ECONOMICS OF POMEGRANATE CULTIVATION IN CHITRADURGA DISTRICT OF KARNATAKA

SAHANA, R. T.

PALB 2111

DEPARTMENT OF AGRICULTURAL ECONOMICS

UNIVERSITY OF AGRICULTURAL SCIENCES

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In

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Affectionately Dedicated to
My Beloved Parents,
Brothers, Sisters

&

My Friends

DEPARTMENT OF AGRICULTURAL ECONOMICS
UNIVERSITY OF AGRICULTURAL SCIENCES
G. K. V. K., BENGALURU - 560065

CERTIFICATE

This is to certify that the thesis entitled "**ECONOMICS OF POMEGRANATE CULTIVATION IN CHITRADURGA DISTRICT OF KARNATAKA.**" submitted by **Ms. SAHANA, R. T.** in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **AGRICULTURAL ECONOMICS** to the University of Agricultural Sciences, GKVK, Bengaluru is a record of bona-fide research work done by her during the period of her study in this university under my guidance and supervision and the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles.

Bengaluru,
April, 2016

(M. N. VENKATARAMANA)
Major Advisor and Associate Professor,
Department of Agricultural Economics
UAS, GKVK, Bengaluru

APPROVED BY

CHAIRMAN:

(M. N. VENKATARAMANA)

MEMBERS:

1. **(B. V. CHINNAPPA REDDY)**

2. **(T. N. PRAKASH KAMMARDI)**

3. **(T. N. VENKATAREDDY)**

4. **(V. MANJUNATH)**

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ECONOMICS OF POMEGRANATE CULTIVATION IN CHITRADURGA DISTRICT OF KARNATAKA

SAHANA, R. T

ABSTRACT

Pomegranate is one of the commercially important fruit crops of India. The study was conducted to examine growth in area, production and productivity, resource use efficiency, costs and returns in pomegranate and document and analyse farmer's method of cultivation of pomegranate in comparison with scientific method. Primary data was collected from 60 sample farmers each under traditional (Hiriyur taluk) and emerging (Hosadurga taluk) areas of Chitradurga district. The results showed increasing trend in pomegranate area, production and productivity during study period (2002-2014) in Chitradurga district. Similar trend was observed in Hosadurga taluk but the production and productivity were showing declining trend in Hiriyur taluk. The annual maintenance cost incurred by farmers in traditional area and emerging area was ₹ 3, 02,145 and ₹ 3, 06,882 per ha, respectively. The net return per hectare was almost same in both regions at ₹ 2, 92,030 and ₹ 2, 91,096, respectively. The average yield per ha of pomegranate obtained in traditional area it was 9.87 t and in emerging area was 9.56 t. The resource use efficiency analysis revealed that the resources were not optimally used in both the areas. The difference in farmer's method and scientific method (Package of practice) of pomegranate cultivation revealed that, additional three crops were taken in farmer's method due to reduction of establishment period to 1.5 years from 3 years (scientific method) and net gain of ₹ 4, 69,360 per ha was obtained in farmers method. The study indicated that pomegranate cultivation is a profitable enterprise.

April, 2016 (M.N. Venkataramana)

UAS, GKVK, Bengaluru (Major advisor)

ಕರ್ನಾಟಕ ರಾಜ್ಯದ ಚಿತ್ರದುರ್ಗ ಜಿಲ್ಲೆಯ ದಾಳಿಂಬೆ ಬೇಸಾಯದ ಆರ್ಥಿಕತೆ

ಸಹನ, ಆರ್.ಟಿ

ಪ್ರಬಂದ ಸಾರಾಂಶ

ದಾಳಿಂಬೆ ಬೆಳೆಯು ಭಾರತದ ಅತಿ ಪ್ರಮುಖ ವಾಣಿಜ್ಯ ಬೆಳೆಗಳಲ್ಲಿ ಒಂದಾಗಿದೆ. ಈ ಸಂಶೋದನೆಯನ್ನು ದಾಳಿಂಬೆ ಬೆಳೆಯ ಪ್ರದೇಶ ಪ್ರವೃತಿ, ಉತ್ಪಾದನೆ, ಉತ್ಪಾದಕತೆ, ಸಂಪನ್ಮೂಲ ಬಳಕೆಯ–ದಕ್ಷತೆ, ದಾಸ್ತಾವೇಜು ವೆಚ್ಚ, ಆದಾಯ ಮತ್ತು ರೈತರು ಅನುಸರಿಸುತ್ತಿರುವ ಪದ್ಧತಿಗಳ ಹಾಗೂ ವೈಜ್ಞಾನಿಕ ಪದ್ಧತಿಗಳ ನಡುವೆ ಇರುವ ವ್ಯತ್ಯಾಸಗಳನ್ನು ವಿಶ್ಲೇಷಿಸಲಾಗಿದೆ. ಪ್ರಾಥಮಿಕ ಮಾಹಿತಿಯನ್ನು 60 ಜನ ರೈತರನ್ನೊಳಗೊಂಡ ಸಾಂಪ್ರದಾಯಕ ಪದೇಶ (ಹಿರಿಯೂರು ತಾಲ್ಲೂಕು) ಹಾಗೂ ಉದಯೋನ್ಮುಖ ಪ್ರದೇಶಗಳಿಂದ (ಹೊಸದುರ್ಗ ತಾಲ್ಲೂಕು) ಸಂಗ್ರಹಿಸಲಾಗಿದೆ. ಚಿತ್ರದುರ್ಗ ಜಿಲ್ಲೆಯಲ್ಲಿ ದಾಳಿಂಬೆ ಬೆಳೆಯ ಪ್ರದೇಶ ಪ್ರವೃತ್ತಿ, ಉತ್ಪಾಧನೆ ಹಾಗೂ ಉತ್ಪಾದಕತೆಯು ಅಧ್ಯಯನದ ಅವಧಿಯಲ್ಲಿ (2002–14) ಹೆಚ್ಚಾಗಿರುವುದು ಫಲಿತಾಂಶದಿಂದ ತಿಳಿದುಬಂದಿದೆ. ಇದೇ ಪ್ರವೃತ್ತಿ ಹೊಸದುರ್ಗ ತಾಲ್ಲೂಕಿನಲ್ಲೂ ಕೂಡ ಮುಂದುವರಿದಿದ್ದು. ಹಿರಿಯೂರು ತಾಲ್ಲೂಕಿನಲ್ಲಿ ಉತ್ಪಾಧನೆ ಹಾಗೂ ಉತ್ಪಾದಕತೆ ಪ್ರವೃತ್ತಿ ಕುಸಿಯುತ್ತಿರುವುದು ಕಂಡುಬಂದಿದೆ. ದಾಳಿಂಬೆ ಬೆಳೆಯ ವಾರ್ಷಿಕ ನಿರ್ವಹಣಾ ವೆಚ್ಚವು ಪ್ರತಿ ಹೆಕ್ಟೇರಿಗೆ ಸರಾಸರಿ ₹ 3,02,145 ಹಾಗೂ ₹ 3,06,882 ಅನುಕ್ರಮವಾಗಿ ಸಾಂಪ್ರದಾಯಕ ಹಾಗೂ ಉದಯೋನ್ಮುಖ ಪ್ರದೇಶಗಳಲ್ಲಿ ಕಂಡುಬಂದಿದೆ. ಸಾಂಪ್ರದಾಯಕ ಹಾಗೂ ಉದಯೋನ್ಮುಖ ಪ್ರದೇಶಗಳಲ್ಲಿ ದಾಳಿಂಬೆ ಬೆಳೆಯ ಇಳುವರಿಯು ಕ್ರಮವಾಗಿ ಸರಾಸರಿ 9.87 ಟನ್ ಮತ್ತು 9.56 ಟನ್ ಆಗಿದ್ದು, ನಿವ್ವಳ ಆದಾಯವು ಉದಯೋನ್ಮುಖ ಪ್ರದೇಶಕ್ಕಿಂತ (₹ 2,91,096) ಸಾಂಪ್ರದಾಯಿಕ ಪ್ರದೇದಲ್ಲಿ (₹ 2,92,030) ಹೆಚ್ಚಾಗಿರುವುದು ಕಂಡುಬಂದಿದೆ. ದಾಳಿಂಬೆ ಬೆಳೆಯಲ್ಲಿ ಸಂಪನ್ಮೂಲ ಬಳಕೆಯ ಧಕ್ಷತೆಯನ್ನು ಕಬ್–ಡಗ್ಲಸ್ (cob-douglas) ಉತ್ಪಾದನಾ ಕಾರ್ಯವನ್ನು ಬಳಸಿಕೊಂಡು ಅಂದಾಜಿಸಲಾಗಿದ್ದು, ಎರಡು ಪ್ರದೇಶಗಳಲ್ಲಿ ಸಂಪನ್ಮೂಲಗಳನ್ನು ಅತ್ಯುತ್ತಮವಾಗಿ ಬಳಸಿಕೊಂಡಿಲ್ಲ ಎಂಬುದು ಫಲಿತಾಂಶದಿಂದ ಧೃಡಪಟ್ಟಿದೆ. ದಾಳಿಂಬೆ ಬೆಳೆಯಲ್ಲಿ ರೈತರು ಅನುಸರಿಸುತ್ತಿರುವು ವಿಧಾನಗಳು ಹಾಗೂ ವೈಜ್ಞಾನಿಕ ಪದ್ದತಿಗಳನ್ನು ಪರಿಶೀಲಿಸಿದಾಗ, ವೈಜ್ಞಾನಿಕ ಪದ್ದತಿಯಲ್ಲಿ ದಾಳಿಂಬೆ ಬೆಳೆಯ ಸ್ಥಾಪನಾ ಅವಧಿಯನ್ನು 3 ವರ್ಷಗಳಿಗೆ ಅನುಸರಿಸಲಾಗಿದೆ. ರೈತರು ಸ್ಥಾಪನಾ ಅವಧಿಯನ್ನು ಕೇವಲ 1.5 ವರ್ಷಗಳನ್ನು ಮಾತ್ರ ಅನುಸರಿಸುತ್ತಿದ್ದು, 3 ಹೆಚ್ಚುವರಿ ಬೆಳೆಗಳನ್ನು ತೆಗೆದುಕೊಳ್ಳುತ್ತಿದ್ದು ವೈಜ್ಞಾನಿಕ ಪದ್ದತಿಗಿಂತ ಹೆಚ್ಚು ನಿವ್ವಳ ಆದಾಯ (₹ 4,69,360 ಹೆಕ್ಟೆರ್) ವನ್ನು ಪಡೆಯುತ್ತಿದ್ದಾರೆ. ಈ ಮೇಲಿನ ಎಲ್ಲಾ ಅಂಶಗಳನ್ನು ಕ್ರೂಢೀಕರಿಸಿ, ದಾಳಿಂಬೆ ಬೆಳೆಯು ಒಂದು ಲಾಭಾದಾಯಕ ಉದ್ಯಮವೆಂದು ಈ ಅಧ್ಯಯನವು ಧೃಡೀಕರಿಸುತ್ತದೆ.

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ಕೃ. ವಿ. ವಿ, ಜಿ.ಕೆ.ವಿ.ಕೆ, ಬೆಂಗಳೂರು ಮುಖ್ಯ ಸೆಲಹೆಗಾರ

The average per ha yield for pooled respondents was 9.71 mt and the net returns obtained were Rs. 2, 92,253 per ha

Economics of pomegranate cultivation in Chitradurga district of Karnataka

SAHANA, R. T. (PALB 2111) AND M.N.VENKATARAMANA

Department of Agricultural Economics, University Of Agricultural Sciences, Bengaluru-65

Introduction

Pomegranate (*Punica granatum*) is one of the commercially important fruit crops of India. It's origin is Iran (Persia). Generally, pomegranate is not similar to other fruit crops of temperate, tropical or subtropical region. It is currently ranked 10th in terms of fruit consumed annually in the world. India is the world's leading producer of pomegranate and presently more than 1.32 lakh hectares area in India is covered by it. There is tremendous potential for Indian pomegranates in the global markets.

Karnataka has been the first state in the country, to set-up a separate department for the development of Horticulture in the year 1965, because of its ideal agro-climatic condition and enterprising farming community.

In Chitradurga district of Karnataka, pomegranate is being grown on commercial scale. The area under pomegranate in the district is 6,911 ha (37.55 % of total area under pomegranate in the state).

OBJECTIVE

- To estimate the cost, return and resource use in pomegranate cultivation in Chitradurga district.

Methodology

Study area and sampling

The present study was purposively undertaken in Chitradurga district of Karnataka, where area under pomegranate was significant. Traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) were selected from the Chitradurga district as the highest area was noticed in the district. Data was collected from 60 farmers. 30 farmers from Hosdurga and 30 farmers from Hiriyur taluk.

Data source:

Primary data: It was collected from the sample farmers using pre-tested schedule.

Secondary data: The data related to district wise area, production and productivity of pomegranate in Karnataka was collected from Directorate of Horticulture, Lalbagh, Bengaluru.

Analytical tools and techniques:

- Descriptive statistics analysis.
- Financial feasibility tests

Cobb – Douglas production function. Following is the per hectare production function specified for the purpose.

$Y = a\ X_1^{b1}\ X_2^{b2}\ X_3^{b3}\ X_4^{b4}\ X_5^{b5} e^{u}$

Y= Gross returns (₹)

X_1 = Human labour (₹)

X_2 = FYM (₹)

X_3 = Fertilizer (₹)

X_4 =Plant protection chemicals (₹)

X_5 = Irrigation (₹)

a = Constant and u = Error term.

Results

Table 1: Table showing cost and returns from per ha pomegranate cultivation.

Sl. No.	Particulars		Traditional area (Hiriyur taluk)		Emerging area (Hosadurga taluk)		Pooled respondents	
		Unit	Quantity	Cost	Quantity	Cost	Quantity	Cost
I.	**Variable cost**							
A.	**Labour cost**							
1	Weeding	Man days	13.6	3400	15.71	3928	14.655	3664
2	Manure and fertilizer application	Man days	25.24	6312	24.28	6071	24.76	6192
3	Plant protection chemical application	Man days	12.8	3202	17.02	4255	14.91	3729
4	Pruning	Rs.	-	38919		39153		39036
5	Watch and ward	Rs.	-	7500		8300		7900
6	Harvesting	Man days	26.71	6678	22.39	5598	24.55	6138
	Total labour cost			**66011**		**67305**		**66659**
B.	**Material cost**							
1	Tank silt	Mt	18.47	6386	12.74	5522	15.605	5954
2	Manures	Mt	9.47	19732	10.36	19891	9.915	20325
3	Fertilizers	Kg	-	26589		22272		24431
4	Plant protection chemicals	Lit	-	29232		36136		32684
5	Irrigation charges	Rs.		11524		9651		10588
6	Miscellaneous	Rs.		1854		1565		1710
	Total material cost			95317		95037		95692
	Interest on working capital @ 10 %			14133		14234		14235
	Total (A+B)			**177461**		**176576**		**176586**
C.	**Marketing cost**							
	a) Box charges	No.	800	9600	760	9120	780	9360
	b) Cello tape	No.	10	380	10	380	10	380
	c) Grading and packaging (labour)	Man days	10.2	2550	12.4	3100	11.3	2825
	d) Commission @ 2 %			11883		11960		11947
	Total marketing cost			**24413**		**24560**		**24512**
	Total variable cost (A+B+C)			**201874**		**203136**		**203098**
II.	**Fixed cost**							
1	Land revenue			35		35		35
2	Depreciation			2472		2876		2674
3	Rental value of land			23586		24092		23839
4	Interest on fixed capital @ 8 %			201		233		217
5	Annualized establishment cost			73975		76510		75243
	Total fixed cost			**100271**		**103746**		**102008**
	Total cost (I + II)			**302145**		**306882**		**305106**

The average per ha maintenance cost incurred by pomegranate growers was Rs. 3,05,106 per ha of which the total variable cost was accounted Rs. 2,03,098 (66.57 %) and fixed costs accounted for about Rs. 1,02,008 (33.43 %).

Table 2: Cost and returns of pomegranate cultivation in the study area.

Sl. No.	Particulars	Traditional area (Hiriyur taluk) (N=30)	Emerging area (Hosadurga taluk) (N=30)	Pooled (N=60)
1	Yield (t/ha)	9.87	9.56	9.71
2	Price (Rs./kg)	60.2	62.55	61.52
3	Gross returns (Rs./ha)	594174	597978	597359
4	Total cost (Rs./ha)	302144	306882	305106
5	Net returns (Rs./ha)	292030	291096	292253
6	Cost of production (Rs./t)	30612	32100	31421
7	Returns on variable cost (Rs./ha)	392300	394842	394261

The average yield of pomegranate obtained by the sample farmers in traditional area (Hiriyur taluk) was 9.87 mt per ha and net returns was Rs. 2, 92,030 per ha. The average total yield of pomegranate obtained by the sample farmers in emerging area (Hosadurga taluk) was 9.56 mt per ha and net returns were Rs. 2, 91,096. The cost of production was to be Rs.30, 612 mt in traditional area (Hiriyur taluk) and Rs.32,100 mt in emerging area (Hosadurga taluk).

Table 3:Economics of investment on pomegranate cultivation.

Sl. No	Particulars	Unit	Traditional area (Hiriyur taluk)	Emerging area (Hosadurga taluk)	Pooled
1	Net Present Value (@ 8 %)	Rs.	1285751	1266536	1280134
2	Benefit Cost Ratio (@ 8 %)	Ratio	1.60	1.58	1.59
3	Internal Rate of Return	Per cent	66	64	65
4	Payback Period	Years	1.66	2.08	1.68

The investment appraisal analysis revealed that the payback period of 1.68 years, net present value of Rs. 12,80,134, discounted benefit cost ratio of 1.59 and internal rate of returns of 65 per cent per ha indicates the worthiness of investment on pomegranate cultivation in the study area.

Discussion

The highest cost of cultivation was incurred by emerging area (Hosadurga taluk) was Rs.306882/ha compared to traditional area (Hiriyur taluk) was Rs.302145/ha. Among variable cost, the major share was for labour cost (21.85%) of which major item was pruning cost constituted the major cost and in case of material cost, plant protection chemicals was highest. In case of fixed cost, rental value of land constituted the major cost component. The net returns were highest in case of traditional area (Rs.292030/ha) compared to emerging area (Rs.291096/ha).The return per rupee of investment was found to be 1.60, 1.58 and 1.59 in case of Hiriyur, Hosadurga and pooled farmers. Resources are not optimally used in pomegranate cultivation.

Fig .1: Pomegranate orchard

Table 4: Resource - use efficiency in pomegranate cultivation in traditional area (Hiriyur taluk)

Variables	Geometric mean level of input (Rs.)	Coefficient	MVP	MFC	MVP/MFC
X_1=Human labour	62127	0.2947	3.25	1	3.25
X_2=FYM	19204	0.0835	0.82	1	0.82
X_3=Fertilizer	25612	0.6650**	6.75	1	6.75
X_4=PPC	27682	0.0880**	0.83	1	0.83
X_5=Irrigation	11275	0.3123***	2.91	1	2.91
Intercept					8.28*
F value					8.69 **
R^2					0.64

Note:1. ***, ** and * indicates significant at 1, 5 and 10 % level

Table 5: Resource - use efficiency in pomegranate cultivation in emerging area (Hosadurga taluk)

Variables	Geometric mean level of input (Rs.)	Coefficient	MVP	MFC	MVP/MFC
X_1=Human labour	65345	0.4967***	5.50	1	5.50
X_2=FYM	20891	0.1110	1.10	1	1.10
X_3=Fertilizer	23272	0.2309**	2.32	1	2.32
X_4=PPC	34156	0.0373	0.39	1	0.39
X_5=Irrigation	9551	0.2199***	2.01	1	2.01
Intercept					7.33*
F value					7.53 **
R^2					0.59

Table 6: Resource - use efficiency in pomegranate cultivation (pooled respondents).

Variables	Geometric mean level of input (Rs.)	Coefficient	MVP	MFC	MVP/MFC
X_1=Human labour (Rs./ha)	64679	-0.0256	-0.28	1	-0.28
X_2=FYM (Rs./ha)	21345	0.0196	0.19	1	0.19
X_3=Fertilizer (Rs./ha)	25631	0.5669***	5.75	1	5.75
X_4=PPC (Rs./ha)	32884	0.0667***	0.69	1	0.69
X_5=Irrigation (Rs./ha)	11568	0.1427***	1.33	1	1.33
Intercept					3.73***
F value					7.59 **
R^2					0.52

Summary

- The study indicated that pomegranate cultivation is a very profitable enterprise. Hence, this needs to be popularized among farmers by the agricultural extension agencies.

- Spending higher amounts on acquiring and using inputs like irrigation water and fertilizers will substantially increase the yield levels and thereby improve the income of the pomegranate farmers.

Advisory committee

Chairperson : Dr.M.N.Venkataramana

Members : Dr. T.N.Prakash kammardi
Dr. B.V.Chinnappa Reddy
Sri.V.Manjunath
Dr. T..N.Venkatareddy

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I INTRODUCTION

India is bestowed with a varied agro climatic conditions that offer immense scope for cultivation of various kinds of fruit crops. This provides an excellent platform for the country to emerge as a leading producer of fruit crops. The horticulture sector encompasses a wide range of crops e.g., fruit crops, vegetable crops, tuber crops, ornamental crops, medicinal and aromatic crops, spices and plantation crops. While, the first few five year Plans assigned priority to achieving self sufficiency in food grain production. Over the years, horticulture has emerged as an indispensable part of agriculture, offering a wide range of choices to the farmers for crop diversification. It is the fastest growing sector within agriculture, thanks to the economic prosperity that has provoked market changes in the life styles and the consumption habits.

The special thrust given to the sector, especially after the introduction of the Horticulture Mission for North East & Himalayan States (HMNEH) and the National Horticulture Mission (NHM) in the X^{th} Plan has borne positive results. Given the increasing pressure on land, the focus of growth strategy is on raising productivity by supporting high density plantations, protected cultivation, micro irrigation, quality planting material, rejuvenation of senile orchards and thrust on post harvest management to ensure that farmers do not lose their produce in transit from farm gate to the consumer's plate.

World scenario

The pomegranate crop is cultivated in Spain, Iran, India, Turkey, South East Asia, Afghanistan, tropical Africa, parts of USA, etc. The crop is also cultivated in the Mediterranean region and thrives well in regions with semi-arid to sub- tropical climatic conditions.

At the Global level, India is the world's largest producer of pomegranate followed by Iran and other countries like Turkey, Spain, Tuni- sia, Morocco, Afghanistan, China, Greece, Japan, France, Armenia, Cyprus, Egypt, Italy and Palestine also cultivating pomegranate. At present, good-quality pomegranates come from Turkey, Iran, Afghanistan, Syria, Morocco and Spain. Pomegranate fruits are mainly used for dessert purposes. It is grown for its fully luscious grains called 'Arils'; the fruits are very attractive with sweet acidic taste. The fruits are also processed to make juice, syrup, jam, jelly, wine, flavor cakes, etc. Its nutritional and medicinal values are given ample importance.

Status of Indian Horticulture

The horticulture sector contributes about 30 per cent of the GDP from about 14 per cent of the total area and about 37 per cent of the total exports of agricultural commodities. It also provides ample opportunities for sustaining large number of agro-industries which generates substantial employment opportunities. This has placed India among the foremost countries in horticulture production just behind China. India as the second largest producer of fruits and vegetables, largest producer and consumer of cashew nut, tea, spices, third largest producer of coconut, fourth largest producer and consumer of rubber and

sixth largest producer of coffee in the world.

The horticulture sector has been a driving force in stimulating a healthy growth trend in Indian agriculture. India is currently producing 281 mt of horticulture produce from an area of 24 m ha. It constitutes about 13 per cent of world's fruit production and 15 per cent of world's vegetable production. Over the last decade, the area under horticulture grew by about 4 per cent per annum but production rise by 8 per cent per annum. The higher growth rate in horticulture was brought about by improvement in productivity of horticulture crops, which increased by about 28 per cent between 2001-02 and 2011-12.

Karnataka scenario

Karnataka is located in the western half of the Deccan Plateau. The state covers an area of 1, 91,976 km^2, which is 6 per cent of the total geographical area of India and enjoys a salubrious climate throughout the year. It is the eight largest states by area. About 38,724 km^2 (20 % of the state's geographic) area is covered by forests. A total of 1, 23,100 km^2 of land (12.31 m ha.) is cultivated in Karnataka constituting 64 per cent of the total geographical area.

Status of National Horticulture Mission in Karnataka

The centrally sponsored scheme of National Horticulture Mission (NHM) is being implemented in 30 districts on a Mission mode approach to address all the issues related to holistic development of horticulture in the state since 2005-06. The programme in the state of Karnataka is being implemented by the State Horticulture Development Society through District Mission Committees involving farmers, societies, NGOs, grower associations, SHGs, State institutions etc. The focus crops identified under the programme includes mango, banana, grape, pomegranate, pineapple, cashew, cocoa, ginger, pepper, flowers and aromatic plants.

Status of Horticulture in Karnataka

Due to the sincere efforts made by the NHM, Karnataka produces about 17.80 mt of horticulture produce from an area of 1.87 m ha which accounts for 7.40 per cent of horticultural production in the country. Major share of production is from vegetables (51 %), fruits (35 %) and plantation crops (10 %).

Pomegranate production in India and Karnataka

Pomegranate (*Punica granatum*) belongs to family *Punicaceae* is one of the commercially important fruit crops of India, which is native to Iran (Persia). It is currently ranked 10^{th} in terms of fruit consumed annually in the world. There is tremendous potential for Indian pomegranates in the global markets. Karnataka has been the first state in the country, to set-up a separate department for the development of horticulture in the year 1965, because of its ideal agro-climatic condition and enterprising farming community.

Generally, pomegranate is not similar to other fruit crops of temperate, tropical or subtropical fruits except that it behaves as deciduous in temperate but in tropical and subtropical regions it behaves as an evergreen or partially deciduous. The fruit is symbolic of plenty and very much liked for its cool, refreshing juice and valued for its medicinal properties. Its popularity is also due to the ornamental nature of the plant which bears bright red attractive flowers.

The versatile adaptability, hardy nature, low maintenance cost, steady but high yields, better keeping quality, fine table and therapeutic values and possibilities to keep the plant into rest period when irrigation potential is generally low, indicate the avenues for increasing the area under pomegranate in India. To highlight its importance, it was chosen as a symbol of the 18th International Horticultural Congress held during 1970.

India is one of the leading countries in pomegranate production and presently more than 1.32 lakh ha area is under cultivation. Out of this, nearly 94,000 ha area is covered in Maharashtra, which produces fruits of over one lakh mt worth about ₹ 400 cores. Karnataka is the second largest pomegranate producing state accounting for 19.2 per cent of total production of pomegranate in the country. The state is producing about 1, 98,600 mt of pomegranate from an area of 18400 ha. The productivity of pomegranate in the state is 10.75 t/ha. The major producing belts are Chitradurga, Vijayapur, Tumkur, Dharwad and Bagalkot.

Pomegranate production in Chitradurga district

In Chitradurga district of Karnataka, pomegranate is being grown on commercial scale. The area under pomegranate in the district is 6,911 ha (37.55 % of total area under pomegranate in the state). Hiriyur taluk and Chitradurga taluks have emerged as the leading pomegranate growing areas in the state, as these two taluks had relatively dry weather and red soil which are favorable for growing the crop.

A few years ago, a group of farmers from Hiriyur taluk and Chitradurga had decided to experiment growing pomegranate after they suffered heavy losses by cultivating traditional crops in dry conditions. The yield surprised their expectations and encouraged villagers of Hosadurga to take up pomegranate cultivation on a large scale. Besides, there is a continuous demand for pomegranate grown in the state in European countries because of the taste, color and higher number of seeds of pomegranate varieties (Ganesh, Dholka, Bedana, Bhagwa and Araktha) cultivated in India.

Study on economics of pomegranate production is indispensible since there is no proper farm business data on cost of production. The accurate figures on establishment cost, operating cost and input requirement of pomegranate orchard could be of great help to the pomegranate growers in Karnataka.

The area under pomegranate is gradually increasing in the district. A few studies have been conducted on the economics of production and marketing of pomegranate. A detailed study in this regard would help the farmers to have first

hand prior knowledge of the profitability of pomegranate cultivation. The present study was undertaken with the following objectives.

Objectives

1) To analyse growth in area, production and productivity of pomegranate in Chitradurga district of Karnataka.

2) To estimate the cost, returns and resource use in pomegranate cultivation in Chitradurga district.

3) To document and analyse farmer's method of cultivation of pomegranate in comparison with scientific method (POP).

Hypothesis

1. a) There is considerable increase in the area and production of pomegranate crop Over the years

   b) Higher net income leads higher area and production

2. a) Cost of plant protection chemical constitute the major cost component

   b) Resources are not optimally used in pomegranate cultivation

3. Majority of farmers are not adopting the scientific method (POP) of pomegranate Cultivation

Presentation of the study

The study is presented under the following chapters

I. Introduction: In the introductory chapter, the nature and importance of research problem, specific objectives and hypothesis of the study have been presented.

II. Review of Literature: It deals with the review of the relevant concepts and past studies useful to the present study.

III. Methodology: This chapter highlights overview of the study area, nature and sources from where relevant data have been collected, analytical tools employed for evaluating objectives of the study.

IV. Results: The empirical results are presented in this chapter.

V. Discussion: It emphasizes on interpretations of the results and attempts to establish relationships between certain variables and their outcomes.

VI. Summary and Policy Implications: Brief summary of the main findings of the study along with policy implications drawn from the findings have been presented.

VII. References: The list of referred journals, books, research reports, papers and thesis is presented in this section**.**

II REVIEW OF LITERATURE

Considering the objectives of the study relevant studies were reviewed. The salient findings are summarized and are presented below. For clarity, these reviews are presented under the following sub headings.

2.1 Compound growth rates

2.2 Cost of cultivation

2.3 Resource use efficiency

2.4 Farmers method of cultivation of pomegranate in comparison with scientific method.

2.1. Compound growth rates

Fialor (1985) studied the production pattern and marketing of cocoa in Ghana. He used the exponential model for computing the growth rate of area, production, yield and export on world cocoa. He concluded that the rate of growth in acreage under cocoa for the world as a whole had decreased. However, the total production had increased at 1.4 per cent per annum, mainly because of a positive growth rate in productivity at 2.3 per cent per annum. The low growth rate of export of the world as a whole (-2.3 % per annum) reflected that the international trade in cocoa was on the declining trend.

Prakash (1986) studied the growth rates in production, consumption, exports and imports of Indian coffee by using modified exponential growth function. The results indicated that the growth rate in production of Indian coffee increased consistently and recorded a positive growth rate of 4.51 per cent per annum during 1962-63 to 1981-82. The consumption recorded 1.69 per cent growth per annum for the same period. Exports, however, had registered a significant increase during the study period, which recorded a compound growth rate of 6.94 per cent per annum.

Patil *et al*. (1987) studied the trends and growth rates in area, production and productivity and the factors responsible for change in acreage under banana crop in Jalgaon district using time series data from 1950-51 to 1979-80. The results revealed that, the area under banana increased tremendously from 6,600 ha to 33,400 ha and the production of banana has increased 69 per cent in the same period. Net irrigated area and one year lagged price of banana have jointly explained nearly 97 per cent of the variation in the acreage under banana.

Indira (1988) worked out the rate of growth in internal release of coffee in comparison with the growth rate in production and exports. The compound growth rates were calculated for two time periods: Period-I from 1953 to 1969 and period-II from 1969 to 1981. Between 1953 and 1969, when production increased at 3.13 per cent per annum, exports increased at the rate of 9.8 per cent. The annual rate of increase in production, internal release and exports for the second period were much smaller relative to the first period. Production increased at an annual rate of 4.32 per

cent, while internal releases and exports recorded a growth rate of 2.44 per cent and 5.79 per cent, respectively.

Indiradevi *et al.* (1990) computed the trends in area, production and yield of banana in Kerala state. Quadratic function was fitted to explain the trend in a period of 17 years (1970-87). The study revealed that banana production in the state showed an increasing trend (94.57 %) because of the intensive cultivation practices and favourable price factors for banana.

Handiganur (1995) studied the growth rates of area, production and productivity of grapes in Bijapur district during the time period 1978-79 to 1992-93. The study showed an increase of 7.12 per cent area of grapes in Bijapur district and an increase of 0.6 per cent in area, 2.80 per cent in production and 2.0 per cent in productivity of grapes in Karnataka state. He concluded that the increase in production and productivity was due to the use of improved cultural practices, increased use of manures, fertilizers and plant protection chemicals.

Mahesh (2000) studied the performance of Indian tea with regard to growth in quantity, value and unit value of export for the time period 1979-80 to 1998-99 using the exponential growth model. The results revealed that, the export quantity of Indian tea exhibited a negative growth rate of 1.15 per cent per annum, whereas the export value and unit price recorded comparatively higher annual growth rates at 8.82 per cent and 7.65 per cent per annum, respectively.

Gangal (2002) studied the growth rate in area, production and productivity of banana in north Karnataka and Karnataka state as a whole. The results revealed that the growth in area (6.69 %) in Karnataka state between 1980 and 2000 was substantially higher than all other major banana growing states and all India average.

Namasivayam and Pual (2004) studied the trend in area, production and productivity of coconut in India. The entire analysis was done separately in three phases for the overall period, under the study period 1977-78 to 1986-87 is I phase, 1987-86 to 1996-97 is II phase, 1997-98 to 2001-2002 is III Phase. The trend in growth rate analysis revealed that the growth in area, production and productivity over the years were positive in the first two periods while in the third period productivity was negative.

Ramchandra (2006) studied the growth rate of area, production and productivity of sapota in Dharwad and Belgaum districts of Karnataka using time series data from 1994-95 to 2004-05. The study showed that the growth rate in area (3.73 %) and production (-4.77 %) of sapota were found to be highest in Dharwad district. Whereas, Belgaum district registered negative growth of 3.07 per cent in case of area, 9.18 per cent in production and 6.30 per cent in productivity, respectively. On the contrary higher growth rate was observed in case of the state as a whole, which registered a positive growth rate in area (4.54 %) and negative growth both in production (-1.98 %) and productivity (-6.24 %) of sapota.

Kareemulla *et al.* (2007) studied the growth rate of area, production and productivity of Indian gooseberry – Aonla (Emblic Officinalis Gaertn.) in Pratapgarh

district of Uttar Pradesh. The study showed that the area occupied by aonla based farming system grew at a growth rate of 4.02 per cent during the period 1995-2005. Whereas, the production increased at a growth rate of 5.2 per cent and the productivity at a growth rate of 5.7 per cent.

Anonymous (2013) submitted report to State Horticulture Mission, Bihar on litchi resource mapping, indicated a declining trend over a decade in the volume of production and almost a constant trend in area of production for litchi in Bihar. While, the area under litchi cultivation slightly increased from 23,500 ha in 1996-97 to 29,800 ha in 2007-08, production declined by almost 20 per cent from 2, 82,000 t to 2, 23,000 t during this period due to decrease in productivity from 12 t/ha to 7.2 t/ha.

2.2 Cost of cultivation

Subrahmanyam and Mohandas (1982) estimated the costs and returns of Coorg mandrin oranges in Karnataka. The study showed that the mandrin orange tree requires seven years to establish and starts bearing from eight year. The average cost of maintenance from the eighth year onwards was found to vary from ₹ 65 to ₹ 590 with an average of ₹ 370 per acre. The per acre returns range between ₹ 219 and ₹ 3000 and the average gross return per acre was found to be ₹ 992.

Sundaresan and Thanasekaran (1984) studied the costs and returns of Muscat grapes production in Madurai district of Tamil Nadu. The study revealed that, on an average ₹ 49,465 per ha was required for establishing vines up to bearing stage, of which, operation and maintenance costs accounted to ₹ 26,658. The cost of production of grape was ₹ 1.58 per kg for the first four years, ₹ 1.80 from the fifth to eight year and ₹ 2.29 per kg after eighth year.

Subrahmanyam (1986) examined the cost of cultivation of lime and sweet orange in Andhra Pradesh. He included the establishment cost (planting as well as maintenance cost up to bearing) and maintenance cost after bearing. The total cost of establishment for lime and sweet orange was found to be ₹ 4,664 and ₹ 5,484 per ha, respectively. The cost of maintenance up to bearing stage in sweet orange was ₹ 260 per ha compared to ₹ 160 per ha on the cost of lime. The average net returns were found to be ₹ 4,617 and ₹ 5,102 per ha in the case of lime and sweet orange, respectively.

Subrahmanyam (1987) studied the cost and returns of mango orchards in Karnataka. The study showed that, on an average the establishment cost of mango orchard required ₹ 3000 per ha. The maintenance cost of mango orchards was only ₹200 per ha. The gross return from a hectare of mango orchard was ₹1200 in Karnataka. As indicated by the study, the payback period was 11 years. Internal rate of return was 30 per cent and B: C ratio was 2 indicating that the investment was profitable.

Thomas and Gupta (1987) studied the economics of banana cultivation in Kottayam district of Kerala. The study revealed that the expenditure on manures and fertilizers followed by labour cost were the major items of cost of cultivation of banana. They found that an amount of more than ₹ 6000 per ha can be gained as

profit by undertaking banana cultivation.

Koujalagi (1990) studied the pattern of investment in pomegranate orchards in Bijapur district, Karnataka. The establishment cost (₹ 24,229) consisted of material cost in the initial year (85.65 %) and maintenance cost (49.35 %) upto bearing period of three years. The material cost included the value of land, plant material, cost of digging of pits and planting, well, pump set, pump house and sprayer. The per ha total establishment cost worked out to be ₹24, 224 and returns were ₹ 45,430.

Raikar (1990) studied production and marketing of cashew in Karnataka. The study revealed that the per hectare annual maintenance cost of cashew plantation was higher on small size (₹1,674) plantations compared to large size plantation (₹ 1,303). The per hectare gross returns over maintenance cost was highest (₹ 3,787). The gross returns were ₹ 3,234 for the overall size group of plantation. The net return over total cost was found to be ₹ 1,487, ₹ 800 and ₹1, 049 on small, large and overall size groups of plantations, respectively.

Senthilnathan and Srinivasan (1994) estimated the costs and returns of poovan cultivar banana production in Trichirapalli district of Tamilnadu over a period of three years. With the per ha total cost of cultivation of ₹1,24,668, the gross income obtained was ₹ 2,86,913 and there by the net income worked to be ₹ 1,62,235. The study clearly showed the high profitability of variety poovan banana with a high returns cost ratio 2.3:1 in the study area.

Shah (1996) studied the production and marketing pattern of grapes in Maharastra. The study showed sharp increase in per acre annual gross maintenance cost as well as returns of grapes orchards. In general, about 67 per cent of gross maintenance cost of grape production was spent on various production related operation and the remaining 33 per cent owed it to investment on various marketing functions. The profitability in grape cultivation was found to be considerably high in the state of Maharashtra.

Maurya *et al.* (1996) studied the profitability of banana production in Hajipur district of Bihar state, India during 1993-94 based on a sample of 60 banana growers selected from five villages in this district. The study revealed that banana production was the most profitable crop production activity in this area, as it provided a net income of ₹ 29,748 per ha with a total expenditure of ₹ 21,607 and gross income of ₹49,958.

Chitra and Ravishankar (1997) studied economics of ber production in and around Hyderabad city of Andhra Pradesh. The results revealed that the total cost of establishment in the first year was ₹ 7913 per ha. The total cost incurred during the maintenance was ₹ 3483 per ha. The total cost of production worked out to ₹ 16,737 per ha. The results of the study indicated profits were relatively higher in ber cultivation.

Rao and Ramanna (1997) conducted study on profitability of mango cultivation in drought prone areas- A case study of Anantapur district of Andhra Pradesh. The results revealed that the investment on mango garden in the region was

profitable proposition. The establishment cost per hectare of mango garden during first four years was ₹ 3748, ₹ 2029, ₹ 2012 and ₹ 2452, respectively. The annual maintenance cost, i.e., from fourth year onwards worked out to be ₹5169 per ha. The cost of production per hectare of mango garden was ₹17,828 and the gross returns realized from the output of mango worked out to ₹ 22,083 per ha. The net returns obtained from the output were ₹ 4,255 per ha.

More (1999) studied the economics of production and marketing of banana in Maharashtra state. The results revealed that the total cost required for banana cultivation in Parbhani district was ₹ 2,423 acre considering the cost concepts A, B and C. The average yield per acre was 142 qtl which was worth of ₹ 4,271 and net returns of ₹ 1,848. The average cost, value and net profit per quintal of banana were to the extent of ₹ 16.98, ₹ 29.95 and ₹ 13.07, respectively and per plant it was to the extent of ₹ 1.69, ₹ 2.92 and ₹ 1.28, respectively.

Mali *et al.* (2001) studied the economics of production and marketing of banana in Jalagaon district of Western Maharashtra. The results revealed that the per ha cost of cultivation of banana worked out to ₹ 1,33,477. The gross returns per ha of banana were ₹ 2,14,867 and net return were ₹ 81,390.

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

Guledgudda *(*2002) conducted study on economics of banana cultivation and its marketing in Haveri district of Karnataka and concluded that the variable cost incurred by producer was ₹ 54,502 per ha which was accounted to 65 per cent of total cost. Among variable costs, human labour cost was found to be the major item, which accounted to 18 per cent. On an average farmer got 175 qtl of banana yield as main product valued.

Sundaravaradarajan and Ramanathan (2003) studied the cost and returns in cashew production. The study showed that the establishment cost of cashew plantation for the first year was ₹ 7690, ₹ 8664 and at ₹ 9491 per ha for marginal, small and large farmers, respectively. The maintenance cost of cashew plantations in the case of marginal farms were ₹ 4059, ₹ 4410, ₹ 4, 910, ₹ 5385, ₹ 5841 ₹ 6332 ₹ 6771 and ₹ 6990 per ha for second, third, fourth, fifth, sixth, seventh, eighth, ninth year, respectively and in case of large farms the maintenance cost were ₹ 5040, ₹ 5250, ₹ 5764, ₹ 6145, ₹ 6558, ₹ 7021 ₹ 7438, and ₹ 7745 per ha for second, third, fourth, fifth, sixth, seventh, eighth and ninth year respectively. The input output ratio per ha were 1.43, 1.55 and 1.83 for marginal, small and large farms, respectively.

Jeevarani (2005) estimated cost of production of coffee in Coorg district of Karnataka and concluded that the cost of cultivation of organic and inorganic coffee per acre was ₹ 4861 and ₹ 6762, respectively and ₹ 5807 for planters cultivating both inorganic and organic coffee. She also reported that net returns per acre was highest for planters cultivating inorganic coffee (₹ 15,693) when compared with planters cultivating only organic coffee (₹ 11,112).

Umesh *et al.* (2005) observed that the establishment cost of cashew was ₹ 15,631 per ha in all the varieties studied during the first three years. The maintenance cost per ha from fourth year onwards varied from ₹ 5,881 to ₹ 8,254 in Chintamani – 1, ₹ 5,640 to ₹ 8,254 in Ullal–4, ₹ 5,812 to ₹ 7,882 in Ullal-3 and ₹ 5,821 to ₹ 7,229 in Ullal-1 at the net returns of cashew orchard per ha being fairly high were in the order of ₹ 61314, ₹ 62425, ₹ 49672 and ₹ 34231 in Chintamani-1, Ullal- 4, Ullal-3 and Ullal- 1.

Rane and Bagade (2006) studied economics of production and marketing of banana in Sindhudurg district of Maharashtra. The study revealed that the per ha cost at cost C in Dodamarg and Sawantadi tahsil were ₹ 1.52 lakhs and ₹ 1.53 lakh, respectively. In Dodamarg tahsil banana was grown as a sole crop where per hectare cost of cultivation was ₹ 1.28 lakh and in Sawantadi tahsil the per ha cost was ₹ 1.15 lakh. The benefit cost ratio in Dodamarg tahsil and Sawantadi tahsil were 2.20 and 2.33, respectively. The average benefit cost ratio of banana cultivation was 2.27.

Naphade and Tingre (2008) conducted a study in Buldhana district of Maharashtra to find out the costs and returns from guava orchard. The result revealed that the per ha cost of establishment of guava orchard was ₹ 34,333 (up to 5 years) and per ha annual cost of production was ₹ 22,522 (after 5 years). Per hectare average yield estimated was 372 qtl with a profit of ₹ 82,036 per year. It was found that profit was increasing with the age of orchard.

Ravikumar *et al.,* (2011) computed the costs and returns in pomegranate cultivation in Chitradurga district during 2008-09 results revealed that, the cost of establishment per ha was found to be ₹ 1,90,888 and ₹ 1,89,644 per ha of which material cost constituted 56.87 and 58.15 per cent and maintenance cost 43.13 and 41.85 per cent in Challakere and Hiriyur taluks, respectively. The average per ha yield in Challakere taluk was 4.68 tonnes and the net returns obtained were ₹ 1, 40,588. Similarly the average yield in Hiriyur taluk was 4.60 tonnes per ha and the net returns were ₹ 1, 37,352 per ha. The internal rate of return was found to be in the range of 57-59 per cent which was much higher compared to the cost of capital (9.5 %) and hence highly profitable. Overall, the proposition of growing pomegranate crop was highly profitable as revealed by the financial feasibility tests.

Anonymous (2013) submitted report to State Horticulture Mission, Bihar, on litchi resource mapping revealed that, cost of orchard establishment was about ₹ 15,000 in which fruit bearing starts from 5-6 years of age. Besides initial establishment cost, growers incur a cost of ₹ 7,000-12,000 per ha annually on maintenance of orchard. The average yield per tree was around 70 kg. The producer's net income without taking into account his initial spending on establishment of orchard was around ₹ 74,000 per ha. To sum up, litchi cultivation is highly profitable, in spite of its cultivation is highly labour oriented. Higher benefit cost ratio and high yield per tree with low maintenance cost can be boon for cultivator.

Koujalgi *et al.* (2013) studied economic analysis of pomegranate cultivation in Karnataka for its viability and sustainability has been taken up in Northern Districts of Karnataka during 2009-10. The results indicated that, the per ha total establishment cost including maintenance cost up to bearing period was ₹ 2,85,998.76 and ₹ 2,78,440.31 for Bagalkot and Koppal districts, respectively. The cost per ha in

pomegranate orchard from the fourth year onwards in Bagalkot district was ₹ 55,009.38 and it was ₹ 56,217.46 for Koppal district. The project evaluation criteria indicated that discounted NPV at the rate of 9 per cent opportunity cost of capital was ₹ 3, 02,602.65 and ₹ 3, 87,900.02 for Bagalkot and Koppal districts, respectively. The B: C ratio was 1.53 and 1.68; IRR was 19.76 and 22.45 per cent for Bagalkot and Koppal districts, respectively. The payback period was 6.11 years for the orchards in Bagalkot district and 6.04 years in Koppal district.

2.3 Resource use efficiency

Kulkarni (1989) employed Cobb-Douglas type of production function to the farm level data for evaluating the resource productivities and allocative efficiency of resources used by the grape cultivators in Bijapur district, Karnataka. The variables included were output in kilograms per acre as dependent variables while number of vines per acre (number), values of manures and fertilizers (rupees), value of plant protection chemicals (rupees) and value of human labour (rupees) were independent variables. The function revealed that 36 per cent of variation in output was accounted by the independent variables.

Koujalagi (1990) examined the resource use efficiency in pomegranate cultivation in Bijapur district. The results showed that the seven variables included in the function explained about 70 per cent of variation in gross returns. It was observed that land, labour, manures, fertilizers and dummy variables (market channel-II) indicated the significant contribution of gross returns, the MVP of inputs indicated that labour, irrigation and plant protection chemicals were used efficiently, while manures and fertilizers were used optimally.

Koujalagi and Kunnal (1992) examined the resource use efficiency in the cultivation of pomegranate. Cobb-Douglas type of production function was used in this study. The variables considered were land, number of plants per acre, labour, plant protection chemicals, irrigation, manure and fertilizers. The functional analysis revealed that 70 per cent of the variation in gross returns was explained by the six independent variables included in the model. The regression coefficient of land, labour, manures and fertilizers indicated that contribution of these inputs to gross income was significant, but the regression coefficient of number of plant per acre and plants protection chemicals was negative and non-significant. The marginal value productivities of inputs indicated that labour, irrigation and plant protection chemicals were used efficiently while, manure and fertilizers were used optimally.

Hiremath (1993) studied the economics of production and marketing of lime in Bijapur district. He employed modified Cobb-Douglas type of production function. The results indicated that four variables like land, labour, farm yard manure and plant protection chemicals explained about 46, 67, and 78 per cent of variation in lime yield in small, medium and large orchards, respectively.

Chinnappa and Ramanna (1997) studied resource use efficiency in guava production using Cobb-Douglas type of production function. The functional analysis revealed that 42 per cent of the variation in gross returns was explained by five independent variables namely land, labour, manures, fertilizers and plant protection chemicals included in the model. The regression coefficient of land and labour

indicated their significant contribution while manures, fertilizers and plant protection chemicals were non-significant.

More (1999) studied the economics of production and marketing of banana in Maharashtra state. Cobb-Douglas type of production function was used to determine the level of resource use efficiency for the banana crop of small, large and pooled farmers. The independent variables included in the function were land, labour, machine labour, farm yard manure, nitrogen, phosphorus, potash, capital, irrigation and bullock labour. The dependent variable was yield of banana. The coefficient of multiple determinations was 73, 67 and 85 per cents, respectively for the three categories of farmers. Land and capital had significant influence on yield in all three categories of farmers and others were non-significant.

Rohile *et al.* (2006) study was conducted to determine the resource use efficiency in banana (Musa paradisiaca) production in Sindhudurg District, Dapoli, Maharashtra, India. The banana growers (n= 90) were classified into two groups based on the type of banana orchards, viz. mixed cropping and sole cropping. Out of 90 growers, 67 growers practiced mixed cropping and 23 growers employed sole cropping. The variation in yield due to various input used in banana cultivation was 99 per cent in both groups. The study found that in mixed cropping, planting material and fertilizers were significant variables, while in sole cropping, planting material, men labour, fertilizers and irrigation charges were statistically significant. The ratio of marginal value product to marginal factor cost of chemical fertilizers in mixed cropping and planting material, female labour and plant protection in sole cropping was less than one, which indicated excess utilization of these resources.

2.4 Farmers method of cultivation of pomegranate in comparison with scientific method (POP)

Narayanamoorthy and Deshpande (1997) conducted a study on prospects and potentials for drip irrigation in India. Results revealed that yield of banana and grape was higher by about 52 and 23 per cent in drip method of irrigation over traditional method. Despite many advantages the sluggish growth of drip irrigation was due to high initial investment, supply of poor quality components like drippers, filters etc., which ultimately affected the farmers motivation on drip irrigation.

Uday (2007) conducted an investigation of drip irrigation system installed for grape orchards in Nasik district of Maharashtra. The results revealed that respondents faced many problems like clogging emitters (85 %), irregular water supply (87 %), and irregular electricity supply (92 %) and high initial cost (75 %). The other problems faced were material transport facilities (37 %), lack of technical knowledge (39 %) and high cost of spare parts (33 %).

Nataraja *et al.* (2011) evaluated 10 multiple hybrid pomegranate progenies comparison with bhagwa and mridula at farmers field in Hiriyur Chitradurga district. The results revealed that MHP 7/2 was an outstanding progeny as the plants were dwarf, medium spreading habit, fruits were medium in size (180 g). Arils were bold, attractive sparkling red in colour, seeds were very soft (2.35 kg/cm^2) edible quality of the fruit was excellent with high juice recovery (55 % per fruit).

Prasad *et al.* (2013) conducted field experiment at farmers field near Hiriyur, Chitradurga district to know the performance of bhagwa variety in comparison with ganesh variety of pomegranate with respect to their physico-chemical characters. The results revealed that the bhagwa variety of pomegranate is an outstanding variety for all the characters studied. Bhagwa variety recorded the maximum fruit weight and weight of arils, maximum number of arils and maximum quantum of juice recovered in the variety ganesh.

III METHODOLOGY

The main aim of any scientific investigation is to draw useful conclusions in the light of objectives of the study. In order to arrive at the conclusion, it is essential for the investigator to adopt appropriate methods and procedure. Hence, this chapter has been devoted to explain the methodology adopted to fulfil the objectives of the study. It deals with the procedure used for selection of sample, method of data collection, type of data collected, source of data and analytical procedure used in the study.

3.1 Description of the study area

Agriculture production primarily depends on the natural resource conditions of the area such as, soil type, temperature, rainfall, etc. The climatic factors are beyond the control of the farmers, so they have to adjust their crops and farming practices to suit these conditions. In addition to these, the economic factors like transportation and irrigation facilities, manpower and availability of efficient and timely credit at cheaper rates also determine the crops to be grown and affect the farm economy (comparative advantage). Therefore, it is necessary to get acquainted with the general information that is, agro-climatic conditions and infrastructure in the study area.

This section mainly deals with general information of the study area including physical features and pattern of agriculture by depicting land use, cropping pattern, etc. As farmers carryout their activities taking into account the environmental and economic conditions existing in the region, the information pertaining the under study region and sample cultivators information facilitates better understanding of the rationale behind the results obtained.

3.1.1 Location and geographical features

Chitradurga district is situated in the central part of Karnataka state at 13° 34' to 15° 02' North latitude and 75° 37' to 77° 01' longitude at 524 m elevation from the mean sea level. The district comes under the transition zone and is bounded by Davangere and Bellary districts in the north, Tumkur in the south, Andhra Pradesh in the east and Shimoga on west part.

The geographical area of Chitradurga district is 7, 70,702 ha spread over six taluks namely, Chitradurga, Molakalmuru, Challakere, Holalkere, Hosadurga and Hiriyur. The population of the district according to the year 2011-12 was 16, 60,378 with 1000: 955 male to female ratio. Out of the total population, about 20 per cent were in urban areas and 80 per cent were in rural areas. The overall population density of the district was 197 per sq.km (Census 2011).

Table 3.1 General features of the study area (as per 2011 Census)

Sl. No	Particulars	Chitradurga district	Hiriyur taluk	Hosadurga taluk
1	Area (in Sq. Km)	8388.78	29.13	16.34
2	No. of villages & names of taluks	6 taluks (Chitradurga, Challakere, Hiriyur, Holalkere, Hosadurga, Molakalmuru)	314 villages	226 villages
3	No. of towns and *hobalies*	6	4	4
4	No. of villages: Inhabited	946	155	198
	Uninhabited	113	4	11
5	Population	16 60378	286133	235115
6	Sex ratio (Male :Female)	1000: 955	985	973
7	Male literacy (%)	81.37	88.48	76
8	Female literacy (%)	65.88	78.85	70
9	Literacy rate (%)	64.50	73.91	72
10	Percentage of scheduled caste population	22	23.97	18.91
11	Percentage of scheduled tribes population	18	25.1	20.5
12	Types of soils	Black, red loamy and red lateritic soils	Red sandy loams, shallow to deep black soil	Black, brown, red and sandy soil
13	Temperature	17 ^{0}C in winter to 41 ^{0}C during summer.	25 ^{0}C in winter to 36 ^{0}C during summer	26 ^{0}C in winter to 39 ^{0}C during summer
14	Rainfall (mm)	524	619	955

Source: Chitradurga district at a glance, 2013-14.

3.1.2 Climate, rainfall, soil type and cropping pattern

The Chitradurga district is generally dry with temperature ranging from 17 ^{0}C in winter to 41 ^{0}C during summer. The normal rainfall is 487 mm, with a record rainfall of 524 mm during the year 2012. The district had faced 59 droughts in the last 100 years. It has three different types of soils viz., black, red loamy and red lateritic

soils. The important crops grown in this area are ragi, jowar, paddy, groundnut, sunflower and cotton in *kharif*, jowar and sunflower in *rabi* and paddy, jowar, sunflower and groundnut in *summer*.

Pomegranate is gradually becoming a popular crop of Chitradurga district because of frequent droughts, consequently the failure of seasonal crops and also due to non-availability of laborers during peak seasons for cultivating seasonal crops. The area under pomegranate cultivation was 6911 ha in Chitradurga district during the year 2013-14. In Karnataka, the major pomegranate growing districts viz. Chitradurga, Bijapur, Bagalkot, Koppal and Bellary was having 6911, 2478, 2293, 1917 and 1846 ha of area under pomegranate, respectively.

Hiriyur taluk, situated 160 km from Bangalore and has total geographical area of 29.13 sq km. Total population of 2, 86,133 with a sex ratio of 1000:985. The overall literacy rate is 74 per cent with the male literacy at 88 per cent and female literacy at 79 per cent and percentage of schedule cast population at 24 per cent and schedule tribe population at 25 per cent. Red sandy loams, shallow to deep block soils are predominant in the taluk and the maximum temperature ranges from 25 ^{0}C in winter to 36 ^{0}C during summer and the average rainfall of the region is 619 mm (table 3.1).

Hosadurga taluk, situated 227 km from Bangalore and has total geographical area of 16.34 sq km. Total population is 2, 35,115 with a sex ratio of 1000:973. The overall literacy rate is 72 per cent with the male literacy at 76 per cent and female literacy at 70 per cent and percentage of schedule cast population at 19 per cent and schedule tribe population at 21 per cent. Black, brown, red and sandy soils are predominant in taluk and the maximum temperature ranges between 26 ^{0}C in winter and 39 ^{0}C during summer and the average rainfall of the region is 955 mm (table 3.1)

The particulars of cropping pattern in the study area are presented in table 3.2 and the table indicated that the total cropped area for Chitradurga district as a whole was around 3, 77,801 ha. Out of the total cultivated area, 30 per cent was under groundnut cultivation and 26 per cent was under maize cultivation. Cultivation of fruits occupied an area of 38,527 ha, which is gaining momentum in recent years. This shows the subsistence of farming in the study area, as the area comes under central dry zone which receives scanty rain fall.

As for as cropping pattern of Hiriyur taluk is concerned, out of the total cropped area (82,392 ha), plantation crops occupied an area of 13 per cent along with the groundnut cropping system (17 %). The proportion of area allocated to maize was only two per cent. With respect to cropping pattern of Hosadurga taluk, one third of the cultivated area was occupied by ragi crop (33,877 ha). About 3,445 ha of area was under fruits cultivation which accounted for four per cent of the total cultivated area.

Table 3.2: Cropping pattern in the study area (2013-14)

Sl. No	Crops	Chitradurga		Traditional area (Hiriyur taluk)		Emerging area (Hosadurga taluk)	
		Area (ha)	%	Area (ha)	%	Area (ha)	%
I	**Cereals**						
1	Paddy	1172	0.31	481	0.58	5	0.01
2	Jowar	3713	0.98	8096	9.83	577	0.62
3	Ragi	39265	10.39	5542	6.73	33877	36.68
4	Maize	96860	25.64	1691	2.05	7129	7.72
5	Bajra	1996	0.53	216	0.26	0	0
6	Small millets	8411	2.23	298	0.36	7321	7.93
	Sub total (I)	**151417**	**40.08**	**16324**	**19.81**	**48909**	**52.95**
II	**Pulses**						
1	Red gram	8960	2.37	3261	3.96	264	0.29
2	Horse gram	3180	0.84	2420	2.94	3124	3.38
3	Green gram	4519	1.2	10627	12.9	3743	4.05
4	Cowpea	733	0.19	135	0.16	20	0.02
5	Field bean	2321	0.61	0	0	438	0.47
	Sub total (II)	**19713**	**5.22**	**16443**	**19.96**	**7589**	**8.22**
III	**Oil seeds**						
1	Groundnut	111988	29.64	14092	17.1	2154	2.33
2	Sunflower	14588	3.86	10035	12.18	150	0.16
3	Sesamum	1167	0.31	1893	2.3	1552	1.68
4	Castor	661	0.17	95	0.12	29	0.03
5	Niger	35	0.01	0	0	5	0.01
6	Mustard	21	0.01	0	0	0	0
	Sub total (III)	**128460**	**34**	**26115**	**31.7**	**3890**	**4.21**
IV	**Commercial crops**						
1	Cotton	20525	5.43	9770	11.86	722	0.78
2	Sugarcane	5	0	0	0	0	0
3	Tobacco	0	0	460	0.56	0	0
	Sub total (IV)	**20530**	**5.43**	**10230**	**12.42**	**722**	**0.78**
V 1	**Plantation crop**	**10575**	**2.8**	**11070**	**13.44**	**26942**	**29.17**
2	Vegetables	8579	2.27	483	0.59	873	0.95
3	Fruits	38527	10.2	1727	2.1	3445	3.73
	Sub total (V)	**57681**	**15.27**	**13280**	**16.12**	**31260**	**33.84**
	Total	**377801**	**100**	**82392**	**100**	**92370**	**100**

Source: Chitradurga district at a glance, 2014-15.

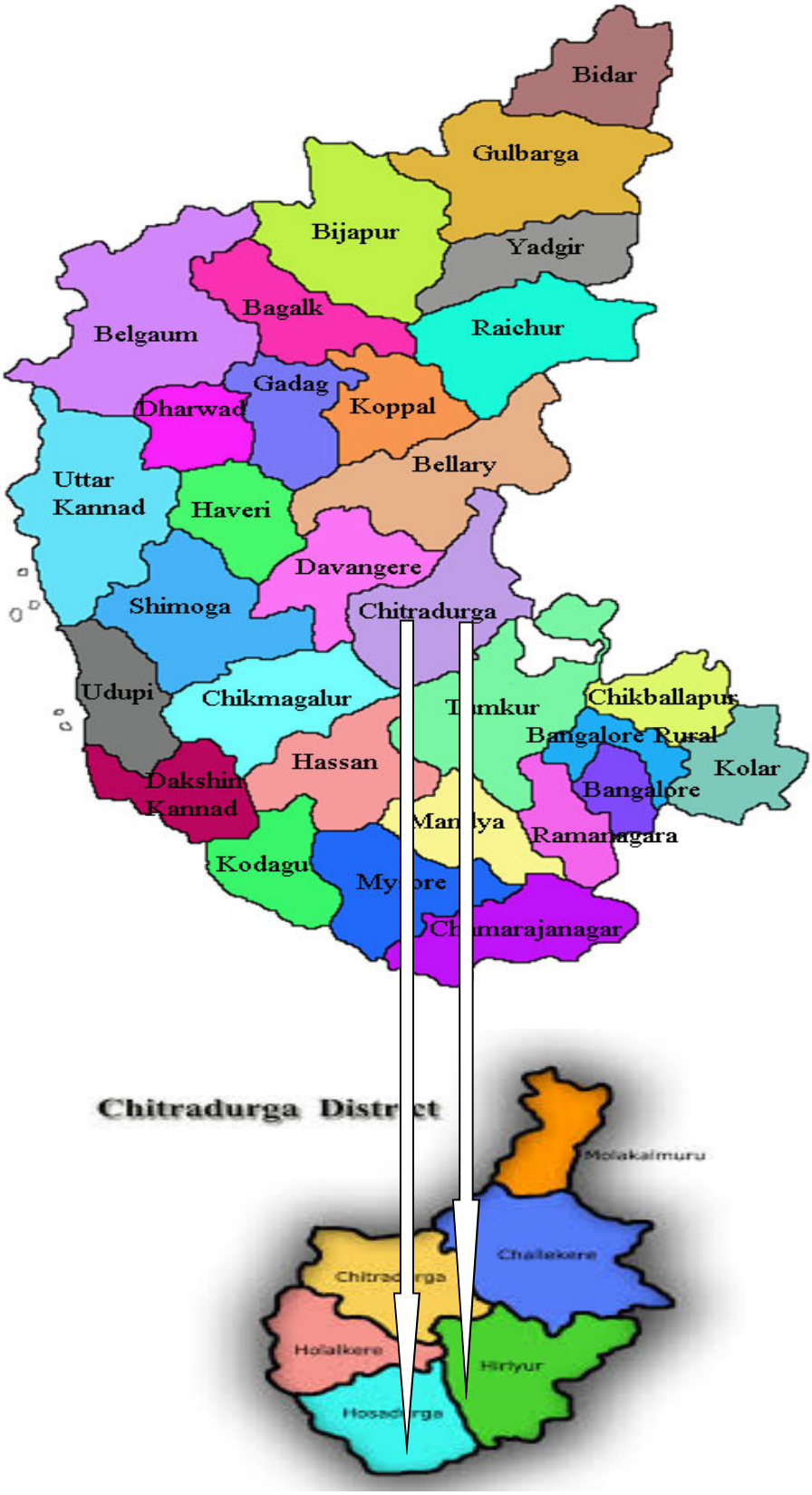

Fig. 3. 1: Map showing the study area

3.1.3 Land utilization

The land utilization pattern of Chitradurga district is presented in the table 3.3. The total geographical area of the Chitradurga district is 7,70,702 ha, out of which the area under forest was 73,719 ha (9.56 % to total geographical area), non agricultural land was 51,243 ha (6.64 %), barren land was 25,403 ha (3.29 %), cultivable waste land was 21,612 ha (2.80 %), permanent pasture was 88,740 (11.51 %), trees and groves was 11,317 ha (1.46 %), fallow land was 1,11,568 ha (14.47 %) and net sown area was 3,87,100 ha (50.22 % to the total geographical area).

In Chitradurga district, the geographical area of traditional area (Hiriyur taluk) (1, 37,423 ha) was more than that of emerging area (Hosadurga taluk) (1, 12,574 ha). In emerging area (Hosadurga taluk), area under forest was 19,074 ha (16.94 %), non agriculture land 10,088 ha (8.96 %), barren land 2,584 ha (2.30 %) and net sown area 61,523 ha (54.65 %) which more than that of traditional area (Hiriyur taluk) with 51,985 ha. In traditional area (Hiriyur taluk) area under forest was 11,358 ha (8.26 %), non agricultural land 7,613 ha (5.54 %), barren land 606 ha (0.44 %) and net sown area 51,985 ha (37.83 %). The cultivable waste land was higher 2,540 ha (1.85 %), permanent pasture 25,926 ha (18.87 %), trees and groves 7,416 (5.40 %) ha and fallow land 29,979 ha (21.81 %).

Table 3.3: land utilization pattern in the study area (ha).

Sl. No	Particulars	Chitradurga	Traditional area (Hiriyur taluk)	Emerging area (Hosadurga taluk)
1	Area under forest	73719 (9.56)	11358 (8.26)	19074 (16.94)
2	Non agricultural land	51243 (6.64)	7613 (5.54)	10088 (8.96)
3	Barren land	25403 (3.29)	606 (0.44)	2584 (2.30)
4	Cultivable waste land	21612 (2.80)	2540 (1.85)	1037 (0.72)
5	Permanent pasture	88740 (11.51)	25926 (18.87)	3392 (3.01)
6	Trees and groves	11317 (1.46)	7416 (5.40)	1479 (1.32)
7	Fallow land	111568(14.47)	29979 (21.81)	13397 (11.90)
8	Net sown area	387100(50.22)	51985 (37.83)	61523 (54.65)
	Total geographical area	770702 (100)	137423(100.00)	112574 (100.00)

Sources: Chitradurga district profile (2011-12).
Note: Figures in parentheses indicate per cent to the total geographical area

3.2 Nature and sources of data

The required data for evaluating objectives of the study were collected from both primary and secondary sources.

3.2.1 Primary data

Primary data was collected from the 60 sample respondents in the study area. Data regarding socio-economic characteristics, demographic features, various aspects of agriculture like size of land holding, asset position, cropping pattern, input utilization, cost of cultivation, yield, returns and other related information in particular to pomegranate was collected in the study area for the year 2013-14 through a well structured and pre-tested schedule to work out the economics of pomegranate cultivation.

3.2.2 Secondary data

The information about the study area regarding total geographical area, cropping pattern, land use pattern, sources of irrigation and other related information was obtained from District Statistical Office, Chitradurga. The data related to district wise area, production and productivity of pomegranate in Karnataka was collected from Directorate of Horticulture, Lalbagh, Bengaluru.

3.3 Sampling procedure

The present study was purposively undertaken in Chitradurga district of Karnataka, where area under pomegranate was significant. Traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) were selected from the Chitradurga district as the highest area was noticed in these districts. From each taluk, five villages were selected based on the highest area under pomegranate cultivation. A random selection of six sample respondents of pomegranate cultivators was made from each village to constitute a total of 60 respondents.

Table 3.4: Details of sample villages selected for study area.

Sl. No	Taluks	Village	No. of respondents choosen
1.	Traditional area (Hiriyur taluk)	Karthikenhalli	6
		K.M. kottige	6
		Nagenhalli	6
		Badarahalli	6
		Yelladakere	6
		Sub total	**30**
2.	Emerging area (Hosadurga taluk)	Kittdal	6
		Harishinagundi	6
		Gudihalli	6
		Belldakere	6
		Kodihalli	6
		Sub total	**30**
		Total	**60**

3.4 Collection of data

Detailed data from the respondents were collected through personal interviews from the head of the each selected household with the help of a pre-tested schedule. The interviewer clearly explained the purpose of the study for better cooperation from respondents so as to ensure the accuracy of the data. The necessary information on pomegranate cultivation was collected for the period 2013-14. Primary data collection consists of following aspects; general information on age, educational level, size of family, social and institutional participation of farmer, operational holding, source of irrigation, etc.

Detailed information regarding amount and year of investment, cost of acquisition of assets, expected life span of new farm assets like farm buildings, farm machinery and equipment, improvement on land, irrigation structures and equipment and livestock and other annual expenditure like food, clothing, education, insurance, health, building maintenance, machinery maintenance, vehicle maintenance and loan structure details like amount borrowed from different institutions and non institutional sources, rate of interest, repayment period, etc., were also collected. In addition, information on cropping pattern was also collected.

3.5 Analysis of data

The collected data were compiled and analyzed using simple statistical tools such as arithmetic averages and percentages. Besides, these to fallowing analytical tools were also used to realize the objective of the study.

3.6 Compound annual growth rate analysis

The data obtained on area, production and productivity of pomegranate for the period 2000-01 to 2013-14 for Karnataka, Chitradurga district and selected taluks were used for the estimation of compound growth rates. The data were computerized to get the compound growth rates in area, production and productivity of pomegranate. This became useful for studying the changes in the performance of pomegranate during the reference period.

In order to assess the trends in area, production and productivity of pomegranate crop in the study district and in Karnataka, the compound growth rate analysis was employed. Compound growth rates were computed using the exponential function of the form,

$$Y_t = ab^t u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

Y_t: Dependent variable for which growth rate was estimated (area/production/yield)

a: Intercept (constant)

b: Regression coefficient

t: The reference period in years which take values, 1, 2, …,n

u_t: Disturbance term for the year t

For the purpose of estimation, equation (1) was transformed into log linear form and was estimated using Ordinary Least Square (OLS) technique. The compound growth rate (g) in percentage was then computed from the following form,

$$g = (\text{Antilog } b\text{-}1) \times 100.$$

3.7 Estimation of costs and returns

The costs were classified into variable and fixed costs. Variable costs include cost of inputs (planting material, farm yard manure, fertilizer, plant protection chemical, *etc*), labour cost and interest on working capital. Fixed costs include land revenue, depreciation on farm implements, rental value of land and interest on fixed cost. The measurement and definitions of various cost components are as follows.

I. Establishment cost

It is the cost incurred during the first 18 months of the establishment of pomegranate cultivation. The costs incurred under this comprise land preparation, digging of pits, manure and tank silt application, planting and filling of pits, fertilizer application, pruning, plant protection chemicals application, staking, weeding and fencing. The total establishment cost was divided in two broad categories:

a) Variable cost

i. Labour cost

ii. Material cost

b). Fixed cost

a. Variable costs

This comprise of following cost items

i. Labour cost

The expenditure incurred on human labour and machine labour constituted the labour costs. In case of human labour, the total labour employed for each activity was recorded. The women labour was converted into man days by multiplying each women day with 0.6 being the ratio of wages of women to wages of man.

ii. Material cost

Material costs covered expenditure on fencing, drip installation, tank silt, manures, fertilizers, plant protection chemicals, irrigation, planting material, staking

material and miscellaneous. These costs were computed based on actual prices paid by the growers and prices prevailing in the locality for owned inputs.

1. Fencing cost

Fencing cost includes the expenditure made on installing stone pillars with barbed wire around the border area of the pomegranate orchard.

2. Drip installation cost

The installation of drip irrigation system includes cost of laterals, micro tubes, pipes, valve, tubes and emitters.

3. Tank silt cost

The tank silt cost was calculated at the actual price paid by farmers.

4. Farm yard manure (FYM) cost

Farm yard manure was charged as per the prevailing market rates during the period of study in the study area.

5. Fertilizers cost

The fertilizer cost was calculated at the actual price paid by farmers.

6. Plant protection chemicals cost

The cost of different insecticides, fungicides and weedicides used for control of pest, diseases and weeds was determined on the basis of actual price paid by the farmers.

7. Irrigation cost

The cost of groundwater irrigation is the amortized cost of irrigation given by amortized cost on bore well + amortized cost on irrigation pumpset + amortized cost on conveyance structure + amortized cost on storage structure if any + repairs cost of irrigation pumpset (Patil, 2014).

The historical investments on bore wells were compounded to the present, in order to have the total investment on all wells as if made at present. Using the detailed methodology, the cost of groundwater irrigation in Central dry zone of Karnataka averaged to around ₹ 417 per ha cm or per acre inch for the year 2013-2014.

Amortization is the process by which the bore well cost is distributed over the economic life of its use.

Step: 1.

$$\text{Amortized cost of bore well} = (\text{compounded investment cost of bore well}) \times \frac{(1+i)^{AL} \times i}{(1+i)^{AL} - i}$$

Where, AL = Average age or life of bore well which is taken as 10 years

i = discount rate taken at 2 per cent

Step: 2. Add annual repairs + maintenance charge of (motor, pump repairs) bore well

Step: 3. Add annual electricity charges

Step: 4. The volume of water extracted = Water yield * No of hours per day water pumped * no of days of irrigation per year

Step: 5. Value of water used for irrigation = Amortized cost/ Water used per year.

Total quantity of water used for pomegranate crop used was 51 acre inches.

8. Planting material cost

Seedlings purchased from nursery at the rate prevailing in the study area were treated as planting material cost.

9. Staking material cost

The staking material cost was calculated at the actual price paid by farmers.

10. Miscellaneous cost

This item includes the cost incurred for miscellaneous expenditure during farming operations like building maintenance and machinery repair expenses and incidental charges.

11. Interest on variable cost

This was calculated on the variable cost of establishment at the prevailing bank rate of 10 per cent per annum.

b. Fixed costs

These include rental value of land, land revenue, depreciation on farm implements and machinery and interest on fixed capital.

1. Land revenue

These were charged according to the actual payments incurred by the cultivators.

2. Depreciation

Depreciation on each capital equipment and machinery owned by the farmers was 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.

$$\text{Annual depreciation} = \frac{\text{Present value} - \text{Salvage value}}{\text{Expected life (No. of useful years of life)}}$$

3. Rental value of land

Rental value of land was calculated as per the rate prevailing for irrigated land in the study area. It is varies with the type of crops, duration and water requirement of crops.

4. Interest on fixed capital

Interest on fixed capital was calculated at the rate of 8 per cent per annum as the fixed deposits in commercial banks would fetch this rate of interest.

5. Amortization of establishment cost

Amortized cost of pomegranate is the annual fixed cost component of establishment, it includes all material cost, fixed cost and labour costs.

$$a = A\frac{(1+r)^n \times r}{(1+r)^n - 1}$$

a = annualized cost

A= total cost

i = rate of interest

n = economic life of orchard (years)

The economic life of pomegranate orchard was considered for 10 years and rate of interest considered was 8 per cent per annum.

6. Total establishment cost

Total establishment cost is the summation of total variable cost (labour cost, total material cost) and total fixed cost.

II. Annual maintenance costs and returns

Pomegranate starts bearing from 18 months onwards and subsequent yield is taken up every six months after the first harvest. The annual maintenance cost includes average cost of cultivation of two crops in a year, which consists of both variable and fixed costs.

a. Variable cost

The variable costs which include cost of weeding, manures and fertilizer application, plant protection chemical application, pruning, watch and ward, harvesting, planting material, wages for human, bullock and machinery labour, miscellaneous charges, marketing cost (box charges, cello tape, grading, packing and commission charge at 2 per cent) and interest on working capital at the rate of 10 per cent per annum.

b. Fixed costs

These include rental value of land, land revenue, depreciation on farm implements and machinery and interest on fixed capital.

3.7 Returns

Pomegranate starts bearing from 18 months onwards and subsequent yield is taken up every six months after the first harvest. The returns include average returns from 18 months onwards to 10^{th} year's age of pomegranate orchards.

a. Gross returns

It is obtained by multiplying the total product with its sale price per kg.

b. Net returns

It is obtained by deducting the total costs incurred from the gross returns.

c. Returns on variable cost

It is calculated by subtracting variable costs from gross returns.

d. Returns per rupee of investment

Return per rupee of investment was calculated by dividing gross return by total costs.

3.8 Break –even analysis

Break –even analysis was employed to know the minimum level of production required to recover the total cost employed in pomegranate cultivation. This concept is important in any business as it indicates minimum amount of business necessary for operating the enterprise in the short run without loss. The Break –even point of output and returns was determined using the formulae,

$$\textbf{BEP (output)} = \frac{\textbf{F}}{\textbf{(P – V)}}$$

$$\textbf{BEP (returns)} = \frac{\textbf{F}}{\textbf{[1- (P – V)]}}$$

Where, F= Fixed cost per unit area.

P= Price per unit of produce

V= Variable cost per unit of produce

3.9. Evaluation of investment

Discounted cash flow techniques were used to evaluate the investment and to find out the feasibility and economic viability of investment on pomegranate orchards.

The discounted cash flow method of evaluating long term projects is based on the fact that a rupee invested today is worth more than a rupee in future years. It is a process of finding the present worth of an amount received or paid in future. This technique has an advantage that the future cash flows are reduced to a single sum at one specific point of time and this facilitates comparison between alternative choices, if any.

The economic feasibility of investment on pomegranate orchard is appraised by using discounted cash flow measures of Net Present Worth, B: C ratio and the Internal Rate of Returns and a non discounted measure of Pay Back Period. In this analysis, return or income obtained by the sale of final products constituted the cash inflows of the project. The cost and returns from establishment upto the end of the project were assumed to be constant.

3.9.1 Net Present worth [NPW]

The net present worth is the present worth of net benefit of a project discounted at the opportunity cost of capital. This criterion ranks the alternatives. Generally, higher the net present value better would be the preference. In computing net present worth, the difference between the present value of the cost streams and present value of the benefit streams were considered at a discount rate of 8 per cent.

This is the rate at which commercial banks provide long term loans. The general mathematical form of net present worth criterion is presented below:

NPW = [Present worth of benefits – Present worth of costs]

$$\mathbf{NPW} = \sum_{t=1}^{t=n} \frac{\mathbf{B_t - C_t}}{\mathbf{(1+d)^t}}$$

Where, B_t = Benefits in each year

C_t = Costs in each year

t = Number of years or life period of investment

d = Discount rate (8 %)

In order to select the project or to consider the worthiness of a project investment, the net present value should be positive.

3.9.2 Benefit-Cost Ratio [BCR]

It is the ratio of discounted cash inflows (project benefits) to discounted cash outflows (project costs) which must be more than unity for an enterprise to be considered worthwhile. The technique also ranks the project for selection. The benefit-cost ratio can be stated mathematically as:

$$\mathbf{B:C\ ratio} = \frac{\text{Discounted cash inflows}}{\text{Discounted cash outflows}}$$

$$\boldsymbol{B:C} = \frac{\sum_{t=1}^{t=n} \frac{\boldsymbol{B_t}}{(1+d)^n}}{\sum_{t=1}^{t=n} \frac{\boldsymbol{C_t}}{1+d^n}}$$

Where, B_t = Benefits in each year

C_t = Costs in each year

n = Number of years or life period of investment

d = Discount rate (8 %)

3.9.3 Internal Rate of Returns [IRR]

The internal rate of return is the rate of return which equates the discounted benefits with the discounted costs. In other words, it is the discounted rate which equates the present worth of benefits to present worth of costs. It represents the average earning capacity of an investment from the projects during its economic life period. The mathematical form of IRR is

$$\mathbf{IRR} = \sum_{t=1}^{t=n} \frac{B_t - C_t}{1 + d^t} = 0$$

Where, B_t = Benefits in each year

C_t= Costs in each year

t = Number of years or life period of investment

d= Discount rate (8 %)

The internal rate of return is arrived through interpolation techniques by using different rates so as to see that the net present worth is equated to zero. The lower and higher discount rates will be used to obtain positive and negative values of net present worth, respectively, and then the interpolation formula indicated below is used to arrive at the IRR.

$$\left(\text{Internal rate of return}\right) = \left(\text{Lower discount rate}\right) + \left(\text{Difference between two discount rates}\right) \left(\frac{\text{Present worth of the cash flow at the lower discount rate}}{\text{Absolute difference between present worth of cash flow at two discount rates}}\right)$$

3.9.4 Payback period

The payback period is the length of time in years taken to liquidate the initial investment. The payback period is estimated by summing up all the undiscounted net benefits over the years to make up the initial investment incurred for establishment.

P = I/E

Where, P = length of time

I = Initial investment

E = Expected return

3.10 Resource productivity and allocative efficiency in pomegranate cultivation

A Cobb Douglas production function was used to find out the factors influencing the yield of the pomegranate. The gross return of the crop was considered as the dependent variable and the cost of human labour, Farm yard manure (FYM), fertilizer, plant protection chemicals (PPC) and irrigation as independent variables.

$$Y = aX_1^{bl} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} e^{u} \quad \ldots\ldots (1)$$

Where,

Y = Gross returns (₹ /ha)

X_1 = Human labour (₹ /ha)

X_2 = FYM (₹ /ha)

X_3 = Fertilizer (₹ /ha)

X_4 = PPC (₹ /ha)

X_5 = Irrigation (₹ /ha)

a = Constant

b_i' s = Regression coefficients

u = Error term

b_1 to b_5 regression coefficients of respective inputs and also represent the elasticity of production of respective inputs.

The equation (1) was transformed into the logarithmic form; it assumed a log linear equation as given below.

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5$$

$$+b_6 \log X_6 + u \log e \quad \ldots\ldots (2)$$

In order to ascertain the goodness of fit, the adjusted coefficient of multiple determination (R^2) was calculated using the formula:

$$\overline{R^2} = 1 - (1-R^2) \frac{n-1}{n-p}$$

Where, $\overline{R^2}$ = the adjusted coefficient of multiple determination (adjusted for the size of sample)

R^2 = the coefficient of multiple determination (It explains amount of variation in dependent variable that is explained by independent variables) which is given by

$$R^2 = \frac{\text{Regression sum of squares}}{\text{Total sum of squares}}$$

n = number of observations in the sample

p = number of parameters in the function

Specification of variables

a. Dependent variable

i) Gross returns (₹) Y=Y×P

(Yield (t/ha) × price of pomegranate)

Gross return obtained per ha in pomegranate cultivation was taken as dependent variable.

b. Independent variables

i) Human labour (man days) X_1

Cost incurred on human labour was expressed in terms of total mandays per ha in the cultivation of pomegranate.

ii) FYM (Tractor load) X_2

This refers to total quantity of FYM (tractor loads) used for pomegranate cultivation per ha.

iii) Fertilizers (₹) X_3

This was defined as the cost incurred on fertilizers used for pomegranate cultivation per ha.

iv) PPC (₹) X_4

Cost incurred on plant protection chemical used for pomegranate cultivation per ha was taken.

v) Irrigation (₹) X_5

This was defined as the cost incurred on irrigation used for pomegranate cultivation per ha.

The estimated coefficients were used to compute the MVP and its ratio (r) with MFC to determine the allocative efficiency of resources used.

The 'r ' was estimated as follows,

r = MVP/MFC

Where, r = efficiency ratio

MVP = Marginal value product of variable input

MFC = Marginal factor cost (price per unit of input)

Marginal Value Product:

By studying the marginal value product of factors of production, we can assess their relative importance. Marginal Value Product of X_i, the i^{th} input is estimated by the following formula:

$$\mathbf{MVP} = \frac{b_i \times GM\ (Y)}{GM\ X_i}$$

G.M. (Y) and G.M. (X_i) represent the geometric means of output and input, respectively and b_i is the regression coefficient of i^{th} input.

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 is <1; resource is excessively used or over utilized hence decreasing the quantity of resource would increase profits.

If r > 1; resource is under used or being underutilized hence increasing its rate of use will increase profit level.

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

3.12 Partial budgeting

It is a method of making a comparative study of costs and returns resulting from a change in a part of the farm business. This change may be made through a

careful selection of alternative methods of production or practices, the choice of which is based on opportunity cost or relative profitability.

The partial budgeting technique helps in the decision making process whenever small changes are contemplated as to which method to adopt, which practices to follow to reduce the unit cost and make higher profits.

In this study partial budgeting technique was used to know the probability of investment on scientific method (POP) v/s farmer's method of pomegranate cultivation. The partial budgeting takes into account accounts added cost and reduced returns on debit side, reduced cost and increased returns on credit side. The final credit minus debit figure was spread across the gross area differential under both the type of method in order to obtain the pomegranate cultivation on per ha basis.

The components like planting material, fertilizer, tank silt, farm yard manure, gross returns are considered. In the farmer's method, farmer takes 3 additional crops due to reduction of establishment period to 1.5 years as compared to 3 years of establishment period in scientific method. In this regard, partial budgeting technique was employed to assess the benefits of scientific method of pomegranate cultivation over farmers' method of cultivation.

Scientific method (POP) of pomegranate cultivation:

The package of practices of pomegranate cultivation of UAS, GKVK, Bangaluru was considered as scientific method. This method recommended wider spacing of 13.5×13.5, 15×15 and 18×18 ft FYM application of 25 t/ha and establishment period of 3 years.

Farmer's method of pomegranate cultivation:

The method of pomegranate cultivation adopted by the farmers in the Chitradurga district was considered as farmers' method. Farmers in Chitradurga district widely follow the high density planting with a spacing of 12×12 and 10×12 ft. Applying extra tank silt, fertilizer and pesticides establishment period is reduced which establish farmers to 1.5 years getting 3 extra crops.

3.13.1 Components of Partial Budgeting

Added returns

This is usually an estimate in which the additional income generated due to increase in yield and increase in price of output due to adoption of scientific method of pomegranate cultivation was taken into account.

Added costs

List of all increased expenses due to the change of scientific method (POP) is being considered. Most of these will be costs of production of pomegranate farming which include increase in planting materials, farm yard manure, fertilizers and tank silt, etc.

Reduced costs

Cost reduction in production activity due to entering into scientific method (POP) was taken into account in the study.

Reduced returns

Any income reduction due to entering into scientific method by farmers was taken into account in the study.

Format 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): ₹……			

IV RESULTS

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 respondent farmers

4.2 Area, production and productivity growth of pomegranate

4.3 Investment pattern and establishment cost in pomegranate orchards

4.4 Maintenance cost of pomegranate orchard during the bearing period

4.5 Cost and returns of pomegranate cultivation

4.6 Break-even analysis of pomegranate cultivation

4.7 Investment evaluation in pomegranate cultivation

4.8 Resources productivity and allocative efficiency in pomegranate cultivation

4.9 Farmers method v/s Scientific method (POP) of cultivation of pomegranate

4.10 Economics of pomegranate cultivation using partial budgeting technique

4.1: Socio –economic characteristics of respondent farmers

The general characteristics of the sample farmers indicated that majority of the sampled farmers in traditional area (Hiriyur taluk) belonged to 36-50 age group (56.70 %) followed by above 50 years (23.30 %) and below 35 years (20 %) groups. In emerging area (Hosadurga taluk), 40 per cent of the sampled farmers belonged to age group of above 50 years followed by 36-50 age group (33.3 %) and below 35 years (26.7 %). The pattern of age distribution between traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) was statistically non-significant (Table 4.1). With regard to the average age, the farmers of emerging area (Hosadurga taluk) had marginally higher average age (42 years) than the farmers of traditional area (Hiriyur taluk) (41.4 years) and the difference in the average age was non-significant.

The classification of the farmer respondents according to their education level revealed that majority of the farmers possessed high school education in both traditional area (Hiriyur taluk) (43.4 %) and emerging area (Hosadurga taluk) (46.7 %). About 23.30 per cent of respondents possessed PUC education in traditional area (Hiriyur taluk) and 26.60 per cent in emerging area (Hosadurga taluk). The percentage of farmers with illiterates was 13.30 per cent followed by primary (10 %) and degree & above (10 %) groups in traditional area (Hiriyur taluk), while in emerging area the corresponding figures were 13.30 per cent for primary education level, illiterates 6.70 per cent and degree and above farmer 6.70 per cent. The differences in the distribution of number of farmers in different education levels between the two taluks were non-significant (Table 4.1).

It was found that majority (53.3 %) of the sample respondents falls in the medium sized family (6-9 members), followed by 26.7 per cent small family (< 5) and 20 per cent large sized family (> 9) in traditional area (Hiriyur taluk). Whereas, in emerging area (Hosadurga taluk), 53.3 per cent, 30.0 per cent and 16.7 per cent of the families fall in medium, large and small sized family, respectively. Average family size in traditional area (Hiriyur taluk) was 7 members and in emerging area (Hosadurga taluk) was 8 members, further, the difference in family size distribution between traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) was found statistically non-significant.

Table 4.1: Socio–economic characteristics of respondent farmers.

Particulars	**Traditional area (Hiriyur taluk) (n=30)**		**Emerging area (Hosadurga taluk) (n=30)**		**Pooled (n=60)**		**Test value**
I. Age group (years)	**No.**	**%**	**No.**	**%**	**No.**	**%**	
a. Below 35	6	20.0	8	26.7	14	23.3	$\chi 2 = 3.42^{NS}$
b. 36-50	17	56.7	10	33.3	27	45.0	
c. Above 50	7	23.3	12	40.0	19	31.7	
Average age	41.4		42.0		41.7		$t=0.29^{NS}$
II. Education level							
a. Illiterate	4	13.3	2	6.7	6	10.0	$\chi 2=1.11^{NS}$
b. Primary	3	10.0	4	13.3	7	11.7	
c. High school	13	43.4	14	46.7	27	45.0	
d. PUC	7	23.3	8	26.6	15	25.0	
e. Degree and above	3	10.0	2	6.7	5	8.3	
III. Family size (No′s)							$\chi 2=1.29^{NS}$
a. Small (< 5)	8	26.7	5	16.7	13	21.7	
b. Medium (6-9)	16	53.3	16	53.3	32	53.3	
c. Large (> 9)	6	20.0	9	30.0	15	25.0	
Average	7.17		8.03		7.60		$t=1.59^{NS}$
IV. Land holding(ha)							$\chi 2=1.55^{NS}$
a. < 2	14	46.7	11	36.7	25	41.7	
b. 2 -4	11	36.6	10	33.3	21	35.0	
c. Above 4	05	16.7	09	30.0	14	23.3	
Average area	2.54		2.88		2.72		$t=1.74^{NS}$
Average area under pomegranate (ha)	0.84		1.01		0.93		$t=1.80^{NS}$

Note: NS: Non- significant

Plate 1. Interview with the pomegranate farmers

Plate 2. Pomegranate orchard

With respect to land holding, the average size of land holdings was higher in Hosadurga farmers (2.88 ha) than traditional area (Hiriyur taluk) farmers (2.54 ha), but the difference was non-significant. The average size of the pomegranate orchards was 0.84 and 1.01 ha in traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk), respectively.

4.1.1 Size of land holding of respondent farmers

Details of the average land holding in the study area of traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) under irrigation and rainfed conditions are indicated in table 4.2. The results indicated that average area of own land was slightly higher in emerging area at 2.12 ha as than in traditional area which was of2.01 ha. Further, land holding under lease in traditional area and emerging area was 0.27 ha and 0.45 ha, respectively. The leased out land was 0.26 ha in traditional area and 0.31 ha in emerging area. It is evident from the table that the average land holding under irrigated condition higher in emerging area (2.26 ha) than in traditional area (1.96 ha). The area under rainfed condition was higher (0.62 ha) in emerging area than in traditional area 0.58 ha.

Table 4.2: Size of land holding of respondent farmers.

Particulars	Average land holdings (ha)								
	Traditional area (Hiriyur taluk) (n=30)			Emerging area (Hosadurga taluk) (n=30)			Pooled (n=60)		
	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total
Own	1.63	0.38	2.01	1.86	0.26	2.12	1.75	0.32	2.07
Leased-in	0.19	0.08	0.27	0.24	0.21	0.45	0.22	0.15	0.36
Leased-out	0.14	0.12	0.26	0.16	0.15	0.31	0.15	0.14	0.28
Total	1.96	0.58	2.54	2.26	0.62	2.88	2.11	0.60	2.71

4.1.2: Inventory of farm buildings respondent farmers

In traditional area (Hiriyur taluk), 36.70 per cent of sample farmers had farm house, 16.70 per cent had cattle shed, 26.70 per cent had storage sheds and 10.0 per cent had pump sheds. In emerging area (Hosadurga), majority of sample farmers had farm houses (43.3 %) followed by storage sheds (30.0 %), cattle sheds (26.7 %) and pump sheds (6.7 %). However, the difference in the inventory of farm buildings between traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) was non-significant (Table 4.3).

Table 4.3: Inventory of farm buildings of respondent farmers.

Particulars	Traditional area (Hiriyur taluk) (n=30)		Emerging area (Hosadurga taluk) (n=30)		Pooled (n=60)		$\chi 2$ value
	Number of farmer possessing	%	Number of farmer possessing	%	Number of farmer possessing	%	
Farm house	11	36.7	13	43.3	24	40.0	0.28^{NS}
Cattle shed	5	16.7	8	26.7	13	21.7	0.88^{NS}
Pump shed	3	10.0	2	6.7	5	8.3	0.22^{NS}
Storage shed	8	26.7	9	30.0	17	28.3	0.08^{NS}

Note: NS: Non- significant

4.1.3: Farm implements/machineries respondent farmers

As shown in table 4.4, out of 30 pomegranate growing farmers in traditional area (Hiriyur taluk), only 7 farmers had tractors (23.34 %), 3 farmers had power tillers (10 %), 30 farmers owned sprayers (100 %), 3 farmers had bullock carts (10 %), 5 farmers (16.67 %) had ploughs and 7 farmers (23.34 %) had cultivators. Out of 30 pomegranate growing farmers in emerging area (Hosadurga taluk), 5 farmers had tractors (16.67 %), 2 farmers had power tillers (6.67 %), 30 farmers owned sprayers (100 %), 5 farmers had bullock carts (16.67 %), 3 farmers (10 %) had plough and 5 farmers (16.67 %) had cultivators. The difference in ownership of farm implements between traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) was statistically non-significant.

Table 4.4: Farm implements/machineries of respondent farmers.

Particulars	Traditional area (Hiriyur taluk) (n=30)		Emerging area (Hosadurga taluk) (n=30)		Pooled (n=60)		$\chi 2$ value
	Number of farmer possessing	%	Number of farmer possessing	%	Number of farmer possessing	%	
Tractor	7	23.34	5	16.67	12	20.00	0.42^{NS}
Power tiller	3	10.00	2	6.67	5	8.34	0.22^{NS}
Sprayers	30	100.00	30	100.00	60	100.00	0.00^{NS}
Bullock cart	3	10.00	5	16.67	8	13.34	0.58^{NS}
Plough	5	16.67	3	10.00	8	13.34	0.58^{NS}
Cultivator	7	23.34	5	16.67	12	20.00	0.42^{NS}

Note: NS: Non- significant

4.1.4: Livestock inventory of respondent farmers

The livestock inventory of the sample respondents indicated in Table 4.5. In traditional area (Hiriyur taluk), (26.67 %) farmers had a pair of bullock, (23.34 %) farmers had cows, (23.34 %) farmers had buffalo, (16.64 %) farmers had sheep, (16.64 %) farmers had goat and 10 % farmers had poultry birds. In emerging area (Hosadurga taluk), there were (30 %) farmers had bullock pair, (40 %) farmers had cows, 33.34 farmers had buffalo, (20 %) farmers had sheep, (20 %) farmers had goat and (16.64 %) farmers had poultry birds. However, the differences in the number of various livestock position were statistically non-significant.

Table 4.5: livestock inventory of respondent farmers.

Particulars	Traditional area (Hiriyur taluk) (n=30)		Emerging area (Hosadurga taluk) (n=30)		Pooled (n=60)		$\chi 2$ value
	Number of farmer possessing	%	Number of farmer possessing	%	Number of farmer possessing	%	
Bullock pairs	8	26.67	9	30.00	17	28.34	0.08^{NS}
Cows	7	23.34	12	40.00	19	31.64	1.93^{NS}
Buffaloes	7	23.34	10	33.34	17	28.34	0.74^{NS}
Sheeps	5	16.64	6	20.00	11	18.34	0.11^{NS}
Goats	5	16.64	6	20.00	11	18.34	0.11^{NS}
Poultry	3	10.00	5	16.64	8	13.34	0.58^{NS}

Note: NS: non- significant

4.1.5: Extension participation of respondent farmers

It is evident from table 4.6 that in traditional area (Hiriyur taluk) out of 30 sample farmers, 93.40 per cent involved in krishimela followed by training programme (53.34 %), extension tours (16.70 %), field days (16.70 %) and demonstration (10 %).

In emerging area (Hosadurga taluk), out of 30 farmers, majority (96.70 %) had undergone training programmes followed by attending of krishimela (76.67 %), extension tours (26.67 %), field days (13.30 %) and demonstrations (6.70 %). The

difference in extension participation between traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) was non-significant except in the case of training programme.

Table 4.6: Extension participation of respondent farmers.

Particulars	Traditional area (Hiriyur taluk) (n=30)		Emerging area (Hosadurga taluk) (n=30)		Pooled (n=60)		χ^2 value
	Number of farmer participation	%	Number of farmer participation	%	Number of farmer participation	%	
Training programme	16	53.34	29	96.70	45	75.00	15.02**
Field days	5	16.70	4	13.30	9	15.00	0.13NS
Extension tour	5	16.70	8	26.67	13	21.67	0.88NS
Krishimela	28	93.40	23	76.67	51	85.00	3.27 NS
Demonstration	3	10.00	2	6.70	5	8.33	0.22 NS

Note: **- Significant at 5 %.
NS: Non- significant

4.1.6 Institutional participation of respondent farmers.

Table 4.7 depicts the institutional participation of farmers. In traditional area (Hiriyur taluk) 66.67 per cent of farmers had involved in *RythaSangha* followed by Milk producer's co-operative society (MPCS) (16.67 %), Village Panchayat (13.34 %), Primary Agricultural Cooperative Society (10.00 %), Youth Club (10.00 %), Primary Land Development bank (6.67 %) and Taluk Panchayat (3.30 %).

In Emerging area (Hosadurga taluk), 50 per cent of farmers had activities of involved in *Rytha Sangha* followed by Youth club (16.67 %), Milk producers co-operative society (MPCS) (10 %), Village Panchayat (10 %), Primary Land Development Bank (10 %), Primary Agricultural Cooperative Society (6.67 %), and Zilla Panchayat (3.30 %). However, the difference in the institutional participation between the two areas was statically non-significant.

Table 4.7: Institutional participation of respondent farmers.

Institutions	Traditional area (Hiriyur taluk) (n=30)		Emerging area (Hosadurga taluk) (n=30)		Pooled (n=60)		$\chi 2$ value
	Number of farmer participation	%	Number of farmer participation	%	Number of farmer participation	%	
PACS	3	10.00	2	6.67	5	8.33	0.22^{NS}
Rytha sangha	20	66.67	15	50.00	35	58.33	1.71^{NS}
Youth club	3	10.00	5	16.67	8	13.33	0.58^{NS}
Village panchayat	4	13.34	3	10.00	7	11.67	0.16^{NS}
Taluk panchayat	1	3.30	2	6.67	3	5.00	0.35^{NS}
Zilla panchayat	0	0.00	1	3.30	1	1.67	1.02^{NS}
Milk producers co-operative society (MPCS)	5	16.67	3	10.00	8	13.33	0.58^{NS}
Primary land development bank	2	6.67	3	10.00	5	8.33	0.22^{NS}

Note: NS: Non-significant

4.1.7: Source of irrigation of respondent farmers

Table 4.8 represents the sources of irrigation for pomegranate cultivation in the study region. The highest area of 1.38 (70.41 %) ha in traditional area and 1.63 (72.12 %) ha in emerging area was under bore well irrigation. The area under tank irrigation was 0.31(15.82 %) ha in traditional area and 0.42 (18.58 %) ha in emerging area. The open well irrigation was the least source of irrigation in both the areas at (13.78 %) and (9.29 %) respectively in the traditional and emerging areas.

Table 4.8: Sources of irrigation of respondent farmers.

Sources of irrigation	Traditional area (Hiriyur taluk) (n=30)		Emerging area (Hosadurga taluk) (n=30)		Pooled (n=60)	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
Open well	0.27	13.78	0.21	9.29	0.24	11.37
Tank (ha)	0.31	15.82	0.42	18.58	0.37	17.30
Bore well (ha)	1.38	70.41	1.63	72.12	1.51	71.33
Total	1.96	100	2.26	100	2.11	100

4.1.8: Details of loan availed, repayment and outstanding of the respondent farmers for pomegranate cultivation

Details on loan availed by respondent farmers in the study area are presented in table 4.9. The percentage of farmers borrowed loan was higher in case of traditional area (33.33 %) than in the emerging area farmers (23.33 %). The average loan amount borrowed by emerging area farmers was ₹1, 41,300 and it was ₹ 1, 22,000 by in the traditional area. The average repayment by Hosadurga farmers was ₹. 35,000 and ₹ 30,500 in the case of traditional area farmers. The outstanding loan amount was higher among farmers in emerging area at ₹1, 06,300 than in traditional area in which it was ₹ 91,500 (Table.4.9)

Table 4.9: Details of loan availed, repayment and outstanding of the respondent farmers for pomegranate cultivation.

(Per farm)

Loan details	Traditional area (Hiriyur taluk) (n=30)	Emerging area (Hosadurga taluk) (n=30)
Number of farmers borrowed loan	10 (33.33)	7 (23.33)
Average loan amount borrowed (₹)	122000	141300
Average repayment (₹)	30500	35000
Loan outstanding (₹)	91500	106300
Rate of interest per annum (%)	11	11

4.1.9: Annual expenditure pattern of the respondent farmers

The table 4.10 presents the annual household expenditure pattern of respondent farmers in both the taluks. Both in traditional area (Hiriyur) and emerging area (Hosadurga), out of total expenditure, (₹59, 643), 62 per cent of expenditure made towards food and clothing. For social functions traditional area farmers spent 10.74 per cent and emerging area farmers spent 11.37 per cent. Other expenditure included expenditure on building maintenance (2.19 %), machinery maintenance (1.83 %), vehicle maintenance (2.61%), land development activity (7.20 %), health (7.82 %), insurance (0.65%) and miscellaneous expenditure (3.91%). Among other expenditure items farmers in traditional area (Hiriyur) spent higher per cent (26.73 %) as compared to emerging area (Hosadurga) (26.21 %). Expenditure on food was highest (58.97 %) in the pooled sample. In the total expenditure, food expenditure was the highest in both the cases (around 59 %) followed by expenditure on clothing (4 %). The expenditure on social functions, expenditure on health and education was about 7 per cent in both the taluks. In the case of other expenditure, expenditure was on land development was the highest at about 8 per cent and lowest expenditure on insurance in both the taluks (Table 4.10).

Table 4.10: Annual expenditure pattern of the respondent farmers.

Sl. No	Items/Aspects	Annual expenditure (₹)					
		Traditional area (Hiriyur taluk) (n=30)		Emerging area (Hosadurga taluk) (n=30)		Pooled (n=60)	
		Expenditure	%	Expenditure	%	Expenditure	%
I	**Household**						
1	Food	35067	58.79	36467	59.14	35767	58.97
2	Clothing	2223	3.73	2023	3.28	2123	3.50
	Total	**37290**	**62.52**	**38490**	**62.42**	**37890**	**62.47**
II	**Social functions**						
1	Education	4255	7.13	4797	7.78	4526	7.46
2	Social Ceremonies	2153	3.61	2217	3.60	2185	3.60
	Total	**6408**	**10.74**	**7014**	**11.37**	**6711**	**11.06**
III	**Others**						
1	Buildings maintenance	1107	1.86	1353	2.19	1230	2.03
2	Machinery maintenance	1340	2.25	1130	1.83	1235	2.04
3	Vehicle maintenance	1433	2.40	1607	2.61	1520	2.51
4	Land development	4950	8.30	4440	7.20	4695	7.74
5	Health	4300	7.21	4820	7.82	4560	7.52
6	Insurance	358	0.60	402	0.65	380	0.63
7	Miscellaneous	2457	4.12	2410	3.91	2434	4.01
	Total	**15945**	**26.73**	**16162**	**26.21**	**16054**	**26.47**
	I+II+III	**59643**	**100.00**	**61666**	**100.00**	**60655**	**100.00**

4.1.10: Cropping pattern of pomegranate farmers

Cropping pattern of sample farmers is presented in table 4.11. The cropping intensity was higher in emerging area (Hosadurga taluk) (187 %) than that of traditional area (Hiriyur taluk) (170 %). It was evident from the table that among cereals, jowar occupied highest percentage (10.07 %) followed by ragi (6.75 %), paddy (3.27 %), maize (3.03%) and pearl millet (0.6 %) and vegetables (0.24 %). Among pulses, bengal gram occupied the highest percentage of area (4.48 %) followed by green gram (2.43 %), horse gram (2.37 %) and cowpea (1.96 %). Among oilseeds and commercial crops, groundnut occupied the highest percentage (12.72 %) followed by onion (11.06 %), cotton (11.06 %) and sunflower (3.32 %). Among perennial crops, pomegranate occupied the highest percentage (22.52 %), second highest area was occupied by arecanut (1.86 %) and mango occupied the lowest area (0.92 %) and net cropped area was about 2.28 ha in traditional area (Hiriyur taluk).

Table 4.11: Cropping pattern of pomegranate farmers.

Sl. No	Crops	Traditional area (Hiriyur taluk) (n=30)		Emerging area (Hosadurga taluk) (n=30)		Pooled (n=60)	
		Area (ha)	%	Area (ha)	%	Area (ha)	%
1	Paddy	0.13	3.27	0.08	1.57	0.10	2.33
2	Ragi	0.26	6.75	0.64	13.35	0.45	10.41
3	Jowar	0.39	10.07	0.45	9.37	0.42	9.68
4	Pearl millet	0.02	0.62	0.00	0.00	0.01	0.28
5	Maize	0.12	3.03	0.28	5.77	0.20	4.55
	Total cereals	**0.92**	**23.74**	**1.45**	**30.07**	**1.18**	**27.25**
1	Horse gram	0.09	2.37	0.13	2.78	0.11	2.60
2	Bengal gram	0.17	4.48	0.25	5.18	0.21	4.87
3	Green gram	0.09	2.43	0.12	2.48	0.11	2.46
4	Cowpea	0.08	1.96	0.14	2.90	0.11	2.48
	Total pulses	**0.43**	**11.23**	**0.64**	**13.34**	**0.54**	**12.40**
1	Groundnut	0.49	12.72	0.43	8.85	0.46	10.57
2	Sunflower	0.13	3.32	0.15	3.08	0.14	3.19
3	Onion	0.43	11.12	0.46	9.58	0.45	10.27
4	Cotton	0.43	11.06	0.34	7.10	0.39	8.87
	Total oilseeds and commercial crops	**1.48**	**38.22**	**1.38**	**28.62**	**1.43**	**32.89**
	Vegetables	**0.01**	**0.24**	**0.04**	**0.73**	**0.02**	**0.51**
1	Pomegranate	0.87	22.52	1.06	21.97	0.96	22.21
2	Coconut	0.05	1.27	0.07	1.39	0.06	1.34
3	Arecanut	0.07	1.86	0.13	2.60	0.10	2.27
4	Mango	0.04	0.92	0.06	1.29	0.05	1.12
	Total perennials	**1.03**	**26.57**	**1.31**	**27.25**	**1.17**	**26.94**
	Gross cropped area	**3.87**	**100.00**	**4.81**	**100.00**	**4.34**	**100.00**
	Net cropped area	**2.28**		**2.57**		**2.43**	
	Cropping intensity (%)	**170**		**187**		**179**	

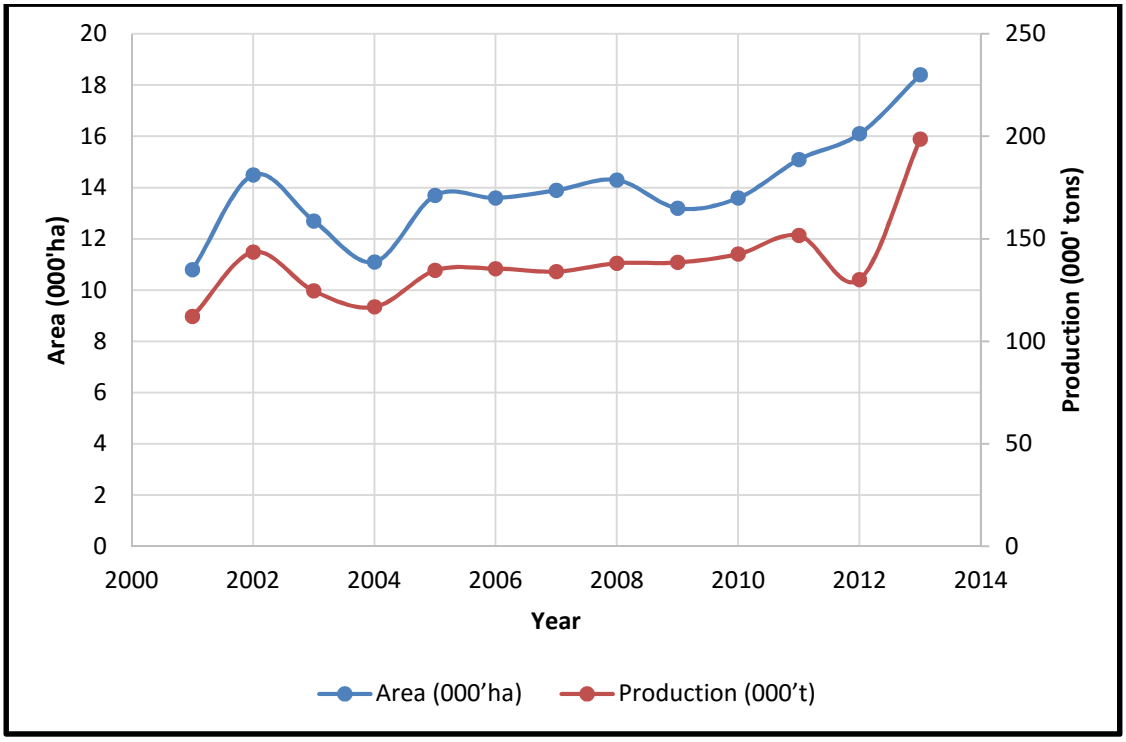

Fig. 4.1: Growth rate in area and production of pomegranate cultivation in Karnataka during 2001-02 to 2013-14.

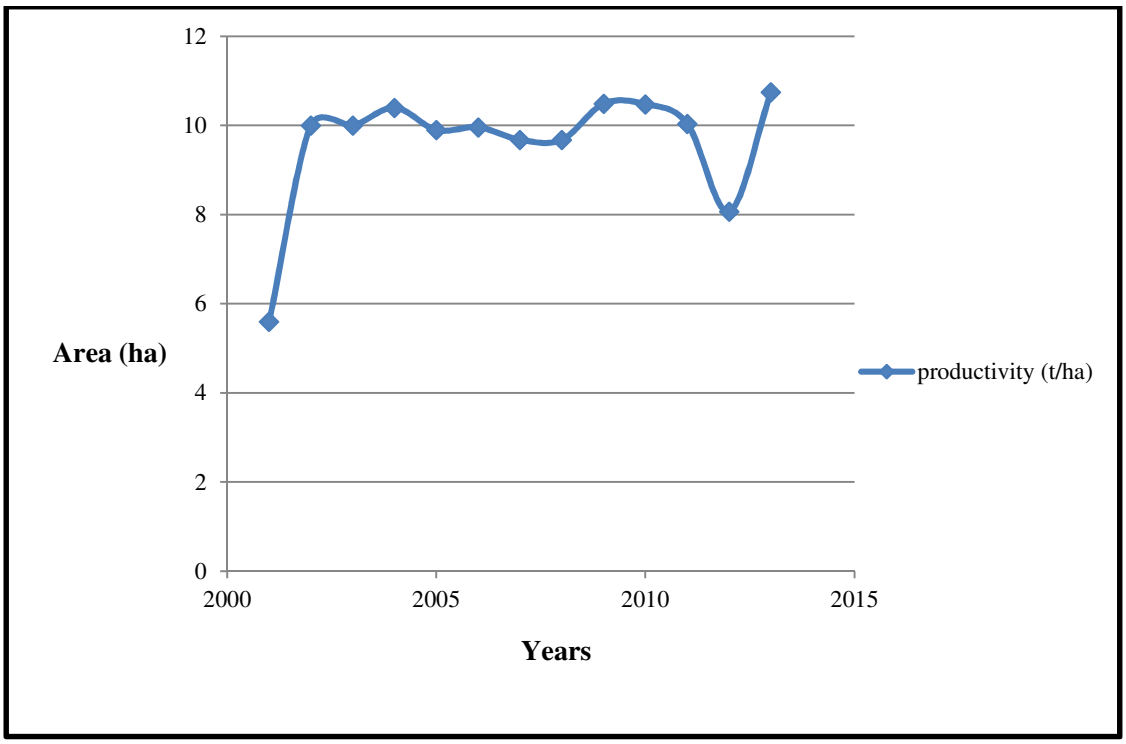

Fig. 4.2: Growth rate in productivity of pomegranate cultivation in Karnataka during 2001-02 to 2013-14.

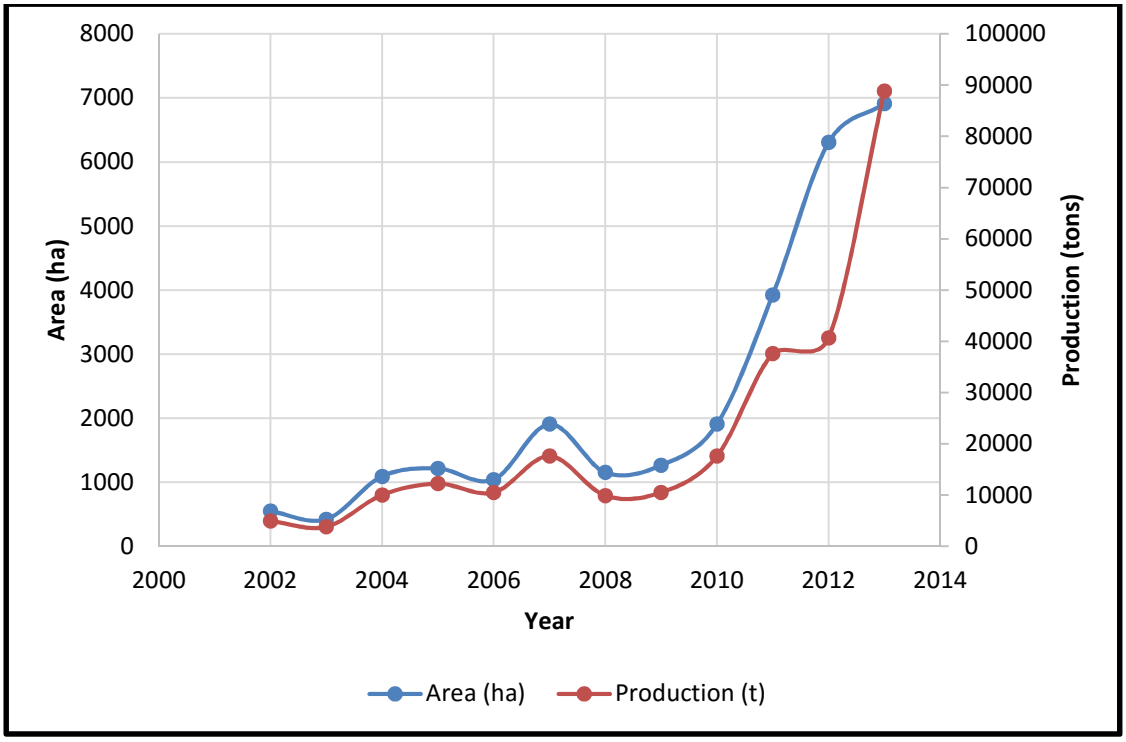

Fig. 4.3: Growth rate in area and production of pomegranate cultivation in Chitradurga district during 2002-03 to 2013-14.

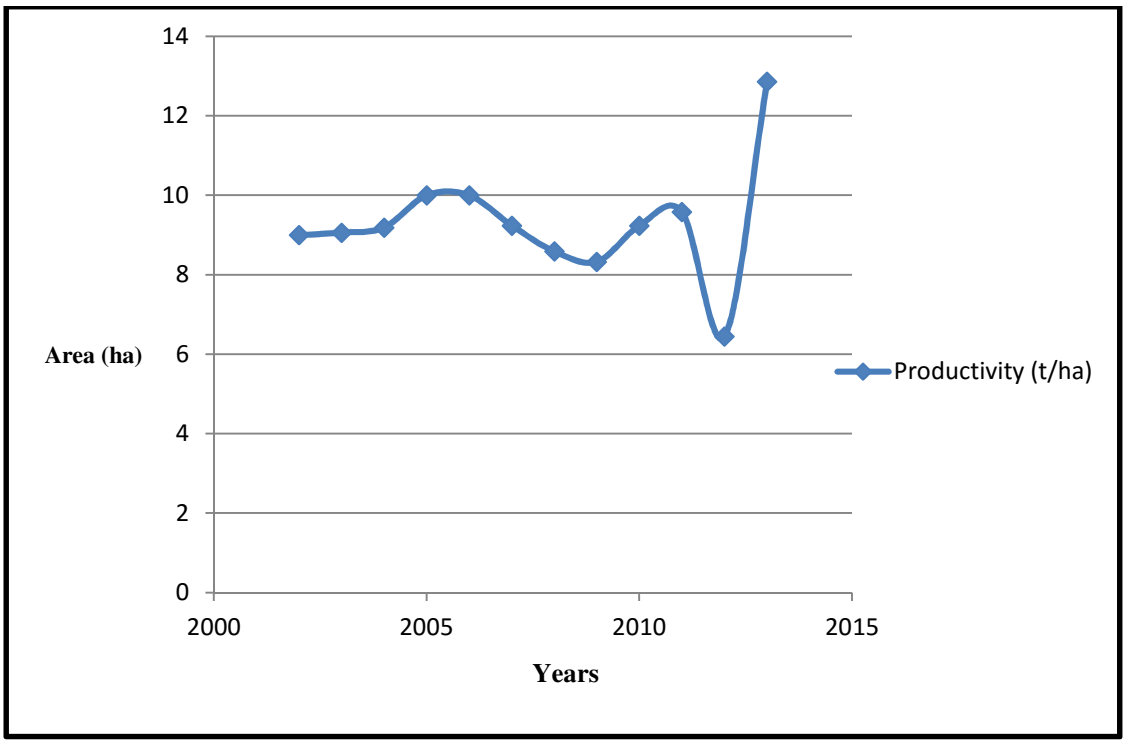

Fig. 4.4: Growth rate in productivity of pomegranate cultivation in Chitradurga district during 2002-03 to 2013-14.

In emerging area, the total net cropped area was 2.57 ha. Among cereals, ragi occupied the first place (13.35 %) followed by jowar (9.37 %) and lowest area was occupied by paddy (1.57 %). In pulses, bengal gram occupied the highest area (5.18 %) followed by cowpea (2.90 %), horse gram (2.78 %) and vegetables (0.73 %). Among oilseeds and commercial crops, onion occupied the highest percentage (9.58 %) followed by groundnut (8.85 %), cotton (7.10 %) and sunflower (3.08 %). In the case of perennial crops, pomegranate occupied the highest area (21.97 %) and lowest area by mango (1.29 %).

4.2 Area, production and productivity growth of pomegranate

4.2.1Growth rate in area, production and productivity of pomegranate cultivation in Karnataka and Chitradurga district

Growth rates in area, production and productivity of pomegranate cultivation in Karnataka and Chitradurga district during the period 2001-02 to 2013-14 and 2002-03 to 2013-14 are depicted in the tables 4.12 and table 4.13. The results indicated that there was positive growth under pomegranate area at state level (2.78 %) and in the Chitradurga district (24.82 %). With respect to production also a positive trend of 2.44 per cent in the state level and 24.86 per cent in Chitradurga district was noticed. The positive growth in production observed was due to increasing area under pomegranate cultivation. Productivity growth was also shown positive but at a increased growth rate of 1.64 per cent in Karnataka state and 0.05 per cent in Chitradurga district**.** The area under pomegranate in Karnataka during 2001-02 was 10.8 thousand ha which increased to 18.4 thousand ha during 2013-14. Chitradurga district also showed an increasing trend from 551 ha of area during 2002-03 to 6,911 ha during 2013-14.

Table 4.12: Growth rate in area, production and productivity of pomegranate cultivation in Karnataka during 2001-02 to 2013-14.

Year	Area (000'ha)	Production (000't)	Productivity (t/ha)
2001-2002	10.8	112.2	5.60
2002-2003	14.5	143.6	10.00
2003-2004	12.7	124.6	10.00
2004-2005	11.1	116.8	10.40
2005-2006	13.7	134.6	9.90
2006-2007	13.6	135.5	9.96
2007-2008	13.9	134.1	9.68
2008-2009	14.3	138.1	9.68
2009-2010	13.2	138.5	10.49
2010-2011	13.6	142.6	10.48
2011-2012	15.1	151.6	10.04
2012-2013	16.1	130.2	8.07
2013-2014	18.4	198.6	10.75
CAGR	**2.78**	**2.44**	**1.64**

Source: Anonymous, *2013(C)*

Table 4.13: Growth rate in area, production and productivity of pomegranate cultivation in Chitradurga district during 2002-03 to 2013-14.

Year	Area (ha)	Production (t)	Productivity (t/ha)
2002-2003	551	4959	9.00
2003-2004	423	3831	9.06
2004-2005	1094	10053	9.19
2005-2006	1217	12254	10.00
2006-2007	1044	10524	10.00
2007-2008	1909	17635	9.24
2008-2009	1155	9924	8.59
2009-2010	1266	10547	8.33
2010-2011	1909	17635	9.24
2011-2012	3926	37605	9.58
2012-2013	6305	40677	6.45
2013-2014	6911	88862	12.86
CAGR	**24.82**	**24.86**	**0.05**

Source: Anonymous, *2013(C)*

4.2.2: Growth rate in area, production and productivity of pomegranate cultivation in traditional area (Hiriyur taluks) and emerging area (Hosadurga taluks)

Growth rate in area, production and productivity of pomegranate cultivation in the traditional area and emerging areas during 2005-06 to 2013-14 has been depicted in the table 4.14 and table 4.15. The results indicated that there was a positive growth rate in area under pomegranate cultivation in both the taluks at Hiriyur taluk (1.99 %) and in emerging area (Hosadurga taluk) (127.6 %). With respect to production, there was a negative growth rate of 1.39 % in the traditional area (Hiriyur taluk) and positive growth rate of 127.73 per cent in emerging area (Hosadurga taluk). The productivity had shown a negative trend with negative growth rate of 3.31 per cent in traditional area (Hiriyur taluk) and positive trend of 0.06 per cent in emerging area (Hosadurga taluk).

The area under pomegranate in traditional area (Hiriyur taluk) during 2005-06 was 731 ha and it enhanced to 925 ha during 2013-14. Emerging area (Hosadurga taluk) had 16 ha of area during 2005-06 and enhanced to 4750 ha during 2013-14.

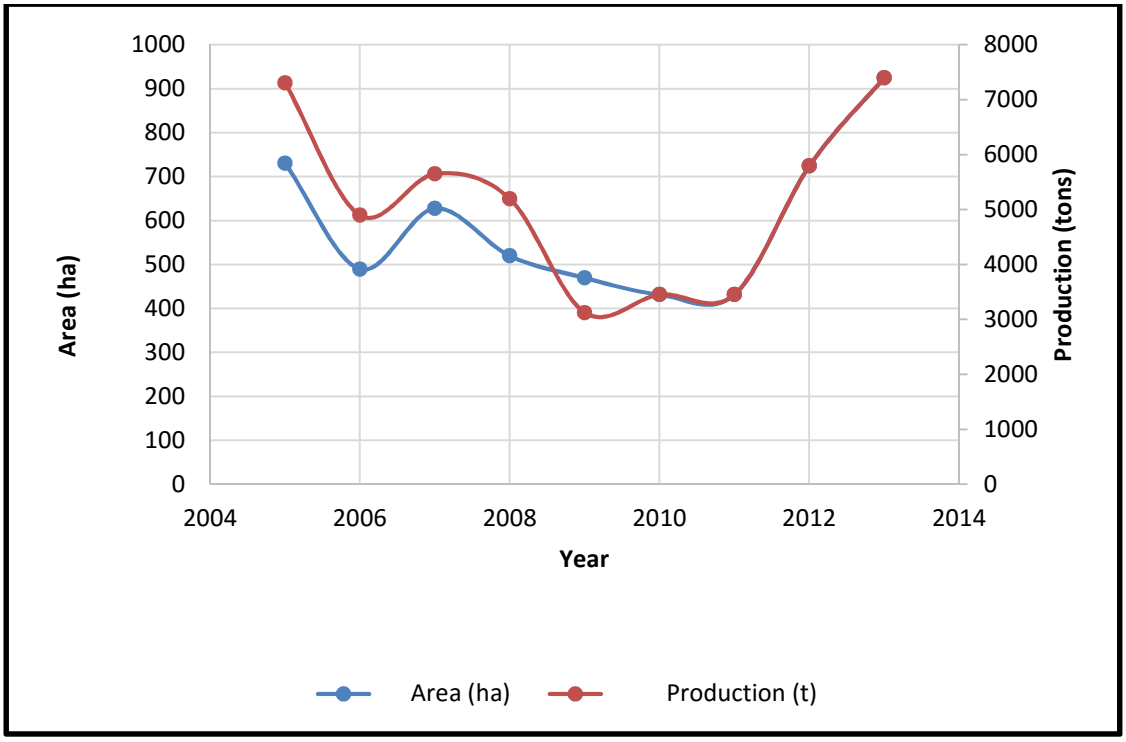

Fig. 4.5: Growth rate in area and production of pomegranate cultivation in traditional area (Hiriyur taluk) during 2005-06 to 2013-14.

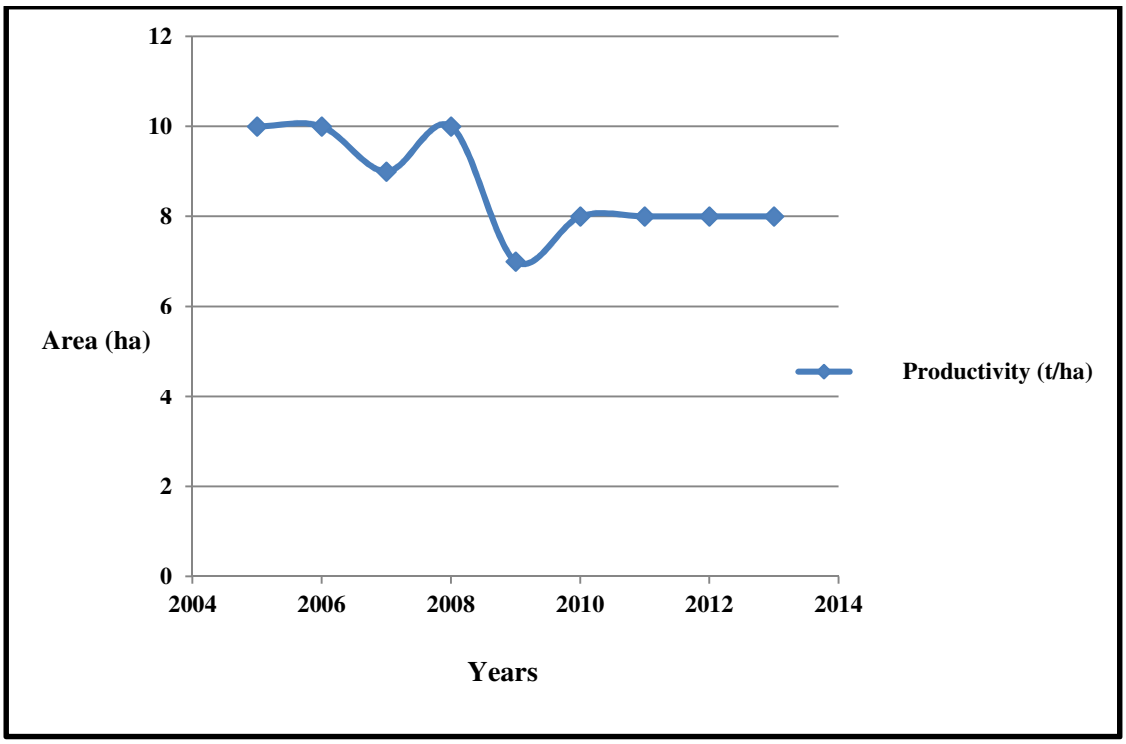

Fig. 4.6: Growth rate in productivity of pomegranate cultivation in traditional area (Hiriyur taluk) during 2005-06 to 2013-14.

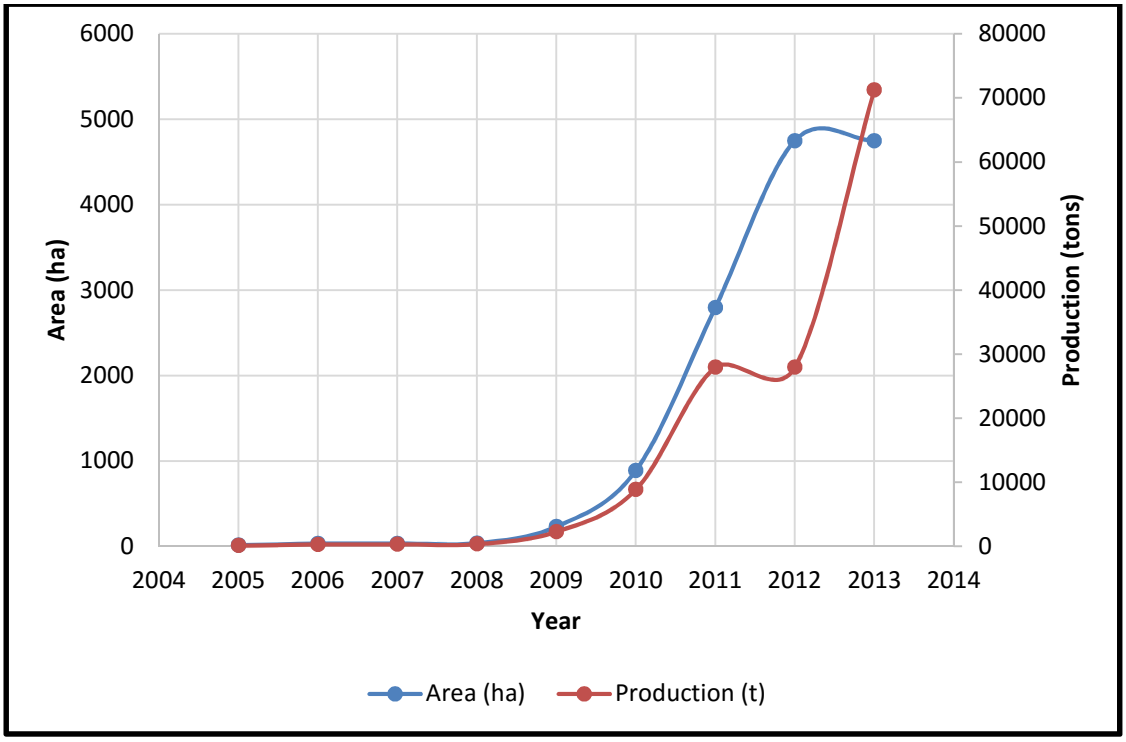

Fig. 4.7: Growth rate in area and production of pomegranate cultivation in emerging area (Hosadurga taluk) during 2005-06 to 2013-14.

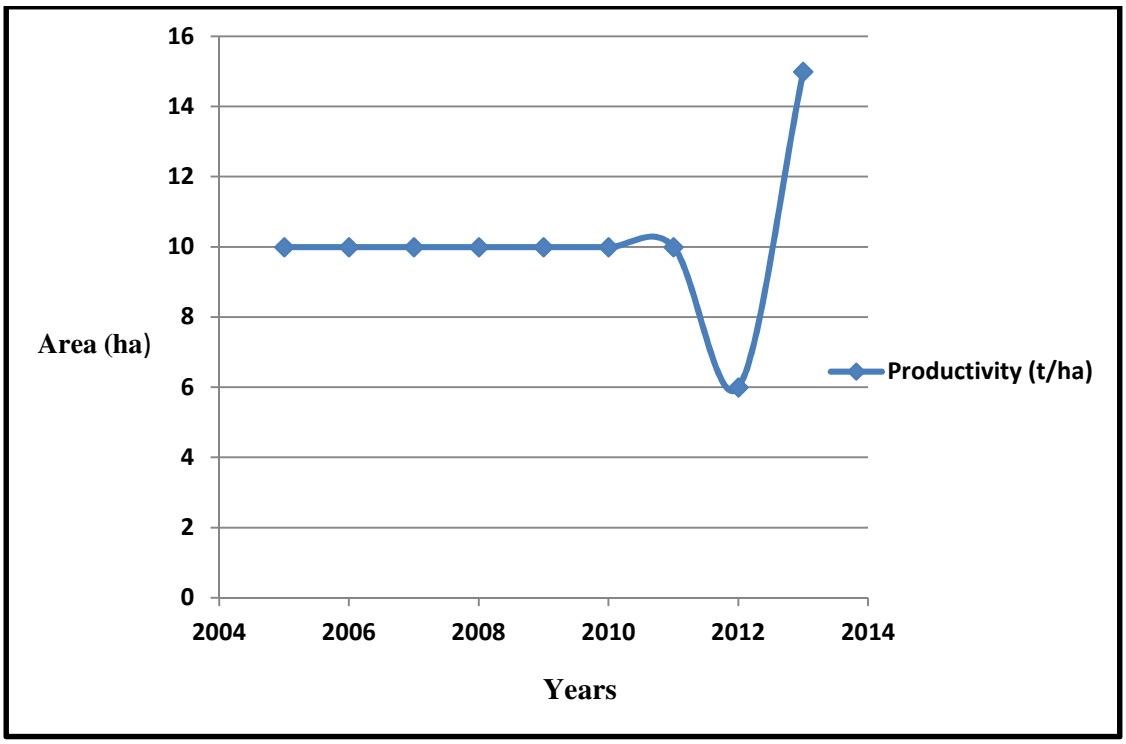

Fig. 4.8: Growth rate in productivity of pomegranate cultivation in emerging area (Hosadurga taluk) during 2005-06 to 2013-14.

Table 4.14: Growth rate in area, production and productivity of pomegranate cultivation in traditional area (Hiriyur taluk) during 2005-06 to 2013-14.

Year	Area (ha)	Production (t)	Productivity (t/ha)
2005-2006	731	7310	10
2006-2007	490	4900	10
2007-2008	628	5652	9
2008-2009	520	5200	10
2009-2010	470	3128	7
2010-2011	432	3456	8
2011-2012	432	3456	8
2012-2013	725	5800	8
2013-2014	925	7400	8
CAGR	**1.99**	**-1.39**	**-3.31**

Source: Anonymous, *2013(C)*

Table 4.15: Growth rate in area, production and productivity of pomegranate cultivation in emerging area (Hosadurga taluk) during 2005-06 to 2013-14.

Year	Area (ha)	Production (t)	Productivity (t/ha)
2005-2006	16	160	10
2006-2007	34	340	10
2007-2008	37	370	10
2008-2009	40	400	10
2009-2010	233	2330	10
2010-2011	890	8900	10
2011-2012	2798	27980	10
2012-2013	4750	27980	6
2013-2014	4750	71250	15
CAGR	**127.6**	**127.73**	**0.06**

Source: Anonymous, *2013(C)*

4.3 Investment pattern and establishment cost of pomegranate orchards

The investment on pomegranate orchards comprised of costs incurred in establishing the orchard that was up to bearing period (18 months). The establishment costs in pomegranate orchards were classified into labour cost, material cost and fixed cost. The Labour cost were the costs incurred during the land preparation, digging of pits, manure and tank silt application, planting and filling of pits, fertilizer application, pruning, plant protection chemical application, staking, weeding and fencing. The material costs include the cost of fencing material, drip material cost, irrigation cost, purchase of planting material, tank silt, manures, fertilizers, plant protection chemicals, staking material and miscellaneous charges. The cost incurred for the maintenance of the orchard till the time of bearing in each year was considered as a establishment cost. Fixed cost comprised of land revenue, depreciation, rental value of land and annualized establishment cost.

4.3.1 Establishment cost of pomegranate orchards in traditional area (Hiriyur taluk)

The details of establishment cost incurred for pomegranate orchard in traditional area (Hiriyur taluk) are presented in table 4.16. The findings revealed that the total establishment cost was around ₹ 4, 35,668 per ha. Further, the labour cost was ₹94, 161 (21.61 %) and material cost of ₹2, 60,334 (59.76 %). Out of the total labour cost, the expenditure made on pruning formed the highest per cent (9.20 %) followed by digging of pits (3.68 %).

Among the material cost, the major share of ₹ 60,880 (13.97 %) was spent on drip material, followed by fencing around the orchard which amount to ₹47,128 (10.82 %) and purchase of staking material was ₹35,632 (8.18 %), planting material of ₹ 28,228 (6.48 %), plant protection chemicals ₹27,142 (6.23 %), fertilizers ₹ 25,262 (5.80 %), manures ₹17,252 (3.96 %), irrigation cost of ₹ 11,524 (2.65 %), tank silt of ₹5714 (1.31 %) and miscellaneous cost of ₹1,572 (0.36 %).

The total fixed cost of pomegranate orchards in traditional area (Hiriyur taluk) was ₹45, 723 (10.49 %), of which major portion was on rental value of land ₹23, 586 (5.41%) and interest on fixed capital ₹19, 630(4.51 %).

4.3.2 Establishment cost of pomegranate orchards in emerging area (Hosadurga taluk)

Table 4.17 shows the cost incurred for the establishment of pomegranate orchard in emerging area (Hosadurga taluk). It was noticed that, the total cost incurred for the establishment of pomegranate orchard was ₹4, 50,585 per ha. Out of total cost, major share was towards cost of drip ₹69, 041 (15.32 %), pruning ₹45,988 (10.21 %), fencing ₹40,522 (8.99 %), staking material ₹39, 697 (8.81 %), plant protection chemicals ₹32, 482 (7.21 %) and manures and fertilizers ₹44,634 (9.9 %).

Table 4.16: Establishment cost of pomegranate orchard in traditional area (Hiriyur taluk).

(₹ /ha)

Sl. no.	Particulars	Unit	Quantity	Cost	%
A.	**Labour cost**				
1	Preparation of land	Machine hours	6.73	6297	1.45
2	Digging of pits	No.	900	16021	3.68
3	Manure and tank silt application	Man days	28.74	7186	1.65
4	Planting and filling of pits	Man days	21.50	5375	1.23
5	Fertilizers application	Man days	15.94	3987	0.92
6	Pruning	₹	-	40068	9.20
7	Plant protection chemical application	Man days	17.45	4363	1.00
8	Staking	Man days	19.52	4882	1.12
9	Weeding	Man days	9.01	2254	0.52
10	Fencing	Man days	14.91	3728	0.86
	Total labour cost			**94161**	**21.61**
B.	**Material cost**				
1	Fencing	₹	-	47128	10.82
2	Drip material	₹		60880	13.97
3	Tank silt	mt	19.94	5714	1.31
4	Manures	mt	8.89	17252	3.96
5	Fertilizers	Kg	820.93	25262	5.80
6	Plant protection chemicals	Lit	10.4	27142	6.23
7	Irrigation	₹	-	11524	2.65
8	Planting material	No.	1036	28228	6.48
9	Staking material	No.	8288	35632	8.18
10	Miscellaneous	₹	-	1572	0.36
	Total material cost			**260334**	**59.76**
	Interest on working capital @ 10 %			35450	8.14
	Subtotal (A+B)			**389945**	**89.51**
C.	**Fixed cost**				
1	Land revenue			35	0.01
2	Depreciation	-	-	2472	0.57
3	Rental value of land			23586	5.41
4	Interest on fixed capital @ 8 %			19630	4.51
	Total fixed cost			**45723**	**10.49**
	Total cost (A+B+C)			**435668**	**100**

Table 4.17: Establishment cost of pomegranate orchards in emerging area (Hosadurga taluk).

(₹ /ha)

Sl. No.	Particulars	Unit	Quantity	Cost	%
A.	**Labour cost**				
1	Preparation of land	Machine hours	7.15	5581	1.24
2	Digging of pits	No.	885	15903	3.53
3	Manure and tank silt application	Mandays	25.91	6478	1.44
4	Planting and filling of pits	Man days	16.53	4134	0.92
5	Fertilizers application	Man days	14.25	3563	0.79
6	Pruning	₹		45988	10.21
7	Plant protection chemical application	Man days	18.15	4538	1.01
8	Staking	Man days	13.52	3380	0.75
9	Weeding	Man days	10.83	2710	0.60
10	Fencing	Man days	12.74	3186	0.71
	Total labour cost			**95461**	**21.19**
B.	**Material cost**				
1	Fencing	₹	-	40522	8.99
2	Drip material	₹		69041	15.32
3	Tank silt	mt	19.81	7642	1.70
4	Manures	mt	8.18	18352	4.07
5	Fertilizers	Kg	703.3	26282	5.83
6	Plant protection chemicals	Lit	15.17	32482	7.21
7	Irrigation	₹	-	9651	2.14
8	Planting material	No.	801	25142	5.58
9	Staking material	No.	6408	39697	8.81
10	Miscellaneous	₹		1093	0.24
	Total material cost			**269904**	**59.90**
	Interest on working capital @ 10 %			36537	8.11
	Subtotal (A+B)			**401902**	**89.20**
C.	**Fixed cost**				
1	Land revenue			35	0.01
2	Depreciation	-	-	2876	0.64
3	Rental value of land			24092	5.35
	Interest on fixed capital @ 8 %			21680	4.81
	Total fixed cost			**48683**	**10.80**
	Total cost (A+B+C)			**450585**	**100**

4.3.3 Establishment cost of pomegranate orchards (pooled respondents)

The details of establishment cost incurred for pomegranate orchards in the study area (pooled respondents) are presented in table 4.18. The findings revealed that the total establishment cost was around ₹ 4, 44,034 per ha. Further, the labour cost was ₹95, 169 (21.43 %) and material cost of ₹2, 65,527 (59.80 %). Out of the total labour cost, the expenditure made on pruning was accounted for the highest per cent (9.69 %) followed by digging of pits (3.63 %).

Table 4.18: Establishment cost of pomegranate orchards (pooled respondents).

(₹ /ha)

Sl. No.	Particulars	Unit	Quantity	Cost	%
A.	**Labour cost**				
1	Preparation of land	Machine hours	6.98	5962	1.34
2	Digging of pits	No.	892	16128	3.63
3	Manure and tank silt application	Man days	27.43	6858	1.54
4	Planting and filling of pits	Man days	19.11	4778	1.08
5	Fertilizers application	Man days	15.25	3812	0.86
6	Pruning	₹		43029	9.69
7	Plant protection chemical application	Man days	17.92	4480	1.01
8	Staking	Man days	16.63	4157	0.94
9	Weeding	Man days	9.98	2495	0.56
10	Fencing	Man days	13.88	3470	0.78
	Total labour cost			**95169**	**21.43**
B.	**Material cost**				
1	Fencing	₹		43829	9.87
2	Drip material	₹		64964	14.63
3	Tank silt	Mt	19.87	6875	1.55
4	Manures	Mt	8.56	17864	4.02
5	Fertilizers	Kg	762.19	25842	5.82
6	Plant protection chemicals	Lit	12.85	29846	6.72
7	Irrigation	₹		10588	2.38
8	Planting material	No.	920	26692	6.01
9	Staking material	No.	7352	37691	8.49
10	Miscellaneous	₹		1336	0.30
	Total material cost			**265527**	**59.80**
	Interest on working capital @ 10 %			**36070**	**8.12**
	Subtotal (A+B)			**396766**	**89.35**
C.	**Fixed cost**				
1	Land revenue			35	0.01
2	Depreciation	-		2678	0.60
3	Rental value of land			23868	5.38
	Interest on fixed capital @ 8 %			20687	4.66
	Total fixed cost			**47268**	**10.65**
	Total cost (A+B+C)			**444034**	**100.00**

Among the material costs, the major share of ₹ 64,964 (14.63 %) was spent towards drip materials, followed by fencing around the orchard ₹ 43,829 (9.87 %) purchase of staking material ₹ 37,691 (8.49 %), planting material ₹ 26,692 (6.01 %), plant protection chemicals ₹ 29,846 (6.72 %), fertilizers ₹ 25,842 (5.82 %), manures ₹ 17,864 (4.02 %), irrigation cost ₹ 10,588 (2.38 %), tank silt of ₹ 6,875 (1.55 %) and miscellaneous costs ₹1,336 (0.30 %).

The total fixed cost of pomegranate orchards in the pooled respondents was ₹ 47,268 (10.65 %), of which major portion was rental value of land ₹ 23,868 (5.38 %) and interest on fixed capital ₹ 20,687 (4.66 %) .

4.4 Annual maintenance cost of pomegranate orchards

Annual maintenance costs were the costs incurred after the establishment of the orchard, after 18 months onwards for the crop production over the economic lifespan of the plants up to 10 years Variable costs include the expenditure on labour for various operations like weeding, manures, fertilizers and plant protection chemical application, pruning, watch and ward and harvesting. Material cost comprised of purchase of tank silt, manure, fertilizer, plant protection chemical, irrigation charges and miscellaneous costs include repair and maintenance charges and other incidental charges. Marketing costs included packaging materials like boxes, cello tape for wrapping, labour for grading and packing and commission charges. The fixed cost comprised of depreciation charges, interest on fixed cost, rental value of land and land revenue. The annual maintenancecosts of pomegranate orchards for sample area wereexplained as below.

4.4.1 Annual maintenance cost of pomegranate orchards in traditional area (Hiriyur taluk)

The average per ha annual maintenance cost incurred by pomegranate growers in traditional area (Hiriyur taluk) is shown in table 4.19. The average per hectare maintenance cost was ₹3, 02,145. Out of which, the total variable cost was ₹ 2, 01,874 (66.81 %) and fixed costs accounted for about 33.19 per cent (₹1, 00,271).

Under variable cost, the major share was for labour cost ₹ 66,011 (21.85 %) of which major item was pruning cost which accounted 12.88 per cent(₹ 38, 919) followed by watch and ward ₹7, 500 (2.48 %), harvesting ₹ 6, 678 (2.21 %) and manures and fertilizer application ₹ 6, 312 (2.09 %), weeding ₹ 3,400 (1.13 %) and application of plant protection chemicals ₹ 3,202 (1.06 %).

Table 4.19: Annual maintenance cost of pomegranate orchard in traditional area (Hiriyur taluk).

(₹ /ha)

Sl. No.	Particulars	Unit	Quantity	Cost	%
I.	**Variable cost**				
A.	**Labour cost**				
1	Weeding	Man days	13.6	3400	1.13
2	Manure and fertilizer application	Man days	25.24	6312	2.09
3	Plant protection chemical application	Man days	12.8	3202	1.06
4	Pruning	₹	-	38919	12.88
5	Watch and ward	₹	-	7500	2.48
6	Harvesting	Man days	26.71	6678	2.21
	Total labour cost			**66011**	**21.85**
B.	**Material cost**		**-**	**-**	
1	Tank silt	Mt	18.47	6386	2.11
2	Manures	Mt	9.47	19732	6.53
3	Fertilizers	Kg	-	26589	8.80
4	Plant protection chemicals	Lit	-	29232	9.67
5	Irrigation charges	₹		11524	3.81
6	Miscellaneous	₹		1854	0.61
	Total material cost			**95317**	**31.55**
	Interest on working capital @ 10 %			16133	5.34
	Total (A+B)			**177461**	**58.73**
C.	**Marketing cost**				
	a) Box charges	No.	800	9600	3.18
	b) Cello tape	No.	10	380	0.13
	c) Grading and packaging (labour)	Man days	10.2	2550	0.84
	d) Commission @ 2 %			11883	3.93
	Total marketing cost			**24413**	**8.08**
	Total variable cost (A+B+C)			**201874**	**66.81**
II.	**Fixed cost**				
1	Land revenue			35	0.01
2	Depreciation			2472	0.82
3	Rental value of land			23586	7.81
4	Interest on fixed capital @ 8 %			201	0.07
5	Annualized establishment cost			73977	24.48
	Total fixed cost			**100271**	**33.19**
	Total cost (I + II)			**302145**	**100**

Among material costs components, it was observed that the cost for annual average plant protection chemicals was highest ₹ 29, 232 (9.67 %) followed by cost on fertilizers ₹ 26,589 (8.80 %), cost of manures ₹ 19,732 (6.53 %), irrigation charges ₹ 11,524 (3.81 %) and other cost items which included tank silt ₹ 6,386 (2.11 %) and miscellaneous costs ₹ 1,854 (0.61 %).

With respect to the marketing costs of pomegranate, they accounted for about 8.08 per cent (₹24, 413 per ha) of the total maintenance cost. The major items included were box charges of ₹9,660 (3.18 %), labour charges for grading and packing ₹ 2, 550 (0.84 %), commission charges of ₹ 11,883 (3.93 %) and cello tape ₹380 (0.13 %).

The total fixed cost was ₹ 1, 00,271 per ha (33.19 %). Fixed costs included the annualized establishment cost of ₹ 73, 977 (24.48 %) rental value of land with ₹ 23, 586 (7.81 %) and depreciation charges for about ₹ 2, 472(0.82 %), interest on fixed capital ₹ 201 (0.07 %) and land revenue ₹ 35 (0.01 %).

4.4.2 Annual maintenance costs of pomegranate orchards in emerging area (Hosadurga taluk)

Table 4.20 indicates the average per ha annual maintenance cost incurred by pomegranate growers in emerging area (Hosadurga taluk). The average maintenance cost was ₹ 3, 06,882 per ha. Out of which, the total variable cost was ₹ 2, 03,136 (66.19 %), and total fixed costs accounted for about ₹ 1,03,746 (33.81 %).

In the total variable cost, labour cost incurred was ₹ 67, 305 per ha. In the total labour cost major item was pruning cost ₹ 39,153 (12.76 %) followed by watch and ward cost ₹ 8,300 (2.70 %), cost for application of manures and fertilizer ₹ 6,071(1.98 %) cost of harvesting ₹ 5,598 (1.82 %), and application of plant protection chemical ₹ 4,255 (1.39 %). The least expenditure was observed for weeding ₹ 3,928 (1.28 %).

It was observed that annual average cost of plant protection chemicals was ₹ 36,136 per ha which formed11.78 per cent of the total maintenance cost followed by cost on fertilizers ₹ 22, 272 (7.26 %), cost of manures ₹ 19,891 (6.48 %), irrigation charges ₹ 9, 651(3.14 %), tank silt 1.80 per cent (₹5, 522) and miscellaneous ₹ 1, 565 (0.51 %). With respect to the marketing of pomegranate, the cost incurred on marketing of pomegranate accounted for about ₹ 24, 560 per ha (8.00 %) of the total maintenance cost. The major cost items in marketing of pomegranates were cost of package material (boxes) accounting to ₹ 9120 per ha (2.97 %), labour charges for grading and packing accounts for about 1.01 per cent (₹ 3, 100), commission charges of ₹ 11,960 (3.90 %) and cello tape ₹ 380 (0.12 %).

The total fixed cost was ₹ 1, 03,746 per ha (33.81 %) of total cost. In the total fixed cost, annualized establishment cost was highest with ₹ 76,510 (24.93 %) followed by cost incurred on rental value of land ₹ 24,092 (7.85 %), depreciation charges about ₹ 2,876 (0.94 %), interest on fixed capital ₹ 233 (0.08%) and land revenue ₹ 35 (0.01 %).

Table 4.20: Annual maintenance cost of pomegranate orchard in emerging area (Hosadurga taluk).

(₹ /ha)

Sl. No	Particulars	Unit	Quantity	Cost	%
I.	**Variable cost**				
A.	**Labour cost**				
1	Weeding	Man days	15.71	3928	1.28
2	Manure and fertilizer application	Man days	24.28	6071	1.98
3	Plant protection chemical application	Man days	17.02	4255	1.39
4	Pruning	₹		39153	12.76
5	Watch and ward	₹		8300	2.70
6	Harvesting	Man days	22.39	5598	1.82
	Total labour cost			**67305**	**21.93**
B.	**Material cost**				
1	Tank silt	mt	12.74	5522	1.80
2	Manures	mt	10.36	19891	6.48
3	Fertilizers	Kg		22272	7.26
4	Plant protection chemicals	Lit		36136	11.78
5	Irrigation charges	₹		9651	3.14
6	Miscellaneous	₹		1565	0.51
	Total material cost			**95037**	**30.97**
	Interest on working capital @ 10 %			16234	5.29
	Total (A+B)			**178576**	**58.19**
C.	**Marketing cost**				
	a) Package material (Boxes)	No.	760	9120	2.97
	b) Cello tape	No.	10	380	0.12
	c) Grading and packaging (labour)	Man days	12.4	3100	1.01
	d) Commission @ 2 %			11960	3.90
	Total marketing cost			**24560**	**8.00**
	Total variable cost (A+B+C)			**203136**	**66.19**
II.	**Fixed cost**				
1	Land revenue			35	0.01
2	Depreciation			2876	0.94
3	Rental value of land			24092	7.85
4	Interest on fixed capital @ 8 %			233	0.08
5	Annualized establishment cost			76510	24.93
	Total fixed cost			**103746**	**33.81**
	Total cost (I + II)			**306882**	**100**

4.4.3 Annual maintenance cost of pomegranate orchards (pooled respondents)

The average annual maintenance cost per hectare incurred by pomegranate growers in the study area (pooled respondents) is presented in table 4.21. The average per ha maintenance cost incurred by pomegranate growers was ₹ 3,05,106, of which the total variable cost was accounted to ₹ 2,03,098 (66.57 %) and fixed costs accounted for 33.43 per cent (₹ 1,02,008).

Table 4.21: Annual maintenance costs of pomegranate orchards (pooled respondents)

(₹ /ha)

Sl. No.	Particulars	Unit	Quantity	Cost	%
I.	**Variable cost**				
A.	**Labour cost**				
1	Weeding	Man days	14.655	3664	1.20
2	Manure and fertilizer application	Man days	24.76	6192	2.03
3	Plant protection chemical application	Man days	14.91	3729	1.22
4	Pruning	₹		39036	12.79
5	Watch and ward	₹		7900	2.59
6	Harvesting	Man days	24.55	6138	2.01
	Total labour cost			**66659**	**21.85**
B.	**Material cost**				
1	Tank silt	t/ha	15.605	5954	1.95
2	Manures	t/ha	9.915	20325	6.66
3	Fertilizers	Kg		24431	8.01
4	Plant protection chemicals	Lit		32684	10.71
5	Irrigation charges	₹		10588	3.47
6	Miscellaneous	₹		1710	0.56
	Total material cost			**95692**	**31.36**
	Interest on working capital @ 10 %			16235	5.32
	Total (A+B)			**178586**	**58.53**
C.	**Marketing cost**				
	a) Package material (Boxes)	No.	780	9360	3.07
	b) Cello tape	No.	10	380	0.12
	c) Grading and packaging (labour)	Man days	11.3	2825	0.93
	d) Commission @ 2 %			11947	3.92
	Total marketing cost			**24512**	**8.03**
	Total variable cost (A+B+C)			**203098**	**66.57**
II.	**Fixed cost**				**0.00**
1	Land revenue			35	0.01
2	Depreciation			2674	0.88
3	Rental value of land			23839	7.81
4	Interest on fixed capital @ 8 %			217	0.07
5	Annualized establishment cost			75243	24.66
	Total fixed cost			**102008**	**33.43**
	Total cost (I + II)			**305106**	**100**

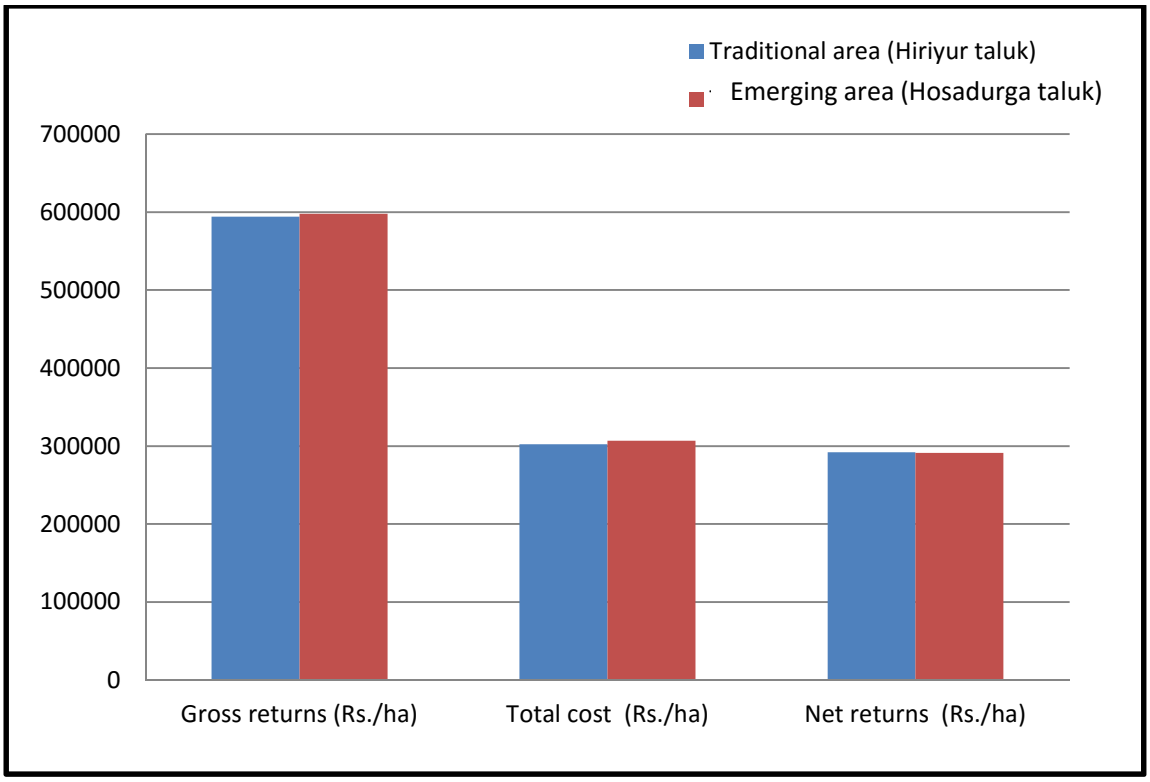

Fig. 4.9: Costs and returns of pomegranate cultivation in the study area.

Among variable costs, labour component was ₹ 66, 659 (21.85 %), of which major item was pruning which was ₹ 39, 036 (12.79 %) followed by cost for watch and ward ₹ 7,900 (2.59 %), manures and fertilizer application cost ₹ 6,192 (2.03 %) harvesting cost ₹ 6,138 (2.01 %), plant protection chemical application cost of ₹ 3,729 (1.22 %) and weeding cost ₹ 3,664 (1.20 %).

It was observed that annual average cost of plant protection chemicals was ₹ 32,684 which formed 10.71 per cent of the total maintenance cost followed by cost on fertilizers ₹ 24,431 (8.01 %), cost of manures ₹ 20,325 (6.66 %), irrigation charges ₹ 10,588 (3.47 %), tank silt cost ₹ 5,954 (1.95 %) and miscellaneous cost ₹1,710 (0.56 %). With respect to the marketing of pomegranate, it accounted for about ₹ 24,512 (8.03 %) of the total annual maintenance cost. The major cost items included in the marketing cost were packaging materials (boxes) to an extent of ₹ 9360 (3.07 %), labour charges for grading and packing at ₹ 2,825 (0.93 %), commission charges of ₹ 11,947 (3.92 %) and cello tape ₹380 (0.12 %).

The total fixed cost accounted for 33.43 per cent (₹ 1,02,008) of which annualized establishment cost was highest with ₹ 75,243 (24.66 %), followed by rental value of land of ₹ 23,839 (7.81 %), depreciation charges for about ₹ 2,674 (0.88 %), interest on fixed capital ₹ 217 (0.07 %) and land revenue ₹ 35(0.01 %).

4.5 Costs and returns of pomegranate cultivation in the study area.

The table 4.22 indicates that the average yield of pomegranate obtained by the sample farmers in traditional area (Hiriyur taluk) was 9.87mtper ha and gross income was ₹ 5, 94,174 per ha. The average total yield of pomegranate obtained by the sample farmers in emerging area (Hosadurga taluk) was 9.56 mt per ha and gross returns were ₹ 5, 97,978. The cost of production was to be ₹ 30,612mt in traditional area (Hiriyur taluk) and ₹ 32,100 mt in emerging area (Hosadurga taluk). The result shows that the pomegranate yields were on par in both the areas.

Table 4.22: Cost and returns of pomegranate cultivation in the study area.

(For 2 crops in a year)

Sl. No.	Particulars	Traditional area (Hiriyur taluk) (N=30)	Emerging area (Hosadurga taluk) (N=30)	Pooled (N=60)
1	Yield (t/ha)	9.87	9.56	9.71
2	Price (₹/kg)	60.2	62.55	61.52
3	Gross returns (₹/ha)	594174	597978	597359
4	Total cost (₹/ha)	302144	306882	305106
5	Net returns (₹/ha)	292030	291096	292253
6	Cost of production (₹/t)	30612	32100	31421
7	Returns on variable cost (₹/ha)	392300	394842	394261

4.6 Break –even analysis of pomegranate cultivation.

It is evident from the table 4.23 that the pomegranate cultivation required to reach break-even point was 2.51 mt of output and net return of ₹1,54,557 per ha in pooled respondents, whereas in the case of traditional area (Hiriyur taluk) the output and returns were 2.52 mt and ₹ 1,51,879 per ha, respectively and 2.51mt of output and net return of ₹ 1,57,190 per ha in the case of emerging area (Hosadurga taluk).

Table 4.23: Break –even analysis of pomegranate cultivation.

Taluks	Fixed cost (₹/ha)	Average variable cost per tonne of pomegranate (₹)	Average price per tonne of pomegranate (₹)	Break-Even point (output) (t/ha)	Break-Even point (return) (₹/ha)
Traditional area (Hiriyur taluk)	100271	20453	60200	2.52	151879
Emerging area (Hosadurga taluk)	103746	21248	62550	2.51	157190
Pooled	102008	20916	61520	2.51	154557

4.7.1: Evaluation of investment on pomegranate cultivation

In order to examine the financial feasibility of investments on pomegranate cultivation, measures of project appraisal were applied. The results of finalized analysis are presented in table 4.24. The measures computed were payback period, net present value, benefit cost ratio and internal rate of return.

Payback Period (PBP)

The payback period refers to the time required for the project to pay its initial investment incurred in establishing the orchard. In pomegranate, the payback period was 1.66, 2.08 and 1.68 years in traditional area (Hiriyur taluk), emerging area (Hosadurga taluk) and pooled, respectively.

Net Present Value (NPV)

The net present value is simply the present value of net returns of the project discounted at the opportunity cost of capital (8 %). The per ha net present values of pomegranate cultivation was ₹ 12,85,751, ₹ 12,66,536 and ₹ 12,80,134 for traditional area (Hiriyur taluk), emerging area (Hosadurga taluk) and pooled, respectively.

Benefit Cost Ratio (BCR)

The benefit cost ratio was obtained by taking the ratio between the discounted net returns to the discounted cost. The net present value of costs and returns were obtained by discounting the cost and return streams by the opportunity cost of capital. The benefit cost ratio in pomegranate cultivation was

1.60, 1.58 and 1.59 in traditional area, emerging area and pooled areas, respectively at 8 per cent discount rate.

Internal Rate of Return (IRR)

This represents the rate of return over the life period of the project. The internal rate of return was computed by interpolating two discount rates. The internal rate of return in pomegranate cultivation was 66, 64 and 65 per cent in traditional area and emerging area and Pooled categories, respectively. The internal rate of return was higher than the opportunity cost of capital of 8 per cent. This indicates the average earning power of money invested in the project was found to be higher.

The fore going analysis revealed that, net present worth was positive, Benefit Cost ratio was greater than one and internal rate of return was higher than the opportunity cost of capital (at 8 %). The investments in pomegranate crop can be recovered after planting. Thus, the results of this study clearly revealed that investments in pomegranate orchard were economically viable.

Table 4.24: Economics of investment on pomegranate cultivation.

Sl. No	Particulars	Unit	Traditional area (Hiriyur taluk)	Emerging area (Hosadurga taluk)	Pooled
1	Net Present Value (@ 8 %)	₹	1285751	1266536	1280134
2	Benefit Cost Ratio (@ 8 %)	Ratio	1.60	1.58	1.59
3	Internal Rate of Return	%	66	64	65
4	Payback Period	Years	1.66	2.08	1.68

4.8 Resource productivity and allocative efficiency in pomegranate production

In order to estimate the factors responsible for productivities and thereby to establish relationship between the yield of pomegranate and resources used, a Cobb-Douglas type of production function was fitted to the data and results are given in table 4.25.

It revealed from the table 4.25 that, at overall level, 52 per cent of variation (R^2) in the output was jointly explained by the independent variables. The regression co-efficient of Human labour (X_1) was positive but non–significant in traditional area (Hiriyur taluk), while it was significant at 10 per cent level for emerging area (Hosadurga taluk) and negative and non-significant on overall basis. The regression co-efficients were 0.29 and 0.49 for traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk), respectively. The value of co-efficient at overall level for Human labour was negative.

The regression co-efficient of the FYM (X_2) was positive and non-significant for Hiriyur taluk, emerging area (Hosadurga taluk) and overall basis. The co-efficient for traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) were 0.08 and 0.11. At overalllevel the regression co-efficient was 0.01.

The variable, Fertilizer (X_3) was positive and significant at five per cent level of significance for traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk). The production elasticity of fertilizer used per ha at overall level was 0.56. The regression co-efficients for fertilizer per ha in the case of traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) were 0.66 and 0.23, respectively.

The regression co-efficients of PPC (X_4) was positive and significant at five per cent level of significance for traditional area (Hiriyur taluk) only, but positive and non-significant for emerging area (Hosadurga taluk). It was significant at one per cent for overall basis. The co-efficient for traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) were 0.08 and 0.03. At overall, level the regression co-efficient was 0.06.

The variable expenses on irrigation per ha (X_5) was positive and significant at one per cent for traditional area (Hiriyur taluk) taluk and emerging area (Hosadurga taluk). While, it was significant at one per cent in overall basis. The co-efficient for traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) were 0.31 and 0.21. At overall level, the regression co-efficient was 0.14.

Table 4.25: Results of estimated Cobb-Douglas type of production function.

(Dependent variable (Y): Gross returns in rupees per hectare)

Variables	Parameters	Traditional area (Hiriyur taluk)	Emerging area (Hosadurga taluk)	Overall
Intercept	A	8.28***	7.33***	3.73***
Human labour (₹/ha)	X_1	0.2947	0.4967***	-0.0256
FYM (₹/ha)	X_2	0.0835	0.1110	0.0196
Fertilizer (₹/ha)	X_3	0.6650**	0.2309**	0.5669***
PPC (₹/ha)	X_4	0.0812**	0.0373	0.0667***
Irrigation (₹/ha)	X_5	0.3123***	0.2199***	0.1427***
Coefficient of determination	R^2	0.64	0.59	0.52
F value		8.69**	7.53**	7.59**

Note: 1. ***, ** and * indicates significant at 1, 5 and 10 % level

4.8.1: Allocative efficiency in the pomegranate cultivation

Allocative efficiency refers to the ability of the firm to combine inputs and outputs in optimal proportions in the light of prevailing prices, and is measured in terms of behavioural goals of the production unit like observed v/s. optimum cost or

observed profit v/s optimum profit. The allocative efficiency was estimated by using the geometric mean levels of the output as well as input use in pomegranate production and represented in tables 4.26 and 4.27

The ratios of MVP to MFC for of traditional area (Hiriyur taluk) (Table 4.26) were more than unity in the case of human labour (3.25), fertilizer (6.75) and irrigation (2.91). This indicated that around the geometric mean level, an investment of one rupee in these inputs gave gross income of ₹3.25, ₹6.75 and ₹2.91 respectively. Hence, there is scope for using additional units of human labour, fertilizer and irrigation, over and above their geometric mean levels to increase gross income. The ratio related to farmyard manures (0.82) and plant protection chemicals (0.83) was less than the unity, indicating the over utilization of these resources by the farmers.

Table 4.26: Resource - use efficiency in pomegranate cultivation in traditional area (Hiriyur taluk)

Variables	Geometric mean level of input (₹)	Coefficient	MVP	MFC	MVP/MFC
X_1=Human labour	62127	0.2947	3.25	1	3.25
X_2=FYM	19204	0.0835	0.82	1	0.82
X_3=Fertilizer	25612	0.6650**	6.75	1	6.75
X_4=PPC	27682	0.0880**	0.83	1	0.83
X_5=Irrigation	11275	0.3123***	2.91	1	2.91
Intercept					8.28*
F value					8.69 **
R^2					0.64

Note: 1. ***, ** and * indicates significant at 1, 5 and 10 % level

The ratios of MVP to MFC in the case of emerging area (Hosadurga taluk) (Table 4.27) were more than unity for human labour (5.50), farmyard manure (1.10), fertilizer (2.32) and irrigation (2.01). This indicated that around the geometric mean level, an investment of one rupee in these inputs gave gross income of ₹5.50, ₹1.10, ₹ 2.32 and ₹2.01 respectively. Hence there is scope for using additional units of human labour, farmyard manure, fertilizer and irrigation over and above their geometric mean levels to increase gross income. The ratio related to plant protection chemicals (0.39) was less than the unity, indicating the over utilization of this resource by the farmers

Table 4.27: Resource - use efficiency in pomegranate cultivation in emerging area (Hosadurga taluk)

Variables	Geometric mean level of input (₹)	Coefficient	MVP	MFC	MVP/MFC
X_1=Human labour	65345	0.4967***	5.50	1	5.50
X_2=FYM	20891	0.1110	1.10	1	1.10
X_3=Fertilizer	23272	0.2309**	2.32	1	2.32
X_4=PPC	34156	0.0373	0.39	1	0.39
X_5=Irrigation	9551	0.2199***	2.01	1	2.01
Intercept					7.33*
F value					7.53 **
R^2					0.59

Note: 1. ***, ** and * indicates significant at 1, 5 and 10 % level

The ratios of MVP to MFC in case for pooled respondents (Table 4.28) were more than unity for fertilizer (5.75) and irrigation (1.33). This indicated that around the geometric mean level, an investment of one rupee in these inputs gave gross income of ₹5.75, and ₹1.33 respectively. Hence there is scope for using additional units of fertilizer and irrigation, over and above their geometric mean level to increase gross income. The ratio related to human labour (-0.28), farmyard manure (0.19) and plant protection chemicals (0.69) was less than the unity, indicating the over utilization of these resources by the farmers.

Table 4.28: Resource - use efficiency in pomegranate cultivation (pooled respondents).

Variables	Geometric mean level of input (₹)	Coefficient	MVP	MFC	MVP/MFC
X_1=Human labour (₹/ha)	64679	-0.0256	-0.28	1	-0.28
X_2=FYM (₹/ha)	21345	0.0196	0.19	1	0.19
X_3=Fertilizer (₹/ha)	25631	0.5669***	5.75	1	5.75
X_4=PPC (₹/ha)	32884	0.0667***	0.69	1	0.69
X_5=Irrigation (₹/ha)	11568	0.1427***	1.33	1	1.33
Intercept					3.73***
F value					7.59 **
R^2					0.52

Note: 1. ***, ** and * indicates significant at 1, 5 and 10 % level

4.9 Farmers method and scientific method of pomegranate cultivation

The difference in farmer's cultivation method and scientific method of pomegranate cultivation is presented in table 4.29. It was observed from the table that, none of the farmers followed the recommended spacing (13.5 ×13.5, 15×15, 18×18 ft) and majority of the farmers (30-33 %) were following high density planting with a spacing of 12×12 and 10×12 ft in both the taluks. It was noticed that the pomegranate cultivars namely Ganesha, Mrudula, Araktha, Jyothi, G-37, etc., were recommended for planting. But, the farmers of traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) have their own choice of cultivars namely, Bhagava, Gkvk, Varada, Jyothi, etc. Only, about ten per cent of the farmers cultivated Ganesha variety of pomegranate.

With respect to the usage of manures and fertilizers, farmers applied more of nitrogenous and potash fertilizers (409:102:204 and 300:166:236 kg/ha) in both the taluks compared to the recommended level of fertilizers (200:205:100 kg/ha). Whereas, application of phosphatic fertilizer by the farmers was almost half of the recommended level and use of farmyard manure was only about one third (8.81 t/ha) of the recommended quantity (25 t/ha) for pomegranate cultivation.

In order to control the menace of pests and diseases, farmers were using acephate to control sucking pests, chloropyripus to control leaf eating caterpillar and monocrotophos to control the insects and disease menace which were different from the chemicals recommended by scientific practices. The yield in both the methods was comparable, however, the yield in the farmer's method (9.87 t/ha and 9.56 t/ha) realized was 0.13 per cent in traditional area and 0.44 per cent in emerging area less compared to scientific method (POP) (10 t/ha).

4.9.1 Farmers method and scientific method of pomegranate cultivation (pooled respondents)

The differences in farmer's method and scientific method of pomegranate cultivation aspects are presented in table 4.30. It was observed from the table that none of the farmers in the study area has followed the recommended spacing (13×13.5, 15×15, 18×18). Majority of the farmers (30 %) were following high density planting with a spacing of 10×11 ft.

The recommended varieties were Ganesha, Mrudula, Araktha, Jyothi, G-37, etc. But, the farmers have their own choice of varieties namely Bhagava, Gkvk, varada, Jyothi, etc. Majority of farmers cultivated Bhagava in both the areas.

With respect to the usage of manures and fertilizers, farmers applied more (354:134:220 kg/ha) than the recommended level of nitrogen and potash fertilizer (200:205:100). Whereas application of phosphorus fertilizer by the farmers was almost half of the scientific level and farmers were applying low amount of farmyard manure (9.71t/ha) compared to scientific method (POP) (25 t/ha)

Table 4.29: Farmers method and scientific method of pomegranate cultivation

Particulars	Scientific method of cultivation (POP)		Farmers method in Traditional area (Hiriyur taluk)				Farmers method in Emerging area (Hosadurga taluk)			
Planting material (No./ ha)	500		900				885			
Spacing	**Spacing**	**Plants**	**Spacing**	**Plants**	**Number of farmers**	**%**	**Spacing**	**Plants**	**Number of farmers**	**%**
	13.5×13.5	609	10×11	1010	8	26.67	10×11	1010	10	23.33
	15×15	493	10×12	925	8	26.67	10×12	925	5	33.33
	18×18	342	11×11	918	5	16.67	11×11	918	7	23.33
			12×12	771	9	30.00	12×12	771	7	20.00
Pit size (ft)	2×2×2		2×2×2				2×2×2			
Farmyard manures (t/ha)	25		8.89				8.18			
Tank silt (t/ha)	Nil		18.47				15.60			
Varieties	**Varieties**		**Varieties**	**Number of farmers**		**%**	**Varieties**	**Number of farmers**		**%**
	Ganesha Mrudula Araktha Jyothi G-37 Rubi red Kesar Bhagya Sindoora		Bhagava	13		43.33	Bhagava	12		40.00
			Gkvk	2		6.67	Gkvk	5		16.67
			Varada	9		30.00	Varada	8		26.66
			Ganesha	3		10.00	Ganesha	2		6.67
			Jyothi	2		6.67	Jyothi	0		0.00
			Guti	1		3.33	Guti	3		10.00
				30.00		100.00		30.00		100.00

Contd….

Fertilizer			
N:P:K(Kg/ha)	200:205:100	409:102:204	300:166:236
Pesticides used for control of insects and pests			
Fruit borer and Mites	Malathion 50 EC Deltamethrin100 EC	Acephate	Acephate
Aphids	Dichilorous 76 EC Dimethoate 30 EC	Acephate	Acephate
Thrips	Imidacloprid17.8 SL	Chloropyripus Monocrotophos	Chloropyripus Monocrotophos
Stem borer and Leaf borer	-do-	Monocrotophos Chloropyripus	Monocrotophos Chloropyripus
Anthracnose	-do-	Kitogen	Kitogen
Yield (t /ha)	10	9.87	9.56
Gross returns (₹/ha)	615200	594174	597978

Table 4.30: Farmers method and scientific method of pomegranate cultivation (pooled respondents).

Particulars	Scientific method (POP) of cultivation		Farmers method in (pooled) Traditional and emerging areas			
Planting material (No./ ha)	500		892			
Spacing	**Spacing**	**Plants**	**Spacing**	**Plants**	**Number of farmers**	**%**
	13.5×13.5	609	10×11	1010	18	30.00
	15×15	493	10×12	925	13	21.67
	18×18	342	11×11	918	12	20.00
			12×12	771	16	26.67
Pit size(ft)	2×2×2		2×2×2			
Farmyard manures (t/ha)	25		8.5			
Tank silt(t/ha)	Nil		17			
Varieties	**Varieties**		**Varieties**	**Number of farmers**	**%**	
	Ganesha Mrudula Araktha Jyothi G-37 Rubi red Kesar Bhagya Sindoora		Bhagava	25	41.66	
			Gkvk	7	11.67	
			Varada	17	28.34	
			Ganesha	5	8.33	
			Jyothi	2	3.34	
			Guti	4	6.66	
				60.00	100.00	
Fertilizer						
N:P:K(Kg/ha)	200:205:100		354:134:220			
Pesticides used in control of insects and pests						
Fruit borer, Mites	Malathion 50 EC Deltamethrin100EC		Acephate			
Aphid	Dichilorous 76 EC Dimethoate 30 EC		Acephate			
Thrips	Imidacloprid17.8 SL		Chloropyripus Monocrotophos			
Stem borer, Leaf borer	-do-		Monocrotophos Chloropyripus			
Anthroxnose	-do-		Kitogen			
Yield (t /ha)	10		9.71			
Gross returns	615200		597359			

The heavy incidences of pest and diseases lead to the use of concentrated chemicals which are contradict the chemicals recommended by scientific practices. The yield in both the methods was comparable, however in farmers method yield (9.71 t/ ha) realized was 0.29 per cent less compare to scientific method (POP) (10 t/ha).

4.9.2 Economics of pomegranate cultivation using partial budgeting technique in traditional area (Hiriyur taluk)

The table 4.31 shows the economic analysis of pomegranate cultivation in traditional area (Hiriyur taluk) by using partial budgeting technique. The results indicated that, extra cost incurred by farmers in farmers' method of growing pomegranate was ₹31,861 as compared to scientific method. In farmers method reduction in returns was ₹ 7,826 per ha. The total debit of ₹39,687 per ha was incurred in farmer's method. The additional benefit in the form of cost saving was ₹31,253 per ha in farmers method and additional returns obtained was ₹4,38,045 er ha i.e., additional 3 crops were taken in farmers method due to reduction of establishment period to 1.5 years (farmers method) from 3 years of establishment period under scientific method (POP). The total gain (credit side) of ₹ 4,69,298 per ha was obtained in farmers method. The total net gain of ₹ 4,29,611 per ha was obtained in farmers method than that of scientific method (POP).

4.9.3 Economics of pomegranate cultivation using partial budgeting technique in emerging area (Hosadurga taluk)

The table 4.32 shows the economic analysis of pomegranate cultivation in emerging area (Hosadurga taluk) by using partial budgeting technique. The results indicated that, the additional cost incurred by farmers in farmers' method of growing pomegranate was ₹ 30,182 as compared scientific method. In farmers method income reduced by ₹ 27,522 per ha. The total debit of ₹ 57,704 per ha was incurred in farmers method. The cost saving was ₹ 37,727 per ha in farmers method and additional returns obtained was ₹ 4,36,644 per ha i.e, additional 3 crops were taken in farmers method due to reduction of establishment period to 1.5 years (farmers method) from 3 years of establishment period (scientific method (POP). The total gain (credit side) of ₹ 4, 74,371 per ha was obtained in farmers method. The total net gain of ₹ 4, 16,667 per ha was obtained in farmers method than that of scientific method (POP).

4.9.4 Economic analysis of pomegranate cultivation using partial budgeting technique in pooled respondents

The table 4.33 shows the economic analysis of pomegranate cultivation for all respondents by using partial budgeting technique. The results indicated that, extra cost incurred by farmers in farmer's method of growing of pomegranate was ₹ 30,429 as compared to the scientific method. In farmers method there income declined by ₹ 17,841 per ha. The total debit of ₹ 48,270 per ha was incurred in farmers method. The cost reduced was ₹ 30,980 per ha in farmers method and additional returns obtained was ₹ 4,38,380 per ha i.e., additional 3 crops were taken in farmers method due to reduction of establishment period to 1.5 years (farmers method) from 3 years of establishment period (Scientific method(POP). The total gain (credit side) of ₹ 4,69,360 per ha was obtained in farmers method. The total net gain of ₹ 4,21,090 per ha was obtained in farmers method as compared to the scientific method (POP)

Table 4.31: Economics of pomegranate cultivation using partial budgeting technique in traditional area (Hiriyur taluk)

Particulars	Methods	Debit			Credit		
		Added cost			Reduced cost		
		Quantity	Price (₹)	Value (₹)	Quantity	Price (₹)	Value (₹)
Opening of pits (No./ha)	Farmers method	900					
	Scientific method	500					
	Difference	400	17	6800			
Labour charges for planting and filling of pits (Man days)	Farmers method	11.12					
	Scientific method	0					
	Difference	11.12	250	2780			
Planting material (No./ha)	Farmers method	900					
	Scientific method	500					
	Difference	400	28	11200			
FYM (t/ha)	Farmers method				8.89		
	Scientific method				25		
	Difference				16.11	1940	31253
Fertilizer (₹/ha)	Farmers method			12473			
	Scientific method			17168			
	Difference			4695			
Tank silt (t/ha)	Farmers method	18.47					
	Scientific method	0					
	Difference	18.47	346	6386			
Sub Total				**31861**			**31253**
		Reduced returns			**Increased returns**		
Yield (t/ha)	Farmers method	9.87					
	Scientific method	10					
	Difference	0.13	60200	7826			
Net returns from additional crops (No.)	Farmers method				3		
	Scientific method				0		
	Difference				3	146015	438045
Sub Total				**7826**			**438045**
Total				**39687**			**469298**
Net gain (Credit-Debit)							**(469298-39687) = 429611**

Table 4.32: Economic of pomegranate cultivation using partial budgeting technique in emerging area (Hosadurga taluk).

Particulars	Methods	Debit			Credit		
		Added cost			Reduced cost		
		Quantity	Price (₹)	Value (₹)	Quantity	Price (₹)	Value (₹)
Opening of pits (No./ha)	Farmers method	885					
	Scientific method	500					
	Difference	385	20	7700			
Labour charges for planting and filling of pits (Man days)	Farmers method	6.2					
	Scientific method	0					
	Difference	6.2	250	1550			
Planting material (No./ha)	Farmers method	885					
	Scientific method	500					
	Difference	385	28	10780			
FYM (t/ha)	Farmers method				8.18		
	Scientific method				25		
	Difference				16.82	2243	37727
Fertilizer (₹/ha)	Farmers method			12473			
	Scientific method			17103			
	Difference			4630			
Tank silt (t/ha)	Farmers method	12.74					
	Scientific method	0					
	Difference	12.74	345	5522			
Sub Total				**30182**			**37727**
		Reduced returns			**Increased returns**		
Yield (t/ha)	Farmers method	9.56					
	Scientific method	10					
	Difference	0.44	62,550	27522			
Net returns from additional crops (No.)	Farmers method				3		
	Scientific method				0		
	Difference				3	145548	436644
Sub Total				**53561**			**436644**
Total				**57704**			**474371**
Net gain (Credit-Debit)							**(474371-57704)= 416667**

Table 4.33: Economics of pomegranate cultivation using partial budgeting technique in pooled respondents

Particulars	Methods	Debit			Credit		
		Added cost			Reduced cost		
		Quantity	Price (₹)	Value (₹)	Quantity	Price (₹)	Value (₹s)
Opening of pits (No./ha)	Farmers method	892					
	Scientific method	500					
	Difference	392	19	7448			
Labour charges for planting and filling of pits (Man days)	Farmers method	7.5					
	Scientific method	0					
	Difference	7.5	250	1878			
Planting material (No./ha)	Farmers method	892					
	Scientific method	500					
	Difference	392	28	1097			
FYM (t/ha)	Farmers method				9.91		
	Scientific method				25		
	Difference				15.09	2053	30980
Fertilizer (₹/ha)	Farmers method			17168			
	Scientific method			12473			
	Difference			4695			
Tank silt (t/ha)	Farmers method	15.7					
	Scientific method	0					
	Difference	15.7	346	5432			
Sub Total				**30429**			**30980**
		Reduced retunes			**Increased returns**		
Yield (t/ha)	Farmers method	9.71					
	Scientific method	10					
	Difference	0.29	61,520	17841			
Net returns from additional crops (No.)	Farmers method				3		
	Scientific method				0		
	Difference				3	146126	438380
Sub Total				**17841**			**438380**
Total				**48270**			**469360**
Net gain(Credit-Debit)							**(469360-48270)=421090**

V DISCUSSION

The results of the study are discussed systematically in this chapter under the following headings.

5.1 Socio-economic characteristics of the respondent farmers

5.2 Area, production and productivity growth of pomegranate orchards

5.3 Investment pattern and establishment cost of pomegranate orchards

5.4 Maintenance cost of pomegranate orchards during the bearing period

5.5 Cost and returns structure of pomegranate cultivation

5.6 Break-even analysis of pomegranate cultivation

5.7 Investment evaluation in pomegranate cultivation

5.8 Resource productivity and allocative efficiency in pomegranate cultivation

5.9 Farmers method v/s scientific method (POP) of cultivation of pomegranate.

5.10 Economic analysis of pomegranate cultivation using partial budgeting technique

5.1 Socio-economic characteristics of the respondent farmers

The analysis of socio-economic characteristics of sample farmers will enable us to relating these variables to cause and affect relationships.

It is evident from table 4.1 that majority of the farmer-respondents belonged to 36-50 years age group in traditional area (Hiriyur taluk) and above 50 years in emerging area (Hosadurga taluk). With regard to the education level, most of the farmers possessed high school education in both the taluks. Classification of the farmers according to family size revealed that, majority of farmers fall in medium sized family (6-9 no.) in both traditional area and emerging area indicating that, availability of family labour for agricultural operations was lower. The average number of family size was more in emerging area compared to traditional area. With regard to the average land holding, there was no significant difference (Table 4.1).

Comparison of pattern of distribution of respondents in different age-groups, education level, family size and land holding revealed that these variations were non-significant which revealed the similarity between two taluks. Even, the difference in the average age, average family size and average land holding of the sample respondents was statistically non-significant. These facts clearly implied that the selected farmer-respondents in traditional area and emerging area were homogeneous with respect to the socio-economic characteristics. The area under irrigation was more in the case of emerging area (Hosadurga taluk) (2.26 ha) compared to traditional area (Hiriyur taluk) (1.96 ha). The size of land holding was

higher in case of emerging area as the farmers in emerging area mainly depend on bore well irrigation (Table 4.2).

5.1.1: Inventory of farm building of respondent farmers

In general the farm inventory which as farm house and storage shed was more or less comparison in both the taluks. Higher percentage of ownership of farm house and storage shed was essentially for the pomegranate growing farmers. Among farmers, 40 per cent and 28.3 per cent were noticed with farm house and storage shed. Further the difference in the inventory of farm building between the study areas was statistically non-significant.

5.1.2: Farm implements/machineries of respondent farmers

Farm implement and machineries in terms of number of tractors, power tiller, plough and cultivator was slightly higher among the farmers of traditional area (Hiriyur taluk) as compared to emerging area (Hosadurga taluk). It was interesting to note that 100 per cent of the farmers had sprayers in both the areas. The owning of bullock carts was higher in emerging area (Hosadurga taluk) compared to traditional area (Hiriyur taluk). Farmers in traditional area owned more of farm implements than in emerging area indicating the existence of better economic status. However, the magnitude of ownership for farm implements between the two study regions was statistically non-significant.

5.1.3: Number of livestock inventory of respondent farmers

As evident from the table 4.5 among livestock position found more number of bullock pairs was highest followed by buffalos and cows in emerging area (Hosadurga taluk) as compared to more number of cows followed by buffaloes and bullock pair in traditional area (Hiriyur taluk). However the difference in the livestock inventory between traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) was significant with respect to the position of cows, buffalos and poultry. Hence, emerging area (Hosadurga taluk) found to be more resourceful for livestock inventory compared to traditional area (Hiriyur taluk).

5.1.4: Extension participation of respondent farmers

It is evident from the findings that the extension participation of pomegranate farmers was considerably good in attending training programmes and krishimelas. The participation in training programmes and attending krishimelas directly leads to get more knowledge on pomegranate cultivation. Regarding the participation in field days, extension tours and demonstrations noticed was very lower. However, the overall extension participation of pomegranate farmers in study region was more similar in the two taluks and statistically non-significant (table 4.6).

5.1.5: Institutional participation of respondent farmers

It is evident from the table 4.7 that participation of farmers in *rytha sangha* was good in both traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk). The reason for this might be due to easy access and approach to get relevant

information by the farmers. However, the institutional participation by farmers found to be comparatively lower in the study region. Further, the different institutional participations of the farmers between the study area was statistically non-significant.

5.1.6: Sources of irrigation of respondent farmers

It is evident from the results that about 71 per cent of the farmers possessed borewell in both the taluks as water source is one of the major requirements for growing pomegranate crop. Further, only 11.37 per cent and 17.30 per cent of the farmers had both open well and tanks irrigation, respectively.

5.1.7: Details of loans of the respondent farmers

The percentage of loan borrowers was higher among traditional area (Hiriyur taluk) farmers (33.33 %) as compared to emerging area (Hosadurga taluk) farmers (23.33 %). It is interesting to note that, the average loan amount borrowed was higher among emerging area (Hosadurga taluk) farmers as compared to traditional area (Hiriyur taluk) farmers. The probable reason could be of better economic condition among farmers of traditional area (Hiriyur taluk) as compared to farmers of emerging area (Hosadurga taluk).

5.1.8: Annual expenditure pattern of the respondent farmer

The annual expenditure on household and social function was slightly higher among farmers of emerging area (Hosadurga taluk) as compared to farmers of traditional area (Hiriyur taluk). On the contrary, the annual expenditure on other aspect identified was more among traditional area (Hiriyur taluk) farmers compared to emerging area (Hosadurga taluk) farmers. The investment on other items was higher among farmers of traditional area (Hiriyur taluk) leading to better economic status in terms of cropping pattern and revenue compared to farmers of emerging area (Hosadurga taluk).

5.1.9: Cropping pattern of respondent farmers

The cropping pattern followed by the sample farmers is given in table 4.11. Emerging area (Hosadurga taluk) had one third out of cultivated area (30.07 %) of cereals of which ragi was the major crop where as in traditional area (Hiriyur taluk) cereals comprised of 23.74 per cent of which jowar occupied major area. Oilseed and commercial crops are important components of cropping pattern which occupied (38.22 %) of cropped area in traditional area (Hiriyur taluk) whereas in emerging area (Hosadurga taluk) only 28.62 per cent of area was under oilseeds and commercial crop, in that groundnut and sunflower were the major crops. Among perennial crops, pomegranate occupied 22 per cent of land area in both the taluks followed by arecanut in some patches (1.86 and 2.60 %) in traditional and emerging areas. In both the taluks, the area under pulse cultivation was only 12 per cent. There is still scope to increase area under pulse cultivation, as pulses are short duration crops which can be grown in perennial orchards during the initial years.

5.2: Area, production and productivity growth of pomegranate

It is evident from the table 4.12 that there is an increasing trend in area under pomegranate cultivation in both as revealed by growth rates of 1.99 per cent and 127.6 per cent in Hiriyur and Hosadurga taluks, respectively during the period 2005-06 to 2013-14. The growth in productivity was found to be positive and it is substantiated with higher production corresponding to the area under cultivation of pomegranate.

5.3: Establishment cost of pomegranate orchards in traditional area (Hiriyur taluk)

The details of establishment cost incurred for pomegranate orchard in traditional area is presented in table 4.16. The findings reveal that, the total establishment cost was ₹ 4,35,668 per ha. Further, the labour cost was accounted ₹ 94, 161 (21.61 % of the total cost) and material cost of ₹ 2, 60,334 (59.76 % of the total cost). Out of the total labour cost, the expenditure made on pruning was highest (9.20 %) followed by digging of pits (3.68 %), manure and silt application (1.65 %), preparation of land (1.45 %), planting and filling of pits (1.23 %). Similar results were obtained in the research work of Koujalgi (1990) and Ravikumar (2009).

The total material cost of pomegranate orchard was ₹ 2, 60,334 per ha. Among the material cost, major share (13.97 %) was spent towards drip material, fencing around the orchard (10.82 %) and purchase of staking material (8.18 %). The expenditure made on purchase of critical inputs like planting material, fertilizers, plant protection chemicals and manures was to the extent of 6.48, 5.80, 6.23 and 3.96 per cent, respectively. The total fixed cost of pomegranate orchard in traditional area (Hiriyur taluk) was accounted ₹ 45, 723 per ha and it formed 10.49 per cent to the total cost which included land revenue (0.01 %), depreciation (0.57 %), rental value of land (5.41 %) and interest on fixed capital (4.51 %). Similar results were obtained by Ravikumar (2009) in Chitradurga district of Karnataka.

5.3.1: Establishment cost of pomegranate orchards in emerging area (Hosadurga taluk)

Table 4.17 shows the cost incurred for the establishment of pomegranate orchard in emerging area (Hosadurga taluk) and it was noticed that the total cost invested for the establishment of pomegranate orchard was ₹ 4, 50,585 per ha, out of which, major share was towards material of drip (15.32 %), followed by pruning (10.21 %), fencing (8.89 %), staking material (8.81 %), plant protection chemical (7.21 %), manures and fertilizers (9.9 %), etc. The results were similar to the finding of Koujalgi (1990) and Ravikumar (2009) in Bijapur district and Chitradurga district of Karnataka.

5.3.2: Establishment cost of pomegranate orchards (pooled respondents)

The details of establishment cost incurred for pomegranate orchard in the study area (Pooled respondents) are presented in table 4.18. The findings revealed that the total establishment cost was ₹ 4, 44,034 per ha. Further, the labour cost accounted for ₹ 95,169 (21.43 % of the total cost) and material cost of ₹ 2, 65,527 (59.80 % of

the total cost). Out of the total labour cost, the expenditure made on pruning was highest (9.69 %) followed by digging of pits (3.63 %), manure and tank silt application (1.54 %), preparation of land (1.34 %) and planting and filling of pits (1.08 %). Similar results were obtained in a study by Koujalgi (1990) and Ravikumar (2009).

The total material cost of pomegranate orchards was ₹ 2, 65,527 per ha. Among the material cost, major share (14.63 %) was on drip installation, fencing around the orchard (9.87 %) and purchase of staking material (8.49 %). The expenditure made on purchase of critical inputs like planting material, fertilizers, plant protection chemicals and manures was of 6.01, 5.82, 6.72 and 4.02 per cent, respectively. The total fixed cost of pomegranate orchard in traditional area (Hiriyur taluk) was ₹ 47,268 per ha and it comprised of 10.65 per cent to the total cost which included land revenue (0.01 %), depreciation (0.60 %), rental value of land (5.38 %) and interest on fixed capital (4.66 %). Similar results were obtained by Ravikumar (2009).

5.4: Maintenance cost of pomegranate orchard

Annual maintenance costs were the recurring costs incurred after the establishment of the orchard *i.e.*, from 18 months onward up to 10 years for the maintenance of the pomegranate orchards (economic lifespan of pomegranate). The maintenance cost included the expenditure towards the use of labour and other material inputs per year along with fixed cost for different age group of orchards.

Under the total variable cost, the labour cost formed an important cost accounting for 21.85 per cent of total maintenance cost. The crop required high amount of labour to perform the important activities like land preparation, digging of pits, weeding, pruning, manures and tank silt application, planting and filling pits, fertilizer and plant protection chemicals application, watch and ward, etc. With regard to material cost, it accounted for 31.55 per cent and 30.97 per cent of the total maintenance cost in both traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk), respectively. Among the total material cost, the major components were purchase of plant protection chemicals (9.67 %), manures (6.53 %) and fertilizers (8.80 %). Since, pomegranate crop is responsive to nutrient and in recent years the diseases like bacterial blight and anthracnose are commonly occurring in pomegranate crop and management of these diseases is highly challenging task for the farmers. Hence, in order to control these diseases farmers have to spray various chemicals which accounted for a high plant protection chemical cost.

As for as fixed cost is concerned, the rental value of land formed the major cost (7.81%) component and it was mainly due to the fact that the soil and the climatic conditions were well suited for pomegranate cultivation is highly profit oriented. Hence, the rental value of land for the production of pomegranate is higher in the study area.

No much difference was observed between traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) with regard to total maintenance cost and the results were in conformity with Ramachandra (2006) and Ravikumar (2009).

5.5: Costs and returns from pomegranate cultivation

The average quantity of fruit yield per ha in case of traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) was 9.87 and 9.56 tonnes, respectively. Fetching gross returns was ₹5, 94,174 in traditional area and ₹5, 97,978 in emerging area, respectively. The net return for pooled respondents was ₹2, 92,253 per ha. It was observed slightly higher in traditional area. The fruits produced in the initial year fetched better price than the fruits bear in succeeding years due to its good size, taste and appealing external appearance. As the plant grows older, the size of fruit reduces and fetch lower price than the initial years of fruit. The yield in pomegranate orchard varies depending upon the age of the crop and size of the orchard. During the initial years (after 18 months) the yield was less and the economic yield started from 3rd year on wards and the yield gets stabilized up to 10th year. The average yield was slightly higher in traditional area (Hiriyur taluk) compared to emerging area (Hosadurga taluk). This might be due to higher density of plant population (900 plants per ha) and use of more quantity of farm yard manures. Similar results were noticed from the studies conducted by Raikar (1990) and Ravikumar (2009).

5.6: Break –even analysis of pomegranate cultivation.

It is evident from the table 4.23 that the pomegranate cultivation required to reach break-even point was 2.51 mt of output and net return of ₹1,54,557 per ha in pooled respondents, whereas in the case of traditional area (Hiriyur taluk) the output and net return was 2.52 mt and ₹ 1,51,879 per ha, respectively and 2.51 mt of output and return were ₹ 1,57,190 per ha in the case of emerging area (Hosadurga taluk). The break-even point indicated that both the areas were running under profitable stream. Further, the small variation in the break-even point in pomegranate cultivation was due to the variation in the fixed cost and variable cost.

5.7: Cash flows in pomegranate orchard

In this section costs and returns over economic life span of pomegranate orchard were discussed and are presented in table 4.22. The annual cost per ha in both the areas was higher in the first two years mainly because more labour required during this period for land preparation, digging of pits, application of manures, fertilizers and plant protection chemicals, weeding, pruning, watch and ward, *etc.* The per ha maintenance cost gradually increased from 2nd to 10th year during bearing period of orchards, since, they were applying different kinds of plant protection chemicals to control the menace of bacterial blight and anthracnose which are the bottle necks in pomegranate growing belts and also the labour employed increased to take up the spraying operations during this period. The returns varied according to age of trees. It was highest during the 3rd year and decreasing gradually in the subsequent years up to 10th year because the yield remained the same but investment has increased year after year because of maintenance cost for diseases control. These findings were similar to those of Patil (1989).

The net returns per ha in both the areas decreased gradually from 3rd year onwards. For these net returns, the discounting factor was worked out at the rate of 8

per cent to know the financial feasibility of investment in the pomegranate production.

5.7.1: Evaluation of investment in pomegranate cultivation

Pomegranate is one of the potential arid region perennial fruit crops, once established continue to bear till 10 year potentially. Average returns are expected only after 18 months of planting, till then higher investment is required. Resources once committed retrieval is impossible. Further this crop needs vast resources and income across the spread over life span. Therefore, costs and returns have to be analyzed carefully to test the worthiness of investment in pomegranate production enterprise. This analysis helps the farmers in decision making. Hence, project evaluation techniques such as payback period, net present value, benefit-cost ratio and internal rate of return were used in pomegranate crop for both traditional and emerging areas.

In analyzing the investment feasibility, the establishment costs, maintenance costs and gross returns were considered at 8 per cent discount rate representing the opportunity cost of capital. The initial investment on per ha of pomegranate was ₹ 4,35,668 and ₹ 4, 50,585 in traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk), respectively.

The annual maintenance cost of bearing orchard was ₹ 3,02,145 and ₹ 3,06,882 in traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk), respectively which was assumed to be constant from 2nd to 10th year. The streams of costs and benefits during establishing period (18 months) and maintenance or bearing period (after 18 months to 10th year) have been annualized at 8 per cent discount rate.

In the both areas, the payback period for pomegranate orchards was 1.66 and 2.08 years, respectively. This undoubtedly indicated that a shorter period of less than two years is required for getting back the initial investment. Considering the other perennial enterprises, farmer can get back their capital investment from pomegranate early, identified in the risk.

To evaluate the benefits accrued and costs incurred during the project life, net present value (NPV) proves best criterion, which gives an idea about surplus money that would be generated by a project at a given discount rate. In this study net present value was calculated by discounting net cash inflows. The net present value of pomegranate orchard on per ha and per orchard at 8 per cent discount rate were ₹ 12,85,751 and ₹ 12,66,536 in traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk), respectively. The formal selection criterion of net present value is to accept all the projects with positive values. Applying this principle, net present value of pomegranate clearly indicated its financial soundness and economic feasibility. This was in confirmation with the research findings of Ravikumar (2009), Sundaravardarajan, Raikar (1990) and Subrahamanyam (1987).

Benefit-cost ratio is one more tool for appraising the worthiness of investment and it helps to find out the feasibility of an enterprise. In pomegranate cultivation, initial investment was to be made to establish the orchard and maintenance costs were to be incurred during subsequent years in both the areas. During these years of maintenance, the cash inflows or benefits exceed the cash outflows or costs.

The benefit cost ratio (B:C ratio) worked out for both the taluks was more than unity indicating worth of the investment on pomegranate cultivation as every rupee invested resulted into more than one rupee returns. Thus, it could be inferred that investment in pomegranate orchard was economically feasible and financially viable in both traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk). These results are in confirmation with the findings of Ravikumar (2009) and Koujalagi (1990).

The internal rate of return (IRR) is an average earning capacity of investment on pomegranate cultivation over the economic life of the crop to yield returns and was found to be in the range from 66 to 64 per cent in traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk), respectively. The internal rate of return thus, indicated a reasonably high earning capacity of the investment in pomegranate cultivation and was found to be greater than the opportunity cost of capital.

Thus, all the four criteria of investment feasibility revealed that investment in pomegranate cultivation is financially attractive and profitable proposition. Similar results were recorded from the studies conducted by Ravikumar (2009), Anonymous (2003), Koujalagi (1990) and Ramachandra (2006).

5.8 Resources productivity and allocative efficiency in pomegranate cultivation

In order to maximize the profits from an enterprise, optimum use of resources was imperative. This is examined on the basis of the productivity of resources used in production. In this section, the productivity of various resources involved in the production of pomegranate is analyzed. In order to determine whether the factors of production were utilized optimally, the efficiency of application of resources was studied by comparing the marginal value products and the marginal factor costs of each of the factors of production.

The resource use efficiency was studied by fitting a Cobb-Douglas type of production function. The R^2 ranged between to 0.64 to 0.59 per ha. The yield was calculated using five variables namely human labour, manures, fertilizer, plant protection chemical and irrigation. The relationship between the yield and its determinants in the traditional area (Hiriyur taluk), emerging area (Hosadurga taluk) and pooled category of farmers were presented in the table 4.25.

The ratio of MVP to MFC in the case of traditional area (Hiriyur taluk) (Table 4.26) was more than one for human labour (3.25), fertilizers (6.75) and irrigation (2.91) indicating that additional investment of rupee one in these resources will fetch a returns of more than one in these resources. The ratio was less than one for manure (0.82) and plant protection chemicals (0.83) indicating that these resources were over utilized by the farmers and furthr investment in this resource will not be beneficial.

The ratio of MVP to MFC in case of emerging area (Hosadurga taluk) (Table 4.27) was more than one for human labour (5.50), FYM (1.10), fertilizer (2.32) and irrigation (2.01) indicating that these resources were highly underutilized and further investment in these resources will lead to additional returns. The ratio was less than one for plant protection chemicals (0.39) suggesting that these resources are over utilized and further additional investment in these resources will leads to reduced returns.

The ratio of MVP to MFC in case of pooled farmers (Table 4.28) was more than one only for fertilizers (5.75) and irrigation (1.33) indicating that these resources are not properly utilized by the farmers and further investment in these resources will lead in increased returns. The ratio was less than one for human labour (0.28), farmyard manures (0.19) and plant protection chemical (0.69) indicating that these resources are over utilized by the farmers and further investment in these resources will not be beneficial.

5.9: Farmers method and scientific method (POP) of pomegranate cultivation in traditional area (Hiriyur taluk).

A critical observation in respect of comparison between farmer's method and scientific method of pomegranate cultivation in traditional area (Hiriyur taluk) (Table 29) showed that farmers follow lesser spacing with more number of plant density (900/ha) compared to scientific method (POP) (500/ha). Farmers in the study are were cultivating several varieties of their own choices in which Ganesha variety was the only recommended variety (scientific method (POP) cultivating by farmers. The reason for such practice could be lack of technical knowledge regarding the suitable cultivars of pomegranate.

Looking at the usage of organic and inorganic supplements in both the methods, more of inorganic fertilizers like N (409 kg/ha) and K (204 kg/ha) in traditional area (Hiriyur taluk) used by farmers compared to recommended dosage of N and K (with 200 and 100 kg/ha, respectively). However, farmers used lesser quantity of FYM (8.89 t/ha) in traditional area (Hiriyur taluk) compared to recommend level (25 t/ha), because of more usage of inorganic fertilizers.

The farmers also carried out pruning operation for two times a year as recommended by the scientific method (POP). The increased plant population crowded canopy resulted in the microclimatic condition for incidence of pests and diseases leading to use higher quantities of chemicals available in the market. This lead to increase cost towards pesticides and insecticide which in turn increasing cost of production.

The yields in both the methods were almost similar, however the yield realized in scientific method (10 t/ha) was slightly higher compared to farmer's method in traditional area (Hiriyur taluk) (9.87 t/ha) even though plant population in scientific method (POP) was lower. The larger spacing between the plants gives opportunity to exploit complete vigor and reduce the chances of disease and pest incidence in pomegranate orchards.

5.9.1: Farmers method and scientific method (POP) of pomegranate cultivation in emerging area (Hosadurga taluk).

A critical observation in respect of comparison between farmer's method and scientific method of pomegranate cultivation in emerging area (Hosadurga taluk) (Table 29) showed that farmers follow lesser spacing with more number of plant density (885/ha) compared to scientific method (500/ha plants). Farmers in the study area were cultivating several varieties of their own choices in which Ganesha variety was the only recommended variety (scientific method) cultivated by farmers. The

reason for such practice could be lack of technical knowledge regarding the suitable cultivars of pomegranate.

Looking at the usage of organic and inorganic supplements in both the methods, more of inorganic fertilizers like N (300 kg/ha) and K (236 kg/ha) in emerging area (Hosadurga taluk) were used by farmers compared to recommended dosage of N and K (with 200 and 100 kg/ha, respectively). However, farmers used lesser quantity of FYM (8.18 t/ha) in emerging area (Hosadurga taluk) compared to recommend level (25 t/ha), the usage of higher quantity of inorganic fertilizers.

The farmers also carried out pruning operation for two times a year as recommended by the scientific method. The increased plant population crowded canopy results in the microclimatic condition for incidence of pests and diseases leading to use of higher quantities of chemicals available in the market. This lead to increased cost towards pesticides and insecticide increased in the cost of production.

The yield in both the methods was almost similar, however the yield realized in scientific method (10 t/ha) was slightly higher compared to farmer's method in emerging area (Hosadurga taluk) (9.56 t/ha) even though plant population in scientific method was lower. The larger spacing between the plants gives opportunity to exploit complete vigor and reduce the chances of disease and pest incidence in pomegranate orchards.

5.9.2: Farmers method and scientific method (POP) of pomegranate cultivation in pooled respondents.

An observation in respect of comparison between farmer's method and scientific method of pomegranate cultivation in the overall (traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk)) as presented in table 30 showed that farmers followed lesser spacing with more number of plant density (892/ha) compared to scientific method (POP) (500/ha plants). Farmers in the study area were cultivating several varieties of their own choices in which Ganesha variety was the only recommended variety (scientific method (POP)) cultivated by farmers. The reason for such practice could be lack of technical knowledge regarding the suitable cultivars of pomegranate.

Looking at the usage of organic and inorganic supplements in both the methods, more of inorganic fertilizers like N (354 kg/ha) and K (220 kg/ha) in pooled area were used by farmers compared to recommended dosage of N and K (with 200 and 100 kg/ha, respectively). However, farmers used lesser quantity of FYM (8.5 t/ha) in pooled area compared to recommend level (25 t/ha), because of more usage of inorganic fertilizers.

The farmers also carried out pruning operation for two times a year as recommended by the scientific method. The increased plant population crowded canopy results in the microclimatic condition for incidence of pests and diseases leading to use of higher quantities of chemicals available in the market. This lead to increased cost towards pesticides and insecticide increased in the cost of production.

The yield in both the methods were almost similar, however the yield realized in scientific method (POP) (10 t/ha) was slightly higher compared to farmer's method in pooled area (9.71 t/ha) even though plant population in scientific method was lower. The larger spacing between the plants gives opportunity to exploit complete vigor and reduce the chances of disease and pest incidence in pomegranate orchards.

5.10: Economic analysis of pomegranate cultivation using partial budgeting technique in traditional area (Hiriyur taluk).

The economics of farmer's practices v/s scientific method was worked out in terms of partial budgeting technique. The partial budgeting considers additional costs and reduced returns and finally gets reduced cost and increased returns.

Added cost

Farmers were practicing their own method of cultivation which induced additional cost of ₹ 31,861 for extra application of tank silt, planting material and increase in labour charges due to the application of tank silt as well as to plant the extra seedlings.

Reduced returns

Reduced returns in terms of reduction in yield was up to 0.13 t/ha which was ₹ 7,826 per ha per year

Reduced cost

Farmers saved ₹ 31,253 per ha towards the application of FYM where, farmers applied only 8.89 t/ha as against of 25 t/ha (Scientific method (POP) there by, farmers saved FYM of 16.11 t/ha as compare to scientific method.

Increased returns

It was observed that farmers obtained net returns of ₹ 4, 38,045 per ha over the scientific method (POP). This was mainly due to 3 additional crops taken in farmers method due to reduction of establishment period to 1.5 years (farmers method) from 3 years of establishment period (Scientific method (POP).The additional net returns per crop accounted for ₹1,46,015 per ha. Considering 3 additional crops, increased returns comes to ₹ 4, 38,045 per ha as compared to Scientific method. Hence the net gain from the farmers method over the scientific method (POP) was of ₹ 4,29,611 per ha. This is more beneficial to farmers

5.10.1: Economic analysis of pomegranate cultivation using partial budgeting technique in emerging area (Hosadurga taluk)

Added cost

The additional cost due to farmer's method was ₹30,182 for extra application of tank silt, planting material and increase in labour charges to the application of tank silt as well as to plant the extra seedlings.

Reduced returns

The farmers method reduced in the reduction in yield was up to 0.44 t/ha which was reduced income by ₹ 27,522 per ha per year.

Reduced cost

Farmers were able to save ₹ 37,727 per ha towards the application of FYM due to lower quantity of FYM where, applied at 8.89 t/ha in the place of 25 t/ha (Scientific method (POP)) there by, farmers saved FYM of 16.82 t/ha as compare to scientific method.

Increased returns

It was observed that farmers obtained net returns of ₹4,36,644 per ha over the scientific method. This was mainly due to 3 additional crops taken in farmers method due to reduction of establishment period to 1.5 years (farmers method) from 3 years of establishment period (Scientific method (POP)).The additional net returns per crop accounted for ₹1,45,548 per ha. Considering 3 additional crops, increased returns comes to ₹ 4, 36,644 per ha as compared to Scientific method. Hence the net gain from the farmers method over the scientific method (POP) was of ₹ 4, 16,667 per ha. This is more beneficial to farmers.

5.10.2 Economic analysis of pomegranate cultivation using partial budgeting technique in pooled respondents

Added cost

The additional cost due to farmer's method was ₹30,429 for extra application of tank silt, planting material and increase in labour charges to the application of tank silt as well as to plant the extra seedlings.

Reduced returns

The farmer method returns in the reduction in yield was up to 0.44 t/ha which was reduced income by ₹ 17,841 per ha per year.

Reduced cost

Farmers were able to save ₹ 30,980 per ha towards the application of FYM due to lower quantity of FYM where, applied at 8.89 t/ha in the place of 25 t/ha (Scientific method (POP)) there by, farmers saved FYM of 15.09 t/ha as compare to scientific method (POP).

Increased returns

It was observed that farmers obtained net returns of ₹ 4, 38,380 per ha over the scientific method (POP). This was mainly due to 3 additional crops taken in farmer's method due to reduction of establishment period to 1.5 years (farmers method) from 3 years of establishment period (Scientific method (POP)). The additional net returns per crop accounted for ₹1,46,126 per ha. Considering 3 additional crops, increased returns comes to ₹ 4, 69,360 per ha as compared to Scientific method (POP). Hence the net gain from the farmers method over the scientific method (POP) was of ₹ 4, 21,090 per ha. This is more beneficial to farmers.

VI SUMMARY AND CONCLUSION

Pomegranate (*Punica granatum*) is one of the commercially important fruit crops of India. It is native of Iran (Persia). Generally, pomegranate is not similar to other fruit crops of temperate, tropical or subtropical fruits except that it behaves as deciduous in temperate but in tropical and subtropical regions it behaves as an evergreen or partially deciduous. Pomegranate is currently ranked 10th in terms of fruit consumed annually in the world. There is tremendous potential for Indian pomegranates in the global markets. Karnataka is the second largest pomegranate producing state accounting for 19.2 per cent of total in the country. The area under pomegranate is increasing over the years in Karnataka due to ideal condition for successful cultivation of pomegranate. The state is producing about 198.6 thousand tonnes of pomegranate from an area of 18.4 thousand ha. The productivity of pomegranate in the state is 10.75 t/ha. The major producing belts are Chitradurga, Bijapur, Tumkur, Dharwad and Bagalkot.

There is a limited study on the economics of pomegranate cultivation in Karnataka. Hence, the present study was focused on economics of pomegranate cultivation in Chitradurga district of Karnataka. The total sample size of 60 pertaining to farmers cultivating pomegranate with 30 each in traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk). The specific objectives of the study are:

1) To analyse growth in area, production and productivity of pomegranate in Chitradurga district of Karnataka.

2) To estimate cost, return and resource use in pomegranate cultivation in Chitradurga district.

3) To document and analyse farmer's method of cultivation of pomegranate in comparison with scientific method (POP).

Methodology

Sampling framework

The present study was purposively undertaken in Chitradurga district of Karnataka, where area under pomegranate in the district was significant. Traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk) were selected in the Chitradurga district as the highest production was noticed in the district. From each taluk, 30 farmers were randomly selected which constituting a total of 60 respondents.

Nature and sources of data

The required data for evaluating objectives of the study were collected from both primary and secondary sources.

Primary data

Primary data was collected from the sixty sample farmers in the study area. Data regarding socio-economic status, demographic characteristics, various aspects of

agriculture like size of land holding, asset position, cropping pattern, input utilization pattern, cost of cultivation, yield, returns and other related information in particular to pomegranate was collected in the study area for the year 2013-14 through well structured and pre-tested schedule to work out the economics of pomegranate cultivation.

Secondary data

The information about the study area regarding total geographical area, cropping pattern, land use pattern, sources of irrigation and other related information was obtained from District Statistical Office, Chitradurga. The data related to district wise area, production and productivity of pomegranate in Karnataka was collected from Directorate of Horticulture, Lalbagh, Bengaluru.

Analytical tools and techniques

Tabular method was employed to compile the socio economic status, resource use pattern and cost and returns from pomegranate cultivation. In order to facilitate interpretation of findings, statistical measures like percentages, averages were also worked. Growth rate analysis was employed to assess the trends in pomegranate cultivation. Cobb-Douglas type of production function was used to study the effect of various inputs used in pomegranate cultivation. In order to know the relative profitability of investment in pomegranate cultivation, measures of project evaluation namely, Pay Back Period (PBP), Net Present Value (NPV), Benefit Cost Ratio (BCR), and Internal Rate of Return (IRR) were computed. Partial budgeting technique was used to know the advantages of farmers' method over scientific method of cultivation.

Findings

1. Around 45 per cent of the respondents were in the age group between 36 to 50 years which indicates the active age group of the pomegranate farmers.

2. In the study area, about 45 per cent of the respondents completed up to secondary school education and 10 per cent were illiterate.

3. Average family size in the study area was 8 members, which is good as more number of owned labourers available to carry out pomegranate cultivation.

4. The average size of farm land holdings was slightly higher in emerging area (Hosadurga taluk) (2.88 ha) than traditional area (Hiriyur taluk) (2.54 ha)**.**

5. The average size of the pomegranate orchards was 0.84 and 1.01 ha in traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk), respectively.

6. The average land holding under irrigated condition found to be higher in emerging area (Hosadurga taluk) (2.26 ha) as compared to traditional area (Hiriyur taluk) (1.96 ha).

7. At the aggregate level, cultivation of oilseeds and commercial crops (32.89 %) formed a major share of the cropping pattern in the study area followed by cereals (27.25 %), pomegranate (22.21 %) and pulses (12.40 %).

8. The results indicated that there was a positive growth under pomegranate area at state level (2.78 %) and in the Chitradurga district (24.82 %). With respect to production also showed a positive trend of 2.44 per cent in the state level and 24.86 per cent in Chitradurga district. The positive growth in production observed was due to increasing area under pomegranate cultivation. Whereas, productivity also shown an increasing trend with growth rate of 1.64 per cent in Karnataka state and 0.05 per cent in Chitradurga district**.**

9. The results indicated that there was a positive growth rate in area under pomegranate cultivation in traditional area (Hiriyur taluk) (1.99 %) and in emerging area (Hosadurga taluk) (127.6 %). With respect to production, there was a negative growth rate of 1.39 per cent in the traditional area (Hiriyur taluk) and positive growth rate of 127.73 per cent in emerging area (Hosadurga taluk). The productivity had shown a negative trend with growth rate of 3.31 per cent in traditional area (Hiriyur taluk) and positive trend of 0.06 per cent in emerging area (Hosadurga taluk).

10. The establishment cost of pomegranate orchards was accounted to ₹ 4, 35,668 and ₹ 4,50,585 per ha in traditional area (Hiriyur taluk) and emerging area (Hosadurga taluk), respectively. In the total establishment cost, major share was towards material cost (60 %) followed by labour cost (21 %) and fixed cost (11 %).

11. The establishment cost of pomegranate orchards in the Pooled respondents was accounted to ₹ 4,44,034 per ha. In the total establishment cost, major share was towards material cost (59.80 %) followed by labour cost (21.43 %) and fixed cost (10.65 %).

12. The average per ha maintenance cost incurred by respondent farmers in traditional area (Hiriyur taluk) was ₹ 3, 02, 145 per ha from 18 months to 10^{th} year age of orchards. The labour cost, material and fixed costs accounted for about 21.85, 31.55 and 33.19 per cent, respectively. While, the maintenance cost was ₹ 3, 06, 882 per ha in emerging area (Hosadurga taluk), where labour cost, material and fixed cost accounted for about 21.93, 30.97 and 33.81 per cent, respectively.

13. The average per ha maintenance cost incurred by pomegranate growers was ₹ 3,05,106 per ha of which the total variable cost was accounted ₹ 2,03,098 (66.57 %) and fixed costs accounted for about ₹ 1,02,008 (33.43 %).

14. The average per ha yield of pomegranate orchards in traditional area (Hiriyur taluk) was 9.87 mt and the net returns obtained were ₹ 2, 92,030 per ha. Similarly, the average yield of pomegranate orchards in emerging area (Hosadurga taluk) was 9.56 mt and the net returns were ₹ 2, 91,096 per ha.

15. The average per ha yield for pooled respondents was 9.71 mt and the net returns obtained were ₹ 2, 92,253 per ha.

16. The break-even point of pomegranate cultivation required to reach break-even point was 2.51 mt of output and net return of ₹1,51,879 per ha in pooled respondents, whereas in the case of traditional area (Hiriyur taluk) the output and net return were 2.52 mt and ₹ 1,57,190 per ha, respectively and 2.51 mt of break-even output and net return of ₹ 1,54,557 per ha in the case of emerging area (Hosadurga taluk).

17. The investment appraisal analysis revealed that the payback period of 1.68 years, net present value of ₹ 12,80,134, discounted benefit cost ratio of 1.59 and internal rate of returns of 65 per cent per ha indicates the worthiness of investment on pomegranate cultivation in the study area.

18. The results of the allocative efficiency analysis in traditional area (Hiriyur taluk) shows that the marginal value product to marginal factor cost ratio of human labour (3.25), fertilizer (6.75), and irrigation (2.91) was greater than unity. Whereas, in emerging area (Hosadurga taluk), MVP to MFC ratio of human labour (5.50), farmyard manure (1.10), fertilizer (2.32) and irrigation (2.01) was greater than unity, which indicates under utilization of these resources by the farmers The ratio related to farmyard manure and plant protection chemical in traditional area and plant protection chemicals in emerging area was less than the unity, indicated the over utilization of these resources by the farmers.

19. In case of pooled respondents, MVP to MFC ratio of fertilizer (5.75) and irrigation (1.33) was indicated under utilization of these resources by the farmers. Whereas, the ratio related to human labour (-0.28), farmyard manure (0.19) and plant protection chemicals (0.69) indicated over utilization of these resources by the farmers and further investment on these resources will not be beneficial.

20. At the overall level 52 per cent variation in the output was jointly explained by the independent variables taken in the regression model. The regression coefficients of fertilizer 0.56 (x_3), plant protection chemicals 0.06 (x_4) and irrigation 0.14 (x_5) were positive and significant at one per cent level.

21. The difference in farmer's method and scientific method (POP) of pomegranate cultivation was observed that, none of the farmers followed the recommended spacing (13.5×13.5, 15×15, 18×18 ft) and majority of the farmers (30-33 %) were followed high density planting with a spacing of 12×12 and 10×12 ft in the study area.

22. Only about 10 per cent of the farmers cultivated Ganesha variety which was recommended in the scientific method (POP) of pomegranate cultivation in the study area.

23. Farmers used more of nitrogenous and potash fertilizers [409:102:204 traditional area (Hiriyur taluk) and 300:166:236 emerging area (Hosadurga taluk) kg/ha] in both the areas compared to the recommended level of fertilizers (200:205:100 kg/ha). Whereas, application of phosphatic fertilizer by the farmers was almost half of the recommended level and use of farmyard manures was only about one third (8.81t/ha) of the recommended quantity (25 t/ha) for pomegranate cultivation.

24. Yield obtained in the farmer's method (9.71 t/ha) was slightly less than the scientific method (POP) (10 t/ha).

25. The partial budgeting technique indicates that, extra cost and reduced returns in farmers method of pomegranate cultivation was ₹ 30,429 and ₹ 17,814 per ha, respectively compared to scientific method (POP). Further, the reduced cost and additional returns of ₹ 30,980 and ₹ 4,38,380 per ha was achieved in farmers' method. Hence, the total net gain of ₹ 4,21,090 per ha observed in the farmers' method than that of scientific method (POP) of pomegranate cultivation.

Policy implications

Based on the findings of the study, the necessary steps to be taken up in the areas of investment and production of pomegranate, and the policy are drawn and are presented as under:

1. The study indicated that pomegranate cultivation is a very profitable enterprise. Hence, this needs to be popularized among farmers by the agricultural extension agencies.

2. Spending higher amounts on acquiring and using inputs like irrigation water and fertilizers will substantially increase the yield levels and thereby improve the income level of the pomegranate farmers.

3. The field demonstrations need to be conducted to educate the farmers to adopt recommended level of fertilizers, plant protection chemicals, farmyard manures and effective irrigation schedules for optimum use of these resources. Since, fertilizers and irrigation resources were under used and farmyard manures and plant protection chemicals were over used.

4. As indicated by the investment measures, the investment made on pomegranate was found to be financially sound. The farmers, who wish to switch over to the establishment of pomegranate orchard, may do so even if they have to borrow for establishing the orchards at the prevailing rates of interest charged by the financial institutions on the loans advanced.

5. In the farmers' method of pomegranate cultivation, farmers are following the high density planting and getting extra 3 crops as compared to scientific method. Therefore, research should be conducted to study the viability and sustainability of these orchards in comparison with the scientific method of pomegranate cultivation.

6. Majority of the farmers are not growing the recommended varieties of pomegranate in the study region. Therefore, farmers have to be educated about the recommended varieties of pomegranate to maximize returns.

7. Pomegranate crop requires huge investment for cultivation and in susceptible to pest and diseases. Hence, the cultivation of pomegranate involves heavy risks so there is need for adequate coverage against the risk. Hence, special insurance scheme may be introduced to reduce the risk in pomegranate cultivation.

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APPENDICES

APPENDICES I: Cash flow analysis of pomegranate orchard in traditional area (Hiriyur taluk).

Year	Cost/Cash Outflow	Returns/Cash Inflow	Net income/net cash flow	Discount factor at 8%	NPW (₹)
1	435667.5	0	-435667.5	0.93	-403396
2	302144	594174	292030	0.86	250369
3	302144	594174	292030	0.79	231823
4	302144	594174	292030	0.74	214651
5	302144	594174	292030	0.68	198751
6	302144	594174	292030	0.63	184028
7	302144	594174	292030	0.58	170397
8	302144	594174	292030	0.54	157775
9	302144	594174	292030	0.50	146088
10	302144	594174	292030	0.46	135266

APPENDICES II: Cash flow analysis of pomegranate orchard in emerging area (Hosadurga taluk).

Year	Cost/Cash Outflow	Returns/Cash Inflow	Net income	Discount factor at 8%	NPW (₹)
1	450585	0	-450585	0.93	-417208
2	306882	597978	291096	0.86	249568
3	306882	597978	291096	0.79	231081
4	306882	597978	291096	0.74	213964
5	306882	597978	291096	0.68	198115
6	306882	597978	291096	0.63	183440
7	306882	597978	291096	0.58	169852
8	306882	597978	291096	0.54	157270
9	306882	597978	291096	0.50	145620
10	306882	597978	291096	0.46	134834

APPENDICES III: Cash flow analysis of pomegranate orchard in traditional area and emerging area (pooled) taluk.

Year	Cost/Cash Outflow	Returns/Cash Inflow	Net income	Discount factor at 8%	NPW (₹)
1	443125.95	0	-443125.95	0.93	-410302
2	305106	597359	292253	0.86	250560
3	305106	597359	292253	0.79	232000
4	305106	597359	292253	0.74	214815
5	305106	597359	292253	0.68	198902
6	305106	597359	292253	0.63	184169
7	305106	597359	292253	0.58	170527
8	305106	597359	292253	0.54	157895
9	305106	597359	292253	0.50	146199
10	305106	597359	292253	0.46	135370

DEPARTMENT OF AGRICULTURAL ECONOMICS, UNIVERSITY OF AGRICULTURAL SCIENCES, GKVK, BANGALORE.

Schedule

Research Topic: "Economics of pomegranate cultivation in Chitradurga District an Karnataka"

Name of the student: Sahana. R. T Date:_____

1. GENERAL INFORMATION

1. Name of the farmer: _____ 3. Education : _____

2. Village : _____ 4. Taluk and district : _____

5. Age : _____

6. Mobile No :_____

7. Family members Men:_____ Women:_____ Children:_____

1. Family information:

Sl. no.	Gender	Numbers	Engaged in farm activities	
			own	Others
1.	Adult male			
2.	Adult female			
3.	Children			
4.	Total			

2. Land holding

Sl. No	Particulars	Irrigated (Area)	Unirrigated	Land revenue (Acres)	Land rent
1	Leased in				
2	Leased out				
3	Own				
4	Total				

3. Participation in extension activity

Activities	Yes	No	Place	Subject
Training				
Demonstration				
Field days				
Extension tours				
Krishi mela				
Others				

4. Social and Institutional participation of farmer

Sl. No	Particulars	Member	Officer bearer
1	PACCS		
2	Ryota Sangha		
3	Youth club		
4	Villege panchyat		
5	Mandal panchyat		
6	Taluk Panchyat		
7	Milk unions		
8	Primary Lead Development		
9	Others		

5. Inventory of farm Buildings

Sl. No	Item	Year of construction	Cost of construction (Rs.)	Present Value (Rs.)
1	Farm House			
2	Cattle shed			
3	Poultry shed			
4	Pump shed			
5	Storage shed			
6				

6. Major farm implements/machinery

SI. No.	Items	No's	Year of purchase	Average life (years)	Annual repairs (Rs.)	Purchase value	Present value
1	Tractor						
2	Power tiller						
3	Sprayers						
4	Bullock cart						
5	Irrigation pump set						
6	Agricultural. implements						
7	Staking sticks						
8.	Wooden plough						
9	Disc plough						
9	Cultivator						
10.	M.B. plough						

7. Sources of irrigation

Sl. No	Irrigation source	Area (acres)
1	Open well	
2	Tank	
3	Tube well/Bore well	
4	Canal	
5	Others	

8. Irrigation Structure details

a) Bore well/Open well

Sl. No	Year of digging	Total Bore well cost	Pump set (HP)		No. functioning/failure
			(HP)	Rs.	
1					
2					
3					

b) Drip irrigation

Particulars	Area (acres)	Price
Drip irrigation		
Sand filter		
Others		

9. Loans availed

Sl. No.	Name of the Institution/Bank /Organization	Type of loan	Amount availed (Rs.)	Purpose	Amount repaid (Rs.)	Balance amount (Rs.)
1						
2						
3						

10. Livestock

Sl. No.	Animals	Purchased /farm produced	No.	Purchase price	Maintenance cost (Rs.)	Present price	Income Generated (Rs.)
1	Bullock pair						
2	Cows						
3	Buffaloes						
4	Sheep						
5	Goats						
6	Poultry						
7	Others						

11. Cropping pattern

Season	Crop	Variety	Area	Yield				Cost of cultivation
				Main product		By product		
				Qty	price	Qty	Price	
Kharif	a) b) c) d) e)							
Rabi	a) b) c) d) e)							
Summer	a) b) c) d) e)							

12. Expenditure pattern of house holding/year

Sl. No.	Items	Amount (Rs.)
1.	Food	
2.	Clothing	
3.	House Rent	
	Social Functions	
1.	Education	
2.	Health	
3.	Ceremonies	
4.	Life Insurance	
	Others	
1.	Building Maintenance	
2.	Machinery Maintenance	
3.	Vehicle Maintenance	
4.	General Insurance	
5.	Land Development	
6.	Miscellaneous	
	Total	

13. Cost of cultivation and returns

Crop —— ; Variety——— ; Spacing ——— ; No. of acres——— ; Pit size;———

Age of plant ;_____ Wage rate: Men_____ Women_____ Children_____

A. Establishment cost

Sl. No	Type	Frequency	Qty/ plant	Price	Men	Women	Children	BP	T/PT /hr	Total
1	Land preparation									
	a) Ploughing									
	b) Cold threshing									
	c) Uprooting of weeds d) Land levelling									
2	Purchase of plant material (No. of plant)									
3	Transport of material									
4	Opening of pits									
5	Planting and filling the pits									
6	Cost of drips/ conveyance pipes									
7	Construction of overhead tank									
8	Irrigation (method of irrigation)									
	a) Quantity of water supplied/plant									
9	Staking materials									
10	Pruning									
11	Watch and ward									
12	Fencing									
13	Soil amendments a)Tank silt b)Gypsum application c)lime									

14	**Fertilizer, manures and pp chemicals**									
	Type of fertilizer									
	a)									
	b)									
	c)									
	Manures (cart loads) a) b) c)									
	PP chemicals									
	a)									
	b)									
	c)									
	d)									
	e)									
15	Harvesting									
16	Other expenses									

2nd year

Sl. No	Type	Frequency	Qty/ plant	Price	Men	Women	Children	BP	T/PT /hr	Total
1	Land preparation									
	e) Ploughing									
	f) Cold threshing									
	g) Uprooting of weeds h) Land levelling									
2	Purchase of plant material (No. of plant)									
3	Transport of material									
4	Opening of pits									
5	Planting and filling the pits									
6	Cost of drips/ conveyance pipes									
7	Construction of overhead tank									

8	Irrigation (method of irrigation)									
	b) Quantity of water supplied/plant									
9	Staking materials									
10	Pruning									
11	Watch and ward									
12	Fencing									
13	Soil amendments a)Tank silt b)Gypsum application c)lime									
14	**Fertilizer, Manures and Pp chemicals**									
	Type of fertilizer									
	a)									
	b)									
	c)									
	Manures (cart loads) a) b) c)									
	PP chemicals									
	a)									
	b)									
	c)									
	d)									
	e)									
15	Harvesting									
16	Other expenses									

3rd Year

Sl. No	Type	Frequency	Qty/ plant	Price	Men	Women	Children	BP	T/PT /hr	Total
1	Land preparation									
	i) Ploughing									
	j) Cold threshing									
	k) Uprooting of weeds l) Land levelling									
2	Purchase of plant material (No. of plant)									
3	Transport of material									
4	Opening of pits									
5	Planting and filling the pits									
6	Cost of drips/ conveyance pipes									
7	Construction of overhead tank									
8	Irrigation (method of irrigation)									
	c) Quantity of water supplied/plant									
9	Staking materials									
10	Pruning									
11	Watch and ward									
12	Fencing									
13	Soil amendments a)Tank silt b)Gypsum application c)lime									

14	**Fertilizer, Manures and Pp chemicals**									
	Type of fertilizer									
	a)									
	b)									
	c)									
	Manures (cart loads) a) b) c)									
	PP chemicals									
	a)									
	b)									
	c)									
	d)									
	e)									
15	Harvesting									
16	Other expenses									

14. Cost and Returns

Sl. No	Type	Frequency	Qty/ plant	Price	Men	Women	Children	BP	T/PT /hr	Total
1	Land preparation									
	m) Ploughing									
	n) Cold threshing									
	o) Uprooting of weeds p) Land levelling									
2	Irrigation (method of irrigation)									
	A) Quantity of water supplied/plant									
3	Staking materials									
4	Pruning									
5	Watch and ward									
6										
7	Soil amendments									

	a) Tank silt b) Gypsum application c) lime									
8	**Fertilizer, Manures and Pp chemicals**									
	Type of fertilizer									
	a)									
	b)									
	c)									
	Manures (cart loads) a) b) c)									
	PP chemicals									
	a)									
	b)									
	c)									
	d)									
	e)									
9	Harvesting									
10	Other expenses									
11	Bagging/packing									
12	Mode of transport									
13	Distance from village									
14	Transportation charge									
15	Loading /unloading cost									
16	Type of buyer: Commission agent/wholesale/others									
17	Commission charges									
18	Incidental charges									
19	Any other cost									

15. Particulars of investment on bore well

Sl. No	particulars	Magnitude	Investment
1	Year of Drilling		
2	Cost of drilling		
3	Casing cost		
4	Cable wire cost		
5	Automatic starter		
6	Other cost		

16. Drip irrigation structure

Particulars	
Area	
Year of establishment	
Cost	
Maintenance cost	
Subsidy/own	
Life of Drip	

18. Method of cultivation of pomegranate orchard (Farmers method/Scientific method)

Sl. no	Operations	Farmers method of cultivation	Scientific method of cultivation
1	Seedlings		
2	Spacing		
3	Pit size		
4	No. of plant/ ha		
5	FYM (before planting)		
6 a) b)	Fertilizer		
7 a) b) c) d)	Pesticides		
8 a)	Diseases Bacterial blight		
9	Drip irrigation		
10	Pruning		