SUPPLY AND DEMAND OF MAJOR PULSES IN KARNATAKA VIS-A-VIS INDIA – AN ECONOMETRIC ANALYSIS

AVINASH C S

DEPARTMENT OF AGRICULTURAL ECONOMICS
COLLEGE OF AGRICULTURE, DHARWAD
UNIVERSITY OF AGRICULTURAL SCIENCES,
DHARWAD-580 005

JULY, 2018

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Thesis submitted to the
University of Agricultural Sciences, Dharwad
in partial fulfillment of the requirements for the
Degree of

DOCTOR OF PHILOSOPHY

IN

AGRICULTURAL ECONOMICS

BY

AVINASH C S

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UNIVERSITY OF AGRICULTURAL SCIENCES, DHARWAD

CERTIFICATE

This is to certify that the thesis entitled "**SUPPLY AND DEMAND OF MAJOR PULSES IN KARNATAKA VIS-A-VIS INDIA – AN ECONOMETRIC ANALYSIS**" submitted by **Mr. AVINASH C S** for the degree of **DOCTOR OF PHILOSOPHY** in **AGRICULTURAL ECONOMICS** of College of Agriculture, University of Agricultural Sciences, Dharwad is a record of research work done by him during the period of his study in this university, under my guidance and supervision and the thesis has not previously formed the basis of the award of any degree, diploma, associateship, fellowship or other similar titles.

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ACKNOWLEDGEMENT

With my kind blessings of the almighty I have been able to complete my studies successfully and present the piece of work for which I am externally indebted to him. No successful Endeavour is a result of an individual effort. I sincerely thank all those who directly or indirectly made this thesis possible.

I wish to record my profound sense of gratitude to **Dr. B. L. PATIL**, Professor and Head ABEKC, Department of Agriculture Economics, College of Agriculture, Dharwad, and Chairman of my Advisory Committee for his untiring and valuable guidance, constructive and critical review and constant encouragement during the course of this study. I had a great pleasure and precious opportunity to be associated with him and I feel no words to express my heartful respects for all his kindness.

It gives me immense pleasure to express my heartfelt thanks to the members of my Advisory Committee **Dr. M. T. SHARMA**, Professor of Agricultural Economics, Diploma (Agri) College, Jamakhandi, **Dr. R. A. YELEDHALLI**, professor, Department of Agri-Business Management, College of Agriculture, Dharwad, and **Dr. A. R. S BHAT** Professor, Department of Agriculture Statistics, College of Agriculture, Dharwad, for their valuable guidance and helpful suggestions during the research work.

From bottom of my heart, with deep sense of gratitude, I owe my debts of thanks to **Dr. Girish N. Kulkarni**, Professor and Head, Department of Agricultural Economics, **Dr. G. K. Hiremath,** Retired Professor and Head, Department of Agricultural Economics, **Dr. S. M. Mundinamani,** Professor and University head, **Dr. Jayashree A. Handigol**, **Dr. H. Basavaraja, Dr. R. S. Poddar, Dr, Guledagudda, Dr, Mahantesh Naik**, **Dr. Basavaraj Jamakhandi**, **Dr. B.S Reddy** and **Dr. Rajur** for their unstinted support, critical comments and valuable suggestions during the study and research work.

I have no words to express my heartfelt love and affection for persistent encouragement and blessings of my grandmother Smt. **Shanti Bai**, Late grandfather Shri. **Eshwar Naik**, mother Smt. **Uma Bai**, Father Shri. **Shankra Naik** sister **Usha**, my brother in law **Devaraj Naik** and My Brother (Guru) **Dr. Sateesh Naik S. J,** ARS scientist, IIPR Kanpur without whose affection, support and sacrifice, this study would scarcely have been accomplished.

I am very much thankful to non taching staff **Girish, Gowramma, Balamma, Shreya** and **Belagal** uncle Department of Agricultural Economics for their help, co-operation and support.

As said dearest is the friends love who's volunteered help at the time of need for achieving my cherished goal and pave me to offer my loveable and indebted thanks to my dearest **Devendra Biraldinni, Santhosh Kamble, Shivraj Kamble, Suresh, Vikash, Dr. Naveen Kumar, Rohith, Sunil, Adarsh, Punith, Kiran, Vikram, Rajesh, Somu, Shasi, Naveen, Naganna, Manjupraksh, Manoj, Devendra, Priyanka, Pooja, Shivu, Teju, Darshan, Jeevan** and my senior friends**, Dr. Ravindra, Dr. Ravi Dupdal, Dr. Gangadhar, Dr. Chethan, Dr. Jainuddin, Dr. Kusuma, Neelamma, Ragu, Mohan** and **Dr. B. O. Patil** for their support and encouragement.

My sincere thanks to my classmate friends **Priyadharshini** and **Radhika,** and my all dear junior friends **Naveen, Asma, Shubha, Gowri, Kumar, Amith, Anannd, Maruthi, Shankar, Sunil, Manu, Sri Kantha, Ankush, Ramachari** and all others who encouraged me during my post graduation.

I acknowledge the financial support by **Indian Council of Agriculture Research (ICAR) - Senior Research Fellow (SRF)** and **University Grant Commission (UGC) – New Delhi** for providing the fellowship to complete my doctoral research work. Am also thankful to respondents of all the categories which i surveyed, for their cooperation during the interviews.

I convey my whole hearted thanks to M/s Anup Computers**,** Dharwad for his meticulous typing of the manuscript neatly, timely and more vitally his co-operation and affection towards

I should not forget my friends and well wishers who have helped me directly and indirectly during my course of research work.

..... **Omission of any names doesn't mean lack of gratitude. Ending inevitable for all good work it is time to end the acknowledgement.**

DHARWAD **-**

JULY, 2018 ***(Avinash C S)***

C O N T E N T S

LIST OF ABBREVIATIONS

₹	=	Rupee
%	=	Per cent
A3P	=	Accelerated Pulses Production Programme
CACP	=	Commission on Agricultural Costs and Prices
DES	=	Department of Economics and Statistics
FAO	=	Food and Agriculture Organization
FYM	=	Farm Yard Manure
GR	=	Gross Revenue
Hrs	=	Hours
HYV	=	High Yielding Varieties
ICMR	=	Indian Council of Medical Research
Kg.	=	Kilogram
l.	=	Liters
m.ha	=	Millon hectare
mm	=	Millimeter
MSP	=	Minimum Support Price
mt	=	Million Tonnes
NFSM	=	National Food Security Mission
NIN	=	National Institute of Nutrition
No.	=	Number
P.P.C.	=	Plant Protection Chemical
PCA	=	Principal Component Analysis
Period-I	=	Pre-liberalization (1980-1990)
Period-II	=	Post-liberalization (1991-2016)
PHL	=	Post Harvest Losses
q.	=	Quintal
SFW	=	Seed, Feed and Industrial wastage
SMD	=	Sterility Mosaic Virus Disease
t.	=	Tonnes
TMOP	=	Technology Mission on Oilseed and Pulses

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

Introduction

1. INTRODUCTION

"If agriculture and conservation of natural resources goes wrong, nothing else will have a chance to go right in the country"

-M. S. Swaminathan

Pulses have been cultivated since time immemorial in rainfed conditions characterized by poor soil fertility and moisture stress environments. These are leguminous plants belong to the Fabaceae family. Pulses are also an excellent feed and fodder for livestock. Endowed with the unique ability of biological nitrogen fixation, carbon sequestration, soil amelioration, low water requirement (250 to 300 mm) and capacity to withstand harsh climate, pulses have remained an integral component of sustainable crop production system, especially in the dry areas (Anon.,2016a). Pulses are the primary sources of protein (22 %) for the poor and the vegetarians (40 %). The total pulse constitutes redgram, bengalgram, greengram, blackgram, lentil, horsegram, cowpea and fieldpea. The split grains of these pulses are called *dal* and are excellent source of high quality protein, essential amino acids and fatty acids, fibers, minerals and vitamins.

1.1 International Year of Pulses, 2016

The Year 2016 was declared as the International Year of Pulses by the sixty eighth session of the United Nations General Assembly on December 20, 2013. The Food and Agriculture Organization (FAO) of the United Nations has been nominated to declare a year for pulses. An international year designation provides an unprecedented opportunity to raise awareness and to celebrate the role of beans, chickpeas, lentils and other pulses in feeding the world. Even more importantly, it will be a galvanizing moment to draw together key factors to further the contribution by pulses to health, nutrition, and sustainability.

The FAO intends to make people more aware of the nutritional value of pulses, for their contribution to sustainability, and more reliable food. The year needs to facilitate cooperation within food production systems to use protein in pulses better. Also the year needs to promote production of pulses worldwide, improve crop rotation and improve trade in pulses. The IYP 2016 aims to heighten public awareness of the nutritional benefits of pulses as part of sustainable food production aimed towards food security and nutrition. The international year of pulses has created a unique opportunity to encourage connections

throughout the food chain that encouraged better utilization of pulse-based proteins at global level. In recent times most of the countries facing nutritional problems, from under nutrition and micronutrient deficiencies to obesity and diet-related diseases (such as type II diabetes and certain types of cancer), or a mix of these. In this context, pulses play an important role in providing nutrient-rich food as a part of healthy diet which helps to fight malnutrition in both developed and developing countries.

1.2 Global scenario

At the global level, pulses are the second most important group of crops after cereals. The global pulses production was 71 million tonnes from an area of 79 million hectare with an average yield of 910 kg per ha during 2015-16 (Anon., 2016b). Dry beans contributed about 32 per cent to global pulses production followed by dry peas (17 %), chickpea (15.9 %), broad beans (7.5 %), lentils (5.7 %), cowpeas (6 %) and pigeonpea (4.0 %). Developing countries contribute about 74 per cent to the global pulses production and the remaining comes from developed countries. India, China, Brazil, Canada, Myanmar and Australia are the major pulse producing countries together contributes nearly 50 per cent of world pulses production.

1.3 National scenario

India is the largest producer and consumer of pulses in the world contributing around 25-28 per cent of the total global production. Globaly 90 per cent of the redgram, 75 per cent of bengalgram and 37 per cent of lentil area is contributed from India. Pulses are the basic ingredient in the diets of a vast majority of the Indian population, as they provide a perfect mix of vegetarian protein component of high biological value when supplemented with cereals. The country grows a variety of pulse crops such as bengalgram, redgram, greengram, blackgram, dry peas, lentils, etc. under a wide range of agro-climatic conditions.

The area under total pulses has increased from 20.35 (2000-01) to 25.26 million ha (2015-16) and production has increased from 11.08 (2000-01) to 16.35 million tonnes (2015-16). This increase in production is not only due to area, mainly due to the enhanced productivity from 544 Kg per hectare (2000-01) to 715 Kg per hectare (2015-16). Out of total production (16.35 mt), chikpea shares 43.18 per cent with a production of 7.06 million tonnes followed by pigeon pea 15.65 per cent with a production of 2.56 million tonnes, these two pulses together contribute more than 50 per cent of the total production in India. However, the

uradbean with 1.95 million tonnes (1.92 %), mungbean with 1.59 million tonnes (09.82 %), lentil with 1.24 million tonnes (7.58 %) and other pulses with 1.95 million tonnes (11.92 %) of production. These figures make India the largest producer of pulses in the world. Since, the large section of population in India is dependent on pulses for their protein requirements and an additional population of 350 million has been added, which led to a sharp decline in the availability of pulses that resulted in an increased import from 1.27 to 3.49 million tonnes during 2015-16. In India the shortfall in pulses has been attributed to a number of factors, the major ones are the population, income, geographical shift, abrupt climatic changes, complex disease–pest syndrome, socioeconomic conditions and poor marketing opportunities (Srivastava *et al*.2010).

1.4 Pulses export and import policy adopted by India

As per the government's third advance estimate, output of pulses — largely gram, urad and tur — is projected at 24.51 million tonnes in 2017-18 as a result of significant increase in the area coverage and productivity of all major pulses. In 2016-17, production of pulses was pegged at 23.13 million tonnes. To check rise in price of pulses, the Centre has been taking steps to boost their output. India is the biggest producer, importer (4-6mt) and consumer (26-27 million tonnes) of pulses in the world. To ensure that farmers get remunerative prices, the government has imposed import duty and put quantitative restrictions on the various varieties of pulses. Import duty on bengalgram has been fixed at 60 per cent, while that for yellow peas is 50 per cent, 30 per cent for lentils and 10 per cent for redgram. The government has also imposed a quantitative cap of 2 lakh tonnes per year on *tur* dal and 3 lakh tonnes on blackgram and greengram. Exports of all pulses have been allowed from November 22, 2017.

1.5 Production of pulses by various states:

In India the 75 per cent of the pulses were produced by 6 states and those are Andhra Pradesh, Maharashtra, Karnataka, Rajasthan, Madhya Pradesh and Uttar Pradesh. The total area under cultivation of pulses in 2015-16 was 25.26 million hectare, if we look at the shares of area under cultivation in different states Madhya Pradesh shares highest area i.e., 22.81 per cent followed by Rajasthan (18.35 %), Maharashtra (18.35 %), Karnataka (11.01 %), Uttar Pradesh (7.38 %) and Andhra Pradesh (5.74 %). However, the highest production was recorded in Madhya Pradesh with a share of 31.07 per cent followed by Rajasthan (11.86 %),

Maharashtra (8.56 %), Karnataka (8.43 %), Andhra Pradesh (7.46 %), Uttar Pradesh (7.40 %) and Odhisa (3.37 %) (Anon., 2016b).

Bengalgram (*Cicer arietinum)*

Bengalgram is the most important pulse crop of India contributing about 39.31 per cent of total pulse acreage and about 43.18 per cent of total pulse production of the nation. It is mainly consumed as *'Dal'* (split cotyledons) and *chhole*. The total area and production of gram during twelth five year plan was 99.30 lakh hectares and 70.65 lakh tonnes respectively. Madhya Pradesh ranked first contributing 34.32 per cent and 39.47 per cent of total area and production of country respectively, followed by Rajasthan (16.64 % and 14.99 %) and Maharashtra (16.09 % and 12.95) in that order. The highest yield was recorded in the state of A.P. (1239 kg/ha) followed by West Bengal (1179 kg/ha) and Bihar (1171 kg/ha). The lowest yield was recorded in Tamil Nadu (649 kg/ha).

Redgram (*Cajanus cajan)*

India ranked first in area and production in the world with 74 per cent and 63 per cent of world area and production respectively. In productivity, Philippines ranked first with 1669 kg per hectare followed by Burundi and Grenada. The country's total area coverage and production of *tur* were 39.02 lakh hectares and 25.60 lakh tonnes respectively. The state-wise trend shows that Maharashtra ranked first both in respect of area and production (29.19 % and 29.68 %) followed by Karnataka (19.23 % and 15.96 %) and Madhya Pradesh (13.17 % and 13.30 %). The highest yield was recorded by Bihar (1739 kg/ha) followed by Haryana (1111 kg/ha) and Gujarat (1105 kg/ha). The lowest yield was observed in the state of A.P. (521 kg/ha) followed by Gujarat (623 kg/ha) and Karnataka (648 kg/ha).

Greengram *(Vigna mungo)*

The total area covered under *moong* in India was 33.80 lakh hectares with a total production of 15.90 lakh tonnes. The coverage of area and its production was the highest in the of Rajasthan (29.68 % & 25.51 % of the total area and production). Maharashtra ranked second in area coverage (12.98 %) and third in production (11.92 %). Andhra Pradesh ranked third in area (8.74 %) and second in production (12.43 %). The highest yield was recorded by the state of Punjab (838 kg/ha) followed by Jharkhand (680 kg/ha) and Tamil Nadu (675 kg/ha). The National average yield was 468 kg/ha. The lowest yield was observed in the state of Karnataka (247 kg/ha) followed by Chhattisgarh (269 kg/ha) and Odisha (337 kg/ha).

Blackgram *(Vigna radiata)*

The total production was 19.50 lakh tonnes on an area of 30.69 lakh hectares. As regards the total contribution from states, Madhya Pradesh stood first in respect of area (19.40 %) followed by Uttar Pradesh (17.88 %) and Andhra Pradesh (11.69 %), whereas in production, Uttar Pradesh stood first (16.98 %) followed by Andhra Pradesh (16.75 %) and Madhya Pradesh (15.07 %). The highest yield was recorded by the state of Bihar (898 kg/ha) followed by Sikkim (895 kg/ha) and Jharkhand (890 kg/ha) and the National average yield was (585 kg/ha). The lowest yield was recorded in the state of Chhattisgarh (309 kg/ha) followed by Odisha (326 kg/ha) and J&K (385 kg/ha).

1.6 Demand and Supply:

Sustained economic growth, increasing population and changing life styles are causing significant changes in Indian food bosket, away from staple food grains towards high value horticultural and animal products (Kumar *et al.,* 2007). While per capita consumption of food grains in general and pulses in particular has declined due to increase in population. On the supply side, per capita annual production of food grains increased significantly even though countries population increased rapidly due to rapid spread of high yielding varieties with improved crop production practices. The growth in production of pulses and yield lagged behind the population growth rate which has resulted in to a decline in per capita availability of pulses from 65g/day/capita during 1965 to 33g/day/capita during 2005. This changing scenario of consumption and production will have significant influence on the demand supply prospects of pulses.

Even with the best efforts, pulses production and productivity has been stagnant. Due to the low productivity-low input use nature, pulses are grown as residual/alternate crops on marginal lands after taking care of food/income needs from high productivity-high input crops like paddy and wheat. In addition to this, these crops are adversely affected by a number of biotic and abiotic stresses, socio-economic constraints, which are responsible for a large extent of the instability and low yields.

The irony is that India is the largest producer and importer of pulses in the world. Annual import of pulses has increased from 0.50 million tonnes to 1.80 million tonnes during last five years. For many pulses, large shares of import, including desi bengalgram, redgram, mungbeans, and kidneybean, comes from Myanmar. Canada and Australia are major suppliers of drypeas and *kabuli* chickpeas to the Indian market, each supplying about one-third of

India's pea imports. Most kabuli chickpeas come from Mexico, Australia, Canada, Turkey and Iran. Nepal and Syria account for the largest shares of Indian lentil imports. Depending on the domestic shortfall in pulses production, India's net imports of pulses have ranged from one million tonnes to three million tonnes, while exports are one-tenth of the volume of imports.

1.6 Karnataka Scenario

Karnataka is one of the major pulses growing state in the country. Pulses are grown in an area of 27.37 lakh hectare with the production of 10.18 lakh tonnes with a productivity of 599 kg per hectare during 2015-16. Major pulses grown in the state are Redgram, Bengalgram, Greengram and Blackgram. These four pulses accounted 84.01 per cent of total pulses area and 91.34 per cent of state total pulses production during 2015-16. With respect to study area, Vijayapura occupies the highest area under cultivation of pulses with an area of 16.88 per cent to the total state area under pulses cultivation followed by Gadag (7.04 %), Bagalkot (5.83 %), Belagavi (5.51 %), Dharwad (4.86 %) and Haveri (0.45 %). Among the northern districts, Vijayapura stand first with a production of 11.51 per cent (1,17,215 tonnes) followed by Bagalkot (6.41 %), Belgaum (3.54 %), Dharwad (3.64 %), Gadag (3.22 %) and Haveri (0.34 %) (DES, Karnataka 2016).

No doubt the production shortage was due to technological fatigues, the pulse crops are highly sensitive to attack by a wide range of pests (plant diseases, insects and weeds) at various stage of crop growth as well as storage conditions. The major causes for low production of pulses are shortage and lack of timely availability of quality seeds, cultivation of pulses on marginal and sub-marginal lands, deficient/depleted in nutrients with low inputs, lack of appropriate pulse production and protection technologies, lack of information related to pest biology, pulse growing land is deficient in water holding capacity making them vulnerable to heat stress resulting in terminal drought and poor post-harvest technology, storage infrastructure (Sharma *et al.*,2012). In general, the pulses production is not keeping pace with the domestic requirements which is a matter of concern.

Keeping in view of the above issue having importance in pulses production the present study is focused on the supply and demand of major pulses in Karnataka in comparison with India.

Objectives of investigation

1. To study the trend in area, production and productivity of major pulses over a period of time in Karnataka and India.
2. To estimate gap between supply and demand of total pulses in Karnataka and India.
3. To estimate total demand projection of total pulses in India
4. To study the growth in export and import of total pulses in India.
5. To estimate cost and returns of major pulses and to identify problems and prospects of pulses cultivation in Karnataka.
6. To identify and asses the various factors of supply for pulses in Karnataka.

Hypothesis

1. There is an rising trend in pulses production in Karnataka and India
2. There is a considerable gap between demand and supply of pulses
3. There is a significant growth in import and export of pulses
4. The cost and returns varies in different pulses production
5. Supply of pulses is determined by many technical, climatic and socio-economic factors

Scope of the study

Majority of Indian population (40 %) are vegetarian and pulses are playing an important role in providing protein (22 %) and other essential nutrients to the large population of the country. However, its area is fluctuating from year to year due to number of biotic and abiotic stresses, which are responsible for a large extent of the instability and low yields. The cost of cultivation of pulses is on rising trend and at the same time farmers are not getting remunerative price for their produce. With respect to productivity the average yield of world during 2014 was 870 kg per hectare whereas in the same period the yield of India was 648 kg per hectare. As such, there was a gap of 242 kg (27 per cent) and also from last 40 years the productivity was stagnant but the India's population has increased fivefold. As per the normative approach requirement of 14.60 kg pulses/capita/year as recommended by National

Institute of Nutrition, Hyderabad works out to be 23.55 million tonnes which in terms of production requirements would be about 26.50 million tonnes assuming seed, feed and wastage as 12.5 per cent of the gross output.

The increasing mismatch between production and consumption of pulses resulted in huge imports of pulses (4.67 mt) in recent years (2015-16). In order to achieve self-sufficiency and to meet out the requirements in pulses the productivity need to be enhanced to 978 kg per hectare and an additional area of about 3.0 million hectare need to be brought under pulses cultivation besides reducing post-harvest losses. Hence, the study will focus on what are the constraints exist for lower productivity and also suggest the strategies and necessary technology to be developed to bridge the yield gap in order to increase productivity to become self-sufficiency and to increase per capita pulses availability. In addition to above issues the study will also focus on the estimation of extent of supply and demand gap, and what are the strategies need to be adopted to minimize the cost of cultivation, growth in area, production and productivity and assess the factors responsible for production of pulses which in turn would help in increasing production. Thus, the present study would throw a light on various above issues which would be helpful to policy makers, administrators, farmers etc. in formulating the appropriate strategies/measures to combat the aforesaid issues.

Limitation of the Study

Due to the limitation of the time and other resources, the present investigation has been restricted to the selection of local sample size. Hence, the findings to be viewed in the specific context of the conditions prevailed in the study area and cannot be generalized for wider geographical area. However, careful and rigorous procedures have been adopted in carrying out the research as objectively as possible.

Since the data has been collected by survey method, the inherent lacunae associated with this type of enquiry have crept into the study. Since estimate were provided by recalling the memory by respondents because of the non-maintenance of the farm records, sincere efforts have been made to elicit the accurate information by cross questioning. However, the degree of discrepancy, if any, would be negligible as the estimates presented on averages.

Due to non-availability of import and export information about individual pulses, growth rate was estimated for limited period (2015-16). Due to the limitation of time it is not possible to estimate income and expenditure elasticity's, consumption habits, etc. The demand

and supply projection are estimated based on population growth. Hence, the results of the study can't be generalized beyond the limits of the study area.

Presentation of the study:

The Thesis is presented in six chapters.

Chapter-I Introduction: In this Chapter, the nature, importance of the present study and the specific objectives of the study have been indicated

Chapter-II: Review of literature: It presents a compressive review of the relevant research work done on related topics by different economists

Chapter-III: Methodology: It outlines the features of the study area, sampling desgine followed, relevant data and analytical tools used in the study

Chapter-IV Results: It is devoted to present the main findings of the study through tables and graphs.

Chapter-V Discussion: It presents meaningful interpretation and discussion of the results of the study

Chapter-VI Summary and Policy Implication: This Chapter provides summary of the entire research work and suggests the policy implication emerged from the findings

Chapter-VII Includes the list of the referred books and journals in the study.

Review of Literature

2. REVIEW OF LITERATURE

With a view to evaluate the objectives of the study, it was considered desirable to have knowledge of the findings of some earlier studies and the methods adopted for arriving valid conclusion. The review of literature connected with the main objectives of the study and it would provide a basis either for confirming the earlier findings or for contradicting the same and thereby to suggest issues for further improvement. Consistent with the objectives of the study, the review of literature is presented in this chapter under the following heads.

2.1 Growth in area, production and productivity

2.2 Demand and Supply gap

2.3 Total demand projection

2.4 Growth in export and import

2.5 Cost and returns

2.6 Problems and prospects

2.7 Factors determining the supply

2.1 Growth in area, production and productivity

Srivastava *et al*. (2003) worked out compound growth rate of area, production and productivity of pulses in Eastern Uttar Pradesh during 1975-76 to 1999-2000. The results of the study revealed that area and production of pulses declined by 1.80 and 0.67 per cent per annum, but productivity increased at a compound growth rate of 1.18 per cent indicated decline in production was contributed by declined in area.

Tuteja (2006) examined the growth performance of pulse crops in India by employing semi log function and found that pulses production grew at the dismal rate of 0.70 per cent per annum during study period 1980-81 to 2001-02. The growth in area was found stagnant while productivity increased by one per cent. Karnataka state as a whole recorded growth in production by two per cent mainly due to growth in area and productivity. The growth in production (1.90 %) during pre-economic reform period was far better than the post- reform period with negative growth of 0.30 per cent per annum.

Amarender Reddy (2009) conducted a study on growth performance of pulses in India. Growth in production of chickpea was due to higher growth rate of area in South India with the expansion of area under rice. The growth rate of pulses production was 1.52 per cent in

the 1980's and 0.59 per cent in the 1990's. It has significantly increased to 3.42 per cent during 2001-08. Growth rate in total area under pulses was negative both in 1980's and 1990's, while it was positive during 2001-08. Growth in productivity of pigeonpea has been significantly higher (2.74 %) during recent years due to wider adoption of long duration varieties. While, growth rate in productivity and area in case of other pulses crops are still quite low. The productivity of pulses has remained virtually stagnant for the last 40 years (539 kg/ha in 1961 to 544 kg/ha in 2001 to 617 kg/ha in 2009).

Singh and Rupam (2009) computed the growth in production and productivity of different pulses in Jharkhand. The study revealed that there was positive change in the area of pulses crops. The annual compound growth rate in the area was estimated to be 8 per cent, 62 per cent, 0.80 per cent and 0.20 per cent in pea, lentil, chickpea and pigeonpea respectively. The production growth rate in the same crop was observed to be 9.2 per cent, 6.8 per cent, 3.5 per cent and 3.9 per cent as compound annual rate in the State. The yield growth rate for these crops was further estimated at 1.20 per cent, 0.05 per cent, 0.20 per cent and 2.20 per cent. The variability in the area was observed high in pea followed by lentil and pigeonpea and minimum in chickpea. Similarly, variability in yield was also found to be high in pea followed by chickpea, lentil and minimum in pigeonpea, respectively.

Elumalai and Sujata (2011) studied the trends and patterns in agricultural growth at the national and sub-national levels in India. It was observe that higher growth in yield of all major crops during 1980-81 to 1989-90. The study indicated that crops other than rice and wheat shared the technological benefits. With decline in area, impressive growth in production of most crops was mainly contributed by growth in yield. Rice registered production and yield growth rate of 3.62 per cent and 3.19 per cent, respectively. Wheat yield also showed splendid growth of 3.57 per cent. Growth in yield of pulses and coarse cereals was appreciable. However, negative growth was reflected in the decline in area under food grains. Despite this, production of food grains was high at 2.73 per cent, which was contributed by yield growth of 2.97 per cent. Oilseeds recorded a growth rate of 5.46 per cent in production and 2.95 per cent in yield. This was attributed to technology mission on oilseeds launched in mid-1980s, which laid emphasis on increasing productivity of oilseeds and bridging yield gaps between experimental stations and farmers' fields by adopting improved package of practices.

Mahal *et al.* (2011) studied the growth performance, variability and instability of pulses and food grains in Punjab, for the years 1960-61 to 2009-10. The study showed that growth rate of pulses production decreased significantly during this period. It was -8.09 per cent per annum during sixties and decreased to -9.16 per cent per annum during 2000-01 to 2009-10. This was due to significant decrease in area i.e. -7.17 per cent for whole period under pulses, whereas production of food grains increased at the rate of 4.62 per cent per annum i.e. five times because of the significant increase in area and yield of food grains. The instability in production of pulses was much higher i.e. up to 35.74 per cent. Variability and instability increased in pulses but decreased in food grains.

Pandey and Gandhi (2011) worked out an empirical study of trends in production and marketing of pulses in two villages of Uttar Pradesh and Madhya Pradesh. Despite the implementation of various programmes, the growth of pulse production was far away from the rate of population growth in the country. study concluded the area under pulses for world showed different trends and the production, area and productivity of pulses has remained static over the last three decades and the growth of pulse production was far away from the rate of population growth in the country also growth rates remained almost stagnant at state level, but in some districts registered positive growth rates in area, yield and production.

Niti (2012) studied the performance of the crop sector in Gujarat during high growth period. He reported that the share of agricultural sector in Gujarat's net domestic product had declined to less than one-fifth, indicating that the state economy was witnessing a structural transformation. The post-liberalization period cropping pattern had favored the cultivation of wheat, cotton, spices, fruits, vegetables, floriculture and medicinal plants.

Saraswati *et al.* (2012) worked out compound growth rate of area, production and productivity of major crops in Karnataka. The results of the study revealed that growth in pulses output in the state was around 0.314 per cent per annum. The average productivity of pulses was about 2269.46 kg/ ha in the state. The productivity showed a growth rate of only 0.20 per cent per annum. The growth rate in area and production under *tur* was about 2.09 per cent and 2.11 per cent respectively. The *tur* productivity in the state witnessed an annual increment of 1.16 per cent per annum. The area under black gram has witnessed an annual growth of 4.23 per cent per annum. However, black gram showed declining growth rate (-0.18 %) with respect to its productivity. The growth in production of black gram was 3.06 per cent

per annum. The area under green gram registered a significant growth of 4.52 per cent per annum. The growth rate for production of green gram was 0.88 per cent per annum. The area under bengalgram showed a significant and positive growth rate of 5.12 per cent per annum. The significant and positive growth in production of bengalgram was observed in Karnataka and the growth rate was 7.39 per cent per annum. The growth rate in productivity of bengalgram was 1.88 per cent per annum.

Balakrishnama Naidu *et al.* (2014) conducted a study on trends in area, production and productivity of selected oil seed crops in Andhra Pradesh. In order to know the trends in area, production and productivity of selected oilseeds crops, compound growth rates were computed. The results revealed that growth rate of area under groundnut and sesame was negative at - 3.23 and 7.60 per cent respectively implied that the area under groundnut and sesame crops has been decreasing year by year.. The growth rates of production of groundnut, sesame are negative and the growth rate of sunflower was positive and implied that the production of groundnut and sesame are also decreasing year by year.

Manesh Choubey (2014) examined the area and production of pulses in India. The study revealed that during the period of 1986-87 to 2010-2011the area of pulses has registered a negative growth. On the other side, Production of pulses has grown at a negative rate. The result showed that decline in trend of pulses production was due to decline in area and production, indicating the positive or direct relationship between the area and production of pulses. Growth trends in production of pulses suggested that area under cultivation has not been able to bring desired increase in production of pulses.

Prem Narayan and Sandeep Kumar (2015) examined the constraints of growth in area production and productivity of pulses in India: An analytical approach to major pulses. The study revealed that growth rate of area-0.09, -0.60 and 1.62 and production 1.52, 0.59 and 3.35 during 1980s, 1990s and 2000s decades, which affect the net per capita per day availability of pulses, has declined sharply from 61 gms to 32 gms from 1951 to 2010. Therefore, the gap of domestic demand and supply widen sharply.

Mohanty and Satyasai (2015) studied the Indian pulses sector. The findings revealed that CAGR in area under total pulses at 0.08 per cent was much lower than the total foodgrains (0.21 %), rice (0.58 %), wheat (1.7 %) and oilseeds (1.4 %). The significant fall in pulses cultivation in the 1960s and in the early 1970s was due to the substitution of pulses

cultivation with high yielding varieties (HYV) of cereals in Punjab, Haryana and Western Uttar Pradesh. The Bengal Gram or *chana* was the largest sufferer in terms of reduced area. However, rainfed *kharif* pulses like *Tur/Arhar* did not face problem of diversion of area to cereals. As against 0.64 per cent growth in productivity of pulses, the CAGR of foodgrains was 2.23 per cent, rice 1.9 per cent, wheat 2.75 per cent and oilseeds 1.53 per cent. Thus, low productivity coupled with loss of area has affected the production of pulses.

Pushpa Singh *et al.* (2016) conducted a study on changing scenario of pulses in India. an Analysis of its Growth and Instability in Eastern States. Study revealed that between periods of 1970-71 to 1984-85 CAGR was 0.36 in area 0.75 production and 0.39 in productivity for eastern India as compared to 0.13, 0.29 and 0.16 CAGR of area, production and yield respectively of the country as a whole. The picture started to change from the period of 1985-86 to 1999 to 2000 when a very visible CAGR is seen in area under pulse cultivation resulting in corresponding negative CAGR in production and yield of pulses both at national and eastern region basis. The situation has improved marginally during the period of 2000-01 to 2014-15. But in the period of 1970-71 to 2014-15 there was negative growth in 0.52 in area of total pulses and 0.16 in production in Eastern India as compared to CAGR of 0.03 and 0.45 in area and production of total pulses respectively at national level.

Faizan Danish and Rohullah Amin (2017) studied the status of growth in area, production and productivity of major crops in Jammu province of Jammu and Kashmir state. The result revealed that for overall (1984-85 to 2013-14) period rice, maize, wheat, millets, fodder crops, fruits & vegetables and condiments & spices had positive area growth, while barley (-2.04 %), bajra (-5.84 %), jawar (-2.00 %), sugarcane (-2.32 %), fibers (-4.19 %), pulses (-1.63 %), oilseeds (-1.19 %), dyes & tanning materials (-2.27 %), drugs, narcotics & plantation crops (-2.88 %) had negative area growth. The growth in production of rice (1.23 %), wheat (0.84 %), pulses (1.11 %) had positive and maize (-0.08 %) had a negative growth. On the other hand, during the same period, rice, wheat and pulses were have positive growth, while maize was witnessed negative growth during overall period under study.

Priya Rampal (2017) examined the situational analysis of pulses production and consumption in India. Study reported that growth rate has been positive for all the pulses till 2010-11. In fact, between 2007-08 and 2010-11, the time period when NFSM was launched, growth in area was 3.7 per cent and production 6.2 per cent. It appears that NFSM did induce

the farmers to grow more pulse crops. Only Uttar Pradesh showed a decline where the farmers shifted to cereals due to improvements in irrigation. This was compensated by positive growth rates of 9 per cent in Andhra Pradesh and 9.7 per cent in Karnataka, per annum.

2.2 Supply and demand gap

Goyal and Sing (2002) worked out the demand and supply of foodgrains in India: implications to food security. The study revealed that cereal demand is expected to fall short of expected supply by about 9 million tonnes in 2009-10. By the next decade i.e., 2019-20, we would be able to produce what we would demand. However, by 2029-30, India is expected to become surplus in cereal production. As for as pulse concerned, demand is expected to short fall of supply. This deficiency is expected to the extent of 4.73 million tonnes by 2009-10. The deficiency is further expected to increase to 14.8 million tonnes by 2029-30.

Mittal (2008) conducted a study on demand and supply of food grains in India. The study revealed that gap between demand and supply of food grains was negative indicating the demand for food grain more than its supply. Study expressed fear of the new varieties not being stable and pest and diseases vulnerability being high. The gap between demand and supply of cereals expected to reach 21.19 mt during 2011 and 16.97 mt in the year 2026.

Amarender Reddy (2009) estimated per capita consumption of pulses in India. The results of the study indicated that pulse production has been stagnant at between 11-14 mt over last two decades. On the other, hand significant growth in population resulted decline in per capita consumption from 61 grams per day per person in1951 to 30 gram per day per person during 2008. They have also predicted that domestic supply would be 9.0 per cent short of domestic demand under most optimistic scenario and 26.0 per cent under pessimistic scenario during 2020.

Praduman Kumar *et al.*(2009) estimated demand for food grains in India for the year 2016-17 and 2021-22 by considering factors like urbanization, change in consumption pattern, shift in dietary pattern and income distribution and change in taste and preference of consumers. The total demand for food grains has been projected to 241.20 mt in 2016-17 and it would reach to 253.20 mt by the end of 2021-22. However, during same period the projected demand for pulses would reach 17.50 mt and 19.50 mt. The author has suggested to increase current food grain yield (1698 kg/ha) to 1981kg per/ha and 2080 kg/ha during 2016-17 and 2020-22 respectively.

Ramesh Chand (2009) estimated demand for cereals and pulses during 2011-12 and 2021-22. The findings of study indicated that the total demand for cereals is expected to reach 218.9 mt during 2011-12 and it would reach 261.50 mt in 2020-21. Similarly, the demand for pulses in the same period would grow to 16.10 mt and 19.10 mt respectively.

Amarender Reddy and Reddy (2010) estimated the Supply and demand gap of Lentil. The study predicted that the domestic supply would be 9 per cent short of domestic demand under most optimistic scenario, and about 26 per cent under the pessimistic scenario. Hence, even by considering only the projected domestic demand, ignoring the export potential, there is an urgent need for increasing the supply of lentil. However, there is a mismatch between the supply and demand for lentil. The study also revealed that annual production of pulses ranges from 11 Mt to 15 Mt, with yield of about 600 kg/ha. Due to the wide gap between supply and demand, import of pulses has increased from 0.38 Mt in 1993 to 2.82 Mt in 2008.

Sanjay *et al.* (2011) conducted a study on demand and supply of cereals in Nepal for the period 2010-2030. The study indicated that the gap between domestic production and direct demand by households for rice is likely to vary between 19-80 per cent. It appears that even with accelerated irrigation and increasing fertilizer supply, this deficit in rice would remain unchanged. However, technological input like HYV seeds, which are not adequately captured in their model, could help to increase productivity.

Hazoor Muhammad *et al*. (2012) worked out the demand and supply of wheat in Punjab state in Pakistan. The study revealed that during 2011-12, 7.83 mt of wheat will be surplus in Punjab as against the total requirement of 12.70 mt for the population of 97.67 million.

Rajesh Kumar (2012) estimated gap between demand and supply of pulses in India. They have projected the demand for pulse will be 33.80 mt and 52.20 mt during 2017 and 2025 respectively. However, projected supply would be 17.00 and 18.00 mt during same period. It was also predicted import of pulses would be around 13.00 and 20.00 mt during 2017 and 2025 respectively.

Singh (2012) worked out the supply and demand gap of pulses in India. The study revealed that India would have to cater excess domestic demand through imports of different pulses. *Masur* would also have excess demand over the domestic supply to the tune of 1.25

and 1.37 MT by the year 2015 and 2020 respectively under moderate scenario. Under high GDP scenario, the situation would be much worse. Considering the import of about 0.27 MT at present, the excess demand of about 2.67 MT expected under moderate scenario during 2015 would call for 10 times more imports than the present level. Since the different types of pulses are not close substitutes for consumption in India, appropriate strategies for different pulses should be followed to augment their domestic supply.

Anil Kumar Singh *et al.* (2014) conducted a study on pulses production in India: present status, bottleneck and way forward. The study revealed that India leading importer of pulses, production of pulse/ legume crops has been stagnant over the years. Consequent upon this there is widening gap between demand and supply. About 20 per cent of the total pulses demands are met by imports only. The gap between demand and supply has been widening and has necessitated import of pulses of 2.8 million tonnes in 2007-08.

Praduman Kumar *et al.* (2016) estimated the supply and demand gap of pulses in India. The study revealed that the domestic production of pulses projected to be about 21 Mt in 2020 and 26 Mt in 2030.The supply of pulses will fall short of their supply by about 1.3 Mt in 2020 and 0.2 mt in 2030 to meet the domestic needs, India will have to continue their imports.

2.3 Total Demand Projection

Goyal and Sing (2002) projected the demand for foodgrains in India. The study revealed that the total demand in 2029-30 will consist of 126.14 million tonnes of rice, 144 million tonnes of wheat, 20.57 million tonnes of coarse grains and 51.40 million tonnes of pulses. The total foodgrains demand in 2009-10 is expected to be higher by 27.63 per cent and in 2029-30 by 63.18 per cent over the base year's level.

Praduman Kumar *et al.* (2009) projected the foodgrains in India. The study revealed that consumption of pulses is likely to be around 9.5 kg during the XIth Plan and would increase only marginally afterwards. By multiplying the projected per capita consumption with projected population, we arrived at the direct household demand for foodgrains as 181.2 million tonnes (Mt) towards the end of XIth Plan with a grain mix of 87.4 Mt rice, 67.2 Mt wheat, 14.2 Mt coarse grains, and 12.5 Mt pulses. The direct household demand for

foodgrains would increase to 202 Mt by 2021-22, comprising 97.4 Mt of rice; 73.5 Mt of wheat; 15.1 Mt of coarse grains and 16.1 Mt of pulses.

Amarender Reddy and Reddy (2010) worked out demand and supply projections of pulse crops for the year 2020. The study shown that demand forecast was carried out in two ways: (i) by assuming the annual growth rate of 2.98 per cent (Kumar, 1998), and (ii) based on actual consumption growth since 1970s. Supply projections under all the three scenarios (including best case scenario) were short of demand projections (1.55 Mt) based on estimations of Kumar (1998) in the year 2020, while all supply estimates way ahead of demand projection (1.19 Mt) based on historical consumption growth rate.

Ganesh Kumar *et al.* (2012) estimated the demand and supply of cereals in India. The study projected that the total demand of rice will remain in the range of 104.7 to 106.8 million tons in 2025–2026 under alternate scenarios of income growth. An almost similar picture emerges for wheat and pulses. The corresponding forecasts for wheat and pulses are in the range of 91.4 to 92.6 million tons and 14.5 to 14.8 million tons, respectively. The projections of total demand are somewhat higher for all the three commodities when the commodity-balance approach is used to project indirect demand. The ranges of forecasts for 2025–2026 are 106.4 to 108.6 million tonnes for rice, 100.5 to 101.7 million tonnes for wheat, and 20.0 to 20.5 million tonnes for pulses. In both cases, the range of demand for the three commodities for 2015–16 and 2020–21 is smaller than that for 2025–26.

Masood Ali and Gupta (2012) examined the carrying capacity of Indian agriculture: pulse crops. The study revealed that as per the projections made by the government, with the present growth rate of 1.45 per cent, show that the population will increase to 1613 million by 2050, surpassing China (1417 million). The consumption requirements alone for the 1613 million people, on normative requirement of 14.60 kg pulses/capita/yr as recommended by National Institute of Nutrition, Hyderabad, works out to be 23.55 MT, which in terms of production requirements would be about 26.50 MT, assuming seed, feed and wastage as 12.5 per cent of the gross output. As against total pulse requirements of 18.33 Mt for 2009–10, the domestic production is only 14.60 MT The annual import of 2–3 MT provides only partial relief and checks escalation in the market price. By 2050, the domestic requirement would be 26.50 MT.

Singh (2012) estimated the total demand projection for major pulses. The study revealed that the demand for pulses was projected in the range of 17-18 mt for the year 2015 and 20-23 MT for the year 2020. The demand for rural area found to be higher than the urban area in the entire scenario. However, the per capita projected demand was higher than urban areas. The North eastern region was projected to have the least demand for pulses with just 0.61 MT projected during 2020 under high growth scenario.

Parvathi and Arulselvam (2013) examined the situational analysis of agricultural production and food security in India. The study revealed that total demand for cereals projected to grow to 218.9 million tonnes by the end of the eleventh plan and it would reach 261 million tonnes the year 2020-21. Demand for pulses the same period would grow to 16.1 and 19.1 million tonnes. Besides, the domestic demand for foodgrains expected to reach 280.6 million tonnes by the end of 2020-21 to meet this demand in foodgrains pulses and cereals. The growth rate in agricultural production has to be substantial.

Anil Kumar Singh *et al.* (2014) worked out the oilseeds and pulses requirement 2050-51. The study revealed that pulses productivity scenario has been forecasted for individual states as well as eastern India as whole. During 2050-51, Bihar will be the leader productivity term (1461.3 kg/ha). Odisha will be the laggard one with less than a ton productivity (800.5 kg/ha). It was estimated that during 2050, with best possible effort, region will produce 4.84 Mt pulses with deficit of 9.79 Mt. However, productivity of region will increase from present (681 kg/ha) to 1185.4 kg per ha and will surpass the then national average (979.6 Kg/ha). During 2050, India will be imports less (1.62 Mt) what we are importing currently (2.83 Mt) (GoI, 2012). Projections clearly indicated that Bihar was the leading states among the eastern state in pulses productivity front with (1461.3 kg/ha) during 2050. Odisha may prove sluggish (800.5 kg/ha) among the seven states of this regions. It is obvious to improve productivity from 689 to 1185 kg per ha through existing and new technologies, institutional support.

Shivagangavva and Reddy (2014) estimated the pulses demand of Karnataka by using normative requirements of pulses as recommended by the National Institute of Nutrition (NIN), Hyderabad, @14.60 and @ 23.73 kg/year/capita as basis and it multiplied with the population to estimate the requirement for a particular year. The study revealed that demand for pulses expected to reach 11.34 and 12.66 lakh tonnes in the year 2020 and 2030 respectively. Whereas, supply of pulses will reach 11.10 and 12.02 lakh tonnes in the same

period indicating narrow gap between demand and supply. Similarly, country as a whole, total pulses requirement worked out to be 225.36 and 255.16 lakh tonnes in the year 2020 and 2030 respectively. In contrary to this projected supply will be only 218.50 and 237.00 lakh tonnes during same period.

Praduman Kumar *et al.* (2016) estimated the futuristic projection of demand vs supply of Food in India. The study revealed that in the year 2020, the demand is worked out to be about 112 MT for rice, 98 MT for wheat, 36 MT for coarse grains, 22 MT for pulses, 252 MT for total cereals, and 274 MT for total food grains. In the year 2030, the total food grains demand will grow to the level of 311 Mt comprising 122 MT of rice, 115 MT of wheat, 47 MT of coarse grains and 27 MT of pulses. The domestic production of pulses is projected to be about 21 MT in 2020 and 26 MT in 2030.

2.4 Growth in export and import

Ashalatha (2000) computed the growth rate in cashew in two periods; period-I (1956-57 to 1970-71) and period-II (1971-72 to 1998-99). The findings revealed that growth rate of area, production, productivity, kernel export, raw cashew import, cashew nut shell liquid value and cashew nut shell liquid unit value of export were showing positive trend while negative growth rate was noticed in cashew nut shell liquid quantity exported and was non-significant.

Angles (2001) conducted a study on production and export of turmeric in south India. The study revealed that that all the states registered significant growth in area, production and productivity, except area and production in Tamil Nadu, area in Kerala and productivity in Karnataka.

Jayesh (2001) studied the production and export performance of pepper and cardamom in south India. The results of the study revealed that the entire south Indian states except Karnataka (-0.47 %) and Tamil Nadu (-1.62 %) recorded significant growth in area and production of pepper. In case of cardamom, all the states recorded a negative growth in area, while positive and significant growth in productivity and production. Further, overall growth was found positive in quantity and value of pepper export and negative growth was recorded in quantity and value of cardamom export.

Rajesh *et al.* (2002) examined the trend in export of major spices in India during the period 1970-71 to 1999-00. The result of the study revealed that black pepper registered a positive growth rate of 2.38 per cent in quantity and 12.78 per cent in value. While large cardamom registered 12.76 per cent of growth in quantity and 21.4 per cent value of export, ginger registered 4.05 per cent growth in quantity and 10.15 per cent in value. Turmeric export registered 4.14 per cent in quantity and 13.08 per cent in volume during the study period.

Joshi and Saxena (2002) conducted a study on profile of pulses production in India: Facts, Trend and opportunities. The study revealed that the per capita availability of pulses has reduced to almost half from about 60 gm per day in 1950-51 to 26 gm per day in 2000-01 as against the recommendation (43 gm/day) of the ICMR. Such a trend was due to dismal production performance of pulses in comparison to population growth. With the acute shortfall in supply, the country was compelled to import pulses, which further restricted the growth of pulses production. The average import of pulses was 870 thousand tonnes per annum during the last five year ending 2001, with an extreme of 2,177 thousand tonnes in 2001-02. In value term, it was approximately US$270 million for the former and a peak of US$ 886 million in 2001-02.

Anjani Kumar *et al.* (2003) studied the growth and instability in export and import of livestock during the period 1974 to 1994. India had showed high growth rate of 11.15 per cent for livestock export and among different livestock products, exports of meat and meat product showed most stable and promising performance.

Amarender Reddy (2009) conducted a study on import and export of pulses from India. The results revealed that India's net import of pulses have ranged between one to three million tonnes. Whereas, export were one-tenth of the volume of import. Imports of pulses increased from 0.58 mt in 1994-96 to 3.10 mt in 2007-09 and are expected to reach 4.00 mt by 2012. The share of peas, chickpeas, pigeonpea and *moong* was higher in total pulses imports.

Sharma *et al.* (2013) estimated the growth and trend of pulses production in India. The study revealed that the import and export of pulses have also grown up substantially per annum to the tune of 8.90 land 23.40 percent annually during the entire period. Effective increase in area and yield has mattered in general in fetching differential production of pulses during post period (1980-81 to 1994-95). Area of pulses has been most stable with few

exceptions as compared to production and yield of pulse corps indicating thereby technological interaction in the pulse production. On other hand, instability in export and import has, however, been quite high during 2011-12.

Ahalwat *et al.* (2016) conducted a study on production, demand and import of pulses in India. The study revealed that the increasing mismatch between production and consumption of pulses has resulted in larger imports of pulses in recent years. The country was importing merely 0.17 million tonnes of pulses during 1980–81, which has in- creased fast to 4.585 million tonnes in the year 2014–15. The import of pulses has grown at compound annual rate of 9.8 per cent per annum since 1980–81, while the production has merely increased at 0.47 per cent per annum during the corresponding period. Total pulses imports were just 1.6 per cent of total pulses production in India during 1980–81, which has presently rose to about 32 per cent.

Sanjay *et al.* (2017) examined the Structural changes taking place in pulses area, production, productivity and trade aspects this analysis was carried out for a period of 10 years ranging from 2007-08 to 2016-17. It was done by calculating compound and simple growth statistics and by developing separate transitional matrix for exports and imports. Results regarding area, production, productivity, collective quantity and value of exports exhibited 1.88 per cent, 3.63 per cent, 1.71 per cent, 5.45 per cent and 3.23 per cent rate of compound growth rate respectively. Markov Chain analysis was attempted through linear programming method to assess the transition probabilities for the major pulses export markets of Indian pulses and nations importing pulses to India.

2.5 Cost and returns

Pawar and Pawar (2007) conducted a study on technique of evaluation in economics of rainfed blackgram and greengram production. The results revealed that main product of blackgram was 9.54 quintal per ha while that of greengram was 9.08 quintal per ha. In production process, cost-'C' was found to be ₹ 10,801.42 per hectare and ₹ 11,232.88 per hectare in case of blackgram and greengram production, respectively. Net profit was ₹ 2,766.78 per hectare from blackgram while that was ₹ 3,701.12 per hectare from greengram. Output-input ratio was 1.25 and 1.33 in case of blackgram and greengram production, respectively. Cost of production of blackgram was ₹ 1,089.98 per hectare while that of greengram was ₹ 1,192.38 per hectare.

Sunit Kumar and Bourai (2012) conducted a study one economic analysis of pulses production their benefits and constraints in Assan valley of Uttarakhand. The study revealed that the average cost of pulses production, shows that there is cost variation in per hectare of average cost of production of different pulses. Blackgram is the cheapest pulse as far as the cost of pulses production per hectare is concerned; it's a rainy season crop which is cost of pulses is ₹ 9,740 per hectare. While in winter pulses, the cost of production per hectare for chickpea is lowest which is ₹ 11,982 per hectare. The price mechanism of chickpea and Black gram is favoring these two crops in the region of Assan valley.

Amarender Reddy (2014) examined the profitability and labour use in cropping systems. The study reported that the cost of cultivation per hectare is higher in high value crops (₹ 40,467/ha) followed by cotton (₹ 22,735/ha), rice-wheat cropping system (₹ 22,664/ha), oilseed based cropping system (₹ 21,595/ha), pulses-cereal based cropping system (₹ 18,557/ha), pulses based cropping system (₹ 15,349/ha) and the least in coarse cereal based cropping system (₹ 11,812/ha). The share of seed cost is higher in oilseed based cropping system (19.8 % of total cost), followed by cotton (15.4 %). The high share of seed cost for oilseed-based cropping systems was mainly due to high seed rate in the case of groundnut, while in case of cotton based cropping systems the seed cost of Bt cotton is much higher. Female labour share was higher in cotton based cropping system as it requires more women labour for picking of cotton during harvest season. The share of male labour in total cost is higher in coarse cereal based cropping systems (28.1 %) followed by pulse-cereal based cropping systems (26.2 %), high value crops (25.8 %) and also rice-wheat cropping systems (23.9 %). Overall, the share of human labor in cost is higher in coarse cereal based cropping system (39.2 %) followed by pulses-cereal based (33.8 %), rice-wheat (30.9 %) and cotton (30.4 %).

Ashutosh Tripathi (2014) estimated price and profitability analysis of major pulses in India. The study reported that the total cost of cultivation was highest for *arhar,* followed by *gram*, and almost equal for *urad* and *moong*. This was because of higher yields in *gram*, followed by *arhar, urad,* and *moong*. In a study on the relationship between real cost of production and yield levels, an inverse relationship between them was found in *arhar, gram, moong,* and *urad.* The analysis shows that real costs (CoP) of *arhar, gram, moong,* and *urad* can be reduced by 4–5 per cent if their respective yield levels increase by 10 per cent. Despite

the total cost of cultivation being almost equal for *moong* and *urad,* the paid out cost of cultivation was higher for *moong*, which indicated lower imputed values of land, labor, and capital for this crop.

Grover and Singh (2015) examined the fiscal viability of pulses cultivation in Punjab. The results revealed that the profitability of summer *moong* in NFSM district per quintal net returns in moong cultivation on overall basis was estimated at ₹ 1,221 in 2006-07, ₹ 1,302 in 2007-08 and ₹ 1,395 in 2008-09. Whereas, the per quintal net returns in *moong* cultivation on overall basis worked out to be ₹ 1,249 in 2006-07, ₹ 1,432 in 2007-08 and ₹ 1,451 in 2008-09.

Chandraka and Pathak (2016) carried out a study on economic analysis of production and marketing of major pulses in Mahasamund district of Chhattisgarh. The study revealed that the cost of cultivation per hectare of green gram was found to ₹ 22,504.44 per hectare. Out of this ₹ 13,821.01 (61.41 %) was incurred as variable cost and remaining ₹ 8,683.43 (38.59 %) was the expenditure towards fixed cost. The major operational cost on green gram was observed as ₹ 3,151.02 per ha (14.00 %) on harvesting/threshing/winnowing which varied from ₹2,998.31 per ha at marginal farms to ₹ 3,373.89 per ha at large farms respectively. Intercultural operation was the second costliest operation on which overall cost incurred was ₹ 2,796.16 per ha (12.42 % per cent to the total cost).

Govind Pal *et al.* (2016) carried out a study on economic analysis of pigeonpea seed production technology and its adoption behavior: Indian context. The study illustrates a ratio of 32 : 68 towards fixed and variable costs in pigeonpea certified seed production with a total cost of ₹ 39,436 and the gross and net returns were ₹ 73,300 and ₹ 33,864 per hectare, respectively. The total cost of cultivation, gross return, and net return in pigeonpea seed production were higher by around 23, 32, and 44 per cent than grain production, respectively.

Govind Pal *et al.* (2016) Conducted a study on Comparative economics of see production vis - à - vis grain production of pigeonpea in Karnataka. The results revealed that the total cost of cultivation in pigeonpea seed production was around 23 per cent higher than grain production. The variable cost was comparatively higher in seed production (₹ 26,936 per ha) over grain production (₹ 20,698 per ha). The gross return was about 32 per cent higher in seed production than grain production and net return from seed production of pigeonpea was 44 per cent higher than grain production. The discriminate analysis indicated that gross

return with 55.88 per cent followed by seed (18.52 per cent), human labour (8.35 %), manures and fertilizers (7.01 %), bullock and machine labour (5.99 %), and plant protection chemicals (4.26 %) contributed to discriminate between the seed and grain production of pigeonpea. It was concluded that the net return from pigeonpea seed production was encouraging therefore the area under seed production may be increased for higher profitability and timely supply of quality seed to the farmers.

Sharma (2016) conducted a study on costs, returns and profitability of soybean cultivation in India: Trends and prospects. The results revealed that the operational cost of soybean cultivation has increased gradually in major soybean growing states. The real operational cost of soybean cultivation (at 2004- 05 constant prices) in Madhya Pradesh has increased from ₹ 3,909 per ha in TE 1983-84 to ₹ 9,594/ha in TE 2011-12. Similarly, it has increased from ₹ 8,567.8 per ha during TE 1998-99 to ₹14,050 per ha recently in Maharashtra, and from ₹ 6,827 per ha in TE 1996-97 to ₹ 8,682.6 per ha in TE 2011-12 in Rajasthan.

Sachin Kumar and Dinesh Kumar (2017) worked out the cost and return of Redgram in Kalaburagi district of Karnataka. The study revealed that the total cost of cultivation of redgram for small, medium and large size farms were (₹ 39,792.2/ha, ₹ 38,504/ha and ₹ 37,003.8/ha) respectively. The gross returns obtained per hectare by large size farms were high (₹ 86,025/ha) as compare to medium and large size farms (₹83,250/ha and ₹80,475 /ha) respectively. The net returns per hectare were highest in large size farms (₹ 49,021.20/ha) as compare to the medium and large size farms (₹ 44,746/ha and ₹ 40,682.8/ha) respectively. Input-output ratio per hectare was highest in large size farms (1:2.32) compare to medium and small size farms (1:2.16 and 1:2.02).

2.6 Problems and Prospects

Tripathi (2003) examined the prospects, problems and scope of maize and pulses in north eastern hill region of India. The results revealed that the biotic factors play a major role in limiting the pulses production. The estimated loss due to disease was around 25 per cent whereas the loss due to insect pests was up to 20 per cent. The socio-economic reason for low production of pulses in NEH states due to low priority given by the farmers because of general consumer acceptance and non-vegetarian food habit. Rice bean assumes great promise which is an indigenous pulse crop of the region and has gained attention as a supplementary

food crop. However, despite the constraints, there is enough scope both for maize and pulses production in NEH region.

Amarender Reddy (2009) conducted a study on pulses production technology: Status and way forward. The study illustrate that abiotic and biotic constraints are the major constraints in pulses cultivation. The major abiotic constraints like water holding capacity of the soil often limits grain yield to the extent of 50 per cent of that possible under irrigation on alfisols. On the contrary, on vertisol soils, higher water holding capacity causes growth reduction up to 5-20 per cent. Higher evapo-transpiration in south India during the *rabi* season causes severe constraints to chickpea yield under drought. Another major problem is salinity and alkalinity of soils. However, in pertain to biotic constraints the study summaries, more than 250 insect species are reported to affect pulses in India. Among these, nearly one dozen cause heavy crop losses. On an average 2-2.4 million tonnes of pulses with a monetary value of nearly ₹ 6,000 crore are lost annually due to ravages of insect pest complex. Among them, pod borer (*Helicovera armigera*) causes the most harm, followed by pod fly, wilt and root rot.

Parveen Kumar *et al,* (2010) conducted a study on constraints in pulses cultivation as perceived by the farmers. The study illustrates that the infrastructural constraints comprised of four related constraints viz non availability of high yielding varieties (HYV) of seeds at the time of sowing, non availability of plants protection chemicals, non availability of fertilizers (mainly Diammonium Phosphate) in the market at the time of sowing and lack of irrigation facilities. Among these, non availability HYV, seeds of pulses and unavailability of fertilizers (DAP) at the time of sowing were the two major constraints that were ranked I and II having a MPS of 88.76 and 82.50 per cent, respectively. Non availability of plant protection chemicals was ranked third in order (MPS 75.76). Lack of irrigation facilities was perceived as the least important constraint (MPS 5.50).

Shah (2011) conducted a study on possibilities and constraints in increasing pulses production in Maharashtra and the impact of national food security mission on pulses. The study revealed that the sampled households of NFSM district had reported low yield and 34 per cent showed both poor quality of grain and low yield as the major problems faced by them in the cultivation of pulses crops on inferior quality of land. The proportion of households in the non-NFSM district of breed reporting low yield as the major problem in the cultivation of pulses crops on inferior quality of land was as high as 58 per cent, whereas 28 per cent of the

sampled households of this district reported poor quality of grain as the major problem faced by them in the cultivation of pulses crops on the inferior quality of land.

Sekhar and Yogesh Bhatt (2012) has conducted a study on major pest problems in NFSM districts of Uttar Pradesh. The study revealed that the major pest problems are pod fly (96 % of the total households) and wilt (20 %). In the non-NFSM district the major pest problems are caused by pod fly (92 %), wilt (16 %), root rot (10 %), pod borer (8 %), and nematodes (8 %).

Choubey (2014) carried out a study on production of pulses in India: an econometric analysis. The study illustrated that non availability of good HYV seeds of pulses, lack of knowledge about HYVS, poor technical guidance and untimely availability of inputs (agro-chemical, fertilizers, etc) socio economic institutional constraints. Poor seed storage facilities, poor marketing facilities, poor transportation for marketing etc the socio economic infrastructural constraints in pulses production in states of India. Others constraints like, terminal drought, temperature, soil acidity and uncertainty in rainfall.

Painkra and Kumar (2014) examined the constraints associated with adoption of technologies in blackgram cultivation tribal farmers of Jashpur district of Chhattisgarh. The study revealed that the maximum respondents experienced various constraints like lack of knowledge about improved variety, lack of knowledge about manure & fertilizer and its accurate quantity for application and non-availability of fertilizer at appropriate time. To overcome the above constraints majority of the respondents suggested that knowledge should be provided about various aspects of black gram production technology i.e. improved variety, Seed treatment, *Rhizobium* culture and use of proper dose of fungicide and insecticide, etc. may be through training and demonstrations.

Shivagangavva and Reddy (2014) conducted a study on economic analysis of outlook of pulses production in Karnataka. The study revealed that non-availability of labour with their work in-efficiency tops the list of agro-biological constraints. Though the quantum of rainfall influenced significantly on production; assessment of factors influencing on production of pulses, inadequate rainfall during sowing and flowering (rank–II) resulted lower yield and high cost on fertilizers and pesticide (rank-III) as perceived by farmers. Incidence of sterility mosaic diseases (SMD), leaf spot, fusarium wilt (rank-IV) in pulses production causes considerable damage. Similarly, incidence of pod borer and pod fly were

the other insect pest causing larger damage in pulses production in general and redgram and bengalgram in particular. In adequate and delay in release of credit from different institutional agency, if sanction, low price during harvesting, sale of spurious plant protection chemicals, lack of technical knowledge about use of micro-nutrient and growth regulars and lack of storage facility after harvesting crops were the other sever socio-economic constraints faced by farmers as per their perception. Incidence of sterility mosaic diseases (SMD), leaf spot, fusarium wilt (rank-IV) in pulses production causes considerable damage.

Prem Narayan and Sandeep Kumar (2015) examined the constraints of growth in area production and productivity of pulses in India. The results revealed that the area of pulses not increase significantly as compare to wheat and rice i.e. first technological like non availability improved variety seeds, lack knowledge of package and practice, input use lack irrigation facilities or mostly depend on rain fed, lack of fertilizers minerals use and The other several reason the low productivity-low in put nature, pulses are grown as residual/alternative crops on marginal lands after preference given to staple food /income needs from high productivity-high input crops like paddy and wheat by the most of farmers . Also, they grow as rain fed crops with little or no modern yield enhancing inputs. The low priority accorded to pulses crops may be related to their relatively low status in the cropping system as treated secondary importance, in many of the farmer's crop management attention. In addition to this, these crops adversely affected by biotic and abiotic stress was not controlled properly. Pulse crops do not attract much the lack marketing facilities, whole prices, minimum support price and policy should be reformed from time to time, which should be beneficial to pulses growers.

Rajesh Kumar *et al.* (2017) conducted a multidimensional study of pulse production in Bundelkhand region of India. The study revealed that lack of quality seed of pulses was perceived most important constraint by majority of farmers (70 %) followed by problem of yellow mosaic disease in mungbean and urdbean (50 %), problem of pod borer (60 %) and problem of weed infestation in pulse cultivation. In Lalitpur district lack of quality seed (64 %), lack of knowledge about quality seed (80 %), non availability of seed timely (88 %), lack of knowledge about used *rhizobium* (60 %), lack of knowledge about used *trichoderma* (100 %), non availability of *rhizobium* of different pulse crops (68 %), non availability fertilizer (100 %), problem of wilt (80 %), problem of yellow mosaic disease (100 %),

problem of pod borer (72 %), poor effect of fungicides (96 %), problem of weed management (100 %). Lack of knowledge about support price (84 %) and problem of blue bull (100 %) perceived by the majority of farmers in Lalitpur district.

2.7 Factors determining the supply

Addisu (2000) studied the production instability and factors determining the area and yield of major oilseed crops in Karnataka. He employed regression analysis, wherein area and yield are regressed on selected causal factors viz., irrigation, relative prices, rainfall and labour wages. The result revealed that said factors showed significant impact on area and yield of oilseeds.

Arega (2000) studied the supply response of maize in Karnataka. The study was conducted to evaluate the impact of relative price and other selected non-price factors on supply of maize. The results indicated that relative price factor had positive and significant impact on hectarage of maize at the state level. Whereas, negative impact was noticed in Belgaum and Bijapur (Vijayapura) districts of Karnataka.

El Batran (2003) conducted a study on supply response of maize during 1980-2001. The results indicated that there is a positive supply response to the relative price of wheat and its competing crops (sugarcane and faba beans). The positive supply response also reflected the role of technical change in increasing the cultivated area under wheat.

Chandrasekhar Rao (2004) worked out the aggregate agricultural supply response in Andhra Pradesh. It was revealed that partial regression coefficients of terms of trade with respect to aggregate agricultural output, crops, food grains and non-food grains are not statistically significant and are positive. The study concluded that the response of agricultural output (includes livestock, crop, food grains and non-food grains output) to changes in terms of trade is positive and non-significant.

Leaver (2004) conducted a study on supply response of tobacco in Zimbabwe, using an adapted Nerlovian model. The results indicated that a short-run elasticity of 0.34 and a long-run elasticity of 0.81, revealed tobacco farmers highly unresponsive to price changes.

Munis Alagh (2004) conducted a study on aggregate agricultural supply to know whether the aggregate agricultural supply function in India was price elastic. An acreage response function for the period 1950-51 to 1996-97 indicated that India's aggregate supply

function is not price responsive. However, due to changed growth rates and policies after 1980-81, indicated a weak relationship between acreage response and terms of trade for the latter period. It still incorrect to say that Indian agriculture responds at the aggregate level to price stimuli but ignoring the marketization of substantial sections of the economy also not useful. The agrarian economy reflects the transitional nature of the policy regime since 1980.

Suleiman Abrar *et al.* (2004) studied the region-wise crop level supply response in Ethiopia. The results showed that the output prices were an important part of the incentive structure, but non-price factors the binding constraints. This most apparent in the non-commercial Northern high lands wherein these factors are more important in affecting production and resource use than price incentives.

Tuteja (2006) studied the acreage response of pulse crops in India. Author used Nerlovian modified model to identify the factors influencing acreage of major pulse in the core states in India. The results revealed that acreage allocation in *rabi* gram and massur got influenced by logged acreage followed by relative price. However, in case of *kharif* season *arhar, moong* and *urad* farmers considered lagged area and magnitude of pre-sowing rainfall as the most important factors.

Savadatti (2007) conducted a study on demand and supply response of pulses in India.The acreage response results revealed that in rain fed areas farm harvest prices and good weather conditions positively influence the area allocation decision of the farmers, but yield turned out to be an insignificant factor in influencing the farmers' decision to allocate land to either gram or *tur*.

Narayan Sharma Rimal *et al.* (2015) studied the supply response of chickpea in Madhya Pradesh. The study illustrated that gross irrigated area positive and significant at 10 per cent level, whereas the A1 cost of cultivation negative but non-significant. The rainfall has shown a positive and significant influence over the yield. This implies that chickpea being grown in *rabi* season, responds positively to the increased number of irrigations and rainfall during the growth and pod formation stages. The negative and non-significant impact of A1 cost of cultivation, used as proxy of prices of all the important inputs, resembles the farmers' perception regarding chickpea and other pulses as a secondary crop and cultivated in the rainfed conditions in marginal land.

Methodology

3. METHODOLOGY

This Chapters deals with the description of the study area, the methods adopted in selection of the samples, the nature and sources for the study, the nature and sources of data and various statistical tools and techniques employed in analyzing the data. The detailed methodology is presented under the following sub headings:

3.1 Description of the study area

3.2 Sampling Procedure

3.3 Nature and Source of data

3.4 Analytical techniques employed

3.5 Definition of terms and concepts used

3.1 Description of the study area

The present study was undertaken in Dharwad, Belagavi, Haveri, Gadag, Vijayapura and Bagalkot districts of Karnataka state during 2017-18 where in redgram, bengalgram and greengram cultivation were taken up extensively by the farmers (Fig.1, 2 and 3).

3.1.1 Karnataka

The States of Karnataka lies between $11^0$30' and $19^0$25' N latitudes and between $74^0$10' and $78^0$35' E longitudes. It is the eighth largest state in India in both area and population with an area of 1,91,800 km^2 and the population of about 61,095,297 according to 2011 Census. The state is bound by Maharashtra, Goa, Andhra Pradesh, Telangana, Tamil Nadu and Kerala in the north, east, southeast, northeast and southwest, respectively. The total cultivated area is about 125.63 lakh ha constituting 65.95 per cent of the geographical area for the year 2010-11. Out of the total cultivable area, 27,37 lakh ha of the total pulses cropped area. However, among pulses bengalgram occupies first place with an area of 14.20 (51.89 %) lakh hectare followed by redgram (24.01 %), greengram (12.44 %), blackgram (3 %), cowpea (2.47 %), horsegram (1.96 %) and fieldbean (1.79 %).

Karnataka is situated in tropical zone and enjoys warm climate throughout the year. The mean temperature ranges from 21.5^0 C to 31.7^0 C, The maximum and minimum temperature being 42^0 C and 14^0 C, respectively. The normal rainfall of the states ranges from as low as 569 mm to as high as 4,029 mm. Average annual rainfall of the state is 1,354 mm.

Fig. 1 Map showing study area for Redgram

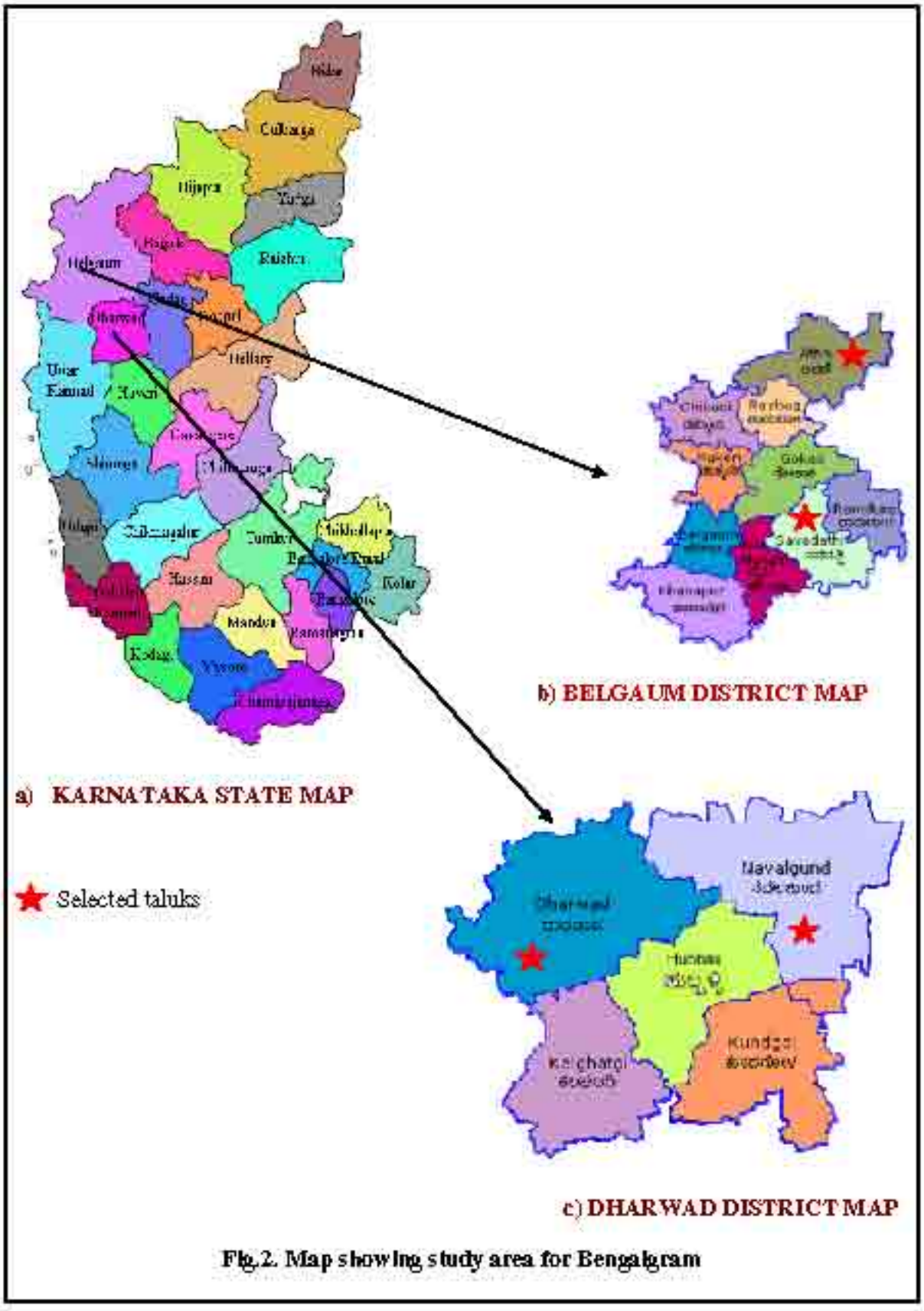


Fig.2. Map showing study area for Bengalgram

Fig.3. Map showing study area for Greengram

The major part of the rainfall received from the southwest monsoon, which commence in the first week of June and continues till the end of September. Major part of the state has red soil. Laterite soils are found in the hilly and coastal region of the western part. The northern part of the state has black soils with high moisture holding capacity.

Some of the objectives of the present study were analyzed using primary data obtained through survey in Dharwad, Belagavi, Haveri, Gadag, Vijayapura and Bagalkot districts of Karnataka states. Therefore, an attempt is made in this section to provide a brief description about the selected district.

3.1.2 Dharwad District

Dharwad district falls in the northern part of Karnataka between $15^0$02' and $15^0$51 N latitude and $73^0$43' and $75^0$35' E longitudes. It consists of five Taluk viz; Dharwad, Hubli, Kalghatgi, Kundgol and Navalgund. The population of the Dharwad district was 18,46,993 (2011 census) and out of the total population 66.15 per cent of the population is literate. District is having 5 main regulated market and 11 sub market. The district receives a average normal rainfall of 787 mm per annum. Total geographical area of Dharwad district is 4,27,329 ha out of this 35,235 ha is under forest, 26,557 ha land is not available for cultivation, 48,279 ha is uncultivable land and total net sown area is 3,10,816 ha. The cropping pattern in Dharwad district (Table 3.1) during 2015-16, indicated that out of the net cultivated area, cereals formed the important component with 26.06 per cent followed by pulses (25.63 %), oilseeds (17.49 %), commercial crops (14.46 %), Fruits and vegetables (8.30 %) and spices (8.06 %). Major cereal crops grown are paddy, ragi, wheat, maize and bajra. Major pulses grown are bengalgram, redgram, greengram. blackgram, cowpea, horsegram and fieldbean. Major oilseeds grown are groundnut, sessamum and castor. Major commercial crops grown are sugarcane, cotton and tobacco.

3.1.3 Belagavi District

Belagavi district falls in the northern part of Karnataka between $15^0$23' and $16^0$58 N latitude and $74^0$05' and $75^0$28' E longitudes. It comprises of ten taluks viz; Belagavi, Athani, Bailhongal, Chhikodi, Gokak, Hukeri, Khanapur, Raibag, Ramdurga and Saundati. The population of Belgavi district was 47,78,439 (2011 census) and out of the total population 64.45 per cent of the population is literate. District was having 10 main regulated market and 32 sub markets. The district has a normal rainfall of 820.7 mm per annum. Total geographical

Table 3.1: Cropping pattern of the study area

Sl.No	Crops	Dharwad		Belagavi		Vijayapura	
I.	**Cereal**	**Area (ha)**	**%**	**Area (ha)**	**%**	**Area (ha)**	**%**
1.	Paddy	23,906	4.57	59,938	5.99	51	0.01
2.	Sorghum	48,420	9.26	1,24,165	12.41	1,76,980	18.54
3.	Bajra	0	0.00	9,256	0.92	20,156	2.11
4.	Maize	30,900	5.91	1,56,718	15.66	40,207	4.21
5.	Wheat	32,836	6.28	46,789	4.68	53,842	5.64
6.	Ragi	27	0.01	1133	0.11	-	-
7.	Others cereals	135	0.03	30	0.003	-	-
	Sub-Total (I)	**1,36,224**	**26.06**	**3,98,029**	**39.77**	**2,91,236**	**30.50**
II.	**Pulses**						
1.	Bengalgram	91,455	17.50	78,642	7.86	3,22,020	33.73
2.	Redgram	1,000	0.19	2,869	0.29	1,35,696	14.21
3.	Greengram	39,814	7.62	25,913	2.59	4,173	0.44
4.	Balckgram	1,093	0.21	2,709	0.27	5	0.00
5.	Cowpea	302	0.06	1,246	0.12	358	0.04
6.	Horsegram	0	0.00	2,354	0.24	513	0.05
7.	Fieldbean	89	0.02	609	0.06	1	0.0001
8.	Other Pulses	199	0.04	2,357	0.24	9,54,794	100.00
	Sub-Total (II)	**1,33,952**	**25.63**	**1,16,699**	**11.66**	**4,62,766**	**48.47**
III.	**Oilseeds**						
1.	Groundnut	36,124	6.91	37,725	3.77	24,779	2.60
2.	Sunflowers	2,988	0.57	15,450	1.54	45,335	4.75
3.	Others	52,297	10.01	78,607	7.85	15,076	1.58
	Sub-Total (III)	**91,409**	**17.49**	**1,31,782**	**13.17**	**85,190**	**8.92**
IV.	**Fruits and Vegetables**						
1.	Fruits	11,231	2.15	9,514	0.95	17,435	1.83
2.	Vegetables	32,140	6.15	23,431	2.34	22,756	2.38
	Sub-Total (IV)	**43,371**	**8.30**	**32,945**	**3.29**	**40,191**	**4.21**
V	**Total Spices**						
1.	Total Spices	42,115	8.06	5,940	0.59	2,558	0.27
	Sub-Total (V)	**42,115**	**8.06**	**5,940**	**0.59**	**2,558**	**0.27**
VI	**Commercial Crop**						
1.	Sugarcane	8,711	1.67	2,66,247	26.61	65,136	6.82
2.	Cotton	66,883	12.80	40,310	4.03	7,717	0.81
3.	Tobaco	-	-	8,786	0.88	-	-
	Sub-Total (VI)	**75,594**	**14.46**	**3,15,343**	**31.51**	**72,853**	**7.63**
	Grand Total	**5,22,665**	**100.00**	**10,00,738**	**100.00**	**9,54,794**	**100.00**

Source: District statistics at a glance, 2015-16

Table 3.1 Contd…

Sl.No	Crops	Haveri		Bagalkot		Gadag	
I.	**Cereal**	**Area (ha)**	**%**	**Area (ha)**	**%**	**Area (ha)**	**%**
1.	Paddy	44,968	10.55	32	0.01	1706	0.366
2.	Sorghum	35,186	8.26	1,10,614	20.19	55,004	11.799
3.	Bajra	-	-	15,898	2.90	1,089	0.234
4.	Maize	1,70,696	40.07	44,300	8.08	34,163	7.328
5.	Wheat	983	0.23	20,118	3.67	16,041	3.441
6.	Ragi	154	0.04	-	-	1	0.0002
7.	Others cereals	1,143	0.27	-	-	102	0.022
	Sub-Total (I)	**2,53,130**	**59.42**	**1,90,962**	**34.85**	**1,08,106**	**23.19**
II.	**Pulses**						
1.	Bengalgram	1,991	0.47	1,33,071	24.29	1,10,162	23.631
2.	Redgram	1,739	0.41	4,547	0.83	1651	0.354
3.	Greengram	2,616	0.61	20,167	3.68	80,133	17.189
4.	Balckgram	140	0.03	4	0.001	6	0.001
5.	Cowpea	958	0.22	890	0.16	607	0.130
6.	Horsegram	4,275	1.00	886	0.16	952	0.204
7.	Fieldbean	377	0.09	0	0.00	6	0.001
8.	Other Pulses	10	0.00	55	0.01	54	0.012
	Sub-Total (II)	**12,096**	**2.84**	**1,59,620**	**29.13**	**1,93,571**	**41.52**
III.	**Oilseeds**						
1.	Groundnut	17,789	4.18	26,333	4.81	41,174	8.832
2.	Sunflowers	3,803	0.89	29,231	5.33	39,748	8.526
3.	Others	8,814	2.07	6,046	1.10	3,104	0.666
	Sub-Total (III)	**30,406**	**7.14**	**61,610**	**11.24**	**84,026**	**18.02**
IV.	**Fruits and Vegetables**						
1.	Fruits	14,121	3.31	16,121	2.94	10,121	2.171
2.	Vegetables	16,143	3.79	11,183	2.04	13,163	2.824
	Sub-Total (IV)	**30,264**	**7.10**	**27,304**	**4.98**	**23,284**	**4.99**
V	**Total Spices**						
1.	Total Spices	883	0.21	1264	0.23	756	0.162
	Sub-Total (V)	**883**	**0.21**	**1264**	**0.23**	**756**	**0.162**
VI	**Commercial Crop**						
1.	Sugarcane	14,826	3.48	1,05,380	19.23	7,586	1.627
2.	Cotton	84,424	19.82	1,807	0.33	48,846	10.478
3.	Tobaco	-	-	**-**	**-**	1	0.0002
	Sub-Total (VI)	**99,250**	**23.30**	**1,07,187**	**19.56**	**56,433**	**12.11**
	Grand Total	**4,26,029**	**100.00**	**5,47,947**	**100.00**	**4,66,176**	**100.00**

Source: District statistics at a glance, 2015-16

area of Belagavi district is 13,44,382 ha out of this 1,90,424 is under forest, 1,14,137 ha land is not available for cultivation, 39,318 ha is uncultivable land and total net sown area is 10,11,264 ha. The cropping pattern in Belagavi district (Table 3.1) during 2015-16, indicated that out of the net cultivated area, cereals formed the important component with 39.77 per cent followed by commercial crops (31.51 %), oilseeds (13.17 %), pulses (11.66 %), Fruits and vegetables (3.29 %) and spices (0.59 %). Major cereals crops grown are paddy, jowar, maize, wheat and bajra. Major pulses grown are tur, horsegram, blackgram and bengalgram. Major oilseeds grown are groundnut, sunflower and sessamum. Major commercial crops grown are sugarcane, cotton and tobacco.

3.1.4 Vijayapura District

Vijayapura district falls in the northern part of Karnataka between$15^{0}20^{1}$ N latitude and $74^{0}28^{1}$ E longitudes. It consist of five taluks viz; Vijayapura, Basavanabagewadi, Indi, Muddebihal and Sindagi. The population of the Vijayapura district was 18,75,102 (2011 census and out of the total population 67.13 per cent of the population is literate. District is having 3 main regulated market and 14 sub market. The district generally has a normal rainfall of 613.6 mm per annum. Total geographical area of the Vijayapura District is 10,53,471 ha out of this 1,977 ha is under forest, 67,063 ha land is not available for cultivation, 16,393 ha is uncultivable land and total net sown area is 8,77,334 ha. The cropping pattern in Vijayapura district (Table 3.1) during 2015-16, indicated that out of the net cultivated area, pulses formed the important component with 48.47 per cent followed by Cereals (30.50 %), oilseeds (8.92 %), commercial crops (7.63 %), Fruits and vegetables (4.21 %) and spices (0.27 %). Major cereals crops grown are jowar, maize and bajra. Major pulses grown are redgram, horsegram, blackgram and bengalgram. major oilseeds grown are ground nut, sunflower, safflower and sessamum. Major commercial crops grown are sugarcane, cotton and tobacco.

3.1.5 Haveri

Haveri District is exactly in the centre of Karnataka between 14.8°N 75.4°E. The district consists of seven taluks, namely Hanagal, Shiggaon, Savanur, Haveri, Byadagi, Hirekerur, and Ranebennur. According to the 2011 census Haveri district has a population of 1,598,506 out of the total population 77.6 per cent of the population is literate. The district generally has a normal rainfall of 656.5 mm per annum. Agriculture being the main

occupation in the district, out of 4,85,000 hectare of the geographical area of the district 3,60,030 hectare is cultivated. Out of this 47,454 ha is under forest, 19156 ha is a fallow land and total net sown area is 4,32,164 ha. The cropping pattern in Haveri district (Table 3.1) during 2015-16, indicated that out of the net cultivated area, cereals formed the important components with 59.42 per cent followed by commercial crop (23.30 %), oilseed (7.14 %) fruits and vegetables, pulses (2.84 %) and spices (0.21 %). Major cereals crops grown are maize and jowar. Major pulses grown are redgram and greengram. Major oilseeds grown are ground nut, sunflower, safflower and sessamum. Major commercial crops grown are sugarcane, cotton and tobacco.

3.1.6 Bagalkot District

The district is located in northern Karnataka and borders districts are Belagavi, Gadag, Koppal, Raichur and Vijayapura. The district comes under Northern dry zone (Zone-III) comprising of six talukas viz., Badami, Bagalkot, Bilagi, Hungund, Jamakhandi and Mudhol. The total geographical area of the district is 6575 sq. km. The gross cropped area in the district is 6,46,797 ha of which 3,04,569 ha is under irrigation. According to the 2011 census Bagalkot district has a population of 18,90,826 out of the total population 77.6 per cent of the population is literate. The district generally has a normal rainfall of 584 mm per annum. Agriculture being the main occupation in the district, out of 6,58,900 hectare of the geographical area of the district is 3,60,030 hectare is cultivated. out of this 81,700 ha is under forest,41,000 ha is a fallow land and total net sown area is 4,59,800 ha. The cropping pattern in Bagalokot district (Table 3.1) during 2015-16, indicated that out of the net cultivated area, cereals formed the important components with 34.85 per cent followed by pulses (29.13 %), commercial crop (19.56 %), oilseeds (11.24 %), Fruits and vegetables (4.98 %), and spices (0.23 %). The major crops grown are Sorghum, Maize, Wheat, Groundnut, Sunflower, Greengram, Redgram, Bengalgram, Sugarcane and Cotton. Horticultural crops like Sapota, Pomegranate, Banana, Grapes, Lime and Papaya are also cultivated extensively in the district. The allied Agricultural enterprises like Dairy, Poultry, Farm Forestry, Sheep and Goat Rearing, Inland Fisheries, Sericulture are also practiced.

3.1.7 Gadag District

The district is located in northern Karnataka North latitude between 75° and 44 °.822' and East longitude between 16 ° and 46 °.208'. The district comprising of six taluks viz.,

Gadag, Mundragi, Naragund, Ron and Shirahatti. The total geographical area of the district is 4,65,715 ha. . According to the 2011 census Bagalkot district has a population of 10,64,570 out of the total population 77.6 per cent of the population is literate 75.12 per cent. The district generally has a normal rainfall of 613.6 mm per annum. Total geographical area of the Gadag District is 4,65,715 ha out of this 32,614 ha is under forest, 10,481 ha land is not available for cultivation, 11,628 ha is uncultivable land and total net sown area is 3,84,731 ha. The cropping pattern in Gadag district (Table 3.1) during 2015-16, indicated that out of the net cultivated area, pulses formed the major component with 41.52 per cent followed by cereal (23.19 %), oilseeds (18.02 %). commercial crop (12.11 %), fruits and vegetables (4.99 %) and spices (0.162). Major cereals crops grown are maize and jowar. Major pulses grown are bengalgram and greengram. Major oilseeds grown are ground nut, sunflower, safflower and sessamum. Major commercial crops grown are sugarcane and cotton.

3.2 Sampling Procedure

Multistage random sampling method was used for selection of district, taluks and villages. The samples namley redgram, bengalgram and greengram growers 360 samples were randomly selected from the selected village (Table.3.2).

3.2.1 Selection of crops

The major pulses crops were chosen based on highest area. The redgram, bengalgram and greengram together accounted 88.34 per cent of area and 81.98 per cent of production of pulses in the state (Table.3.3). Hence, these three crops were selected based on highest area.

3.2.2 Selection of districts

Karnataka, one of the major pulses growing states in the country was selected purposively for the study. All most all type of pulses are grown in the state. Based on the highest area three major pulses were considered for the present study, namely, Redgram (24.01 %), Bengalgram (54.24 %) and Greengram (12.44 %). For each crop two districts having largest area under the pulses were selected. The two district selected were Bagalkot and Vijayapura for redgram, Dahrwad and Belagavi for bengalgram, Gadag and Haveri for greengram (Table.3.4).

3.2.3 Selection of taluks

Out of five taluks of Vijayapura district, Sindagi and Muddebihal taluk and out of six taluks of Bagalkot district, Bagalkot and Hunugund taluks were selected for redgram crop.

Table 3.2: Distribution of sample farmers selected for the study

Sl.No	Crops	Districts	Taluks	Villages	Samples	Total Samples
1.	Redgram	Vijayapura	Sindagi	V-1	10	60
				V-2	10	
				V-3	10	
			Muddebihal	V-1	10	
				V-2	10	
				V-3	10	
		Bagalkot	Bagalkot	V-1	10	60
				V-2	10	
				V-3	10	
			Hunugund	V-1	10	
				V-2	10	
				V-3	10	
2.	Bengalgram	Dharwad	Navalgund	V-1	10	60
				V-2	10	
				V-3	10	
			Dharwad	V-1	10	
				V-2	10	
				V-3	10	
		Belagavi	Athani	V-1	10	60
				V-2	10	
				V-3	10	
			Savadati	V-1	10	
				V-2	10	
				V-3	10	
3.	Greengram	Gadag	Ron	V-1	10	60
				V-2	10	
				V-3	10	
			Gadag	V-1	10	
				V-2	10	
				V-3	10	
		Haveri	Hangal	V-1	10	60
				V-2	10	
				V-3	10	
			Savanur	V-1	10	
				V-2	10	
				V-3	10	
	Total				**360**	**360**

Table 3.3: Crop wise area and production of different pulses in Karnataka during 2015-16

Sl.No	Crops	Area (ha)	%	Production (t)	%
1	Redgram	657354	24.01	241626	23.72
2	Bengalgram	1420431	51.89	552442	54.24
3	Greengram	340527	12.44	40983	4.02
4	Blackgram	82234	3.00	20640	2.03
5	Horsegram	53718	1.96	24923	2.45
6	Field Bean (*Avare*)	48970	1.79	67333	6.61
7	Cowpea	67727	2.47	28064	2.76
8	Other Pulses	66539	2.43	42544	4.18
	Total	**2737500**	**100.00**	**1018555**	**100.00**

Source: Fully revised estimates of principal crops in Karnataka 2016, DES Publication

Table 3.4: District wise area and production of different pulses in Karnataka during 2015-16

Sl.No	Districts	Redgram				Bengalgram				Greengram				Total Pulses			
		Area (ha)	(%)	Production (tonnes)	(%)	Area (ha)	(%)	Production (tonnes)	(%)	Area (ha)	(%)	Production (tonnes)	(%)	Area (ha)	(%)	Production (tonnes)	(%)
1	**Bagalkot**	**4,547**	**0.69**	**1,261**	**0.52**	**133,071**	**9.37**	**62,577**	**11.3**	**21,067**	**6.19**	**1,081**	**2.64**	**159,698**	**5.834**	**65,253**	**6.41**
2	Bangalore Urban	463	0.07	170	0.07	9	0.00	3	0.0	14	0.00	2	0.00	1,012	0.037	275	0.03
3	Banglore rural	1,416	0.22	527	0.22	87	0.01	34	0.0	3	0.00	-	0.00	3,008	0.110	817	0.08
4	**Belagavi**	**5,075**	**0.77**	**1,143**	**0.47**	**104,263**	**7.34**	**31,102**	**5.6**	**32,378**	**9.51**	**2,891**	**7.05**	**151,012**	**5.517**	**36,485**	**3.58**
5	Bellary	2,931	0.45	1,041	0.43	75,356	5.31	48,680	8.8	285	0.08	41	0.10	80,030	2.924	50,464	4.96
6	Bidar	67,453	10.3	29,797	12.3	47,060	3.31	11,534	2.1	29,955	8.80	2,675	6.53	170,529	6.230	86,533	8.50
7	**Vijayapura**	**135,696**	**20.6**	**39,576**	**16.4**	**322,020**	**22.67**	**77,398**	**14.0**	**4,173**	**1.23**	**159**	**0.39**	**462,263**	**16.888**	**147,215**	**11.51**
8	Chamarajanagara	542	0.08	141	0.06	3,202	0.23	1,886	0.3	4,375	1.28	943	2.30	48,741	1.781	12,156	1.19
9	Chikkaballapura	7,685	1.17	3,780	1.56	122	0.01	47	0.0	-	0.00	-	0.00	8,052	0.294	3,896	0.38
10	Chikamagalore	754	0.11	277	0.11	13,249	0.93	15,985	2.9	4,914	1.44	1,993	4.86	27,603	1.008	24,148	2.37
11	Chitradurga	9,587	1.46	9,581	3.97	40,431	2.85	25,773	4.7	5,410	1.59	1,614	3.94	57,637	2.106	37,814	3.71
12	Dakshina K	-	0	-	0	-	0.00	-	0.0	-	0.00	-	0.00	390	0.014	181	0.02
13	Davanagere	8,373	1.27	5,361	2.22	1,177	0.08	416	0.1	65	0.02	8	0.02	10,225	0.374	6,153	0.60
14	**Dharwad**	**1,002**	**0.15**	**267**	**0.11**	**91,455**	**6.44**	**21,547**	**3.9**	**37,894**	**11.13**	**4,284**	**10.45**	**133,124**	**4.863**	**37,025**	**3.64**
15	**Gadag**	**1,651**	**0.25**	**289**	**0.12**	**110,163**	**7.76**	**29,827**	**5.4**	**80,133**	**23.53**	**2,436**	**5.94**	**192,864**	**7.046**	**32,757**	**3.22**
16	Gulbarga	261,076	**39.7**	94,993	39.3	196,138	13.81	83,849	15.2	25,063	7.36	6,072	14.82	505,439	18.465	192,395	18.89
17	Hassan	1,915	0.29	990	0.41	3,594	0.25	2,267	0.4	9,046	2.66	1,968	4.80	30,948	1.131	8,122	0.80
18	**Haveri**	**1,739**	**0.26**	**831**	**0.34**	**1,991**	**0.14**	**751**	**0.1**	**907**	**0.27**	**253**	**0.62**	**12,540**	**0.458**	**3,490**	**0.34**
19	Kodagu	-	0	-	0	-	0.00	-	0.0	-	0.00	-	0.00	-	0.000	-	0.00
20	Kolar	2,637	0.4	1,816	0.75	-	0.00	-	0.0	-	0.00	-	0.00	15,092	0.551	8,991	0.88
21	Koppal	11,637	1.77	3,969	1.64	89,794	6.32	27,895	5.0	18,323	5.38	783	1.91	140,279	5.125	64,498	6.33
22	Mandya	1,245	0.19	457	0.19	172	0.01	67	0.0	188	0.06	23	0.06	25,380	0.927	13,033	1.28
23	Mysore	2,774	0.42	1,181	0.49	1,052	0.07	795	0.1	12,379	3.64	4,445	10.85	116,631	4.261	47,413	4.66
24	Raichur	33,623	5.11	14,246	5.9	155,722	10.96	99,117	17.9	178	0.05	21	0.05	189,779	6.933	103,425	10.16
25	Ramanagar	3,557	0.54	2,774	1.15	9	0.00	3	0.0	1	0.00	-	0.00	7,916	0.289	7,502	0.74
26	Shivamogga	296	0.05	109	0.05	9	0.00	3	0.0	3	0.00	-	0.00	482	0.018	156	0.02
27	Tumkur	9,824	1.49	3,378	1.4	1,536	0.11	207	0.0	9,604	2.82	3,458	8.44	22,367	0.817	17,634	1.73
28	Udapi	-	0	-	0	-	0.00	-	0.0	-	0.00	-	0.00	183	0.007	114	0.01
29	Uttar K.	13	0	5	0	7	0.00	3	0.0	-	0.00	-	0.00	694	0.025	149	0.01
30	Yadgiri	79,846	12.1	23,666	9.79	28,742	2.02	10,676	1.9	44,169	12.97	5,833	14.23	163,294	5.966	40,318	3.96
	Total Pulses	**6,57,354**	**100**	**2,41,626**	**100**	**14,20,431**	**100.00**	**5,52,442**	**100.0**	**3,40,527**	**100.00**	**40,983**	**100.0**	**27,37,212**	**100**	**10,18,412**	**100.00**

Source: Final estimates of principal crops in Karnataka 2016, DES Publication

Similarly, Athni and Savadathi taluks from Belagavi district and Dharwad and Navalgund taluks from Dharwad district were selected for bengalgram crop. The primary data pertain to greengram crop was collected from Ron and Shirahatti from Gadag district and Savanur and Hanagal from Haveri district

3.2.4 Selection of villages

Based on the highest area under major pulses cultivation, three villages from each selected taluk were chosen. Thus, totally 36 villages from 12 taluks were selected for the study.

3.2.5 Selection of the growers

From each village 10 farmers growing major pulses were randomly selected. From each district 60 pulses growers were selected for each crop. Thus, for three crop, 360 growers were selected (Table.3.2) from 36 villages.

3.3 Nature and Source of data

3.3.1 Primary data

For evaluating the objectives of the study, the required data were collected through personal interview method with the help of pre-tested well structure schedule. The collected data pertained to agriculture year 2016-17. The general information about the size of the land holding, area under pulses cultivation, resources use pattern, labour use pattern and factor influencing supply of pulses cultivation and also constraints faced by farmers were collected from the sample respondent. The farmers were personally interviewed to ensure the data made available by them were appropriate, comprehensives and reasonably correct.

3.3.2 Secondary data

The time series data on area, production, productivity, import and export, population growth rate, demand etc., were collected from different secondary source (Table.3.5). The collected secondary information pertain to four major pulses crops, namely, bengalgram, redgram, greengram and blackgram because these four crops accounted 80.24 per cent of area and 80.49 per cent of production of pulses in the state (Table.3.6).

Table 3.5: Nature and source of secondary data

Sl.No	Nature of data	Source	Year
1.	Area, production and productivity of the principal crop in Karnataka	i) Karnataka at a glance	1980-2016
		ii) Brochure of fully revised estimation of principal crops in Karnataka, Directorate of economic and statistics, Bengaluru	1980-2016
2.	Area, Production and Productivity of the principal crop in India	i) Government of India, Department of Agriculture, Co-operation and farmers welfare	1980-2016
		ii) Indian Institute of pulses Research, Kanpur, Uttar Pradesh (India)	1980-2016
3.	Export and Import of Pulses	i) Department of Commerce	2001 -2016
		ii) India stat.Com	2001-2016
		iii) DGCIS website (www.dgciskol.nic.in)	2001-2016
4.	Population	i) Population census report 2001 to 2011	2001&2011

Table 3.6: Major pulses area and production of India during 2015-16

Sl.No	Major Pulses	Area (M.ha)	(%)	Production (Mt)	(%)
1	Bengalgram	9.93	39.31	7.06	43.18
2	Redgram	3.90	15.44	2.56	15.66
3	Blackgram	3.06	12.11	1.95	11.93
4	Greengaram	3.38	13.38	1.59	9.72
5	lentil	1.42	5.62	1.24	7.58
6	Other Pulses	3.57	14.13	1.95	11.93
	Total	**25.26**	**100.00**	**16.35**	**100.00**

Source: Ministry of Agriculture and farmer's welfare, DES, GOI. 2016

a. Amingad village

b. Amingad village

c. Agarkhed village

d. Balkundi village

e. Agarkhed village

f. Agarkhed village

Plate 1: Primary data collection from the farmer's respondent of redgram growers

a. Lokur village

b. Madanbhavi village

c. Lalgatti village

Plate 2: Primary data collection from the farmer's respondent of bengalgram growers

a. Shirahatti village

b. Shirahatti village

Plate 3: Primary data collection from the farmer's respondent of greengram

3.3.3 Selection of major pulses and major pulses producing states for comparison with Karnataka state

3.3.3.1 Selection of major pulses

The secondary data analysis pertain to growth in area, production, productivity, supply and demand gap, projection and export and import performance of the major pulses crop in India was chosen based on highest area under selected crops and the crops are redgram, bengalgram, greengram and blackgram. These four crops together accounted 80.24 per cent of area and 80.49 per cent of production of pulses in the country (Table.3.6).

3.3.3.2 Selection of major states

The growth in area, production and productivity analysis of major pulses crop were carried out for major pulses producing seven states namely, Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Andhra Pradesh (Including Telanaga state), Odisha and Tamil Nadu. These seven states together accounted 84.16 per cent of area and 80.91 per cent production of pulses in the country (Table 3.7) and these states were compared with Karnataka state.

3.3.4 Study period

In view of the limitation of data, the present study is restricted for a period of 36 years from 1980 to 2016 for all analytical purposes (Table.3.8). However, for better understanding of growth and development of pulses, the growth rates in area, production and productivity were compared for the period of 1980 to 2016 which was further divided into two sub periods: Period -I: (1980 to 1990), Period-II: (1991 to 2016). The year 1990 was taken as a base period point because of introduction of programme called *"Technology Mission on Oilseeds and Pulses (TMOP)"* To promote the pulses industry in India Wherein, Karnataka state has also covered. To examine the export performance, the data on export and import for the period from 1980 to 2016 was considered. The period 1980 to 2016 was further sub divided into two periods: (1) period -I: 1980 to 1990 (2) Period-II: 1991 to 2016 by taking 1991 as a cut-off point in view of liberalization of Indian economy to promote trade and export of agricultural commodities. However, the data on export and import of individual pulses selected for study pertained to the period from 2001 to 2016 for computing the growth in export and import.

Table 3.7: Major state wise area, production and productivity of pulses in India (2015-16)

SL.No	Major States	Area (M.ha)	(%)	Production (Mt)	(%)	Yield (kg/ha)
1	Madhya Pradesh	5.76	22.80	5.12	31.31	876
2	Rajasthan	3.87	15.32	1.95	11.93	580
3	Maharashtra	3.36	13.30	1.41	8.62	602
4	Karnataka	2.73	10.81	1.18	7.22	599
5	Uttar Pradesh	1.87	7.40	1.22	7.46	612
6	Andhra Pradesh	1.45	5.74	1.23	7.52	911
7	Odhisa	1.29	5.11	0.55	3.36	532
8	Tamil Nadu	0.93	3.68	0.57	3.49	852
9	Other states	4.00	15.84	3.12	19.08	-
	Total	**25.26**	**100.00**	**16.35**	**100.00**	**785**

Source: Ministry of Agriculture and farmer's welfare, DES, GOI. 2016

Table 3.8: Periods and range of secondary data used in the study

Particulars/Crops	Redgram	Bengalgram	Greengram	Blackgram	Total Pulses
Period-I					
Area	1980-1990	1980-1990	1980-1990	1980-1990	1980-1990
Production	1980-1990	1980-1990	1980-1990	1980-1990	1980-1990
Productivity	1980-1990	1980-1990	1980-1990	1980-1990	1980-1990
Quantity export	--	--	--	--	1980-1990
Quantity import	--	--	--	--	1980-1990
Period-II					
Area	1991-2016	1991-2016	1991-2016	1991-2016	1991-2016
Production	1991-2016	1991-2016	1991-2016	1991-2016	1991-2016
Productivity	1991-2016	1991-2016	1991-2016	1991-2016	1991-2016
Quantity export	2001-2016	2001-2016	2001-2016	2001-2016	2001-2016
Quantity import	2001-2016	2001-2016	2001-2016	2001-2016	2001-2016
Aggregate					
Area	1980-2016	1980-2016	1980-2016	1980-2016	1980-2016
Production	1980-2016	1980-2016	1980-2016	1980-2016	1980-2016
Productivity	1980-2016	1980-2016	1980-2016	1980-2016	1980-2016
Quantity export	2001-2016	2001-2016	2001-2016	2001-2016	2001-2016
Quantity import	2001-2016	2001-2016	2001-2016	2001-2016	2001-2016

The time series data on area, production, productivity, import and export etc were collected from secondary sources.

3.4 Analytical techniques employed

To fulfill the specific objectives of the study, based on the nature and extent of availability of data, the following analytical tool and techniques have been adopted to draw the meaning full interpretation and inferences.

3.4.1 Compound Growth rate analysis

3.4.2 Tabular analysis/Budgeting technique

3.4.3 Compound growth rate with normative approach

3.4.4 Principal component analysis

3.4.5 Multiple regression analysis

3.4.6 Garrett Ranking Technique

3.4.1 Compound Growth rate analysis

Growth rate in area, production, productivity, import and export of selected pulse crops were computed for a period of 36 years from 1980 to 2016 depending upon the availability of data. However, for import and export of individual pulses period from 2001-2016 was considered (Table.3.8).

The linear, log-linear, exponential and power functions are some of the important functional forms employed to study the growth rates. Different functional forms were tried in the past for working out the growth rates in area, yield and production by Chengappa (1981), Sikka *et al.* (1985) and Bieche *et al.* (1992). Some of the important forms tried were the linear growth model ($Y = a + bt$), exponential function ($Y = ab^t$) and quadratic function ($Y = a+bt+ct^2$). However, it was found that the exponential form of the function $Y_t = ab^t$ is the better and most frequently used one. In the present study, compound growth rates in area, production, productivity, import and exports of pulses were estimated by specifying the following relationship.

$$Y_t = ab^t U_t \quad \ldots\ldots\ldots\ldots \quad (1.1)$$

Where,

Y_t = area, production, productivity, quantity and value of pulses imported and exported in the year‘t’

t = year which takes value 1, 2, …….. n

U_t = disturbance term in year‘t’

‘a’ and ‘b’ are parameters to be estimated.

The equation (1.1) was transformed into log- linear form and written as:

$\log Y = \log a + t \log b + \log U_t$ …….. (1.2)

Equation (1.2) was estimated by using ordinary least square (OLS) technique.

Compound growth rate (g) was then estimated by the identity given in equation (1.3).

$$\hat{g} = (\hat{b}-1)\ 100 \quad \ldots\ldots\ldots\ldots \quad (1.3)$$

Where,

$\hat{g}$ = estimated compound growth rate in per cent per annum.

$\hat{b}$ = antilog of log b

The standard error of the growth rate was estimated and tested for its significance with‘t’ statistic.

3.4.2 Tabular analysis/Budgeting technique

The data collected were presented in the tabular form to facilitate easy comparison. This technique of tabular presentation was employed for estimating cost and returns, demand and supply of redgram, bengalgram, greengram and total pulses.

3.4.3 Compound growth rate with normative approach

Data on population were drawn from population census of 2001 and 2011 for the study area, state and country as a whole. The year wise data were worked out by interpolation method between these two censuses.

There are different approaches to workout demand for food grains Viz. (i) household consumption approach; (ii) normative consumption approach; (iii) behavioral approach; and (iv) absorption approach. In the present study based on the availability of data, normative consumption approach was used which is based on the requirement of food and nutrient contents of a balanced diet for a moderately active person life style.

Normative approach determines consumption levels by using normative requirements of pulses as recommended by the National Institute of Nutrition (NIN), Hyderabad, @ 14.60 and @ 23.73 kg/year/capita as basis and it is multiplied with the population to estimate the requirement for a particular year. The requirement towards seed, feed and wastage (SFW) assumed to be 12.5 per cent of the gross output is also added to arrive at total requirement i.e. Demand-I and Demand-II (Anon., 2011).

Demand-I = (NIN, Hyd. recommendation @14.60 kg/capita/year * population) + SFW

Demand-II = (NIN, Hyd. recommendation @23.73 kg/capita/year * population) + SFW

The study conducted by Rajiv, R. and Verma, P., 2007, IIPR, Kanpur estimated 7.95 per cent of output as a post harvest losses during storage, transportation, etc. Accordingly, some per cent of losses (7.95 %) were taken into consideration for estimating total supply of pulses in the study area, Karnataka state and country as a whole. However, at the country level supply of pulses were worked out considering net import plus total production minus post harvest losses.

i.e. Supply=Total production +Net import - Post harvest losses.

Projection of demand and supply:

The projections are based on growth in population, change in productivity level, etc. The domestic demand projections for pulses was arrived at by adding of direct demand (Consumption demand=growth in population * per capita recommendation) and indirect demand (Requirement of seed, feed and industrial wastage @ 12.5 % of the gross output). The domestic demand was projected under two scenario of per capita recommendation. The below mentioned scenario's are used by Ali (2012) and Amarender Reddy (2009) for estimating demand for pulses in the study.

i) Consumption requirement on normative basis for sedentary life recommended by National Institute of Nutrition, Hyderabad for @ 14.60 kg/capita/year was multiplied with growth rate of population.

ii) Consumption requirement on normative basis for moderate life recommended by National Institute of nutrition Hyderabad @ 23.73 kg/year/capita was multiplied with growth rate of population.

3.4.4 Principal component analysis

The technique of factor analysis, which is a multivariate statistical technique, was employed to ascertain the major factors influencing supply of pulses in the study area. Factor analysis was used in data reduction by identifying a small number of factors, which explain most of the variance observed in a much larger number of variables. In this study, principal component analysis was used because it has some advantages over other techniques (Mittal & Paul, 2004). In principal component analysis, a set of original variables are transformed into a new set of uncorrelated variables called principal components. The new variables are linear functions of the original variables. The objective is to find out only a few components, which account for most of the variation in the original set of data. The principal component (Pi) is determined as follows.

$$P_i = a_{1j}Z_1 + a_{2j}Z_2 + a_{3j}Z_3 + \ldots\ldots + a_njZ_n$$

Where,

P_i = 1 to n, are new uncorrelated components,

a_{ij} = i = 1 to n, and j = 1 to n, the Z coefficients are factor loadings,

Z_i = 1 to n, are observed variables as standardized by dividing $(X- \overline{X})$ by its standard deviation (σx).

Each component makes a maximum contribution in descending order to the sum of the variance of the variables. Normally, the first principal component contributes a maximum to their total variance; the second principal component contributes to the residual variance and so on. The sum of the variance of all the principal components is equal to the sum of the variance of the original variables. Sum of square of factor loadings ($a_{21}j + a_{22}j + a_{23}j + \ldots\ldots + a_2n_j$) is called variance explained by factor (j). This is also known as Eigen value (λ). The percentage contribution of P_i in the total variance of original variables (X_i) is given by,

$$P_i = \lambda/n \times 100 \quad (n = \text{number of variables})$$

The principal component analysis was carried out to identify important variables. The package provided output such as correlation matrix, initial factor matrix and rotated factor matrix. Initial factor matrix generally fails to be meaningfully interpretable. Therefore, rotated factor matrix was used for identification of factors. Varimax rotation (an orthogonal method), the most common rotation method was used for rotation. This method tries to produce factors

that are as simple as possible by maximizing the variance of the loadings across the items within factors. For the selection of factors eigen values more than one were taken into account. Identification of and naming of any factor would be a subjective conclusion. Generally, the heavy loaded key variables would be considered as basis for identification and naming of dimension. In order to assign some meaning to factor solution a minimum level of significance for factor loading 0.5 was taken. Higher the value of factor loading of the variable on a particular factor, greater would be the association with that factor. In pulse production, 20 variables were considered as major factors influencing supply of pulses in the study area. These variables were identified after careful investigation of the earlier studies conducted on different pulses crops. The selected variables are given below.

Sl.No.	Label	Particulars
1	P1	Rainfall during sowing/pre-sowing rainfall(mm)
2	P2	RH during flowering (%)
3	P3	Rainfall during pod formation (mm)
4	P4	Rainfall during flowering(mm)
5	P5	Weedicide (ml)
6	P6	Availability of Labour (Shortage, Normal)
7	P7	Quantity of Labour used (Mandays)
8	P8	Bullock Labour (Pairs)
9	P9	Machines Labour (Hrs.)
10	P10	Seeds (kg.)
11	P11	Growth regulators(ml)
12	P12	Micro Nutrients (kg.)
13	P13	Farm Yard Manure (t.)
14	P14	Pest incidence (%)
15	P15	Disease incidence (%)
16	P16	Vermicompost (q.)
17	P17	Fertilizers (q.)
18	P18	Market price (High, Low)
19	P19	Varieties used (HYV, Local)
20	P20	Area under crop(Acres)

3.4.5 Multiple regression analysis

To ascertain the response of production to a given change in selected inputs as indicated by principal component analysis, following multiple linear regression equation was employed.

$$Y = a+b_1X_1+b_2 X_2+b_3 X_3+b_4 X_4+b_5 X_5+b_6 X_6+b_7D_1+b_8D_2+U_i \ldots\ldots (2.1)$$

Where,

Y = Output

a = Intercept

bi's = Regression coefficients of i^{th} input

X_1 = Area (acres)

X_2 = Fertilizers (Kg.)

X_3 = Seeds (Kg.)

X_4 = Pest incidence (%)

X_5 = Disease incidence(%)

X_6 = Rainfall during sowing (mm)

D_1 = Variety (Dummy variable, D1= 1 improved variety,D1= 0 for local)

D_2 = Market price (Dummy variable D2= 1 More than MSP, D2 =0 Less than MSP)

U_i = Error term

The regression co-efficient were tested for their significance using 't' test at chosen level of significance while the function as a whole was tested using the 'F' test.

$$t = \frac{b_i}{SE\,(b_i)} \quad \ldots\ldots (2.2)$$

Where,

b_i = Regression co-efficient of i^{th} input

SE (b_i) = Standard error of i^{th} input

$$F = \frac{R^2/P}{(1-R^2) / (n - 1 - P)} \quad \ldots\ldots (2.3)$$

Where·

R^2 = Co-efficient of multiple determination (unadjusted)

P = Number of parameters in the sample

n = Number of observations in the sample

To test the goodness of fit of the estimated function, the adjusted co-efficient of multiple determination (R^2) was calculated using the formula.

$$\bar{R}^2 = \frac{\text{Regression sum of squares (RSS)}}{\text{Total sum of squares (TSS)}}$$

$$\bar{R}^2 = \frac{[1-(1-R^2)]}{[(n-1)/(n-P)]} \quad \text{..... (2.4)}$$

Variables in the equation 2.4 are same as defined in equation 2.3

3.4.6 Garrett Ranking Technique

To know the acceptance of farmers and constraints in production and marketing of pulses Garrett's ranking techniques was used. Basically it gives the change of orders of constraints and advantages into numerical scores. The major advantages of this technique as compared to simple frequency.

Frequency distribution is that the constraints and advantages are arranged based on their importance from the point of view of respondents. Hence the same number of respondents on two or more constraints may have been given different rank (Kumar and Pandey, 1999).

Garrett's formula for converting ranks into per cent was given by

$$\text{Per cent position} = 100^{*} (R_{ij}-0.5)/N_j$$

Where,

R_{ij} = rank given for i^{th} factor by j^{th} individual

N_j = number of factors ranked by j^{th} individual

The per cent position of each rank then converted into scores referring to the Table given by Garrett and Woodswordh (1996). For each factor, the scores of individual respondents were added together and divided by the total number of the respondents for whom scores were added. These mean scores for all the factors were arranged in descending order, ranks were given and most important factors were identified.

Garrett's ranking technique was adopted for studying problems faced by farmers in production and marketing.

3.5 Definition of terms and concepts used

Demand-I: Per capita consumption recommended by NIN, Hyderabad @ 14.60 kg * population + seed feed and wastage (SFW).

Demand-II: Per capita consumption recommended by NIN, Hyderabad @ 23.73 kg* population plus seed feed and wastage (SFW).

Indirect Demand-I: Seed, Feed and wastage (SFW) @ 12.5% of gross output of Direct Demand-I

Indirect Demand-II: Seed, Feed and wastage (SFW) @ 12.5% of gross output of Direct Demand-II

Supply: Total production minus post harvest losses @ 7.95 per cent except India where net import is also added to the total production.

Gap-I: Demand-I (NIN recommendation @ 14.60 kg * population + SFW) minus supply.

Gap-II: Demand-I (NIN recommendation @ 23.73 kg * population + SFW) minus supply.

Direct Demand-I: NIN, Recommendation (14.60 kg/Year/Capita) * Population

Direct Demand-II: NIN, Recommendation (23.73 kg/Year/Capita) * Population

Total Demand-I: Direct Demand-I+ Indirect Demand-I

Total Demand-II: Direct Demand-II+ Indirect Demand-II

Eigen values: Measures the amount of variation explained by each principal component (PC) and will be largest for the first PC and smaller for the subsequent PCs. An eigen value greater than one indicates that PCs account for more variance than accounted by one of the original variables in standardized data. This is commonly used as a cut off point for which PCs are retained.

Factor loading: Means correlation coefficients between the PC scores and the original variables. It measures the importance of each variable in accounting for the variability in the PC. It is possible to interpret the first few PCs in terms of 'overall' effect or a 'contrast' between groups of variables based on the structures of PC loadings.

Variable costs: The variable costs include cost on seeds, manure, fertilizer, wages of human and bullock labour, plant protection chemicals, interest on working capital and repairs and maintenance charges.

Seeds: The cost of purchased seeds was based on the actual amount paid by the respondents. The farm-produced seeds were imputed based on the prices which prevailed at the time of sowing.

Farm yard manure: The prevailing price per tonnes was used to impute the value of a farm yard manure produced at the farm.

Fertilizers and plant protection chemicals costs: The cost of fertilizers and plant protection chemicals were based on the actual prices paid by the sample farmer including the cost of transportation and other incidental charges, if any.

Labour cost: The cost of hired labour was calculated at the prevailing wage rates paid per day (8 hours) in the study area for men, women, bullock pairs and machine labour during the study period. The same wage rates were imputed for family labour. While expressing labour in mandays, women days were converted into mandays by taking 1.33 women days equal to one manday.

Interest on working capital: The working capital consists of the expenditure on labour, seeds, farm yard manure, growth regulators, fertilizers and plant protection chemicals. The interest on operational capital was calculated at the rate of 15.00 per cent per annum (the rate at which commercial banks advance short-term and medium-term loans) for 50 per cent of the operational capital since this capital was used at different stages of crop production and was apportioned to the crop based on the duration of crop.

Repair and maintenance charges: Repair and maintenance charges of implements and machinery used in the cultivation were computed on the basis of actual expenses incurred by the respondents. The amount of these expenses was apportioned to these crops based on the acreage.

Fixed costs: The fixed cost includes depreciation on farm implements and machinery, interest on fixed capital, land revenue and rental value of land.

Depreciation Charges: Depreciation on each capital equipment and machinery owned by the farmers and used for dry land cultivation was calculated for each individual farmer separately based on the purchase value and using the straight line method. The average life of the asset as indicated by each farmer was used in the computation of the depreciation. The average value of the asset after its useful life as estimated by respondents was considered for

calculation of junk value. The depreciation cost of each equipment was apportioned to the crop based on its percentage use.

Interest on fixed capital: Interest on fixed capital was calculated at the rate of 8.00 per cent, as the fixed deposits in commercial banks would fetch this rate of interest. The items considered under fixed capital were implements and machinery. Interest was considered on the value of these assets after deducting the depreciation for the year. No interest was charged on the land value since the rental value of owned land was considered. Then the amount so calculated was apportioned to the crop acreage based on duration of the crop.

Land revenue: Land revenue was taken at the rates levied by the government (Rupees 28 per acre)

Rental value of land: Rental value of land was calculated at the prevailing rate per acre (20 per cent of the gross revenue) per annum in the study area and was apportioned to the respective crop.

Results

4. RESULTS

Keeping in view the objectives of the study, the data collected were analysed employing various appropriate statistical tools and major findings are presented under following sub heads.

4.1 Socio-economic characteristics of sample farmers

4.2 Growth in area, production and productivity of major pulses

4.3 Demand and supply of total pulses

4.4 Total demand projection of total pulses

4.5 Export and import performance of total pulses

4.6 Cost and returns

4.7 Constraint faced by farmers in production of pulses

4.8 Factors influencing the supply of pulses

4.1 Socio-economic characteristics of sample farmers

The data presented in Table 4.1 shows the socio economic characteristics of sample respondents.

The average family size in Dharwad district was 5 members and the average age of the family head was 51 year old. From the total respondent, 20 per cent were illiterate, 46.67 per cent were educated up to primary level, only 5 per cent of the respondent were graduated. The study also indicated that 15 per cent of the respondents were the members of social organization like Panchayath Raj institution and village education committee. Agriculture constituted the primary occupation of 70 per cent of respondent. Majority of them were medium farmers having 2.5 to 5 hectare of land.

In case of Belagavi district, the average age of the family head was 44 year old and the average family size was 6 members. In Belagavi district, out of 60 respondent only 13.33 per cent were illiterate and remaining 87.66 per cent were literate. Among literate farmers highest farmer perceived education up to middle class. The social participation revealed that 6.67 per cent farmers were participated in village education committee and 1.67 per cent farmer participated in Panchayath Raj institution. Majority of the respondent were medium farmers

Table 4.1: Socio-economic characteristics of sample farmers

Sl.No	Particulars	Dharwad		Belagavi		Vijayapura		Bagalkot		Gadag		Haveri	
		n=60		n=60		n=60		n=60		n=60		n=60	
		No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
1	**Average age**	51		44		42		38		52		46	
2	**Avg. Family size**	5		6		7		6		6		6	
3	**Education**												
a	Illiterate	12	20.00	8	13.33	19	31.67	14	23.33	18	30.00	21	35.00
b	Primary	28	46.67	16	26.67	27	45.00	8	13.33	16	26.67	18	30.00
c	Middle	10	16.67	18	30.00	8	13.33	12	20.00	8	13.33	11	18.33
d	Secondary	7	11.67	12	20.00	4	6.67	14	23.33	12	20.00	7	11.67
e	Graduate	3	5.00	6	10.00	2	3.33	12	20.00	6	10.00	3	5.00
	Total	**60**	**100.00**	**60**	**100.00**	**60**	**100.00**	**60**	**100.00**	**60**	**100.00**	**60**	**100.00**
4.	**Social participation**												
a	Panchayath Raj Institution	3	5.00	1	1.67	0	-	2	3.33	-	-	1	1.67
b	Village education committee	6	10.00	4	6.67	3	5	8	13.33	5	8.33	6	10.00
5	**Landholding**												
a	Marginal (< 1 ha)	10	16.67	7	11.67	11	18.33	9	15.00	13	21.67	15	25.00
b	small (up to 2 hectare)	16	26.67	11	18.33	17	28.33	12	20.00	20	33.33	16	26.67
c	Medium (2-5 to 5 Hectare)	22	36.67	31	51.67	22	36.67	27	45.00	19	31.67	23	38.33
d	Large (More than 5 hectare)	12	20.00	11	18.33	10	16.67	12	20.00	8	13.33	6	10.00
6	**Occupation**												
a	Agriculture	42	70.00	49	81.67	39	65.00	51	88.00	46	76.67	43	71.67
b	Agriculture + Subsidiary	18	30.00	11	18.33	21	35.00	09	15.00	14	23.33	17	28.33

Note: Average values are rounded off to near value

(51.67 %) having 2.5 to 5 hectare of land. Agriculture constituted the primary occupation of 81.67 per cent of respondent.

The socio economic characteristics of Vijayapura district revealed that (Table 4.1). The average age of the family head was 42 year old and the average family size was 7 members. The total respondent of Vijayapura District was 60, out of which 31.67 per cent farmers were illiterate and only 3.33 per cent of farmers perceived the graduation. The study also revealed that only 5 per cent of the respondent were the members of social organization like Panchayath Raj institution and village education committee. Agriculture constituted the primary occupation of 65 per cent of respondent. Majority of them were medium farmers (36.67 %) having 2.5 to 5 hectare of land.

In the case of Bagalkot district, the average age of the family head was 38 year old and the average family size was 6 members. In Bagalkot district, out of 60 respondent 23.33 per cent were illiterate and remaining 76.77 per cent were literate. Among literate farmer highest farmer perceived education up to secondary class (23.33 %). The social participation revealed that 13.33 per cent farmers were participated in village education committee and 3.33 per cent farmer participated in Panchayath Raj Institution. Majority of the respondent were medium farmers (45 %) having 2.5 to 5 hectate of land. Agriculture constituted the primary occupation of 88 per cent of respondent.

The average family size in Gadag district was 6 members and the average age of the family head was 52 year old. Out of the total respondent(n=60), 30 per cent were illiterate, 26.67 per cent were educated up to primary level and 10 per cent of the respondent were perceived graduation. The study also revealed that 8.33 per cent of the respondent were the members of social organization like Panchayath Raj institution and village education committee. Agriculture constituted the primary occupation of 76.66 per cent of respondent. Majority of them were small farmers (33.33 %) having up to 2 hectare.

The socio economic characteristics of Haveri district revealed that (Table 4.1). The average age of the family head was 46 year old and the average family size was 6 members. The total respondent of Haveri district was 60, out of which 35 per cent farmers were illiterate and only 5 per cent of farmers perceived the graduation. The study also revealed that only 11.67 per cent of the respondents were the members of social organization like Panchayath Raj institution and village education committee. Agriculture constituted the primary

occupation of 71.67 per cent of respondent. Majority of them were medium farmers (38.33%) having 2.5 to 5 hectare of land.

4.2 Growth in area, production and productivity of pulses

4.2.1 Growth rate of area, production and productivity of major pulses in study area

The results of compound growth rate analysis of area, production and productivity of individual as well as total pulses in the study area are presented in Table 4.2 to 4.3 (Fig. 4 to 9).

4.2.1.1 Redgram

In the case of Dharwad district, the growth rate in area, production and productivity were found positive in all the period except area in period-II (-2.75 %) and over all period (-0.44 %). While, growth in production and productivity found significant in all the period except period-II (1.80 %) the production was not found significant. In Belagavi district, growth rate in area and production showed negative trend and same is reflected in the growth in overall period. The growth in production (-0.20 %) marginally declining and the growth in area (-2.41 %) was found negative and significant. However, the productivity of redgram was significantly increasing in all the period.

The area, production and productivity of pulses in Vijayapura district was found positive in all the periods and it is pertinent to note that growth in area (6.72 %), production (10.32 %) and productivity (2.70 %) was significantly increasing and showed positive direction in overall period. In the case of Bagalkot district, except the productivity in period-I (1.05 %) the area, production and productivity of redgram showed negative in all the period. In Gadag district, growth rate in area, production and productivity showed positive in all the period and found significant. It is important to highlight that the production (4.50 %) of redgram was considerably increasing due to significant increases in productivity (2.68 %).

In the case of Haveri district, the growth in productivity was found to be positive in all the period but the growth in area and production was negative growth in all the period. However, the production (-7.33 %) is declining significantly due to decline in area (-5.82 %).

4.2.1.2 Bengalgram

Dharwad district showed positive growth in area (0.29 %) in period-I, Period-II (2.84 %) and overall period (0.37 %). The growth rates pertaining to production Period-II registered

Table 4.2: Growth rate of area, production and productivity of major pulses in study area

(Per cent/annum)

Crops	Particulars	Dharwad			Belagavi			Vijayapura		
		A	P	Y	A	P	Y	A	P	Y
Redgram	Period -I	1.06**	1.21*	3.00**	-2.12**	-0.84	1.22*	3.45**	8.25***	7.31**
	Period-II	-2.75**	1.80	1.73*	-4.84***	-1.95	3.03	10.45***	16.49***	4.19***
	Over all	-0.44	1.67**	1.60**	-2.41***	-0.20	2.49**	6.72***	10.32***	2.70***
Bengalgram	Period -I	0.29	-0.35	-0.64	-0.51	1.23	1.75	1.22	2.04**	3.66**
	Period-II	2.84	2.47	-0.43	2.19	0.36	-1.78	4.73**	5.83**	-1.76
	Over all	0.37	-0.63	-0.74	1.07	-0.10	-1.17**	4.65***	3.20	-1.38
Greengram	Period -I	3.08	1.56	-1.47	-0.37	0.92	1.29	3.36**	2.08*	-1.23
	Period-II	-0.59	-1.73	-1.14	-1.21	-2.99	-1.80	-6.25*	-12.13***	-6.27***
	Over all	0.49	-0.80	-1.29*	0.10	-1.28	-1.38*	-3.66***	-7.29***	-3.78***
Blackgram	Period -I	-0.23	-2.51	-2.28	4.37*	-3.11	-7.17***	-	-	-
	Period-II	3.66***	3.61	-0.05	2.05*	0.54	-1.47	-0.09	0.44	0.54
	Over all	-1.59*	-2.14	-0.55	1.02*	1.30*	0.26	-0.09	0.44	0.54
Total Pulses	Period -I	1.12	1.20	0.07	-0.51	-0.53	-0.02	1.50	4.02***	8.93***
	Period-II	2.02***	4.77***	2.68**	0.69	-1.15	-1.83**	6.39***	9.74***	3.14*
	Over all	0.68*	2.16***	1.47**	0.66*	-0.64	-1.29***	3.94***	4.93***	4.99***

Note: Period-I = 1980 to 1990, Period-II =1991 to 2016 and Over all = 1980 to 2016

Period –I Blackgram data pertain to Vijayapura is not documented by the DES

A: Area, P: Production, Y: Yield (Productivity)

***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.

Table 4.2: Contd…

(Per cent/annum)

Crops	Particulars	Bagalkot			Gadag			Haveri		
		A	P	Y	A	P	Y	A	P	Y
Redgram	**Period -I**	-5.21**	-3.65	1.05	7.05***	9.26**	2.07	-4.63***	-2.15	0.41
	Period-II	-1.59	-4.25	-1.94	1.01	3.32**	3.31***	-8.25***	-11.09***	0.01
	Over all	-2.24**	-4.49***	-2.13**	1.76***	4.50***	2.68***	-5.82***	-7.73***	0.11
Bengalgram	**Period -I**	-4.79***	-10.83***	-5.70***	9.45	13.60*	3.39	5.40**	11.12**	5.42
	Period-II	6.21**	5.99**	-0.21	3.93	5.07*	1.10	-0.67	-1.99	-1.33*
	Over all	2.23	2.47	0.23	4.61***	6.15***	1.47*	1.45**	1.54**	0.08
Greengram	**Period -I**	1.87	13.16*	11.09**	0.56	7.61*	7.02**	0.96	5.42*	4.42
	Period-II	1.17	-3.60-	-4.72	2.08*	-0.39	-3.11	-7.43	-6.50***	1.00
	Over all	0.89	-2.07	-2.94*	1.29	0.08	-1.19	-4.10	-3.09	1.04
Blackgram	**Period -I**	-	-	-	-	-	-	-	-	-
	Period-II	3.05	7.83	6.81	6.01	11.66	5.33	-13.03***	-12.48***	1.68
	Over all	3.05	7.83	6.81	6.01	11.66	5.33	-13.03***	-12.48***	1.68
Total Pulses	**Period -I**	-1.78***	-2.06**	-0.28	-2.00	-3.24	-1.26	0.27	2.88***	2.60
	Period-II	3.20***	2.99**	-0.20	3.86***	5.10***	1.18**	2.17**	3.66*	1.82
	Over all	1.18**	0.65	-0.51	1.55***	2.30***	0.73**	1.18	1.02*	0.88

Note: Period-I = 1980 to 1990, Period-II =1991 to 2016 and Over all = 1980 to 2016

Period –I Blackgram data pertain to Bagalkot, Gadag and Haveri is not documented by the DES

A: Area, P: Production, Y: Yield (Productivity)

***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.

Table 4.3: Direction of growth in area, production and productivity of major pulses in study area

Districts	Particulars	Directions	Period-I	Period-II	Over All
Dharwad	Area	Positive	Redgram, Bengalgram, Greengram and Total Pulses	Bengalgram, Blackgram*** and Total pulses***	Bengalgram, Greengram and Total Pulses
		Negative	Blackgram	Redgram** and Greengram	Redgram and Blackgram*
	Production	Positive	Redgram*, Greengram and Total Pulses	Redgram, Bengalgram, Blackgram and Total Pulses***	Redgram** and Total Pulses***
		Negative	Bengalgram and Blackgram	Greengram	Bengalgram, Greengram and Blackgram
	Productivity	Positive	Redgram** and Total Pulses	Redgram* and Total Pulses**	Redgram** and Total Pulses**
		Negative	Bengalgram, Greengram and Blackgram	Bengalgram, Greengram and Blackgram	Bengalgram, Greengram* and Blackgram
Belagavi	Area	Positive	Redgram** and Blackgram*	Bengalgram, Blackgram* and Total Pulses	Bengalgram, Greengram, Blackgram* and Total Pulses*
		Negative	Bengalgram, Greengram and Total Pulses	Redgram*** and Greengram	Redgram***
	Production	Positive	Bengalgram and Greengram	Bengalgram and Blackgram	Blackgram
		Negative	Redgram, Blackgram and Total Pulses	Redgram, Greengram and Total Pulses	Redgram, Bengalgram, Greengram and Total Pulses
	Productivity	Positive	Redgram**, Bengalgram and Greengram	Redgram	Redgram** and Blackgram
		Negative	Blackgram and Total Pulses	Bengalgram, Greengram, Blackgram and Total Pulses**	Bengalgram**, Grengram* and Total Pulses***

Note: Period-I = 1980 to 1990, Period-II =1991 to 2016 and Over all = 1980 to 2016

***Significant at 1% level, **Significant at 5% level and *Significant at 10% level..

Table 4.3: Contd…

Districts	Particulars	Directions	Period-I	Period-II	Over All
Vijayapura	**Area**	Positive	Redgram**, Bengalgram, Greengram** and Total Pulses	Redgram***, Bengalgram** and Total Pulses***	Redgram***, Bengalgram** and Total Pulses***
		Negative	-	Greengram* and Blackgram	Greengram** and Blackgram
	Production	Positive	Redgram***, Bengalgram**, Greengram* and Total Pulses	Redgram***, Bengalgram**, Blakgram* and Total Pulses***	Redgram***, Bengalgram, Blackgram and Total Pulses***
		Negative	-	Greengram***	Greengram***
	Productivity	Positive	Redgram**, Bengalgram** and Total Pulses***	Redgram***, Blackgram and total Pulses*	Redgram***, Blackgram and Total Pulses***
		Negative	Greengram	Bengalgram and Blackgram	Bengalgram and Greengram
Bagalkot	**Area**	Positive	Greengram	Bengalgram**, Greengram, Blackgram and Total pulses***	Bengalgram, Greengram, Blackgram and Total pulses**
		Negative	Redgram, Bengalgram and Total Pulses**	Redgram	Redgram**
	Production	Positive	Greengram*	Bengalgram**, Blackgram and Total Pulses**	Bengalgram, Blackgram and Total Pulses
		Negative	Redgram, Bengalgram and Total Pulses**	Redgram and Greengram	Redgram*** and Greengram
	Productivity	Positive	Redgram and Greengram**	Blackgram	Bengalgram and Blackgram
		Negative	Bengalgram*** and Total Pulses	Redgram, Bengalgram, Greengram and Total Pulses	Redgram, Greengram and total Pulses

Note: Period-I = 1980 to 1990, Period-II =1991 to 2016 and Over all = 1980 to 2016

***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.

Table 4.3: Contd…

Districts	Particulars	Directions	Period-I	Period-II	Over All
Gadag	**Area**	Positive	Redgram***, Bengalgram and Greengram	Redgram, Bengalgram, Greengram*, Blackgram and Total Pulses***	Redgram***, Bengalgram***, greengram, Blackgram and Total Pulses***
		Negative	Total Pulses	-	-
	Production	Positive	Redgram**, Bengalgram* and greengram*	Redgram**, Bengalgram*, Blackgram and total Pulses***	Redgram***, Bengalgram***, greengram, Blackgram and total Pulses***
		Negative	Total Pulses	Greengram	-
	Productivity	Positive	Redgram, Bengalgram and Greengram***	Redgram***, Bengalgram, Blackgram and Total Pulses**	Redgram***, Bengalgram*, Blackgram and total Pulses**
		Negative	Total Pulses	Greengram	Greengram
Haveri	**Area**	Positive	Bengalgram**, Greengram and Total Pulses	Total Pulses**	Bengalgram** and Total Pulses
		Negative	Redgram	Redgram***, Bengalgram, Greengram and Blackgram***	Redgram***, Greengram and Blackgram***
	Production	Positive	Bengalgram, Greengram* and Total Pulses***	Total Pulses*	Bengalgram** and total Pulses*
		Negative	Redgram	Redgram***, Bengalgram*** and Blackgram***	Redgram***. Greengram and Blackgram***
	Productivity	Positive	Redgram, Bengalgram, Greengram, and Total Pulses	Redgram, greengram, Blackgram and Total Pulses	Redgram, Bengalgram, Greengram and Blockgram and Total Pulses
		Negative	-	Bengalgram	-

Note: Period-I = 1980 to 1990, Period-II =1991 to 2016 and Over all = 1980 to 2016

***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.

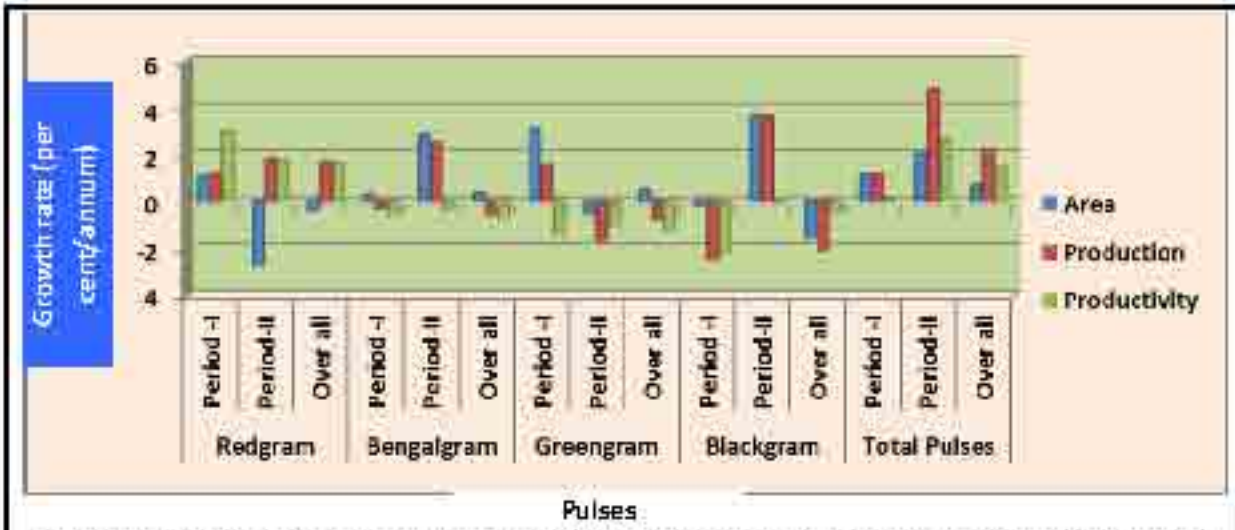


Fig. 4: Growth rate of area, production and productivity of major pulses in Dharwad

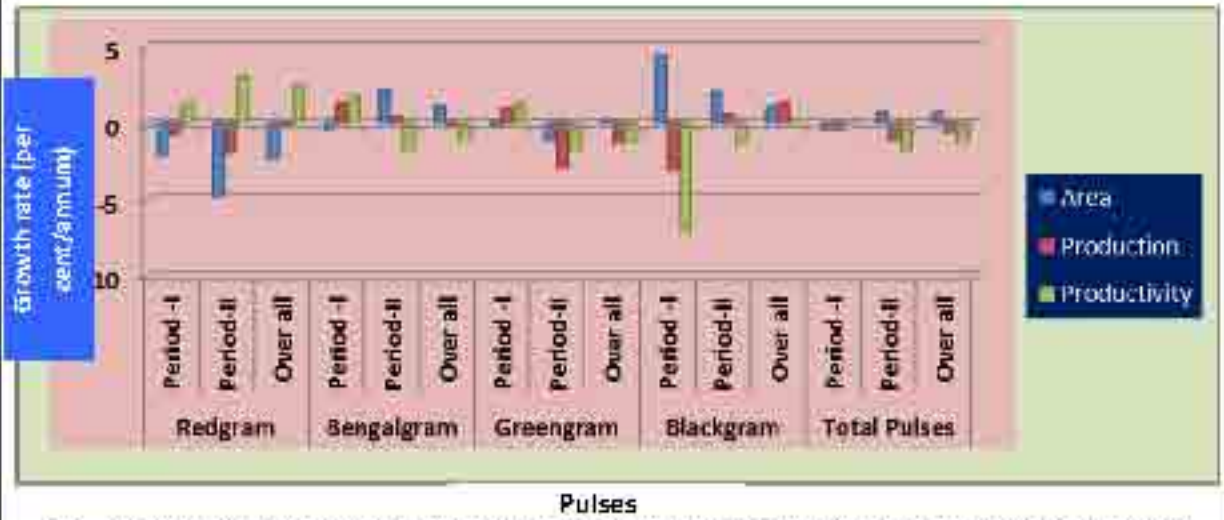


Fig. 5: Growth rate of area, production and productivity of major pulses in Belagavi

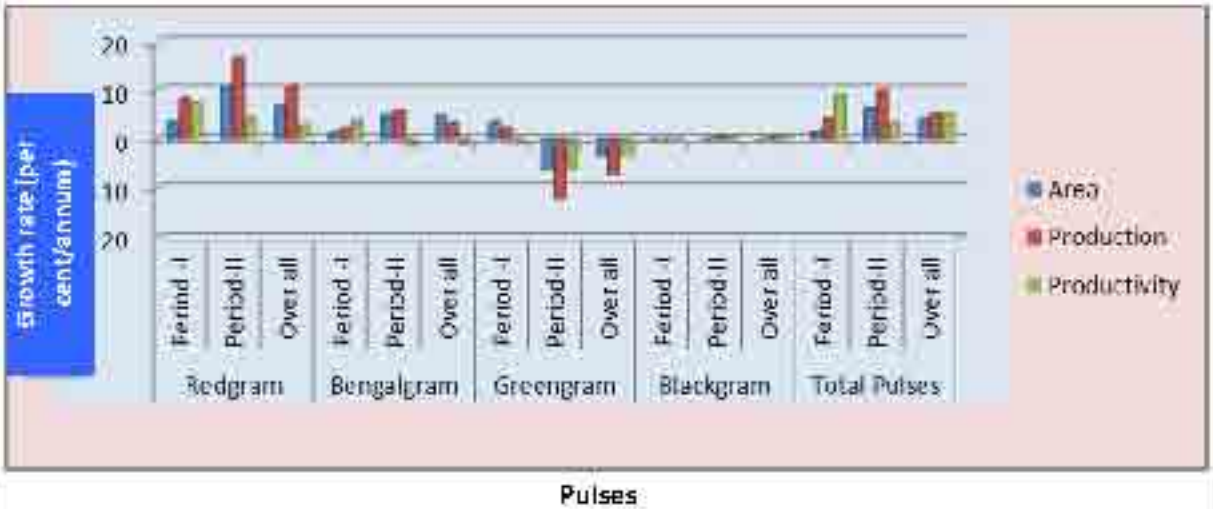


Fig.6: Growth rate of area, production and productivity of major pulses in Vijayapura

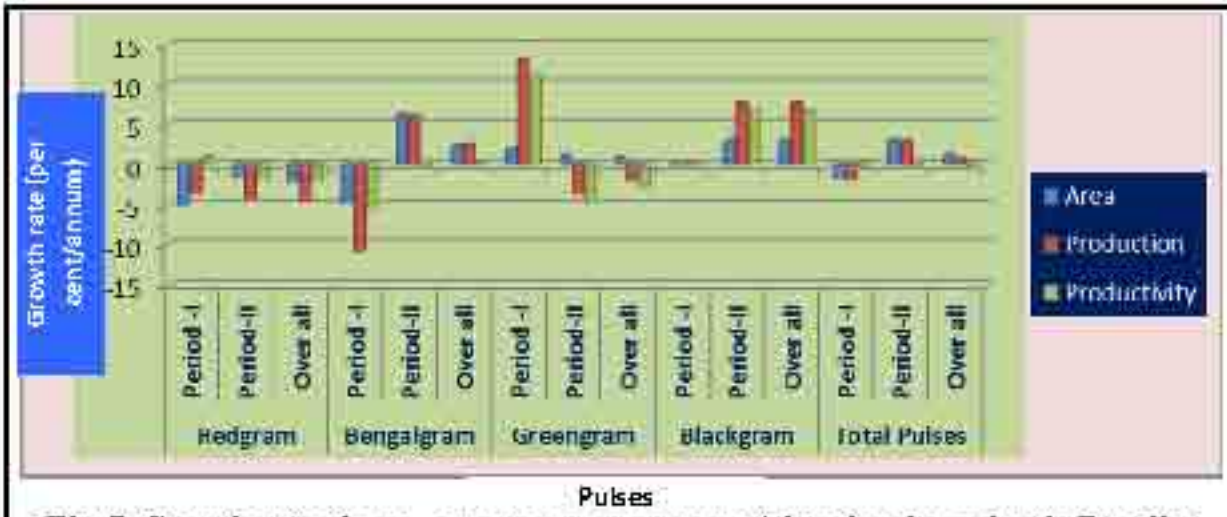


Fig. 7: Growth rate of area, production and productivity of major pulses in Bagalkot

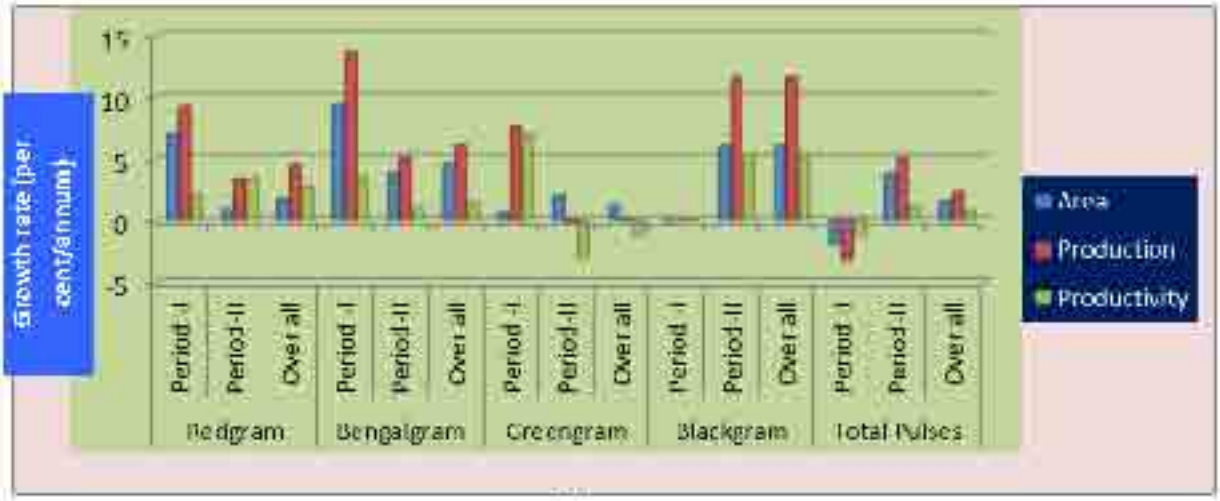


Fig. 8: Growth rate of area, production and productivity of major pulses in Gadag

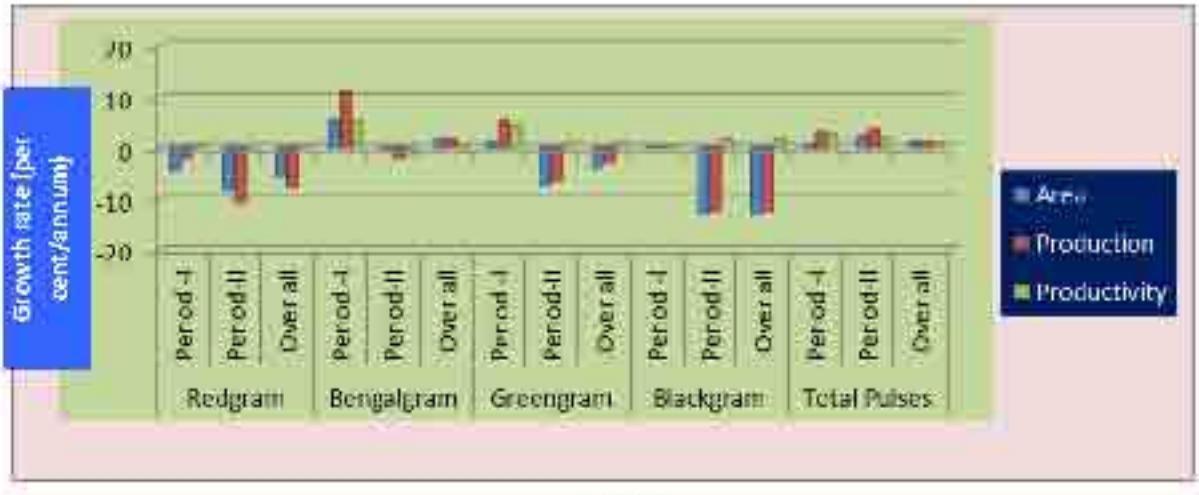


Fig. 9: Growth rate of area, production and productivity of major pulses in Haveri

positive (2.47 %) growth but period-I (-0.35 %) and overall period (-1.73 %) registered negative growth. Whereas, the growth in productivity was negative in all the periods. In the case Belagavi district, though the growth in area of bengalgram was found positive in overall period (1.07 %) but the production (-0.10 %) and productivity was found negative (-1.17 %) due to poor practice of bengalgram cultivation and diversification of cropping system in Belagavi district.

In the case of Vijayapura district the growth of area and production found positive in all the period. Whereas, growth in productivity was negative in Period-II (-1.76 %) and overall period (-1.38 %). However, growth of area was found positive and significant in period-I (3.66 %). Bagalkot district showed mixed growth trend with negative growth in area (-4.79 %), production (-10.83 %) and productivity (-5.70 %) in period-I, while positive and significant growth in area (6.21 %) and production (5.99 %) in period-II but productivity was found to be negative (-0.21 %). However, in overall period the growth of area (2.23 %), production (2.47 %) and productivity (0.23 %) found positive.

The growth in area, production and productivity of bengalgram in Gadag district, found positive in all the period but it is important to note that in overall period the growth of area (4.61 %), production (6.15 %) and productivity (1.47 %) found positive and significant. In Haveri district, the growth of area, production and productivity found positive in period-I and overall study period but it was found negative in period -II.

4.2.1.3 Greengram

In the case of Dharwad district, the growth of area, production and productivity of greengram (Table.4.2) was found negative in all the period except area in period-I (3.08 %) and overall period (0.49 %). Similarly, the production in period-I (1.56 %) found positive. Whereas, the area is increasing marginally while the growth in production and productivity is declining considerably. This might be due to replacing soybean crop to greengrm. In Belagavi district except production (0.92 %) in period-I and area (0.16 %) in overall period the area, production and productivity growth was found negative.

Vijayapura district (Table.4.2) showed negative growth trend in all the periods except area (3.36 %) and production (2.08 %) in period-I. The growth rates of greengram in Vijayapura district pertaining to area, production and productivity were significantly declined in overall period. In the case of Bagalkot district, the growth in area registered positive in all

the periods. Whereas, the production and productivity found negative in period-II and overall period however, growth in production (13.16 %) and productivity (11.09 %) were found positive and significant.

In Gadag district, the growth of area, production and productivity in period-I was positive but in period-II except area (2.08 %), the growth in production (-0.39 %) and productivity (-3.11 %), was found to be negative. Whereas, in overall period, the growth in productivity (-1.19 %) was negative but area (1.29 %) and production (0.08 %) showed positive growth. It is worth noting that production of greengram increased marginally or negligible due to negative growth in productivity. In the case of Haveri district the negative growth in area (-4.10 %) and production (-3.09 %) was considerable in overall period, while the growth in productivity was (1.04 %) positive.

4.2.1.4 Blackgram

The growth in area, production and productivity of blackgram in Dharwad district was found negative in all the period except area (3.66 %) and production (3.61 %) in period-II. In the case of Belagavi district, the growth in area (4.73 %) was positive in period-I but it was negative in the case of production (-3.11 %) and productivity (-7.17 %). However, in period-II except productivity (-1.47) area, production showed positive growth. In the case of Vijayapura district, there was marginal growth rate in production (0.44 %) and productivity (0.54 %) but area (-0.09 %) was declining marginally or negligible.

Bagalkot district, showed positive growth in overall period but not significant in all the period and similar pattern of result were observed in Gadag district also. In case of Haveri district, area (-13.03 %) and production (-12.48 %) found negative growth in overall period but productivity found positive (1.68 %) but not significant.

4.2.1.5 Total Pulses

Dharwad district (Table 4.2) showed positive growth trend in all the period. However, the growth in area, production and productivity were found positive and significant in period-II and overall period. In the case of Belagavi district, the growth in production and productivity was negative in all the periods, while growth in area was positive in period-II (0.69 %) and overall period (0.66 %) but in period-I (0.15 %) the growth of area found

negative. Though the growth of area was increasing in overall (0.66 %) but it was not considerably high.

The positive growth in area, production and productivity was noticed in all the periods in Vijayapura district. However, except area (1.50 %) in period-I, growth of area and production found positive and significant at 1 per cent level for other periods, which is considered as a appreciable performance of total pulses in Vijayapura district. In the case of Bagalkot district, negative growth in area (-1.78 %), production (-2.06 %) and productivity (-0.28 %) during period-I. However, area and production register positive growth in period-II and overall period. Whereas, the productivity in period-I (-0.20 %), period-II (-0.20%) and overall period (-0.51 %) were found negative.

Gadag distircit showed mixed growth trend with negative growth in area (-2.00 %), production (-3.24 %) and productivity (-4.12 %) in period-I. While, positive and significant growth in area (3.86 %), production (5.10 %) and productivity (1.18 %) in period II and ultimately resulted positive growth rate and significant in area (1.55 %), production (2.30 % and productivity (0.73 %) in the entire periods. In case of Haveri district, the growth in area, production and productivity of total pulses found positive but not significant in overall period. Though the growth in area and productivity were not significant but the production was found positive and significant.

4.2.2 Growth rate of area, production and productivity of major pulses in Karnataka

The results of compound growth rate of area, production and productivity of individual as well as total pulses in Karnataka presented in Table 4.4 and Fig. 10. The growth in area, production and productivity of redgram in Karnataka were found positive and significant in all the period except productivity (-1.95 %) in period-I. The growth in area, production and productivity of bengalgram was found positive in all the period except productivity (-3.13 %) in period-I. Further, growth in production and productivity was positive and significant in all the period. The growth rate pertain to greengram crop found a mixed growth trend with positive and significant growth in area (5.81 %) and production (8.78 %) in period-I but negative growth in productivity (-6.40 %). Whereas, the area, only registered positive growth (1.10 %) but production (0.94 %) and productivity (-4.38 %) found negative. The greengram performance in entire period showed that the area (2.19 %) and

Table 4.4: Growth rate of area, production and productivity of major pulses in Karnataka

(Per cent/annum)

Crops	Particulars	Karnataka		
		Period-I	**Period-II**	**Over all**
Redgram	Area	3.64***	3.18***	2.11***
	Production	1.59**	0.34***	3.39***
	Productivity	-1.95	2.97***	1.24**
Bengalgram	Area	5.39***	6.75***	5.92***
	Production	2.09	8.77***	7.74***
	Productivity	-3.13*	1.83***	1.73**
Greengram	Area	5.81***	1.10**	2.19***
	Production	8.79***	-0.94	0.34
	Productivity	-6.40***	-4.38***	-4.87***
Blackgram	Area	6.26***	-0.99*	2.08***
	Production	6.02***	-1.74	2.02***
	Productivity	-0.03	-0.74	0.02
Total Pulses	Area	0.89*	2.08***	1.49***
	Production	0.22	4.05***	2.96***
	Productivity	-0.82	1.92***	1.42***

Note: Period-I = 1980 to 1990, Period-II =1991 to 2016 and Over all = 1980 to 2016

***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.

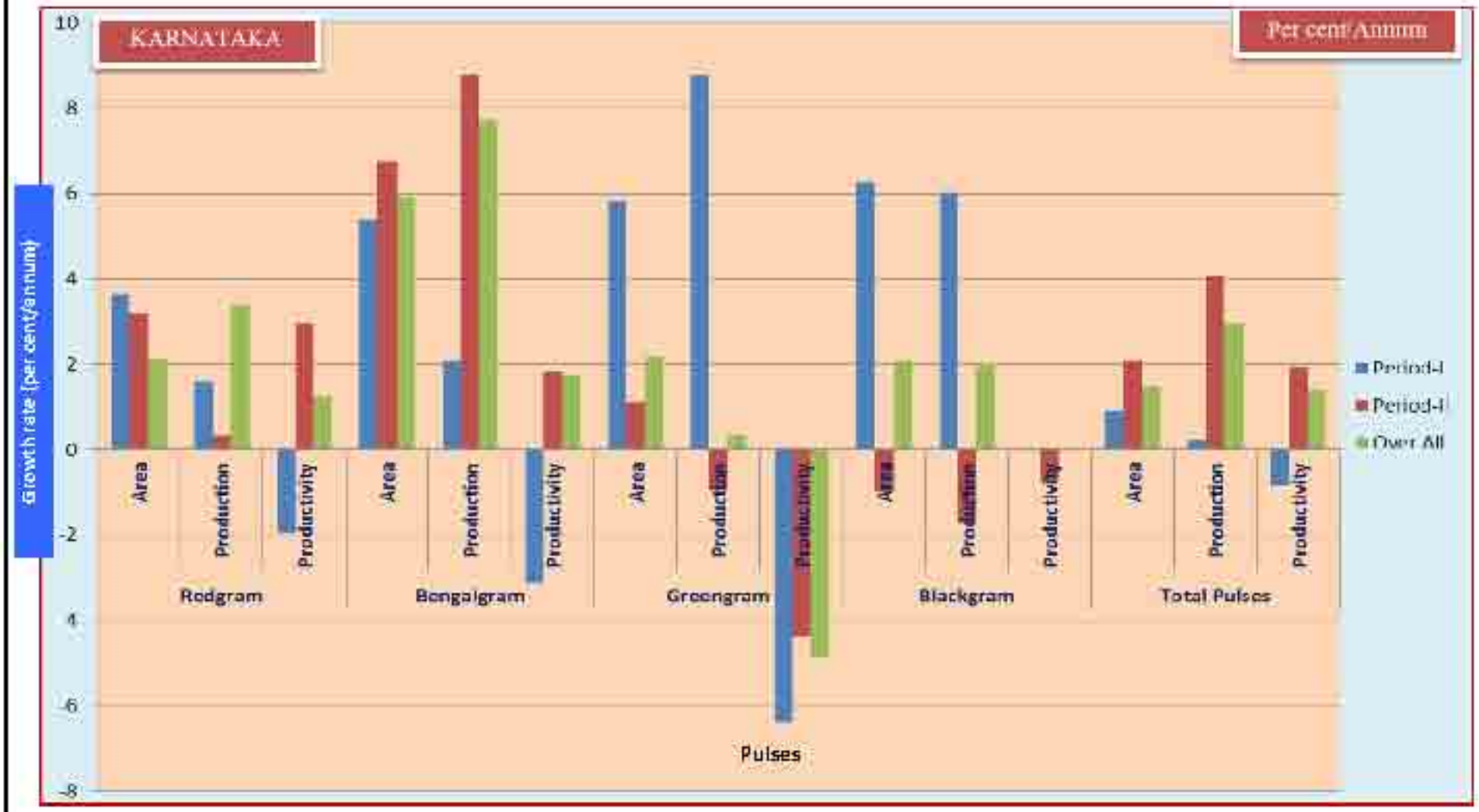


Fig. 10: Growth rate of area, production and productivity of major pulses in Karnataka

production (0.34 %) found positive growth but productivity (-4.87 %) registered negative growth.

In case of Blackgram the growth of area (6.26 %) and production (6.02 %) found positive in period-I but it was negative growth in productivity (0.03 %). However, the growth of area, production and productivity in period-II found negative. Whereas, the growth performance of area (2.08 %), production (2.02 %) and productivity (0.02 %) in entire period was positive but the growth of area was negligible. The total scenario of growth in pulses in Karnataka revealed that, the growth in area, production and productivity were positive in all the period except productivity (-0.82 %) in period-I. It is important to highlight that though the growth rates of productivity is found negative, but the growth in production was found positive in period-I.

4.2.3 Growth rate of area, production and productivity of major pulses growing states of India

The results of compound growth rate analysis of area, production and productivity of individual as well as total pulses in the major pulses growing states of India presented in Table 4.5 to 4.6 (Fig. 11).

4.2.3.1 Redgram

Maharashtra state showed positive growth rate in area, production and productivity in all periods. However, state like Madhya Pradesh, Rajasthan, Uttar Pradesh and Tamil Nadu showed mixed trend of growth in area, production and productivity.

Andhra Pradesh state showed positive and significant in all the period except productivity (-0.86 %) in period-I. Similarly Odisha state registered positive growth in all the period except negative growth of area (-0.78 %) in period-II. The Karnataka state showed positive growth in area, production and productivity in all the period except productivity (-1.95 %) in period-I which showed negative growth.

4.2.3.2 Bengalgram

The area, production and productivity of bengalgram in Madhya Pradesh was found positive and significant in all the period but the growth of area (0.94 %) was not significant in period-I. Similarly the growth rate in the case of Maharashtra and Andhra Pradesh showed

Table 4.5: Growth rate of area, production and productivity of major pulses growing states of India

(Per cent/annum)

Crops	Particulars	Madhya Pradesh			Rajasthan			Maharashtra		
		A	P	Y	A	P	Y	A	P	Y
Redgram	**Period -I**	-1.89***	5.11**	7.14	-3.60	0.60	5.22	3.06***	4.86***	1.74
	Period-II	0.59	-0.88	-1.47***	-2.40***	-0.56	1.88*	0.59***	2.73***	2.12***
	Over all	-0.71**	-1.34***	-0.63*	-1.56***	1.07	2.60	1.53***	2.52***	0.97***
Bengalgram	**Period -I**	0.94	3.54**	2.54*	-3.77	-.3.27	0.51	3.93***	7.14**	3.08
	Period-II	1.11***	2.45***	1.32***	-0.34	0.44	0.78	3.92***	6.02***	2.02***
	Over all	1.12***	2.93***	1.80**	0-61	-0.09	0.51	3.74***	6.07***	2.50***
Greengram	**Period -I**	-3.38***	0.14	3.64*	3.13*	10.31	6.92	4.17***	10.85***	6.40***
	Period-II	-0.098	1.09	1.19***	4.89***	8.92***	2.56	-2.87***	-2.84	-0.24
	Over all	-2.25	-0.90	1.37***	5.42***	9.52***	3.11	-0.62	0.98	1.06**
Blackgram	**Period -I**	-1.02	1.15	2.49	0.03	-0.21	-0.24	-0.32	4.43*	4.57***
	Period-II	0.33	1.83**	1.49***	0.37	2.13	1.76**	-1.56**	-1.71	0.11
	Over all	-0.98***	0.79**	1.81***	0.42	2.04	1.62**	-0.54	0.90	1.47
Total Pulses	**Period -I**	-0.44	2.78**	3.24**	-2.52	-1.45	1.10	2.01***	5.96***	3.87***
	Period-II	0.16	-0.56	1.40***	0.59	1.53	1.89*	0.22	2.28***	2.05***
	Over all	-0.028	0.85	1.93***	0.46	1.23*	0.90	0.74***	2.76***	2.00***

Note: Period-I = 1980 to 1990, Period-II =1991 to 2016 and Over all = 1980 to 2016

A: Area, P: Production, Y: Yield (Productivity)

***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.

Table 4.5: Contd...

(Per cent/Annum)

Crops	Particulars	Uttar Pradesh			Andhra Pradesh			Odisha		
		A	P	Y	A	P	Y	A	P	Y
Redgram	**Period -I**	-0.53	0.27	0.79	4.89***	4.26*	-0.86	6.77***	11.68***	4.58***
	Period-II	-2.50	-3.68	-1.21	1.90***	4.52***	2.57***	-0.78	0.40	1.13**
	Over all	-1.74	-3.00***	-1.27***	2.28***	5.13***	2.73***	0.53*	1.45***	0.80***
Bengalgram	**Period -I**	-0.541	0.27	0.79	0.55	3.63	2.96	0.33	2.98**	2.68*
	Period-II	-2.50***	-3.68***	-1.26***	10.77***	15.02	3.38***	1.32**	2.46***	1.08***
	Over all	-1.72***	-3.11***	-1.22	9.42***	14.49***	4.65***	-0.31	0.42	0.75***
Greengram	**Period -I**	-0.57	1.17	1.71	-0.11	5.30	5.42**	0.26	1.20	0.92
	Period-II	-0.41	-0.95	0.66	-1.84***	-0.89	1.13	-1.18	-1.65	-0.48
	Over all	-2.04***	-0.95**	1.16***	-1.22***	-0.41	0.91**	-3.59***	-5.94***	-2.45***
Blackgram	**Period -I**	2.40**	6.90**	4.40**	8.42***	17.92***	8.75***	3.14***	4.17***	1.38
	Period-II	3.40***	5.04***	1.58***	-1.40***	-0.58	0.76**	-4.33***	-5.79***	-1.53***
	Over all	3.61***	6.18***	2.47***	1.49***	1.88***	0..37	-5.39***	-7.59***	-2.28***
Total Pulses	**Period -I**	0.36	2.53	2.25	0.70	6.46***	5.72***	2.12***	4.34***	2.16
	Period-II	-0.98***	-1.44***	-0.10	0.67**	3.91***	3.21***	-1.73***	-2.89	0.48
	Over all	-0.69***	-0.72***	0.19	0.98***	3.79***	2.78***	-3.21***	-3.80***	-0.43

Note: Period-I = 1980 to 1990, Period-II =1991 to 2016 and Over all = 1980 to 2016

A: Area, P: Production, Y: Yield (Productivity)

***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.

Table 4.5: Contd…

(Per cent/Annum)

Crops	Particulars	Tamil Nadu			Karnataka			India		
		A	P	Y	A	P	Y	A	P	Y
Redgram	**Period -I**	6.42**	12.04***	5.25**	3.64***	1.59**	-1.95	2.44***	3.51***	1.07
	Period-II	-4.65***	-3.30***	1.00**	3.18***	0.34***	2.97***	-0.01	0.93***	0.55
	Over all	-3.40***	-2.42***	0.81**	2.11	3.39***	1.24**	0.46**	0.67***	0.02
Bengalgram	**Period -I**	-5.36*	-4.44	0.95	5.39***	2.09	-3.13*	-1.09	0.88	1.99*
	Period-II	0.19	0.05	-0.10	6.75***	8.77***	1.83*	1.43***	2.40***	0.94***
	Over all	-0.41	-0.27	0.14	5.92***	7.74***	1.73**	0.61***	1.80***	1.17***
Greengram	**Period -I**	3.08	7.19**	4.08**	5.81***	8.79***	-6.40	2.07***	4.59***	2.48*
	Period-II	1.64***	1.32	-0.34	1.10**	-0.94	-4.38	-1.93	0.55	0.41
	Over all	1.77***	2.79***	1.07**	2.19***	-0.34	-4.87	0.59	0.53	0.23
Blackgram	**Period -I**	7.74***	13.89***	5.57*	6.26***	6.02***	0.03	2.11***	6.57	4.38***
	Period-II	-0.46	0.88	0.02	0.99*	1.74	-0.74	0.01	0.65*	0.69**
	Over all	0.59	2.14	1.10	-2.03***	2.02***	0.02	0.20*	1.19***	1.01**
Total Pulses	**Period -I**	5.87***	10.04***	3.94***	0.89	0.22	-0.82	0.08	2.71**	2.62***
	Period-II	-0.42	-0.23	0.16	2.08***	4.05***	2.96***	0.23	1.40***	1.16***
	Over all	-0.29	0.44	0.71**	1.49***	1.92***	1.42***	0.06	1.23***	1.17***

Note: Period-I = 1980 to 1990, Period-II =1991 to 2016 and Over all = 1980 to 2016

A: Area, P: Production, Y: Yield (Productivity)

***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.

Table 4.6: Direction of growth in area, production and productivity of major pulses growing states of India

States	Period	Area		Production		Productivity	
		Positive	Negative	Positive	Negative	Positive	Negative
Madhya Pradesh	**Over all (1980 to 2016)**	Bengalgram***	Redgram**, Greengram, Blackgramm*** and Total Pulses	Bengalgram***, Blackgram** and Total Pulses	Redgram***, Greengram	Bengalgram***, Greengram***, Blackgramm*** and Total Pulses	Redgram*
Rajasthan	**Over all (1980 to 2016)**	Bengalgram, Greengram***, Blackgram and Total Pulses	Redgram	Redgram, Greengram***, Blackgram and Total Pulses*	Bengalgram	Redgram, Bengalgram, Greengram, Blackgram and Total pulses	—
Maharashtra	**Over all (1980 to 2016)**	Redgramm***, Bengalgram*** and Total pulses	Greengram and Blackgram	Redgram, Bengalgram, Greengram, Blackgram and Total pulses	—	Redgram, Bengalgram, Greengram, Blackgram and Total Pulses	—
Uttar Pradesh	**Over all (1980 to 2016)**	Blackgramm***	Bengalgram***, Greengram***, Redgram and Total Pulses***	Blackgram***	Redgram***, Bengalgram***, Greengram and Total pulses	Greengram***, Blackgram*** and Total pulses	Redgram***, Bengalgram
Andhra Pradesh	**Over all (1980 to 2016)**	Redgram***, Bengalgram***, Blackgramm*** and Total Pulses	Greengram***	Redgram***, Bengalgram***, Blackgramm and Total Pulses	Greengram	Redgram***, Bengalgram***, Greengram***, Blackgram and Total Pulses***	—
Odisha	**Over all (1980 to 2016)**	Redgram*	Bengalgram, Greengram***, Blackgram*** and Total Pulses***8	Bengalgram	Redgram*, Greengram***, Blackgram*** and Total Pulses	Redgram*** and Blackgram***	Greengram*** and Bengalgram*** and Total Pulses

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

Table 4.6: Contd..

States	Period	Area		Production		Productivity	
		Positive	Negative	Positive	Negative	Positive	Negative
Tamil Nadu	**Over all (1980 to 2016)**	Greengram*** and Blackgram	Redgramm ***, Bengalgram and Total Pulses	Greengram***, Blackgram and Total Pulses	Redgramm*** and Bengalgram	Redgramm**, Bengalgram, Greengram**, Blackgram and Total Pulses**	—
Karnataka	**Over all (1980 to 2016)**	Redgram, Bengalgram*, Greengram***, and Total Pulses	Blackgram	Redgram***, Bengalgram***, Total Pulses***	Greengram*** and Blackgram	Redgram**, Bengalgram**, Blackgram and Total Pulses***	Greengram***
India	**Over all (1980 to 2016)**	Redgram**, Bengalgram***, Greengram, Blackgram and Total Pulses	—	Redgram***, Bengalgram***, Greengram, Blackgram*** and Total Pulses	—	Redgram, Bengalgram***, Greengram, Blackgram** and Total pulses***	—

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

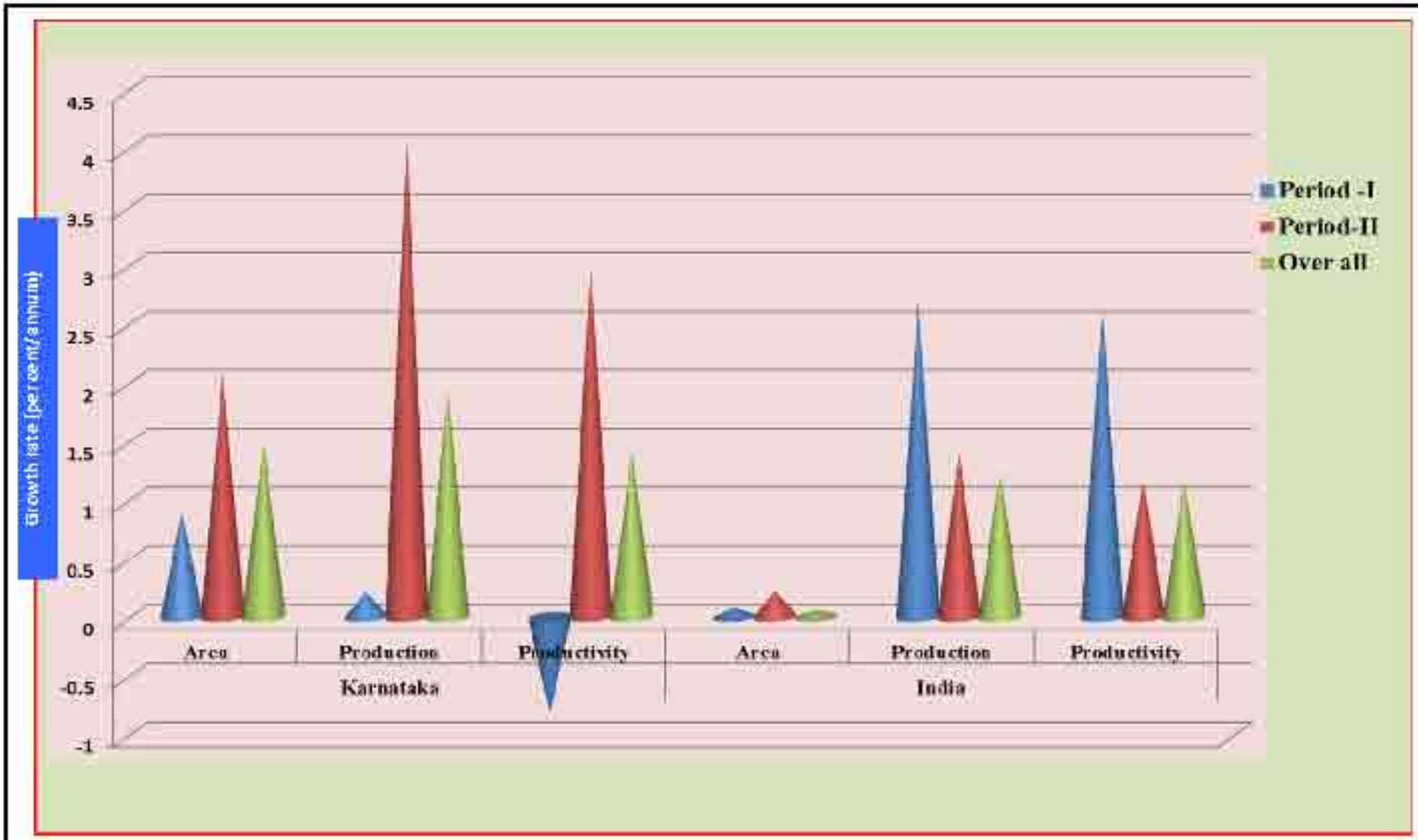


Fig. 11: Growth rate of area, production and productivity of total pulses in Karnataka and India

positive trend in all the periods. Whereas, Rajasthan, Uttar Pradesh and Tamil Nadu showed the mixed trend of growth in area, production and productivity of bengalgram.

The bengalgram growth performance pertaining to Karnataka and Odisha showed positive growth in all the periods except area (0.31 %) in overall period and productivity (-3.13 %) in period-I found negative in Odhisa and Karnataka respectively. However, the country as a whole the growth performance of bengalgram in area, production and productivity was positive in all the periods except area (-1.09 %) in period-I.

4.2.3.3 Greengram

The growth performance of area, production and productivity of greengram in Rajasthan state (Table 4.5) showed positive trend in all the periods and it was significant for area and production. Madhya Pradesh state showed positive and significant growth in all the periods but the growth of area in period-I (-3.38 %), period-II (-0.098 %) and overall period (-2.25 %) showed negative growth. Whereas, the production in period-I (0.14 %) found positive but it was found to be negative in overall period (-0.90 %).

The states like Maharashtra, Uttar Pradesh, Andhra Pradesh and Odisha state in overall period showed negative growth in area (-3.59 %), production (-5.94 %) and productivity (-2.45 %). Tamil Nadu states showed positive growth in all the period except productivity (-0.34 %) in period-II. In case of Karnataka the growth rate of area showed positive in all the period but the productivity of greengram found negative in all the period.

For the country as a whole (Table.4.5) the area (0.59 %), production (0.53 %) and productivity (0.23 %) increased marginally in the overall study period.

4.2.3.4 Blackgram

The growth in production and productivity was positive and significant in period-II and overall period in the case of Madhya Pradesh states but the growth of area (-1.02 %) in period-I and (-0.98 %) in overall period found negative.

The growth performance of blackgram in area, production and productivity Uttar Pradesh is the only state registered positive and significant growth in all the period but the other all the major pulses producing states (Table 4.5) showed mixed trend of growth in area, production and productivity.

The country as a whole showed positive growth rate in area, production and productivity in all the periods. It is worth noting that the productivity of blackgram in period-I (4.38 %), period-II (0.69 %) and productivity (1.05 %) found positive and significant.

4.2.3.5 Total pulses

The performance of total pulses in major pulses producing state is depicted in Table 4.5. It is revealed that the growth performance of total pulses in Maharashtra, Andhra Pradesh and country as a whole showed positive trend for area, production and productivity in all the period.

Madhya Pradesh states showed both positive and negative growth in area and production but pertain to productivity, showed positive and significant in all the period. Rajasthan state register negative growth in area (-2.52 %) and production (-1.45 %) in period-I and the other study period found positive but not significant. Whereas, productivity found positive in all the period. In case of Uttar Pradesh state, area (0.36 %), production (2.53 %) and productivity (2.25 %) in period-I found positive but in period-II and overall study period showed negative growth.

Odhisa and Tamil Nadu states, showed mixed trend of growth in area, production and productivity. In case of Karnataka the growth rate of total pulses in area, production and productivity showed positive in all the period except productivity (-0.82 %) in period-I.

The country as a whole showed positive growth in area, production and productivity in all the period but it is worth noting that the production and productivity found positive and significant in all the period.

To examine the state wise performance of pulses according to the positive and negative growth direction in area, production and productivity. Table 4.6 throws light on the directional shift in growth in the major pulses producing states.

The bengalgram performance in overall period showed the positive direction in Madhya Pradesh and remaining pulses showed negative direction. The productivity of redgram in Madhya Pradesh showed negative direction and all the major pulses showed the positive direction. In case of Rajasthan state, none of the pulses showed negative direction in productivity. The growth direction of major pulses in Maharashtra during overall period all the pulses showed positive direction in production and productivity.

The states like Uttar Pradesh, Odhisa and Karnataka showed the mixed type of direction in the overall period. The productivity performance of all the major pulses in Tamil Nadu and Andhra Pradesh registered positive direction. The country as a whole, none of the pulses showed negative direction in area, production and productivity.

4.3 Demand and supply of pulses

4.3.1 Demand and supply of total pulses in study area

The results pertaining to demand and supply of total pulses in study area are presented in Table 4.7 (Fig. 12). The average mean value of demand-I and demand-II in Dharwad district were 31.28 and 50.84 thousand tonnes respectively. However, total supply of pulses was 43.67 thousand tonnes indicating 12.39 thousand tonnes surplus over demand-I and 7.17 thousand tones deficit as per demand-II estimation. Further, year to year variation was noticed both in demand and supply of pulses due to fluctuation in production and allocation of area under pulses crops. In the case of Belagavi district, the demand for pulses was 80.66 (Demand-I) and 131.10 (Demand-II) thousand tonnes. On the other hand, supply of pulses was 22.09 thousand tonnes revealing deficit of 58.57 (Gap-I) and 109.11 (Gap-II) thousand tonnes. It is interesting to note that gap between supply and demand is widening over the year in Belagavi district due to the more geographical area of the district and the more population is present on the district.

In the case of Vijayapura district, the average mean value of demand for pulses was 37.20 (Demand-I) and 60.47 (Demand-II) thousand tonnes and the average supply of pulses was 198.76 thousand tonnes indicating 161.56 (Gap-I) thousand tonnes surplus over demand-I and 138.29 (Gap-II) thouosand tonnes over demand-II. It is important note that the district showed surplus of pulses over demand from all the indicated years in the study. In the case of Bagalkot, demand-I and demand-II were 31.99 and 52.00 thousand tonnes respectively with the supply of 36.78 thousand tonnes indicating 4.79 (Gap-I) thousand tonnes surplus and 15.22 thousand tonnes of deficit.

The results of demand and supply gap of Gadag district are depicted in the Table 4.7. It is revealed that the average mean value of Demand-I and Demand-II in Haveri district was 17.88 and 29.00 thousand tonnes respectively. However, total supply of pulses was 28.14 thousand tonnes indicating 10.29 thousand tonnes surplus over demand-I and 0.86 thousand tonnes deficit as per demand-II estimation. In the case of Haveri district, the supply of pulses

Table 4.7: Demand and supply of total pulses in study area

(Quantity in thousand tonnes)

Year	Consumption-I	Consumption-II	Demand-I	Demand-II	Production	Supply	Gap-I	Gap-II
Dharwad								
2001	26.96	43.82	30.33	49.30	8.72	8.03	-22.30	-41.27
2011	26.95	43.81	30.32	49.29	45.44	41.83	11.51	-7.46
2012	27.35	44.45	30.77	50.01	47.44	43.67	12.90	-6.34
2013	27.74	45.09	31.21	50.73	51.06	47.00	15.79	-3.73
2014	28.13	45.73	31.65	51.45	62.30	57.35	25.70	5.90
2015	28.54	46.39	32.11	52.19	58.56	53.90	21.80	1.72
2016	28.95	47.05	32.57	52.93	58.56	53.92	21.35	0.99
Overall Mean	**27.80**	**45.19**	**31.28**	**50.84**	**47.44**	**43.67**	**12.39**	**-7.17**
Belagavi								
2001	69.78	113.42	78.51	127.60	15.5	14.27	-64.24	-113.33
2011	69.77	113.39	78.49	127.57	22.3	20.53	-57.96	-107.04
2012	70.65	114.83	79.48	129.19	14.06	12.94	-66.54	-116.24
2013	71.55	116.29	80.49	130.83	25.34	23.33	-57.17	-107.50
2014	72.46	117.77	81.51	132.49	35.6	32.77	-48.74	-99.72
2015	73.38	119.27	82.55	134.17	18.73	17.24	-65.31	-116.93
2016	74.31	120.78	83.60	135.88	36.48	33.58	-50.02	-102.30
Overall Mean	**71.70**	**116.54**	**80.66**	**131.10**	**24.00**	**22.09**	**-58.57**	**-109.01**

Note: 1. Consumption-I as per NIN, Recommendation (14.60kg/Year/Capita), Consumption-II as per NIN recommendation (23.73kg/year/capita)

2. Seed, Feed & wastage (SFW)@12.5% of gross output, Post harvest losses (PHL) @7.95% of output

3. Demand-I= Consumption-I + SFW, Demand-II= Consumption-II + SFW

4. Gap-I= Supply-Demand-I. Gap-II= Supply-Demand-II

5. Supply= Production- PHL @ 7.95%

Table 4.7: Contd…

(Quantity in thousand tonnes)

Year	Consumption-I	Consumption-II	Demand-I	Demand-II	Production	Supply	Gap-I	Gap-II
Vijayapura								
2001	31.79	51.67	35.76	58.13	202.27	186.19	150.43	128.06
2011	31.76	51.62	35.73	58.07	220	202.51	166.78	144.44
2012	32.35	52.58	36.40	59.16	270	248.54	212.14	189.38
2013	32.96	53.57	37.08	60.27	242	222.76	185.68	162.49
2014	33.58	54.58	37.78	61.40	249	229.20	191.43	167.81
2015	34.21	55.60	38.49	62.55	181	166.61	128.13	104.06
2016	34.85	56.65	39.21	63.73	147.22	135.52	96.31	71.79
Overall Mean	**33.07**	**53.75**	**37.20**	**60.47**	**215.93**	**198.76**	**161.56**	**138.29**
Bagalkot								
2001	27.59	44.84	31.04	50.45	27.81	25.60	-5.44	-24.85
2011	27.61	44.87	31.06	50.48	35.98	33.12	2.06	-17.36
2012	27.99	45.49	31.49	51.17	23.63	21.75	-9.73	-29.42
2013	28.37	46.12	31.92	51.88	39.03	35.93	4.01	-15.96
2014	28.77	46.76	32.36	52.60	39.67	36.52	4.15	-16.09
2015	29.17	47.41	32.81	53.33	48.31	44.47	11.66	-8.86
2016	29.57	48.07	33.27	54.08	65.25	60.06	26.79	5.99
Overall Mean	**28.44**	**46.22**	**31.99**	**52.00**	**39.95**	**36.78**	**4.79**	**-15.22**

Note: 1. Consumption-I as per NIN, Recommendation (14.60kg/Year/Capita), Consumption-II as per NIN recommendation (23.73kg/year/capita)

2. Seed, Feed & wastage (SFW)@12.5% of gross output, Post harvest losses (PHL) @7.95% of output

3. Demand-I= Consumption-I + SFW, Demand-II= Consumption-II + SFW

4. Gap-I= Supply-Demand-I. Gap-II= Supply-Demand-II

5. Supply= Production- PHL @ 7.95%

Table 4.7: Contd…

(Quantity in thousand tones)

Year	Consumption-I	Consumption-II	Demand-I	Demand-II	Production	Supply	Gap-I	Gap-II
Gadag								
2001	15.54	25.26	17.49	28.42	14.43	13.28	-4.20	-15.14
2011	15.55	25.28	17.50	28.44	27.94	25.72	8.22	-2.72
2012	15.70	25.51	17.66	28.70	25.25	23.24	5.58	-5.46
2013	15.84	25.75	17.82	28.97	33.81	31.12	13.30	2.16
2014	15.99	25.98	17.99	29.23	37.64	34.65	16.66	5.42
2015	16.13	26.22	18.15	29.50	42.16	38.81	20.66	9.31
2016	16.28	26.47	18.32	29.77	32.76	30.16	11.84	0.38
Overall Mean	**15.86**	**25.78**	**17.85**	**29.00**	**30.57**	**28.14**	**10.29**	**-0.86**
Haveri								
2001	23.33	37.91	26.24	42.65	3.11	2.86	-23.38	-39.79
2011	23.34	37.93	26.26	42.67	8.57	7.89	-18.37	-34.79
2012	23.59	38.34	26.53	43.13	2.16	1.99	-24.55	-41.14
2013	23.84	38.74	26.82	43.59	2.22	2.04	-24.77	-41.54
2014	24.09	39.16	27.10	44.05	2.64	2.43	-24.67	-41.62
2015	24.35	39.58	27.39	44.52	4.88	4.49	-22.90	-40.03
2016	24.61	40.00	27.69	45.00	3.4	3.13	-24.56	-41.87
Overall Mean	**23.88**	**38.81**	**26.86**	**43.66**	**3.85**	**3.55**	**-23.31**	**-40.11**

Note: 1. Consumption-I as per NIN, Recommendation (14.60kg/Year/Capita), Consumption-II as per NIN recommendation (23.73kg/year/capita)

2. Seed, Feed & wastage (SFW)@12.5% of gross output, Post harvest losses (PHL) @7.95% of output

3. Demand-I= Consumption-I + SFW, Demand-II= Consumption-II + SFW

4. Gap-I= Supply-Demand-I. Gap-II= Supply-Demand-II

5. Supply= Production- PHL @ 7.95%

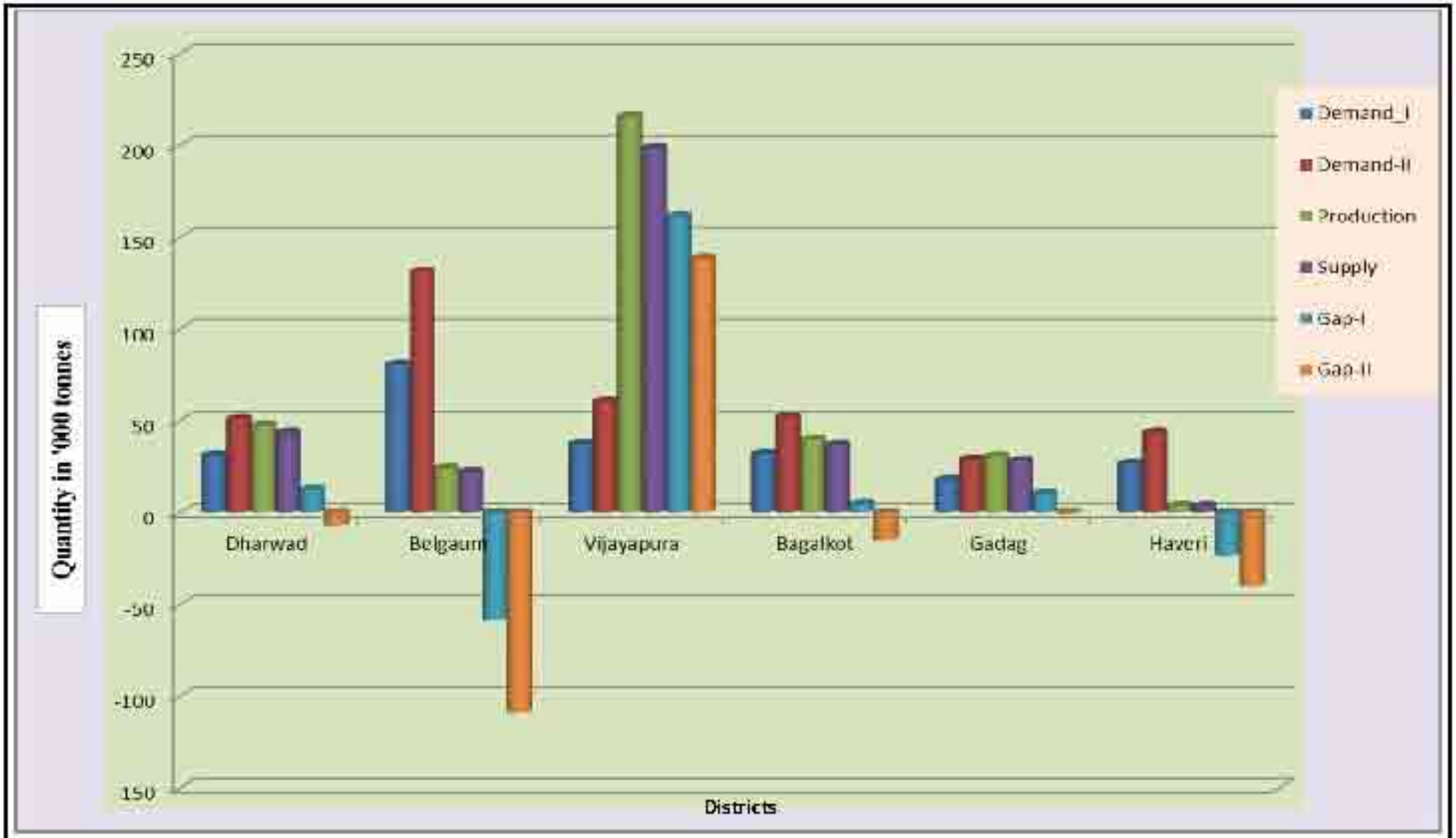


Fig. 12: Extent of demand and supply of total pulses in study area

was found deficit in both gap-I (23.31 Thousand tonnes) and gap-II (40.11 thousand tonnes). The demand and supply gap indicating the both demand-I (26.86 Thousand tonnes) and demand-II (43.66 thousand tonnes) are more than the actual supply (3.55 thousand tonnes) of pulses.

4.3.2 Demand and supply of total pulses in Karnataka

Karnataka is one of the important pulses growing state and it contributes 7.22 per cent of the total pulses production in the country. The Table 4.8 (Fig. 13) indicates that the average estimated demand for pulses was 10.39 (Demand-I) and 16.88 (Demand-II) lakh tonnnes over supply of 11.31 lakh tonnes indicating surplus of 0.92 (Gap-I) thousand tonnes and deficit of 5.57 lakh tonnes.

4.3.3 Demand and supply of total pulses in major pulses growing states of India

In India the major pulses producing states are Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Andhra Pradesh, Odisha, Tamil Nadu and Karnataka. These eight states together accounted 84.16 per cent of area and 80.91 per cent of production of pulses in the country. Hence, it is important to estimate the demand and supply gap of total pulses. The results on supply and demand gap of all the major pulses producing states are presented in Table 4.9. It could be seen from the table that average mean value of demand-I and demand-II in Madhya Pradesh state was 11.98 and 19.47 lakh tonnes respectively. However, total supply of pulses was 39.42 lakh tonnes indicating 27.43 and 19.94 lakh tonnes surplus over demand –I and demand-II respectively. It is important to highlight that from 2011 to 2016 all the year showed the surplus of pulses over demand-I and demand-II.

In the case of Rajasthan, the demand for pulses was 11.24 (demand-I) and 18.27 (demand-II) lakh tonnes. On the other hand supply of pulses was 17.68 lakh tonnes indicating the surplus of 6.44 (Gap-I) and deficit of 0.59 (Gap-II) lakh tonnes. In the case of Maharashtra state, the average demand-I and demand-II were 18.66 and 30.33 lakh tonnes with the supply of 20.63 lakh tonnes indicating 1.97 lakh tonnes (Gap-I) surplus supply and 9.70 lakh tonnes of deficit (Gap-II).

In the case of Uttar Pradesh state, the demand-I (33.39 Lakh tonnes) and demand-II (54.27 Lakh tonnes) were more than the actual average supply (17.15lakh tonnes). Thus, both the gap-I (-16.24 lakh tonnes) and gap-II -(37.11 lakh tonnes) were negative or the supply is

Table 4.8: Demand and supply of total pulses in Karnataka

(Quantity in lakh tonnes)

Year	Consumption-I	Consumption-II	Demand-I	Demand-II	Production	Supply	Gap-I	Gap-II
Karnataka								
2001	8.92	14.50	10.03	16.31	7.51	6.91	-3.12	-9.40
2011	8.93	14.51	10.04	16.32	14.97	13.78	3.74	-2.54
2012	9.06	14.73	10.20	16.57	10.61	9.77	-0.43	-6.81
2013	9.21	14.97	10.36	16.84	12.59	11.59	1.23	-5.25
2014	9.36	15.21	10.53	17.11	16	14.73	4.20	-2.38
2015	9.51	15.45	10.70	17.38	14.14	13.02	2.32	-4.37
2016	9.65	15.69	10.86	17.65	10.18	9.37	-1.49	-8.28
Overall Mean	**9.23**	**15.01**	**10.39**	**16.88**	**12.29**	**11.31**	**0.92**	**-5.57**

Note: 1. Consumption-I as per NIN, Recommendation (14.60kg/Year/Capita), Consumption-II as per NIN recommendation (23.73kg/year/capita)

2. Seed, Feed & wastage (SFW)@12.5% of gross output, Post harvest losses (PHL) @7.95% of output

3. Demand-I= Consumption-I + SFW, Demand-II= Consumption-II + SFW

4. Gap-I= Supply-Demand-I. Gap-II= Supply-Demand-II

5. Supply= Production- PHL @ 7.95%

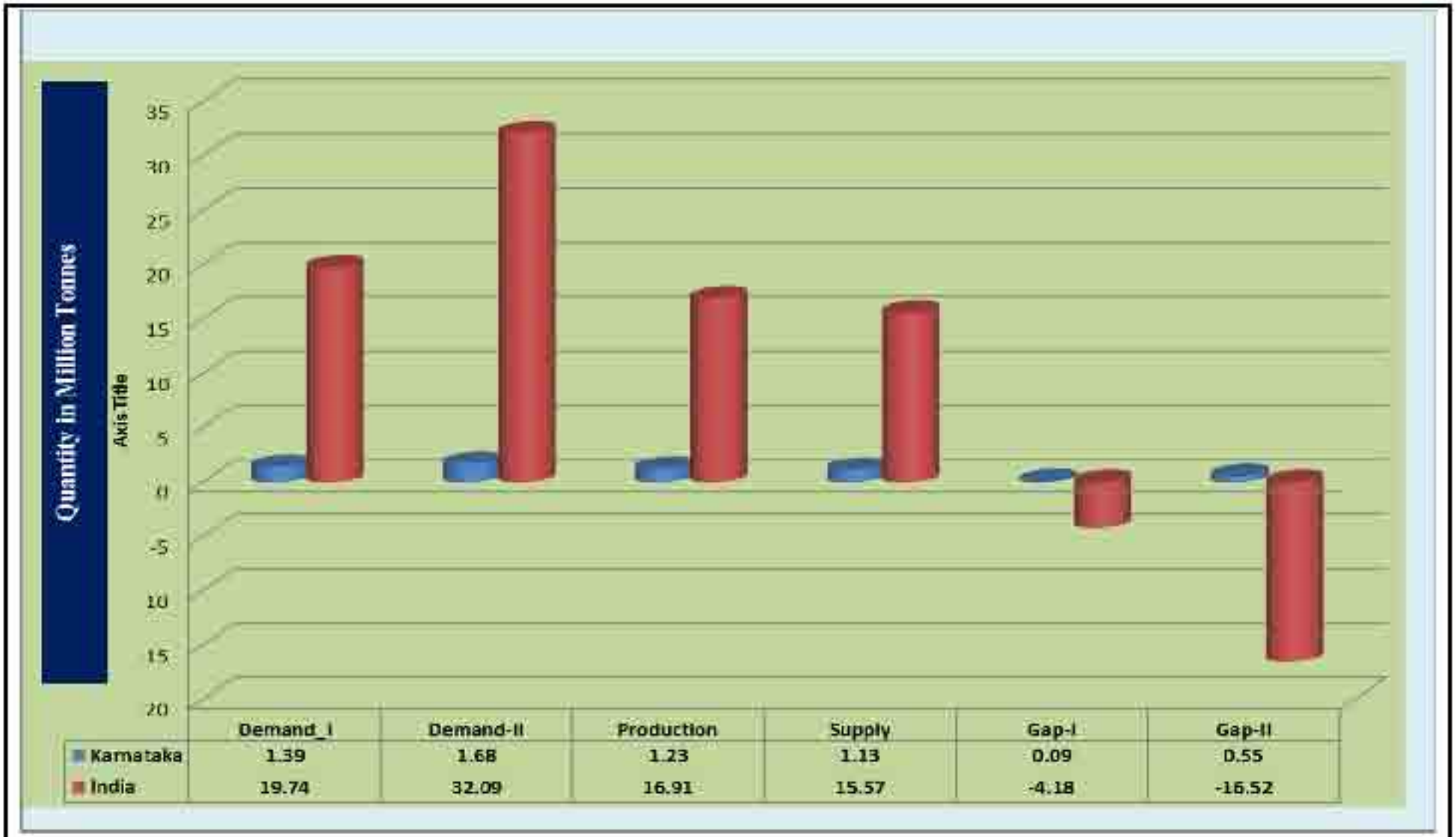


Fig. 13: Extent of demand and supply of total pulses in Karnataka and India

Table 4.9: Demand and supply of total pulses in major pulses growing states of India

(Quantity in lakh tonnes)

Year	Consumption-I	Consumption-II	Demand-I	Demand-II	Production	Supply	Gap-I	Gap-II
Madhya Pradesh								
2001	8.81	14.32	9.91	16.11	22.75	20.94	11.03	4.83
2011	10.54	17.13	11.86	19.27	33.91	31.21	19.36	11.94
2012	10.71	17.40	12.05	19.58	41.6	38.29	26.25	18.71
2013	10.87	17.67	12.23	19.88	51.6	47.50	35.26	27.61
2014	11.04	17.94	12.42	20.19	46.44	42.75	30.33	22.56
2015	11.20	18.21	12.61	20.49	52.24	48.09	35.48	27.60
2016	11.37	18.48	12.79	20.79	51.2	47.13	34.34	26.34
Overall Mean	**10.65**	**17.31**	**11.98**	**19.47**	**42.82**	**39.42**	**27.43**	**19.94**
Rajasthan								
2001	8.25	13.41	9.28	15.09	7.31	6.73	-2.55	-8.36
2011	9.90	16.10	11.14	18.11	7.43	6.84	-4.30	-11.27
2012	10.06	16.35	11.32	18.39	32.16	29.60	18.29	11.21
2013	10.21	16.60	11.49	18.67	23.6	21.72	10.24	3.05
2014	10.36	16.84	11.66	18.95	19.56	18.00	6.35	-0.94
2015	10.51	17.08	11.82	19.21	24.9	22.92	11.10	3.71
2016	10.65	17.31	11.98	19.47	19.5	17.95	5.97	-1.52
Overall Mean	**9.99**	**16.24**	**11.24**	**18.27**	**19.21**	**17.68**	**6.44**	**-0.59**

Note: 1. Consumption-I as per NIN, Recommendation (14.60kg/Year/Capita), Consumption-II as per NIN recommendation (23.73kg/year/capita)

2. Seed, Feed & wastage (SFW)@12.5% of gross output, Post harvest losses (PHL) @7.95% of output

3. Demand-I= Consumption-I + SFW, Demand-II= Consumption-II + SFW

4. Gap-I= Supply-Demand-I. Gap-II= Supply-Demand-II

5. Supply= Production- PHL @ 7.95%

Table 4.9: Contd…

(Quantity in lakh tonnes)

Year	Consumption-I	Consumption-II	Demand-I	Demand-II	Production	Supply	Gap-I	Gap-II
Maharashtra								
2001	14.14	22.99	15.91	25.86	16.37	15.07	-0.84	-10.79
2011	16.45	26.73	18.50	30.08	31.46	28.96	10.45	-1.12
2012	16.67	27.10	18.75	30.48	22.15	20.39	1.63	-10.09
2013	16.89	27.45	19.00	30.89	23.06	21.23	2.22	-9.66
2014	17.11	27.81	19.25	31.29	31.69	29.17	9.92	-2.11
2015	17.32	28.16	19.49	31.68	18.05	16.62	-2.87	-15.06
2016	17.53	28.49	19.72	32.06	14.1	12.98	-6.74	-19.08
Overall Mean	**16.59**	**26.96**	**18.66**	**30.33**	**22.41**	**20.63**	**1.97**	**-9.70**
Uttar Pradesh								
2001	24.26	39.44	27.30	44.37	21.6	19.88	-7.42	-24.49
2011	29.31	47.64	32.98	53.60	20.12	18.52	-14.46	-35.08
2012	29.82	48.47	33.55	54.53	14.26	13.13	-20.42	-41.40
2013	30.33	49.30	34.12	55.46	23.32	21.47	-12.66	-33.99
2014	30.84	50.12	34.69	56.39	16.97	15.62	-19.07	-40.77
2015	31.34	50.94	35.26	57.31	21.97	20.22	-15.04	-37.09
2016	31.84	51.75	35.82	58.22	12.2	11.23	-24.59	-46.99
Overall Mean	**29.68**	**48.24**	**33.39**	**54.27**	**18.63**	**17.15**	**-16.24**	**-37.11**

Note: 1. Consumption-I as per NIN, Recommendation (14.60kg/Year/Capita), Consumption-II as per NIN recommendation (23.73kg/year/capita)

2. Seed, Feed & wastage (SFW)@12.5% of gross output, Post harvest losses (PHL) @7.95% of output

3. Demand-I= Consumption-I + SFW, Demand-II= Consumption-II + SFW

4. Gap-I= Supply-Demand-I. Gap-II= Supply-Demand-II

5. Supply= Production- PHL @ 7.95%

Table 4.9: Contd…

(Quantity in lakh tonnes)

Year	Consumption-I	Consumption-II	Demand-I	Demand-II	Production	Supply	Gap-I	Gap-II
Andhra Pradesh								
2001	11.13	18.08	12.52	20.35	10.54	9.70	-2.82	-10.64
2011	12.37	20.11	13.92	22.62	14.39	13.25	-0.67	-9.38
2012	12.48	20.29	14.04	22.82	12.47	11.48	-2.56	-11.34
2013	12.59	20.46	14.16	23.02	16.23	14.94	0.78	-8.08
2014	12.69	20.63	14.28	23.21	15.51	14.28	0.00	-8.94
2015	12.80	20.80	14.40	23.40	11.36	10.46	-3.94	-12.95
2016	12.90	20.97	14.51	23.59	12.3	11.32	-3.19	-12.27
Overall Mean	**12.42**	**20.19**	**13.98**	**22.72**	**13.26**	**12.20**	**-1.77**	**-10.51**
Odisha								
2001	5.37	8.73	6.05	9.83	2.12	1.95	-4.09	-7.87
2011	5.95	9.67	6.69	10.88	4.14	3.81	-2.88	-7.07
2012	6.00	9.75	6.75	10.97	3.57	3.29	-3.47	-7.69
2013	6.05	9.84	6.81	11.07	4.24	3.90	-2.91	-7.16
2014	6.10	9.92	6.87	11.16	4.19	3.86	-3.01	-7.30
2015	6.15	10.00	6.92	11.25	4.45	4.10	-2.82	-7.15
2016	6.20	10.08	6.98	11.34	5.5	5.06	-1.91	-6.28
Overall Mean	**5.98**	**9.71**	**6.72**	**10.93**	**4.03**	**3.71**	**-3.01**	**-7.22**

Note: 1. Consumption-I as per NIN, Recommendation (14.60kg/Year/Capita), Consumption-II as per NIN recommendation (23.73kg/year/capita)

2. Seed, Feed & wastage (SFW)@12.5% of gross output, Post harvest losses (PHL) @7.95% of output

3. Demand-I= Consumption-I + SFW, Demand-II= Consumption-II + SFW

4. Gap-I= Supply-Demand-I. Gap-II= Supply-Demand-II

5. Supply= Production- PHL @ 7.95%

Table 4.9: Contd…

(Quantity in lakh tonnes)

Year	Consumption-I	Consumption-II	Demand-I	Demand-II	Production	Supply	Gap-I	Gap-II
Tamil Nadu								
2001	9.11	14.81	10.25	16.66	3.13	2.88	-7.37	-13.78
2011	9.85	16.00	11.08	18.01	2.96	2.72	-8.35	-15.28
2012	9.91	16.10	11.15	18.12	4.01	3.69	-7.46	-14.43
2013	9.97	16.20	11.21	18.22	2.1	1.93	-9.28	-16.29
2014	10.02	16.29	11.28	18.33	6.13	5.64	-5.63	-12.69
2015	10.08	16.38	11.34	18.43	3.65	3.36	-7.98	-15.07
2016	10.13	16.47	11.40	18.53	5.7	5.25	-6.15	-13.28
Overall Mean	**9.87**	**16.04**	**11.10**	**18.04**	**3.95**	**3.64**	**-7.46**	**-14.40**
India						(Quantity in million tonnes)		
2001	15.02	24.41	16.89	27.46	11.08	10.20	-6.70	-17.26
2011	17.41	28.30	19.59	31.84	18.24	16.79	-2.80	-15.05
2012	17.64	28.67	19.84	32.25	17.21	15.84	-4.00	-16.41
2013	17.86	29.04	20.10	32.67	18.34	16.88	-3.22	-15.78
2014	18.09	29.40	20.35	33.07	19.78	18.21	-2.14	-14.87
2015	18.31	29.76	20.60	33.48	17.38	16.00	-4.60	-17.48
2016	18.53	30.11	20.84	33.88	16.35	15.05	-5.79	-18.83
Overall Mean	**17.55**	**28.53**	**19.74**	**32.09**	**16.91**	**15.57**	**-4.18**	**-16.52**

Note: 1. Consumption-I as per NIN, Recommendation (14.60kg/Year/Capita), Consumption-II as per NIN recommendation (23.73kg/year/capita)

2. Seed, Feed & wastage (SFW)@12.5% of gross output, Post harvest losses (PHL) @7.95% of output

3. Demand-I= Consumption-I + SFW, Demand-II= Consumption-II + SFW

4. Gap-I= Supply-Demand-I. Gap-II= Supply-Demand-II

5. Supply= Production- PHL @ 7.95%

less than the demand. In Andhra Pradesh the average supply of pulses was 12.20 lakh tonnes but the demand-I (13.98 lakh tonnes) and demand-II (22.72 lakh tonnes) were more than the supply. Hence, the gap were 1.77 (Gap-I) and 10.51 (Gap-II) lakh tonnes.

The Table 4.9 revealed that the averages mean value of demand-I and demand-II in Odisha was 6.72 and 10.93 lakh tonnes respectively. However, total supply of pulses was 3.71 lakh tonnes indicating 3.01 and 7.22 lakh tonnes deficit to the demand –I and demand-II respectively. In the case of Tamil Nadu, the demand for pulses were 11.10 (Demand-I) and 18.04 (Demand-II) lakh tonnes on the other side, supply of pulses were 3.64 lakh tonnes revealing the deficit of 7.46 (Gap-I) and 14.40 (Gap-II) lakh tonnes. It is important to note that Uttar Pradesh, Andhra Pradesh, Odisha and Tamil Nadu showed supply of pulses was deficit in all the years of the study as indicated in Table 4.9

The country as a whole the average consumption-I of pulses was increased from 17.41 million tonnes from 2011 to 18.53 million tonnes in 2016 due to positive growth rate (1.23 per cent/annum) population in the country. It could be seen from the Table.4.9 (Fig. 13) that the average mean value of demand-I and demand-II were 19.74 and 32.09 million tonnes with the supply of 15.57 million tonnes indicating deficit of pulses to the tune of 4 to 4.5 million tonnes as per demand-I estimation and 16.52 million tonnes as per demand-II estimation.

4.3.4 Status of demand and supply at different level

The abstract of demand and supply of pulses in the study area, Karnataka and major pulses producing states of India is presented in Table 4.10. It could be seen from the table that in the case of Dharwad, Vijayapura, Gadag and Bagalkot, the supply of pulses as per the demand-I estimation indicated a surplus of 0.10 to 1.61 lakh tonnes. However, Bagalkot district showed very minute quantity of surplus (0.05 lakh tonnes) but Belagavi and Haveri district showed deficit of 0.58 and 0.23 lakh tonnes respectively. For major pulses producing states, the gap-I showed the surplus of pulses supply in Madhya Pradesh (27.43 lakh tonnes), Rajasthan (6.44 Lakh tonnes) and Maharashtra (1.97 lakh tonnes). However, the supply of pulses was less than demand-I and demand-II in the case of Uttar Pradesh, Andhra Pradesh, Odisha and Tamil Nadu. It is important highlight the country as a whole India is facing a deficit of 4 to 4.5 million tonnes of pulses as per the demand –I estimation.

Table 4.10: Extent of demand and supply of pulses at different levels

(Quantity in lakh tones)

Sl. No	Regions	Demand-I	Demand-II	Supply	Gap-I	Gap-II
I	**Study Area**					
1.	Dharwad	0.32	0.59	0.43	0.13	-0.07
2.	Belagavi	0.86	1.31	0.22	-0.58	-1.09
3.	Vijayapura	0.37	0.61	1.98	1.61	1.38
4.	Bagalkot	0.32	0.52	0.36	0.05	-0.15
5.	Gadag	0.18	0.29	0.28	0.10	-0.008
6.	Haveri	0.27	0.44	0.03	-0.23	-0.40
7.	Karnataka	10.39	16.88	11.31	0.92	-5.57
II	**Major pulses producing states**					
1.	Madhya Pradesh	11.98	19.47	39.42	27.43	19.94
2.	Rajasthan	11.24	18.27	17.68	6.44	-0.59
3.	Maharashtra	18.66	30.33	20.63	1.97	-9.70
4.	Uttar Pradesh	33.39	54.27	17.15	-16.24	-37.11
5.	Andhra Pradesh	13.98	22.72	12.20	-1.77	-10.51
6.	Odissa	6.72	10.93	3.71	-3.01	-7.22
7.	Tamil Nadu	11.40	18.04	3.64	-7.46	-14.40
8.	**India**	**197.40**	**320.90**	**155.70**	**-41.80**	**-165.20**

Note: 1.Demand-I= Consumption-I + SFW, Demand-II= Consumption-II + SFW

2. Gap-I= Supply-Demand-I. Gap-II= Supply-Demand-II

3. Supply= Production- PHL @ 7.95%

4.4 Total demand projection of pulses

4.4.1 Projected demand of total pulses in study area

The imbalance between supply and demand impacts the prices and profitability which call for policy intervention and planning to tackle the situation in future. Thus, the projection on demand side become very relevant to make policy intervention in the national level and state level in general and study area in particular.

The demand projection of total pulses in the study area, Karnataka and major pulses producing states were projected for the year 2018 to 2031. As evident from the Table 4.11 (Fig. 14) that the demand for pulses in Dharwad district is likely to reach 34.98 thousand tonnes (Total Demand-I) and 56.86 thousand tonnes (Total Demand-II) during 2021 and about 40.33 thousand tonnes (Total Demand-I) and 65.55 thousand tonnes (Total Demand-II) by 2031. In the case of Belagavi district, the projected total demand-I may increase from 89.08 thousand tonnes during 2021 to 101.09 thousand tonnes by 2031. Similarly, the projected total demand-II would be 144.78 thousand tonnes during 2021 and about 164.30 thousand tonnes by 2031.

The Total demand-I for pulses in Vijayapura district is likely to reach 43.04 thousand tonnes during 2021 and about 51.84 thousand tonnes by 2031. Similarly, the total demand-II is likely to reach 69.95 thousand tonnes during 2021 and about 84.26 thousand tonnes by 2031. In the case of Bagalkot, projected total demand-I for pulses is likely to reach 35.68 and 57.99 thousand tonnes during 2021and 2031 respectively and about 40.98 (Total demand-I) and 66.60 (Total Demand-II) thousand tonnes by 2021 and 2031 respectively.

In the case of Gadag district, projected total demand-I would be 19.18 and 21.03 thousand tonnes during 2021 and 2031 respectively while, projected total demand-II 31.18 and 34.18 thousand tonnes by 2021 and 2031 respectively. The total demand-I for pulses in Haveri district is likely to reach 29.20 thousand tonnes during 2021 and about 32.48 thousand tonnes by 2031. However, total demand-II is expected to reach 47.47 and 52.79 thousand tonnes during 2021 and 2031 respectively.

4.4.2 Projected demand of total pulses in Karnataka

The Karnataka state as a whole Table 4.12 (Fig. 15) total demand-I for pulses is expected to reach 11.83 and 13.91 lakh tonnes during 2021 and 2031 respectively. Similarly,

Table 4.11: Projected demand of total pulses in study area

(Quantity in thousand tonnes)

Years	Direct Demand-I	Direct Demand-II	Indirect Demand-I	Indirect Demand-II	Total Demand-I	Total Demand-II
Dharwad						
2018	29.79	48.42	3.72	6.05	33.51	54.47
2019	30.22	49.11	3.78	6.14	33.99	55.25
2020	30.65	49.82	3.83	6.23	34.48	56.05
2021	31.09	50.54	3.89	6.32	34.98	56.86
2022	31.54	51.26	3.94	6.41	35.48	57.66
2023	31.99	51.99	4.00	6.50	35.99	58.49
2024	32.45	52.74	4.06	6.59	36.50	59.33
2025	32.91	53.50	4.11	6.69	37.03	60.18
2026	33.39	54.26	4.17	6.78	37.56	61.05
2027	33.86	55.04	4.23	6.88	38.10	61.92
2028	34.35	55.83	4.29	6.98	38.64	62.81
2029	34.84	56.63	4.36	7.08	39.20	63.71
2030	35.34	57.44	4.42	7.18	39.76	64.62
2031	35.85	58.27	4.48	7.28	40.33	65.55
Belagavi						
2018	76.22	123.88	9.53	15.49	85.75	139.37
2019	77.19	125.46	9.65	15.68	86.84	141.15
2020	78.18	127.07	9.77	15.88	87.95	142.95
2021	79.18	128.69	9.90	16.09	89.08	144.78
2022	80.18	130.32	10.02	16.29	90.20	146.61
2023	81.20	131.98	10.15	16.50	91.35	148.48
2024	82.24	133.66	10.28	16.71	92.52	150.37
2025	83.28	135.36	10.41	16.92	93.69	152.28
2026	84.34	137.09	10.54	17.14	94.89	154.22
2027	85.42	138.83	10.68	17.35	96.10	156.19
2028	86.51	140.60	10.81	17.58	97.32	158.18
2029	87.61	142.39	10.95	17.80	98.56	160.19
2030	88.72	144.21	11.09	18.03	99.81	162.23
2031	89.85	146.04	11.23	18.26	101.09	164.30

Note: 1. Direct Demand-I= NIN, Recommendation (14.60kg/Year/Capita)*Population
2. Direct Demand-II= NIN, Recommendation (23.73kg/Year/Capita)*Population
3. Indirect Demand-I= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-I
4. Indirect Demand-II= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-II
5. Total Demand-I= Direct Demand-I+ Indirect Demand-I
6. Total Demand-II = Direct Demand-II+ Indirect Demand-II

Table 4.11: Contd…

(Quantity in thousand tonnes)

Years	Direct Demand-I	Direct Demand-II	Indirect Demand-I	Indirect Demand-II	Total Demand-I	Total Demand-II
Vijayapura						
2018	36.17	58.80	4.52	7.35	40.70	66.15
2019	36.86	59.90	4.61	7.49	41.46	67.39
2020	37.55	61.03	4.69	7.63	42.24	68.66
2021	38.26	62.18	4.78	7.77	43.04	69.95
2022	38.97	63.34	4.87	7.92	43.84	71.26
2023	39.71	64.53	4.96	8.07	44.67	72.60
2024	40.45	65.75	5.06	8.22	45.51	73.97
2025	41.21	66.98	5.15	8.37	46.36	75.36
2026	41.99	68.24	5.25	8.53	47.23	76.77
2027	42.78	69.52	5.35	8.69	48.12	78.22
2028	43.58	70.83	5.45	8.85	49.03	79.69
2029	44.40	72.16	5.55	9.02	49.95	81.18
2030	45.23	73.52	5.65	9.19	50.89	82.71
2031	46.08	74.90	5.76	9.36	51.84	84.26
Bagalkot						
2018	30.41	49.42	3.80	6.18	34.21	55.60
2019	30.84	50.12	3.85	6.26	34.69	56.38
2020	31.27	50.82	3.91	6.35	35.18	57.18
2021	31.71	51.54	3.96	6.44	35.68	57.99
2022	32.15	52.25	4.02	6.53	36.17	58.78
2023	32.60	52.98	4.07	6.62	36.67	59.60
2024	33.05	53.72	4.13	6.72	37.18	60.44
2025	33.51	54.47	4.19	6.81	37.70	61.28
2026	33.98	55.23	4.25	6.90	38.23	62.14
2027	34.46	56.01	4.31	7.00	38.77	63.01
2028	34.94	56.79	4.37	7.10	39.31	63.89
2029	35.43	57.58	4.43	7.20	39.86	64.78
2030	35.92	58.39	4.49	7.30	40.41	65.69
2031	36.43	59.20	4.55	7.40	40.98	66.60

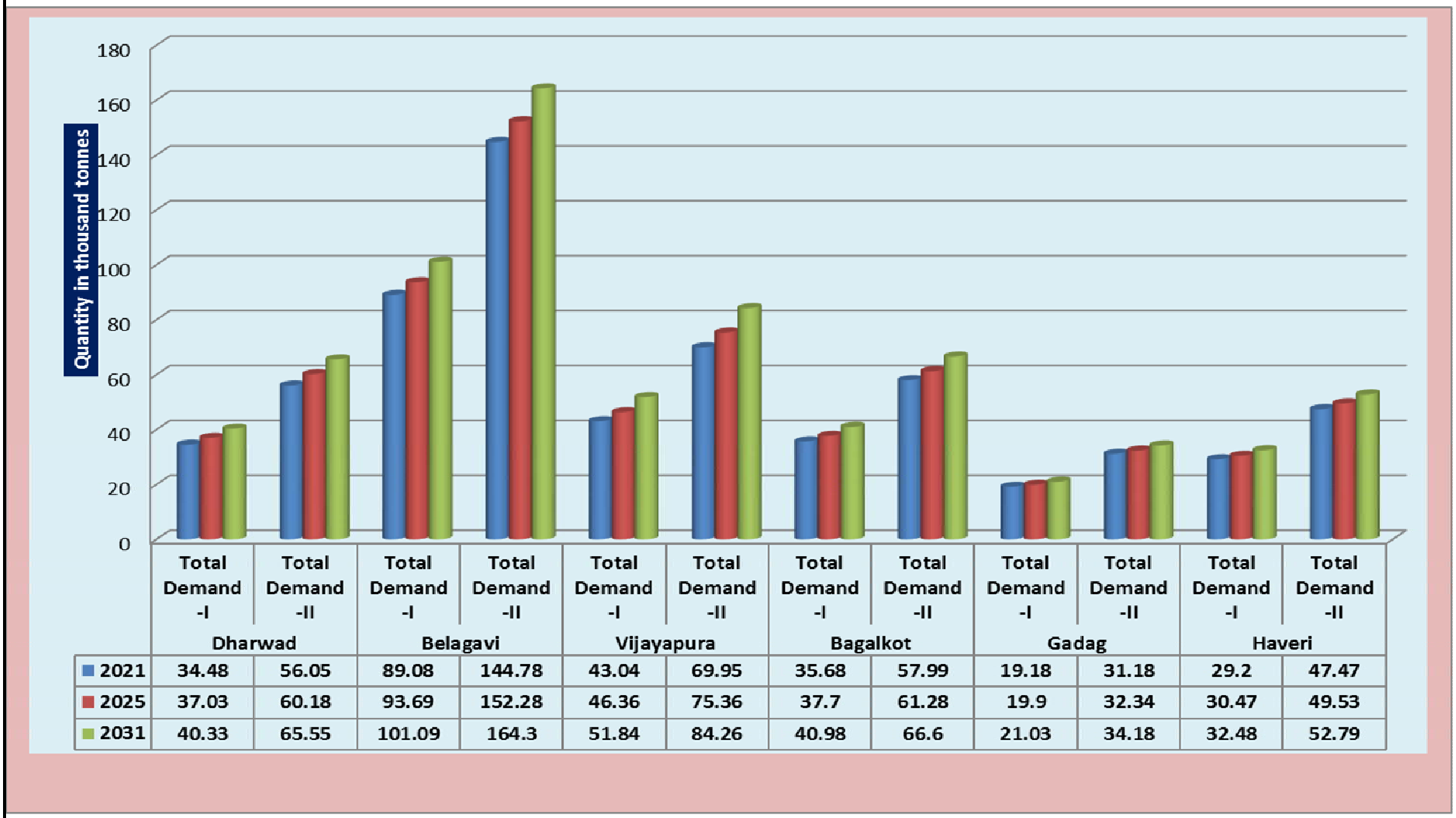
Note: 1. Direct Demand-I= NIN, Recommendation (14.60kg/Year/Capita)*Population
2. Direct Demand-II= NIN, Recommendation (23.73kg/Year/Capita)*Population
3. Indirect Demand-I= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-I
4. Indirect Demand-II= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-II
5. Total Demand-I= Direct Demand-I+ Indirect Demand-I
6. Total Demand-II = Direct Demand-II+ Indirect Demand-II

Table 4.11: Contd…

(Quantity in thousand tonnes)

Years	Direct Demand-I	Direct Demand-II	Indirect Demand-I	Indirect Demand-II	Total Demand-I	Total Demand-II
Gadag						
2018	16.59	26.96	2.07	3.37	18.66	30.33
2019	16.74	27.21	2.09	3.40	18.83	30.61
2020	16.89	27.46	2.11	3.43	19.01	30.89
2021	17.05	27.71	2.13	3.46	19.18	31.18
2022	17.21	27.97	2.15	3.50	19.36	31.46
2023	17.37	28.23	2.17	3.53	19.54	31.75
2024	17.53	28.49	2.19	3.56	19.72	32.05
2025	17.69	28.75	2.21	3.59	19.90	32.34
2026	17.85	29.02	2.23	3.63	20.08	32.64
2027	18.02	29.28	2.25	3.66	20.27	32.94
2028	18.18	29.55	2.27	3.69	20.46	33.25
2029	18.35	29.83	2.29	3.73	20.64	33.55
2030	18.52	30.10	2.32	3.76	20.84	33.86
2031	18.69	30.38	2.34	3.80	21.03	34.18
Haveri						
2018	25.14	40.86	3.14	5.11	28.28	45.97
2019	25.41	41.30	3.18	5.16	28.59	46.46
2020	25.68	41.74	3.21	5.22	28.89	46.96
2021	25.96	42.19	3.24	5.27	29.20	47.47
2022	26.23	42.64	3.28	5.33	29.51	47.97
2023	26.51	43.10	3.31	5.39	29.83	48.48
2024	26.80	43.56	3.35	5.44	30.15	49.00
2025	27.09	44.02	3.39	5.50	30.47	49.53
2026	27.38	44.49	3.42	5.56	30.80	50.06
2027	27.67	44.97	3.46	5.62	31.13	50.59
2028	27.96	45.45	3.50	5.68	31.46	51.13
2029	28.26	45.94	3.53	5.74	31.80	51.68
2030	28.57	46.43	3.57	5.80	32.14	52.23
2031	28.87	46.93	3.61	5.87	32.48	52.79

Note: 1. Direct Demand-I= NIN, Recommendation (14.60kg/Year/Capita)*Population
2. Direct Demand-II= NIN, Recommendation (23.73kg/Year/Capita)*Population
3. Indirect Demand-I= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-I
4. Indirect Demand-II= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-II
5. Total Demand-I= Direct Demand-I+ Indirect Demand-I
6. Total Demand-II = Direct Demand-II+ Indirect Demand-II



	Dharwad		Belagavi		Vijayapura		Bagalkot		Gadag		Haveri	
	Total Demand -I	Total Demand -II	Total Demand -I	Total Demand -II	Total Demand -I	Total Demand -II	Total Demand -I	Total Demand -II	Total Demand -I	Total Demand -II	Total Demand -I	Total Demand -II
2021	34.48	56.05	89.08	144.78	43.04	69.95	35.68	57.99	19.18	31.18	29.2	47.47
2025	37.03	60.18	93.69	152.28	46.36	75.36	37.7	61.28	19.9	32.34	30.47	49.53
2031	40.33	65.55	101.09	164.3	51.84	84.26	40.98	66.6	21.03	34.18	32.48	52.79

Fig. 14: Projected demand of total pulses in study area

Table 4.12: Projected demand of total pulses in Karnataka

(Quantity in lakh tonnes)

Years	Direct Demand-I	Direct Demand-II	Indirect Demand-I	Indirect Demand-II	Total Demand-I	Total Demand-II
Karnataka						
2018	9.99	16.24	1.25	2.03	11.24	18.26
2019	10.16	16.51	1.27	2.06	11.43	18.57
2020	10.33	16.79	1.29	2.10	11.62	18.89
2021	10.51	17.09	1.31	2.14	11.83	19.22
2022	10.67	17.34	1.33	2.17	12.00	19.51
2023	10.85	17.63	1.36	2.20	12.20	19.83
2024	11.03	17.92	1.38	2.24	12.40	20.16
2025	11.21	18.22	1.40	2.28	12.61	20.49
2026	11.39	18.52	1.42	2.31	12.82	20.83
2027	11.58	18.82	1.45	2.35	13.03	21.18
2028	11.77	19.13	1.47	2.39	13.24	21.53
2029	11.97	19.45	1.50	2.43	13.46	21.88
2030	12.16	19.77	1.52	2.47	13.68	22.24
2031	12.36	20.10	1.55	2.51	13.91	22.61

Note: 1. Direct Demand-I= NIN, Recommendation (14.60kg/Year/Capita)*Population
2. Direct Demand-II= NIN, Recommendation (23.73kg/Year/Capita)*Population
3. Indirect Demand-I= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-I
4. Indirect Demand-II= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-II
5. Total Demand-I= Direct Demand-I+ Indirect Demand-I
6. Total Demand-II = Direct Demand-II+ Indirect Demand-II

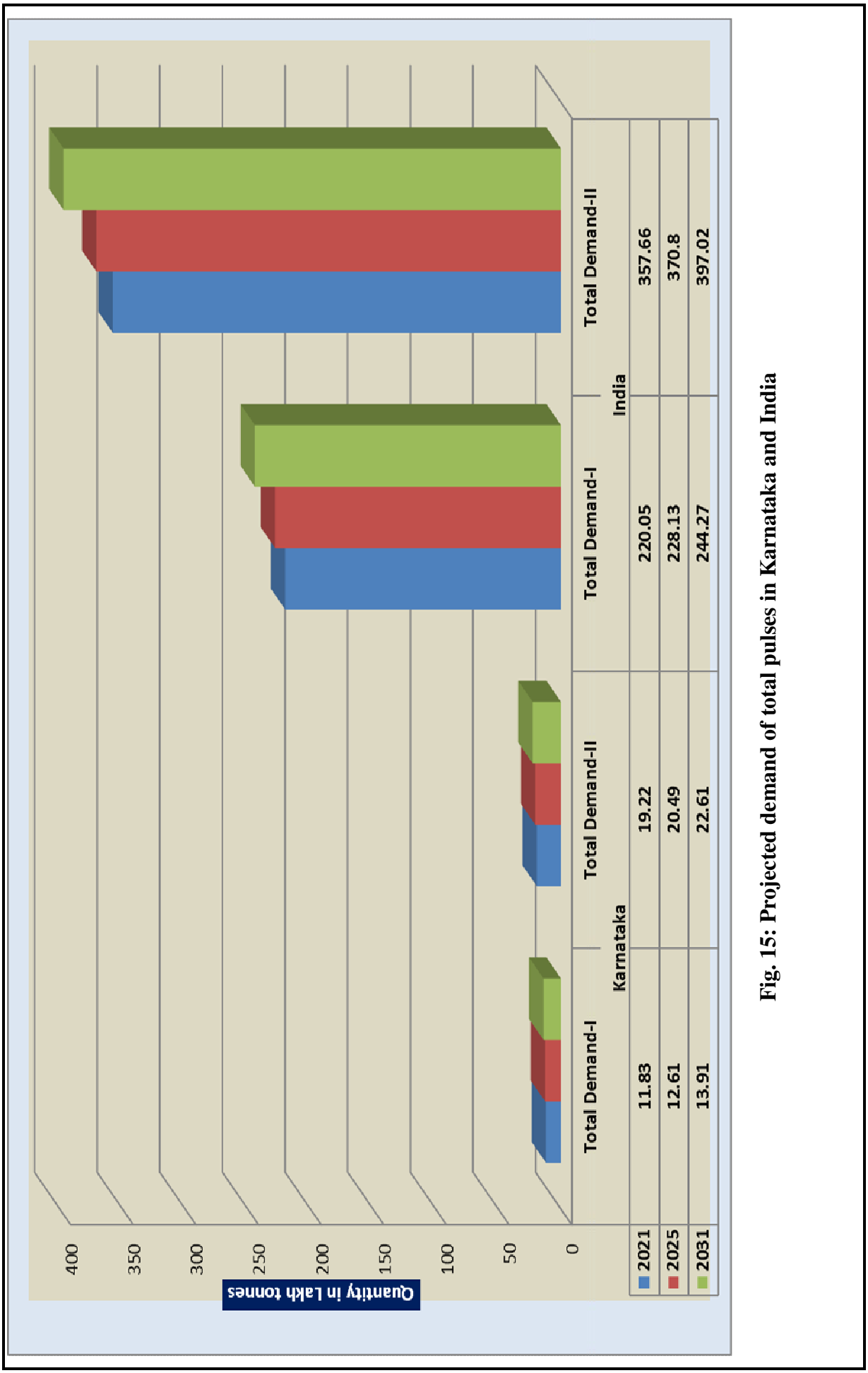


Fig. 15: Projected demand of total pulses in Karnataka and India

total demand-II is expected to reach 19.22 and 22.61 lakh tonnes during 2021 and 2031 respectively.

4.4.3 Projected demand of total pulses in major pulses growing states of India

The demand estimates of total pulses in the major pulses producing states are presented in Table 4.13. The table indicated that the projected total demand-I and total demand-II in Madhya Pradesh was 13.65 and 22.19 lakh tonnes respectively during 2021 and 15.50 (Total demand-I) and 25.20 (Total demand-II) lakh tonnes during 2031. In the case of Rajasthan, projected total demand-I for pulses would be 12.76 and 14.37 lakh tonnes during 2021 and 2031 respectively. Similarly, during 2021 and 2031 the projected total demand-II would be 20.74 and 23.36 lakh tonnes respectively.

The projected total demand-I for pulses in Maharashtra is likely to reach 20.87 lakh tonnes during 2021 and 23.30 lakh tonnes during 2031. However, the total demand-II expected to reach 33.93 and 37.87 lakh tonnes during 2021 and 2031 respectively. In the case of Uttar Pradesh, projected total demand-I for pulses would be 38.54 and 44.32 lakh tonnes during 2021 and 2031 respectively while projected total demand-II is expected to reach 62.64 and 72.04 lakh tonnes during same period.

In Andhra Pradesh, the projected demand-I is expected to touch 15.04 and 16.09 lakh tonnes during 2021 and 2031 respectively. Similarly, the expected total demand-II would be 24.44 lakh tonnes during 2021 and 26.15 lakh tonnes during 2031. In the case of Odisha, projected total demand-I for pulses would be 7.24 and 7.76 lakh tonnes during 2021 and 2031 respectively while projected total demand-II expected to reach 11.76 and 12.61 lakh tonnes during same period. In the case of Tamil Nadu projected Total Demand-I for Pulses would be 11.64 and 12.12 lakh tonnes during 2021 and 2031 respectively. Similarly, during 2021 and 2031 the projected total demand-II would be 18.92 and 19.69 lakh tonnes respectively.

Country as a whole (Table 4.13 and Fig. 15) total pulses requirement worked out to be 220.05 (Total demand-I) and 244.27 (Total demand-II) lakh tonnes during 2021. However, during 2031 the total pulses requirement would touch 357.66 (Total demand-I) and 397.02 (Total Demand-II) lakh tonnes. It is important to note that the requirement of pulses in future would increase because of increase in population growth (1.23 per cent/annum).

Table 4.13: Projected demand of total pulses in major pulses growing states of India

(Quantity in lakh tonnes)

Years	Direct Demand-I	Direct Demand-II	Indirect Demand-I	Indirect Demand-II	Total Demand-I	Total Demand-II
Madhya Pradesh						
2018	11.69	18.99	1.46	2.37	13.15	21.37
2019	11.84	19.25	1.48	2.41	13.32	21.65
2020	11.99	19.49	1.50	2.44	13.49	21.93
2021	12.14	19.73	1.52	2.47	13.65	22.19
2022	12.28	19.96	1.54	2.49	13.82	22.45
2023	12.42	20.19	1.55	2.52	13.97	22.71
2024	12.55	20.41	1.57	2.55	14.12	22.96
2025	12.68	20.62	1.59	2.58	14.27	23.19
2026	12.81	20.82	1.60	2.60	14.41	23.42
2027	13.08	21.26	1.63	2.66	14.71	23.92
2028	13.25	21.54	1.66	2.69	14.91	24.23
2029	13.43	21.82	1.68	2.73	15.10	24.55
2030	13.60	22.11	1.70	2.76	15.30	24.87
2031	13.78	22.40	1.72	2.80	15.50	25.20
Rajasthan						
2018	10.93	17.77	1.37	2.22	12.30	19.99
2019	11.07	17.99	1.38	2.25	12.45	20.24
2020	11.21	18.21	1.40	2.28	12.61	20.49
2021	11.34	18.43	1.42	2.30	12.76	20.74
2022	11.47	18.63	1.43	2.33	12.90	20.96
2023	11.58	18.83	1.45	2.35	13.03	21.18
2024	11.70	19.01	1.46	2.38	13.16	21.39
2025	11.80	19.18	1.48	2.40	13.28	21.58
2026	11.90	19.34	1.49	2.42	13.39	21.76
2027	12.16	19.76	1.52	2.47	13.68	22.23
2028	12.31	20.01	1.54	2.50	13.85	22.51
2029	12.46	20.26	1.56	2.53	14.02	22.79
2030	12.62	20.51	1.58	2.56	14.19	23.07
2031	12.77	20.76	1.60	2.60	14.37	23.36

Note: 1. Direct Demand-I= NIN, Recommendation (14.60kg/Year/Capita)*Population
2. Direct Demand-II= NIN, Recommendation (23.73kg/Year/Capita)*Population
3. Indirect Demand-I= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-I
4. Indirect Demand-II= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-II
5. Total Demand-I= Direct Demand-I+ Indirect Demand-I
6. Total Demand-II = Direct Demand-II+ Indirect Demand-II

Table 4.13: Contd...

(Quantity in lakh tonnes)

Years	Direct Demand-I	Direct Demand-II	Indirect Demand-I	Indirect Demand-II	Total Demand-I	Total Demand-II
Maharashtra						
2018	17.95	29.17	2.24	3.65	20.19	32.82
2019	18.15	29.50	2.27	3.69	20.42	33.19
2020	18.35	29.83	2.29	3.73	20.65	33.56
2021	18.55	30.16	2.32	3.77	20.87	33.93
2022	18.75	30.47	2.34	3.81	21.09	34.28
2023	18.93	30.78	2.37	3.85	21.30	34.62
2024	19.12	31.07	2.39	3.88	21.51	34.96
2025	19.30	31.36	2.41	3.92	21.71	35.28
2026	19.47	31.64	2.43	3.95	21.90	35.59
2027	19.80	32.18	2.47	4.02	22.27	36.20
2028	20.02	32.55	2.50	4.07	22.53	36.61
2029	20.25	32.91	2.53	4.11	22.78	37.03
2030	20.48	33.29	2.56	4.16	23.04	37.45
2031	20.71	33.66	2.59	4.21	23.30	37.87
Uttar Pradesh						
2018	32.83	53.35	4.10	6.67	36.93	60.02
2019	33.31	54.14	4.16	6.77	37.47	60.91
2020	33.79	54.92	4.22	6.86	38.01	61.78
2021	34.26	55.68	4.28	6.96	38.54	62.64
2022	34.70	56.40	4.34	7.05	39.04	63.45
2023	35.14	57.11	4.39	7.14	39.53	64.24
2024	35.55	57.79	4.44	7.22	40.00	65.01
2025	35.95	58.43	4.49	7.30	40.44	65.74
2026	36.32	59.03	4.54	7.38	40.86	66.41
2027	37.19	60.45	4.65	7.56	41.84	68.00
2028	37.73	61.32	4.72	7.67	42.45	68.99
2029	38.28	62.21	4.78	7.78	43.06	69.99
2030	38.83	63.12	4.85	7.89	43.69	71.01
2031	39.40	64.03	4.92	8.00	44.32	72.04

Note: 1. Direct Demand-I= NIN, Recommendation (14.60kg/Year/Capita)*Population
2. Direct Demand-II= NIN, Recommendation (23.73kg/Year/Capita)*Population
3. Indirect Demand-I= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-I
4. Indirect Demand-II= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-II
5. Total Demand-I= Direct Demand-I+ Indirect Demand-I
6. Total Demand-II = Direct Demand-II+ Indirect Demand-II

Table 4.13:Contd...

(Quantity in lakh tonnes)

Years	Direct Demand-I	Direct Demand-II	Indirect Demand-I	Indirect Demand-II	Total Demand-I	Total Demand-II
Andhra Pradesh						
2018	13.09	21.28	1.64	2.66	14.73	23.94
2019	13.19	21.44	1.65	2.68	14.84	24.11
2020	13.28	21.58	1.66	2.70	14.94	24.28
2021	13.37	21.72	1.67	2.72	15.04	24.44
2022	13.45	21.86	1.68	2.73	15.13	24.59
2023	13.53	21.99	1.69	2.75	15.22	24.73
2024	13.60	22.11	1.70	2.76	15.30	24.87
2025	13.67	22.22	1.71	2.78	15.38	25.00
2026	13.73	22.32	1.72	2.79	15.45	25.11
2027	13.91	22.60	1.74	2.83	15.65	25.43
2028	14.00	22.76	1.75	2.85	15.76	25.61
2029	14.10	22.92	1.76	2.87	15.87	25.79
2030	14.20	23.08	1.78	2.89	15.98	25.97
2031	14.30	23.25	1.79	2.91	16.09	26.15
Odisha						
2018	6.30	10.24	0.79	1.28	7.08	11.51
2019	6.34	10.31	0.79	1.29	7.14	11.60
2020	6.39	10.38	0.80	1.30	7.19	11.68
2021	6.43	10.46	0.80	1.31	7.24	11.76
2022	6.47	10.52	0.81	1.32	7.28	11.84
2023	6.51	10.59	0.81	1.32	7.33	11.91
2024	6.55	10.65	0.82	1.33	7.37	11.98
2025	6.59	10.71	0.82	1.34	7.41	12.04
2026	6.62	10.76	0.83	1.34	7.44	12.10
2027	6.70	10.89	0.84	1.36	7.54	12.25
2028	6.75	10.97	0.84	1.37	7.59	12.34
2029	6.80	11.05	0.85	1.38	7.65	12.43
2030	6.85	11.13	0.86	1.39	7.70	12.52
2031	6.90	11.21	0.86	1.40	7.76	12.61

Note: 1. Direct Demand-I= NIN, Recommendation (14.60kg/Year/Capita)*Population
2. Direct Demand-II= NIN, Recommendation (23.73kg/Year/Capita)*Population
3. Indirect Demand-I= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-I
4. Indirect Demand-II= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-II
5. Total Demand-I= Direct Demand-I+ Indirect Demand-I
6. Total Demand-II = Direct Demand-II+ Indirect Demand-II

Table 4.13: Contd...

(Quantity in lakh tonnes)

Years	Direct Demand-I	Direct Demand-II	Indirect Demand-I	Indirect Demand-II	Total Demand-I	Total Demand-II
Tamil Nadu						
2018	10.23	16.62	1.28	2.08	11.51	18.70
2019	10.27	16.69	1.28	2.09	11.55	18.78
2020	10.31	16.76	1.29	2.09	11.60	18.85
2021	10.35	16.82	1.29	2.10	11.64	18.92
2022	10.38	16.87	1.30	2.11	11.68	18.98
2023	10.41	16.92	1.30	2.12	11.71	19.04
2024	10.44	16.97	1.31	2.12	11.75	19.09
2025	10.47	17.01	1.31	2.13	11.78	19.14
2026	10.49	17.05	1.31	2.13	11.80	19.18
2027	10.59	17.21	1.32	2.15	11.91	19.36
2028	10.63	17.28	1.33	2.16	11.96	19.44
2029	10.68	17.36	1.33	2.17	12.01	19.53
2030	10.72	17.43	1.34	2.18	12.06	19.61
2031	10.77	17.50	1.35	2.19	12.12	19.69
India						
2018	189.51	308.03	23.69	38.50	213.20	346.53
2019	191.59	311.39	23.95	38.92	215.54	350.32
2020	193.62	314.70	24.20	39.34	217.82	354.03
2021	195.60	317.92	24.45	39.74	220.05	357.66
2022	197.49	320.99	24.69	40.12	222.18	361.12
2023	199.33	323.99	24.92	40.50	224.25	364.48
2024	201.11	326.87	25.14	40.86	226.24	367.73
2025	202.79	329.60	25.35	41.20	228.13	370.80
2026	204.38	332.18	25.55	41.52	229.92	373.70
2027	207.99	338.06	26.00	42.26	233.99	380.32
2028	210.24	341.71	26.28	42.71	236.52	384.43
2029	212.51	345.40	26.56	43.18	239.07	388.58
2030	214.81	349.13	26.85	43.64	241.66	392.78
2031	217.13	352.90	27.14	44.11	244.27	397.02

Note: 1. Direct Demand-I= NIN, Recommendation (14.60kg/Year/Capita)*Population
2. Direct Demand-II= NIN, Recommendation (23.73kg/Year/Capita)*Population
3. Indirect Demand-I= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-I
4. Indirect Demand-II= Seed, Feed & wastage (SFW) @12.5% of gross output of Direct Demand-II
5. Total Demand-I= Direct Demand-I+ Indirect Demand-I
6. Total Demand-II = Direct Demand-II+ Indirect Demand-II

4.5 Export and import performance of pulses

4.5.1 Import

The rapid growth in Indian agriculture trade is witnessed particularly after 1990 and exports are now poised for a major breakthrough. However, India has been steadily increasing its world market share in imports of pulses. Therefore, an attempt is made to evaluate the growth in import and export of pulses viz., redgram, bengalgram, greengram, blackgram and total pulses.

The exponential function was employed to arrive growth rates in quantity and value of imports and exports of different pulses during pre-liberalized (periods-I) and post- liberalized (period-II) periods.

The compound growth rates in quantity and value of pulses import (Table-4.14 and Fig. 16) clearly indicated that both quantity and value of import of total pulses increased significantly in pre and post-liberalized periods as well as in the overall period. The growth rate of quantity of pulses imports were 17.66, 10.93 and 9.07 per cent in period-I, period-II and overall period respectively. Further, growth in value of imports was significantly higher in period–I (36.33 %) compared to period-II (16.88 %) revealing overall growth of 16.79 per cent in the overall period.

The compound growth rates in quantity as value of redgram, bengalgram, greengram and blackgram were also worked out and presented in the Table-4.14. Growth rate for these individual pulses restricted to period-II due to non-availability of data on imports in period-I. The growth rates in import of both in quantity (11.11 %) and value (5.15 %) of redgram during post-liberalized period were found to be significantly increasing. In case bengalgram, growth in import of both quantity (4.08 %) and value (1.34 %) were found to be lower than redgram. The import performance of greengram during post-liberalization period showed positive and significant in quantity (14.22 %) while growth in import value (8.55 %) was non-significant. However, negative growth rate was found in import of blackgram in quantity (-15.41 %) during some period, even though growth in value (-19.12 %) was negative and significant.

4.5.2 Export

The growth in export of quantity (21.42 %) and value (44.07 %) of total pulses during pre-liberalized period was found to be significantly higher than that of post-liberalized period.

Table 4.14: Growth rate of export and import of total pulses in India

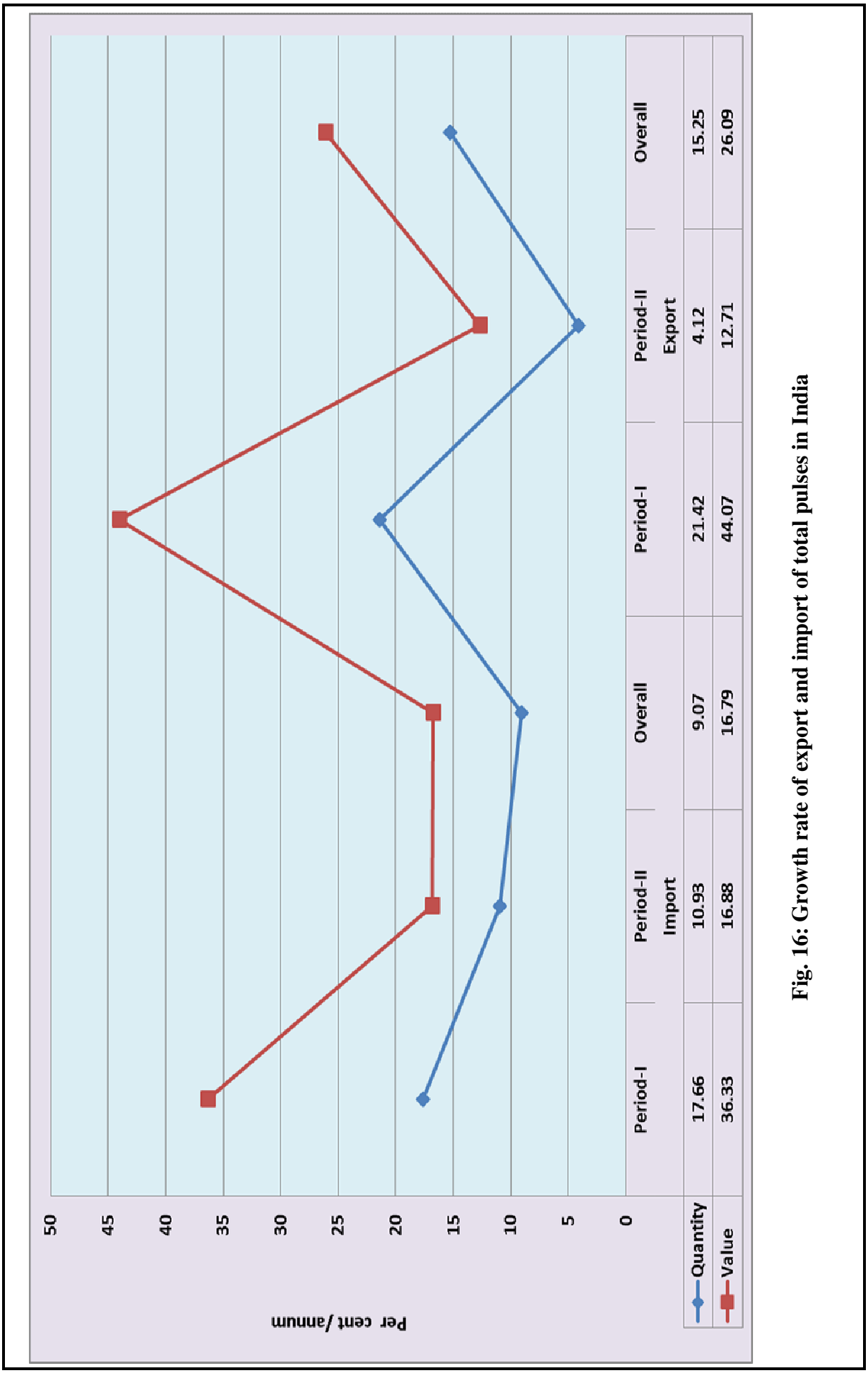
(Per cent/annum)

Crop	Particulars	Import			Export		
		Period-I	Period-II	Overall	Period-I	Period-II	Overall
Redgram	Quantity	NA	11.11***	11.11***	NA	-8.15**	-8.15**
	Value		5.15**	5.15**		-3.15	-3.15
Bengalgram	Quantity		4.08*	4.08*		20.12***	20.12***
	Value		1.34	1.34		11.23***	11.23***
Greengram	Quantity		14.22***	14.22***		-0.62	-0.62
	Value		8.55	8.55		-1.01	-1.01
Blackgram	Quantity		-15.41	-15.41		3.65**	3.65**
	Value		-19.12**	-19.12**		1.82***	1.82***
Total Pulses	Quantity	17.66***	10.93***	9.07***	21.42***	4.12*	15.25***
	Value	36.33***	16.88***	16.79***	44.07***	12.71***	26.09***

Note: Period-I= 1980 to 1990, Period-II= 1991 to 2016 and Overall= 1980 to 2016

NA= Data not available

***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.



	Import			Export		
	Period-I	Period-II	Overall	Period-I	Period-II	Overall
Quantity	17.66	10.93	9.07	21.42	4.12	15.25
Value	36.33	16.88	16.79	44.07	12.71	26.09

Fig. 16: Growth rate of export and import of total pulses in India

Whereas, growth in value (26.09 %) of export were higher than its quantity (15.25 %) in the overall period. It was interesting to note that export of individual pulses indicated that redgram export in terms of quantity (-8.15 %) was significantly decreasing while values of export (-3.15 %) also were declining but non-significant. A similar trend was noticed in export of both in quantity and value of greengram. In contrary to this, bengalgram and blackgram growth in quantity and value of exports were significantly increasing.

The import and export of major pulses during 2015-16 is presented in Table 4.15 it could be seen from the table that among the major pulses the highest quantity imported was peas with a quantity of 2245.39 thousand tonnes (38.72 %) followed by lentils (21.73 %), bengalgram (17.79 %), greengram + blackgram (10.03 %) and redgram (7.98 %). However, pertain to export bengalgram (84.87 %) shares highest quantity followed by lentils (4.60 %), peas (2.52 %), greengram+blackgram (2.50 %), and redgram (1.57 %). The total quantity imported by India during 2015-16 was 5799.77 thousant tonnes and the exported quantity was 255.6 thousand tonnes.

India was trades destination of major pulses (Table 4.16) showed that UAS (40.79 %), UAE (18.28 %), Canada (11.28 %), UK (10.75 %) and Singapore (5.11 %) are top five export destination of redgram from India. Similarly, Mayanmar (46.35 %), Tanzania (18.71 %), Mozambique (15.36 %), Malawi (12.56 %) and Sudan (3.36 %) countries are import source of redgram to India. In case of bengalgram, Pakistan (35.60 %), Algeria (15.17 %), Turkey (8.58 %), Sri Lanka (8.07 %) and UAE (4.97 %) countries are top five export destination from India. The top five import source countries for bengalgram to India were Australia (74.40 %), Russia (16.49 %), Tanzania (2.79 %), Mayanmar (0.92 %) and USA (0.74 %).

In case of greengram and blackgram the top five export destination countries were USA (39.96 %), Sri Lanka (13.05 %), UK (9.86 %), Australia (7.77 %) and Malaysia (7.63 %). However, the top five import source countries for bengalgram+greengram were Mynamar (0.92 %), Kenya (7.43 %), Australia (6.32 %), Tanzania (3.15 %) and Uzbekistan (2.60 %). The highest quantity of lentil was mainly imported from Sri Lanka (43.39 %) followed by Bangladesh (18.11 %), UAE (8.35 %), Egypt (3.98 %) and UAS (3.67 %). Though, lentil was imported from other countries in other side lentil was exported to Canada (89.58 %), USA (7.47 %), Australia (2.88 %), Turkey (0.03 %) and Mozambique (0.03 %).

Table 4.15: India's import and export of major pulses in 2015-16

(Unit: Thousand tonnes)

Sl. No	Pulses	Import	Share in Total Pulses Import (%)	Export	Share in Total Pulses Export (%)
1	Redgram	462.71	7.98	4.02	1.57
2	Bengalgram	1031.48	17.79	216.93	84.87
3	Greengram and Blackgram	581.60	10.03	6.39	2.50
4	Lentils	1260.19	21.73	11.77	4.60
5	Peas	2245.39	38.72	6.44	2.52
	Total pulses	**5797.77**	**100**	**255.6**	**100.00**

Data Source: Department of Commerce

Table 4.16: India's trade destination of major pulses for 2015-16

Sl. No	Pulses	Top 5 Export Destination		Top 5 Import Source	
		Country	Per cent Share	Country	Per cent Share
1	Redgram	USA	40.79	Myanmar	46.35
		UAE	18.28	Tanzania	18.71
		Canada	11.28	Mozambique	15.36
		UK	10.75	Malawi	12.56
		Singapore	5.11	Sudan	3.36
2	Bengalgram	Pakistan	35.60	Australia	74.40
		Algeria	15.17	Russia	16.49,
		Turkey	8.58	Tanzania	2.79
		Sri Lanka	8.07	Myanmar	0.92
		UAE	4.97	USA	0.74
3	Greengram and Blackgram	USA	39.96	Myanmar	70.37
		Sri Lanka	13.05	Kenya	7.43
		UK	9.86	Australia	6.32,
		Australia	7.77	Tanzania	3.15
		Malaysia	7.63	Uzbekistan	2.60
4	Lentil	Sri Lanka	43.39	Canada	89.58
		Bangladesh	18.11	USA	7.47
		UAE	8.35	Australia	2.88
		Egypt A RP	3.98	Turkey	0.03
		USA	3.67	Mozambique	0.03
5	Peas	Sri Lanka	81.07	Canada	60.97
		Nepal	12.56	Russia	14.82
		Ukrain	4.28	USA	6.96
		USA	1.63	France	5.36
		Bangladesh	0.42	Luthuania	4.15

Data Source: Department of Commerce

As evident from the Table 4.15 among the major pulses, peas were imported in largest quantity and the top five import source countries are Canada (60.97 %), Russia (14.82 %), USA (6.96 %), France (5.36 %) and Luthuania (4.15 %). Though, India was largest importer of peas but in other side the country exported the peas to Sri Lanka (81.07 %), Nepal (12.56 %), Ukrain (4.28 %), USA (1.63 %) and Bangladesh (0.42 %).

4.6 Cost and returns

The crop wise details of variable cost and fixed cost incurred, cost of cultivation as well as returns obtained in cultivation of pulses in the study area are presented in Table 4.17

4.6.1 Redgram

On an average farmer incurred a total cost of cultivation of ₹ 17,137 per acre of which variable cost accounted for more than 70.05 per cent (Table 4.17). Among the variable cost, expenditure on human labour (17.85 %, Family+Hired) constituted major items of total cost of cultivation followed by interest on working capital (9.14 %), plant protection chemical (8.26 %), fertilizer (7.29 %), thresher cost (6.07 %),tractor cost (5.60 %), farm yard manure (5.54 %), bullock labour (5.49 %), marketing expenses (2.11 %), seeds (2.08 %) and sprayer (0.67 %). The rental value of land formed major component (26.26 %) of the total cost of cultivation among fixed cost. The overall average net returns obtained by redgram growers amounted ₹ 8,353 per acre with gross returns of ₹ 25,490 per acre with a 1.49 returns per rupee of investment.

4.6.2 Bengalgram

The farmers of bengalgram cultivation incurred a total cost of ₹ 16,046 per acre out of which ₹ 10,307 (64.23 %) constituted by variable cost. Out of total cost of cultivation, the expenditure on labour (16.83 %, Family+Hired), formed a major component followed by interest on working capital (8.38 %), fertilizer (6.54 %), seeds (6.34 %), farm yard manure (5.30 %), bullock labour (5.23 %), plant protection chemicals (5.15 %),tractor cost (4.05 %), thresher cost (2.77 %), marketing expenses (2.56 %) and sprayer (1.09 %). The rental value of land (31.16 %) formed major component of fixed cost followed by interest on fixed capital (2.65 %), depreciation (1.78 %) and land revenue (0.17 %).

Table 4.17: Cost and returns structure of selected pulses in study area

(₹/acre)

Sl.No	Particulars	Redgram (n=120)		Bengalgram (n=120)		Greengram (n=120)	
		Value (₹)	Percentage	Value (₹)	Percentage	Value (₹)	Percentage
I	**Variable Cost**						
1	Farm yard Manure	950	5.54	850	5.30	850	5.92
2	Seeds	357	2.08	1,017	6.34	861	6.00
3	Fertilizer	1,250	7.29	1,049	6.54	1,198	8.35
4	P.P. Chemicals	1,416	8.26	827	5.15	350	2.44
5	Labour						
	a) Family	1,800	10.56	1,250	7.79	877	6.11
	b) Hired	1,249	7.29	1,450	9.04	1,400	9.75
6	Bullock Labour	940	5.49	840	5.23	900	6.27
7	Machine Labour						
	a) Tractor	960	5.60	650	4.05	620	4.32
	b) Thresher	1,040	6.07	445	2.77	460	3.21
	c) Sprayer	114	0.67	175	1.09	100	0.70
8	Marketing Expenses	362	2.11	410	2.56	401	2.79
9	Interest on Working Capital (15%)	1,566	9.14	1,344	8.38	1,202	8.38
Sub Total		**12,004**	**70.05**	**10,307**	**64.23**	**9,219**	**64.23**
II	**Fixed Cost**						
1	Depreciation	225	1.31	286	1.78	225	1.57
2	Rental value of land (20% of GR)	4,500	26.26	5,000	31.16	4,500	31.35
3	Land revenue	28	0.16	28	0.17	28	0.20
4	Interest on fixed capital (8%)	380	2.22	425	2.65	380	2.65
Sub total		**5,133**	**29.95**	**5,739**	**35.77**	**5,133**	**35.77**
Grand Total		**17,137**	**100.00**	**16,046**	**100.00**	**14,352**	**100.00**

Table 4.17: Contd…

III	**Output**						
1	Yield (qtl)	4.8		6.5		3.8	
2	Price (MSP) (₹/q)	5,050		4,000		4,850	
3	By product(₹ tractor load)	1,250		1,000		1,000	
IV	**Returns**						
1	Gross returns	25,490		27,000		19,430	
2	Net Returns	8,353		10,954		5,078	
3	Returns per rupee of investment	1.49		1.68		1.35	
4	Total cost of cultivation	17,139		16,046		14,352	
5	Total cost of production (₹/q)	3,570		2,468		3,776	
6	Net returns (₹/q)	1,480		1,532		1,074	

Note: Percentage are to the total cost of cultivation of respective crop. GR: Gross Revenue

It is interesting to note that overall average yield obtained by bengalgram grower was 6.59 quintal per acre and net returns recovered to the tune of ₹ 10,954 per acre with gross returns of ₹ 27,000 per acre with 1.68 returns per rupee of investment.

4.6.3 Greengram

In case of greengram, the overall cost of cultivation amounted to ₹14,352 per acre of which ₹ 9,219 (64.23 %) was incurred on variable cost. Out of total cost of cultivation, the expenditure on human labour (15.86 %, Family+Hired), formed the major component followed by interest on working capital (8.38 %), fertilizer (8.35 %), bullock labour (6.27 %), seeds (6 %), farm yard manure (5.92 %), tractor cost (4.32 %), thresher cost (3.21 %), marketing expenses (2.79 %), plant protection chemical (2.44 %) and sprayer cost (0.70 %) were the other important variable cost. While rental value of land (31.35 %) formed the major cost among the fixed cost.

In case of returns, on an average farmers realized 3.89 quintal output per acre. The farmer sold greengram relatively at higher price compared to other pulses. On an average farmer obtained per acre net returns of ₹ 5,078 with gross returns of ₹ 19,430.

The findings of the study showed that per quintal cost of production was higher in redgram (₹ 3,570) followed by greengram (₹ 3,776) and bengalgram (₹ 2,468). However, minimum support price (MSP) announced by CACP during study period were indicated inter pulse price parity. Though the cost of production was higher in redgram and bengalgram which are long duration crop leading to higher cost of cultivation compared to greengram (Short duration with lower cost of cultivation). In contrary to this, MSP announced during study period higher in greengram (₹4,850) compared to bengalgram (₹ 4,000). Whereas, the MSP announced for redgram was (₹ 5,050) which is higher than bengalgram and greengram. Therefore, To encourage pulses grower particularly bengalgram and greengram, inter pulses price parity need to be corrected.

4.7 Constraint faced by farmers in production of pulses

The major constraints in pulses cultivation perceived by farmers presented in Table 4.18. It can be seen from the table that infrastructural constraint comprised of four related constraints viz, non availability of high yielding variety (HYV) of seeds at the time of sowing, non availability of suitable plant protection chemicals, non availability of required fertilizer in

Table 4.18: Major constraints in pulses cultivation as perceived by the farmers

(N=360)

Sl. No	Problems (Constraints)	Garret Score	Rank
I	**Infrastructural constraints**		
1	Non availability of HYV seeds at the time of sowing	67.33	I
2	Non availability of suitable plant protection chemicals in the market	49.63	III
3	Non availability required fertilizer in the market	53.63	II
4	Lack of irrigation facilities	28.50	IV
II	**Socio-economic constraints**		
1	High cost of inputs	79.56	I
2	High cost of labour.	71.86	III
3	Labour scarcity	74.43	II
4	Non availability of credits in time	66.73	V
5	Lack of subsidy for inputs.	66.71	VI
6	Low profit	69.30	IV
III	**Technological Constraints**		
1	Lack of proper knowledge about improved varieties, seed, rate, spacing and sowing date	77.00	I
2	Lack of knowledge about seed treatment.	74.33	II
3	Lack of knowledge about fertilizer dosage and method of fertilizer application.	66.73	V
4	Lack of knowledge about weed management.	69.30	IV
5	Lack of knowledge about insect pest and diseases management	71.86	III
6	Lack of knowledge about use of growth regulators	66.20	VI
IV	**Institutional Constraints**		
1	Weak research-extension farmer linkages	89.95	I
2	Non availability of suitable literature.	77.43	III
3	Poor performance of regulated market.	86.74	II
V	**Marketing Constraints**		
1	Lack market information	72.33	IV
2	High marketing cost	81.24	II
3	Poor marketing infrastructure	83.75	I
4	Lack of transparency in market operation	68.55	V
5	Poor performance of pledged loan scheme	59.66	VI
6	High market margins to middlemen	76.55	III

the market and lack of irrigation facilities. Among these, non availability of high yielding variety seeds of pulses and non availability of required fertilizer in the market were the two major constraint that were ranked I and II having a Garret score of 67.33 and 53.63 respectively (Table 4.18), non availability of suitable plant protection chemical in the market (Garret score 49.63) and lack of irrigation facilities (Garret score 28.50) was perceived as the least important constraint.

Table 4.18 also showed that six constraints were perceived by the farmers are related to their socio-economic conditions, high cost of inputs, labour scarcity and high cost of labour were the major constraints in the category and these were ranked I. II and III with an overall Garret score of 79.56, 74.43 and 71.86 respectively. The other constraints in this category were low profit from pulses cultivation (Garret score, 69.30), non availability of credit in time (Garret score, 66.73) and lack of subsidy for inpurs (Garret score, 66.71).

An analysis of technological constraints presented in Table 4.18 reflects the lack of proper knowledge about improved varieties, seedrate, spacing and sowing date was ranked I on the basis of Garret score (77.00), lack of knowledge about seed treatment and lack of knowledge about insect pest and disease management were II and III with an overall Garret score of 74.33 and 71.86 respectively. The other constraint in this category were lack of knowledge of weed management (Garret score, 69.30) and lack of knowledge about use of growth regulator (Garret score, 66.20).

Regarding institutional constraints it was observed that weak research-extension farmer's linkage was ranked-I (Garret score, 89.95) and poor performance of regulated market ranked II (Garret score, 86.74). The third in order to this category was non availability of suitable literature (Garret score 77.43). It can be observed from the table 4.18 that poor marketing infrastructure rank I(Garret score, 83.75) in marketing constraints followed by high marketing cost (Rank II), high market margin to middlemen (Rank III), lack of market information (Rank IV), lack of transparency in market operation (Rank V) and poor performance of pledged loan schemes (VI).

An observation of the data in Table 4.19 showed that Institutional constraint ranked I by the respondent (Garret score, 84.17) followed by technological constraints (Garret score, 81.66), socio-economic constraint (Garret score, 77.50) and marketing constraint (Garret score 57.42). The infrastructural constraint was ranked least (Garret score, 63.23).

Table 4.19: Major categories of constraints as perceived by the farmers in pulses cultivation

(N=360)

Sl. No	Categories Constraints	Garret score	Rank
1	Infrastructural constraints	63.23	IV
2	Socio-economic constraints	77.50	III
3	Technological constraints	81.16	II
4	Institutional constraints	84.17	I
5	Marketing constraints	57.42	V

4.8 Factors influencing the supply of pulses

4.8.1 Identification of factors influencing pulses production

The technique of principal component analysis (PCA) was applied to isolate the influencing variables on the performance of pulses production. An attempt was made to know which of the variable exerted more influence on the performance of production of pulses in the study area.

The variable having a bearing on production of pulses, 20 variables were identified in consultation with scientists and experts and was subjected to PCA. This technique was adopted to identify most important factor having bearing on performance of pulses production.

The co-efficient of eigen vector constituted the weights assigned to the each variable, the variables which had higher weight were considered dominant in the component.

The results of principal component analysis (Table 4.20) showed that out of 20 variables, 8 variables were found in the first component, 4 were grouped in second component, 2 variables each in component third and fourth and remaining 4 variables were found in fifth component. The important variables with higher factor loading were found in the first component viz. area under crop, variety used, fertilizers, seeds, incidence of pest and market price. Similarly, the influencing factors in the second cluster were incidence of disease and rainfall during flowering.

Out of five factors, two factors explained 97.29 per cent of total variance were selected for interpretation. Table-4.20 shows factor loading of each variable under different factors and per cent variation explained by each factor.

The first component explains 90.07 per cent of variation among 20 variables chosen for the study, six variables showed higher factor loading (above 0.80) on the first dimension. The area under pulses, use of improved varieties, fertilizers, seeds, pest incidence and market price had highest factor loadings of 0.958, 0.945, 0.941, 0.940, 0.923 and 0.888 respectively. This implied that these variables were the important variables in the production of pulses.

The second component explained 7.22 per cent of variation and it consists of two variables with above 0.80 factor loading viz., disease incidence (0.827) and rain fall during sowing (0.815).

Table 4.20: Principle component and factor loading of variables influencing on production/ supply of selected pulses in study area

Sl. No	Variables	Label	Factor Loading
A	**Component-I**		
1.	Area under crop	P20	0.95872
2.	Varieties	P19	0.94566
3.	Fertilizers	P17	0.94121
4.	Seeds	P10	0.94038
5.	Pest incidence	P14	0.92322
6.	Market price	P18	0.88822
7.	Rainfall during pod formation	P3	0.79625
8.	RH during flowering	P4	0.60537
	Variance Explained		**90.07**
B	**Component-II**		
9.	Disease incidence	P15	0.82712
10.	Rainfall during sowing	P1	0.81527
11.	Rainfall during flowering	P2	0.78829
12.	Bullock labour	P8	0.55985
	Variance Explained		**7.22**
C	**Component-III**		
13.	Quantity of labour used	P7	0.78948
14.	Availability of labour	P6	0.72759
	Variance explained		**2.25**
D	**Component-IV**		
15.	Growth regulator	P11	0.79845
16.	FYM	P13	-0.6925
	Variance explained		**0.36**
E	**Component-V**		
17.	Weedicide	P5	0.79919
18.	Vermicompost	P16	0.63112
19.	Micro nutrient	P12	0.24778
20.	Machine labour	P9	0.00253
	Variance Explained		**0.10**
	Cumulative variance explained		**100.00**

From the above discussion it can be concluded that area under crop, variety used, fertilizers, seeds, incidence of pest and disease, market price and adequate and timely rainfall during sowing were relatively more important than the other variables included in the model.

4.8.2 Assessment of factors influencing pulses production

The main objective of any production unit was better co-ordination and utilization of various resources to realize higher returns. In this section, an attempt was made to analyse the potentiality of variables identified by principal component analysis. The analysis was done separately for selected crops and also for pooled data, in order to determine whether or not these factors significantly influencing production of pulses. The regression analysis was carried out on per farm bases.

To study the influence of different variables on production of pulses, multiple regression analysis was carried out. To know the impact of explanatory variables on production, crop output as dependent variable and area (X_1) under crop, fertilizers (X_2), seeds (X_3), pest incidence (X_4), disease incidence (X_5) rainfall during sowing (X_6) used as independent variable in addition to variety used (D_1) and market price (D_2) were introduced as dummy variables.

The regression estimates in redgram production (Table 4.21) in general with significant co-efficient (0.969) of multiple determination (R^2) implied that 97.00 per cent of variation in the redgram output was explained by variables included in the model.

The regression co-efficient of fertilizers (10.549) and rainfall during sowing (0.807) were found positive and highly significant at one and ten per cent respectively. The co-efficient of area under crop (0.41) was positive but statically non-significant. However, regression of co-efficient of seeds (-0.004), pest incidence (-0.801) and disease incidence (-0.481) were negative and non-significant. This implies that one per cent increase in incidence of pest and disease leads to decline in the production of redgram by about 0.801 and 0.481 per cent respectively, with marginal negative influence of seeds on production. It is interesting to note that area under crop fail to excert any significant influence on redgram production as indicated by non significant co-efficient of 0.41. Whereas, use of improved variety (2.558)

Table 4.21: Multiple regressions estimated in selected pulses production in study area

(Per farm)

Sl. No	Explanatory Variables	Parameters	Redgram	Bengalgram	Greengram
1	Intercept	a	56.905 (64.611)	33.019 (17.404)	4.984 (16.365)
2	Area (acres)	X1	0.41 ^{NS} (2.806)	4.113*** (0.661)	2.611** (1.058)
3	Fertilizers (Kg)	X2	10.549*** (2.908)	1.100 ^{NS} (0.485)	-1.243* (0.619)
4	Seeds (Kg)	X3	-0.004 ^{NS} (0.313)	0.153 ^{NS} (0.136)	0.215* (0.172)
5	Pest incidence (%)	X4	-0.801 ^{NS} (6.388)	-0.758* (0.495)	-1.174 ^{NS} (1.012)
6	Disease incidence (%)	X5	-0.481 ^{NS} (0.815)	-0.136** (0.056)	-0.955** (0.461)
7	Rainfall during sowing (mm)	X6	0.807* (0.618)	2.810* (1.619)	0.22 ^{NS} (0.171)
8	Variety	D1	2.558* (3.996)	2.115 ^{NS} (1.981)	0.429 ^{NS} (2.11)
9	Market price	D2	1.889 ^{NS} (5.764)	2.651 ^{NS} (2582)	1.881 ^{NS} (1.641)
10	Coefficient of determination	R^2	0.969	0.978	0.971
11	Adjusted R^2	Adjusted R^2	0.951	0.974	0.964
12	F Value	F	90.722	221.81	132.441
13	No. of Observation	N	120	120	120

Note: Figures in parenthesis indicates standard errors of respective regression coefficient

***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.

NS: Non significant

and market price (1.889) introduced as dummy variables were influencing positively on production of redgram in the study area.

The coefficient of multiple determination was highly significant indicating that independent variables included in the model explained a very high percentage of variation (98 %) in the bengalgram production.

The regression coefficients of area (4113) and rainfall (2.810) were positive and highly significant at one and ten per cent probability level, while it was positive and non-significant in case of fertilizers (1.100) and seeds (0.153). Similarly, use of improved variety (2.115) and higher market price (2.651) were influenced positively on production of bengalgram. In other words increase in area and rainfall by one per cent leads to increase in production of bengalgram by 4.11and 2.81 per cent respectively with positive influence of use of improved varieties and higher market price. However, increase in pest and disease incidence resulted significant declining in production by 0.75 and 0.13 per cent respectively.

The regression estimate of greengram production (Table 4.21) showed that the independent variables included in the model explained more than 97 per cent variations in greengram production as indicated by co-efficient of multiple determination (R^2) of 0.97. The calculated F value was also statistically significant.

Among the independent variables included in the model, regression co-efficient of area (2.611) under crop and seeds (0.215) were positives and significant at five and ten per cent level. Whereas fertilizer (-1.243) and disease incidence (-0.955) were also significant but have influenced negatively on production of greengram. However, rainfall (0.22) was influenced positively with non-significant coefficient. It was interesting to note that pest incidence had negative regression co-efficient implying increase in pest incidence (-1.174) which was not going to influence significantly on decline in production of greengram. Further, use of improved varieties (0.429) and higher market price (1.881) were influenced positively on production of greengram.

Discussion

5. DISCUSSION

The results of the investigation presented in the preceding chapter are discussed in detail in this chapter. The main focus here is to throw light on some of the causes responsible for the important result noted in the previous chapter. It also attempts at an evaluation of the results and their policy implication. . Keeping objectives of the study in view the results are discussed under the following sub heads:

5.1 Growth in area, production and productivity of major pulses

5.2 Demand and supply of total pulses

5.3 Total demand projection of total pulses

5.4 Export and import performance of total pulses

5.5 Cost and returns

5.6 Constraint faced by farmers in production of pulses

5.7 Factors influencing the supply of pulses

5.1 Growth in area, production and productivity of major pulses

5.1.1 Growth rate of area, production and productivity of major pulses in study area

The results of compound growth rate analysis of area, production and productivity of individual pulses as well as total pulses in the study area found that the growth rate in area, production and productivity were positive in all the periods except area in period-II (-2.75 %) and over all period (-0.44 %). Though the area under cultivation of pulses declined over the years but the production found positive in Dharwad district. This was mainly because of use of improved varietie like DGGV-2 (Greengram), GBM-2 (Blackgram), TS3R and better cultivation practices under good management conditions as advised by the Dharwad agriculture university scientist.

In Belagavi district, growth rate in area and production revealed negative trend but it was important to notice that in overall period the production (-0.20 %) was marginally declined and the area (-2.41 %) was observed negative but significant. The declined in production was led by decline in area due to diversification from pulses to some other commercial crops like sugarcane because of sufficient availability of irrigation facility. The similar result were obtained by Siddeshwar and Guledagudda (2016) in growth performance

of pulses in Karnataka but the growth rate of production of pulses in Belagavi district are much contradictory to the above referred study because diversification of cropping system and intensive cultivation of commercial crops like sugarcane, fruits crops and recent years also started practicing the sericulture.

The area, production and productivity of redgram in Vijayapura district was found positive in all the periods and it was important to note that growth in area, production, and productivity were significantly increasing and reveled positive direction in all the period. The results are in line with Nethrayani (2013) who studied the growth performance of redgram and bengalgram. The significant increase in area, production and productivity in Vijayapura district was mainly due to the farmers switch over to *tur dal.* In recent years as they are reaping significant benefits cultivating the redgram and the newly developed variety TSR-3 which as boon to farmers. According to officials of the Agriculture Department. Redgram is being cultivated on 3.14 lakh hectares, which is much higher compared to the last five years. Normally, growers cultivate 40 per cent of the crop in the *kharif* season and the rest in the *rabi* season. But, this trend was also changed in recent time. Area under sunflower cultivation, a major crop in the *kharif* season, has come down by five times this year. *Tur dal* reached place now.

The productivity of redgram in Bagalkot was declined from Period –II onwards but productivity was found positive in case of Haveri and Gadag district. This was mainly due to more farmers replacing other crops by pigeonpea because of more popularization of pigeonpea variety like TS-3R in recent year in the study area coupled with increase in price of pulses over the years contributing to grab the attention of the farmers towards cultivation of pigeonpea. Similar results were reported by Siddeshwar and Guledagudda (2016).

Dharwad district revealed positive growth in area of bengalgram (0.29 %) in period-I, Period-II (2.84 %) and overall period (0.37 %). In pertain to growth of production Period-II registered positive growth but period-I and overall period registered negative growth. Whereas, the productivity were found negative in all the period. This was mainly due to more farmers diverting their cropping system by cultivating other crops like wheat and jowar, Jayadhar cotton, sunflower for bengalgram during *kahrif* season. In Belagavi district, though the growth in area of bengalgram was found positive in overall period (1.07 %) but the production (-0.10 %) and productivity found negative (-1.17 %) due to poor practice of

bengalgram cultivation and diversification of cropping system in Belagavi district. The similar result were obtained by Siddeshwar and Guledagudda (2016) in growth performance of pulses in Karnataka.

In case of Vijayapura district, the growth rate of area and production of bengalgram found positive in all the periods. Whereas, productivity was negative in Period-II and overall period. This is because of failure of rainfall during critical growth stage of the crop and farmers were lack in irrigation facility to provide protective irrigation during critical growth stage of the crop which led to the loss in yield (15 %). Similar results were reported by Ambana and Guledagudda (2015). Bagalkot district revealed mixed growth trend with negative growth in area, production, and productivity. In case of Gadag district, growth rate of area production and productivity were observed positive and significant. In Haveri district the growth rate of area, production and productivity were found positive in period-I and overall study period but it was found negative in period –II. With respect to growth of area, production and productivity in overall period found mixed trend of growth in study area. Similar results are found and confirmed by Bindhu Kumar (2006).

Bengalgram crop is cultivated mainly in 11 district of North Karnataka. Among 11 district, Belagavi, Vijayapura, Dharwad, Gadag and Bagalkot district are covered in the present study. The performance of Bengalgram in study area was appreciable because the programme launched by Union Government i.e., National Food Security Mission (NFSM). Farmers has been provided chemical and equipment to control pest and disease affecting bengalgram plant, seeds of high yielding varieties (GBM-2, JG-11, Vihar and BGD-103), nutrient kits and pest management kits were distributed under the Accelerated Pulses Production Programme (A3P) in North Karnataka for increasing the area under crop.

In case of greengram, Vijayapura, Bagalkot, Gadag and Haveri district revealed positive growth in area, production and productivity in period-I but in period-II the production and productivity were found negative in all the district except Haveri district. This might be due to non-availability of quality seeds in adequate quantity because farmers are still using the farm produced seeds is one of the major constraints in greengram production so there is a need to educate farmer to use improved varieties released by agriculture universities. Transfer of improved pulse production technologies remains the most neglected component and consequently the benefit of improved varieties and production technology could not be

harnessed. Fertilizers were applied to this crop was not as per the recommendation which was recorded during survey. Availability of soil testing facilities inoculation with *Rhizobium* culture and application of phosphate and potash fertilizers need to be promoted in order to increase the production.

In case of greengram, Vijayapura, Bagalkoti and Gadag districts registered positive growth in area, production and productivity in over all period. Whereas, it was found negative in Dharwad, Belagavi and Haveri (Table 4.2). In over all, the decline in production and productivity was mainly due to insufficient portioning of assimilates, poor pod setting due to the flower abscission and lack of nutrients during critical stages of crop growth, coupled with a number of diseases and pests are the reasons for the poor yield reported by Kuttimani and Velayutham (2011) during their study foliar application of nutrients and growth regulators on yield and economics of green gram.

5.1.2 Growth rate of area, production and productivity of major pulses in Karnataka

The growth in area, production and productivity of redgram in Karnataka were found positive and significant in all the periods except productivity (-1.95 %) in over all period. This might be due to in recent scenario redgram was solely cultivated in Kalburgi, Vijayapura, Bagalkot and Yadgiri of North Karnataka and North-Eastern Karnataka district but in central and south Karnataka redgram was bean cultivated as intercrop in maize and sorghum. The growth in area, production and productivity of bengalgram was found positive in all the period except productivity (-3.13 %) in overall period. Further, growth in production and productivity was positive and significant in all the period. This might be due to increase in area under bengalgram cultivation coupled with popularity of recently released (2016) improved varieties like JG-11, GBM-2 etc, which are found suitable for mechanical harvesting in view of non availability of labour during peak period and also congenial climate condition suitable for bengalgram in Karnataka. Similar finding were also reported by Nethrayani (2013) while studying the growth in chickpea crop.

The growth rate pertain to greengram crop found a mixed growth trend with positive and significant growth in area and production in period-I. The greengram performance in entire period revealed that the area (2.19 %) and production (0.34 %) found positive growth but productivity (-4.87 %) registered negative growth. However, the growth of area, production and productivity of blackgram in period-II observed negative. Whereas, the

growth performance of area (2.08 %), production (2.02 %) and productivity (0.02 %) in entire period was positive but the growth of area was negligible.

In case of total pulses scenario in Karnataka revealed that the growth in area, production and productivity were positive in all the periods except productivity (-0.82 %) in period-I. It is important to highlight that though the growth rates of productivity was observed negative but the production was found positive in period-I (Table.4.4). This might be due to intensive promotional programmes like National Food Security Mission (NFSM), Accelerated Pulses Production Programmes (A3P) launched in the state including release of improved varieties like Maruti, TS-3R, TAU-, Pusa Baisaki, T-9, BSMR, GBM-2 etc., and awareness about package of practice for higher productivity by state agriculture universities. Similar findings were reported by Siddeshwar and Guledgudda (2016). However, for the country as a whole the growth rate of area, production and productivity was found positive in all the periods. It was important to note that the area under cultivation of pulses was been increasing marginally but not significantly. Whereas, the production and productivity were found significant in all the periods.

5.1.3 Growth rate of area, production and productivity of major pulses growing states of India

Table 4.6 revealed that Madhy Pradesh had negative growth in area of all the major pulses and total pulses but bengalgram was the only crop showed positive growth in area due to the total area under cultivation of this crop has been increased at the rate of 1.12 per cent. In case of productivity except redgram all other pulses found positive growth (Table 4.6). Low production with high fluctuation was mainly caused by low productivity and uncertain yield of redgram. The result of stagnant productivity of redgram showed that there was not proper management in redgram production and lack of necessary technology like suitable variety. Looking to the poor production with high fluctuation and increasing demand of pulse, the redgram productivity needs to be increased using advanced technology. There is only one possibility to raise production of redgram through technological adoption, particularly adoption of high yielding varieties of seed, use of balance fertilizer, adoption of *Rhizobium* culture and organic manure, plant protection measure etc. The similar findigs was reported by Thakur (2014) who studied on instability and trend analysis of pigeonpea production in Madhya Pradesh.

The growth rate in area of pigeonpea was observed 1.15 per cent which was negatively significant revealed that the pulse policies have not been encouraging to the farmer and growth rate in production and yield of pigeonpea were observed 1.07 per cent and 2.60 per cent non-significant, The yield of total pulses has been growing at the rate of 0.90 per cent per annum (Table 4.5) indicating that the productivity of pulses has been responding to the technologies adopted by pulse growers. The positive growth in production (except bengalgram) and yield of all individual pulses crops also indicated positive impact of technology for pulse production in Rajasthan. The similar results were observed by Shivalik (2017).

In Maharastra state, redgram was cultivated widely compared to other pulse crops probably because short duration high yielding varieties/hybrids (Samrat, Meha, BSMR-853) , more demand in the market, high market price were available, it can be grown on less fertile area, less efforts is required in its cultivation. Kannan (2012) reported similar results while studying the trends in India's agricultural growth and its determinants. Growth in area under gram was 3.74 per cent per annum. The significant and positive growth in production of gram was observed in state it was around 6.07 per cent per annum (Table 4.5). The gram productivity in state witnessed an annual increment of 2.50 per cent per annum. Bengalgram cultivated widely might be due to wide spread use of high yielding and disease resistance varieties (IPCK-2004-29, IPA 203, PDU-1) improved package of technology increased area under irrigation, high demand in the market and better relative price. Production and productivity of major pulses showed increasing trend in the state. This is might be the impact of National Pulses Development Programme (NPDP) was implemented mainly for redgram and bengalgram. Shinde *et al.* (2016) reported similar results while studying the growth performance of principal crops in Maharashtra.

In case of Uttar Pradesh, the productivity of redgram (-1.27 %) and bengalgram (-1.22 %) is declined and were negatively but the productivity of greengram (1.66 %), blackgram (2.47 %) and total pulses (0.19 %) were positively observed and increased (Table 4.5). The main reason to boost the productivity of total pulses were Scientific farming techniques, availability of funds at right time, soil testing, use of organic manure and crop insurance will be made available to the farmers and to tackle the arid situation, which poses a major challenge for irrigation, the state government has started *Khet Taalaab Yojnaa* (Agriculture

Land Pond Scheme) under which the farmers will be allowed to make ponds in the agriculture fields. Similar results were observed by Tuteja (2006) who studied the growth performance and acreage response of pulse crops- a state level analysis.

The production and productivity of major pulses in overall period found positive direction except greengram which was found negative direction in production (Table.4.6). In overall period the major pulses as well as total pulses showed positive direction, The reasons for increasing production and productivity of pulses in the state were pulses are grown under rainfed conditions and also the *rabi* season with a protective irrigation, nearly 13 districts of Andhra Pradesh are cultivating the pulses in medium to good fertile soil, the pulses are grown as an inter crop or as a mixed crop which enhancing the production and availability of short duration and suitable to local conditions. The results are in line with Yahya (2013) during his stidy trends in area, production and productivity of pulses in Andhra Pradesh.

In case of odisha, bengalgram crop was the only pulses crop which is sowing the positive direction in production and all other pulses showing negative direction (Table 4.6). This might be due to the cropping pattern changes, however, are the outcome of the interactive effect of many factors such as resource-related factors (irrigation, rainfall and soil fertility); technology related factors (seed, fertilizer, and storage and processing), and institutional and infrastructure-related factors (farm size, extension, marketing systems, investment, output and input prices, government regulatory policies, and research). The similar finding was reported by Paltasingh *et al.,* (2012).

The productivity performance of all the major pulses in Tamil Nadu registered positive direction. The country as a whole, none of the pulses showed negative direction in area, production and productivity. The growth rate of production and yield were significant during 1980-90 due to initiative taken by the technology mission and pulses development. The result obtained was confirmed with Srvastava *et al,* (2010) conducted a study on diagnosis of pulses performance of India.

5.2 Demand and supply of total pulses

5.2.1 Demand and supply of total pulses in study area

The average mean value of demand-I and demand-II in Dharwad district were 31.28 and 50.84 thousand tonnes respectively. However, total supply of pulses was 43.67 thousand

tonnes indicating 12.39 thousand tonnes surplus over demand-I (Table 4.7). Similarly, Vijayapura district, the average mean value of demand for pulses were 37.20 (Demand-I) and 60.47 (Demand-II) thousand tonnes but the average supply of pulses was 198.76 thousand tonnes indicating 161.56 (Gap-I) thousand tonnes surplus over demand-I and 138.29 (Gap-II) thouosand tonnes over demand-II. Table 4.7 reveals an important note that the district showed surplus of pulses over demand from all the indicated years. This might be due to increase in area under cultivation of all major pulses and total pulses coupled with high yielding varieties and adoption of improved technologies. In Haveri, total supply of pulses was 28.14 thousand tonnes indicating 10.29 thousand tonnes surplus over demand-I. It is important notice that Haveri, Dharwad, Bagalkot and Vijayapura district were revealed surplus of pulses over demand-I as per the sedentary recommendation of NIN. The excess supply might be due to increase in area under pulses as observed in growth rate section, suitability of pulses and adoption modern technology like use of improved varieties, adoption of IPM technology and realization of better price. The findings of the study are in contrary to the result obtained by Amarender Reddy (2004), Praduman Kumar *et al.* (2009), Srivastava *et al*. (2010) and Rajesh Kumar (2012) for pulses at national level.

In contrary to this, a negative gap in Belagavi (-0.58 lakh tonnes) and Haveri (-0.23 lakh tonnes) indicating supply of pulses are lower than its demand. This might be due to rapid increase in population and marginal growth in production of pulses was observed in growth rate section.

The growth performance of pulses production as well as surplus production over demand in the study area is caution to the administrators and policy makers to tackle the situation. In this regard, it is necessary to create infrastructure facilities with modern post harvest technology for processing quality finished product/establish pulses park to capture international market.

5.2.2 Demand and supply of total pulses in Karnataka and major pulses growing states

Karnataka state (Table 4.8) as whole revealed that the average estimated demand for pulses were 10.39 (Demand-I) and 16.88 (Demand-II) lakh tonnnes over supply of 11.31 lakh tonnes indicating surplus of 0.92 (Gap-I) thousand tonnes and deficit of 5.57 lakh tonnes. The country as a whole the average consumption-I of pulses was increased from 17.41 million tonnes from 2011 to 18.53 million tonnes in 2016 due to positive growth rate (1.23 per

cent/annum) population in the country. It could be seen from the Table.4.9 (Fig. 4.10) that the average mean value of demand-I and demand-II were 19.74 and 32.09 million tonnes with the supply of 15.57 million tonnes indicating deficit of pulses to the tune of 4 to 4.5 million tonnes as per demand-I estimation and 16.52 million tonnes as per demand-II estimation. This clearly revealed that there is urgent need to increase pulses production to meet out the consumption requirement of growing population and per capita income. Thus we need to have necessary policy initiatives to increase the supply in future. The findings of the study are in line with Rosegrant *et al.* (1995), Praduman Kumar (1998), Bhalla (2001) Hanchate and Dyson (2004).

It could be seen from the Table 4.10 that the supply of pulses in Madhya Pradesh, Rajasthan and Maharashtra was more than the sedentary life style consumption-I. It revealed that the supply is more than the demand-I. This might be due to increase in area under pulses as observed in growth rates section, suitability of pulses and adoption of modern technology like use of improved varieties which directly helped to increase productivity and that enhanced the production which helped to meet out the demand-I. In contrast to this, a negative gap in Uttar Pradesh (-16.24, lakh tonnes), Andhra Pradesh (-10.51 lakh tonnes), Odisha (-7.22 lakh tonnes) and Tamil Nadu (-14.40 lakh tonnes) revelaing supply of pulses were lower than its demand. This might be due to rapid increase in population and marginal growth in production of pulses was observed in growth rates section.

5.3 Total demand projection of total pulses

5.3.1 Projected demand of total pulses in study area

Future demand for and supply of pulses estimated by different economist were based on population growth, per capita income, expenditure elasticity and economic growth. The estimates vary owing to difference in methodology and variables used. However, in present study normative approach was used to estimate future demand of pulses based on population growth, seed, and feed and industrial wastage (SFW) and post harvest losses (PHL) parameters. The demand projection of total pulses in study area, Karnataka and major pulses producing states were projected for the year 2018 to 2031.

Dharwad district is likely to reach 34.98 thousand tonnes (Total Demand-I) and 56.86 thousand tonnes (Total Demand-II) during 2021 and about 40.33 thousand tonnes (Total Demand-I) and 65.55 thousand tonnes (Total Demand-II) by 2031. In case of Belagavi,

district the projected total demand-I may increase from 89.08 thousand tonnes during 2021 to 101.09 thousand tonnes by 2031. The Total demand-I for pulses in Vijayapura district were likely to reach 43.04 thousand tonnes during 2021 and about 51.84 thousand tonnes by 2031. In case of Bagalkot, projected total demand-I for pulses were likely to reach 35.68 and 57.99 thousand tonnes during 2021and 2031 respectively. In case of Gadag district, projected total demand-I would be 19.18 and 21.03 thousand tonnes during 2021 and 2031 respectively. The total demand-I for pulses in Haveri district were likely to reach 29.20 thousand tonnes during 2021 and about 32.48 thousand tonnes by 2031. Shivagangavva and Reddy (2014) during their study an economic analysis of outlook of pulses production in Karnataka.

The gap between supply and demand for pulses is expected to widen in future. So tackle the future gap by establishing the pulses park in surplus pulses producing districts so the surplus quantity can be made available to deficit district. Thus, the districts need to focus on productivity enhancement by promoting short duration verities on drought prone area and promoting micro irrigation system. In addition to this there is a need to reduce post harvest losses by developing the stored grain pest resistant varieties, modernizing how the *dal* mills and establishing small processing units like IIPR mini *dal* mills in pulses producing zones.

5.3.2 Projected demand of total pulses in Karnataka and major pulses growing states

The demand for pulses in Karnataka as per NIN, Hyderabad recommendation (14.60 kg pulses/captia/year) worked out to be demand-I for pulses is expected to reach 11.83 and 13.91 lakh tonnes during 2021 and 2031 respectively. Similarly, total demand-II is expected (23.73kg/year/capita) to reach 19.22 and 22.61 lakh tonnes during 2021 and 2031 respectively. The future requirement can be achieved through cropping system improvising like greengram and blackgram as catch crop in summer/spring under cereal based cropping system, intercropping short duration pulses (greengram, blackgram and cowpea) in sugarcane (Belagavi District), millets, cotton (Haveri district) and intercropping of redgram in maize production area of Haveri district. In the districts of Haveri and Vijayapura where cotton is grown in larger area, redgram will be a suitable relay crop.

The demand and supply of total pulses in the major pulses producing states are revealed that as per NIN, Hyderabad recommendation sedentary life style consumption (14.60 kg pulses/captia/year) and Moderate life style consumption (23.73kg/year/capita) the total demand-I and total demand-II is expected to reach in the upcoming years. Country as a whole

(Table 4.13) total pulses requirement worked out to be 220.05 (Total demand-I) and 244.27 (Total demand-II) lakh tonnes during 2021. However, during 2031 the total pulses requirement would be touch 357.66 (Total demand-I) and 397.02 (Total Demand-II) lakh tonnes. It is important to note here that the requirement of pulses in future increase because of increase in population growth (1.23 per cent/annum). This implies that in the year to come, the country will have to rely on imports to meet the domestic requirement. Similar results were observed for cereal and pulses by Mittal (2008), Amarender Reddy, Ramesh Chand and Praduman Kumar *et al.* (2009), Srivastava *et al.* (2010), Rajesh Kumar (2012), Ali (2012).

Thus, we need to have necessary policy initiatives to increase the supply in future, it seems growth in production is limited, import could help to improve the countries supply situation for a short term but for the long term the country will need to focus on productivity enhancement through public investment in research and efficient use of inputs. This will help in maintaining balance between demand and supply of pulses in the country.

5.4 Export and import performance of total pulses

In this section an attempt is made to discuss the findings of growth in import and export of total pulses as well as individual pulses viz, redgram, bengalgram, greengram and blackgram

5.4.1 Growth in import of pulses

The growth rate both in quantity and value of import in all the pulses increased significant (Table 4.14) over a period from 1980-2016 including pre and post –liberalized periods. Similar findings on growth in import of pulses were found by Amarender reddy (2004), Satya Sundrum (2010) and Shivagangavva and Reddy (2014) in their study. This could be attributed to the shortfall in supply as evident from growth in production at the state and national level as coated in the earlier section. The production of pulses is on an increase, thus because they generate better farm income. Thus considering the countries varied agro-climatic conditions there exist vast potential for production to minimize the import of pulses which needs to be harnessed effectively in coming years.

Due to non availability of individual pulses import data for pre-liberalised period, growth rate was worked out only for the post-liberalised period. In case of total pulses, the growth in value of imports were higher than its quantity. This might be due to growth in unit

value paid as result of higher demand for pulses in the world market. Whereas, reverse trend was noticed in individual pulses except blackgram on account of lower unit value paid for the import of these pulses. The findings of the study are in line with results obtained by Bindu Kumar (2006) in redgram import.

5.4.2 Growth in export of pulses:

The positive growth in both quantity and value of export were noticed in case of bengalgrm, blackgram and total pulses while negative growth rate was observed in redgram and greengram (Table 4.14). The similar finding was observed by Shivagangavva and Reddy (2014). Although India exported substantial quantity over a period of time, it also imported large quantity of pulses to full fill the bilateral agreement as mentioned in the earlier section.

Aforesaid findings of import and export of pulses indicated that India needs to increase production of pulses through increase in productivity to check the increase in import, for which we need to follow import substitution. On the other hand, there is a need to increase area under blackgram, bengalgram and total pulses as India had comparative advantage in the export of these commodities reflected by positive growth in export.

5.5 Cost and returns

The cost of cultivation of, output and returns are critically analyzed and discussed in detail. The cost of cultivation was higher in redgram (₹17,137) as compared to bengalgram (₹ 16,046) and greengram (₹14,352). Further, there was difference in the use of human and bullock labours which were used relatively higher quantity in redgram followed by bengalgram and greengram. In spite of higher level of inputs use and cost incurred, the extent of output obtained was found to be higher in bengalgram. Thus, the returns realized by bengalgram growers were found to be higher than redgram and greengram cultivators mainly because of additional output obtained was more than proportionate increase in input use and cost incurred. Similar results were obtained in redgram production in Gulbarga district by Balappa *et al.* (1997).

It is worth to note that returns to a rupee investment in all the pulses were more than one indicating the profitability of pulses production. However, the magnitude of returns to a rupee investment in bengalgram was found to be higher than that of redgram and greengram mainly because higher price realized lower level of input use and cost incurred especially

major inputs like human labour, chemical fertilizers and plant protection chemicals as stated earlier.

Out of the total cost of cultivation, expenditure on variable inputs formed more than 65 to 70 per cent and remaining 30 to 35 per cent constituted by fixed cost in all the pulses. It is worth noting that the expenditure on human labour formed the major constituent of total variable cost in the pulses. The results are in line with the findings of Banarjee and Palke (2010) and Balappa (1997) in pulses and redgram respectively.

This clearly indicates that the pulses were cultivated with traditional practices which are labour intensive. However, availability of labour especially during peak season was inadequate and inefficient as perceived by the farmers during their opinion survey. Therefore, in order to reduce the cost of cultivation, there is immediate need to develop labour saving practices such as use of application of weedicides, improved equipments for spraying and harvesting, etc. Further, appropriate extension methods may be adopted to educate the farmers on modern technology for optimum use of inputs.

In case of bengalgram, magnitude of cost incurred on seeds (6.34 %) was higher mainly due to higher dose of seed rate coupled with higher prices of seeds. The cost on chemical fertilizers and manures also shared a major component of the total cost of cultivation incurred by the farmer in pulses production. This is in conformation with results obtained by Patil (2008) in redgram cultivation. However, regression coefficient of fertilizers was significant in all the pulses while the influence of manure on output was non-significant implied that farmers applied higher quantity of fertilizers in greengram. Even though it was negatively influencing on production mainly they believed that pulses yields are very much responsive to high dose of fertilizers. Further, during survey farmers opened that they have applied fertilizers on their own experience and input dealer advice. Hence, need to strengthen extension services to educate the pulses growing farmer about importance of recommended doses of fertilizers.

In case of plant protection chemicals, the magnitude of cost incurred in redgram (8.26 %), blackgram (5.15 %) and greengram (2.44 %), mainly due to sever incidence of insect pests and diseases like pod borer and pod fly in redgram and bengalgram, while sterility mosaic virus disease(SMD), leaf spot and fusarium wilt in greengram. Similar results were obtained in redgram cultivation in Bidar district by Patil (2008).

There is need to address the structural issues that encourage pulses production. The pulse grower faces challenges on increase in yield and availability of high cost inputs and real need is to increase production through wider adoption of technology. This is possible by making critical inputs available, accessible and affordable, the favorable price support to pulses grower is the at most need to incentivise farmers in the adoption of technology.

5.6 Constraint faced by farmers in production of pulses

Based on the major constraints opined by the pulses growers there were several constraints faced by the farmers in cultivation of pulses. The major constraints were non availability of HYV seeds, non availability of fertilizers, non availability of plant protection chemicals at the time of sowing, low price of produce, lack of subsidy for inputs, lack of knowledge about seed rate, seed, treatment, weed management dosage and method of fertilizer application. Similar have also been reported by Yadav et al (2002). The findings of the present study provides the empirical feedback to agricultural development departments, state agricultural universities and various non-governmental organizations working in agricultural and allied departments to strengthen the research-extension farmer linkage by providing credible and timely information to the farming community. The government of India has set up a target of 32 million tonnes with the productivity of 850 kg/hectare for the period 2007-12 (Yadav, 2007). The ICAR has started a programme of organizing front line demonstrations on pulses in order to motivate farmers to increase the area under cultivation there by enhancing production to achieve this extension personnel needs to disseminate the technology related to plant protection measure with emphasis on providing knowledge and skills to farmers. Farmer programmer and result demonstrations on pulses cultivation needs to be organized by the extension personnel's.

The technology needs to be such that the farmers could get the net returns equivalent to that they get from the crops they mainly grow. Only then, will the farmers will go for cultivation of pulses. Among the mention constraint in the study the institutional constraint ranks first (Garret score 84.17) pertain to procurement operation and ineffective implementation. So for effective implementation of MSP there is need to establish national level institute solely for pulses

5.7 Factors influencing the supply of pulses

The results of principal component analysis revealed that out of 20 variables selected for principal component analysis, eight variables were found influenced on the production of pulses. The most important variables influenced on production of pulses were adequate and timely rainfall during pre-sowing period, area under crop, use of improved variety, fertilizers, seeds, incidence of pest and disease and market price. However, pre-sowing rainfall, area under crop, use of improved varieties, seeds, fertilizers and increase in market price were positively influenced on production while incidence of pests and diseases were negatively influenced on pulses production. The findings of the study are in line with the results of Dhindsa *et al* (1997), Joshi and Saxena (2002) and Tuteja (2006) in pulses.

The regression analysis provides useful information on extent of influence of resource on the production of pulses in general and redgram, bengalgram and greengram in particular. In case of redgram, fertilizers, adequate and timely pre-sowing rainfall and use of improved varieties were influenced significantly on redgram production. However, area under crop and market price have not influenced significantly. In case of bengalgram area under crop and pre-sowing rainfall were positive and significantly influenced on production. Whereas, increase in incidence pests and diseases resulted significant decline in production because serve incidence of insect pests and diseases namely Pod borer, Pod fly, Serility mosaic disease (SMD) and Wilt were observed during study and also expressed by farmers during survey.

Among the independent variable included in the model regression co-efficient of area (2.611) and seeds (0.215) were influencing positively and are highly significant at five and ten per cent probability level implying for every one per cent increase in area under crop and seeds would increase production of greengram by 2.6 and 0.21 per cent. Whereas, elasticity co-efficient of fertilizers, incidence of pests and disease were negative implying for every one per cent increase in these variables resulted decline in production by1.24, 1.17 and 0.95 per cent respectively.

From the results it is clear that most of the variables were positive in all the selected pulses except diseases and pests. Therefore, in order to increase the production and optimize the external use of input, there is immediate need to educate the farmers to scientific cultivation of pulses including the use of weedicide, bio-fertilizers, improved tools for planting and harvesting, integrated pest management, etc. in addition to this necessary infrastructure needs to be develop in the pulses growing area.

Summary and Policy Implications

6. SUMMARY AND POLICY IMPLICATIONS

Pulses are the primary sources of protein (22 %) for the poor and the vegetarians (40 %). The total pulse constitutes redgram, bengalgram, greengram, blackgram, lentil, horsegram, cowpea and fieldpea. The split grains of these pulses are called *dal* and are excellent source of high quality protein, essential amino acids and fatty acids, fibers, minerals and vitamins. The Year 2016 was declared as the International Year of Pulses by the sixty eighth session of the United Nations General Assembly on December 20, 2013. The Food and Agriculture Organization (FAO) of the United Nations has been nominated to declare a year for pulses. An international year designation provides an unprecedented opportunity to raise awareness and to celebrate the role of beans, chickpeas, lentils and other pulses in feeding the world. Even more importantly, it will be a galvanizing moment to draw together key actors to further the contributions pulses make to health, nutrition, and sustainability.

At the global level, pulses are the second most important group of crops after cereals. The global pulses production was 71 million tonnes from an area of 79 million hectare with an average yield of 910 kg per ha during 2015-16. Dry beans contributed about 32 per cent to global pulses production followed by dry peas (17 %), chickpea (15.9 %), broad beans (7.5 %), lentils (5.7 %), cowpeas (6 %) and pigeonpea (4.0 %).

The area under total pulses has increased from 20.35 (2000-01) to 25.26 million ha (2015-16) and production has increased from 11.08 (2000-01) to 16.35 million tonnes (2015-16). This increase in production is not only due to area, mainly due to the enhanced productivity from 544 kg per hectare (2000-01) to 715 kg per hectare (31.43 % increase) (2015-16). Sharp decline in the availability of pulses what resulted in increased imports from 1.27 to 3.49 million tonnes during 2015-16. In India the 75 per cent of the pulses were produced by 6 states and those are Andhra Pradesh, Maharashtra, Karnataka, Rajasthan, Madhya Pradesh and Uttar Pradesh.

The total area under cultivation of pulses in 2015-16 was 25.26 million hectare, if we look at the shares of area under cultivation in different states Madhya Pradesh shares highest area i.e., 22.81 per cent followed by Rajasthan (18.35 %), Maharashtra (18.35 %), Karnataka (11.01 %), Uttar Pradesh (7.38 %) and Andhra Pradesh (5.74 %). However, the highest production was recorded in Madhya Pradesh with a share of 31.07 per cent followed by Rajasthan (11.86 %), Maharashtra (8.56 %), Karnataka (8.43 %), Andhra Pradesh (7.46 %), Uttar Pradesh (7.40 %) and Odhisa (3.37 %).

Karnataka is one of the major pulses growing state in the country. Pulses are grown in an area of 27.37 lakh hectares with production of 10.18 lakh tonnes and with a productivity of 599 kg per hectare during 2015-16. Major pulses grown in the state are redgram, bengalgram, greengram and blackgram. These four pulses accounted 84.01 per cent of total pulses area and 91.34 per cent of state total pulses production during 2015-16. No doubt the production shortage is due to technological fatigues, the pulse crops are highly sensitive to attack by a wide range of pests (plant diseases, insects and weeds) at various stages of crop growth as well as storage conditions. The major causes for low production of pulses are shortage and lack of timely availability of quality seeds, cultivation of pulses on marginal and sub-marginal lands, deficient/depleted in nutrients with low inputs, lack of appropriate pulse production and protection technologies, lack of information related to pest biology, pulse growing land is deficient in water holding capacity making them vulnerable to heat stress resulting in terminal drought and poor post-harvest technology, storage infrastructure. In general, the pulses production is not keeping pace with the domestic requirements and is a matter of real concern.

Keeping in view of the above issue importance in pulses production the present study is focused on the supply and demand of major pulses in Karnataka in comparison with India.

Objectives of investigation

1. To study the trend in area, production and productivity of major pulses over a period of time in Karnataka and India.
2. To estimate gap between supply and demand of total pulses in Karnataka and India.
3. To estimate total demand projection of total pulses in India
4. To study the growth in export and import of total pulses in India.
5. To estimate cost and returns of major pulses and to identify problems and prospects of pulses cultivation in Karnataka.
6. To identify and asses the various factors of supply for pulses in Karnataka.

Methodology

The present study was taken up in the University of Agricultural Sciences Dharwad jurisdiction which falls in Northern dry zone and Northern Transitional zone of Karnataka. Northern dry zone comprises of total 35 taluks and northern transitional zone includes 14 taluks and 8 districts. Multistage random sampling technique was followed in designing

sampling frame for the study. In the first stage, major pulses growing six districts, namely Baglkot, Belgaum, Vijayapura, Dharwad, Haveri and Gadag were selected based on the highest area under selected pulses in the North Karnataka region. Similarly, in the second stage, two taluks were selected based on potentiality and highest area under each crop, in the third stage, 3 Villages from each taluk were selected and in the fourth stage10 farmers for each selected crop from selected taluks of the district were chosen at random in view of spread out of pulses growers in different villages. Thus, total sample size constituted 360 sample respondents.

The time series data on area, production, productivity, import and export, population growth rate, demand etc., were collected from different secondary source. The collected secondary information pertain to four major pulses crops, namely, bengalgram, redgram, greengram and blackgram because these four crops accounted 80.24 per cent of area and 80.49 per cent of production of pulses in the state. The growth in area, production and productivity analysis of major pulses crop were carried out for major pulses producing seven states namely, Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Andhra Pradesh (Including Telanaga state), Odisha and Tamil Nadu. These seven states together accounted 84.16 per cent of area and 80.91 per cent production of pulses in the country and these states were compared with Karnataka. In view of the limitation of data, the present study is restricted for a period of 36 years from 1980 to 2016 for all analytical purposes. However, for better understanding of growth and development of pulses, the growth rates in area, production and productivity were compared for the period of 1980 to 2016 which was further divided into two sub periods: Period -I: (1980 to 1990), Period-II: (1991 to 2016).

Analytical techniques

For the purpose of achieving the objectives of the study, the data collected were subjected to rigorous statistical analysis. To study the growth rate in area, production and productivity and to study the growth in export and import of pulses crops in Karnataka and India, compound growth rate model was used. Further, Normative consumption approach was used which is based on the requirement of food and nutrient contents of a balanced diet for a moderately active person life style. Normative approach determines consumption levels by using normative requirements of pulses as recommended by the National Institute of Nutrition (NIN), Hyderabad, @14.60 kg per year per capita as basis and it is multiplied with the population to estimate the requirement for a particular year + seed, feed and wastage (SFW).

Principal component analysis method was used to transform a original data into a new set of uncorrelated variables called principal components and to find out only a few components, which account for most of the variation in the original set of data. To analyse the cost and returns, demand and supply of pulses and to study economic characteristics of sample farmers the budgeting techniques was used. Further, Multiple regression analysis was used to analyses the response of production to a given change in selected inputs which indicate by principal component analysis. The different constraints opined by the farmers were prioritized by using Garrett ranking technique.

Major findings of the study:

1. The growth rate in area, production and productivity were found positive in all the period except area in period-II (-2.75 %) and over all period (-0.44 %) in Dharwad district. In Belagavi district, growth rate in area and production revealed negative trend but it is important to note that in overall period the production (-0.20 %) is marginally declining and the area (-2.41 %) was found negative and significant.

2. The area, production and productivity of pulses in Vijayapura district was found positive in all the periods and it is important to notice that growth in area (6.72 %), production (10.32 %) and productivity (2.70 %) were significantly increasing and showed positive direction in all the period.

3. In case of Bagalkot district except the productivity in period-I (1.05 %) the area, production and productivity of redgram revealed negative in all the period. In Gadag district, growth rate in area, production and productivity showed positive in all the period was significant. It is important to emphasize that the production (4.50 %) of redgram is considerably increasing due to significant increases in productivity (2.68 %). In case of Haveri district, the growth in productivity found positive in all the period but area and production found negative growth in all the period.

4. Dharwad district showed positive growth in area (0.29 %) in period-I, Period-II (2.84 %) and overall period (0.37 %). In pertain to growth of production Period-II registered positive (2.47 %) growth but period-I (-0.35 %) and overall period (-1.73 %) registered negative growth. Belagavi district, though the growth in area of bengalgram was found positive in overall period (1.07 %) but the production (-0.10 %) and productivity found negative (-1.17 %).

5. The growth of area and production in Vijayapura district found positive in all the period. Whereas, productivity was negative in Period-II (-1.76 %) and overall period (-1.38 %) but growth of area was found positive and significant in period-I (3.66 %). Whereas, Bagalkot district revealed mixed growth trend with negative growth in area (-4.79 %), production (-10.83 %) and productivity (-5.70 %) in period-I, while positive and significant growth in area (6.21 %) and production (5.99 %) in period-II but productivity found negative (-0.21 %).

6. The growth of area, production and productivity of Bengalgram in Gadag district found positive in all the period but it is important to note that in overall period the growth of area (4.61 %), production (6.15 %) and productivity (1.47 %) were found positive and significant. In Haveri district the growth of area, production and productivity found positive in period-I and overall study period but it was found negative in period -II.

7. The greengram in Vijayapura district pertains to area, production and productivity is significantly declining in overall period. In case of Bagalkot district the growth of area registered positive in all the period. Whereas, the production and productivity found negative in period-II and overall period but production (13.16 %) and productivity (11.09 %) found positive and significant. In Gadag district the growth of area, production and productivity in period-I found positive growth but in period-II except area (2.08 %), production (-0.39 %) and productivity (-3.11 %) found negative.

8. Pertain to to growth performance area, production and productivity of total pulses in Dharwad, Vijayapura and Haveri district was found positive growth all the period. Whereas, Belgavi, Bagalkot and Gadag district showed mixed trend of growth in Area, production and productivity.

9. The growth in area, production and productivity of redgram in Karnataka were found positive and significant in all the period except productivity (-1.95 %) in over all period. The growth in area, production and productivity of bengalgram was found positive in all the period except productivity (-3.13 %) in overall.

10. In Karnataka, growth rate pertain to greengram crop found a mixed growth trend with positive and significant growth in area (5.81 %) and production (8.78 %) in period-I but negative growth in productivity (-6.40 %). Whereas, the area, only registered positive growth (1.10 %) but production (0.94 %) and productivity (-4.38 %) found negative. In

case of blackgram the growth of area (6.26 %) and production (6.02 %) found positive in period-I but it was negative growth in productivity (0.03 %). However, the growth of area, production and productivity in period-II found negative.

11. In case of total pulses scenario in Karnataka revealed that the growth in area, production and productivity were positive in all the period except productivity (-0.82 %) in period-I. It is important to highlight that though the growth rates of productivity is found negative but the production found positive in period-I.

12. The growth performance of redgram in Maharashtra state, showed positive growth rate in area, production and productivity in all periods. However, state like Madhya Pradesh, Rajasthan, Uttar Pradesh and Tamil Nadu revealed mixed trend of growth in area, production and productivity. Andhra Pradesh state found positive and significant in all the period except productivity (-0.86 %) in period-I. Similarly Odisha state registered positive growth in all the period except negative growth of area (-0.78 %) in period-II. The Karnataka state showed positive growth in area, production and productivity in all the period except productivity (-1.95 %) in period-I which found negative growth.

13. The area, production and productivity of bengalgram in Madhya Pradesh was found positive and significant in all the period but the growth of area (0.94 %) was not significant in period-I. Similarly, the Maharashtra and Andhra Pradesh showed positive growth in all the period. Whereas, Rajasthan, Uttar Pradesh and Tamil Nadu showed the mixed trend of growth in area, production and productivity.

14. The growth performance of area, production and productivity of greengram in Maharasthra, Uttar Pradesh, Andhra Pradesh and Odisha state pertain to overall period showed negative growth in area (-3.59 %), production (-5.94 %) and productivity (-2.45 %). Tamil Nadu states showed positive growth in all the period except productivity (-0.34 %) in period-II. In case of Karnataka, the growth rate of area showed positive in all the period but the productivity of greengram found negative in all the period.

15. The growth in production and productivity found positive and significant in period-II and overall period in Madhya Pradesh states but the growth of area (-1.02 %) in period-I and (-0.98 %) in overall period found negative. The growth performance of blackgram in area, production and productivity Uttar Pradesh is the only state registered positive and significant growth in all the period but the other all the major pulses producing states

showed mixed trend of growth in area, production and productivity. The country as a whole showed positive growth rate in area, production and productivity in all the periods. It is worth noting that the productivity of blackgram in period-I (4.38 %), period-II (0.69 %) and productivity (1.05 %) found positive and significant.

16. The performance of total pulses in major pulses producing states depicted that the performance of total pulses in Maharashtra, Andhra Pradesh and country as a whole showed positive growth area, production and productivity in all the period.

17. The average mean value of demand-I and demand-II in Dharwad district were 31.28 and 50.84 thousand tonnes respectively. However, total supply of pulses was 43.67 thousand tonnes indicating 12.39 thousand tonnes surplus over demand-I and 7.17 thousand tones deficit as per demand-II estimation. In case of Belagavi district, the demand for pulses were 80.66 (Demand-I) and 131.10 (Demand-II) thousand tonnes on the other side, supply of pulses were 22.09 thousand tonnes revealing deficit of 58.57 (Gap-I) and 109.11 (Gap-II) thousand tonnes.

18. In Vijayapura district, the average mean value of demand for pulses were 37.20 (Demand-I) and 60.47 (Demand-II) thousand tonnes but the average supply of pulses was 198.76 thousand tonnes indicating 161.56 (Gap-I) thousand tonnes surplus over demand-I and 138.29 (Gap-II) thousand tonnes over demand-II. It is important notice that the district showed surplus of pulses over demand from all the indicated years in the study. a negative gap in Belagavi (-0.58 lakh tonnes) and Haveri (-0.23 lakh tonnes) revealing supply of pulses are lower than its demand.

19. Karnataka state as a whole, revealed that the average estimated demand for pulses were 10.39 (Demand-I) and 16.88 (Demand-II) lakh tonnnes over supply of 11.31 lakh tonnes indicating surplus of 0.92 (Gap-I) thousand tonnes and deficit of 5.57 lakh tonnes

20. In Madhya Pradesh state were 11.98 and 19.47 lakh tonnes respectively. However, total supply of pulses was 39.42 lakh tonnes indicating 27.43 and 19.94 lakh tonnes surplus over demand –I and demand-II respectively. It is important to highlight that from 2011 to 2016 all the year showed the surplus of pulses over demand-I and demand-II.

21. In Rajasthan state, the demand for pulses were 11.24 (demand-I) and 18.27 (demand-II) lakh tonnes on the other side supply of pulses was 17.68 lakh tonnes revealed the surplus

of 6.44 (Gap-I) and deficit of 0.59 (Gap-II) lakh tonnes. In Maharashtra states, the average demand-I and demand-II were 18.66 and 30.33 lakh tonnes with the supply of 20.63 lakh tonnes indicating 1.97 lakh tonnes (Gap-I) surplus supply and 9.70 lakh tonnes of deficit (Gap-II).

22. The country as a whole the average consumption-I of pulses increased from 17.41 million tonnes from 2011 to 18.53 million tonnes in 2016 due to positive growth rate (1.23 per cent/annum) population in the country. It could be seen from the table that the average mean value of demand-I and demand-II were 19.74 and 32.09 million tonnes with the supply of 15.57 million tonnes indicating deficit of pulses to the tune of 4 to 4.5 million tonnes as per demand-I estimation and 16.52 million tonnes as per demand-II estimation.

23. The major pulses producing states gap-I showed the surplus of pulses supply in Madhya Pradesh (27.43 lakh tonnes), Rajasthan (6.44 Lakh tonnes) and Maharashtra (1.97 lakh tonnes). However, the supply of pulses was less than demand-I and demand-II in Uttar Pradesh, Andhra Pradesh, Odisha and Tamil Nadu. It is important highlight the country as a whole India is facing a deficit of 4 to 4.5 million tonnes of pulses as per the demand –I estimation.

24. Dharwad district is likely to reach 34.98 thousand tonnes (Total Demand-I) and 56.86 thousand tonnes (Total Demand-II) during 2021 and about 40.33 thousand tonnes (Total Demand-I) and 65.55 thousand tonnes (Total Demand-II) by 2031. In case of Belagavi, district the projected total demand-I may increase from 89.08 thousand tonnes during 2021 to 101.09 thousand tonnes by 2031. Similarly, the projected total demand-II would be 144.78 thousand tonnes during 2021 and about 164.30 thousand tonnes by 2031.

25. Vijayapura district is likely to reach 43.04 thousand tonnes during 2021 and about 51.84 thousand tonnes by 2031. Similarly, the total demand-II is likely to reach 69.95 thousand tonnes during 2021 and about 84.26 thousand tonnes by 2031. In case of Bagalkot, projected total demand-I for pulses is likely to reach 35.68 and 57.99 thousand tonnes during 2021and 2031 respectively and about 40.98 (Total demand-II) and 66.60 (Total Demand-II) thousand tonnes by 2021 and 2031 respectively.

26. In case of Gadag district, projected total demand-I would be 19.18 and 21.03 thousand tonnes during 2021 and 2031 respectively while, projected total demand-II 31.18 and 34.18 thousand tonnes by 2021 and 2031 respectively. The total demand-I for pulses in

Haveri district is likely to reach 29.20 thousand tonnes during 2021 and about 32.48 thousand tonnes by 2031. However, total demand-II is expected to reach 47.47 and 52.79 thousand tonnes during 2021 and 2031 respectively.

27. The Karnataka state as a whole total demand-I for pulses is expected to reach 11.83 and 13.91 lakh tonnes during 2021 and 2031 respectively. Similarly, total demand-II is expected to reach 19.22 and 22.61 lakh tonnes during 2021 and 2031 respectively.

28. The Country as a whole total pulses requirement worked out to be 220.05 (Total demand-I) and 244.27 (Total demand-II) lakh tonnes during 2021. However, during 2031 the total pulses requirement would be touch 357.66 (Total demand-I) and 397.02 (Total Demand-II) lakh tonnes. It is important to note that the requirement of pulses in future increase because of increase in population growth (1.23 per cent/annum) and nutritional awareness.

29. The compound growth rates in quantity and value of pulses import clearly indicated that both quantity and value of import of total pulses increased significantly in pre and post-liberalized periods as well as in the overall period. The growth rate of quantity of pulses imports were 17.66, 10.93 and 9.07 per cent in period-I, period-II and overall period respectively. Further, growth in value of imports was significantly higher in period–I (36.33 %) compared to period-II (16.88 %) revealing overall growth of 16.79 per cent in the overall period.

30. The growth in export of quantity (21.42 %) and value (44.07 %) of total pulses during pre-liberalized period was found to be significantly higher than that of post-liberalized period. Whereas, growth in value (26.09 %) of export were higher than its quantity (15.25 %) in the overall period.

31. Per quintal cost of production was higher in redgram (₹ 3,570) followed by greengram (₹ 3,776) and bengalgram (₹ 2,468). However, minimum support price (MSP) announced by CACP during study period were indicated inter pulse price parity. Though the cost of production was higher in redgram and bengalgram which are long duration crop leading to higher cost of cultivation compared to greengram (Short duration with lower cost of cultivation). In contrary to this, MSP announced during study period higher in greengram (₹4,850) compared to bengalgram (₹ 4,000). Whereas, the MSP announced for redgram was (₹ 5,050) which is higher than bengalgram and greengram.

32. Among the major category of constraints Institutional constraint ranked I by the respondent (Garret score, 84.17) followed by technological constraints (Garret score, 81.66), socio-economic constraint (Garret score, 77.50) and marketing constraint (Garret score 57.42). The infrastructural constraint was ranked least (Garret score, 63.23).

33. The first component explains 90.07 per cent of variation among 20 variables chosen for the study, six variables showed higher factor loading (above 0.80) on the first dimension. The area under pulses, use of improved varieties, fertilizers, seeds, pest incidence and market price had highest factor loadings of 0.958, 0.945, 0.941, 0.940, 0.923 and 0.888 respectively. This implied that these variables were the important variables in the production of pulses.

34. The regression estimates in redgram production, regression co-efficient of fertilizers (10.549) and rainfall during sowing (0.807) were found positive and highly significant at one and ten per cent respectively. The co-efficient of area under crop (0.41) was positive but statically non-significant. However, regression of co-efficient of seeds (-0.004), pest incidence (-0.801) and disease incidence (-0.481) were negative and non-significant.

35. The regression coefficients of area (4113) and rainfall (2.810) were positive and highly significant at one and ten per cent probability level, while it was positive and non-significant in case of fertilizers (1.100) and seeds (0.153). Similarly, use of improved variety (2.115) and higher market price (2.651) were influenced positively on production of bengalgram.

36. Among the independent variables included in the model, regression co-efficient of area (2.611) under crop and seeds (0.215) were positives and significant at five and ten per cent level. Whereas fertilizer (-1.243) and disease incidence (-0.955) were also significant but have influenced negatively on production of greengram.

Policy implications

1. The growth in productivity of total pulses in Belagavi (-1.29 %) and Bagalkot (-0.51 %), found negative. Hence there is a need to enhance the productivity of pulses in Belagavi district by encouraging the farmers to take up the pulses cultivation in irrigated condition. Similarly, the yield of pulses in Bagalkot district can be enhanced by motivating the

farmers to shift from other crops to pulses by providing price incentive and proper utilization of critical inputs like biofertilizer, biopesticide (NPV Trichoderma, NSKE) and effective utilization of rain water by constructing farm ponds.

2. Excess supply over its demand was observed in the studied districts like Vijayapura (161.56 thousand tonnes), Dharwad (12.39 Thousand tonnes) Bagalkot (4.79 thousand tonnes) and Gadag (10.29 Thousand tonnes) and the same trend will continue in the future. Therefore, there is need to create infrastructure for establishing pulses park in these districts to tackle the situation of surplus production in the future. In contrary to this the deficit supply of pulses was found in Belgavi (58.57 Thousand tonnes) and Haveri (23.31 thousand tonnes) district. Hence, the widening supply- demand gap in these two districts can be minimized by productivity enhancement by cultivating high yielding and short duration varieties and providing protective irrigation during critical growth stage in addition to this the addition area need to increase under pulses cultivation by intercropping the short duration greengram and blackgram in sugarcane (Belagavi).

3. The gap between demand and supply of pulses is expected to widen in future at the major pulses producing states and national level (244.27 lakh tonnes during 2031). Thus, the country needs to focus on productivity enhancement by promoting short duration verities on drought prone area and promoting micro irrigation system. In addition to this there is a need to reduce post harvest losses (7.50 %) by developing the stored grain pest resistant varieties, modernizing the *dal* mills and establishing small processing units like IIPR mini *dal* mills in pulses producing zones.

4. To achieve self sufficiency in pulses, the projected requirement by the year 2050 is estimated at 26.62 million tonnes as per the sedentary recommendation by NIN, Hyderabad. Thus, to meet this requirement the productivity need to enhanced to about 978 kg/ha and in addition area about 3 million hectare has to brought under pulses besides reducing post harvest lossess and seed, feed wastage. Hence, the productivity could increased by easy and timely available of critical input, production of quality seed of improved varieties, encourage pulses processing industry instituted between group of villagers so that proper milling is done. However, the addition area can be brought under pulses cultivation by diversification of rice –wheat system in Indo-gangetic plains, promotion of blackgram and greengram cultivation in rice fallow in peninsular India and

promoting intercropping of blackgram/greengram with sugarcane, bengalgram with Mustard and redgram with groundnut/Soyabean/millet.

5. The gap between demand and supply of pulses in study area is also expected to widen future especially the districts like Belagave (-0.58 lakh tonnes) and Haveri (0.23 lakh tonnes) as per the Sedentary recommendation of NIN, Hyderabad. The state as a wholes showed surplus in Gap-1 (0.92 lakh tonnes) and deficit in Gap-II (-5.57 lakh tonnes). Thus, to minimize the supply Demand gap in study area can be done by cropping system improvising like greengram and blackgram as catch crop in summer/spring under cereal based cropping system, intercropping short duration pulses (greengram, blackgram and cowpea) in sugarcane (Belagavi District), millets, cotton (Haveri district) and intercropping of redgram in maize production area of Haveri district. In the districts of Haveri and Vijayapura where cotton is grown in larger area, redgram will be a suitable relay crop.

6. The study estimated 4.18 million tonnes of supply –demand gap of pulse. Despite increase in production of pulses, India has the largest importers of pulses since the beginning. The import of pulses has increased the more than 24 per cent of domestic production during 2015-16, to minimize the increasing importing trend in the future there is a need to increase the production by the way of enhancing productivity (978 kg/ha) and bringing more area (3 m.ha) under cultivation.

7. It has been observed in the study area that the farmer are not used the critical inputs in production of major pulses. Hence, there is a need to encourage the farmers by providing awareness about the role biopestcides, seed dressing of fungicides, fortification of fertilizer with specific nutrient like S, Fe, Zn, Bo etc., in increasing the crop productivity.

8. Among the mentioned constraint in the study the institutional constraint ranks first (Garret score 84.17) pertain to procurement operation and ineffective implementation. So for effective implementation of MSP there is need to establish national level institute solely for pulses like cotton corporation of India which is successfully implementing the MSP as a result today India is self sufficient in cotton production similar attempt has to be made by establishing Pulses development Board or Pulses corporation of India in pulses industry which will helps in enhancing area, production and productivity by providing a flat form for assured procurement and processing .

9. Most of the variables chosen through PCA analysis were significantly influenced on production of pulses except disease and pest. There is need to educate and support farmers about effective control of pest and diseases through Integrated Pest Management and Integrated Diseases Management which effects the crop to the extent (8 %) so that yield could be enhanced to the extent (12 %) through the doubling of the income could be realized.

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Appendices

APPENDIX-I

Area, production and Productivity of Total pulses in Madhya Pradesh

Years	Area (000 ha)	Production (000 tonnes)	Yield (Kg/ha)
1980-81	4,923.3	1,606.6	326
1981-82	4,576.3	2,010.8	439
1982-83	4,856.7	2,473.1	509
1983-84	5,129.0	2,608.0	508
1984-85	4,972.0	2,702.3	544
1985-86	4,834.0	2,343.6	485
1986-87	5,142.2	2,610.4	508
1987-88	4,769.4	2,493.7	523
1988-89	4,727.0	2,531.9	536
1989-90	4,709.0	2,488.0	528
1990-91	4,535.8	2,505.5	552
1991-92	5,012.6	3,103.9	619
1992-93	4,528.4	2,792.4	617
1993-94	4,745.4	2,898.2	611
1994-95	4,871.4	3,264.6	670
1995-96	5,194.8	3,653.8	703
1996-97	5,176.9	3,097.7	598
1997-98	5,025.1	3,544.0	705
1998-99	5,014.8	3,282.2	655
1999-2000	5,023.3	3,573.4	720
2000-01	4,938.0	3,780.5	766
2001-02	3,554.2	2,275.4	640
2002-03	4,170.2	3,224.6	773
2003-04	4,137.5	2,375.5	574
2004-05	4,585.4	3,488.0	761
2005-06	4,519.7	3,429.2	759
2006-07	4,284.9	3,232.6	754
2007-08	4,108.1	3,203.1	780
2008-09	4,026.2	2,453.6	609
2009-10	4,559.8	3,683.1	808
2010-11	4,940.5	4,304.6	871
2011-12	5,178.0	3,391.0	655
2012-13	5,179.0	4,160.1	803
2013-14	5,314.4	5,165.9	972
2014-15	5,395.8	4,644.3	861
2015-16	5,548.9	5,522.4	941

APPENDIX-II

Area, production and productivity of total pulses in Rajasthan

Years	Area (000 ha)	Production (000 tonnes)	Yield (Kg/ha)
1980-81	3,030.6	843.7	278
1981-82	3,147.2	1,169.7	372
1982-83	3,786.4	1,532.9	405
1983-84	3,533.0	1,570.0	444
1984-85	3,701.7	1,679.4	454
1985-86	3,376.9	1,382.5	409
1986-87	3,890.6	1,766.9	454
1987-88	3,207.0	946.2	295
1988-89	1,796.0	472.0	263
1989-90	2,935.9	1,622.5	553
1990-91	2,939.5	1,155.6	393
1991-92	3,682.8	1,718.8	467
1992-93	2,830.7	916.9	324
1993-94	3,440.7	1,457.9	124
1994-95	3,328.0	1,071.1	322
1995-96	3,601.9	1,965.5	546
1996-97	3,573.9	1,455.8	407
1997-98	3,760.0	1,844.6	491
1998-99	4,389.4	2,634.9	600
1999-2000	4,643.8	2,444.2	526
2000-01	2,473.1	890.9	360
2001-02	2,374.8	731.5	308
2002-03	3,357.3	1,426.1	425
2003-04	1,802.9	484.5	269
2004-05	3,860.9	2,278.5	590
2005-06	3,571.1	1,337.4	375
2006-07	3,444.6	898.1	261
2007-08	3,207.6	1,481.3	462
2008-09	3,869.9	1,552.8	401
2009-10	3,672.5	1,826.4	497
2010-11	3,501.0	713.7	204
2011-12	4,710.0	3,216.0	683
2012-13	4,451.1	2,360.0	530
2013-14	3,245.6	1,956.6	603
2014-15	4,197.7	2,490.9	593
2015-16	3,574.4	2,169.8	607

APPENDIX-III

Area, production and productivity of total pulses in Maharashtra

Years	Area (000 ha)	Production (000 tonnes)	Yield (Kg/ha)
1980-81	2,665.5	1,037.6	389
1981-82	2,804.4	831.2	296
1982-83	2,752.2	1,039.1	378
1983-84	2,574.2	962.9	374
1984-85	2,961.1	1,257.7	425
1985-86	2,833.4	1,114.3	393
1986-87	2,859.7	1,164.1	407
1987-88	2,836.1	975.0	344
1988-89	3,032.6	1,414.0	466
1989-90	3,330.4	1,729.7	519
1990-91	3,289.5	1,734.5	527
1991-92	3,257.3	1,443.9	443
1992-93	3,008.4	932.6	310
1993-94	3,350.4	1,829.1	546
1994-95	3,432.8	2,205.3	642
1995-96	3,595.6	1,697.9	472
1996-97	3,305.0	1,639.2	496
1997-98	3,325.0	2,036.8	613
1998-99	3,260.0	1,187.8	364
1999-2000	3,499.5	2,254.9	644
2000-01	3,597.7	2,206.1	613
2001-02	3,557.3	1,637.4	460
2002-03	3,388.0	1,881.0	555
2003-04	3,569.8	2,058.1	577
2004-05	3,446.1	1,960.0	569
2005-06	3,384.0	1,664.0	492
2006-07	3,432.0	2,005.0	584
2007-08	3,828.0	2,304.0	602
2008-09	4,056.0	3,024.0	746
2009-10	3,082.0	1,656.0	537
2010-11	3,376.0	2,370.0	702
2011-12	4,070.0	3,146.0	773
2012-13	3,186.0	2,215.0	695
2013-14	3,274.0	2,306.0	704
2014-15	3,953.0	3,169.0	802
2015-16	2,977.0	1,805.9	607

APPENDIX-IV

Area, production and productivity of total pulses in Uttar Pradesh

Years	Area (000 ha)	Production (000 tonnes)	Yield (Kg/ha)
1980-81	2,941.8	1,555.2	529
1981-82	2,862.3	2,523.6	882
1982-83	3,043.9	2,262.9	743
1983-84	2,977.0	2,542.0	854
1984-85	2,797.3	2,487.2	889
1985-86	2,583.3	2,688.9	942
1986-87	3,158.1	2,811.6	890
1987-88	3,079.6	2,627.9	853
1988-89	3,090.0	2,388.0	793
1989-90	2,912.6	2,657.5	912
1990-91	3,000.0	2,413.4	804
1991-92	3,040.2	2,771.9	912
1992-93	2,875.5	2,522.1	877
1993-94	2,922.0	2,526.9	865
1994-95	2,874.6	2,516.0	875
1995-96	2,831.9	2,479.2	875
1996-97	2,829.9	2,189.3	774
1997-98	2,832.8	2,625.4	927
1998-99	2,753.7	2,285.2	830
1999-2000	2,810.0	2,323.6	827
2000-01	2,685.9	2,598.8	968
2001-02	2,691.7	2,160.3	803
2002-03	2,682.5	2,377.0	886
2003-04	2,677.7	2,202.0	822
2004-05	2,698.4	2,400.3	890
2005-06	2,803.7	2,375.0	847
2006-07	2,750.7	2,231.5	811
2007-08	2,724.3	1,975.1	725
2008-09	2,156.0	1,976.9	917
2009-10	2,223.3	1,998.1	899
2010-11	2,540.7	1,901.4	748
2011-12	2,427.0	2,012.0	829
2012-13	2,448.0	1,426.0	991
2013-14	2,367.0	2,332.0	985
2014-15	2,305.0	1,697.4	736
2015-16	2,522.0	2,197.2	871

APPENDIX-V

Area, production and productivity of total pulses in Andhra Pradesh

Years	Area (000 ha)	Production (000 tonnes)	Yield (Kg/ha)
1980-81	1,366.7	328.0	240
1981-82	1,445.7	414.5	287
1982-83	1,429.5	466.6	326
1983-84	1,458.0	585.0	401
1984-85	1,498.3	566.1	378
1985-86	1,345.6	501.8	373
1986-87	1,350.2	629.0	466
1987-88	1,422.7	616.8	434
1988-89	1,481.0	644.0	435
1989-90	1,488.6	692.4	465
1990-91	1,571.7	682.0	434
1991-92	1,637.9	695.5	426
1992-93	1,645.2	791.8	481
1993-94	1,588.4	739.0	465
1994-95	1,559.3	677.0	434
1995-96	1,600.1	672.5	420
1996-97	1,610.6	771.2	479
1997-98	1,615.5	838.0	519
1998-99	1,565.0	515.7	330
1999-2000	1,587.0	827.0	521
2000-01	1,644.9	800.2	486
2001-02	1,902.2	1,054.2	554
2002-03	1,920.0	1,137.7	593
2003-04	2,100.1	1,061.6	506
2004-05	2,185.0	1,239.0	567
2005-06	1,803.8	1,019.0	565
2006-07	1,781.7	1,376.0	772
2007-08	1,984.0	1,347.0	679
2008-09	2,113.0	1,697.0	803
2009-10	1,771.0	1,448.0	818
2010-11	1,932.0	1,429.0	740
2011-12	2,130.0	1,439.0	676
2012-13	1,931.0	1,247.0	646
2013-14	1,949.0	1,623.2	833
2014-15	1,672.0	1,551.0	928
2015-16	1,367.0	1,136.2	831

APPENDIX-VI

Area, production and productivity of total pulses in Odisha

Years	Area (000 ha)	Production (000 tonnes)	Yield (Kg/ha)
1980-81	1,651.3	566.8	343
1981-82	1,725.5	886.1	514
1982-83	1,767.3	944.3	534
1983-84	1,642.6	921.6	561
1984-85	1,718.3	1,054.8	614
1985-86	1,649.8	910.8	552
1986-87	1,814.9	1,031.3	568
1987-88	1,968.2	1,057.6	537
1988-89	2,022.0	1,040.0	514
1989-90	1,957.5	1,066.6	545
1990-91	2,013.3	1,116.6	555
1991-92	1,957.9	1,085.8	555
1992-93	2,142.9	1,132.9	529
1993-94	849.3	362.4	427
1994-95	972.8	4,989.6	513
1995-96	929.2	410.0	441
1996-97	929.7	431.1	464
1997-98	658.8	225.9	343
1998-99	786.1	286.5	364
1999-2000	721.9	249.3	345
2000-01	684.0	364.8	387
2001-02	604.3	212.7	352
2002-03	713.7	284.2	398
2003-04	548.7	194.4	354
2004-05	714.8	272.7	382
2005-06	642.5	249.6	388
2006-07	809.2	336.3	416
2007-08	791.0	351.8	445
2008-09	859.0	383.5	446
2009-10	804.9	387.3	481
2010-11	867.2	399.4	461
2011-12	852.0	414.0	486
2012-13	757.0	357.2	471
2013-14	827.2	424.4	513
2014-15	780.8	419.3	537
2015-16	811.0	445.3	549

APPENDIX-VII

Area, production and productivity of total pulses in Tamil Nadu

Years	Area (000 ha)	Production (000 Tonnes)	Yield (Kg/ha)
1980-81	605.8	194.9	322
1981-82	532.6	146.7	275
1982-83	583.5	183.3	314
1983-84	600.0	210.0	350
1984-85	707.5	246.4	348
1985-86	617.8	209.9	340
1986-87	840.1	322.3	384
1987-88	689.2	286.9	416
1988-89	930.0	363.0	390
1989-90	890.6	384.0	431
1990-91	974.2	411.8	423
1991-92	863.4	348.2	403
1992-93	795.5	331.2	416
1993-94	739.0	342.7	464
1994-95	689.9	276.4	401
1995-96	691.3	340.0	492
1996-97	577.3	233.1	404
1997-98	581.6	232.8	400
1998-99	591.5	244.2	413
1999-2000	637.1	304.3	478
2000-01	860.4	370.8	431
2001-02	687.9	312.7	455
2002-03	734.9	313.9	427
2003-04	527.4	182.2	345
2004-05	536.9	200.8	374
2005-06	537.0	245.6	410
2006-07	525.3	177.0	337
2007-08	536.5	290.5	541
2008-09	609.8	185.0	303
2009-10	536.1	164.5	307
2010-11	534.7	204.2	382
2011-12	728.0	296.0	407
2012-13	780.6	399.5	512
2013-14	507.6	209.9	413
2014-15	815.8	613.8	752
2015-16	886.9	365.3	412

APPENDIX-VIII

Area, production and productivity of total pulses in India

Years	Area (lakh ha)	Production (Lakh tonnes)	Yield (Kg/ha)
1980-81	1,485.7	462.5	311
1981-82	1,567.5	622.9	397
1982-83	1,585.0	519.0	348
1983-84	1,573.5	619.0	393
1984-85	1,645.5	580.4	353
1985-86	1,583.6	488.9	309
1986-87	1,657.2	589.5	356
1987-88	1,799.0	694.0	386
1988-89	1,625.8	462.6	285
1989-90	1,646.3	545.0	331
1990-91	1,621.5	551.7	340
1991-92	1,753.9	665.9	380
1992-93	1,659.4	562.6	339
1993-94	1,523.0	630.3	414
1994-95	1,648.3	620.7	377
1995-96	1,519.4	688.1	453
1996-97	1,776.4	722.2	407
1997-98	1,681.7	496.5	295
1998-99	1,820.0	746.9	410
1999-2000	1,920.5	848.7	442
2000-01	2,046.7	956.2	468
2001-02	1,893.1	751.5	397
2002-03	2,060.6	693.6	337
2003-04	1,874.3	569.2	304
2004-05	2,106.0	792.0	376
2005-06	1,981.0	964.0	487
2006-07	2,369.0	893.0	377
2007-08	2,383.0	1,265.0	531
2008-09	2,087.0	972.0	466
2009-10	2,479.0	1,118.0	452
2010-11	2,699.0	1,497.0	555
2011-12	2,332.0	1,061.0	455
2012-13	2,269.0	1,259.3	555
2013-14	2,498.0	1,600.5	641
2014-15	2,235.0	1,635.0	792

APPENDIX-IX

Supply and Demand of Major Pulses in Karnataka Vis- A -Vis India:

An Econometric Analysis

Schedule No: _____ Date:_____

Contact No:_____

I. General Information

1. Name:_____ Age:_____ Education:_____

2. Village:_____ Taluk:_____ District:_____

3. Family Size: Male:_____ Female:_____ Children:_____ Total_____

4. Occupation: Main:_____ Subsidiary: _____

II. Land Holding:

Sl. No	Particulars	Irrigated (Acre)	Dry(Acre)	Total(Acre)
	Area			
	i) Owned			
	ii) Leased in			
	iii) Leased out			
	iv)Land Value			

III. Cropping Pattern

Sl.No	Crop	CONDITION	Crop	Variety	Area (acre)	Soil Type
I	Kharif	Dry	1.			
			2.			
			3.			
		Irrigated	1			
			2			
I	Rabi	Dry	1.			
			2.			
			3.			
		Irrigated	1			
			2			
III	Summer	Dry	1.			
			2.			
			3.			
		Irrigated	1			
			2			

Objective 1.To estimates cost and returns of major pulses and to identify problems and prospects of pulses cultivations in Karnataka.

I. Detail Cost of Cultivation of Crop

1. General information

1.Crop: Redgram/Bengalgram/Greengram Variety: _____

2. Area (acre)_____

3. Soil Type:_____

4. Seed Source:_____

2. Input Utilization Pattern

Sl. No	Particulars	Unit	Quantity	Amount (Rs)
I.	**Variable cost**			
1	Seeds			
2	Seed treatment Chemicals			
3	FYM			
4	Chemical Fertilizer			
i.	Urea			
ii.	DAP			
iii.	SSP			
iv.	MOP			
v.	Complex			
vi.	Others, if any			
5	Plant protection chemicals			
i.				
ii.				
iii.				
iv.				
6	Bio fertilizer			
7	Green Manures			
8	Bio-Pesticides			
10.	Others if any			
II.	**Fixed cost**			
1.	Rental value of land			
2.	Land revenue			
3.	Depreciation cost on farm machinery			
4,	Interest on fixed capital			

3.Labour Utilization Pattern

Sl. No	Operations	No.of Times	Family labour (Mandays)		Hired Labour (Mandays)		Bullock Labour (Pairdays)		Machine Labour (Hour per days)		Wage rate			
			M	W	M	W	O	H	O	H	M	W	B	Machine
1.	Land preparation													
2	Appl^{n}. of FYM													
3	Appl^{n}. of Vermicompost													
4	Appl^{n}.of Micronutrient													
5	Sowing													
6	Weeding													
7	Appl^{n}.of Weedicides													
8	Appl^{n}.of Chem. Fertilizer													
9	Appl^{n}.of Pesticides													
10	Intercultural Operation													
11	Harvesting													
12	Threshing													
13	Winnowing													
14	Cleaning													
15	Packing and loading													
16	Post harvest operation													

II. Major problems in pulses cultivation

Sl.No	Problems (Constraints)	Rank
1.	**Infrastructural constraints**	
a.	Non availability of HYV seeds at time of sowing	
b.	Non availability of plant protection chemicals in the market	
c.	Non availability of Fertilizer in the market	
d.	Lack of irrigation facilities	
2.	**Socio-economic constraints**	
a.	High cost of inputs	
b.	High cost of labour.	
c.	Labour scarcity	
d.	Non availability of credits in time	
e.	Lack of subsidy for inputs.	
f.	Low profit	
3.	**Technological Constraints**	
a.	a. Lack of proper knowledge about improved varieties, seed, rate, spacing and sowing date	
b.	Lack of knowledge about seed treatment.	
c.	Lack of knowledge about fertilizer dosage and method of fertilizer application.	
d.	Lack of knowledge about weed management.	
e.	Lack of knowledge about insect pest and diseases management	
f.	Lack of knowledge about use of growth regulators	
4.	**Institutional Constraints**	
a.	Weak research-extension farmer linkages	
b.	Non availability of suitable literature.	
c.	Lack of regulated market.	
5.	**Marketing Constraints**	
a.	Lack Market information	
b.	High Marketing cost	
c.	Poor marketing Infrastructure	
d.	Lack of transparency in Market operation	
e.	Poor performance of Pledged Loan Scheme	
f.	High market margins to middlemen	

Objective 2. To identify and asses the factors of supply for pulses in Karnataka.

I. Biotic factors determining Supply:

Sl.No	Factors	During Sowing		During Flowering		During pod formation	
1.	Rain Fall						
2.	Temperature						
3.	Relative humidity						
4.	**Pest**	Normal	Abrupt	Normal	Abrupt	Normal	Abrupt
a).							
b)							
c)							
d)							

5.	**Disease**						
a).							
b)							
c)							
d)							

II. Abiotic factors determining Supply:

Sl.No	**Particulars**	**Quantity**	**Price**
1.	Variety		
	a)		
	b)		
	c)		
	d)		
2.	FYM		
3.	Weedicide		
4.	Green Manure		
5.	Vermicompost		
6.	Micronutrient		
7.	Growth regulator		
8	Fertilizer		

III. Technical Factor

Sl.No	**Particulars**	**Good**	**Not Good**
1.	Seed rate Knowledge		
2.	Seed Treatment Knowledge		
3.	Spacing Knowledge		
4.	Knowledge Fertilizer Dosage		
5.	Pest and Disease Management Knowledge		
6.	Marketing Knowledge		
7.	Extension Service		

IV. Socio Economic Factors

Sl.No	**Particulars**	**Frequency**			
1.	Land holding	Marginal	Small	Medium	Large
2.	Family Size	2-4	5-8	>8	
3.	Education	Illiteracy	Primary	Secondary	College and Above
4.	Farm mechanization				

APPENDIX-X

Minimum Support Price (₹/quintal) of Pulses (2011-12 to 2016-17)

Crops	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	Absolute increase (Rs/q)	Per cent (%)
Pigeonpea	3,200	3,850	4,300	4,350	4,625	5,050	425	9.19
Chickpea	2,800	3,000	3,100	3,175	3,500	3,925	425	13.57
Mungbean	3,500	4,400	4,500	4,600	4,850	5,225	375	7.73
Urdbean	3,300	4,300	4,300	4,350	4,625	5,000	375	8.11
Lentil	2,800	2,900	2,950	3,075	3,400	3,775	375	11.03

APPENDIX-XI

Nutritive value of pulses (Values per 100g)

Pulses	Energy (k cal)	Proteins (g)	Fat (g)	Calcium (mg)	Iron (mg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)
Bengalgram	360	17.1	5.3	202	4.6	0.30	0.15	2.9
Redgram	335	24	1.4	154	3.8	0.42	0.20	2.0
Balckgram	347	24	1.4	154	3.8	0.42	0.20	2.0
Greengram	348	24.5	1.2	75	3.9	0.47	0.21	2.4

SUPPLY AND DEMAND OF MAJOR PULSES IN KARNATAKA VIS-A-VIS INDIA – AN ECONOMETRIC ANALYSIS

AVINASH C S **2018** **Dr. B. L. PATIL**
Major Advisor

ABSTRACT

India is the largest producer and consumer of pulses in the world contributing around 25-28 per cent of the total global production. Globaly 90 per cent of the redgram, 75 per cent of bengalgram and 37 per cent of lentil area is contributed from India. Sustained economic growth, increasing population and changing life styles are causing significant changes in Indian food bosket, away from staple food grains towards high value horticultural and animal products. Study includes both primary and secondary data, based on the nature and extent of availability of data, the analytical tools like compound growth rate, tabular presentation technique, compound growth rate with normative approach, Principal component analysis, multiple regression analysis and Garrett ranking technique have been adopted to draw the meaning full interpretation and inferences. In pertain to total pulses scenario in Karnataka revealed that the growth in area, production and productivity were positive in all the period except productivity (-0.82 %) in period-I. It is important to highlight that though the growth rates of productivity is observed negative but the production was found positive in period-I. The abstract of demand and supply of pulses in the study area revealed that Dharwad, Vijayapura, Gadag and Bagalkot, the supply of pulses as per the demand-I estimation indicating surplus of 0.10 to 1.61 lakh tonnes. However, Bagalkot district showed very minute quantity of surplus (0.05 lakh tonnes) but Belagavi and Haveri district were showed deficit of 0.58 and 0.23 lakh tonnes respectively. Country as a whole total pulses requirement worked out to be 220.05 (Total demand-I) and 244.27 (Total demand-II) lakh tonnes during 2021. However, during 2031 the total pulses requirement would be 357.66 (Total demand-I) and 397.02 (Total Demand-II) lakh tonnes.