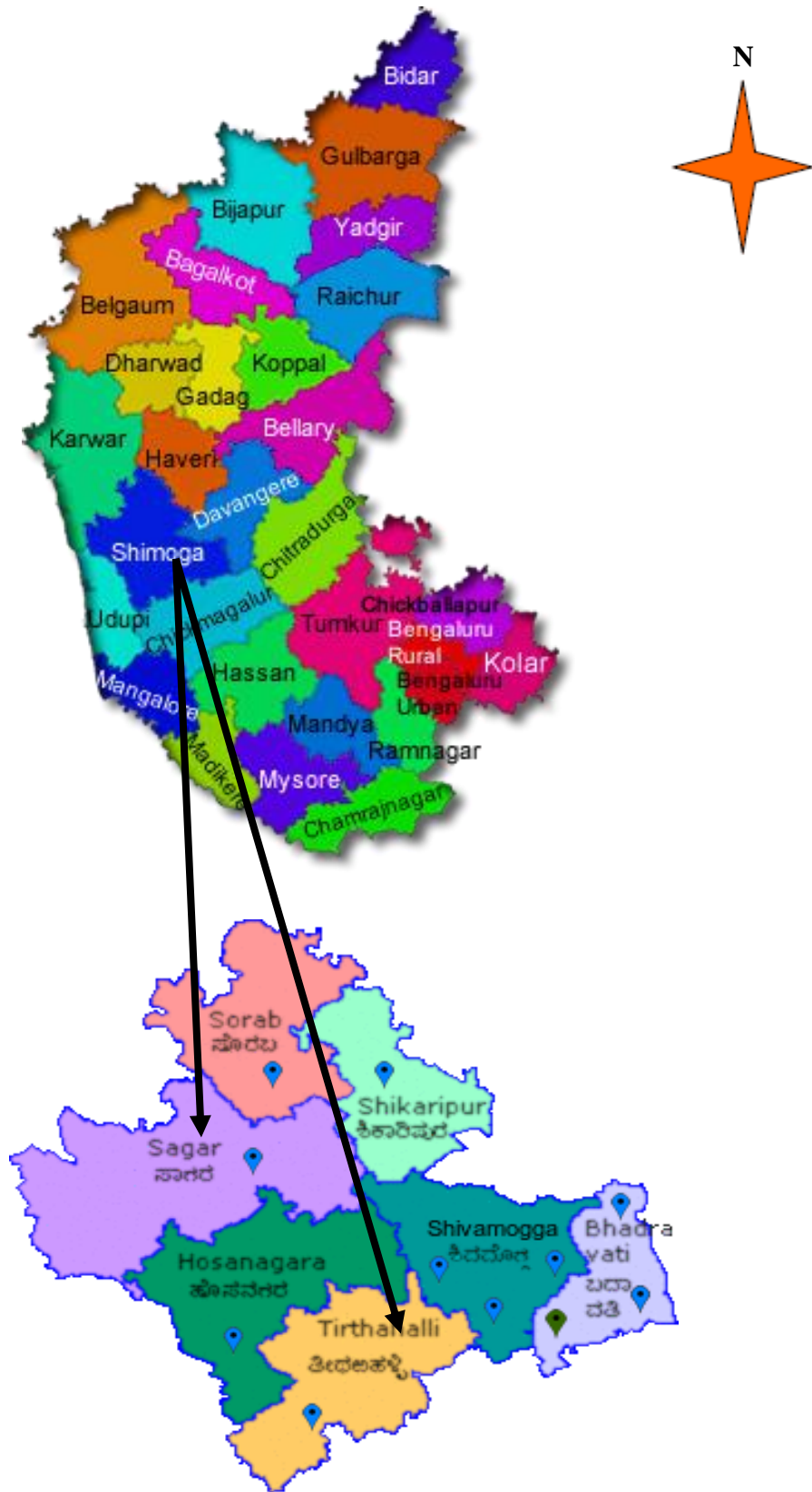
### **3.4 Analytical Tools Employed**

For the purpose of evaluating the objectives of the study, based on the nature and extent of data availability, the following analytical tools were employed for processing the data to draw meaningful results and conclusions.

- 3.4.1 Descriptive analysis
- 3.4.2 Chi-square independent test
- 3.4.3 Compound annual growth rate analysis.
- 3.4.4 Instability index



**Fig. 3.1 Map showing study area Chikkamagaluru District**



**Fig. 3.2: Map showing study area Shivamogga District**

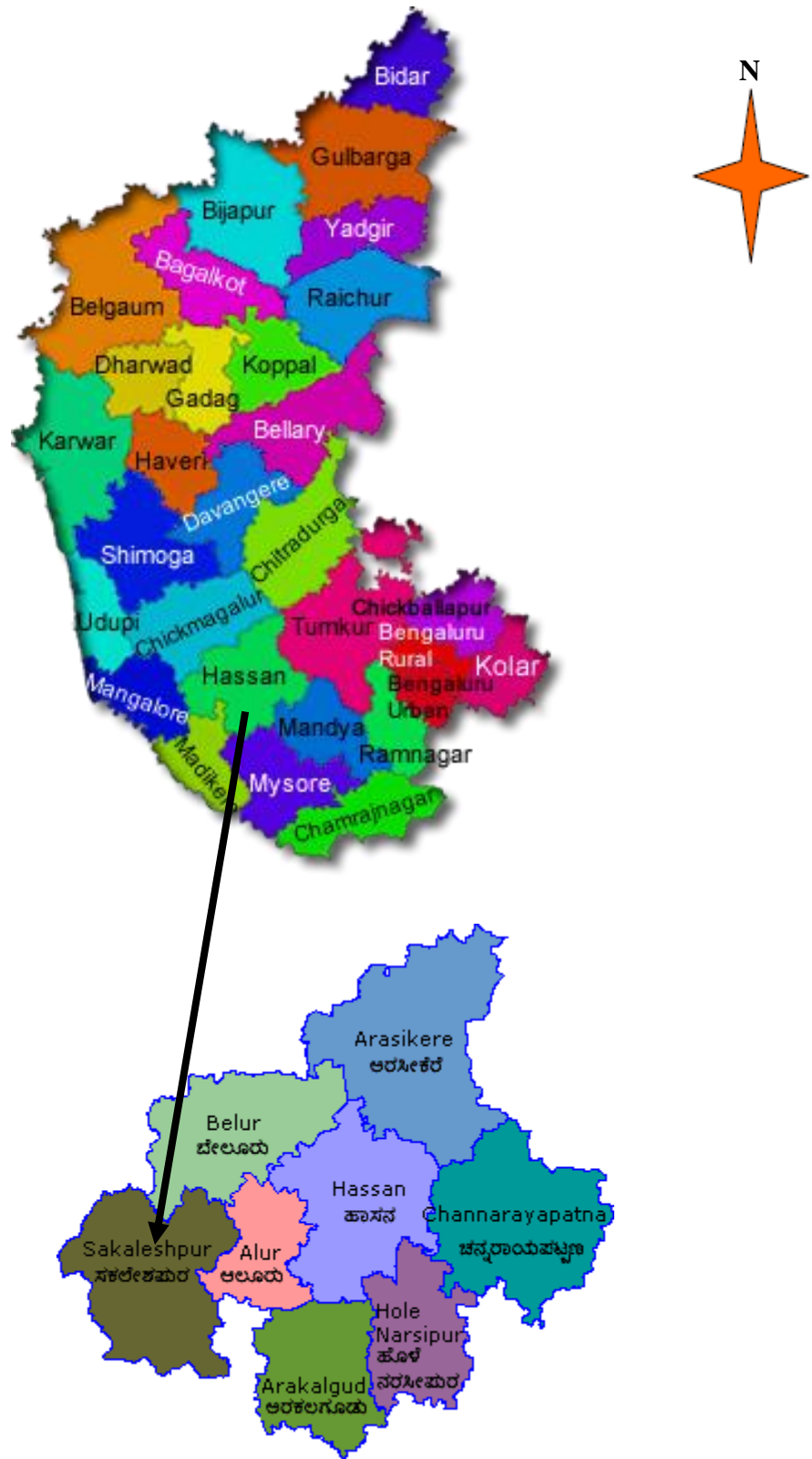
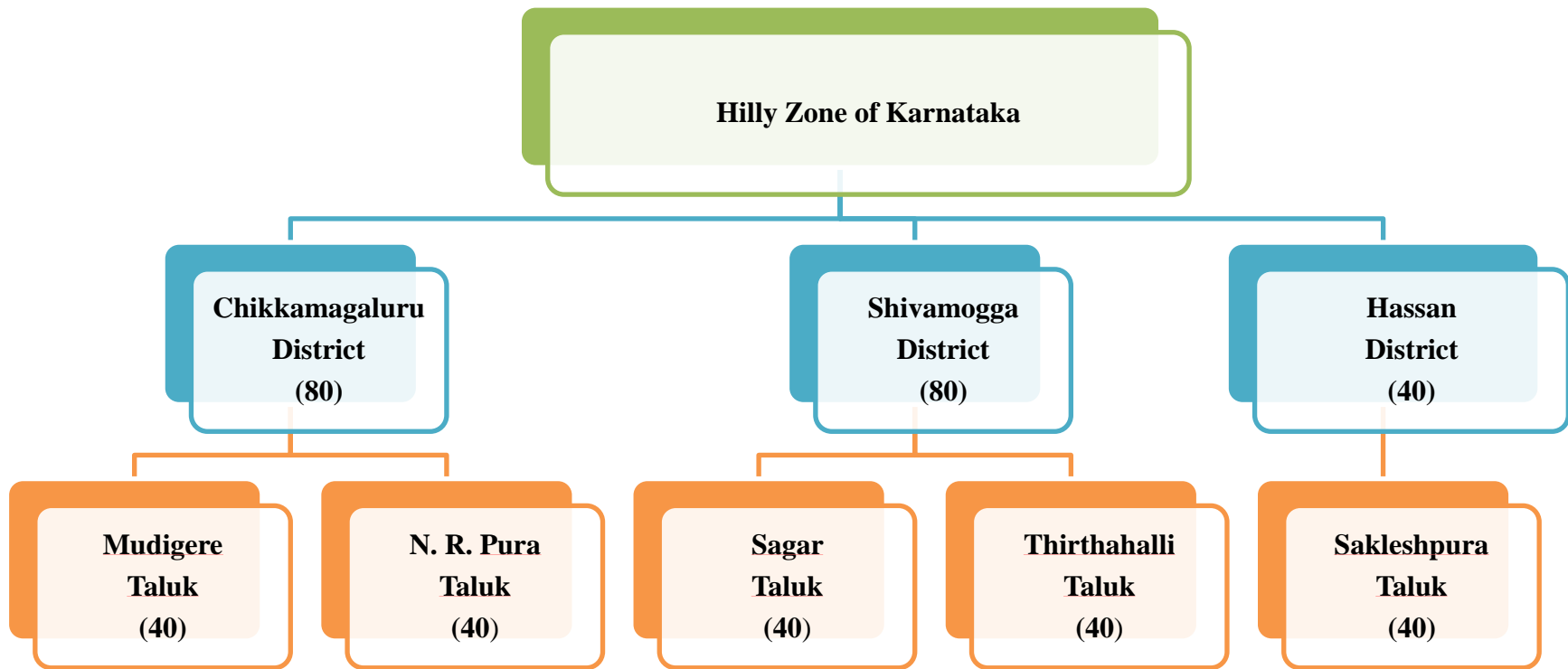
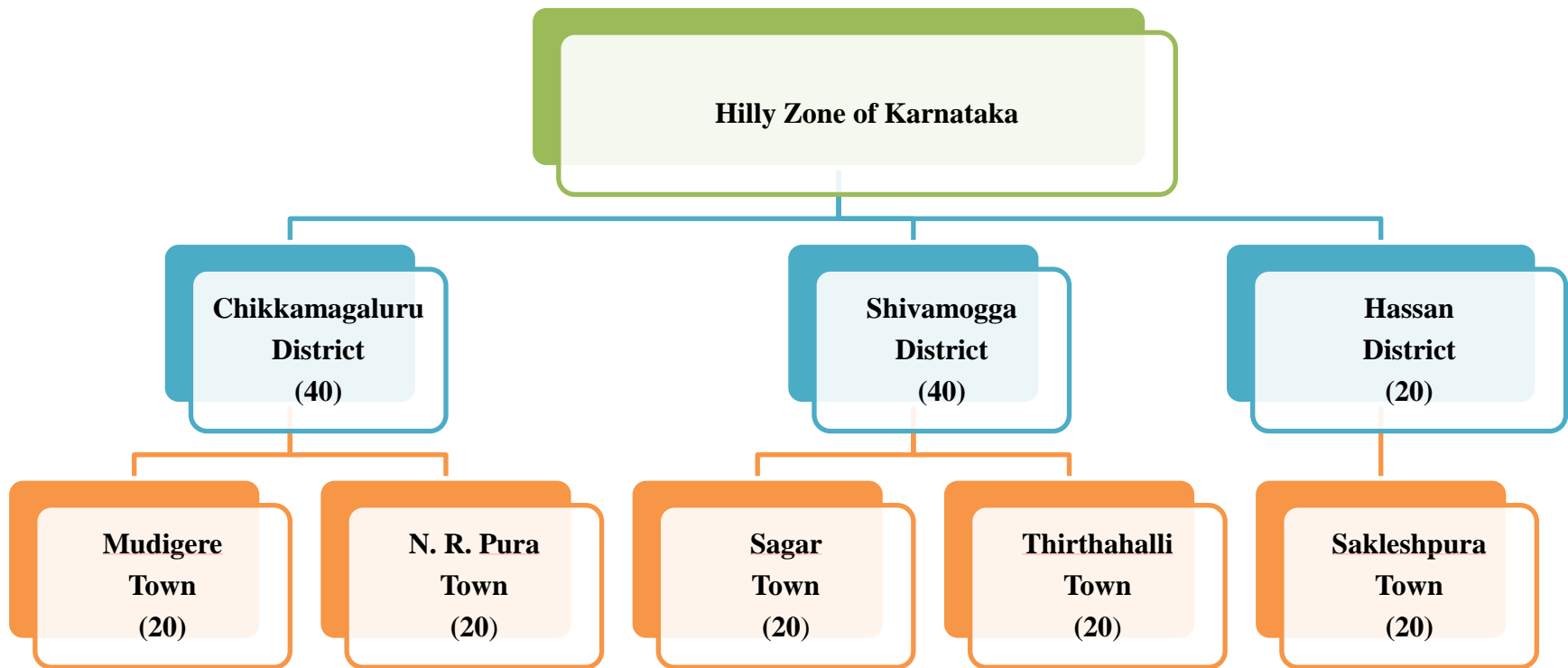


Fig. 3.3: Map showing study area Hassan District



**Fig. 3.4 Sampling frame-Banana farmers**



**Fig. 3.5 Sampling frame-Consumers**



**Plate 1: Researcher collecting data from sample farmers in the study area**



**Plate 2: Researcher collecting data from sample farmers in the study area**

- 3.4.5 Crop diversification indices
- 3.4.6 Partial budgeting technique
- 3.4.7 Cobb Douglas production function
- 3.4.8 Garrett ranking technique

### **3.4.1 Descriptive analysis**

The descriptive analysis was employed to compile the socio-economic status, cost and returns of banana and its competing crops, labour use pattern and other related issues. In order to facilitate interpretation of findings, statistical measures like percentages and averages were also worked out wherever necessary.

### **3.4.2 Chi-square independent test**

This is a most frequently used non-parametric statistical test in social sciences as it can be used for any levels of measurement in general and nominal scale in particular. Chi-square test of independence was used to evaluate group differences when the dependent variable is nominal, dichotomous, ordinal, or grouped interval. The Chi square test of independence allows the researcher to determine whether variables are independent of each other or whether there is a pattern of dependence between them. If there is dependence, the researcher can claim that the two variables have statistical relationship with each other.

This approach consists of four steps:

- (1) State the null and alternative hypotheses
- (2) Formulate an analysis plan
- (3) Analyze the sample data
- (4) Interpretation of results

**Step 1:** Null Hypothesis ( $H_0$ ): Two variables are independent

Alternative hypothesis ( $H_1$ ): Two variables are not independent.

**Step 2:** This deals with the use of the data to accept or reject the null hypothesis. In this stage researcher also needs to set up the significance level. Often, researchers choose significance levels equal to 0.01, 0.05, or 0.10.

**Step 3:** Using sample data from the contingency tables, find the degrees of freedom, expected frequency counts, test statistic, and the P-value associated with the test statistic. The formula used to find out the Chi square statistic is as follows

$$X_{ij}^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \dots\dots\dots (1)$$

Follows  $\chi^2$  ((r-1) × (c-1) df)

Where,

$O_{ij}$  is the observed number of cases with respect to  $i^{th}$  factor in  $j^{th}$  district

$E_{ij}$  the expected number of cases with respect to  $i^{th}$  factor in  $j^{th}$  district

N is the total number of observations, r is number of rows, c is number of columns and df is the degrees of freedom ((r-1) × (c-1))

The expected value of the each category can be calculated as follows

Expected number of  $ij^{th}$  case= {( $i^{th}$  row total ×  $j^{th}$  column total) / grand total}

This Chi square statistic is obtained by calculating the difference between the observed number of cases and the expected number of cases in each category. This difference is squared and divided by the expected number of cases in that category. These values are then added for all the categories, and the total is referred to as the Chi squared value. Since the test statistic is a Chi-square, Chi-Square distribution calculator is used to assess the probability associated with the test statistic using the degrees of freedom computed above.

**Step 4:** Reject the null hypothesis if the probability of test statistic is less than or equal to alpha (0.05)

In the present study this test was employed to know the relationship between socio-economic characteristics of the sample respondents of banana producer and consumer in Hilly zone of Karnataka.

### 3.4.3 Compound annual growth rate analysis

For estimating the compound annual growth rates of the selected variables cited below, exponential function of the following form was used.

$$Y_t = A B^t V_t \dots\dots\dots (2)$$

Where,

- $Y_t$  = area/production/productivity/other variable under consideration in the year t
- $A$  = Intercept indicating Y in the base period (t = 0)
- $B$  = 1 + g
- t = time period
- $V_t$  = Random disturbance term

Equation (2) was converted into linear form by taking logarithm as follows:

$$\ln Y_t = \ln A + t * \ln B + \ln V_t \dots\dots\dots (3)$$

This is of the following form

$$Q_t = a + b_t + U_t \dots\dots\dots (4)$$

Where,

- $Q_t$  =  $\ln Y$
- a =  $\ln A$
- b =  $\ln B$
- $U_t$  =  $\ln V_t$

The parameters ‘a’ and ‘b’ were estimated using the Ordinary Least Squares estimation technique. Later, the original ‘A’ and ‘B’ parameters in equation (4) were obtained by taking antilogarithms of ‘a’ and ‘b’.

Average annual compound growth rate (%) was calculated as follows:

$$g = (B - 1) * 100$$

### 3.4.4 Instability analysis

Definition of Instability: The state of being likely to change and the tendency to behave in an unpredictable, changeable and erratic manner.

The coefficient of variation was used as a measure to study the variability in the area, production and productivity of banana. The coefficient of variation (CV) was computed using the following formula.

$$\text{Coefficient of variation} = \left( \frac{\text{Standard Deviation}}{\text{Mean}} \right) * 100 \dots\dots\dots (5)$$

Linear trend was fitted to the original time series data on area, production and productivity for the two study periods. The formula suggested by Cuddy and Della (1978) was used to compute the degree of variation around the trend, means coefficient of variation was multiplied by the square root of the difference between the unity and coefficient of determination ( $R^2$ ). A high degree of instability index signifies violent variations.

$$\text{Instability Index} = \left( \frac{\text{Standard Deviation}}{\text{Mean}} \right) * 100 * (1 - R_i^2)^{0.5} \dots\dots\dots (6)$$

Where,

$$R^2 = \text{Coefficient of determination}$$

**Interpretation of Instability:** It is expressed in percentage. Where, higher value indicates more instability and lower value indicates more stability in (variables) area under crops.

### 3.4.5 Crop diversification Indices

#### Herfindahl Index (HI)

Herfindahl Index (Pant *et al.*, 2005) given below was computed by taking sum of squares of acreage proportion of each crop in the total cropped area. Mathematically, the index is given as below

$$HI = \sum_{i=1}^N P_i^2 \dots\dots\dots (7)$$

Where,

N = total number of crops

P<sub>i</sub> = represents area proportion of the i<sup>th</sup> crop in total cropped area.

The index takes a value one when there is complete concentration and approaches zero when diversification is perfect. Thus the HI is bounded by Zero and one.

**Simpson Index (SI)**

One minus HI will give the Simpsons index of diversification (SI) and similar to HI the range of SI also ranges between zero and one, but interpretation is quite opposite to HI i.e, A value of SID closer to zero indicates specialization and a value closer to one indicates diversification.

**Composite Entropy Index (CEI)**

This index possesses all desirable properties of above mentioned indices and was used to compare diversification across situations having different and large number of crops since it gives due weightage to a number of crops. The formula of C.E.I. is given by:

$$C. E. I = \left( \sum_{i=1}^N P_i \cdot \log P_i \right) \times \left( 1 - \frac{1}{N} \right) \dots\dots\dots (8)$$

The value of Composite Entropy Index increases with the decrease in concentration and rises with the number of crops. The value of C.E.I. ranges between zero and one.

**3.4.6 Partial budgeting**

Partial budgeting is a planning and decision making framework used to compare the costs and benefits of proposed alternatives in the farm business. It focuses only on the changes in income and expenses that would result from implementing a specific alternative. Thus, all aspects of farm profits that are unchanged by the decision can be safely ignored. In a nutshell, partial budgeting allows to get a better understanding on

how a decision will affect the profitability of the enterprise and ultimately the profitability of the farm itself. However, the value of a partial budgeting analysis is highly dependent upon the quality of the information used in the study.

A partial budget consists of two columns, a subtotal for each column and a grand total. The left hand column has the items that added returns while the right hand column notes those that reduced returns for a farm business. The partial budget can be divided into four component parts.

- a. **Added returns:** This is usually an estimate in which additional income generated due to increase in the yield and increase in price of output due to adoption of banana crop.
- b. **Added costs:** List of all increased expenses due to the change of crops.
- c. **Reduced costs:** Cost reduction in production activity due to entering into banana cultivation.
- d. **Reduced returns:** Any income reduction due to banana cultivation by farmers.

#### 3.4.6.1 Outlook for partial budgeting

Debit		Credit	
A)	Added cost ₹_____	A)	Reduced cost ₹_____
B)	Reduced returns ₹_____	B)	Increased returns ₹_____
Total (A+B) ₹_____		Total (A+B) ₹_____	
Net gain or loss (credit-debit): ₹_____			

#### Interpretation of partial budgeting

The net impact of the above effects will be the positive financial changes minus the negative financial changes. A positive net indicates that farm income will increase due to the change, while a negative net indicates the change will reduce farm income.

### 3.4.7 Cobb-Douglas production function

Cobb-Douglas production function was employed to study the resource use efficiency in banana and its competing crops in Hilly zone of Karnataka .The estimated Cobb-Douglas model is specified as follows.

#### Cobb-Douglas model for banana/paddy/ginger

$$Y = a X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7} e^u \dots\dots\dots (9)$$

Where,

#### Dependent variable:

$$Y = \text{Gross returns (₹/ha)}$$

#### Independent variable:

- $X_1$  = Sucker in banana (₹/ha) / Seeds in Paddy/ Rhizome in ginger
- $X_2$  = Farm yard manure (₹/ha)
- $X_3$  = Chemical fertilizer (₹/ha)
- $X_4$  = Human labour (₹/ha)
- $X_5$  = Bullock labour (₹/ha)
- $X_6$  = Plant protection chemical PPC (₹/ha)
- $X_7$  = Propping in banana (₹/ha) / mulching in ginger (₹/ha)
- $e^u$  = Random/disturbance term
- $b_1$  to  $b_7$  = Elasticity coefficients of respective inputs

Equation (7) was converted into the logarithmic form as follows to make it a linear form:

$$\ln Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + u \log e \dots\dots\dots(10)$$

The allocative efficiency was carried out to infer about optimal resources use by farmer by using the MVP and MFC ratio. The estimated coefficients were used to compute the MVP and its ratio (r) with MFC.

The model was estimated as follows

$$r = \text{MVP/MFC} \dots\dots\dots (11)$$

Where,

r = Efficiency ratio

MVP = Marginal value product of variable inputs

MFC = Marginal factor cost (price per unit inputs)

Based on economic theory, a firm maximizes profits with regards to resource use when the ratio of the marginal return to the opportunity cost is one. The values are interpreted thus,

If  $r < 1$ ; resource is excessively used or over utilized hence decreasing the quantity of resource used, increases profits.

If  $r > 1$ ; resource is underutilized hence increasing its use will increase profit level.

If  $r = 1$ ; the resource is efficiently used, that is optimum utilization of resource hence the point of profit maximization

### 3.4.8 Garrett ranking technique

For carrying out this analysis, both producers and consumers of banana were asked to mention specific factors influencing banana cultivation by farmer and specific factor influencing selection of banana by consumer. All possible known factors were listed in the schedule and they were asked to rank the factors in the order of their importance. The ranks given by them were quantified using the Garrett ranking technique using the following formula:

$$\text{Per cent position} = \sum_{j=1}^n (R_{ij} - 0.5)/N_j * 100 \dots\dots\dots (12)$$

Where,

$R_{ij}$  = Rank given for the  $i^{\text{th}}$  item by the  $j^{\text{th}}$  individual and

$N_j$  = Number of items ranked by the  $j^{\text{th}}$  individual

The per cent position of each rank was converted into scores referring to the Garrett score card. For each factor, the scores of individual respondents were added together and divided by the total number of respondents for whom scores were added. These mean scores for all the factors were arranged in descending order, ranks were given and most important factors were identified.

### **3.5 Terms and Concepts Used in the Study**

#### **3.5.1 Estimation of costs and returns**

The costs were classified into variable and fixed costs. Variable cost includes cost of inputs (seed, FYM, fertilizer), labour cost and interest on working capital. Fixed cost includes depreciation on farm implements, rental value of land etc. The definitions of various cost components are as follows.

#### **3.5.2 Variable cost**

Those costs which vary with the level of production were included in this category. The items included under this section are given below.

##### **a) Labour cost**

The cost on human labour was calculated by multiplying the man days with existing wage rate. Women days were converted into man days by multiplying it with the ratio of wages given to women labour to that of men labour. The cost on family labour was imputed by multiplying man days with the prevailing wage rate. The bullock labour was taken in pair days and the cost towards it was estimated by multiplying pair days with wage rate. Machine labour was measured in hours and valued at prevailing hourly rates in the study area.

##### **b) Cost of inputs**

Cost of various inputs like seed material, fertilisers, and FYM were included in this category. Non-farm inputs and owned farm inputs were valued at prevailing prices.

### **c) Irrigation cost**

The cost of electricity (subsidy by Government) to lift the water from bore well was calculated using the following formula (₹ 3.5 is the cost of electricity per KWH),

Electricity charges = No. of irrigations x No. of hours irrigated per irrigation x Area x hp of motor x 0.75 KWH x 3.5 per KWH.

Amortization cost of bore well, pump and conveyance structure was calculated using the formula,

$$\text{Amortized cost} = \text{Initial investment} * [(1+i)^{AL} * i] \div [(1+i)^{AL} - 1],$$

Where, AL- Average life of bore well, pump and other assets.

i - Discounting rate of interest.

Thus, Irrigation cost was obtained by the summation of electricity charges and amortization cost.

### **d) Interest on working capital**

The prevailing bank rate of eight per cent (Commercial bank lending rate in the study area) was taken to work out the interest on working capital for the duration of the crop.

### **3.5.3 Fixed cost**

This consists of those cost items which don't vary with the level of production. The items included under this section were,

#### **a) Rental value of land**

Rental value is accounted based on present market rate. In this study rental value of land is taken based on prevailing for mode value of land

## **b) Depreciation**

Depreciation on each capital equipment and machinery owned by the farmers were calculated separately, by using straight line method. The average life of the asset as indicated by each farmer was used in computation of the depreciation.

## **c) Interest on fixed capital**

Interest on fixed capital was computed at the rate of ten per cent per annum. The interest was worked out on the values of fixed assets, after deducting depreciation for the year.

## **d) Land revenue and taxes**

Land revenue and taxes was charged at the rates levied by the government.

## **e) Managerial Cost**

It is the cost accounted for the management of farm by the farmer-owner. Farmer as an owner plays a multiple role in the production system with his mental and physical involvement. Hence, 10 per cent of the working capital has been taken as managerial cost.

## **f) Risk premium**

Risk premium is the cost paid by the farmer to overcome the risk from natural calamities. A part of premium cost is also considered in the cost concept. In the *Pradhan Mantri Fasal Bima Yojana*, 5 per cent of the 80 per cent of working capital is considered as the risk premium for commercial crops. The same has been considered to account for risk in horticultural crops in the present study.

## **f) Total cost**

Total cost is the summation of variable cost and fixed costs.

### **3.5.4 Returns**

#### **a) Gross returns**

Gross returns include the gross value of main product and by-product imputed on the basis of post-harvest prices prevailing in the study area.

#### **b) Net returns over total cost**

Net return was computed by subtracting the gross returns from cost of cultivation.

#### **c) Cost of production per quintal**

Cost of production per quintal was worked out by dividing total cost by the yield of main product.

#### **d) Returns per rupee of expenditure**

Return per rupee of expenditure was calculated by dividing the gross return by total cost.

## **IV RESULTS AND DISCUSSION**

The findings of the study are presented in this chapter under the following headings in consonance with the objectives of the study.

- 4.1 Socio-economic characteristics of the sample farmers
- 4.2 Livestock inventory on sample farmer
- 4.3 Status of farm inventory of sample respondents
- 4.4 Growth and instability of banana in Karnataka and India
- 4.5 Growth performance of banana and its competing crops in Hilly Zone of Karnataka
- 4.6 Crop diversification indices
- 4.7 Cost and returns of banana and its competing crops
- 4.8 Partial budgeting
- 4.9 Resource use efficiency
- 4.10 Factors for sustained production
- 4.11 Externalities of banana and its competing crops
- 4.12 General characteristics of consumers
- 4.13 Purchase frequency of banana by consumers
- 4.14 Attributes determining consumers preferences for banana
- 4.15 Factors influencing banana purchase by consumers

### **4.1 Socio-economic characteristics of the sample farmers**

An understanding of general characteristics of sample farmers is expected to provide a bird's eye view of the general features prevailing in the study area. Therefore, an attempt has been made in the study to analyse some of the important characteristics of the sample farmers. The general characteristics of the respondents viz., age group, educational level, family size and land holding are presented in Table 4.1.

### **Age of farmers**

The study comprised of 200 sample respondents spread over Hassan, Chikkamagaluru and Shivamogga districts of Karnataka. The general characteristics of the sample respondents indicated that majority of the farmers were above 50 years which constituted around 60 per cent and 54 per cent in Hassan and Chikkamagaluru districts respectively. In Shivamogga, majority were in the age group of 35-50 years (41 per cent). However, on overall basis, 48 per cent of respondents were above 50 years. The pattern of distribution in three selected district in different age groups were statistically non-significant (Table 4.1).

### **Education level**

Majority of the respondents in Hassan had PUC education (33 %) and few had got post graduate degree (5 %). Similarly, in Chikkamagaluru, majority have passed PUC (34 %) and very few illiterates were seen (6 %). On the other hand, in Shivamogga, respondents with PUC education (30 %) were higher and the least was postgraduates (4 %). However, for the overall study area, majority of the respondents possessed PUC education (32 %) and few postgraduates (6 %). Educational distribution pattern in the study area was moderately high among the farmers. However, not much difference was noticed among the district with respect to literacy as revealed by non-significant value of chi-square test.

### **Family size**

The classification of sample households in Hassan, Chikkamagaluru and Shivamogga based on family size (Table 4.1) showed that majority belonged to medium sized family (4-6) which constituted 65, 59 and 53 per cent, respectively. Majority on overall basis, majority of the respondents belonged to medium size family (58 %). The difference in family size between three districts was statistically non-significant. The average family size was same in three districts (5no.) and was statistically non-significant indicating that the contribution of family labour was same under three districts.

**Table 4.1: Demographic profile of sample respondents**

Particular	Hassan (n=40)	Chikkamagaluru (n=80)	Shivamogga (n=80)	Pooled (N=200)	$\chi^2$ Value
I. Age group (No.)					
a. Below 35 years	6 (15)	11 (14)	18 (23)	35 (18)	
b. 35-50 years	10 (25)	26 (33)	33 (41)	69 (35)	
c. Above 50 years	24 (60)	43 (54)	29 (36)	96 (48)	
Average age (year)	52	49	46	49	
II. Education level (No.)					
a. Illiterate	4 (10)	5 (6)	12 (15)	21 (11)	15.42 <sup>NS</sup>
b. Primary	3 (8)	9 (11)	11 (14)	23 (12)	
c. Secondary	12 (30)	20 (25)	16 (20)	48 (24)	
d. PUC	13 (33)	27 (34)	24 (30)	64 (32)	
e. Degree	6 (15)	13 (16)	14 (18)	33 (17)	
f. Postgraduates	2 (5)	6 (8)	3 (4)	11 (6)	
III. Family size (No.)					
a. Small (<4)	8 (20)	14 (18)	15 (19)	37 (19)	
b. Medium (4-6)	26 (65)	47 (59)	42 (53)	115 (58)	
c. Large (>6)	6 (15)	19 (24)	23 (29)	48 (24)	
Average family size (No.)	5	5	5	5	7.48 <sup>NS</sup>
IV. Land holding (No.)					
a. Small farmers (< 2 ha)	21 (53)	41 (51)	29 (36)	91 (46)	
b. Medium farmers (2 to 5 ha)	12 (30)	28 (35)	38 (48)	78 (39)	
c. Large farmers (> 5 ha)	7 (18)	11 (14)	13 (16)	31 (16)	
Average land holding (ha)	1.76	1.44	1.64	1.61	6.14 <sup>NS</sup>

Note: 1. \*\*, \* - Significant at 1 & 5 per cent, respectively

2. Figures in parentheses indicate percentage.

3. NS : Non-Significant

### Land Holding

Small farmers owning less than 2 ha constituted majority in the sample of Hassan and Chikkamagaluru which accounted for 53 per cent and 51 per cent, respectively. Where as in Shivamogga, majority of the respondents belonged to medium (48 %). In the overall study area, 46 per cent belonged to small category farmers with less than 2 ha.

With respect to land holding, the average size of land holdings was higher in Hassan district (1.76 ha) followed by Shivamogga (1.64 ha) and Chikkamagaluru (1.44 ha) districts. Across three districts, average land holding difference was statistically non-significant. The results clearly reflected the homogeneity of sample respondents in respect of age, education, farm size and land holdings (Table 4.1).

#### 4.2 Livestock inventory

The details on livestock possession (Table 4.2) revealed that, In Hassan among different categories of livestock, local cows (62) were found to be dominant, followed by cross breed cows (33) in Hassan, whereas in Chikkamagaluru district the number of local cows (106) was higher followed by cross breed cows (65) and poultry birds (51). However, livestock asset details in Shivamogga revealed that majority of livestock population was constituted by cross breed cows (78) followed by local cows (63). Thus for the overall study area, population of cows (231) was higher followed by cross breed cows (176). It was observed that, among livestock component in the study area, majority of the famers possessed local cows due to low maintenance cost compared to high breed yielding cows.

**Table 4.2: Livestock possession by sample respondents**

(Numbers)

Sl. No	Particular (No.)	Hassan (n=40)	Chikkamagaluru (n=80)	Shivamogga (n=80)	Pooled (N=200)
1	Bullock (pair)	18	31	58	107
2	Cow Local	62	106	63	231
3	Cross breed cow	33	65	78	176
4	Buffaloes	14	22	46	82
5	Sheep	8	14	19	41
6	Goat	3	15	18	36
7	Poultry birds*	15	51	71	137

**Note:** \*Back yard poultry

### 4.3 Status of farm inventory of sample respondents

The status of farm inventory in the study area is presented in Table 4.3. The results revealed that, the major farm inventory in Hassan district were sprayers (21) followed by power tiller (18), wooden/M.B plough (12). In Chikkamagaluru district, sprayers (55), irrigation pump/ motor (45), cattle shed (34) were the major farm inventory. Similarly, in Shivamogga district, irrigation pump/motor (68), sprayers and wooden plough (48 each) and power tiller were the major inventories. On overall basis, in the study area, irrigation pump/motor was the major farm inventory followed by sprayers, power tiller and wooden ploughs.

**Table 4.3: Status of farm inventory of sample respondents**

(Numbers)

Sl. No	Particular	Hassan (n=40)	Chikkamagaluru (n=80)	Shivamogga (n=80)	Pooled (N=200)
1	Wooden/M.B plough	12	27	48	87
2	Power tiller	18	32	42	92
3	Tractor and accessories	5	24	15	44
4	Sprayers	21	55	48	124
5	Irrigation pump & motor	14	45	68	127
6	Tube well/ open well	2	16	21	39
7	Farm house/building	4	14	12	30
8	Cattle shed	11	34	42	87

### 4.4 Growth and instability of banana in Karnataka and India

#### 4.4.1 Growth performance of banana in Karnataka and India

Growth in area, production and productivity of banana in India and Karnataka was estimated using the exponential function. The study period (1995-96 to 2014-15) was divided into two sub periods viz, Period - I (1995-96 to 2004-05) and Period-II (2005-06 to 2014-15) due to significant shift in area, production and productivity of Horticultural crops in general and banana in particular. This break, the two study periods was

synchronized with introduction of National Horticulture Mission (NHM) during 2005-06 by Government of India, and has contributed for the increase in area, production and productivity of banana in India and Karnataka.

**Table 4.4: Growth rates in area, production and productivity of banana in Karnataka and India**

Karnataka		India	
Period	CAGR (%)	Period	CAGR (%)
<b>Area (000 ha)</b>			
Period-I (1995-96 to 2004-05)	1.86*	Period-I (1995-96 to 2004-05)	1.59**
Period-II (2005-06 to 2014-15)	5.98**	Period-II (2005-06 to 2014-15)	4.64**
Overall period (1995-96 to 2014-15)	4.28**	Overall period (1995-96 to 2014-15)	3.40**
<b>Production (000 tonne)</b>			
Period-I (1995-96 to 2004-05)	2.71	Period-I (1995-96 to 2004-05)	2.28
Period-II (2005-06 to 2014-15)	9.86**	Period-II (2005-06 to 2014-15)	7.84**
Overall period (1995-96 to 2014-15)	6.17**	Overall period (1995-96 to 2014-15)	5.86**
<b>Productivity (kg/ha)</b>			
Period-I (1995-96 to 2004-05)	0.85	Period-I (1995-96 to 2004-05)	0.69
Period-II (2005-06 to 2014-15)	3.82**	Period-II (2005-06 to 2014-15)	2.56**
Overall period (1995-96 to 2014-15)	1.89*	Overall period (1995-96 to 2014-15)	2.06*

Note: \*\*&\* indicates Significant at one per cent and five per cent, respectively

CAGR: Compound Annual Growth Rate

The results presented in Table 4.4 on compound annual growth rates (CAGR) for Karnataka and India revealed that, the growth rates of area during all the three study

periods Period I (1995-96 to 2004-05), Period II (2005-06 to 2014-15) and Overall Period (1995-96 to 2014-15) for Karnataka were found positive and significant (1.86 %, 5.98 % and 4.28 %, respectively). The respective figures for area of banana in India viz., 1.59 per cent, 4.64 per cent and 3.40 per cent were also found significant at one percent probability level. The banana production in Karnataka and India also showed significant growth during the Period-II and Overall Period, however the growth rate of banana production during the period-I was not significant. In spite of significant increase in area under banana during pre-NHM period, the growth rate of banana production was not significant due to non-significant growth rate of banana productivity for both Karnataka and India. The findings of Kumar and Chandrashekar (2015) also confirmed highly with significant positive growth rates for major horticultural crops in Karnataka.

#### **4.4.2 Instability analysis of banana in Karnataka and India**

The results on instability analysis of banana showed a moderate degree of instability during Period-I (8.2 %) and relatively high degree of instability during Period-II in Karnataka (11.74 %). With respect to area under banana in the country, Period – II (2000-01 to 2013-14) showed high degree of instability (15.07 %) compared to Period-I (1995-96 to 2004-05) where it was only 5.18 per cent. The results on production of banana in Karnataka represent relatively high degree of instability during Period II (2005-06 to 2014-15) and Overall Period (1995-96 to 2014-15) with instability indices of 26.09 per cent and 32.78 per cent, respectively compared to India (Table 4.5).

The instability analysis on productivity of banana in Karnataka also indicated comparatively high degree of instability for Period - II (2005-06 to 2014-15) and overall period (1995-96 to 2014-15) with respective indices values of 35.75 per cent and 31.29 per cent compared to India. Introduction of NHM lead to high growth in area, production and productivity of major horticultural crops in India and Karnataka. This programme assisted the horticultural crop growers by providing quality seed material, subsidy to irrigation and created awareness about advance technologies in production of horticultural crops. Thereby, higher growth in horticultural crops resulted in occurrence

of high degree of instability compared to pre NHM period. Similar findings were reported by Singha *et al.*, (2014), on high degree of instability for horticultural crops in Karnataka.

**Table 4.5: Instability indices for area, production and productivity of banana in Karnataka and India**

<b>Karnataka</b>	<b>Instability Index (%)</b>	<b>India</b>	<b>Instability Index (%)</b>
<b>Area</b>			
Period-I (1995-96 to 2004-05)	8.22	Period-I (1995-96 to 2004-05)	5.18
Period-II (2005-06 to 2014-15)	11.74	Period-II (2005-06 to 2014-15)	15.07
Overall period (1995-96 to 2014-15)	9.31	Overall period (1995-96 to 2014-15)	14.50
<b>Production</b>			
Period-I (1995-96 to 2004-05)	6.94	Period-I (1995-96 to 2004-05)	14.58
Period-II (2005-06 to 2014-15)	26.09	Period-II (2005-06 to 2014-15)	18.06
Overall period (1995-96 to 2014-15)	32.78	Overall period (1995-96 to 2014-15)	21.59
<b>Productivity</b>			
Period-I (1995-96 to 2004-05)	18.82	Period-I (1995-96 to 2004-05)	5.84
Period-II (2005-06 to 2014-15)	35.57	Period-II (2005-06 to 2014-15)	11.60
Overall period (1995-96 to 2014-15)	31.29	Overall period (1995-96 to 2014-15)	9.89

#### 4.4.3 Growth performance of banana in Karnataka

District-wise growth rates in area, production and productivity for all the major banana growing districts of Karnataka for the study period of 15 years from 2001-02 to 2015-16 were estimated using the exponential function and results are presented in the Table 4.6. It could be observed from the table that, the growth rate of area under banana was the highest in Chamarajanagar (15.35 %) followed by Mysore (10.13 %),

Shivamogga (9.64 %), Chikkamagaluru (7.96 %), Hassan (7.47 %) and Bellary (6.50 %) districts. While with respect to production of banana the highest growth rate was registered in Chamarajanagar (15.35 %) followed by Shivamogga (12.86 %), Mysore (10.93 %), Chikkamagaluru (9.91 %), Bellary (9.02 %), and Hassan (8.95 %) districts. Similarly growth rate analysis of banana productivity revealed that, productivity growth rates of banana during 2001-02 to 2015-16 found to be positive and significant in Shivamogga (3.29 %) followed by Chikkamagaluru (2.50 %), Bellary (2.45 %), Chamarajanagar (2.14 %), Belgaum (2.13 %) and Hassan (1.50 %) districts. Similar findings were reported by Saraswati *et al.*, (2012) on growth rates for banana area and production in Karnataka.

**Table 4.6: Growth rates in area, production and productivity of banana in Karnataka (2001-02 to 2015-16)**

(Per cent)

Sl. No.	Districts	Area (ha)	Production (tonnes)	Productivity (kg/ha)
1	Chamarajanagar	15.35**	17.25**	2.14**
2	Mysore	10.12**	10.93**	0.81*
3	Shivamogga	9.64**	12.95**	3.29**
4	Chikkamagaluru	7.96**	9.91**	1.96**
5	Hassan	7.47**	8.95**	1.50*
6	Bellary	6.50**	9.02**	2.45**
7	Bagalkot	5.89*	7.52*	1.63*
8	Koppal	4.98**	6.47**	1.49**
9	Chitradurga	4.77*	5.35*	0.55
10	Haveri	4.33*	4.58*	0.25*
11	Tumakuru	3.89**	4.55**	0.62*
12	Kolar	3.96	5.81	1.85*
13	Belgaum	3.84**	5.96**	2.13**
14	Mandya	3.46*	4.07	0.59
15	Davanagere	2.50*	3.75*	1.25
16	Gulbarga	2.54**	2.89**	0.42
17	Uttara Kannada	2.20	3.20*	1.02
18	Ramanagara	1.80	2.45*	0.60
19	Chikkaballapura	0.99	2.54**	1.53
20	Dakshina Kannada	0.73	1.41*	0.64
	Karnataka	5.21**	7.35**	2.14**

Note: \*\*&\* indicate significant levels at 1 and 5 per cent, respectively

#### 4.4.4 Instability analysis of banana in Karnataka

Variations in area, production and productivity of crops is a cause of concern, hence, it is important to know the extent of variability in area, production and productivity of major banana growing districts of Karnataka and was analysed by computing the instability indices. Among the various districts, the higher degree of instability in area under banana was exhibited in Kolar (32.22 %) followed by Chamarajanagar (24.58 %), Bagalkot (22.47 %), Mysore (21.75 %), Gulbarga (19.66 %) and Haveri (14.87 %) districts (Table 4.7).

**Table 4.7: Instability in area, production and productivity of banana in Karnataka (2001-02 to 2015-16)**

(Per cent)

Sl. No.	Districts	Area (ha)	Production (tonnes)	Productivity (kg/ha)
1	Chamarajanagar	24.58	17.49	5.92
2	Mysore	21.75	26.59	16.56
3	Shivamogga	8.04	14.64	9.79
4	Chikkamagaluru	10.31	13.78	13.32
5	Hassan	12.64	15.87	8.75
6	Bellary	12.75	17.68	16.11
7	Bagalkot	22.47	38.25	18.74
8	Koppal	7.83	10.21	4.08
9	Chitradurga	9.04	10.12	3.90
10	Haveri	14.87	12.79	5.06
11	Tumakuru	8.94	16.60	14.63
12	Kolar	32.22	34.97	10.75
13	Belgaum	6.79	4.86	4.22
14	Mandya	11.00	9.13	6.38
15	Davanagere	14.42	15.47	11.26
16	Gulbarga	19.66	19.91	3.18
17	Uttara Kannada	3.01	6.09	13.79
18	Ramanagara	7.35	19.41	12.28
19	Chikkaballapura	8.64	6.43	3.07
20	Dakshina Kannada	1.96	2.31	3.84
	Karnataka	12.74	23.14	18.75

While the area under banana was found to be relatively stable in the districts like Dakshina Kannada (1.96 %), Uttara Kannada (3.01 %) and Shivamogga (8.04 %). Similarly instability analysis of banana production revealed that, Bagalkot (38.25 %) showed the high degree of variation followed by Kolar (26.59 %), Mysore (34.97 %) and Gulbarga (19.91 %) districts, while the among the major banana producing districts in Karnataka, Dakshina Kannada and Belgaum showed lower degree of variation in production of 2.31 per cent and 4.86 per cent, respectively.

In respect of productivity of banana, Bagalkot (18.74 %) district exhibited the highest degree of instability, followed by Mysore (16.56 %), Bellary (16.11 %) and Tumakuru (14.63 %) districts. In the case of Chikkaballapura (3.07 %) and Gulbarga (3.18 %) districts the banana productivity appears to be stable with lower values of instability. The findings of the study are in conformity with the results of Bairwa *et al.*, (2012).

#### **4.5 Growth and instability of banana and its competing crops in Hilly zone of Karnataka**

##### **4.5.1 Growth rates in area of major crops in Hilly Zone of Karnataka (2001-02 to 2015-16)**

The results on growth rates for area under major cereals, pulses, oilseeds, vegetables, spices, fruit crops and other major commercial crops of Hilly Zone for the period from 2001-02 to 2015-16 are presented in the Table 4.8. The analysis was carried out using exponential function.

The estimated growth results revealed that Sakaleshpura taluk showed the highest positive and significant growth in area under pepper (12.31 %) followed by banana (5.49 %), total spices (5.30 %) and ginger (4.78 %). On the other hand, the highest negative and significant growth rate of area was observed for total oilseeds (-25.93 %) followed by total vegetables (-11.95 %) total food grains (-1.23 %) and paddy (-1.17 %). The growth performance of area under different crops for the Hassan district as a whole revealed that ginger registered the highest (21.47 %) positive and significant growth followed by pepper (15.27 %), banana (7.47 %) and total spices (7.15 %).

**Table 4.8: Growth rates in area of major crops in Hilly Zone of Karnataka (2001-02 to 2015-16)**

Sl. No.	Crops	Hassan		Chikkamagaluru			Shivamogga		
		Sakaleshpura	Hassan Dist.	Mudigere	N R pura	Chikkamagaluru Dist.	Thirthahalli	Sagar	Shivamogga Dist.
1	Banana	5.49**	7.47**	6.42**	10.97**	7.96**	8.43**	10.56**	9.64**
2	Total fruits	3.51**	3.80**	1.63**	4.97**	5.58**	3.08**	4.32**	6.77**
3	Ginger	4.78*	21.47**	-4.74*	-5.89**	3.89*	3.91**	4.19**	9.52**
4	Cardamom	-0.09	0.12*	-3.04**	-10.27**	-2.58*	-0.02*	2.48**	1.62*
5	Pepper	12.31**	15.27**	7.61**	22.34**	14.47**	0.30	3.35**	1.40
6	Total spices	5.30*	7.15**	0.78*	6.89**	3.57**	3.69**	3.48**	5.31**
7	Areca nut	3.39**	5.20**	1.19**	7.91*	4.70**	4.02**	3.72**	5.55**
8	Coconut	0.12	1.01*	-0.36	3.73*	2.48	-4.31**	-1.96**	-1.62**
9	Coffee	-0.02	0.55*	0.73*	0.45*	1.08*	0.86	2.19	0.97
10	Rubber	-	-	0.52	10.34**	4.42**	7.21**	7.84**	6.27**
11	Total vegetables	-11.95**	-1.20**	-15.21*	-8.02*	3.57**	-10.29**	-8.94**	-5.31**
12	Paddy	-1.17**	-0.87**	-0.81**	-1.25**	-1.02*	-1.62**	-0.90**	-0.94**
13	Total cereals	-1.15**	-0.09*	-0.76**	-0.86*	-1.04*	-1.62**	-0.13	0.35
14	Total pulses	-	2.27	-10.50**	-15.52**	-10.81**	-14.24**	-18.97**	-7.48**
15	Total food grains	-1.23**	-0.27	-0.95**	-0.89*	-0.25*	-2.05**	-0.27*	0.17
16	Total oilseeds	-25.93**	-6.24**	-18.58**	-16.99**	-4.37**	-5.83**	-8.43*	-7.32**

Note: \*\*\*&\*\* indicate significant levels at 1 and 5 per cent, respectively

The results on Mudigere taluk showed that, the highest positive and significant growth in area was noticed for pepper (7.61 %) followed by banana (6.42 %), total fruits (1.63 %) and arecanut (1.19 %). While, the highest negative and significant growth rate was registered for total oilseeds (-18.58 %) followed by total vegetables (-15.21 %) and total pulses (-10.50 %). Similarly, incase of N. R. Pura taluk area under pepper (22.34 %) was observed highest growth rate followed by banana (10.97 %), rubber (10.34 %) and arecanut (7.91 %). Whereas, highest negative growth was observed under total oilseeds (-16.99 %) followed by total pulses (-15.52 %) and cardamom (-10.27 %). In Chikkamagaluru district as a whole the growth rates revealed that, pepper (14.47 %) occupies highest positive and significant growth followed by banana (7.96 %) and total fruits (5.58 %). Similarly lowest growth was noticed under total pulses (-10.81 %) and oilseeds (-4.37 %).

The estimated growth results revealed that Sagar taluk showed the highest positive and significant growth in area under banana (10.56 %) followed by rubber (7.84 %), total fruits (4.32 %) and ginger (4.19 %). On the other hand the highest negative and significant growth rate of area was observed for total pulses (-18.97 %) followed by total vegetables (-8.94 %) and total oilseeds (-8.43 %). In Thirthahalli taluk area under banana (8.43 %) showed a positive and significant growth followed by rubber (7.21 %), arecanut (4.02 %) and total spices (3.69 %). While declining trend was observed for area under total pulses (-14.24 %), total vegetables (-10.29 %) and coconut (-4.31 %). The growth performance of area under different crops for the Shivamogga district as a whole revealed that banana registered the highest (9.64 %) positive and significant growth rate followed by ginger (9.52 %), total fruits (6.77 %) and rubber (6.27 %). The findings are in conformity with the results of Kamble and Wali (2016).

#### **4.5.2 Instability indices of major crops in Hilly Zone of Karnataka (2001-02 to 2015-16)**

The details on instability indices for area under major cereals, pulses, oilseeds, vegetables, spices, fruit crops and other major commercial crops of Hassan,

Chikkamagaluru and Shivamogga district for the period from 2001-02 to 2015-16 is presented in the Table 4.9. The estimated instability index for Hassan district revealed high degree of instability for total pulses (163.95 %) followed by ginger (68.22 %), total vegetables (38.58 %) and total spices (30.40 %), while competitively high degree of instability was registered for area under ginger (55.95 %) and followed by total oilseeds (27.92 %) total pulses (27.18 %) and pepper (22.11 %) for Chikkamagaluru. Similarly, the instability results for Shivamogga district depicted that, area under total oilseed crops (27.58 %) followed by ginger (26.02 %), total pulses (22.24 %), total fruits (19.98 %), rubber (18.57 %), pepper (17.69 %) and total vegetables (15.45 %).

#### **4.5.3 Growth rates of banana and its competing crops in Hilly Zone of Karnataka**

The results on growth rates of area, production and productivity of banana and its competing crops chosen for the study i.e, Paddy and Ginger for the period from 2001-02 to 2015-16 in Hilly Zone of Karnataka are presented in Table 4.10. The results reveal that, significant growth rates in area under banana were observed in Shivamogga (9.64 %) and Chikkamagaluru (7.95 %) districts compared to its competing crops. Whereas, growth rate of area under paddy registered not only negative but also found to be statistically significant in both the districts of Hilly Zone of Karnataka. On the other hand, the growth rate of banana production in Shivamogga (12.95 %) and Chikkamagaluru (9.91 %) found to be positive and significant compared to its competing crops like ginger and paddy in Hilly Zone of Karnataka. The findings of Kumar and Chandrashekar (2015) also confirm high and significant positive growth rates for major fruit crops in Karnataka. Among the districts, growth rates of banana productivity found to be higher in Shivamogga district (3.29 %) compared to Chikkamagaluru (1.96 %). On the contrary, there was a positive and significant growth in paddy both in Chikkamagaluru and Shivamogga districts.

**Table 4.9: Instability indices of major crops in Hilly Zone of Karnataka (2001-02 to 2015-16)****(Per cent)**

Sl. No.	Crops	Hassan		Chikkamagaluru			Shivamogga		
		Sakaleshpura	Hassan Dist.	Mudigere	N R Pura	Chikkamagaluru Dist.	Thirthahalli	Sagar	Shivamogga Dist.
1	Banana	3.23	12.64	5.13	8.22	10.31	16.27	9.70	8.04
2	Total fruits	15.01	12.76	9.55	12.03	3.38	10.17	4.44	19.98
3	Ginger	114.07	68.22	124.10	57.10	55.95	22.80	23.39	26.02
4	Cardamom	1.22	1.21	6.52	39.63	4.80	18.13	14.60	12.87
5	Pepper	8.34	19.84	22.33	33.06	22.11	20.08	10.71	17.69
6	Total spices	9.54	30.40	5.92	13.97	8.71	4.56	5.04	3.49
7	Arecanut	29.36	10.64	3.27	9.96	3.68	5.70	4.35	2.85
8	Coconut	13.27	4.47	6.76	15.20	4.61	9.44	3.74	4.76
9	Coffee	0.40	1.21	2.14	3.95	1.99	18.68	20.65	12.82
10	Rubber	-	-	3.42	13.26	11.73	10.11	38.11	18.57
11	Total vegetables	55.13	38.58	41.25	50.10	21.10	65.21	79.29	15.45
12	Paddy	6.78	10.97	3.38	3.46	4.75	1.43	1.70	5.38
13	Total cereals	6.74	6.32	4.25	3.68	5.10	1.42	2.19	2.96
14	Total pulses	-	163.95	85.24	42.96	27.18	56.02	61.06	22.24
15	Total food grains	6.38	7.61	3.39	3.70	4.07	4.13	2.13	2.88
16	Total oilseeds	41.54	29.59	30.04	34.49	27.92	87.54	111.32	27.58

**Table 4.10: Growth rates in area, production and productivity of banana and competing crops in Hilly zone of Karnataka (2001-02 to 2015-16)**

(Per cent)

Hilly Zone of Karnataka	Banana	Ginger	Paddy
<b>Area</b>			
Shivamogga	9.64**	9.52**	-0.94**
Chikkamagaluru	7.95**	3.89**	-1.28**
<b>Production</b>			
Shivamogga	12.95**	10.08**	1.42
Chikkamagaluru	9.91**	5.95**	2.35*
<b>Productivity</b>			
Shivamogga	3.29**	0.56*	2.36*
Chikkamagaluru	1.96**	0.42	3.64*

Note: \*\*&\* indicates Significant at one per cent and five per cent, respectively

#### **4.5.4 Instability indices of banana and its competing crops in Hilly Zone of Karnataka**

The details on instability indices for area, production and productivity of banana and its competing crops (paddy and ginger) in Shivamogga and Chikkamagaluru district for period from 2001-02 to 2015-16 are presented in Table 4.11. Here, paddy showed a moderate degree of instability in both Shivamogga (5.38 %) and Chikkamagaluru (6.17 %). While, with respect to area under ginger, Chikkamagaluru and Shivamogga had experienced higher degree of variation compared to banana and paddy. The results on production of banana revealed that, Chikkamagaluru and Shivamogga showed low degree of instability compared to production of paddy and ginger during 2001-02 to 2015-16. The productivity of banana in Chikkamagaluru and Shivamogga indicated comparatively low degree of variation compared to productivity of paddy and ginger. Similar findings

were reported by Singha *et al.*, (2014), on high degree of instability for horticultural crops in Karnataka.

**Table 4.11: Instability indices for area, production and productivity of banana and its competing crops in Hilly zone of Karnataka (2001-02 to 2015-16)**  
(Per cent)

Hilly Zone of Karnataka	Banana	Ginger	Paddy
<b>Area</b>			
Shivamogga	8.04	26.02	5.38
Chikkamagaluru	10.04	55.95	6.17
<b>Production</b>			
Shivamogga	15.62	16.05	21.31
Chikkamagaluru	19.07	36.52	28.54
<b>Productivity</b>			
Shivamogga	9.97	13.72	19.50
Chikkamagaluru	13.32	45.88	28.04

#### **4.5.5 Growth and instability in prices of banana and competing crops in Hilly Zone of Karnataka**

Growth rate analysis of prices of banana and its competing crops in Chikkamagaluru and Shivamogga districts of Karnataka for period from 2001-02 to 2015-16 carried out using the exponential function and the results are presented in Table 4.12. The banana prices showed positive and significant increase in Chikkamagaluru (8.85 %) and Shivamogga (7.89 %). Similarly, the growth in paddy and ginger prices were also observed positive and significant in Chikkamagaluru and Shivamogga districts of Karnataka.

A variation in prices of crops in general and banana and its competing crops in particular is a cause for concern. Hence in the present study it was also attempted to know the extent of price variability. The variability in monthly prices of banana, paddy and ginger for the period 2001-02 and 2015-16 was analysed by computing the instability

indices and the results are presented in Table 4.12. The result on instability analysis of paddy exhibits a moderate degree of variation in both Shivamogga (8.93 %) and Chikkamagaluru (7.26 %). While ginger prices showed high degree of variability in the Chikkamagaluru (40.63 %) and Shivamogga (37.68 %) compared to prices of banana and paddy. The findings are in conformity with the results of Savitha and Kunnal (2016).

**Table 4.12: Growth and instability in prices of banana and competing crops in Hilly zone of Karnataka (2001-02 to 2015-16)**

Hilly Zone of Karnataka	Banana	Ginger	Paddy
<b>CAGR (%)</b>			
Shivamogga	7.87**	11.19**	11.02**
Chikkamagaluru	8.85**	10.63**	9.68**
<b>Instability Index (%)</b>			
Shivamogga	12.42	37.68	8.93
Chikkamagaluru	13.85	40.63	7.26

Note: \*\*&\* indicates Significant at one per cent and five per cent, respectively

#### **4.6. Crop Diversification in Hilly Zone of Karnataka (2001-02 to 2015-16)**

The pattern of crop diversification in Hassan, Chikkamagaluru and Shivamogga districts were captured by using Herfindal, Simpson and Composite Entropy Index for the period from 2001-02 to 2015-16 and results are presented in the Table 4.13. The results from composite entropy index revealed that, among five selected taluks from three districts, N R Pura registered the high percentage of crops diversification (69 %) followed by Sakaleshpura (65 %), Sagar (63 %) and Mudigere (54 %). Similarly, the results from Simpson index for district level showed that, Chikkamagaluru was noticed higher degree of crops diversification (82 %) followed by Hassan (77 %) and Shivamogga district (67 %). These findings are in confirmatory with the results of Ramappa *et al.*, (2015).

**Table 4.13: Crop diversification in Hilly zone of Karnataka (2001-02 to 2015-16)**

Sl. No.	Diversification Index	Herfindal Index	Simpson Index	Composite Entropy Index
1	Sakaleshpura	0.34	0.66	0.65
2	Hassan Dist.	0.23	0.77	0.76
3	Mudigere	0.44	0.56	0.54
4	N. R. Pura	0.28	0.72	0.69
5	Chikkamagaluru Dist.	0.18	0.82	0.81
6	Thirthahalli	0.44	0.56	0.57
7	Sagar	0.39	0.61	0.63
8	Shivamogga Dist.	0.33	0.67	0.69

#### **4.7 Cost and returns of banana and its competing crops**

##### **4.7.1 Per hectare cost of cultivation of banana in Hassan district**

The cost components of banana cultivation per hectare in Hassan district is estimated and the results are presented in Table 4.14. The results indicated that, total cost of cultivation of banana was ₹ 19,5780/ha. The variable cost was ₹ 13,2972/ha and the fixed cost was ₹ 62,808/ha, which accounted for 67.92 and 32.08 per cent, respectively. Among the variable costs, the cost of suckers was found to be higher (17.52 %) followed by fertilizers (NPK and others-13.66 %) and human labour (12.16 %). In fixed costs, the rental value of owned land contributed higher share (22.99 %) in banana cultivation. It was evident from the result that, among variable cost components, sucker cost accounted major share compared to other inputs costs, this is due to the fact that, famers barrow suckers from different locations keeping criteria like healthy, disease free and pest free suckers.

**Table 4.14 Per hectare cost of cultivation of banana in Hassan district**

Sl. No.	Particular	Quantity	Cost (₹)	Per cent
<b>I</b>	<b>Variable cost</b>			
1	Suckers (No)	2450	34300	17.52
2	Farm yard manure (FYM) (Tractor load)	7	16100	8.22
3	Fertilizer (NPK and other) (₹)		26745	13.66
4	Plant protection chemicals (₹)		3150	1.61
5	Machine labour (hours)	9	7650	3.91
6	Bullock labour (Pair days)	0.45	428	0.22
7	Human labour (Mandays)	68	23800	12.16
8	Irrigation (acre inches)	39	5850	2.99
9	Propping material (₹)		6250	3.19
10	Interest on working capital @7 %		8699	4.44
	Total Variable Cost		132972	67.92
<b>II</b>	<b>Fixed costs</b>			
1	Land revenue		50	0.03
2	Annual depreciation		360	0.18
3	Rental value of owned land (@ prevailing mode value)		45000	22.99
4	Managerial cost @ 10 % of Working capital		12427	6.35
5	Risk premium (5 % of 80 % of working capital)		4971	2.54
	Total fixed cost		62808	32.08
<b>III</b>	<b>Total cost (I+II)</b>		195780	100.00

**4.7.2 Per hectare returns from banana in Hassan district**

The details on per hectare yield and returns from banana cultivation are presented in Table 4.15. A perusal of table revealed that the gross returns from banana was ₹ 46,4825/ha. The net return was ₹ 269045/ha. The cost of production was ₹ 464/q and farmer realized a return of ₹ 638/q which resulted to ₹ 2.37 returns per rupee of



**Plate 3: Banana growing farmers in the study area**

expenditure. This results indicated that banana framers obtained moderately higher yield. This was mainly attributable to adoption of proper management practices like maintaining optimum sucker spacing, use of timely and correct dose of fertilizer, FYM, propping and timely irrigation.

**Table 4.15: Per hectare returns from banana in Hassan district**

Sl. No.	Returns	Quantity	Price/q (₹)	Value (₹)
1	Yield (q)	422	1100	464200
2	Suckers (No.)	125	5	625
3	Gross returns (₹)	464825		
4	Net returns (₹)	269045		
5	Cost of production (₹/q)	464		
6	Net returns per quintal of production	638		
7	Returns per rupee of variable cost	3.50		
8	Returns per rupee of Total cost	2.37		

#### **4.7.3 Per hectare cost of cultivation of banana in Chikkamagaluru district**

The cost of banana cultivation per hectare is presented in Table 4.16. It could be observed that, variable cost was ₹ 1,31,000/ha and fixed cost was ₹ 55,575/ha which constitute 70.21 and 29.79 per cent of the total cost of cultivation, respectively. Sucker was major item of variable cost accounting for 17.53 per cent of total cost of cultivation. Cost of fertilizer (NKP), human labour were the next major variable costs in banana cultivation accounting for 13.11 and 13.03 per cent, respectively. The rental value of owned land formed the major item of the fixed cost accounting to 20.37 per cent (₹ 38 000). The total cost of cultivation of banana was ₹ 1,86,575/ha. Among costs rental value of owned accounted highest share followed by seed material (sucker) and fertilizer cost. Similar findings were reported by Kumudha (2015).

**Table 4.16: Per hectare cost of cultivation of banana in Chikkamagaluru district**

Sl. No.	Particular	Quantity	Cost (₹)	Per cent
<b>I</b>	<b>Variable cost</b>			
1	Suckers (No.)	2180	32700	17.53
2	Farm yard manure (FYM) (Tractor load)	6	15000	8.04
3	Fertilizer (NPK and other) (₹)		24452	13.11
4	Plant protection chemicals (₹)		3850	2.06
5	Machine labour (hours)	8	6400	3.43
6	Bullock labour (Pair days)	0.65	553	0.30
7	Human labour (Mandays)	76	24320	13.03
8	Irrigation (acre inches)	39	7605	4.08
9	Propping material (₹)		7550	4.05
10	Interest on working capital @7 %		8570	4.59
	Total Variable Cost		131000	70.21
<b>II</b>	<b>Fixed costs</b>			
1	Land revenue		50	0.03
2	Annual depreciation		385	0.21
3	Rental value of owned land (@ prevailing mode value)		38000	20.37
4	Managerial cost @ 10 % of Working capital		12243	6.56
5	Risk premium (5 % of 80 % of working capital)		4897	2.62
	Total fixed cost		55575	29.79
<b>III</b>	<b>Total cost (I+II)</b>		186575	100.00



**Plate 4: Banana growing farmers in the study area**

#### 4.7.4 Per hectare returns from banana in Chikkamagaluru district

The returns from banana cultivation per ha is presented in Table 4.17. An examination of the table revealed that the gross returns of ₹ 4,99,300/ha was obtained from both main yield (₹ 4,98,750) and suckers (₹ 550). The net returns was ₹ 3,12,725/ha with a cost of production of ₹ 655/q and ₹ 1097 was the returns from a quintal of banana with ₹ 2.68 returns per rupee of expenditure. In Chikkamagaluru district the Nendran and Elakki banana varieties were predominantly grown, as there is a high demand in domestic as well as neighbouring states like Tamil Nadu and Kerala.

**Table 4.17: Per hectare returns from banana in Chikkamagaluru district**

Sl. No.	Returns	Quantity	Price/q (₹)	Value (₹)
1	Yield (q)	285	1750	498750
2	Suckers (No.)	110	5	550
3	Gross returns (₹)	499300		
4	Net returns (₹)	312725		
5	Cost of production (₹/q)	655		
6	Net returns per quintal of production	1097		
7	Returns per rupee of variable cost	3.81		
8	Returns per rupee of Total cost	2.68		

#### 4.7.5 Per hectare cost of cultivation of banana in Shivamogga district

The cost structure of banana cultivation per hectare was estimated for Shivamogga district and the results are presented in Table 4.18. The total cost of cultivation of banana was ₹ 2,14,276/ha. Under variable costs, the cost of suckers contributed (₹ 33,800) followed by fertilizer (NPK), human labour accounting for 11.74 per cent and 9.54 per cent of the total cost, respectively. The total fixed cost constituted 37.46 per cent of the total cost. Under fixed costs, rental value of owned land was higher (₹ 55000/ha) compared to other components and it accounted to 25.67 per cent of the total cost. It was evident from the result that, among costs, the rental value of owned land

accounted major share followed by seed material (sucker) and fertilizer cost. Similar findings were reported by Hanumantharaya *et al.* (2010).

**Table 4.18: Per hectare cost of cultivation of banana in Shivamogga district**

Sl. No.	Particular	Unit	Cost (₹)	Per cent
<b>I</b>	<b>Variable cost</b>			
1	Suckers (No.)	2600	33800	15.77
2	Farm yard manure (FYM) (Tractor load)	6.5	18200	8.49
3	Fertilizer (NPK and other) (₹)		25154	11.74
4	Plant protection chemicals (₹)		4680	2.18
5	Machine labour (hours)	7.5	5625	2.63
6	Bullock labour (Pair days)	0.5	475	0.22
7	Human labour (Mandays)	73	20440	9.54
8	Irrigation (acre inches)	39	7995	3.73
9	Propping material (₹)		5250	2.45
10	Interest on working capital @7 %		12394	5.78
	Total Variable Cost		134013	62.54
<b>II</b>	<b>Fixed costs</b>			
1	Land revenue		50	0.02
2	Annual depreciation		425	0.20
3	Rental value of owned land (@ prevailing mode value)		55000	25.67
4	Managerial cost @ 10 % of Working capital		17706	8.26
5	Risk premium (5 % of 80 % of working capital)		7082	3.31
	Total fixed cost		80263	37.46
<b>III</b>	<b>Total cost (I+II)</b>		214276	100.00



**Plate 5: Banana grown in the study area**

#### 4.7.6 Per hectare returns from banana in Shivamogga district

The return from banana cultivation is represented in Table 4.19. The gross return was ₹ 5,45,930/ha from both main yield and suckers. The net return was ₹ 3,31,654/ha with a production cost ₹ 491/q and returns from a quintal of banana was ₹ 761 which accounted to ₹ 2.55 returns per rupee of expenditure. In Shivamogga district, the Grand nine (G-9) banana variety was predominantly cultivated, where special feature of G 9 variety is high bunch yield per banana plant compared to other varieties. The bunch yield ranges from 30 kg to 65 kg per banana plant. As a result, farmers get high profit even with low price because of its yield advantage.

**Table 4.19: Per hectare returns from banana in Shivamogga district**

Sl. No.	Returns	Quantity	Price/q (₹)	Value (₹)
1	Yield (q)	436	1250	545000
2	Suckers (No.)	186	5	930
3	Gross returns (₹)	545930		
4	Net returns (₹)	331654		
5	Cost of production (₹/q)	491		
6	Net returns per quintal of production	761		
7	Returns per rupee of variable cost	4.07		
8	Returns per rupee of total cost	2.55		

#### 4.7.7 Per hectare cost of cultivation of paddy in Hassan district

A perusal of Table 4.20 revealed that the total cost of paddy was ₹ 93412/ha in Hassan district. It could be observed that the variable cost and fixed cost were ₹ 66,773/ha and ₹ 2,66,39/ha, respectively which contributed to 71.48 per cent and 28.52 per cent in the total cost of cultivation. Human labour was found to be the major item of variable cost accounting for 28.85 per cent of total cost of cultivation. The cost of fertilizer (NPK) was the next major item in variable cost accounting for 10.15 per cent. Rental value of owned land formed the major item in the fixed costs with ₹ 19,000 accounting to 20.34 per cent. It was evident from the table that, cost of human labour

accounted for major share in the cost of cultivation which indicated paddy cultivation was labour intensive and requires more labour for its operations like transplanting, weeding, fertilizer application and harvesting. Similar findings were reported by Anjaneyulu, (2015).

**Table 4.20: Per hectare cost of cultivation of paddy in Hassan district**

Sl. No.	Particular	Quantity	Cost (₹)	Per cent
I	Variable cost			
1	Seeds (kg)	67	2345	2.51
2	Farm yard manure (FYM) (Tractor load)	3	5400	5.78
3	Fertilizer (NPK and other) (₹)		9480	10.15
4	Plant protection chemicals (₹)		5240	5.61
5	Machine labour (hours)	5	3750	4.01
6	Bullock labour (Pair days)	1.5	1140	1.22
7	Human labour (Mandays)	77	26950	28.85
8	Irrigation (acre inches)	45	8100	8.67
9	Interest on working capital @7 %		4368	4.68
	Total variable cost		66773	71.48
II	Fixed costs			
1	Land revenue		50	0.05
2	Annual depreciation		350	0.37
3	Rental value of owned land (@ prevailing mode value)		19000	20.34
4	Managerial cost @ 10 % of Working capital		6241	6.68
5	Risk premium (2 % of 80 % of working capital)		998	1.07
	Total fixed cost		26639	28.52
III	Total cost (I+II)		93412	100.00



**Plate 6: Paddy cultivated in the study area**

#### 4.7.8 Per hectare returns from paddy in Hassan district

The return from paddy cultivation is presented in Table 4.21. The results indicate that both main yield and paddy straw valued at ₹ 94,050/ha and ₹ 2,350/ha, respectively which gave a gross returns of ₹ 96,400/ha. The net returns was ₹ 2,988/ha with a cost production of ₹ 1,639/q with ₹ 1.03 return per rupee of expenditure, Whereas returns from a quintal of paddy was ₹ 52.

**Table 4.21: Per hectare returns from paddy in Hassan district**

I	Returns	Quantity	Price/q (₹)	Value (₹)
1	Yield (q)	57	1650	94050
2	Paddy straw (₹)		2350	
3	Gross returns (₹)		96400	
4	Net returns (₹)		2988	
5	Cost of production (₹/q)		1639	
6	Net returns per quintal of production		52	
7	Returns per rupee of variable cost		1.44	
8	Returns per rupee of total cost		1.03	

#### 4.7.9 Per hectare cost of cultivation of paddy in Chikkamagaluru district

The cost of cultivation per hectare of paddy in Chikkamagaluru district is presented in Table 4.22. The variable costs showed that the human labour (26.59 %) has taken major share followed by irrigation charges (12.77 %) and fertilizer (NKP and other) (9.73 %). The total variable cost accounted to 72.91 per cent of the total cost. The total fixed cost accounted for ₹ 36,420/ha that contributed to 27.09 per cent of the total cost. Under fixed cost, rental value of owned land was the major item (18.74 %). The total cost of paddy cultivation was ₹ 98,694/ha.

**Table 4.22: Per hectare cost of cultivation of paddy in Chikkamagaluru district**

Sl. No.	Particular	Quantity	Cost (₹)	Per cent
I	Variable cost			
1	Seeds (kg)	63	2520	2.55
2	Farm yard manure (FYM) (Tractor load)	4	6400	6.48
3	Fertilizer (NPK and other) (₹)		9600	9.73
4	Plant protection chemicals (₹)		5750	5.83
5	Machine labour (hours)	4	2680	2.72
6	Bullock labour (Pair days)	2	1460	1.48
7	Human labour (Mandays)	82	26240	26.59
8	Irrigation (acre inches)	45	12600	12.77
9	Interest on working capital @7 %		4708	4.77
	Total variable cost		71958	72.91
II	Fixed costs			
1	Land revenue		50	0.05
2	Annual depreciation		385	0.39
3	Rental value of owned land (@ prevailing mode value)		18500	18.74
4	Managerial cost @ 10 % of Working capital		6725	6.81
5	Risk premium (2 % of 80 % of working capital)		1076	1.09
	Total fixed cost		36420	27.09
III	Total cost (I+II)		98694	100.00

**4.7.10 Per hectare returns from paddy in Chikkamagaluru district**

A perusal of Table 4.23 revealed that gross returns from paddy in Chikkamagaluru district was ₹ 1,07,020/ha. The net return was ₹ 8327/ha with a cost of production ₹ 1618/q. Thus the returns obtained per quintal were ₹ 137. Returns per rupee of total cost were ₹ 1.08 which means per every rupee invested farmer will be receiving

₹ 1.08. It clear that the farmers in this district were realizing normal profits compared to paddy growers in Hassan district.

**Table 4.23: Per hectare returns from paddy in Chikkamagaluru district**

I	Returns	Quantity	Price/q (₹)	Value (₹)
1	Yield (q)	61	1720	104920
2	Paddy straw		2100	
3	Gross returns (₹)		107020	
4	Net returns (₹)		8327	
5	Cost of production (₹/q)		1618	
6	Net returns per quintal of production		137	
7	Returns per rupee of variable cost		1.49	
8	Returns per rupee of total cost		1.08	

#### **4.7.11 Per hectare cost of cultivation of paddy in Shivamogga district**

The cost of paddy cultivation per hectare is presented in Table 4.24. It could be observed from the table that the total variable cost was ₹ 70,724/ha and fixed cost was ₹ 29,497/ha which constituted 70.57 and 29.43 per cent, respectively. Human labour was the major item of variable cost accounting for 21.99 per cent of the total cost of cultivation. Irrigation chargers and cost of fertilizer (NPK) were the next major item in variable cost in paddy cultivation accounting for 12.12 per cent and 9.93 per cent, respectively. Rental value of owned land formed the major item of fixed cost (21.45 %). The total cost cultivation of paddy was ₹ 1,00,221/ha. It is clear from the result that, cost of human labour accounted major share to the cost of cultivation which indicates that, paddy requires more labor for its operations like transplanting, weeding, fertilizer application and harvesting. These results are in confirmatory with study conducted by Basavarajappa and Chinnappa, (2013).

**Table 4.24: Per hectare cost of cultivation of paddy in Shivamogga district**

Sl. No.	Particular	Quantity	Cost (₹)	Per cent
I	Variable cost			
1	Seeds (kg)	65	2405	2.40
2	Farm yard manure (FYM) (Tractor load)	4	7400	7.38
3	Fertilizer (NPK and other) (₹)		9852	9.83
4	Plant protection chemicals (₹)		5900	5.89
5	Machine labour (hours)	6.2	4650	4.64
6	Bullock labour (Pair days)	2	1700	1.70
7	Human labour (Mandays)	76	22040	21.99
8	Irrigation (acre inches)	45	12150	12.12
9	Interest on working capital @7 %		4627	4.62
	Total variable cost		70724	70.57
II	Fixed costs			
1	Land revenue		50	0.05
2	Annual depreciation		280	0.28
3	Rental value of owned land (@ prevailing mode value)		21500	21.45
4	Managerial cost @ 10 % of working capital		6610	6.60
5	Risk premium (2 % of 80 % of working capital)		1058	1.06
	Total fixed cost		29497	29.43
III	Total cost (I+II)		100221	100.00

#### 4.7.12 Per hectare returns from paddy in Shivamogga district of Karnataka

The gross returns from the paddy was ₹ 1,10,080/ha, which comprised of returns from main product and paddy straw which amounted to ₹ 107520/ha and ₹ 2560/ha, respectively. The net returns realized were ₹ 9859/ha with cost of production of ₹1566 and returns per rupee of expenditure is ₹ 1.10. Thus paddy cultivation is found to be preferable in the study area (Table 4.25). Similar findings were reported by Anandaraj (2015).

**Table 4.25: Per hectare returns from paddy in Shivamogga district**

Sl. No.	Returns	Quantity	Price/q (₹)	Value (₹)
1	Yield (q)	64	1650	107520
2	Paddy straw		2560	
3	Gross returns (₹)		110080	
4	Net returns (₹)		9859	
5	Cost of production (₹/q)		1566	
6	Net returns per quintal of production		154	
7	Returns per rupee of variable cost		1.56	
8	Returns per rupee of total cost		1.10	

#### 4.7.13 Per hectare cost of cultivation of ginger in Hassan district

The detection on cost of cultivation of ginger in Hassan district are given in Table 4.26. The total cost of cultivation of ginger was ₹ 3,65,070/ha. In the total cost, total variable cost (₹ 2,90,778/ha) and fixed cost (₹ 74,293/ha) accounted for 79.65 per cent and 20.35 per cent, respectively. Cost of PPC was the major item of variable cost accounting for 18.20 per cent, followed by rhizome (seed material), human labour and fertilizer (NPK). Rental value of owned land (₹ 45,500/ha) formed the major item of the fixed cost which contributed for 12.46 per cent of the total cost. Thus PPC cost accounted for the highest share followed by seed material (Rhizome) and human labour.

**Table 4.26: Per hectare cost of cultivation of ginger in Hassan district**

Sl. No.	Particular	Quantity	Cost (₹)	Per cent
I	Variable cost			
1	Rhizome (q)	25	65500	17.94
2	Farm yard manure (FYM) (Tractor load)	7	14700	4.03
3	Fertilizer (NPK and other) (₹)		42750	11.71
4	Plant protection chemicals (₹)		66450	18.20
5	Machine labour (hours)	15	10125	2.77
6	Bullock labour (Pair days)	2.4	2040	0.56
7	Human labour (Mandays)	230	59800	16.38
8	Irrigation (acre inches)	38	6840	1.87
9	Mulching material (₹)		3550	0.97
10	Interest on working capital @7 %		19023	5.21
	Total variable cost		290778	79.65
II	Fixed costs			
1	Land revenue		50	0.01
2	Annual depreciation		480	0.13
3	Rental value of owned land (@ prevailing mode value)		45500	12.46
4	Managerial cost @ 10 % of Working capital		27176	7.44
5	Risk premium (5 % of 80 % of working capital)		1087	0.30
	Total fixed cost		74293	20.35
III	Total cost (I+II)		365070	100.00

It indicated that farmers apply more of PPC in ginger cultivation due to high fungal disease infestation and ginger requires more labour for various operations like sowing, weeding spraying, harvesting etc. These findings are in conformity with the results of Bharati *et al.* (2012).

#### 4.7.14 Per hectare returns from ginger in Hassan district of Karnataka

The results on yield and returns from ginger cultivation are presented in Table 4.27. Perusal of table reveals that gross returns of ₹ 4,62,000/ha. The net returns from one ha of ginger cultivation were accounted ₹ 96,930/ha with a cost of production of ₹ 1185/q. The ginger cultivation gave ₹ 1.27 returns per rupee of expenditure. Whereas returns per rupee of variable cost was ₹ 1.59/ha. Thus cultivation of ginger is not so preferable as projected as it was also associated with lot of negative externalities.

**Table 4.27: Per hectare returns from ginger in Hassan district**

Sl. No.	Particular	Unit	Value (₹)
1	Ginger production	q	308
2	Price	₹/q	1500
3	Gross returns	₹	462000
4	Net returns	₹	96930
5	Cost of production	(₹/q)	1185
6	Net returns per quintal of production		315
7	Returns per rupee of variable cost		1.59
8	Returns per rupee of total cost		1.27

#### 4.7.15 Per hectare cost of cultivation of ginger in Chikkamagaluru district

The cost of cultivation per hectare of ginger in Chikkamagaluru district is given in Table 4.28. Among variable costs, plant protection chemical cost 19.87 % followed by human labour, rhizome, fertilizer (NPK) was the major cost accounting for 16.99 per cent, 14.04 per cent and 11.89 per cent, respectively. The total variable cost accounted for 79.11 per cent in the total cost. The total fixed cost was ₹ 77,757/ha contributing to 20.89 per cent. Under fixed costs, rental value of owned land was the major cost (12.90 %). The total cost of ginger cultivation was ₹ 3,72,234/ha. It is apparent from the table that, the PPC accounted major share followed by seed material (Rhizome) and human labour. The farmers in Chikkamagaluru district apply higher dosage of plant protection chemical in

ginger cultivation due to rhizome rot disease infestation. And also ginger requires high labour for its operations viz., sowing, weeding and as well as harvesting. The findings are in conformity with the results of Pandey *et al.* (2016).

**Table 4.28: Per hectare cost of cultivation of ginger in Chikkamagaluru district**

Sl. No.	Particular	Quantity	Cost (₹)	Per cent
I	Variable cost			
1	Rhizome (q)	19	52250	14.04
2	Farm yard manure (FYM) (Tractor load)	8	15600	4.19
3	Fertilizer (NPK and other) (₹)		44253	11.89
4	Plant protection chemicals (₹)		73954	19.87
5	Machine labour (hours)	17	12325	3.31
6	Bullock labour (Pair days)	1.85	1758	0.47
7	Human labour (Mandays)	253	63250	16.99
8	Irrigation (acre inches)	38	7220	1.94
9	Mulching material (₹)		4255	1.14
10	Interest on working capital @7 %		19612	5.27
	Total variable cost		294476	79.11
II	Fixed costs			
1	Land revenue		50	0.01
2	Annual depreciation		570	0.15
3	Rental value of owned land (@ prevailing mode value)		48000	12.90
4	Managerial cost @ 10 % of Working capital		28017	7.53
5	Risk premium (5 % of 80 % of working capital)		1121	0.30
	Total fixed cost		77757	20.89
III	Total cost (I+II)		372234	100.00

#### 4.7.16 Per hectare returns from ginger in Chikkamagaluru district

The return from ginger cultivation per hectare (Table 4.29) revealed that, the gross returns was ₹ 4,80,500/ha with 310q/ha yield. The net returns was ₹ 1,082,66/ha. The cost of production was ₹ 1,201/ha. The returns rupee of expenditure was ₹ 1.29.

**Table 4.29: Per hectare returns from ginger in Chikkamagaluru district**

Sl. No.	Particular	Unit	Value (₹)
1	Ginger production	q	310
2	Price	₹/q	1550
3	Gross returns	₹	480500
4	Net returns	₹	108266
5	Cost of production	(₹/q)	1201
6	Net returns per quintal of production	(₹/q)	349
7	Returns per rupee of variable cost		1.63
8	Returns per rupee of expenditure		1.29

#### 4.7.17 Per hectare cost of cultivation of ginger in Shivamogga district

The per hectare cost of cultivation of ginger in Shivamogga district (Table 4.30) showed that the total variable cost and fixed cost were ₹ 2,86,456/ha and ₹ 81,044/ha, respectively. Plant protection chemical was major item of variable costs accounting for 18.54 per cent of total cost of cultivation. Rhizome, human labour and fertilizer (NPK) were the next major items of variable costs in ginger cultivation. Rental value of owned land formed the major item of fixed cost (14.29 %). The total cost of cultivation of ginger was ₹ 3,67,501/ha.

**Table 4.30: Per hectare cost of cultivation of ginger in Shivamogga district**

Sl. No.	Particular	Quantity	Cost (₹)	Per cent
I	Variable cost			
1	Rhizome (q)	23	56350	15.33
2	Farm yard manure (FYM) (Tractor load)	8	17600	4.79
3	Fertilizer (NPK and other) (₹)		42597	11.59
4	Plant protection chemicals (₹)		68152	18.54
5	Machine labour (hours)	19	15200	4.14
6	Bullock labour (Pair days)	1.95	1482	0.40
7	Human labour (Mandays)	236	54280	14.77
8	Irrigation (acre inches)	41	8190	2.23
9	Mulching material (₹)		3865	1.05
10	Interest on working capital @7 %		18740	5.10
	Total variable cost		286456	77.95
II	Fixed costs			
1	Land revenue		50	0.01
2	Annual depreciation		652	0.18
3	Rental value of owned land (@ prevailing mode value)		52500	14.29
4	Managerial cost @ 10 % of Working capital		26772	7.28
5	Risk premium (5 % of 80 % of working capital)		1071	0.29
	Total fixed cost		81044	22.05
III	Total cost (I+II)		367501	100.00



**Plate 7: Ginger cultivated in the study area**

#### 4.7.18 Per hectare returns from ginger in Shivamogga district

A perusal of Table 4.31 revealed that gross returns from ginger cultivation in Shivamogga district was ₹ 5,18,100/ha with a yield of 314 q/ha priced at ₹ 1650/q. The net returns was ₹ 1,50,599/ha. The cost of production was ₹ 1,170/ha. The farmers obtained ₹ 1.41 returns per rupee of expenditure. The findings of the study are in conformity with the results of Pandey *et al.* (2016).

**Table 4.31: Per hectare returns from ginger in Shivamogga district**

Sl. No.	Particular	Unit	Value (₹)
1	Ginger production	q	314
2	Price	₹/q	1650
3	Gross returns	₹	518100
4	Net returns	₹	150599
5	Cost of production	(₹/q)	1170
6	Net returns per quintal of production		480
7	Returns per rupee of variable cost		1.81
8	Returns per rupee of expenditure		1.41

#### 4.7.19 Share of inorganic and organic input costs to the total cost in the study area (per ha)

The ratios indicating inorganic and organic input costs to total cost of banana and its competing crops are presented in Table 4.32. The per cent commercial pesticides and chemical fertilizers to total cost of cultivation was less in banana compared to its competing crops (paddy and ginger), which accounted to 15.27, 15.17 and 13.92 per cent in banana in Hassan, Chikkamagaluru and Shivamogga districts, respectively. This indicated less dependency of banana crop on external inputs (NPK based fertilizer). While the ratio of non-destructive inputs cost to the total cost of cultivation of banana was at the higher end accounting for 8.22, 8.04 and 8.49 per cent in Hassan,

Chikkamagaluru and Shivamogga districts, respectively. This indicated more eco-friendly nature of banana cultivation. The competing crops of banana i.e. paddy and ginger used more of external inputs like fertilizer and PPC. Thus, it has adverse effect on soil health, water and users of those commodities.

**Table 4.32: Share of inorganic and organic input costs to the total cost in the study area (per ha)**

Crops	Share of pesticides and chemical fertilizers to total cost of cultivation (%)	Share of Eco-friendly inputs cost to total cost of cultivation (%)
Hassan district		
Banana	15.27	8.22
Paddy	15.76	5.78
Ginger	29.91	4.03
Chikkamagaluru district		
Banana	15.17	8.04
Paddy	15.55	6.48
Ginger	31.76	4.19
Shivamogga district		
Banana	13.92	8.49
Paddy	15.72	7.38
Ginger	30.14	4.79

## 4.8 Partial budgeting

### 4.8.1 Economic advantage of banana over paddy in Hassan district

The finds on economic advantage of banana over paddy in Hassan district is estimated through partial budgeting are presented in Table 4.33. The results indicated that extra cost incurred by farmers by growing banana was ₹ 27,965/ha mostly on fertilizers

and FYM component compared to paddy. On the other side, the additional benefit in the form of cost saving was ₹ 7,490/ha in banana accounted by savings in irrigation charges, human labour and expenditure on PPC. This led to a total increased returns of ₹ 3,68,425/ha from banana over paddy. The net gain resulted from banana cultivation in place of paddy amounted to ₹ 3,47,950/ha as revealed by higher value on credit side ₹ 3,75,915/ha.

**Table 4.33: Economic advantage of banana over paddy in Hassan district**

(Per ha)

Sl. No.	Particular	Crops	Cost (₹)	Debit side	Credit side
				Added cost (₹)	Reduced cost (₹)
1	Irrigation charges (₹/ha)	Paddy	8100	0	2250
		Banana	5850		
2	Human labour (₹/ha)	Paddy	26950	0	3150
		Banana	23800		
3	Farm yard manure (₹/ha)	Paddy	5400	10700	0
		Banana	16100		
4	Fertilizer (₹/ha)	Paddy	9480	17265	0
		Banana	26745		
5	Expenditure on PPC (₹/ha)	Paddy	5240	0	2090
		Banana	3150		
<b>Sub total</b>				27965	7490
				<b>Reduced returns (₹)</b>	<b>Increased returns (₹)</b>
6	Gross returns (₹/ha)	Paddy	96400	0	368425
		Banana	464825		
<b>Sub total</b>				0	368425
7	<b>Total</b>			27965	375915
8	<b>Net Gain (Credit-Debit)</b>			<b>3,47,950</b>	

#### 4.8.2 Economic advantage of banana over ginger in Hassan district

Economic advantage of banana over ginger in Hassan district is given in Table 4.34. The results revealed that, extra cost incurred by farmers by growing banana was ₹ 1,400/ha by FYM component compared to paddy. Similarly, the additional benefit in the form of cost saving was ₹ 1,16,295/ha in banana constituted by irrigation charges, human labour, fertilizer and expenditure on PPC. This led to increased returns of ₹ 2,825 /ha from banana over Ginger. The total gain (credit side) and the total loss (debit side) was ₹ 1,400 /ha and ₹ 1,19,120 respectively in banana cultivation. The net gain accounted to ₹ 1,17,720/ha in banana cultivation over ginger.

**Table 4.34: Economic advantage of banana over ginger in Hassan district**

(Per ha)

Sl. No.	Particular	Crops	Cost (₹)	Debit side	Credit side
				Added cost (₹)	Reduced cost (₹)
1	Irrigation charges (₹/ha)	Ginger	6840	0	990
		Banana	5850		
2	Human labour (₹/ha)	Ginger	59800	0	36000
		Banana	23800		
3	Farm yard manure (₹/ha)	Ginger	14700	1400	0
		Banana	16100		
4	Fertilizer (₹/ha)	Ginger	42750	0	16005
		Banana	26745		
5	Expenditure on PPC (₹/ha)	Ginger	66450	0	63300
		Banana	3150		
<b>Sub total</b>				1400	116295
				<b>Reduced returns (₹)</b>	<b>Increased returns (₹)</b>
6	Gross returns	Ginger	462000	0	2825
		Banana	464825		
<b>Sub total</b>				0	2825
7	<b>Total</b>			1400	119120
8	<b>Net Gain (Credit-Debit)</b>			<b>1,17,720</b>	

### 4.8.3 Economic advantage of banana over paddy in Chikkamagaluru district

A perusal of table 4.35 presents the economic advantages of banana over paddy through partial budgeting in Chikkamagaluru district. The results indicated that extra cost incurred by farmers by growing banana was ₹ 23,452/ha which was contributed by fertilizers and FYM component. On the other side, the additional benefit in the form of cost saving was ₹ 8,815/ha in banana constituted by irrigation charges, human labour and expenditure on PPC. This led to increased returns of ₹ 3,92,280/ha from banana over paddy. The total gain (credit side) and the total loss (debit side) was ₹ 4,01,095/ha and ₹ 23,452 respectively in banana cultivation. ₹ 3,68,828 /ha was the net gain in banana cultivation compared to paddy.

**Table 4.35: Economic advantage of banana over paddy in Chikkamagaluru district**

(Per ha)

Sl. No.	Particular	Crops	Cost (₹)	Debit side		Credit side	
				Added cost (₹)	Reduced cost (₹)	Reduced returns	Increased returns
1	Irrigation charges (₹/ha)	Paddy	12600	0	4995		
		Banana	7605				
2	Human labour (₹/ha)	Paddy	26240	0	1920		
		Banana	24320				
3	Farm yard manure (₹/ha)	Paddy	6400	8600	0		
		Banana	15000				
4	Fertilizer (₹/ha)	Paddy	9600	14852	0		
		Banana	24452				
5	Expenditure on PPC (₹/ha)	Paddy	5750	0	1900		
		Banana	3850				
<b>Sub total</b>				23452	8815		
				<b>Reduced returns</b>	<b>Increased returns</b>		
6	Gross returns	Paddy	107020	0	392280		
		Banana	499300				
<b>Sub total</b>				0	392280		
7	<b>Total</b>			23452	401095		
8	<b>Net Gain (Credit-Debit)</b>			<b>3,68,828</b>			

#### 4.8.4 Economic advantage of banana over ginger in Chikkamagaluru district

Partial budgeting for the banana and ginger in Chikkamagaluru district is presented in Table 4.36. The results indicated that extra cost incurred by farmers by growing banana was ₹ 385/ha by irrigation charges component compared to ginger. On the other side, the additional benefit in the form of cost saving was ₹ 1,29,435/ha in banana constituted by human labour, Fertilizers, FYM and expenditure on PPC. Increased returns on the other hand accounted to ₹ 18,000/ha from banana over ginger. The total gain (credit side) and the total loss (debit side) was ₹ 1,48,235/ha and ₹ 385 respectively in banana cultivation. The net gain accounted to ₹ 1,47,850/ha in banana cultivation over ginger.

**Table 4.36: Economic advantage of banana over ginger in Chikkamagaluru district**

(Per ha)

Sl. No.	Particular	Crops	Cost (₹)	Debit side	Credit side
				Added cost (₹)	Reduced cost (₹)
1	Irrigation charges (₹/ha)	Ginger	7220	385	0
		Banana	7605		
2	Human labour (₹/ha)	Ginger	63250	0	38930
		Banana	24320		
3	Farm yard manure (₹/ha)	Ginger	15600	0	600
		Banana	15000		
3	Fertilizer (₹/ha)	Ginger	44253	0	19801
		Banana	24452		
4	Expenditure on PPC (₹/ha)	Ginger	73954	0	70104
		Banana	3850		
<b>Sub total</b>				385	129435
				<b>Reduced returns (₹)</b>	<b>Increased returns (₹)</b>
5	Gross returns	Ginger	480500	0	18800
		Banana	499300		
<b>Sub total</b>				0	18800
6	<b>Total</b>			385	148235
7	<b>Net Gain (Credit-Debit)</b>			<b>1,47,850</b>	

#### 4.8.5 Economic advantage of banana over paddy in Shivamogga district

A perusal of table 4.37 present the economic advantage of banana over paddy in Shivamogga district .The results indicated that extra cost incurred by farmers by growing banana was ₹ 26,102/ha by fertilizer and FYM component compared to paddy. On the other side, the additional benefit in the form of cost saving was ₹ 6,975/ha in banana constituted by irrigation charges, human labour, and expenditure on PPC. This led to increased returns of ₹ 4,35,850/ha from banana over paddy. The total gain (credit side) and the total loss (debit side) was ₹ 4,42,825/ha and ₹ 26,102/ha respectively in banana cultivation. The net gain accounted to ₹ 4,16,723 /ha in banana cultivation than that of paddy.

**Table 4.37: Economic advantage of banana over paddy in Shivamogga district**

(Per ha)

Sl. No.	Particular	Crops	Cost (₹)	Debit side	Credit side
				Added cost (₹)	Reduced cost (₹)
1	Irrigation charges (₹/ha)	Paddy	12150	0	4155
		Banana	7995		
2	Human labour (₹/ha)	Paddy	22040	0	1600
		Banana	20440		
3	Farm yard manure (₹/ha)	Paddy	7400	10800	0
		Banana	18200		
4	Fertilizer (₹/ha)	Paddy	9852	15302	0
		Banana	25154		
5	Expenditure on PPC (₹/ha)	Paddy	5900	0	1220
		Banana	4680		
<b>Sub total</b>				26102	6975
				<b>Reduced returns (₹)</b>	<b>Increased returns (₹)</b>
6	Gross returns	Paddy	110080	0	435850
		Banana	545930		
<b>Sub total</b>				0	435850
7	<b>Total</b>			26102	442825
8	<b>Net Gain (Credit-Debit)</b>			<b>4,16,723</b>	

#### 4.8.6 Economic advantage of banana over ginger in Shivamogga district

Befits of banana over ginger in Shivamogga district is presented in Table 4.38. Perusal of the table indicated that extra cost incurred by farmers by growing banana was ₹ 600 /ha by FYM component compared to ginger. Similarly, farmers reduced the cost up to ₹ 1,14,950/ha constituted by reduction of cost in irrigation charges, human labour, fertilizer and expenditure on PPC with increased return of ₹ 27,830/ha over ginger. The total profit (credit side) accounted to ₹ 1,42,180/ha and the net gain accounted to ₹ 1,42,180/ha in banana cultivation than that of ginger.

**Table 4.38: Economic advantage of banana over ginger in Shivamogga district**

(Per ha)

Sl. No.	Particular	Crops	Cost (₹)	Debit side	Credit side
				Added cost (₹)	Reduced cost (₹)
1	Irrigation charges (₹/ha)	Ginger	8190	0	195
		Banana	7995		
2	Human labour (₹/ha)	Ginger	54280	0	33840
		Banana	20440		
3	Farm yard manure (₹/ha)	Ginger	17600	600	0
		Banana	18200		
4	Fertilizer (₹/ha)	Ginger	42597	0	17443
		Banana	25154		
5	Expenditure on PPC (₹/ha)	Ginger	68152	0	63472
		Banana	4680		
<b>Sub total</b>				600	114950
				<b>Reduced returns (₹)</b>	<b>Increased returns (₹)</b>
6	Gross returns	Ginger	518100	0	27830
		Banana	545930		
<b>Sub total</b>				0	27830
7	<b>Total</b>			<b>600</b>	<b>142780</b>
8	<b>Net Gain (Credit-Debit)</b>			<b>1,42,180</b>	

## 4.9 Resource use efficiency

### 4.9.1 Resource productivity in banana cultivation in Hilly zone of Karnataka

The productivity of resources used in banana cultivation in Hilly Zone of Karnataka is presented in Table 4.39. The Cobb-Douglas type of production function was employed to examine the influence of different inputs on gross returns. The variables considered in the production function are sucker, FYM, Chemical fertilizer, Human labour, Bullock labour, PPC and Irrigation (X1 to X7) as independent variables and gross returns of banana production per hectare is taken as dependent variable.

**Table 4.39: Resource productivity in banana cultivation in Hilly zone of Karnataka**

Sl. No.	Independent variable	Parameter	Coefficient	Standard error
1	Intercept	ln A	4.243	2.560
2	Sucker (₹/ha)	X1	0.156**	0.051
3	FYM (₹/ha)	X2	0.082*	0.028
4	Chemical fertilizer (₹/ha)	X3	0.215**	0.062
5	Human labour (₹/ha)	X4	0.041	0.142
6	Bullock labour (₹/ha)	X5	-0.016	0.114
7	Plant protection chemical (PPC) (₹/ha)	X6	0.512	0.352
8	Irrigation (₹/ha)	X7	0.078*	0.039
9	Coefficient of multiple determination	R <sup>2</sup>	0.895	
10	F value	F	209.44	
11	Number of sample	N	180	

Note: \*\*&\* indicates significant at one per cent and five per cent, respectively

The results revealed that, among the variable considered in the production function, the variables such as sucker, FYM, chemical fertilizer and irrigation cost showed significant and positive contribution to increase in gross returns. Further, the chemical fertilizers and planting material were the major variables which are contributing major share towards increasing gross returns. The coefficient of chemical fertilizers and planting material was 0.215 and 0.156, which means one per cent increase above the

geometric mean increases gross returns by 2.1 per cent and 1.56 per cent, respectively. The same interpretation holds good for other variables also. The coefficient of multiple determination ( $R^2$ ) was 0.895 which indicates 89.50 per cent variation in banana gross returns was explained by all the independent variables included in the model. The calculated F value is greater than the table F value. Hence, the results are significant, indicating that each explanatory variable on its own was not very important, but together they explained a significant part of variation in gross returns of banana cultivation in Hilly zone of Karnataka.

#### 4.9.2 Allocative efficiency in banana cultivation in Hilly zone of Karnataka

The ratio of marginal value product to marginal factor cost is presented in Table 4.40 which indicated that resource use efficiency was highest in chemical fertilizer (4.32) followed by sucker (3.25) FYM (2.47) and irrigation (1.93). These ratios were considerably higher than unity, which indicates considerable scope to increase banana production by the increasing level of these variables. MVP of Human labour, Bullock labour and PPC were found less than unity indicating their excess use. This implied that, human labour, Bullock labour and PPC were not efficiently used to achieve desired level of production. Similar findings were reported by Bhatia (1999).

**Table 4.40: Allocative efficiency in banana cultivation in Hilly Zone of Karnataka**

Sl. No.	Variable	Coefficient	MVP	MFC	MVP/MFC	Inference
1	Sucker (₹/ha)	0.156**	3.25	1	3.25	Under utilized
2	FYM (₹/ha)	0.082*	2.47	1	2.47	Under utilized
3	Chemical fertilizer (₹/ha)	0.215**	4.32	1	4.32	Under utilized
4	Human labour (₹/ha)	0.041	0.85	1	0.85	Over utilized
5	Bullock labour (₹/ha)	-0.016	-1.58	1	-1.58	Over utilized
6	Plant protection chemical (PPC) (₹/ha)	0.512	0.47	1	0.47	Over utilized
7	Irrigation (₹/ha)	0.078*	1.93	1	1.93	Under utilized

Note: \*\*&\* indicates significant at one per cent and five per cent, respectively

### 4.9.3 Resource productivity in ginger cultivation in Hilly zone of Karnataka

The resource productivity of input used in the cultivation of paddy is given in Table 4.41. The result revealed that, inputs such as, FYM, fertilizer, human labour, and PPC were found positive influence on gross returns with significant co-efficient of 0.043, 0.182, 0.086 and 0.257, respectively. The elasticity coefficient for the seed used for the cultivation of paddy was -0.13, but it was statistically non-significant, indicating that a marginal increase in the amount of this input would not raise the total value of output realized. The elasticity coefficients of other inputs like bullock labour and irrigation were statistically non-significant, indicating that influence of these inputs in increasing the gross returns is very meager. The coefficient of multiple determination was 0.68, indicating that 68 per cent of the total variation in the return of paddy cultivation was explained by the regression analysis. The computed F value for the regression analysis was statistically significant at one per cent level. Hence selected model is goodness of fit in measuring the resource use efficiency of ginger cultivation.

**Table 4.41: Resource productivity in paddy cultivation in Hilly Zone of Karnataka**

Sl. No	Particular	Parameter	Co-efficient	Standard error
1	Intercept	Ln A	-3.450	-1.933
2	Seeds (₹/ha)	X1	-0.268	-0.313
3	Farm yard manure (₹/ha)	X2	0.043**	0.015
4	Chemical fertilizer (₹/ha)	X3	0.182*	0.092
5	Human labour (₹/ha)	X4	0.086**	0.027
6	Bullock labour (₹/ha)	X5	0.152	0.070
7	Plant protection chemicals (₹/ha)	X6	0.257**	0.041
8	Irrigation charges (₹/ha)	X7	0.514	0.379
9	Coefficient of multiple determination	R <sup>2</sup>	0.762	
10	F value	F	25.613	
11	Number of sample	N	64	

Note: \*\*&\* indicates significant at one per cent and five per cent, respectively

#### 4.9.4 Allocative efficiency in paddy in Hilly zone of Karnataka

The allocative efficiency in paddy cultivation is given in Table 4.42. The allocative efficiency indicated the price response of the farmers. The allocative efficiency of one indicated that the farmers were price efficient in allocating that particular resource in paddy cultivation. The allocative efficiency of more than one indicated the under-utilization of that particular resource and scope in increase in its application till the ratio reached one. The results indicated that the MVP/MFC ratio was highest in the case of chemical fertilizer (1.95) followed by FYM (1.45) and bullock labour (1.02). This indicated that use more FYM and bullock labour under paddy cultivation would result in higher gross returns. However, MVP/MFC ratio of seeds, human labour and irrigation under paddy was less than unity, which indicates seeds, fertilizer, human and irrigation were not efficiently used to achieve desired level of production.

**Table 4.42: Allocative efficiency in paddy cultivation in Hilly Zone of Karnataka**

Sl. No.	Variable	Coefficient	MVP	MFC	MVP/MFC	Inference
1	Seeds (₹/ha)	-0.268	-0.38	1	-0.38	Over utilized
2	FYM (₹/ha)	0.043**	1.45	1	1.45	Under utilized
3	Chemical fertilizer (₹/ha)	0.182*	1.95	1	1.95	Under utilized
4	Human labour (₹/ha)	0.086**	0.36	1	0.36	Over utilized
5	Bullock labour (₹/ha)	0.152	1.02	1	1.02	Under utilized
6	Plant protection chemical (₹/ha)	0.257**	0.47	1	0.47	Over utilized
7	Irrigation	0.514	0.93	1	0.93	Over utilized

Note: \*\*&\* indicates significant at one per cent and five per cent, respectively

#### 4.9.5 Resource productivity in ginger cultivation in Hilly zone of Karnataka

The resource productivity of input used in the ginger cultivation in Hilly Zone of Karnataka is presented in Table 4.43 Cobb-Douglas type of production function was employed to examine the influence of different inputs on gross returns. A perusal of the table reveals the significance of both the production functions as proved by the

significance of F value at one per cent probability level. The regression coefficients of seed material (Rhizome), FYM, and human labour and mulching were positive and significant in contributing increased gross returns. Whereas the elasticity coefficients of other inputs like fertilizer, PPC and irrigation were found statistically non-significant, indicating that influence of these inputs in increasing the gross returns is very meager. The coefficient of determination ( $R^2$ ) for ginger cultivation was 84 per cent, which indicated a selected production function model is fairly high degree of 'goodness of fit' and also represent that 84 per cent variation in ginger gross returns was explained by all independent variables included in the model.

**Table 4.43: Resource productivity in ginger cultivation in Hilly zone of Karnataka**

Sl. No.	Particular	Parameter	Co-efficient	Standard error
1	Intercept	Ln A	-5.451	-3.586
2	Rhizome (₹/ha)	X1	0.052**	0.012
3	Farm yard manure (₹/ha)	X2	0.142*	0.073
4	Chemical fertilizer (₹/ha)	X3	0.392	0.281
5	Human labour (₹/ha)	X4	0.135**	0.026
6	Mulching (₹/ha)	X5	0.092*	0.048
7	Plant protection chemicals (₹/ha)	X6	0.286	0.198
8	Irrigation charges (₹/ha)	X7	0.085	0.542
9	Coefficient of multiple determination	$R^2$	0.847	
10	F value	F	47.450	
11	Number of sample	N	68	

Note: \*\*&\* indicates significant at one per cent and five per cent, respectively

#### **4.9.6 Allocative efficiency in ginger cultivation in Hilly zone of Karnataka**

The ratio of marginal value product to marginal factor cost is calculated and presented in Table 4.44 indicated that resource use efficiency was highest in seeds (Rhizome) material (3.69) followed by mulching (2.89) and FYM. These ratios were

considerably higher than unity which indicates considerable scope to increase ginger production by increasing the level of these variables. MVP of fertilizer, PPC and irrigation were found less than unity indicating their excess use. This implied that, fertilizer, PPC and irrigation were not efficiently used to achieve desired level of production.

**Table 4.44: Allocative efficiency in ginger cultivation in Hilly zone of Karnataka (per ha)**

Sl. No.	Particular	Co-efficient	MVP	MFC	MVP/MFC	Inference
1	Rhizome (₹/ha)	0.052**	3.69	1	3.69	Under utilized
2	FYM (₹/ha)	0.142*	2.54	1	2.54	Under utilized
3	Fertilizer (₹/ha)	0.392	0.74	1	0.74	Over utilized
4	Human labour (₹/ha)	0.135**	0.92	1	0.92	Over utilized
5	Mulching (₹/ha)	0.092*	2.89	1	2.89	Under utilized
6	PPC (₹/ha)	0.286	0.17	1	0.17	Over utilized
7	Irrigation (₹/ha)	0.085	0.64	1	0.64	Over utilized

Note: \*\*&\* indicates significant at one per cent and five per cent, respectively

#### 4.8 Factors influencing sustained production of banana in the study area

The factors influencing the sustained production of banana in the study area is given in Table 4.45. In Hassan district, the banana production was found sustainable mainly due to less labor requirement (I), followed by high profitability, regular demand in market as revealed by results. The factor contributing least was demonstration effect (conversion by neighbouring farmer) in Hassan.

As against to this in Chikkamagaluru district, high profitability (I) banana cultivation was found to be the factor considered for its sustainability, followed by less labour requirement and regular demand in the market. Lack of government support for other crops in Chikkamagaluru district was the least contributing factor. Similarly, in Shivamogga district, high profitability (I) followed by regular demand in the market, less

**Table 4.45: Factors influencing sustained production of banana in the study area**

Sl. No.	Particular	Hassan (n=40)		Chikkamagaluru (n=80)		Shivamogga (n=80)	
		Average garret score	Rank	Average Garret score	Rank	Average garret score	Rank
1	Less labour requirement	84.36	I	87.45	II	75.69	III
2	High profitability of banana	76.95	II	89.93	I	86.56	I
3	Regular demand in the market	74.32	III	78.47	III	79.16	II
4	Cultivation of competing crops is more tedious	71.75	IV	68.78	VI	73.87	IV
5	Low pest and disease compared to other competing crops	69.74	V	73.48	V	65.33	VI
6	Easy weed management	67.37	VI	76.56	IV	71.46	V
7	Yield advantage over other crops	64.58	VII	67.58	VII	64.79	VII
8	Non-remunerative price of other crops	64.48	VIII	64.81	IX	59.78	X
9	Lack of Govt. support for other crops	63.45	IX	62.62	X	62.78	VIII
10	Demonstration effect (influenced by neighbouring farmer)	61.43	X	65.22	VIII	61.64	IX

labour requirement were the major factors contributed for sustainability of banana cultivation. The non-remunerative price of the other crops was least contributed for its suitability. It is evident from the results that, banana is considered to be high value commercial fruit crop in the study area, it requires relatively less labour for different operations compared to other competing crops like paddy and ginger. Availability and synchronization of labour for different agricultural operations was very difficult in the study area. Thereby banana was sustained well. Besides factors like stable price of banana, less labour requirement and regular demand was also contributed for sustainability of banana. The findings are aptly supported by Kathirvel, (2007).

#### 4.11 Externalities of banana and its competing crops

##### 4.11.1 Quantified externality for resource use in banana and its competing crop

The quantified externality for resource use in banana in comparison to its competing crops is presented in Table 4.46. The result revealed that the cost incurred on fertilizers was more in case of ginger (₹ 43,200/ha) followed banana (₹ 25,450/ha) and paddy (₹ 9,644/ ha). With respect to PPC also the cost was more in ginger (₹ 69,519/ha) compared to paddy (₹ 5,630/ ha) and banana (₹ 3,893/ ha). This clearly indicates that ecologically banana has very less negative impact due to less usage of PPC.

**Table 4.46: Quantified externality for resource used in the production of banana and its competing crops**

Sl. No.	Resources	Banana (₹/ ha)	Paddy (₹/ha)	Ginger (₹/ha)
1.	Fertilizer (₹/ha)	25450	9644	43200
2.	Plant protection chemical (₹/ha)	3893	5630	69519
3.	Irrigation charges (₹/ha)	7150	10650	7417
4.	Total (1+2+3)	36493	25924	120136
Net returns (₹/ha)		304475	3829	118598

The irrigation charges is at the higher end in the case of paddy which accounted ₹ 10,650/ ha followed by ginger (₹ 7,417/ha) and banana (₹ 7,150/ ha). It is a known fact

that paddy cultivation requires large amount of irrigation. On overall basis, the cost of resources i.e. fertilizers, PPC and irrigation together accounted for ₹ 1,20,136/ ha in ginger with net returns of ₹ 1,18,598/ ha whereas in paddy the cost accounted to ₹ 25,924/ ha with net returns of ₹ 3,829/ ha. The cost incurred on banana was less (₹ 36,493/ ha) but with higher net returns (₹ 3,04,475/ ha) in comparison to ginger and paddy.

#### **4.11.2 Externalities of banana and its competing crops (qualitative parameters)**

The qualitative parameters depicting the externalities of banana over its competing crops is presented in the Table 4.47. The table reveals that banana has many positive impacts over paddy and ginger. Firstly, because of its high canopy, banana stands out in aesthetic value. Regarding the growing requirements, banana being grown in aerobic conditions does not produce methane gas as well as restores soil bio-mass to a greater extent and also provides ample opportunity for taking up water saving technologies and crop intensification through micro-irrigation and intercropping respectively. The nutritive value of banana is higher than its competing crops. On the other hand, paddy and ginger have few negative externalities over banana. Both, paddy and ginger affect the soil texture as soil puddling is required for paddy and fine tilth soil is must for ginger cultivation. They also require higher content of PPC, fertilizers and more number of labors in comparison to banana which directly affects the soil health and even the successive crops.

There is not much opportunity for taking up water saving technologies because of which salinity problem and nutrient leaching losses is seen in paddy. Accordingly, paddy and ginger are more prone to pest attacks. The major negative externality from paddy is, it adds to global warming by releasing greenhouse gases especially methane. On overall basis, banana has many positive externalities with respect to both environment and the farmer over paddy and ginger.

**Table: 4.47: Externalities of banana and its competing crops (qualitative parameters)**

<b>Positive externality of banana over paddy and ginger</b>	<b>Negative externality of paddy over banana</b>	<b>Negative externality of ginger over banana</b>
<p>Aesthetic value - Banana is high canopy crop</p> <p>Banana is grown under aerobic condition there by there is no emission of methane gas</p> <p>Banana restores soil bio-mass, as well as minimal damage to the soil structure.</p> <p>Water requirement of banana is less (39 acre inch) and also water saving technologies (micro irrigation) can be easily adopted. Thus, water use efficiency is higher</p> <p>Crop intensification through intercrop is possible</p> <p>Nutritive value is relatively higher in case of banana compared to paddy</p>	<p>Paddy accelerates for global warming by way of emission of green house gases (majorly methane).</p> <p>Paddy cultivation will affect the soil structure and texture, as cultivation of paddy requires puddling of soil.</p> <p>Majorly paddy is cultivated under anaerobic condition, where water requirement is relatively higher (45 acre inch) and it is highly cumbersome to adopt any water saving technologies.</p> <p>Salinity problem and nutrient leaching losses is high</p> <p>Labour intensive crop</p> <p>More Susceptible to immediate pest out break</p> <p>There is higher application of pesticides which not only affects the soil health but also affects the health of the farmer.</p>	<p>Being a nutrient exhaustive crop cultivation of successive crops is affected</p> <p>Highly susceptible to pest and diseases as a result there is higher application of plant protection chemicals.</p> <p>Less water use efficiency.</p> <p>Cultivation of ginger will affect the soil structure and texture, as it requires fine tilth of soil.</p> <p>Labour intensive crop</p> <p>There is higher application of pesticides which not only affects the soil health but also affects the health of the farmer.</p>

## 4.12 General characteristics of consumers

### Age of the consumers

Fifty per cent of the (Table 4.48) consumers belonged to the category of 35 to 50 years age group in Hassan district. In Chikkamagaluru, it was 55 percent as in Shivamogga it was in the category of above 50 years age group. On overall basis also 50 per cent of the consumers belonged to 35-50 years age group. The pattern of distribution of sample in three selected districts in different age groups were statistically significant. It indicates banana consumer were heterogeneous in their age groups.

**Table 4.48: General characteristics of consumers**

Particular	Hassan (n=20)	Chikkamagaluru (n=40)	Shivamogga (n=40)	Pooled (N=100)	$\chi^2$ Value
I. Age group (No.)					
a. Below 35 years	3 (15)	5 (13)	2 (5)	10 (10)	
b. 35-50 years	10 (50)	22 (55)	18 (45)	50 (50)	
c. Above 50 years	7 (35)	13 (33)	20 (50)	40 (40)	
Average age (year)	39	42	48	43	10.47*
II. Education level (No.)					
a. Illiterate	2 (10)	5 (13)	8 (20)	15 (15)	6.15 <sup>NS</sup>
b. Primary	5 (25)	10 (25)	7 (18)	22 (22)	
c. Secondary	2 (10)	5 (8)	3 (13)	10 (10)	
d. PUC	6 (30)	11 (28)	9 (23)	26 (26)	
e. Degree	3 (15)	6 (15)	11 (28)	20 (20)	
f. Postgraduates	2 (10)	3 (8)	2 (5)	7 (7)	
III. Family size (No.)					
a. Small (<4)	6 (30)	18 (45)	15 (39)	39 (39)	
b. Medium (4-6)	9 (45)	14 (35)	21 (53)	44 (44)	
c. Large (>6)	5 (25)	8 (20)	4 (10)	17 (17)	
Average family size (No.)	4	3	5	4	12.85**

Note: 1. \*\*, \* - Significant at 1 & 5 per cent, respectively

2. Figures in parentheses indicate percentage.

3. NS : Non-significant

## **Education level**

It was observed that 30 per cent of consumers in Hassan and 28 per cent in Chikkamagaluru were educated up to PUC, whereas in Shivamogga, around 28 per cent of the consumers had post-graduate degree (Table 4.48). In case of pooled, majority consumers possessed PUC education. Educational distribution pattern in the study area indicated that the education level was moderately high among the consumers. The differences in the distribution of number of banana consumer in different education levels were non-significant indicates that consumer were homogeneous.

## **Family Size**

Around 45 per cent of consumers in Hassan and 53 per cent of consumers in Shivamogga district belonged to Medium sized family (4-6 people), whereas in Chikkamagaluru, 45 per cent belonged to small sized family (Table 4.48). On overall basis, 44 per cent of consumers belonged to medium sized family. The difference in family size of consumer in three districts was statistically significant.

### **4.13 Purchase frequency of banana by consumers**

The frequency of purchase of banana by consumers is presented in Table 4.49. It can be observed from the table that in Hassan district, 35 per cent of the consumers consume banana on fortnight basis and the consumers consuming banana occasionally has very low. In Chikkamagaluru and Shivamogga districts, majority consume banana on weekly basis. On overall basis, majority of the consumer were consumed banana on weekly basis. The results indicated that, consumer were well versed with the importance of banana and its nutritional value. It was also identified from the primary survey that, the consumer purchases banana frequently due to its year round availability with easy access from market compared to other fruits.

**Table 4.49: Purchase frequency of banana by consumers**

Sl. No.	Particular (No.)	Hassan (n=20)	Chikkamagaluru (n=40)	Shivamogga (n=40)	Pooled (N=100)
1	Daily	4 (20)	7 (18)	12 (30)	23 (23)
2	Weekly	5 (25)	15 (38)	10 (25)	30 (30)
3	Fortnight	7 (35)	11 (28)	9 (23)	27 (27)
4	Monthly	3 (15)	4 (10)	7 (18)	14 (14)
5	Occasionally	1 (5)	3 (8)	2 (5)	6 (6)

Note: Figures in parentheses indicate percentages

#### 4.14 Attributes determining consumers preference for banana

The attributes that determine consumer preference for banana is presented in Table 4.50. A perusal of table revealed that, skin color, price, taste, variety, nutritional quality were the major factors influencing consumers to prefer banana in Hassan district.

**Table 4.50: Attributes determining consumers preferences for banana**

Sl. No.	Opinion	Hassan		Chikkamagaluru		Shivamogga	
		Average garret score	Rank	Average garret score	Rank	Average garret score	Rank
1	Skin colour	72.18	I	70.15	II	68.74	III
2	Price	68.74	II	74.24	I	75.89	I
3	Taste	68.74	III	58.94	IV	57.39	V
4	Variety	55.82	IV	69.98	III	71.96	II
5	Nutritional quality	47.86	V	39.85	VII	62.86	IV
6	Texture	39.73	VI	28.76	VIII	42.54	VII
7	Pulp quality	35.51	VII	55.45	V	51.96	VI
8	Size of the fruit	26.24	VIII	48.25	VI	29.77	VIII

In Chikkamagaluru district, the attributes contributing were price, skin colour, taste, and pulp quality. Similarly in Shivamogga district, price, variety, and skin colour

played a major role. The factor contributing least were size of the fruit, nutritional quality, pulp quality and texture in Hassan, Chikkamagaluru and Shivamogga districts respectively. Thus it is clear from the analysis that, consumers were good at selection of banana with major phenotypic criteria like skin colour, texture and pulp quality. Similar findings were reported by Dhamotharan and Selvaraj, (2013).

#### 4.15 Factor influencing banana purchase by the consumers

The results on consumer preferences for banana based on few selected criterias are presented in Table 4.51. Results revealed that year round availability of banana was the major factor for its preference in Hassan district, followed by price factor, taste, religious festivals, health concern and nutritional quality. Similarly, in Chikkamagaluru and Shivamogga districts, health concern was ranked the first factor for preferring banana by the consumers. Other important factors responsible for banana preference in Chikkamagaluru were year round availability and price advantage. In Shivamogga district, other factors were price advantage, nutritional quality, year round availability and taste. It clearly indicates that, price and regular availability plays a vital role in preference for banana by consumers. These results are in confirmatory with the study conducted by Priyadarshini, (2016).

**Table 4.51: Factors influencing banana purchase by consumers**

Sl. No.	Opinion	Hassan		Chikkamagaluru		Shivamogga	
		Average garret score	Rank	Average garret score	Rank	Average garret score	Rank
1	Year round availability	65.60	I	66.82	II	52.78	IV
2	Price of banana	64.35	II	63.58	III	65.98	II
3	Taste	61.14	III	55.85	IV	43.28	V
4	Religious festivals	48.58	IV	44.78	V	37.02	VI
5	Health concern	42.30	V	68.45	I	67.74	I
6	Nutritional quality	36.65	VI	38.78	VI	62.17	III

## V SUMMARY AND CONCLUSION

Indian agriculture has undergone a radical transition from traditional to high-value horticultural crops during recent years. The economy has also witnessed shifting of consumption pattern from traditional cereals to a more holistic and nutritious diet of fruit and vegetables, milk, fish, meat and poultry products. There by, agricultural diversification towards high-value hotri-crops has been instituted within Indian agriculture.

Karnataka is one of the progressive states of India with great potential for development of fruit crops. The state is blessed with ten Agro-Climatic Zones suitable for growing variety of fruits all-round the year. Of the ten Agro-Climatic Zones, Hilly Zone contribute maximum chunk to fruit production in Karnataka.

Banana is the major staple food crop for millions of people in the developing countries of tropics, have an antiquity of over 4000 years dating back to 2020 BC. India leads the world in banana production (29 %) with an annual output of about 29163 tonne. Banana ranks first in production (39 %) and second in area (13 %) after mango in the country. In India, Tamil Nadu leads in production (5650 '000 t) and area (118.04 '000 ha). Karnataka stands fifth in area (102.71 '000 ha) as well as in production (2675.63 '000 t) of banana (Anonymous, 2016a).

One of the unique features of banana crop is that it's, year round availability compared to other fruits. Considering importance of banana, this study made an attempt to throw light on capturing the growth performance of banana in major growing districts of Karnataka. The study also attempt to assess comparative economics of banana cultivation and its competing crops in Hilly Zone of Karnataka in terms of resource use efficiency, profitability and the externality issues.

### **Specific objectives of the study**

- To assess the dynamics of area, production and prices of banana and competing crops

- To assess and compare the resource use efficiency and profitability of banana and competing crops
- To identify the factors influencing sustained production and profitability of banana
- To assess the externalities associated with banana and competing crops
- To analyze the consumption behaviour of banana and factors influencing it.

## **Methodology**

The present study pertains to three districts of Hilly Zone of Karnataka, viz Chikkamagaluru, Shivamogga and Hassan, which were purposively selected based on banana area, production and productivity share. Further, two taluks from each Chikkamagaluru and Shivamogga district, namely, Mudigere and N. R. Pura from Chikkamagaluru district and Sagar and Thirthahalli from Shivamogga district and one taluk from Hassan district i.e Sakleshpura were selected based on banana area share. For evaluating the specific objectives of the study, requisite primary data were collected from 200 sample farmers spread across three selected districts in Hilly zone of Karnataka (40 from each taluk) and 100 consumers were selected for the study (20 consumers in each taluk town was selected to analyze the consumption behavior).

For achieving the objectives of the study, both primary and secondary data were used. Secondary data were mainly collected from [indiastat.com](http://indiastat.com), Horticultural Statistics at a Glance and Directorate of Economics and Statistics (DES), Government of Karnataka. Primary data required for the study were elicited from the respondents by personal interview method using well-designed and pre-tested schedule prepared for the purpose. For analyzing the primary data and secondary data descriptive analysis, Growth rate analysis, instability indices, crop diversification indices, partial budgeting technique, Cobb-Douglas production function and Garrett ranking technique were used.

## **Major findings of the study**

- The growth rates in area during all the three study periods Period I (1995-96 to 2004-05), Period II (2005-06 to 2014-15) and Overall Period (1995-96 to 2014-15) for

Karnataka were found positive and significant (1.86 %, 5.98 % and 4.28 %, respectively).

- The results on instability analysis of banana showed a moderate degree of instability during Period-I (8.2 %) and relatively high degree of instability during Period-II in Karnataka (11.74 %). With respect to area under banana in the country, Period-II (2000-01 to 2013-14) showed high degree of instability (15.07 %) compared to Period-I (1995-96 to 2004-05) where it was only 5.18 per cent.
- The growth rate in area under banana was highest in Chamarajanagar (15.35 %) followed by Mysore (10.12 %), Shivamogga (9.64 %), Chikkamagaluru (7.96 %), Hassan (7.47 %) and Bellary (6.50 %) districts.
- The growth in production of banana registered highest growth rate in Chamarajanagar (17.25 %) followed by Shivamogga (12.95 %), Mysore (10.93 %), Chikkamagaluru (9.91 %), Bellary (9.02 %), and Hassan (8.95 %) districts.
- Among the various districts, the higher degree of instability in area under banana was exhibited in Kolar (32.22 %) followed by Chamarajanagar (24.58 %), Bagalkot (22.47 %), Mysore (21.75 %), Gulbarga (19.66 %) and Haveri (14.87 %) districts. While the area under banana found to be relatively stable in the districts like Dakshina Kannada (1.96 %), Uttara Kannada (3.01 %) and Shivamogga (8.04 %).
- In respect of productivity of banana, Bagalkot (18.74 %) district showed highest degree of instability, followed by Mysore (16.56 %), Bellary (16.11 %) and Tumakuru (14.63 %) districts. In case of Chikkaballapura (3.07 %) and Gulbarga (3.18 %) districts, the banana productivity appears to be stable with lower values of instability.
- The estimated growth results revealed that Sakaleshpura taluk showed the highest positive and significant growth in area under pepper (12.31 %) followed by banana (5.49 %), total spices (5.30 %) and ginger (4.78 %).

- In Mudigere taluk, the highest positive and significant growth in area was noticed in pepper (7.61 %) followed by banana (6.42 %), total fruits (1.63 %) and arecanut (1.19 %). While, the highest negative and significant growth rate was registered for total oilseeds (-18.58 %) followed by total vegetables (-15.21 %) and total pulses (-10.50%).
- Sagar taluk showed the highest positive and significant growth in area under banana (10.56 %) followed by rubber (7.84 %), total fruits (4.32 %) and ginger (4.19 %). On the other hand, the highest negative and significant growth rate of area was observed in total pulses (-18.97 %) followed by total vegetables (-8.94 %) and total oilseeds (-8.43 %).
- In Thirthahalli taluk, area under banana (8.43 %) showed a positive and significant growth followed by rubber (7.21 %), arecanut (4.02 %) and total spices (3.69 %). While declining trend was observed for area under total pulses (-14.24 %), total vegetables (-10.29 %) and coconut (-4.31 %).
- The estimated instability index for Hassan district revealed high degree of instability for total pulses (163.95 %) followed by ginger (68.22 %), total vegetables (38.58 %) and total spices (30.40 %). The high degree of instability was registered in area under ginger (55.95 %) followed by total oilseeds (27.92 %) total pulses (27.18 %) and pepper (22.11 %) in Chikkamagaluru District.
- The results from composite entropy index revealed that, among five selected taluks from three districts, N. R. Pura registered greater percentage of crops diversification (72 %) followed by Sakaleshpura (66 %), Sagar (61 %) and Mudigere (56 %). Similarly, the results from Simpson index at district level showed that, Chikkamagaluru exhibited higher degree of crops diversification (82 %) followed by Hassan (77 %) and Shivamogga district (67 %).
- In Hassan district, total cost of cultivation of banana was ₹ 1,95,780/ha. The variable cost was ₹ 1,32,972/ha and the fixed cost was ₹ 62,808/ha, which accounted for 67.92 and 32.08 per cent, respectively. Among the variable costs, the cost of suckers was

higher (17.52 %) followed by fertilizers (NPK and others-13.66 %) and human labour (12.16 %). The gross returns from banana was ₹ 4,64,825/ha. The net return was ₹ 26,9045/ha. The cost of production was ₹ 464/q and farmer realized a return of ₹ 638/q which accounted to ₹ 2.37 returns per rupee of expenditure.

- In Chikkamagaluru district, the total cost of cultivation of banana was ₹ 1,86,575/ha. Among costs, rental value of owned land accounted highest share followed by seed material (sucker) and fertilizer cost. The gross returns of ₹ 4,99,300/ha was obtained from both main yield (₹ 4,98,750) and suckers (₹ 550). The net return was ₹ 3,12,725/ha with a cost of production of ₹ 655/q and ₹ 1097 was the returns from a quintal of banana with ₹ 2.68 returns per rupee of expenditure.
- In Shivamogga district, the total cost of cultivation of banana was ₹ 2,14,276/ha. Under variable costs, the cost of suckers was ₹ 33,800 followed by fertilizer (NPK) and human labour accounting for 11.74 per cent and 9.54 per cent of the total cost, respectively. The gross return was ₹ 5,45,930/ha from both main yield and suckers. The net return was ₹ 3,31,654/ha with a production cost ₹ 491/q and returns from a quintal of banana was ₹ 761 which accounted to ₹ 2.55 returns per rupee of expenditure.
- In Hassan district, the total cost of paddy cultivation was ₹ 93,412/ha, the variable cost and fixed cost were ₹ 66,773/ha and ₹ 26,639/ha, respectively which contributed to 71.48 per cent and 28.52 per cent of the total cost. The net return was ₹ 2,988/ha with a cost of production of ₹ 1639/q with ₹ 1.03 return per rupee of expenditure.
- In Chikkamagaluru district, among the total cost of paddy cultivation, the human labour (26.59 %) has taken the major share followed by irrigation charges (12.77 %) and fertilizer (NPK) (9.73 %). The total variable cost accounted to 72.91 per cent of the total cost. The total fixed cost accounted for ₹ 36,420/ha that contributed to 27.09 per cent of the total cost. The net return was ₹ 8327/ha with a cost of production ₹ 1,618/q with ₹ 1.08 return per rupee of expenditure.

- In Shivamogga district, the total cost of cultivation of paddy was ₹ 1,00,221/ha. The gross returns from the paddy was ₹ 1,10,080/ha from both main yield and paddy straw which accounted to ₹ 1,07,520/ha and ₹ 2,560/ha, respectively. The net returns was ₹ 9,859/ha with cost of production of ₹ 1566 giving ₹ 1.10 returns per rupee of expenditure.
- In Hassan district, the total cost of cultivation of ginger was ₹ 3,65,070/ha. In the total cost, total variable cost and fixed cost were ₹ 2,90,778/ha and ₹ 74,293/ha, respectively which contributed 79.65 per cent and 20.35 per cent, respectively. The net returns was ₹ 96,930/ha with cost of production of ₹ 1185/q. The ginger cultivation gave ₹ 1.27 returns per rupee of expenditure. Whereas returns per rupee of variable cost was ₹ 1.59.
- In Chikkamagaluru district, the total cost of ginger cultivation was ₹ 3,72,234/ha. Among variable costs, plant protection chemical cost was the major (19.87 %) followed by human labour, rhizome, fertilizer (NPK) accounting for 16.99 per cent, 14.04 per cent and 11.89 per cent, respectively. The total variable cost accounted for 79.11 per cent in the total cost. The total fixed cost was ₹ 77,757/ha contributing to 20.89 per cent. Under fixed costs, rental value of owned land was the major cost (12.90 %). The net returns was ₹ 1,08,266/ha. The cost of production was ₹ 1,201/ha. The returns per rupee of expenditure was ₹ 1.29.
- In Shivamogga district, the per hectare cost of cultivation of ginger showed that the total variable cost and fixed cost were ₹ 2,86,456/ha and ₹ 81,044/ha, respectively. Rental value of owned land formed the major item of fixed cost (14.29 %). The total cost of cultivation of ginger was ₹ 3,67,501/ha. Gross returns from ginger cultivation was ₹ 5,18,100/ha with a yield of 314 q/ha priced at ₹ 1,650/q. The net returns was ₹ 1,50,599/ha. The cost of production was ₹ 1170/q.
- In Hassan district, the banana production was found sustainable mainly due to less labour requirement, followed by high profitability, regular demand in market.

- In Chikkamagaluru district, banana cultivation was found sustainable due to high profitability, followed by less labour requirement, regular demand in the market.
- In Shivamogga district, high profitability followed by regular demand in the market, less labour requirement were the factors which contributed for sustainability of banana cultivation.
- In Hassan district, 35 per cent of the consumers consume banana on fortnight basis and the consumers consuming banana occasionally were very low. In Chikkamagaluru and Shivamogga districts, majority consume banana on weekly basis. On overall basis, majority of the consumers consumed banana on weekly basis.
- Skin color, price, taste, variety, nutritional quality were the major factors contributing for consumer preference for banana in Hassan district. In Chikkamagaluru district, the attributes like price, skin colour, taste, and pulp quality were attribute. Similarly in Shivamogga district, price, variety, and skin colour plays a major role.
- Year round availability of banana was the major factor for preference in Hassan district, followed by price factor, taste, religious festivals, health concern and nutritional quality. In Shivamogga district, the important factors were price, nutritional quality, year round availability and taste.

### **Policy recommendations**

- Though there is a significant increase in the growth in area and production of banana, this is not seen in productivity. To enhance the productivity, there is a need to strengthen extension activities in the study area, to provide technical knowledge/skill to the farmers.
- Production of banana seed material (suckers) is dominated by the private sector and the seed material is highly expensive, also they are located at distant places from the production centre. Hence, there is a need to establish nurseries locally, which helps in timely availability of suckers and reduce transportation and transaction cost.

- As private seed production agencies are exploiting the farmers by way of higher prices for the seed (suckers) material, there is a need to promote farmer producer organizations by way of providing incentives by the government.
- In the study area, Nendran variety is one of the predominantly cultivated varieties, which is in high demand in Andhra Pradesh, Tamil Nadu and Kerala. The procurement of the produce is done in bulk quantity by the middlemen of neighboring States. As, the bulk quantity is procured the farmers who take up early harvest needs to wait causing huge post harvest loss. Thus, there is a need to establish a suitable storage structure which helps to reduce the post harvest losses.
- While developing new varieties, the scientists need to consider the traits (skin color, taste and nutritional quality) preferred by the consumers, so that sustained production can be maintained.

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## APPENDIX-I

### Banana varieties grown in different states of India

States	Varieties
Andhra Pradesh	Dwarf Cavendish, Robusta, Rasthali, Amritpant, Thellachakrakeli, Karpoora Poovan, Chakrakeli, Monthan, Grand Naine and Yengu Bontha
Assam	Jahali, Borjahaji, Honda, Manjahaji, Chinia, Kanchkol, Chini champa, Bhimkol, Attikol, Jaitkol, Digjowa, Kulpait and Bharat Moni
Bihar	Dwarf Cavendish, Alpon, Chinia, Chini champa, Malbhog, Muthia, Kothia and Gauria
Gujarat	Dwarf Cavendish, Lacatan, Harichal and Gandevi Selection, Karnataka Dwarf Cavendish, Robusta, Poovan, Rasabale, Monthan & Elakkibatle
Kerala	Nendran, Poovan, Grand Naine, Rasthali, Monthan, Red Banana, Palayankodan, Safed Velchi, Kunnan, Kadhali and Nijalipoovan.
Karnataka	Dwarf Cavendish, Grand Naine, Robusta, Elakkibale, Rasabale, Chandra bale, Marabale, Ney Poovan, Amruthapani/Rasthali Monthan/karibale, Poovan, Red Banana, Bontha and Safed Velchi
Maharashtra	Dwarf Cavendish, Basari, Robusta, Lal Velchi, Safed Velchi, Rajaji nendran
Orissa	Orissa & Monthan
Tamil Nadu	Virupakshi, Robusta, Red banana, Monthan, Namarai, Matti, Sirumalai, Poovan, Rasthali, Nendran, Sakkai, Peyan, Matti, Monthan, Grand Naine and Karpuravalli
West Bengal	Champa, Mortman Rasthali, Amrit Sagar, Giant Governor, Lacatan

### Commercially and traditionally grown banana varieties in Hilly Zone of Karnataka

Zone	Varieties
Hilly Zone	Dwarf Cavendish, Grand Naine, Robusta, Elakkibale, Chandra bale, Monthan/Karibale, Poovan and Red Banana

## APPENDIX-II

Area of major crops in Hilly Zone of Karnataka (2001-02 to 2015-16) (Mean area in 000'ha)

Sl. No.	Crops	Hassan		Chikkamagaluru			Shivamogga		
		Sakaleshpura	Hassan Dist.	Mudigere	N R Pura	Chikkamagaluru Dist.	Thirthahalli	Sagar	Shivamogga Dist.
1	Banana	402.80	3309.20	482.20	353.60	2118.53	811.60	944.13	4967.33
2	Total fruits	10407.60	238952.07	10225.67	6011.67	141432.27	1207.73	1950.87	10559.40
3	Ginger	785.86	10499.53	97.73	96.93	541.67	154.40	736.13	3784.60
4	Cardamom	7285.33	7538.47	1847.20	52.47	2426.93	143.80	96.00	301.80
5	Pepper	1164.40	2691.73	1060.47	343.80	3368.80	356.53	205.00	826.53
6	Total spices	9656.60	27390.33	5353.73	2310.13	30627.60	7567.60	4981.60	42099.87
7	Arecanut	224.00	3693.53	2189.00	1656.60	20100.73	6838.00	3844.07	36141.60
8	Coconut	135.07	60190.80	132.00	303.67	36353.73	587.07	608.60	6395.27
9	Coffee	23459.07	38093.60	27202.93	3958.53	72715.00	312.47	116.13	506.80
10	Rubber	5.00	5.00	48.47	836.20	924.87	212.87	414.53	1408.53
11	Total vegetables	90.13	36596.73	11.67	23.67	11029.40	15.21	16.53	390.53
12	Paddy	10304.40	51584.20	10223.80	5964.20	43751.80	14985.00	15529.87	128650.40
13	Total cereals	10334.53	194310.47	10224.87	6006.60	110118.87	14988.00	17007.00	172571.90
14	Total pulses	84.31	76763.93	10.00	25.33	24488.67	183.45	217.40	2941.53
15	Total food grains	10407.60	238952.07	10225.67	6011.67	141432.27	14843.67	17156.93	175197.40
16	Total oilseeds	32.42	19562.20	5.50	86.47	20749.33	8.60	295.20	3296.20

### APPENDIX-III

#### List of villages and distribution of the respondents

District	Taluka	Village	No. of farmers
1. Hassan	1. Sakleshpura	1.Arekere	8
		2.Kamanahalli	5
		3.Kalagane	8
		4.Hethur	9
		5.Hanbal	10
2. Chikkamagaluru	1. Mudigere	1.Palguni	8
		2.Banakal	9
		3.Balur	6
		4.Markal	10
		5.Halase	7
	2. N. R. Pura	1.Mansur	6
		2.Kabase	8
		3.Sankse	9
		4.Shatti Koppa	10
		5.Muttina Koppa	7
3. Shivamogga	1. Thirthahalli	1.Kulur	8
		2.Bettamakki	9
		3.Neraturu	7
		4.Horani	10
		5.Shirupathi	6
	2. Sagar	1.Kumsi	10
		2.Kalmane	8
		3.Sampalli	9
		4.Baniga	6
		5.Duguru	7
<b>Total</b>			<b>200</b>



**APPENDIX-IV**  
**UNIVERSITY OF AGRICULTURAL SCIENCES, BENGALURU**  
**DEPARTMENT OF AGRICULTURAL ECONOMICS**

**Comparative economics of Banana cultivation and its competing  
 crops in Hilly Zone of Karnataka**

**Farmer Survey Schedule**

Respondent No.: \_\_\_\_\_ Date: \_\_\_\_\_

Village: \_\_\_\_\_ Taluka: \_\_\_\_\_ District: \_\_\_\_\_

**A. GENERAL INFORMATION**

1. Name of the respondent: \_\_\_\_\_

2. Age (Years): \_\_\_\_\_ 3. Education: Illit / Pri / Sec / SSLC / PUC / Dip / Deg / PG

4. Category: SC / ST / OBC / GEN 5. Family Type: Nuclear / Joint

6. Religion: Hindu / Muslim / Christian / Others (Specify)

7. Type of house: Shed / Thatched / Tiled / RCC

8. Family size: Total: \_\_\_\_\_ Male: \_\_\_\_\_ Female: \_\_\_\_\_ Children: \_\_\_\_\_

9. Occupation: Main: \_\_\_\_\_ Subsidiary: \_\_\_\_\_

**B. BENEFITS UNDER GOVERNMENT PROGRAMMES OR SCHMES**

{(GOK/GOI)/NGO}

1) Are you a Ration Card holder? Yes / No AA Y / BPL (LPG) /BPL/ APL

Sl. No.	Name of the Programme	Year during which benefited	Benefit availed		
			Cash (₹)	Kind	
				Item	Value
1					
2					
3					
4					
5					
6					

### C. LAND HOLDING AND USE PATTERN

RF / IR	Area (acres)				Land use			
	Own	Leased-in*	Leased-out*	Total	Field crops	Horti-culture	Permanent fallow	Others
Rainfed								
Irrigated+								
Total								

\* If leased-in / leased-out, rent paid / received (₹/acre): \_\_\_\_\_ (per season / per year)

+ If irrigated, source of irrigation: \_\_\_\_\_ (open well, borewell, tank, canal, others)

### D. CROPPING PATTERN (2015-16)

Sl. No.	Kharif (July-Oct)		Rabi (Oct-Mar)		Summer (Mar-Jun)		Perennial	
	Crop	Area (ac)	Crop	Area (ac)	Crop	Area (ac)	Crop	Area (ac)
<b>Rainfed</b>								
1								
2								
3								
4								
<b>Irrigated</b>								
1								
2								
3								
4								

### E. AREA UNDER BANANA AND COMPETING CROPS DURING PAST YEARS (ACRES)

Year/Area	2016	2015	2014	2013	2012	2011	Before 10 years
Area under banana							
Area under competing crops							
1. Kharif							
2. Rabi							
3. Summer							
Total							

**F. FARM INVENTORY:**

Sl. No.	Items	No.	Year of purchase/ Construction		Expected life (years)	Annual repairs (₹)
			Year	Value (₹)		
I	<b>Vehicles and house</b>					
1	Motorcycle					
2	Car/Jeep					
3	Farm house					
4	Cowshed					
5	Godown					
II	<b>Farm machinery</b>					
1	Tractor					
2	cultivator					
3	Leveller					
4	Weeder					
5	Power tiller					
6	Sprayers					
III	Bullock cart					
	Any other specify					
IV	<b>Farm implements</b>					
1	Iron/ wooden plough					
2	Blade harrow					
3	Seed drill					
4	Hoes					
5	Spade / Pickaxe					
6	Any other specify					
V	<b>Irrigation structure</b>					
7	Bore well					
8	Drip					
9	Pump set					
10	Pump house					
	Any other					

**G. LIVESTOCK POSITION:**

Sl. No.	Items	No	Year of Purchase	Purchase Value (₹)	Present value (in ₹)	Expenditure (₹/ month or year)	Total Income (₹/ month or year)
1	Bullock						
2	Local Cows						
3	Cross breed cows						
4	Buffaloes						
5	Sheep						
6	Goat						
7	Poultry						
8	Others						

**H. FUNDS MOBILIZATION FOR CROP PRODUCTION**

Sl. No.	Items	Type of loan	Amount (₹)	Interest rate (%)	Purpose	Repayment	Subsidy (₹)
1	Owned fund						
2	Borrowed fund						
A	Commercial banks						
B	RRBs						
C	Co-operative banks						
D	Traders and commission agents						
E	Money lenders						
F	Friends and relatives						
H	Others (specify):						

**I. OTHERS SOURCES OF INCOME (₹/annum)**

SN	Activity	Income (₹/year)
1	Dairy	
2	Services	
3	Business	
4	Artisans	
5	MGNERGA	
5	Other(Specify):	



## 2. Harvesting /cleaning/ packing /bagging/sorting details##

Wage rate:

Men wage:

Women wage:

Sl. No.	Particulars	Month	Qty	Labour used				Cleaning and Packing		By product		Marketing details				Price (farm gate price or market price)	Others
				Men		Women		Material used	Material cost	Qty	Price	Place of Marketing	Sold to	distance (km)	Market charges (If any)		
				O	H	O	H										
	Total Harvest (in Number)																
1	Harvesting																
2	Harvesting																
3	Harvesting																
4	Harvesting																
5	Harvesting																
6	Harvesting																
7	Harvesting																
8	Harvesting																
	Contract sale																

**K. DETAILS OF SALE OF PRODUCE (2015-16):**

Sl. No.	Agency to whom sold	Quantity sold (Qty in ___)			Average Price (₹/___)		
		Peak	Mid	Off	Peak	Mid	Off
1	Itinerant merchant						
2	CA cum WS*						
3	Processor						
4	Exporter						
5	Retailer						
6	Consumer						

\*CA cum WS – Commission Agent- cum- Wholesaler

**L. MARKETING COSTS INCURRED BY FARMER**

SN	Particulars	Material cost (₹/year)	Labour Cost (₹/year)	Others
1	Grading			
2	Packing			
3	Transportation			
4	Loading & unloading charges			
5	Loss of produce upto market			
6	Commission charges @			
7	Other costs-			

**M. CONSTRAINTS FACED BY FARMERS IN PRODUCTION AND MARKETING**

SN	Constraints	Tick	Rank
1	Lack of irrigation facilities		
2	Labour shortage		
3	Pest and disease attack		
4	Power cuts/ Electricity problem		
5	High transportation cost		
6	Price fluctuation		
7	Lack of storage facilities		
8	Poor market intelligence		
9	High commission charges		
10	High cost of labour		
11	Wind damage		
12	Excessive rainfall		
13	Any other (specify)		

**N. FACTORS RESPONSIBLE FOR SHIFT TO BANANA CULTIVATION  
(BY FARMERS)**

Sl. No.	Factors	High relevant	Relevant	Not relevant
1	Non availability of timely labours			
2	Competing crops is required more tedious			
3	Low price for other crops			
4	Low yield from other crops			
5	Weed menace in other crops			
6	High incidence of pest and disease in other crops			
7	Lack of Govt. support for other crops cultivation			
8	Conversion by neighboring farmers			
9	High profitability of banana			
10	Low value of paddy lands or other competing crops			
11				
12				

**O. COST OF CULTIVATION**

I. Crop Name: \_\_\_\_\_ Season: \_\_\_\_\_  
 Variety: \_\_\_\_\_ Rainfed / Irrigated: \_\_\_\_\_  
 Acreage: \_\_\_\_\_ Duration: \_\_\_\_\_

**II. WAGE RATE (RS):**

Wage rate (₹) for the year			
Men labour/day	Women labour/day	Bullock pair/day	Machine labour/hour

**III. LABOUR USE PATTERN IN \_\_\_\_\_ CROP**

Sl. No.	Name of the operation	No. of times	Family		Hired		Bullock pair days	Machine hours
			Men	Women	Men	Women		
1	Land Preparation							
2	Puddling							
3	Sowing/Planting							
4	Manure Application							
5	Inter cultivation							
6	Thinning & Line making							
7	Weeding							
8	Fertilizer application							

9	Plant protection							
10	Irrigation							
11	Harvesting							
12	Threshing							
13	Packing							
14	Marketing							
15	Miscellaneous							
	Total							

#### IV. RESOURCE USE PATTERN IN \_\_\_\_\_ CULTIVATION

Sl. No.	Input	Quantity	Rate (₹.)	Amount (₹.)
1	Seeds			
2	FYM			
3	Fertilizers			
	a)			
	b)			
	c)			
4	PP chemicals			
	a)			
	b)			
5	Weedicides			
	a)			
	b)			
6	Growth promoters			
7	Electricity			
8	Irrigation charges			
9	Land revenue			
10	others			

#### V. YIELD AND RETURNS

SN	Particulars	Unit	Yield	Price(₹.)	Total value
1	Main Product				
2	By product				

#### VI. QUALITY OF OUTPUTS

Particulars					
Main Product					
By product					

**P. EXTERNALITY COST OF BANANA AND ITS COMPETING CROPS**

Sl. No.	Externalities	Unit	Banana		Paddy		Arecanut		Coffee		Ginger	
			Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost
1	Water requirement											
2	Labour required (saving)											
3	Soil erosion (proxy) (In terms of reduced yields)											
4	Multiple income generating crops											
5	Herbicides:											
6	Fertilizer application : N : P : K Others :											
7	Plant protection chemical:											
8	Growth regulator:											
9	Waste management											
10	Deforestation & destructions of habitats											
11	Expenditure on Health											
12	Saving of health expenditure by Banana consumption											
13	Shade plant											
14	Any other (specify)											



## APPENDIX-V

### UNIVERSITY OF AGRICULTURAL SCIENCES, BENGALURU DEPARTMENT OF AGRICULTURAL ECONOMICS

#### Comparative economics of Banana cultivation and its competing crops in Hilly Zone of Karnataka

#### Consumer Survey Schedule

Respondent No.: \_\_\_\_\_ Date: \_\_\_\_\_

Village: \_\_\_\_\_ Taluka: \_\_\_\_\_ District: \_\_\_\_\_

#### A. GENERAL INFORMATION

1. Name of the respondent:

\_\_\_\_\_

2. Age (Years): \_\_\_\_\_ 3. Education: Illit / Pri / Sec / SSLC / PUC / Dip / Deg / PG

4. Category: SC / ST / OBC / GEN

5. Family Type: Nuclear / Joint

6. Religion: Hindu / Muslim / Christian / Others (Specify)

7. Type of house: Shed / Thatched / Tiled / RCC

8. Family size: Total: \_\_\_\_\_ Male: \_\_\_\_\_ Female: \_\_\_\_\_ Children: \_\_\_\_\_

9. Occupation: Main: \_\_\_\_\_ Subsidiary: \_\_\_\_\_

#### B. PRODUCT PURCHASE FREQUENCY

Sl. No.	Frequency	Variety	Qty (kg)/_____		Price (Rs/kg)/___		Purchased from	
			Fruit	*By product	Fruit	*By product	Fruit	*By product
1	Daily							
2	Once a Week							
3	Fortnight							
4	Once a Month							
5	Once in two months							
6	Once in three months							
7	Occasionally							

\*- Byproduct includes: banana leaves, vegetable banana, banana chips, etc

- C. i. Do you think that current price is reasonable? (Yes/No)  
 ii. If price is increased, will you continue the consumption? (Yes/No)  
 If yes,

Sl. No.	Increase in price over current price by (Rs./kg)	Same consumption level	Change in consumption level
A	2		
B	4		
C	6		
D	8		
E	10		
F	12		
G	14		
H	16		
I	18		
J	20		
K	>20		

**E. ATTRIBUTES DETERMINING PREFERENCE FOR BANANA BY CONSUMERS**

Sl. No.	Factors	Rank	Sub	Scoring
1	Varieties		1. Cavendish 2. Robusta 3. Red banana	
2	Price		1. Low price (Rs 20 to 30) 2. Medium price (Rs 30 to 50) 3. High price (Rs 50 and above)	
3	Size		1. Small 2. Medium	
4	Skin Colour		1. Green 2. Yellow	
5	Taste		1. Good 2. Average	
6	Texture		1. Smooth 2. Rough	
7	Pulp quality		1. Full ripen 2. Partial ripen	
8	Nutritional quality		1. Good 2. Average	

**M. FACTORS RESPONSIBLE FOR CONSUMPTION OF BANANA**

<b>SN</b>	<b>Factors</b>	<b>Tick</b>	<b>Rank</b>
1	Health concerns		
2	Taste		
3	Year round availability fruit		
4	Religious festivals		
5	Price factor		
6			
7			
8			
9			
10			

# **Dynamics of Agri-Horti Crops in Hilly Zone of Karnataka: An Economic Analysis**

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## **ABSTRACT**

The present study aimed at analyzing the trends in area, production and yield of banana for two different periods viz., Period-I (1995-96 to 2004-05) and Period-II (2005-06 to 2014-15) of Karnataka and India using growth and instability indices. The analysis for two periods was purposefully made to capture the impact of National Horticulture Mission (2005-06) on area, production and productivity of banana. The results revealed that, growth rates of area, production and productivity of banana in India and Karnataka during Period -II was found higher, positive and significant compared to Period-I. The study also focused on shift in cropping pattern between major agriculture and horticultural crops in Hilly Zone of Karnataka for the period from 2001-02 to 2015-16. The results revealed that majority of horticulture crops shown positive trend compared to agriculture crops. Thus, it could be inferred that farmer in Hilly Zone of Karnataka are shifting from traditionally grown less remunerative crops to more remunerative horticultural crops.

**Keywords:** Growth rates, Crop diversification and Instability index.

## **INTRODUCTION**

Horticulture is the fastest growing sector within agriculture, presently contributes 30 per cent of agricultural GDP (Agarwal *et al.*, 2016). The horticultural sector has also received considerable attention in recent years as it is recognized as a potentially important source of growth, employment generation and foreign exchange earnings (Singh, 2015). The horticulture sector encompasses a wide range of crops viz., fruits, vegetables, plantations, ornamental crops, etc. India, with its wide variability of climate and soil, is highly favorable for growing a large number of horticultural crops.

Horticulture has emerged as the key instrument of the Indian agricultural development strategy for reduction of poverty, unemployment and malnourishment. The, horticultural-based agricultural diversification in India has been most prominent in the southern states of India (Saraswati *et al.*, 2012). Karnataka is one of the progressive states of India with great potential for development of horticultural crops. The state is blessed with ten agro-climatic regions suitable for growing variety of horticultural crops all-round the year. Of the ten agro-climatic zones, Hilly Zone contribute maximum chunk to fruit production in Karnataka. The agriculture in Karnataka is gradually diversifying towards high-value food commodities especially towards fruits, vegetables, spices, etc. Keeping all these issues in mind, the present study tries to examine the shift in cropping pattern between major agriculture and horticultural crops in Hilly Zone of Karnataka. One of the major landmark reasons to emphasise this sector is being reflected in establishing National Horticulture Mission (NHM) in 2005-06. There by, the study also aimed to explore the impact of establishment of NHM (2005-06) on area, production and productivity of one of the important fruit crops i.e. banana in India and Karnataka.

## **METHODOLOGY**

For achieving the objectives of the study, secondary data were collected from various published sources of Government of Karnataka and Government of India on area, production and productivity of banana for the country and Karnataka for two time periods *viz.*, Period-I (1995-96 to 2004-05) and Period -II (2005-06 to 2014-15). Data were drawn from indiastat.com and various issues of The Horticultural Statistics at a Glance. Taluk-wise area under major cereals, pulses, oilseeds, vegetables, spices, fruit crops, and other major commercial crops of Shivamogga district which comes under Hilly Zone for 2001-02 to 2014-15 were collected from the Directorate of Economics and Statistics, Bengaluru. For the purpose of evaluating the objectives of the study, based on the nature and extent of data, the following analytical tools were employed for processing the data to arrive at meaningful results and draw useful conclusions.

1. Compound annual growth rate analysis
2. Instability analysis
3. Crop diversification Indices

## 1. Compound Annual Growth Rate Analysis

For evaluating the compound annual growth rates of the selected variables cited below. Exponential function of the following form was used.

$$Y_t = A B^t V_t \quad \dots (1)$$

Where,

$Y_t$  = area/production/productivity/other variable under consideration in the year t

A = Intercept indicating Y in the base period (t = 0)

B = 1 + g

t = time period

$V_t$  = Random disturbance term

Equation (1) was converted into linear form by taking logarithmic as follows:

$$\ln Y_t = \ln A + t * \ln B + \ln V_t$$

This is of the following form

$$Q_t = a + b_t + U_t \quad \dots (2)$$

Where,

$$Q_t = \ln Y$$

$$a = \ln A$$

$$b = \ln B$$

$$U_t = \ln V_t$$

The parameters 'a' and 'b' were estimated using the Ordinary Least Squares estimation technique. Later, the original 'A' and 'B' parameters in equation (1) were obtained by taking antilogarithms of 'a' and 'b'

Average annual compound growth rate (%) was calculated as follows:

$$g = (B - 1) * 100$$

## 2. Instability analysis

The coefficient of variation was used as a measure to study the variability in the area, production and productivity of the selected crop viz., Banana. The coefficient of variation (CV) was computed using the following formula.

$$CV = (\text{Standard Deviation} / \text{Mean}) \times 100$$

Linear trend was fitted to the original time series data on area, production and productivity for the two study periods. The formula suggested by Cuddy and Della (1978) was used to compute the degree of variation around the trend, means coefficient of variation was multiplied by the square root of the difference between the unity and coefficient of determination ( $R^2$ ). A high degree of instability index signifies violent variations.

$$\text{Instability Index} = (\text{Standard Deviation} / \text{Mean}) * 100 * (1 - R^2)^{0.5}$$

$$R^2 = \text{Coefficient of determination}$$

## 3. Crop diversification Indices

### Herfindahl Index (HI)

Herfindahl Index (Pant *et al.*, 2005) given below is computed by taking sum of squares of acreage proportion of each crop in the total cropped area. Mathematically, the index is given as below

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

Where,

N = total number of crops

$P_i$  = represents area proportion of the  $i^{\text{th}}$  crop in total cropped area.

This index takes a value one when there is complete concentration and approaches zero when diversification is perfect. Thus the HI is bounded by Zero and one. One minus HI will give the Simpsons index of diversification (SI) and similar to HI the range of SI

range between zero to one but interpretation is quite opposite to HI ie., Value of SID closer to zero indicates near to the specialization and value closer to one indicates diversification .

### **Composite Entropy Index (CEI):**

This index possesses all desirable properties of above mentioned indices and is used to compare diversification across situations having different and large number of crops since it gives due weight age to the number of crops. The formula of C.E.I. is given by:

$$\text{C. E. I} = \left( \sum_{i=1}^N P_i \log P_i \right) \times \left( 1 - \left( \frac{1}{N} \right) \right)$$

The value of Composite Entropy Index increases with the decrease in concentration and rises with the number of crops. The value of C.E.I. ranges between zero to one.

## **RESULTS AND DISCUSSION**

### **Growth performance of Banana in Karnataka and India**

Growth in area, production and productivity of banana in India and Karnataka was estimated by using the exponential function. The study period (1995-96 to 2014-15) was divided into two sub periods viz, Period – I (1995-96 to 2004-05) and Period-II (2005-06 to 2014-15) due to significant shift in area, production and productivity of Horticultural crops in general and banana in particular. This break in two study periods was synchronized with introduction of National Horticulture Mission (NHM) during 2005-06 by Government of India, and has contributed for the increase in area, production and productivity of banana in India and Karnataka.

The results presented in Table-I on compound annual growth rates (CAGR) for Karnataka and India revealed that, the growth rates of area during all the three study periods Period I (1995-96 to 2004-05), Period II (2005-06 to 2014-15) and Overall Period (1995-96 to 2014-15) for Karnataka were found positive and significant (1.86%, 5.98%

and 4.28 %, respectively). The respective figures for area of banana in India 1.59 per cent, 4.64 per cent and 3.40 per cent and were also found significant. The banana production in Karnataka and India also showed significant growth during the Period-II and Overall Period, however the growth rate of banana production during the period-I was not significant. In spite of significant area increase under banana during pre-NHM period, the growth rate of banana production was not significant due to non-significant growth rate of banana productivity for both Karnataka and India. The findings of Kumar and Chandrashekar (2015) also confirmed highly and significant positive growth rates for major horticultural crops in Karnataka.

**TABLE I**

***Growth rates in area, production and productivity of Banana in Karnataka and India***

<b>Karnataka</b>		<b>India</b>	
<b>Period</b>	<b>CAGR (%)</b>	<b>Period</b>	<b>CAGR (%)</b>
Area (000 ha)			
Period-I (1995-96 to 2004-05)	1.86*	Period-I (1995-96 to 2004-05)	1.59**
Period-II (2005-06 to 2014-15)	5.98**	Period-II (2005-06 to 2014-15)	4.64**
Overall period (1995-96 to 2014-15)	4.28**	Overall period (1995-96 to 2014-15)	3.40**
Production (000 tonne)			
Period-I (1995-96 to 2004-05)	2.71	Period-I (1995-96 to 2004-05)	2.28
Period-II (2005-06 to 2014-15)	9.86**	Period-II (2005-06 to 2014-15)	7.84**
Overall period (1995-96 to 2014-15)	6.17**	Overall period (1995-96 to 2014-15)	5.86**
Productivity (kg/ha)			
Period-I (1995-96 to 2004-05)	0.85	Period-I (1995-96 to 2004-05)	0.69
Period-II (2005-06 to 2014-15)	3.82**	Period-II (2005-06 to 2014-15)	2.56**
Overall period (1995-96 to 2014-15)	1.89*	Overall period (1995-96 to 2014-15)	2.06*

Note: \*\*&\* indicates Significant at one per cent and five per cent, respectively

CAGR: Compound Annual Growth Rate

**Instability analysis of Banana in Karnataka and India**

The results on instability analysis of banana showed a moderate degree of instability during Period-I (8.2%) and relatively high degree of instability during Period-II in Karnataka (11.74%). With respect to banana area in the country, Period – II (2000-01 to 2013-14) showed high degree of instability (15.07%) compared to Period-I (1995-96 to 2004-05) where it was only 5.18 per cent. The results on production of banana in

Karnataka represent relatively high degree of instability during Period II (2005-06 to 2014-15) and Overall Period (1995-96 to 2014-15) with instability indices of 26.09 per cent and 32.78 per cent, respectively compared to India (Table-II).

**TABLE II**  
***Instability indices for area, production and productivity of Banana in Karnataka and India***

Karnataka	Instability Index (%)	India	Instability Index (%)
Area			
Period-I (1995-96 to 2004-05)	8.22	Period-I (1995-96 to 2004-05)	5.18
Period-II (2005-06 to 2014-15)	11.74	Period-II (2005-06 to 2014-15)	15.07
Overall period (1995-96 to 2014-15)	9.31	Overall period (1995-96 to 2014-15)	14.50
Production			
Period-I (1995-96 to 2004-05)	6.94	Period-I (1995-96 to 2004-05)	14.58
Period-II (2005-06 to 2014-15)	26.09	Period-II (2005-06 to 2014-15)	18.06
Overall period (1995-96 to 2014-15)	32.78	Overall period (1995-96 to 2014-15)	21.59
Productivity			
Period-I (1995-96 to 2004-05)	18.82	Period-I (1995-96 to 2004-05)	5.84
Period-II (2005-06 to 2014-15)	35.57	Period-II (2005-06 to 2014-15)	11.60
Overall period (1995-96 to 2014-15)	31.29	Overall period (1995-96 to 2014-15)	9.89

The instability analysis on productivity of banana in Karnataka also indicated comparatively high degree of instability for Period - II (2005-06 to 2014-15) and overall period (1995-96 to 2014-15) with respective indices values of 35.75 per cent and 31.29 per cent compared to India. Similar findings were reported by Singha *et al.*, (2014), on high degree of instability for horticultural crops in Karnataka.

#### **Growth rates of major crops in Hilly Zone of Karnataka (2001-02 to 2015-16)**

The results on growth rates for area under major cereals, pulses, oilseeds, vegetables, spices, fruit crops and other major commercial crops of Shivamogga district of Hilly Zone for the period from 2001-02 to 2015-16 are presented in the Table-III. The analysis was carried out using exponential function. The estimated growth results revealed that Hosanagara taluk showed the highest positive and significant growth in area under rubber (9.52%) followed by Areacanut (7.23 %), total spices (6.02%) and banana

TABLE III

*Growth rates of major crops in Hilly Zone of Karnataka (2001-02 to 2015-16)*

Crops	Shivamogga								Shivamogga Dist.	
	Hosanagara		Soraba		Thirthahalli		Sagar		Mean area (in ha)	CAGR (%)
	Mean area (in ha)	CAGR (%)	Mean area (in ha)	CAGR (%)	Mean area (in ha)	CAGR (%)	Mean area (in ha)	CAGR (%)		
Banana	784.53	3.90**	705.40	7.72**	811.60	8.43**	944.13	10.56**	4967.33	9.64**
Total Fruits	1179.00	2.02*	3251.67	2.91**	1207.73	3.08**	1950.87	4.32**	10559.40	6.77**
Ginger	820.93	3.17*	959.13	12.87**	154.40	3.91**	736.13	4.19**	3784.60	9.52**
Cardamom	53.87	3.34**	16.60	5.12	143.80	-0.02*	96.00	2.48**	301.80	1.62*
Pepper	149.33	2.84*	105.00	-3.14	356.53	0.30	205.00	3.35**	826.53	1.40
Total Spices	3674.80	6.02**	3951.47	5.91**	7567.60	3.69**	4981.60	3.48**	42099.87	5.31**
Arecanut	2632.33	7.23**	2590.80	6.91**	6838.00	4.02**	3844.07	3.72**	36141.60	5.55**
Coconut	447.00	-0.30	424.73	-2.18**	587.07	-4.31**	608.60	-1.96**	6395.27	-1.62**
Coffee	21.13	4.84**	32.87	-3.84*	312.47	0.86	116.13	2.19	506.80	0.97
Rubber	372.93	9.52**	361.00	8.41**	212.87	7.21**	414.53	7.84**	1408.53	6.27**
Total Vegetables	9.13	-2.87	29.07	-14.29*	15.21	-10.29**	16.53	-8.94**	390.53	-5.31**
Paddy	11521.93	-0.77**	28662.67	-0.72**	14985.00	-1.62**	15529.87	-0.90**	128650.40	-0.94**
Total cereals	11876.53	-0.56**	36039.80	1.26**	14988.00	-1.62**	17007.00	-0.13	172571.87	0.35
Total Pulses	32.47	-27.85**	802.33	-6.80**	183.45	-14.24**	217.40	-18.97**	2941.53	-7.48**
Total Food Grains	11909.47	-0.62**	36811.00	1.04**	14843.67	-2.05**	17156.93	-0.27*	175197.40	0.17
Total Oilseeds	59.40	1.27	969.80	-15.24**	8.60	-5.83**	295.20	-8.43*	3296.20	-7.32**

Note: \*\*&\* indicates Significant at one per cent and five per cent, respectively  
CAGR: Compound Annual Growth Rate

(3.90%). On the other hand the highest negative and significant growth rate of area was observed for total pulses (-27.85%) followed by total vegetables (-2.87%) and paddy (-0.77%). The results on Soraba taluk showed that, the highest positive and significant growth in area was noticed for ginger (12.87%) followed by Rubber (8.41 %), arecanut (6.91%), banana (7.72%) and total spices (5.91%). While, the highest negative and significant growth rate was observed for total oilseeds (-15.24%) followed by total vegetables (-14.29%) and total pulses (-6.8/0%).

In Thirthahalli taluk area under banana (8.43%) showed a positive and significant growth followed by rubber (7.21%), arecanut (4.02 %) and total spices (3.69%). While declining trend was observed for area under total pulses (-14.24%), total vegetables (-10.29%) and coconut (-4.31%). Area under banana (10.56%) showed a significant growth rate followed by rubber (7.84%), total fruits (4.32%) and ginger (4.19%) in Sagar taluk. The growth performance of area under different crops for the Shivamogga district as a whole, revealed that banana registered the highest (9.64%) positive and significant growth rate followed by ginger (9.52%), total fruits (6.77%) and rubber (6.24%). The findings are in conformity with the results of Kamble and Wali (2016),

### **Instability indices of major crops in Hilly Zone of Karnataka (2001-02 to 2015-16)**

The details on instability indices for area under major cereals, pulses, oilseeds, vegetables, spices, fruit crops and other major commercial crops of Shivamogga district for the period from 2001-02 to 2015-16 is presented in the Table-IV. The estimated instability index for Hosanagara taluk revealed high degree of instability for total vegetables (48.27%) followed by total pulses (39.39%), total oilseeds (29.17%), cardamom (19.98%), ginger (18.57%) and coffee (23.50%). While competitively high degree of instability was registered for area under total vegetables (100.98%) and followed by cardamom (61.45%), total pulses (36.18%), ginger (30.02%), and coffee (28.73%) for Soraba taluk. Similarly, the instability results for Thirthahalli taluk depicted that, area under total oilseeds (87.54%) showed high degree of instability followed by total vegetables (65.21%), total pulses (56.02%), ginger (22.80%) and coffee (18.68%). With respect to Sagar taluk, area under total oilseeds (111.32%) showed the high degree

of instability followed by total vegetables (79.29%), total pulses (61.06%), rubber (38.11%), ginger (23.39%) and coffee (20.65%).

For the district as whole, higher degree of instability was observed for area under total oilseed crops (27.58%) followed by ginger (26.02%), total pulses (22.24%), total fruits (19.98%), rubber (18.57%), pepper (17.69%) and total vegetables (15.54%).

**TABLE IV**

*Instability indices of major crops in Hilly Zone of Karnataka (2001-02 to 2015-16)*  
(In per cent)

Crops	Shivamogga				Shivamogga Dist.
	Hosanagara	Soraba	Thirthahalli	Sagar	
Banana	18.15	14.44	16.27	9.70	8.04
Total Fruits	15.35	11.48	10.17	4.44	19.98
Ginger	28.54	30.02	22.80	23.39	26.02
Cardamom	29.04	61.45	18.13	14.60	12.87
Pepper	21.59	30.39	20.08	10.71	17.69
Total Spices	10.10	9.34	4.56	5.04	3.49
Areca nut	8.64	5.12	5.70	4.35	2.85
Coconut	7.04	6.91	9.44	3.74	4.76
Coffee	23.50	28.73	18.68	20.65	12.82
Rubber	13.58	26.44	10.11	38.11	18.57
Total Vegetables	48.27	100.98	65.21	79.29	15.45
Paddy	2.05	2.16	1.43	1.70	5.38
Total cereals	1.83	3.80	1.42	2.19	2.96
Total Pulses	39.39	36.18	56.02	61.06	22.24
Total Food Grains	1.88	3.33	4.13	2.13	2.88
Total Oilseeds	29.17	26.39	87.54	111.32	27.58

### **Crop Diversification in Hilly Zone of Karnataka (2001-02 to 2015-16)**

The pattern of crop diversification in Hilly Zone of Shivamogga district was captured by using Herfindal, Simpson and Composite entropy Index for the period from 2001-02 to 2015-16 and results are presented in the Table-V. The results from composite entropy index revealed that, among four selected taluks of Shivamogga district, Soraba

registered the high percentage of crops diversification (66%) followed by Sagar (63%), Thirthahalli (57%) and Hosanagar (54%). Similarly, the results from Simpson index showed that, Soraba showed the higher degree of crops diversification (61%) followed by Sagar (64%), Thirthahalli (56%) and Hosanagar (52%) taluks of Shivamogga district. These findings are in confirmatory with the results of Ramappa *et al.*, (2015).

**TABLE V**  
*Crop diversification in Hilly zone of Karnataka (2001-02 to 2015-16)*

<b>Diversification Index</b>	<b>Herfindal Index</b>	<b>Simpson Index</b>	<b>Composite Entropy Index</b>
Hosanagara	0.48	0.52	0.54
Soraba	0.36	0.64	0.66
Thirthahalli	0.44	0.56	0.57
Sagar	0.39	0.61	0.63
Shivamogga	0.33	0.67	0.69

## CONCLUSION

The trends in area, production and yield of banana for two study periods *viz.*, *Period-I* (1995-96 to 2004-05) and *Period-II* (2005-06 to 2014-15) for Karnataka and India were analysed using growth and instability indices. The bifurcation of study period was purposefully made to capture the impact of National Horticulture Mission (2005-06) on growth performance of area, production and productivity of banana. The study revealed that the area, production and productivity of banana both in India and Karnataka during the period from 2005-06 to 2014-15 showed significant growth rates compared to *Period-I* (1995-96 to 2004-05). The significant growth rates in area, production and productivity in banana during *Period-II* was synchronized with introduction of NHM during 2005-06 by Government of India. The NHM contributed for the significant increase in area, production and productivity of banana in India and Karnataka. The results on shift in cropping pattern in Hilly Zone of Karnataka for the period from 2001-02 to 2015-16 revealed that, majority horticulture crops exhibits positive trend compared to agricultural crops. Thus, farmers in the Zone shifted crop area from traditionally grown, less remunerative crop to more remunerative horticultural crops.

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# **Dynamics of Banana and its Competing Crops in Hilly Zone of Karnataka: An Economic Analysis**

**R.<sup>1</sup> Rangegowda, K. B. Umesh<sup>2</sup> and G. M. Gaddi<sup>3</sup>**

## **ABSTRACT**

The present study aimed at analyzing the trend in area, production and yield of banana in major growing districts of Karnataka for the period from 2001-02 to 2015-16 using growth and instability indices. The results revealed that growth rates of area, production and productivity of banana was positive and significant in Chamarajanagar district followed by Mysore, Shivamogga, Chikkamagaluru, Hassan and Bellary districts of Karnataka during 2001-02 to 2015-16. The study also concentrates on dynamics of banana and its competing crops like paddy and ginger in Hilly zone of Karnataka by considering the growth and instability in area, production, productivity and prices during the study period. The growth in area and production in banana showed relatively higher positive and significant growth trend compared to its competing crops in Shivamogga and Chikkamagaluru districts of Karnataka. Further, ginger exhibited a high degree of price variation compared to prices of banana and paddy in Hilly Zone of Karnataka. Thus, in the Hilly Zone of Karnataka farmers are shifting from traditionally grown less remunerative crops to more remunerative horticultural crops.

**Keywords:** Growth rates and Instability index, horticultural crops

## **INTRODUCTION**

Banana “Apple of Paradise” is one of the oldest fruits known to mankind and also a rich source of energy which contains 104 cal/100 grams. Banana is reported to be grown in 130 countries in the world with a annual production of 103.63 million tonnes

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(Anon, 2015). India leads the world in banana production (29%) with an annual output of about 29725 tonne. Among the fruit crops, Banana ranks first in production (39%) and second in area (13%) after mango in the country (Anon, 2016). Banana is the major staple food crop for millions of people in the developing countries of tropics, have an antiquity of over 4000 years dating back to 2020 BC. Banana serves as an ideal and low cost food source for developing countries where population rely mostly on banana for food and dietary purpose (Kumar, *et al.*, 2011). Banana plants are used as insecticide, antioxidant, colour absorber. The various products like Banana puree, powder, flour, chips, vinegar, jam, jelly, wine, alcohol, biogas, cattle feed can be prepared. Hence it is referred as “Kalpatharu” (plant of virtues) because of multifaceted uses. Thus banana is the important fruit crops with its easy reach by common man. Karnataka is one of the progressive states of India with great potential for development of fruit crops. The state is blessed with ten Agro-Climatic Zones suitable for growing variety of fruits all-round the year. Of the ten Agro-Climatic Zones, Hilly Zone contribute maximum chunk to fruit production in Karnataka. One of the unique features of Banana crop is that it’s, year round availability compared to other fruits. Considering these issues in mind, this study makes an attempt to throw light on capturing the growth performance of banana in major growing districts of Karnataka. This study also attempts to compare growth and instability of banana and its competing crops (paddy and ginger) in Hilly Zone of Karnataka in terms of area, production, productivity and prices for the period from 2001-02 to 2015-16.

## **METHODOLOGY**

The required secondary data on district-wise area, production and productivity of Banana for the study for the period from 2001-02 to 2015-16 were collected from various published sources of Government of Karnataka and Government of India for Karnataka. Area, production, productivity and monthly prices of Banana, Paddy and Ginger for Shivamogga and Chikkamagaluru districts of Karnataka for 2001-02 to 2015-16 were collected from the Directorate of Economics and Statistics, Bengaluru. The Shivamogga and Chikkamagaluru districts were chosen for the study as more than 50 per cent geographical area of these districts comes under “Hilly Zone of Karnataka”. Paddy

and ginger were purposefully selected as competing crops for banana based on area share and sustainability. . For the purpose of evaluating the objectives of the study, Compound annual growth rate analysis and Instability analysis were employed to arrive at meaningful results and draw valid and useful conclusions.

## 1. Compound Annual Growth Rate Analysis

For estimating the compound annual growth rates of the selected variables cited below, exponential function of the following form used.

$$Y_t = A B^t V_t \quad \dots (1)$$

Where,

$Y_t$  = Area/production/productivity/other variable under consideration in the year t

A = Intercept indicating Y in the base period (t = 0)

B = 1 + g

t = time period

$V_t$  = Random disturbance term

Equation (1) was converted into linear logarithmic form as follows:

$$\ln Y_t = \ln A + t * \ln B + \ln V_t$$

This is of the following form

$$Q_t = a + b_t + U_t \quad \dots (2)$$

Where,

$Q_t = \ln Y$

a = ln A

b = ln B

$U_t = \ln V_t$

The parameters 'a' and 'b' were estimated using the Ordinary Least Squares [OLS] technique. Later, the 'A' and 'B' parameters in equation (1) were obtained by taking antilogarithms of 'a' and 'b'

Average annual compound growth rate (%) was calculated using:

$$g = (B-1)*100$$

## 2. Instability analysis

The Coefficient of Variation (CV) was used as a measure to study the variability in the area, production and productivity of the selected crop. The coefficient of variation (CV) was computed using the following formula.

$$CV = (\text{Standard Deviation} / \text{Mean}) \times 100$$

Linear trend was fitted to the original time series data on area, production and productivity for the selected period. The formula suggested by Cuddy and Della (1978) was used to compute the degree of variation around the trend, mean coefficient of variation was multiplied by the square root of the difference between the unity and coefficient of determination ( $R^2$ ). A high degree of instability index signifies violent variations.

$$\text{Instability Index} = (\text{Standard Deviation} / \text{Mean}) * 100 * (1 - R^2)^{0.5}$$

$$R^2 = \text{Coefficient of determination}$$

## Results and discussion

### Growth performance of Banana in Karnataka

District-wise growth rates in area, production and productivity for all the major banana growing districts of Karnataka for the study period of 15 years from 2001-02 to 2015-16 were estimated using the exponential function and results are presented in the Table-1. It could be observed from the table that, the growth rate of area under banana was the highest in Chamarajanagar (15.35%) followed by Mysore (10.13%), Shivamogga (9.64%), Chikkamagaluru (7.96%), Hassan (7.47%) and Bellary (6.50%) districts. While with respect to production of banana the highest growth rate was registered in Chamarajanagar (15.35%) followed by Shivamogga (12.86%), Mysore (10.93%), Chikkamagaluru (10.10%), Bellary (9.02%), and Hassan (8.95%) districts. Similarly growth rate analysis of banana productivity revealed that, productivity growth rates of

banana during 2001-02 to 2015-16 found to be positive and significant in Shivamogga (3.29%) followed by Chikkamagaluru (2.50%), Bellary (2.45%), Chamarajanagar (2.14%), Belgaum (2.13%) and Hassan (1.50%) districts. Similar findings were reported by Saraswati *et al.*, (2012) on growth rates for banana area and production in Karnataka.

**Table 1: Growth rates in area, production and productivity of Banana in Karnataka (2001-02 to 2015-16) (In per cent)**

Sl. No.	Districts	Area (ha)	Production (tonnes)	Productivity (kg/ha)
1	Chamarajanagar	15.35**	17.25**	2.14**
2	Mysore	10.12**	10.93**	0.81*
3	Shivamogga	9.64**	12.86**	3.29**
4	Chikkamagaluru	7.96**	10.10**	2.50**
5	Hassan	7.47**	8.95**	1.50*
6	Bellary	6.50**	9.02**	2.45**
7	Bagalkot	5.89*	7.52*	1.63*
8	Koppal	4.98**	6.47**	1.49**
9	Chitradurga	4.77*	5.35*	0.55
10	Haveri	4.33*	4.58*	0.25*
11	Tumakuru	3.89**	4.55**	0.62*
12	Kolar	3.96	5.81	1.85*
13	Belgaum	3.84**	5.96**	2.13**
14	Mandya	3.46*	4.07	0.59
15	Davanagere	2.50*	3.75*	1.25
16	Gulbarga	2.54**	2.89**	0.42
17	Uttara Kannada	2.20	3.20*	1.02
18	Ramanagara	1.80	2.45*	0.60
19	Chikkaballapura	0.99	2.54**	1.53
20	Dakshina Kannada	0.77	1.41*	0.64

Note: \*\*\*&\*\* indicate significant levels at 1 and 5 per cent, respectively

### **Instability analysis of Banana in Karnataka**

Variations in area, production and productivity of crops is a cause of concern, hence, it is important to know the extent of variability in area, production and productivity of major banana growing districts of Karnataka and was analysed by computing the instability indices.

Among the various districts, the higher degree of instability in banana area was exhibited in Kolar (32.22%) followed by Chamarajanagar (24.58%), Bagalkot (22.47%), Mysore (21.75%), Gulbarga (19.66%) and Haveri (14.87%) districts (Table 2). While the banana area found to be relatively stable in the districts like Dakshina Kannada (1.96%), Uttara Kannada (3.01%) and Shivamogga (8.04%). Similarly instability analysis of banana production revealed that, Bagalkot (38.25%) showed the high degree of variation followed by Mysore (26.59%), Kolar (34.97%) and Gulbarga (19.91%) districts, while the among the major banana producing districts in Karnataka, Dakshina Kannada and Belgaum showed lower degree of variation in production of 2.31 per cent and 4.86 per cent, respectively.

**Table 2: Instability in area, production and productivity of Banana in Karnataka (2001-02 to 2015-16) (In per cent)**

Sl. No.	Districts	Area (ha)	Production (tonnes)	Productivity (kg/ha)
1	Chamarajanagar	24.58	17.49	5.92
2	Mysore	21.75	26.59	16.56
3	Shimoga	8.04	14.64	9.79
4	Chikkamagaluru	10.31	13.78	13.32
5	Hassan	12.64	15.87	8.75
6	Bellary	12.75	17.68	16.11
7	Bagalkot	22.47	38.25	18.74
8	Koppal	7.83	10.21	4.08
9	Chitradurga	9.04	10.12	3.90
10	Haveri	14.87	12.79	5.06
11	Tumakuru	8.94	16.60	14.63
12	Kolar	32.22	34.97	10.75
13	Belgaum	6.79	4.86	4.22
14	Mandya	11.00	9.13	6.38
15	Davanagere	14.42	15.47	11.26
16	Gulbarga	19.66	19.91	3.18
17	Uttara Kannada	3.01	6.09	13.79
18	Ramanagara	7.35	19.41	12.28
19	Chikkaballapura	8.64	6.43	3.07
20	Dakshina Kannada	1.96	2.31	3.84

In respect of productivity of banana, Bagalkot (18.74%) district exhibited the highest degree of instability, followed by Mysore (16.56%), Bellary (16.11%) and Tumakuru (14.63%) districts. In the case of Chikkaballapura (3.07%) and Gulbarga (3.18%) districts the banana productivity appears to be stable with lower values of instability. The findings of the study are in conformity with the results of Bairwa *et al.*, (2012).

### **Growth Rates of Banana and its Competing Crops in Hilly Zone of Karnataka**

The results on growth rates for area, production and productivity of Banana and its competing crops chosen for the study i.e, Paddy and Ginger for the period from 2001-02 to 2015-16 in Hilly Zone of Karnataka are presented in Table-3. The results reveal that, significant growth rates in area under banana were observed in Shivamogga (9.64%) and Chikkamagaluru (7.95%) districts compared to its competing crops. Whereas, growth rate of area under paddy registered not only negative but also found to be statistically significant in both the districts of Hilly Zone of Karnataka. On the other hand, the growth rate banana production in Shivamogga (12.95%) and Chikkamagaluru (9.91%) found to be positive and significant compared to its competing crops like ginger and paddy in Hilly Zone of Karnataka. The findings of Kumar and Chandrashekar (2015) also confirm high and significant positive growth rates for major fruit crops in Karnataka.

**Table 3: Growth rates in area, production and productivity of Banana and competing crops in Hilly zone of Karnataka (2001-02 to 2015-16)**

<b>Growth (In per cent)</b>			
<b>Hilly Zone of Karnataka</b>	<b>Banana</b>	<b>Ginger</b>	<b>Paddy</b>
<b>Area</b>			
Shivamogga	9.64**	9.52**	-0.94**
Chikkamagaluru	7.95**	5.53**	-1.28**
<b>Production</b>			
Shivamogga	12.95**	10.08**	1.42
Chikkamagaluru	9.91**	5.95**	2.35*
<b>Productivity</b>			
Shivamogga	3.29**	0.56*	2.36*
Chikkamagaluru	1.96**	0.42	3.64*

Note: \*\*&\* indicates Significant at one per cent and five per cent, respectively

Among the districts, growth rates of banana productivity found to be higher in Shivamogga district (3.29%) compared to Chikkamagaluru (1.96%). On the contrary, there was positive and significant growth in paddy both in Chikkamagaluru and Shivamogga districts.

### **Instability Indices of Banana and its Competing Crops in Hilly Zone of Karnataka**

The details on instability indices for area, production and productivity of banana and its competing crops (paddy and ginger) in Shivamogga and Chikamangalur district for period from 2001-02 to 2015-16 are presented in Table-4. The results revealed that paddy showed a moderate degree of instability in both Shivamogga (5.38%) and Chikkamagaluru (6.17). While, with respect to ginger area in Chikkamagaluru and Shivamogga had experienced higher degree of variation compared to banana and paddy. The results on production of banana revealed that in Chikkamagaluru and Shivamogga showed low degree of instability compared to paddy and ginger during 2001-02 to 2015-16. The productivity of banana in Chikkamagaluru and Shivamogga indicated comparatively low degree of variation compared to paddy and ginger. Similar findings were reported by Singha *et al.*, (2014), on high degree of instability for horticultural crops in Karnataka.

**Table 4: Instability indices for area, production and productivity of Banana and its competing crops in Hilly zone of Karnataka (2001-02 to 2015-16)**

<b>Hilly Zone of Karnataka</b>	<b>Instability Index (in per cent)</b>		
	<b>Banana</b>	<b>Ginger</b>	<b>Paddy</b>
<b>Area</b>			
Shivamogga	8.04	26.02	5.38
Chikkamagaluru	10.04	30.22	6.17
<b>Production</b>			
Shivamogga	15.62	16.05	21.31
Chikkamagaluru	19.07	36.52	28.54
<b>Productivity</b>			
Shivamogga	10.35	13.72	19.50
Chikkamagaluru	13.31	45.88	28.04

## Growth and Instability in Prices of Banana and Competing Crops in Hilly Zone of Karnataka

Growth rate analysis of prices of banana and its competing crops in Chikkamagaluru and Shivamogga of Karnataka for period 2001-02 to 2015-16 carried out using the exponential function and the results are presented in Table-5. The banana prices showed positive and significant increase in Chikkamagaluru (15.35%) and Shivamogga (9.64%). Similarly, the growth paddy and ginger prices were also observed positive and significant in Chikkamagaluru and Shivamogga districts of Karnataka.

**Table 5: Growth and Instability in Prices of Banana and competing crops in Hilly zone of Karnataka (2001-02 to 2015-16)**

Hilly Zone of Karnataka	Banana	Ginger	Paddy
<b>CAGR (%)</b>			
Shivamogga	7.87**	11.19**	11.02**
Chikkamagaluru	8.85**	10.63**	9.68**
<b>Instability Index (%)</b>			
Shivamogga	12.42	37.68	8.93
Chikkamagaluru	13.85	40.63	7.26

Note: \*\*&\* indicates Significant at one per cent and five per cent, respectively

A variation in prices of crops in general and banana and its competing crops in particular is a cause for concern. Hence in the present study it was also attempted to know the extent of price variability. The variability in monthly prices of banana, paddy and ginger for the period 2001-02 and 2015-16 was analysed by computing the instability indices and the results are presented in Table-5. The result on instability analysis of paddy exhibits a moderate degree of variation in both Shivamogga (8.93%) and Chikkamagaluru (7.26%). While ginger prices showed high degree of variability in the Chikkamagaluru (40.63%) and Shivamogga (37.68%) compared to prices of banana and paddy. The findings are in conformity with the results of Savitha and Kunnal (2016).

## CONCLUSION

The positive trends in area, production and yield of banana was observed in Chamarajanagar, Mysore, Shivamogga, Chikkamagaluru, Hassan and Bellary districts of Karnataka during 2001-02 to 2015-16. The study also brought out interesting fact that the growth in area and production of banana was higher compared to its competing crops in Shivamogga and Chikkamagaluru districts of Karnataka. Further, ginger exhibited a high degree of variation compared to prices of banana and paddy in Hilly Zone of Karnataka. Thus, it could be inferred that farmer in Hilly Zone of Karnataka shifting from traditionally grown less remunerative crops to more remunerative horticultural crops.

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Subject: Acceptance of Research Paper

Sir,

Your research paper entitled "Dynamics of Banana and its Competing Crops in Hilly Zone of Karnataka: An Economic Analysis" has been accepted for publication as *Full Length Research Paper*. The paper shall be published in **Research Journal of Agricultural Sciences (An International Journal)** Vol. 8(5): Sept-Oct 2017.

  
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