PULSES IN INDIA
RETROSPECT AND PROSPECTS

सत्यमेव जयते

GOVERNMENT OF INDIA
MINISTRY OF AGRICULTURE
(DEPARTMENT OF AGRICULTURE AND COOPERATION)
DIRECTORATE OF PULSES DEVELOPMENT
VINDHYACHAL BHAVAN
BHOPAL (M.P.)
462004

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Compiled & Edited by

Dr. A.K. Tiwari
Director

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सार्वजनिक वितरण मंत्री
भारत सरकार
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& CONSUMER AFFAIRS
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17 March, 2008

MESSAGE

The role of Government by way of public policies, programme and investment is going to be extremely important. Effective governance at the grassroots level shall be the key to success. Interaction with the farmers is essential for ensuring relevance of the location specific interventions and programme module.

I am happy that the Directorate of Pulses Development, Government of India, Bhopal (MP) is bringing out a publication on "Pulses in India : Retrospect & Prospects" covering the roles, functions of this National Commodity Directorate and the progress on pulses development made by way of critical interventions of the different CS/CSS during different plan periods.

I trust that the critical plan wise analysis, proposed strategies, interventions to augment production of pulses commensurate to burgeoning vegetarian population, sector wise technical advisories etc., would be of immense help to all the ISOPOM/NFSM states and other stake holders in strategic planning and implementation of the programmes relating to Pulses. I expect that the synergistic approach in implementation of the programme will benefit the farmers, especially the small, marginal and the scheduled categories.

I hope that the strategies and policies, the cropping systems approach delineated in the book shall serve as ICAR-DAC interface recommendation and help in expansion of targeted pulses area with projected production.

पी.के. मिश्र, पी एच डी,
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सत्यमेव जयते

FOREWORD

भारत सरकार
कृषि मंत्रालय
कृषि एवं सहकारिता विभाग
Government of India
Ministry of Agriculture
Department of Agriculture & Cooperation

In compiling a well researched document on the retrospect and prospects of pulses in India, Dr. A.K. Tiwari who heads the Directorate of Pulses Development in the Government of India has made a significant contribution to the understanding of the subject.

India is the world's largest producer of pulses and the largest importer too. The major pulses grown in India are chick pea, pigeon pea, moong bean, urad bean, field pea and lentil which together form 80.7% of the pulses grown in the country.

Pulses play a critical role in ensuring the nutritional security of the common man. They are rich in protein, carbohydrates, fibres, some 'B' vitamins and low in fat. The protein content of pulses is twice that of wheat and three times that of rice. It is this property which has earned pulses the description, 'poor man's meat'. The impact of pulses on human health has been established by research.

From time to time Government of India has taken effective steps to facilitate increase in the production of pulses in the country. The integrated Scheme on Oilseeds, Pulses, Oil Palm and Maize (ISOPOM) sponsored by the Government of India is now in operation.

The National Food Security Mission envisages enhancing the production of pulses by 2 million tonnes by the end of the Eleventh Plan.

Governmental efforts are there to supplement and not supplant the initiatives of the farmer, because the farmers know best what is good for him. If the area coverage, production and productivity of pulses have not made a quantum jump in the country over the years and if India still continues to import pulses, the reason is not far to seek. Farmers are yet to find attractive reasons to concentrate on the cultivation of pulses instead of more remunerative crops.

Dynamics of change ought to inform governmental policy and any enlightened policy should be founded on analytical information from the field gathered through extensive study and research. In compiling the present document, Dr. A.K. Tiwari has contributed to this critical need for information.

I hope the publication, 'Pulses in India: retrospect and prospects' will go a long way in providing much needed information to students, researchers and policy makers in this field.

I congratulate Dr. Tiwari for his dedication and academic pursuit.

(P.K. Mishra)

New Delhi
18th April 2008

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FOREWORD

Achieving and sustaining food security for the country, whose population is continuously increasing, is a major challenge. Food output growth at less than 3 per cent in India is unable to match the demand of an economy growing at over 8 per cent. Food prices have been on the rise across the globe and are projected to follow a rising trend over the next few years.

Although agriculture accounts for just 19 per cent of India's economic output, it provides livelihood to 60 per cent of its population Productivity of pulses has stagnated for a decade. The per capita availability of cereals and pulses has fallen to 422 gm per day as against 510 grams in 1991. Pulses are the main source of protein for our large vegetarian population. Concerned over the inadequate production of pulses in the country, the NDC resolved to raise wheat, rice and pulses production by eight, ten and two million tonnes over the next four years, the terminal year of Eleventh plan. In pursuance of NDC's decision, National Food Security Mission has been launched in the country. Pulses are an important component of NFSM. In addition to ISOPOM-pulses under the TMOP, the NFSM-pulses has been launched in 14 potential States targeting 168 potential districts, which have high potential for enhancing production of pulses. Popularization of short duration pulse varieties, coupled with critical interventions on developmental front can definitely help to achieve the targeted production.

Critical and empirical plan-wise analysis on different interventions, pulse scenario, crops' status, their feasibility and scope, agro-climatic zone-wise constraints and suggested strategies in "Pulses in India: Retrospect and Prospects" is a sincere, comprehensive and incisive effort to highlight relevant issues with regard to pulses. For analytical and positive approach, the author deserves appreciation.

I am sure the publication will serve as an important reference manual for all those involved in the planning, development and research and trade in pulses.

(S.L. Bhat)

New Delhi,
March, 2008

PREFACE

Food security and affordability top the Government's agenda as production stagnates and prices continue to be firm. The *compound annual growth rate* between triennium ending 1995-96 and 2006-07 for total foodgrains at 1.04% and pulses 0.25%, reveal loss of dynamism in agriculture and allied sectors and is an alarming concern. There are weather and yield concerns and concerns of demand and supply whereby 20 million tones of pulses would be required by 2011-12.

Nutritional security is another area to be taken care of as most of our vegetarian population is devoid of balanced diet leading to diverse forms of ailments and associated deficiency disorders. Pulses fill the void in supplementing the nutritional shortfall with the available proteins in fair quantities. Vital roles of pulses in sustaining the soil fertility by way of nitrogen fixation, feed and fodder values, inter-alia add the degree of their importance in sustainable agriculture

India's outstanding contribution towards total global acreage and production of pulses at 32 and 23 per cent respectively is credited to our strength The three five year plans of post-TMOP interventions, realized about 600 kg national average yield, as against the world's average productivity of 870 kg, is still much less than the demonstrated potential under the FLD. This, however, indicates that the targeted production and productivity is possible with the pulses under new niches, utilizing present systems of scientific inputs and modernized methods of pulse cultivation, complimented with generous governmental policies and appropriate development funding support under the ambitious ISOPOM, NFSM and the contractual research programs.

Acreage stability factors may be attributed to pulse coverage and production having comparative statistics between the periods *prior to and during* the TMOP, despite increase in infrastructural/irrigational potential from nine per cent to thirteen per cent and marginalization of these marginal crops. NPDP in 1986 during the Seventh Plan and ISOPOM during 2004-05 boosted the pulse production as evident from the increase in national average productivity from eighth plan onward. The ISOPOM with further infusion of the NFSM during the Eleventh plan would certainly display a catalytic role in translation of technology in all the 14 ISOPOM implementing states in general and identified potential 168 NFSM- pulses districts in particular.

Efforts, through compilation, have been made to have an access to most of the FAQs on pulses development, plan efforts impacts, scenario, strategies, post harvest and processing aspects along-with the production technology. The publication also provides information on various agencies/stake holders, operating in isolation, may work in a participatory mode.

This Publication is inevitable and indispensable to highlight the *past scenario*, *present status* and the *prospects* of this commodity in the country delineating the districts, as well. Emphasis has also been given on the proposed strategies during XIth plan and beyond in the face of the *national food security*. The strategies recommended would certainly cope-up with the limited and dwindling resources at hand. Various aspects of need-based pulse production and developmental programs associated with the Directorate, in line with the *National Agricultural Policy*, have been incorporated with their varying degrees of impacts during different eras.

I hope the small volume of "*Pulses in India-Retrospect and Prospects*" would not only benefit the intelligentsia, the developmental organizations, extension workers, traders, farmers, readers and all other stake-holders, but a sense of motivation may be imbibed to all concerned in making the country *self-sufficient* and *self-reliant* in the pulse sector. The book would certainly cast a new vista of hopes which may creep into the readers' minds, keeping alive the core and intrinsic purpose of sustained pulse production in the long run.

I consider it my privilege to express my deep admiration and immense gratitude to Dr. P.K.Mishra, Secretary, Department of Agriculture and Cooperation, Mrs Radha Singh, the then Secretary (DAC), Shri S.L.Bhat and Dr.C.V.Ananda Bose Additional Secretary, Dr.N.B.Singh, Agriculture Commissioner, Shri R.K.Tiwari and Shri Mukesh Khullar, Joint Secretary, Shri P.K.Sharma, Director and Dr.R.V.Singh, former Director (CDD) for their sustained support and encouragement in bringing out the much sought of publication.

I am thankful to Dr.A.K.Shivhare, Stat.Investigator, Shri A.L.Waghmare, Dr. A.K. Singh, Dr.D.K.Srivastava, Sr.Technical Assistants, S/Shri Rajesh Pawar, N.K. Jha, H.K. Choudhary and other supporting staff of my Directorate for their contribution in this endeavour. Shri Waghmare and Dr.Shivhare deserve special mention for their sincere association.

April 07, 2008

(A.K. Tiwari)
Director

EXPLANATION TO ABBREVIATIONS

ALP	Aluminum Phosphate
AFC	Agriculture Finance Commission
AICRP	All India Coordinated Research Project
ADO	Agriculture Development Officer
ATMA	Agriculture Technology Management Agency
AES	Agro-ecological situations
AMDP	Accelerated Maize Development Programme
'A' lines	Male sterile lines
a.i	Active ingredient
A, P, Y	Area, Production, Yield
A.P	Andhra Pradesh
B	Boron
'B' lines	Maintainer lines
BCMV	Bean Curl Mosaic Virus
BSP	Breeder Seed Production
BNF	Biological nitrogen fixation
BT	*Bacillus thuringenesis*
COPP	Change over previous plan periods
CAGR	Compound Annual Growth Rate
CZ	Central Zone
C.G.	Chhattisgarh
CGMS	Cytoplasmic Genetic Male Sterility
CEC	Cation Exchange Capacity
CAZRI	Central Arid Zone Research Institute, Jodhpur
CZ	Central Zone
CPWD	Central Public Work Department
CIAE	Central Institute of Agriculture Engineering
CCL	Cash Credit Limit
CFTRI	Central Food Technology Research Institute
CWC	Central Warehousing Corporation
DFSMEC	District Food Security Mission Executive Committee
DAP	Diamonium phosphate
DGCI&S	Director General of Commerce Intelligence and Statistics
DAC	Department of Agriculture & Cooperation
DAS	Days after sowing
EC	Emulsifying concentrate
ETL	Economic Threshold Level
EC	Empowered Committee
FAQ	Fair Average Quality
FFS	Farmers field school
FOs	Farmers organization
FIGs	Farmers interest group
FLD	Front line Demonstration
FAO	Food and Agriculture Organization

FYM	Farm Yard Manure
GOI	Government of India
GMS	Genetic Male Sterility
HDPE	High Density Poly Ethylene
HI	Harvest Index
HRD	Human Resource Development
HP	Horse power
ITD	Innovations in Technology Dissemination
IFFCO	Indian Farmers Fertilizer Co-operative Ltd.
IPM	Integrated pests management
ISOPOM	Integrated Scheme of oilseeds, pulses, oil palm & maize
IIPR	Indian Institute of Pulses Research
ICAR	Indian Council of Agriculture Research
INM	Integrated nutrient management
ICMR	Indian Council of Medical Research
KCl	Potassium chloride
K	Potassium
K	Kharif
KVK	Krishi Vigyan Kendra
KVIC	Khadi Village Industries Commission
KW	Kilo watt
KRIBHCO	Krishak Bharti Co-operative Ltd
LE	Larval extract
MM-1	Mini-mission-1
MSP	Minimum support price
Min.	Minimum
Max.	Maximum
Mo	Molibdenum
MP	Madhya Pradesh
MS	Maharashtra
NAT	New Agriculture Technology
NEPZ	North East Plain Zone
NWPZ	North West Plain Zone
NHZ	North Hilly Zone
N	Nitrogen
NPV	Nuclear Polyhedrosis Virus
NATP	National Agriculture Technology Project
NCDC	National Cooperative Development Corporation
NGOs	Non-Government organization
NABARD	National Bank for Agriculture & Rural Development
NPDP	National Pulses Development Project
NALMOT	National Monitoring Team
NUE	Nutrient use efficiency
NFSM	National Food Security Mission
NAFED	National Agricultural Marketing Federation Ltd.
NBSS&LUP	National Bureau of Soil Science & Land use planning

NWDPRA	National Watershed Development project for Rural Agriculture
NSC	National Seed Corporation
NAEP	National Agriculture Extension Project
NE	North east
NW	North western parts
OPDP	Oil Palm Development Project
OILFED	Oil Federation
OPDP	Oil palm Development Project
OPP	Oilseed Production Programme
PSHG	Pulses self help group
PHT	Post Harvest Technology
PSB	Phosphate Solubilizing Bacteria
PWD	Public Work Department
PGPR	Plant Growth Promoting Rhizobacteria
PC	Project Coordinator
PAU	Punjab Agriculture University, Ludhiana
PKV	Panjabrao Krishi Vidyapeeth, Akola (MS)
PFA	Prevention of Food Adulteration
PHT	Post Harvest Technology
PSS	Price Support Scheme
P	Phosphorous
Q	Quintal
RGK	Rural Gram Kendra
RBI	Reserve Bank of India
R	Rabi
‘R’ lines	Restorer lines
RAEO	Rural Agriculture Extension Officer
R&D	Research & Development
SPPP	Strategic pulses production plan
SVS	Seed village scheme
SES	Socio-Economic Status
SBI	State Bank of India
SSP	Single super phosphate
SDA	State Department of Agriculture
SL	Solublite
SRR	Seed Replacement Rate
SHGs	Self Help Groups
SWCs	State Warehousing Corporation
SZ	South Zone
SFPP	Special Foodgrain Production Programme
SSC	State Seed Corporation
SFCI	State Farm Corporation of India
SALMOT	State Level Monitoring Team
ToT	Transfer of Technology
TMC	Technology Mission on Cotton
T&V	Training & visit

TAC	Technical Advisory Committee
TE	Triennium Ending
TMO	Technology Mission on Oilseeds
TN	Tamil Nadu
UK	United Kingdom
UNDP	United Nations Development Programme
USA	United States of America
UTs	Union Territory
UP	Uttar Pradesh
W.B.	West Bengal
WSC	Water soluble concentrate
YI	Yield Index
YMV	Yellow Mosaic Virus
ZRS	Zonal Research Station
&	And
@	At the rate
Ca	Calcium
Cm	Centimeter
^{O}C	Degree Centigrade
g	Gram
>	Greater than
hr	Hour
Kg/ha	Kilogram/hectare
ml	Mili litre
mg	Mili gram
pH	Potential Hydrogen
%	Per cent
m^2	Square meter
Zn	Zinc

ABOUT THE DIRECTORATE

Established in 1971 at Lucknow (Uttar Pradesh) merging the Regional Extension Unit, Ahmedabad to it with the re-organization of Crop Development Directorate in the year 1995, it functions from Madhya Pradesh (Bhopal) as its National Head Quarter. The Directorate of Pulses Development is one of the nine Commodity Development Directorates (CDDs), a subordinate national level field formation under the Ministry of Agriculture, (Department of Agriculture & Cooperation), Government of India. Other CDDs, with its national crop significance, are Directorate of Jute Development, Kolkata (W.B.); Directorate of Oilseeds Development, Hyderabad (AP); Directorate of Wheat Development, Ghaziabad (UP); Directorate of Sugarcane Development, Lucknow (UP); Directorate of Millets Development, Jaipur (Rajasthan); Directorate of Cotton Development, Mumbai (MS); Directorate of Rice Development, Patna (Bihar); and Directorate of Tobacco Development, Chennai (TN).

The Directorate is mandated with bifocal responsibilities i.e. the nodal crop pulses across the country and all other crops, in the assigned states viz. Madhya Pradesh and Chhattisgarh, of the sister directorates apart from collection, compilation and analysis of data pertaining to nodal and other crops and bringing out All India weekly weather watch report for review by the Crop Tracking Committee, Department of Agriculture & Cooperation. Recently the Directorate has been entrusted with the responsibility to act as convener/coordinator for the NFSM-Wheat/Pulses/Rice implementation/ monitoring for the six central and southern states of MP, MS, Gujarat, Tamil Nadu, Karnataka and Andhra Pradesh.

Since 21st January, 2004 it is the Central nodal agency for operationalization of Government of India run Kisan Call Centre (KCC) in the state of MP and Chattisgarh. Although proportionately poorly strengthened than its research counterpart IIPR, it assumes significance by way of its contribution and association as a Task force/Core-group Member organization in formulation of Action Plan on “Increasing pulses for X^{th} Plan in view of National Agriculture Policy” targeting a growth rate of 4 percent per annum during 2000, “Alternate structure of TMOP - a New Mission Document” under the Chairmanship of Dr. Mangla Rai, Secretary, DARE and DG ICAR the then DDG (Crop Sciences), and the “Doubling Food grain Production - Detailed Project Report (DPR)” by the end of XI Plan 2004-05 to 2011-12, as per decision of Committee of Secretaries under the Chairmanship of Cabinet Secretary and directives of Planning Commission vide 9th March, 2004.

Core Activities

Besides the technical responsibilities at Planning/Development/Monitoring fronts, Directorate is entrusted with the diverse activities ranging from extension supports to public relations vis-a-vis its assigned centrally sponsored project on ISOPOM & NFSM across the country. It regularly monitors the crop prospects/crop scenario on weekly basis,

production forecast/estimates etc. For strengthening of existing SRR, formulation of plan period seed-rolling plan (breeder/foundation/certified seed production), ensure its production, distribution coordination of Research and Development (DAC-ICAR) interface and dissemination of research recommendations etc, is also ensured. To garner the extension support, strategically, the Directorate as DACs representative participates in the national/state/regional level meetings, conferences, seminars, symposia, workshops and other extension activities.

For assessment of project impact and pilot studies on specific areas, tours and field visits to every corner of the country are executed. Close coordination with IIPR, ICRISAT, CRIDA, ICAR, SAUs, SDAs, E&S, CACP and other such stake holders in the field of pulse production/processing etc, dissemination of latest technologies breakthrough to the states, farming communities and institutes etc, are the other integrated part of the executed jobs. The Directorate also acts as a part and parcel of any Central Team in survey operations due to the occurrences of such natural calamities, more particularly to the states of Chhattisgarh and Madhya Pradesh, where the Directorate is located.

Technically, it monitors the concurrent implementation and coordinates the ISOPOM and NFSM implementation. The Monthly Progress reports/QPR/APR submitted by the SDA on programme/Mission implementation, are analyzed/examined and the observations are communicated to all the participating agencies for further corrective measures at their end. Preparation of Agro-climatic zone-wise/state-wise/season-wise and crop-wise advisories, preparation of state action plans, representing to various task force/state committees, “Committee on Climate Change Adaptation and Board of Directors in State Agro-Industries etc are the other brief profile of responsibilities.

It has been associated with the formulation of “externally aided project (UNDP) on chickpea & pigeonpea”; “short term developmental strategy on increasing lentil production in the country”; “Country statement and General Debate on Food & Agriculture Situation in India” during Secretary’s visit to FAO; “Overseas project proposal of Collaborative Nature on Break-Through in Seed Production Programme in pulses” for FAO Meet 2001; seed rolling plan for 10 years (2002-03 to 2011-12) apart from formulation of guidelines on ISOPOM, NFSM-Pulses and to act as convener for national Rabi, kharif and summer seed minikit meeting.

With the launch of ISOPOM, the DPD, Bhopal organized a National Seminar-cum-Workshop on “Delineation of Thrust Areas on Pulses Development Activities under Modified ISOPOM Scheme” (27-28 March, 2004) at CSAU&T Kanpur (UP) involving all stake holders representing ISOPOM states and other Central development/Research agencies. Similarly coordinated the organization of DAC-ICAR Inter-face on Existing Water Resources & Technologies for Enhancing Agricultural Production in North Central India (April 2-3, 2005) at IISS (ICAR), Bhopal (MP).

With the enhanced responsibilities and expectations, proper strengthening both in terms of technical/secretarial staff and critical need based HRD support/exposure visit

and level playing fields to such a National level field formations, is felt as the need of the hour.

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PEAS (MATAR)

MOTHBEAN (MOTH)

HORSEGRAM (KULTHI)

LATHYRUS (KHESARI)

RAJMASH (FRENCHBEAN)

COWPEA (LOBIA)

PULSES OVERVIEW

1. INTRODUCTION

Pulses are an important commodity group of crops that provide high quality protein complementing cereal proteins for pre-dominantly substantial vegetarian population of the country. Although, being the largest pulse crop cultivating country in the World, India's production of pulses is relatively mere in comparison to total cereal crops productions. The cultivation of pulses builds-up a mechanism to fix atmospheric nitrogen in their root nodules and thus meet their nitrogen requirements to a great extent.

In India, pulses can be produced with a minimum use of resources and hence, it becomes less costly even than animal protein. In comparison to other vegetables, pulses are rich in protein which are less expensive and can be cultivated as an inter-crop and also as mixed crop. Pulses are mostly cultivated under rainfed conditions and do not require intensive irrigation facility and this is the reason why pulses are grown in areas left after satisfying the demand for cereals/cash crops. Even in such conditions, pulses give better returns. Apart from this, pulses possess several other qualities such as they are rich in protein, improve soil fertility and physical structure, fit in mixed/inter-cropping system, crop rotations and dry farming and provide green pods for vegetable and nutritious fodder for cattle as well.

Although this crop group is more important from the nutritional point of view, there has not been any significant development both in area and production during the last fifty years. With the increase in infrastructural and irrigation facilities/resources, the pulses are met with the marginalized treatment pushing them to another poor and marginal land piece. It is imperative to mention that the New Agriculture Technology (NAT) introduced during mid-sixties has increased the production of food-grains from 50.82 million tonnes during 1950-51 to 217.28 million tonnes during 2006-2007 with the increase in area from 97.32 million hectares to 123.50 million hectares. The productivity of food grains has also sharply increased to 1750 kg/ha during 2006-2007 from the level of only 522 kg/ha during 1950-51.

Pulses are grown in all three seasons. The three crop seasons for the commodity are:

i) ***Kharif*** – Arhar (Tur), Urd (Blackgram), Moong (Greengram), Lobia (Cowpea), Kulthi (Horsegram) and Moth. ii)***Rabi*** – Gram, Lentil, Pea, Lathyrus and Rajmash and iii) ***Summer*** – Greengram, Blackgram and Cowpea.

1.1. Pulse's Share To Total Foodgrain Basket: per cent share of pulses to total food-grain basket in the country in terms of area, production and productivity was 19.62, 16.55 and 84.48 per cent respectively during 1950-51. This trend continued till 1960-61 and started decleration from 1970-71(after green revolution) due to no break through in production technology of pulses in comparision to other commodities of foodgrains. At present, except the area stablization, the production during 2006-07 has gone down to 6.66 per cent due to stagnation in productivity of pulses as

compared to other commodities of foodgrains. Deceleration of Per cent contribution of pulses to total foodgrains has prompted the Ministry of Agriculture to vigorously pursue the NFSM-Pulses during the Eleventh Plan (2007-08 to 2011-12), a centrally sponsored scheme, in addition to on going ISOPOM scheme for all 14 pulse potential states.(**Table 1.1**)

Table 1.1 - Contribution of pulses to total foodgrains in India

A= Area Million ha, P= Production Million Tonnes, Y= Yield Kg/ha

Year	Pulses			Foodgrains			Pulses % to Foodgrains		
	A	P	Y	A	P	Y	A	P	Y
1950-51	19.09	8.41	441	97.32	50.82	522	19.62	16.55	84.48
1960-61	23.56	12.70	539	115.58	82.02	710	20.38	15.48	75.92
1970-71	22.54	11.82	524	124.32	108.42	872	18.13	10.90	60.09
1980-81	22.46	10.63	473	126.67	129.59	1023	17.73	8.20	46.24
1990-91	24.66	14.26	578	127.84	176.39	1380	19.29	8.08	41.88
1995-96	22.28	12.31	552	121.01	180.42	1491	18.41	6.82	37.02
2000-01	20.35	11.08	544	121.05	196.81	1626	16.81	5.63	33.46
2001-02	22.01	13.37	607	122.78	212.85	1734	17.93	6.28	35.01
2002-03	20.50	11.13	543	113.86	174.77	1535	18.00	6.37	35.37
2003-04	23.46	14.91	635	123.45	213.19	1727	19.00	6.99	36.77
2004-05	22.76	13.13	577	120.00	198.36	1652	18.97	6.62	34.93
2005-06	23.39	13.39	598	121.60	208.60	1715	18.41	6.42	34.87
2006-07	23.76	14.11	594	124.07	211.78	1707	19.15	6.66	34.80

1.2. Growth Rate of Total Pulses: From 1950-51 to 2006-07, the total acreage under pulses has almost been stagnated but for 1990-91 (24.66 million ha), however, the maximum growth rate in area was recorded between the period from 2002-03 to 2003-04 at 14.4%. Maximum production growth rate of 34.0% and maximum yield growth rate of 16.9% were also observed during the same period. The highest production (15 million tonnes) and yield (635Kg/ha) was recorded during 1998-99 and 2002-03 (**table 1.2**)

Table 1.2-Growth Rate of Total Pulses

Year	Area		Production		Yield		% coverage under irrigation
	Million ha	Growth rate %	Million Tonnes	Growth rate %	Kg/ha	Growth rate %	
1950-51	19.09	-	8.41	-	441	-	9.4
1955-56	23.22	4.3	11.04	6.3	476	1.6	8.4
1960-61	23.56	0.3	12.70	3.0	539	2.6	8.0
1965-66	22.72	-0.7	9.94	-4.3	438	-3.7	9.4
1967-68*	22.65	-0.2	12.10	10.9	534	11.0	8.7
1970-71	22.54	-0.2	11.82	-0.8	524	-0.6	8.8
1975-76	24.45	1.7	13.04	2.1	533	0.3	7.9
1980-81	22.46	-1.6	10.63	-3.7	473	-2.3	9.0

(Continued)

(Table 1.2. continued)

Year	Area		Production		Yield		% coverage under irrigation
	Million ha	Growth rate %	Million Tonnes	Growth rate %	Kg/ha	Growth rate %	
1985-86	24.42	1.7	13.36	5.1	547	3.1	8.5
1990-91	24.66	0.2	14.26	1.3	578	1.1	10.5
1995-96	22.28	-3.3	12.31	-12.3	552	-9.5	12.9
1996-97	22.45	0.8	14.24	15.7	635	15.0	12.7
1997-98	22.87	1.9	12.98	-8.8	567	-10.7	11.3
1998-99	23.50	2.8	14.91	14.9	634	11.8	12.1
1999-00	21.12	-10.1	13.42	-10.0	635	0.2	16.1
2000-01	20.35	-3.6	11.08	-17.4	544	-14.3	12.5
2001-02	22.01	8.2	13.37	20.7	607	11.6	13.3
2002-03	20.50	-6.9	11.13	-16.8	543	-10.5	14.4
2003-04	23.46	14.4	14.91	34.0	635	16.9	13.6
2004-05	22.76	-3.0	13.13	-11.9	577	-9.1	N.A.
2005-06	22.39	-1.6	13.39	2.0	598	3.6	N.A.
2006-07**	23.76	6.1	14.11	5.4	594	-0.7	N.A.

Note: The yield rates given above have been worked out on the basis of production & area figures taken in '000 units. * Green Revolution period, N.A. Not available. ** Advance estimate as on 4.4.2007

Source: *Agricultural Statistics at a Glance, 2007.* Directorate of Economics and Statistics, Ministry of Agriculture, Govt. of India (Website http://www.dacnet.nic.in/eands).

2. NUTRITIVE VALUE

Table 1.3. Nutritive values of pulses

Name of foodstuff	Protein (%)	Vit. A (I.U.)	Thiamine (mg)/ 100g	Ribo-flavin (mg)/ 100g	Nicotinic-acid (mg)/ 100g	Vit. C (mg)/ 100g	Biotin (g)/ 100g	Choline (mg)/ 100g	Folic-acid (g)/ 100g	Inositol (mg)/ 100g	Panto thenic-acid (mg)/ 100g	Vit. K (mg)/ 100g
Bengalgram	20	316	0.30	0.51	2.1	3.00	10.0	194	125	240	1.30	0.29
Blackgram	24	64	0.41	0.37	2.0	0	7.5	206	144	90	3.5	0.19
Greengram	25	83	0.72	0.15	2.4	0	-	-	-	-	-	-
Horsegram	22	119	0.42	0.20	1.5	1	-	-	-	-	-	-
Lentil	25	450	0.45	0.49	1.5	0	13.2	299	107	130	1.6	0.25
Pea	22	31	0.47	0.21	3.5	0	-	-	-	-	-	-
Redgram	22	220	0.45	0.51	2.6	0	7.6	183	83	100	1.5	-
Mothbeans	25	16	0.45	0.09	1.5	2	-	-	-	-	-	-
Khesari	31	200	0.39	0.41	2.2	0	7.5	-	100	140	2.6	-
Cowpea	23	60	0.50	0.48	1.3	0	202	-	-	-	-	-

Source: *The Nutritive value of Indian Foods & the planning of satisfactory Diets (ICMR)*

3. PER CAPITA AVAILABILITY OF PULSES IN INDIA

As a result of stagnant pulse production and continuous increase in population, the per capita availability of pulses has decreased considerably. The *per capita* per day availability of pulses in 1951 was 60 g that dwindled down to a provisional level of 32.5 g in the year 2006. The *per capita* per year availability shows the same decreasing trend from 22.1 kg in 1951 to 11.8 kg in 2006. This amply proves that increase in population growth affects the pulses availability on *per capita* basis (**table 1.4**).

Table- 1.4 per capita availability of pulses in India

Year	Pulses Availability	
	(g *per capita per* day)	**(kg *per capita* per year)**
1951	60.7	22.1
1961	69.0	25.2
1971	51.2	18.7
1981	37.5	13.7
1991	41.6	15.2
1992	34.3	12.5
1993	36.2	13.2
1994	37.2	13.6
1995	37.8	13.8
1996	32.7	12.0
1997	37.1	13.5
1998	32.8	12.0
1999	36.5	13.3
2000	31.8	11.6
2001	30.0	10.9
2002	35.4	12.9
2003	29.1	10.6
2004	35.8	13.1
2005	31.5	11.5
2006(P)	32.5	11.8

P= Provisional

Source: Agricultural statistics at a glance-2007

4. DEMAND AND SUPPLY STATUS - PRODUCTION AND IMPORT/EXPORT

4.1. Domestic supply/availability vis-a-vis import/export

The domestic production of pulses and imports/exports during few years is given in the table below: (table 1.5)

Table 1.5- Availability status of pulses production, import and export

Year	Production (lakh tonnes)	Import (lakh tonnes)	Export (lakh tonnes)	Total availability (lakh tonnes)
1992-93	128.15	3.83	0.34	131.64
1993-94	133.05	6.28	0.44	138.89
1994-95	140.04	5.54	0.51	145.07
1995-96	123.10	4.91	0.61	127.40
1996-97	142.44	6.54	0.55	148.43
1997-98	129.79	10.08	1.68	138.19
1998-99	148.10	5.63	1.04	152.69
1999-2000	135.50	2.50	1.94	136.06
2000-01	110.80	3.50	2.44	111.86
2001-02	133.70	22.18	1.61	154.27
2002-03	111.30	19.92	1.48	129.74
2003-04	149.10	17.23	1.54	164.79
2004-05	131.30	13.39	2.71	141.98
2005-06	133.90	16.96	4.47	146.39
2006-07 (P)	142.30	22.56	2.47	162.40

Source: DGCI&S, Ministry of Commerce, Kolkata

4.2. IMPORT: The import of pulse crops in India during April, 2005 to March, 2006 was 16.96 lakh quintals worth Rs.2476.25 crores against the value of Rs.2635.91 crore for total foodgrains, Rs.21499.22 crore for total agricultural imports and against Rs.660408.9 crore for total National Import. The provisional import during April, 2006 to March, 2007 was 22.56 lakh tonnes worth Rs.3851.45 crore against the import value of Rs. 3996.51 crore for total foodgrains, Rs.23545.11 crore for total agricultural import and Rs.862301.53 crore for total National import respectively during this period. The share of Agricultural import to National import was 3.26% and 2.73% respectively during April, 2005 to March, 2006 and April, 2006 to March, 2007 (provisional).

4.3. EXPORT: The pulses export of the country during April, 2005 to March, 2006 was 4.47 lakh tonnes worth Rs.1115.2 crore against the value of Rs.8347.8 crore for total foodgrains, Rs.49216.96 crore for total agricultural exports and against Rs.456417.86 crore for total National export. The provisional export during April, 2006 to March, 2007 was 2.47 lakh tonnes worth Rs.764.05 crore against the export value of Rs. 8427.51 crore for total foodgrains, Rs.61194.22 crore for total agricultural export and Rs.571641.88 crore for total National export respectively during this period. The share of agricultural export to National export was 10.78% and 10.70% respectively during April, 2005 to March, 2006 and April, 2006 to March, 2007 (provisional).

Table 1.6 Pulse importing and exporting countries

Crop	**Countries**	
	Importer	**Exporter**
Pigeonpea	USA, UK, Kuwait, Singapore, Saudi Arabia, Malaysia	Myanmar (90), Tanzania (4), Canada (1), Mozambique (1)
Chickpea	India (25), Pakistan (22), Spain (7), Bangladesh (7), Algeria (4), Saudi Arabia (3), Italy (3)	Mexico (19), Iran (19), Canada (15), Turkey (14), Australia (13), Ethiopia (7), USA (3), Tanzania (3)
Lentil	Sri Lanka (10), Egypt (9), Pakistan (6), India (6), Colombia (6), Bangladesh (6), Algeria (6), Spain (6)	Canada (34), Australia (24), Turkey (12), USA (10), India (9), china (2)
Dry peas	India, (33), Bangladesh (10), Belgium (8), Spain (8), Netherlands (4), China (4), Italy (4), Pakistan (3)	France (30), Canada (25), Australia (14), Ukraine (7), Russia (5), USA (3), Germany (3), Denmark (3), UK (3)
Dry bean	India (10), USA (7), Japan (6), UK (5), Mexico (5), Italy (4), Pakistan (4), Brazil (4), Cuba (3), Netherlands (3), Venezuela (3)	Myanmar (33), China (23), USA (10), Canada (8), Argentina (7), UK (2)
Total Pulses	India, (16.7), Spain (10.7), Egypt (4.9), Italy (4.8), Bangladesh (4.8), Belgium (4.6), Netherlands (3.0), Pakistan (3.0), USA (2.9), Cuba (2.5), UK (1.9), China (1.9)	Canada (26.2), Myanmar (10.2), China (8.9), France (8.7), Australia (8.3), USA (6.3), UK (4.7), Turkey (3.6), India (2.9), Argentina (2.1), Ukraine (2.1), Syria (1.3)

figures in parenthesis indicates percentage share of global import/export

5. PROJECTED DEMAND (Eleventh Plan)

Table 1.7. Tentative demand/production and projected target

(Qty: Million Tonnes)

Year	Demand *	Production @	Gap	Target
2007-08	16.77	13.61	-3.16	17.00
2008-09	17.51	13.65	-3.87	18.00
2009-10	18.29	13.68	-4.60	18.50
2010-11	19.08	13.72	-5.37	19.00
2011-12	19.91	13.75	-6.16	20.00

Note: ** Demand includes seed, feed and wastage and based on behavioristic approach. The rate of growth of per capita disposable income is 4.8%.*

@ likely production is based on the CAGR of 0.25% for the period between TE 1995-96 and TE 2006-07.

Source: Projections of XI Plan working group (Planning Commission)

6. CROP/SEASON-WISE SHARE

Table –1.8 Normal area, production and yield (crop-wise)

Crop	Season	Area * (Lakh ha)	Production * (lakh tonnes)	Productivity* (Kg/ha)
Arhar	*Kharif*	34.603 **(16%)**	23.774 **(18%)**	687
Urd	*Kharif*	25.305	10.058	397
	Rabi/Summer	7.525	3.973	528
	Total	**32.830 (14%)**	**14.031** (**11%**)	**427**
Moong	*Kharif*	26.252	8.858	339
	Rabi/Summer	6.040	2.511	416
	Total	**32.292 (14 %)**	**11.369 (9%)**	**352**
Horse Gram	*Kharif*	4.205	1.559	372
	Rabi/Summer	3.207	1.155	360
	Total	**7.412 (3 %)**	**2.714 (2%)**	**366**
Moth	*Kharif*	12.723 (**6%**)	3.208 **(2%)**	252
Chickpea	*Rabi*	66.023 (**30%**)	52.993 **(40%)**	803
Lentil	*Rabi*	14.436 (**6%**)	9.652 **(7%)**	669
Peas & Beans	*Rabi*	7.175 (**3%**)	6.812 **(5%)**	949
Lathyrus	*Rabi*	6.487 (**3%**)	3.881 **(3%)**	598
Total	***Kharif***	**108.705**	**49.472**	**455**
	Rabi/Summer	**113.529**	**82.352**	**725**
	Total Pulses	**222.234**	**131.824**	**593**

**- Average of 2001-02 to 2005-06 (figures in parenthesis indicates % share of crop)*

7. PRODUCTION TRENDS

7.1. Global Scenario

The total world acreage under pulses as recorded during 2005 is about 697.14 lakh ha with production at 607.10 lakh tones and productivity 871 kg/ha (**table 1.9**). It reveals that the India ranked first in area and production with 32% and 23% respectively of world area and production. However, in case of productively Ireland stood first with 5185 kg/ha while India stands at 138th position. Thus it is also evident that the country's productivity at 618 kg/ha is far below the world average productivity of 871 kg/ha (**table 1.10**).

Table-1.9 Crop-wise total area, production and yield : Global

Crop	Area (Lakh ha)	% to Total	Production (Lakh tonnes)	% to Total	Productivity (Kg/ha)
Chickpea	105.57	15.00	84.70	13.95	802
Lentil	41.41	5.94	41.53	6.84	1003
Pigeonpea	46.02	6.60	32.41	5.34	704
Other Pulses	504.14	72.31	448.45	73.87	1204
Total Pulses	**697.14**		**607.10**		**871**

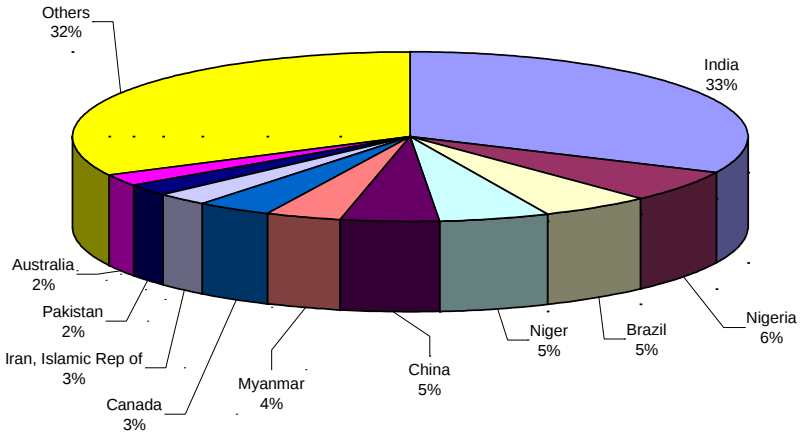
Source: FAO Statistics.

Table – 1.10 Global ranking in area, production and yield : Major countries

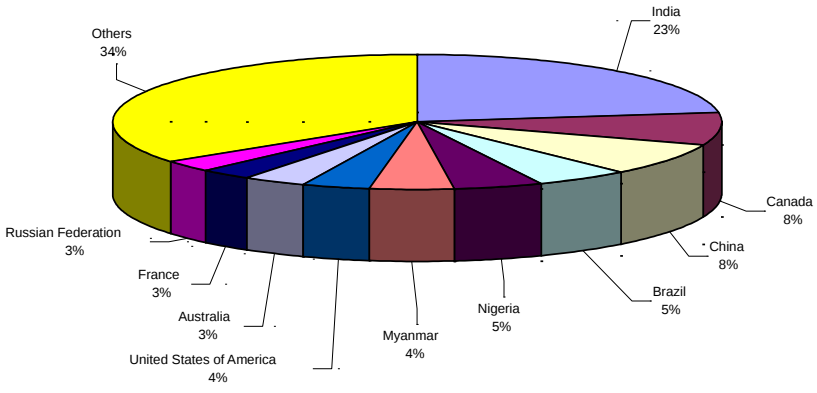
Country	Area (Lakh ha)		Country	Production (Lakh tonnes)			Yield (Kg/ha)
	Area	% to World		Prod.	% to World	Country	
India	222.56	31.92	India	137.51	22.65	Ireland	5185
Nigeria	42.60	6.11	Canada	48.10	7.92	Tajikistan	4741
Brazil	37.61	5.39	China	47.93	7.89	France	3997
Niger	35.19	5.05	Brazil	30.33	5.00	Netherlands	3808
China	33.11	4.75	Nigeria	28.65	4.72	Switzerland	3662
Myanmar	26.51	3.80	Myanmar	25.71	4.24	United Kingdom	3606
Canada	24.32	3.49	USA	21.67	3.57	Belgium	3413
Iran	17.74	2.55	Australia	21.12	3.48	Denmark	3252
Pakistan	15.95	2.29	France	17.54	2.89	Luxem-bourg	3188
Australia	15.18	2.18	Russian Federation	16.30	2.69	Croatia	3131
World	**697.14**		**World**	**607.10**		**India**	**618**
						World	**871**

Source: FAO Statistics.

Global Scenario (2005) - Area



Global Scenario (2005)- Production



7.2. National Scenario

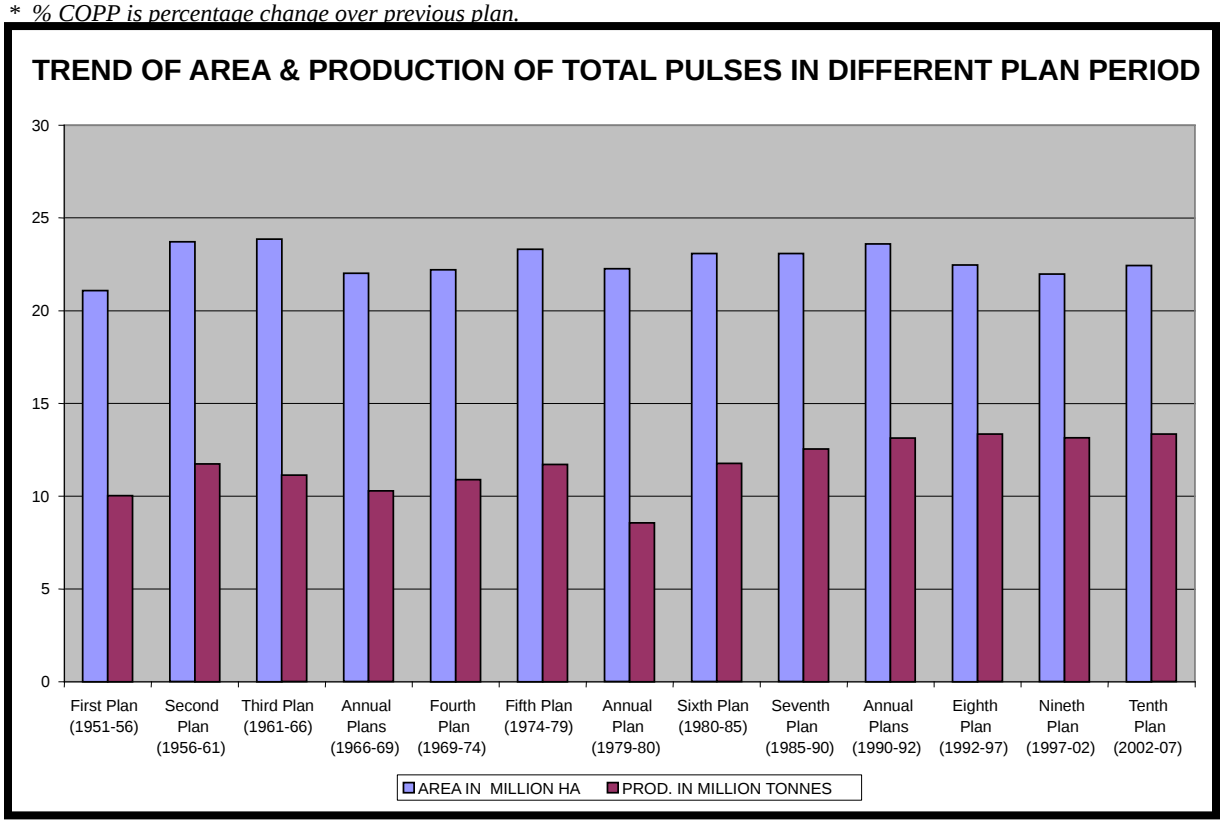
7.2.1. Total Pulses - Plan Periods

A visit to different plan periods records a slight growth in total production and productivity from Annual plans 1990-92. The pulses development was brought under the Technology Mission (TMO) during 1990. However, the area remained almost stagnant, stabilized uptill tenth plan. Plan-wise area and production of total pulses and percentage change over previous plan periods (COPP) is given at **table-1.11**

Table-1.11 Plan-wise scenario (APY) – All India

Plan	Area	%COPP* (M ha)	Production	%COP P (Mt)	Productivity	%COPP (kg/ha)
First Plan (1951-56)	21.09	-	10.04	-	475	-
Second Plan (1956-61)	23.71	12.42	11.75	17.03	495	4.04
Third Plan (1961-66)	23.86	0.63	11.14	-5.19	467	-5.56
Annual Plans (1966-69)	22.01	-7.75	10.29	-7.63	467	0.00
Fourth Plan (1969-74)	22.21	0.91	10.90	-5.92	491	5.14
Fifth Plan (1974-79)	23.32	5.00	11.71	7.43	501	2.04
Annual Plan (1979-80)	22.26	-4.55	8.57	-26.81	385	-23.15
Sixth Plan (1980-85)	23.08	3.68	11.77	37.34	510	32.47
Seventh Plan (1985-90)	23.08	0.00	12.55	6.63	527	6.47
Annual Plans (1990-92)	23.60	2.25	13.14	4.70	555	2.21
Eighth Plan (1992-97)	22.47	-4.15	13.34	1.83	594	6.49
Nineth Plan (1997-02)	21.97		13.15		598	
Tenth Plan (2002-07)	22.44		13.35		595	

** % COPP is percentage change over previous plan.*



7.2.2. States' Scenario

Total Pulses – Plan-wise (VIII-IX)

Eighth Plan*:* The total pulse area in the country during the Eighth plan was 225.01 lakh hectares with a total production of 133.58 lakh tonnes.The same trend of pulse scenerio was observed during the Eighth plan as in the triennium period. Madhya Pradesh again ranked first in area (49.65 lakh hectares or 22.1 %) with a total production of 32.75 lakh tonnes (24.5 % of the total production). In area coverage under total pulse,Rajasthan was placed second with 35.41 lakh hectares (15.6 %), while in respect of total production, Uttar Pradesh could rank second with 24.55 lakh tonnes (18.4 % of the total pulse production of the country) (Table 1.12).

Ninth Plan: During ninth plan period the total pulses area and production were 219.70 lakh ha and 131.50 lakh tonnes respectively. Out of 219.70 lakh hectares about 53% area under rabi and 47% area under kharif were covered. However, approx. 64% share of rabi production and 36% share of kharif production exhibited in total pulse production in the country which explained the productivity of Rabi pulses is much higher than the kharif pulses. The state-wise analysis exhibited first rank to Madhya Pradesh, both in area and production with 45.40 lakh hectares and 32.36 lakh tonnes which was 30.41% and 32.61% respectively. Maharashtra ranked second in coverage with 15.75% i.e (34.61 lakh hectares) while at production front, state of Uttar Pradesh ranked at second with 17.86% (i.e. 23.49 lakh tonnes) followed by Maharashtra with 13.94% (i.e. 18.33 lakh tonnes). Rajasthan ranked third in area with 15.69% and fourth in production with 12.36% of country's production while in area, U.P. stood at IVth rank with 12.40% of country coverage during that IX plan.

Tenth plan (TE 2005-06): In India, total pulse area and production irrespective of seasons during the triennium ending 2005-06 was 228.71 lakh hectares and 138.06 lakh tonnes respectively.Out of the total area, 44.63 lakh hectares is confined to Madhya Pradesh alone, earning a good pulse status and position contributing a remarkable 19.52 % of the country's total area and a production of 33.83 lakh tonnes ,thereby ranking first both in area and production followed by Rajasthan in area (36.26 lakh hectares, 15.85 % of the total area). While Rajasthan ranked fourth in production with 10.90% of the total pulse production and Uttar Pradesh which ranked second (23.36 lakh tonnes or 16.92 % of the total production); Maharashtra was hardly placed at the third rank both in area & production (34.21 lakh hectares or 14.96 % of the total area) and (13.59 % of the total production of pulses).

Table 1.12- Plan-wise states' scenario – total pulses

A= Area lakh ha, P= Production Lkh Tonnes, Y= Yield Kg/ha)

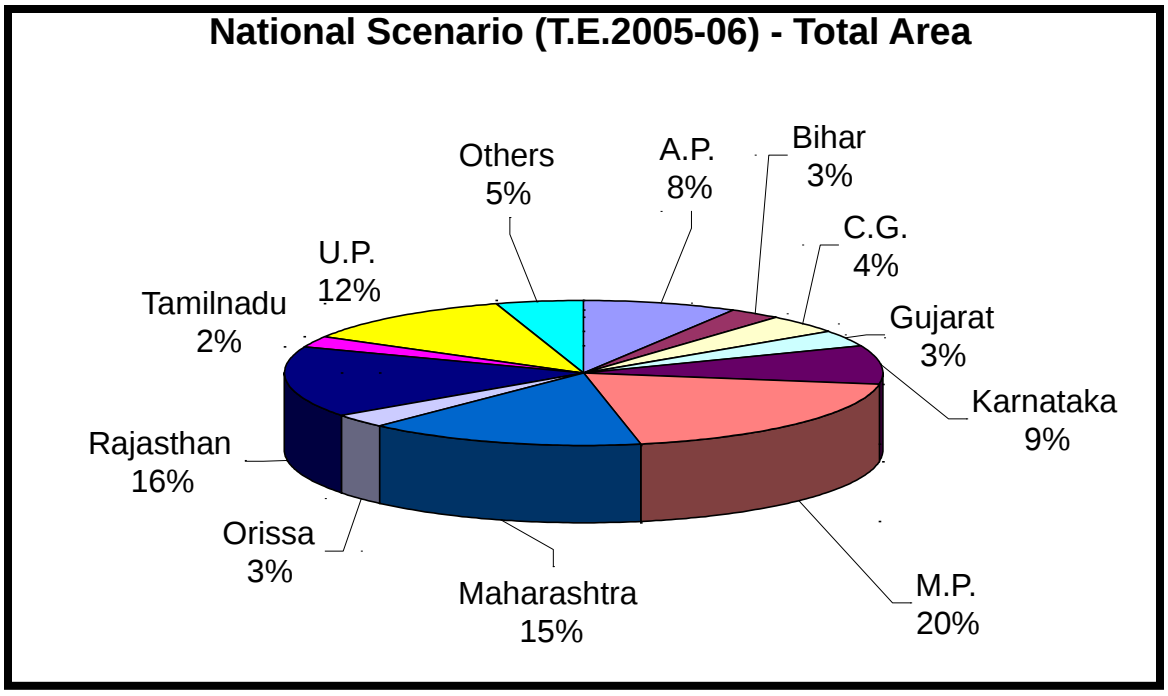
State		Eighth Plan	% to Country	Ninth Plan	% to Country	Tenth plan (T.E.2005-06)	% to Country
Andhra Pradesh	A	15.91	7.07	17.24	7.85	19.24	8.41
	P	7.32	5.48	8.65	6.57	12.11	8.77
	Y	460	78	495	83	635	105
Bihar	A	9.60	4.27	8.16	3.72	6.49	2.84
	P	7.09	5.31	6.75	5.13	4.92	3.56
	Y	748	126	827	138	757	126

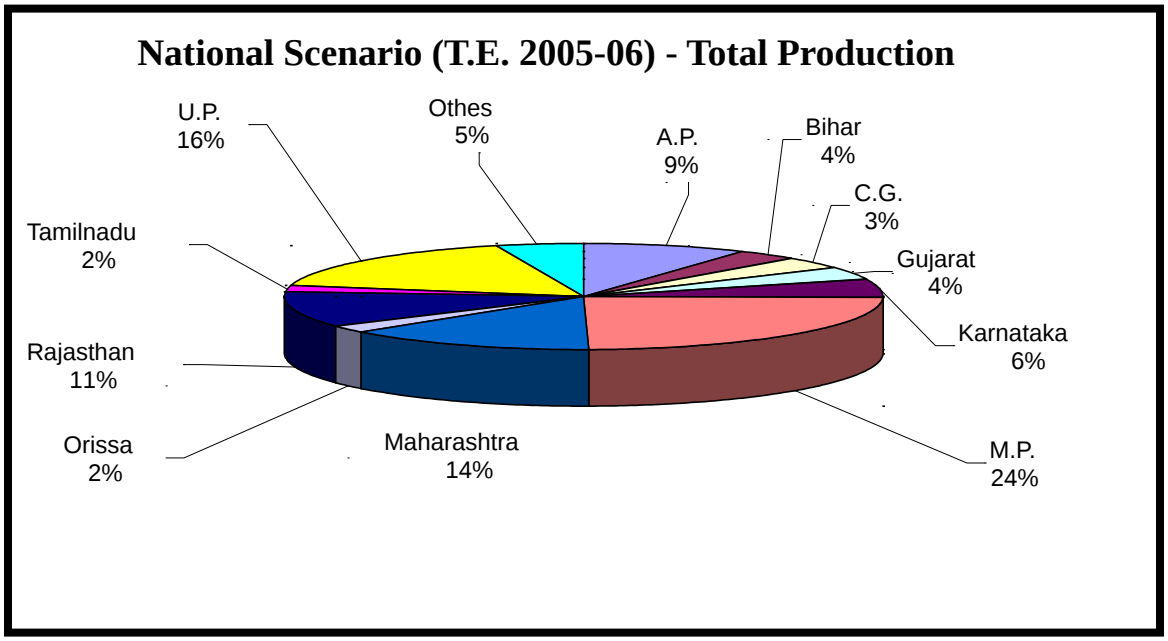
(Continued)

(Table 1.12. continued)

State		Eighth Plan	% to Country	Ninth Plan	% to Country	Tenth plan (T.E.2005-06)	% to Country
Chhattisgarh	A	*		3.07	1.40	9.46	4.13
	P			1.43	1.09	4.67	3.38
	Y			184	31	493	82
Gujarat	A	9.05	4.02	7.65	3.48	7.73	3.38
	P	5.65	4.23	4.45	3.38	5.50	3.98
	Y	622	105	564	94	709	118
Haryana	A	4.50	2.00	2.66	1.21	1.91	0.84
	P	4.10	3.07	2.11	1.60	1.36	0.98
	Y	911.00	154	743	124	711	118
Jharkhand	A	*		0.35	0.16	2.77	1.21
	P			0.28	0.21	1.56	1.13
	Y			312	52	562	93
Karnataka	A	16.23	7.21	18.72	8.52	19.87	8.69
	P	6.46	4.83	7.60	5.78	7.75	5.61
	Y	399	67	402	67	389	64
Madhya Pradesh	A	49.65	22.07	45.40	20.67	44.63	19.52
	P	32.75	24.52	32.36	24.61	33.83	24.51
	Y	660	111	711	119	758	126
Maharashtra	A	34.02	15.12	34.61	15.75	34.21	14.96
	P	18.82	14.09	18.33	13.94	18.76	13.59
	Y	554	93	527	88	548	91
Orissa	A	8.78	3.90	7.02	3.20	7.22	3.16
	P	4.16	3.12	2.60	1.97	2.86	2.07
	Y	465	78	369	62	395	66
Punjab	A	8.38	3.73	0.69	0.31	0.40	0.18
	P	0.82	0.61	0.47	0.36	0.32	0.23
	Y	809	136	687.0	115	809	134
Rajasthan	A	35.41	15.74	34.48	15.69	36.26	15.85
	P	15.59	11.67	16.26	12.36	15.05	10.90
	Y	438	74	444	74	408	68
Tamil Nadu	A	7.16	3.18	7.04	3.21	5.54	2.42
	P	2.96	2.22	3.09	2.35	2.64	1.91
	Y	414	70	439	74	481	80
Uttar Pradesh.	A	28.55	12.69	27.25	12.40	27.51	12.03
	P	24.55	18.38	23.49	17.86	23.36	16.92
	Y	860	145	863	144	849	141
West bengal	A	2.46	1.09	2.44	1.11	2.33	1.02
	P	1.67	1.25	1.77	1.34	1.84	1.34
	Y	680	115	716	120	789	131
All India	**A**	**225.01**		**219.69**		**228.71**	
	P	**133.58**		**131.50**		**138.06**	
	Y	**593**		**598**		**603**	

* *States carved out during 2000*





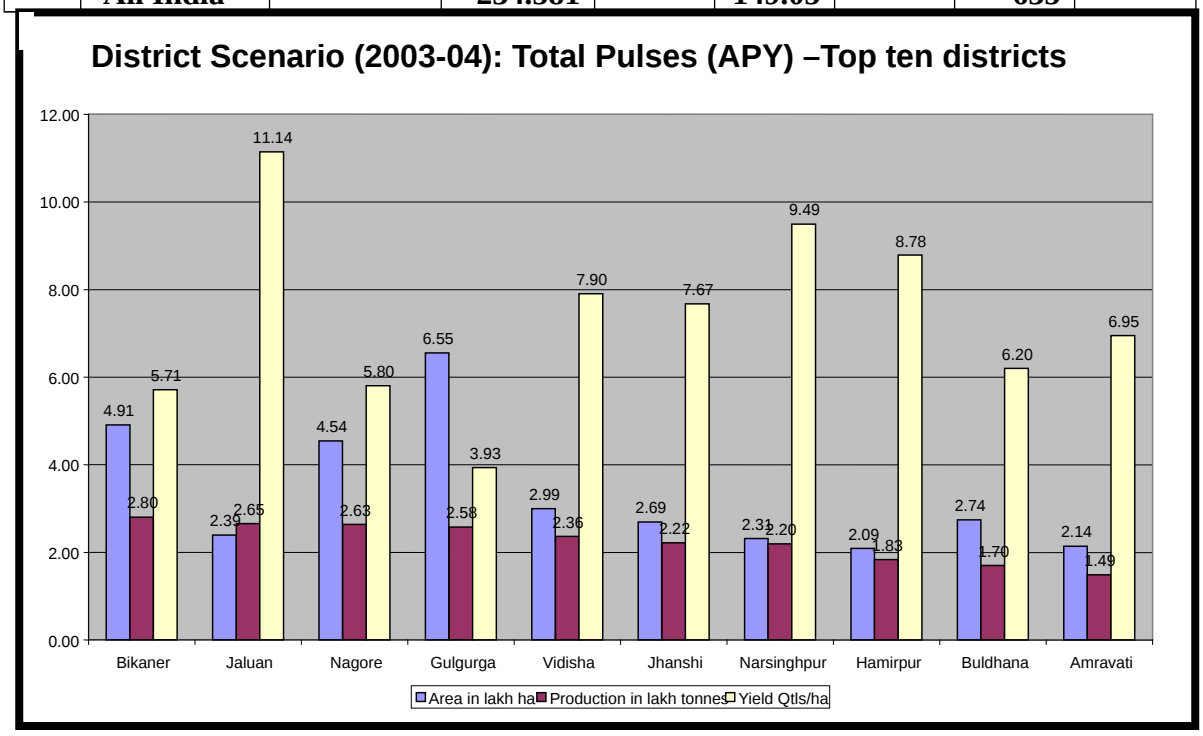
7.2.3. District scenario (2003-04) – Potential districts

The micro analysis at district level was also carried out and presented in **table 1.13**. The intra-state analysis revealed that Bikaner district of Rajasthan had the highest production with 1.88 per cent share to India followed by Jaluan of UP (1.78%) and Nagore of Rajasthan (1.77%) Inrespect of area coverage, Gulburga of Karnataka ranked first with 2.79 per cent share followed by Bikaner and Nagore districts of Rajasthan with 2.09% and 1.94% respectively.

District-wise area, production and yield of top ten districts of India in respect of production are presented below which contributed 14.22 percent and 15.07 percent of area and production of the country.

Table 1.13- Top potential districts (2003-04) (APY) – total pulses

Sr. No.	Name of District	State	Area (lakh ha)		Prod. (lakh tonnes)		Yield (Kg/ha)	
			Area	% to India	Prod.	% to India	Yield	YI
I	Bikaner	Rajasthan	4.909	2.09	2.802	1.88	571	90
II	Jaluan	UP	2.392	1.02	2.653	1.78	1114	175
III	Nagore	Rajasthan	4.541	1.94	2.633	1.77	580	91
IV	Gulberga	Karnataka	6.550	2.79	2.576	1.73	393	62
V	Vidisha	MP	2.992	1.28	2.362	1.58	790	124
VI	Jhanshi	UP	2.687	1.15	2.215	1.49	767	121
VII	Narsinghpur	MP	2.312	0.99	2.195	1.47	949	149
VIII	Hamirpur	UP	2.089	0.89	1.833	1.23	878	138
IX	Buldhana	MS	2.740	1.17	1.700	1.14	620	98
X	Amravati	MS	2.138	0.91	1.486	1.00	695	109
	Total above		**33.350**	**14.22**	**22.455**	**15.07**	**673**	**106**
	All India		**234.581**		**149.05**		**635**	



7.2.4. Season-wise trend (VIIIth plan to Xth Plan (TE 2005-06))

a. Kharif Pulses

***Eighth Plan(1992-97)*:** With a total coverage of 107.62 lakh hectares and a total production of 51.84 lakh tonnes, the Eighth plan recorded comparatively more kharif coverage (3.60 lakh ha) and production (5 lakh tonnes) than the IXth plan. In area and production, Maharashtra ranked first with 25.63 lakh hectares (23.8%) and 13.95 lakh tonnes (26.9%) of the total area and production under kharif pulses in the country. Rajasthan trailed to second in area (20.17 lakh hectares) with 18.7% of the total kharif area. Uttar Pradesh was the second largest producer with 6.44 lakh tonnes (12.4%) while Madhya Pradesh third in acreage of 11.82 lakh hectares (11%) during the plan period with a mere 6.01 lakh tonnes of production (11.6%), placed at third rank (Table 1.14).

Ninth Plan (1998-2002): The area and production under kharif pulses during ninth plan were 104.06 lakh hectares and 47.08 lakh tonnes respectively. The state-wise contribution to total kharif pulses exhibited that the state of Maharashtra ranked first both in area and production with 24.38% and 28.19% respectively (25.37 lakh ha and 13.27 lakh tonnes) followed by Rajasthan in respect of area while at production front U.P. ranked second with 6.24 lakh tonnes which is 13.26% of country's total kharif production. Karnataka ranked third both in area and production with 12.70 lakh hectares and 4.70 lakh tonnes, which are 12.20% and 9.99% respectively. The highest yield was recorded by the state of Bihar (879 kg/ha) followed by Uttar Pradesh (826 kg/ha) and Haryana (689 kg/ha) with the over all National yield average of 453 kg/ha.

***Tenth plan (TE 2005-06)*:** The total area coverage and production of Kharif Pulses in India during the triennium ending 2005-06 was 112.27 lakh hectares and 52.49 lakh tonnes respectively, out of which Rajasthan ranked first (25 lakh hectares) and contributed 22.27% of total area while in production Maharashtra ranked first with 24.74 % (12.99 lakh tones) and ranked second in area accounting for 21.54% (24.18 lakh hectares) of the total area while at the production front, Rajasthan ranked second with 15.03% of the country's production (7.89 lakh tonnes). Karnataka was placed third in area accounting for 11.98% (13.45 lakh hectares) and Uttar Pradesh stood third in Production which accounted for 10.78% (5.66 lakh tonnes) of the total Kharif pulses during the period.

Table 1.14 Plan-wise states' scenario (APY)- Kharif Pulses

(A= Area lakh ha, P= Production Lkh Tonnes, Y= Yield Kg/ha)

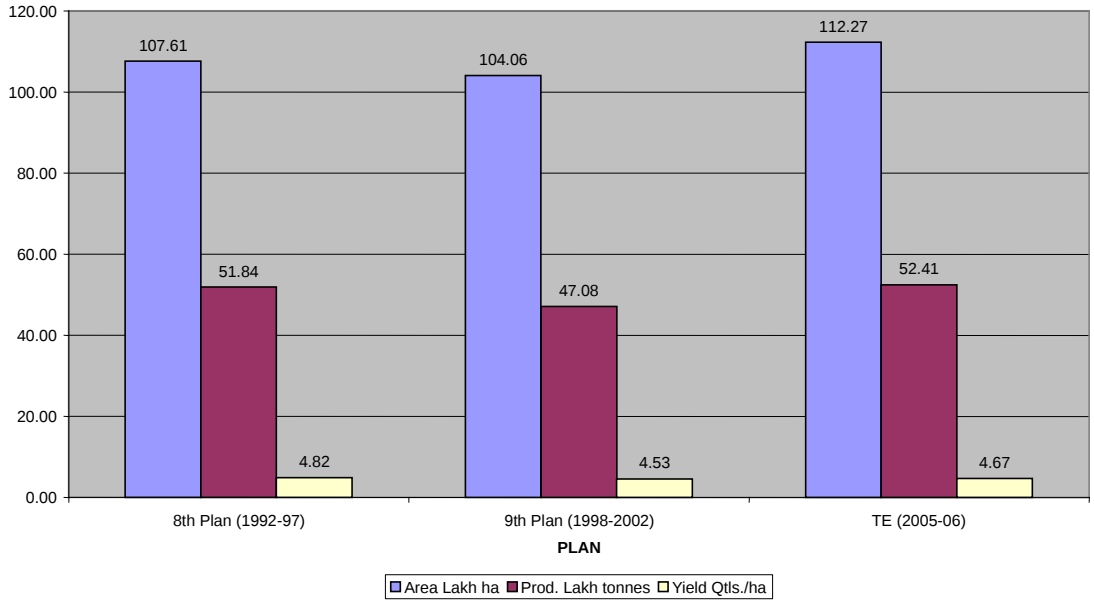
State		Eighth Plan	% to Country	Ninth Plan	% to Country	Tenth plan (T.E.2005-06)	% to Country
	A	8.02	7.46	8.80	8.45	9.54	8.50
Andhra Pradesh	P	3.14	6.06	3.36	7.13	4.61	8.78
	Y	391	81	380	84	484	104
Bihar	A	2.40	2.23	1.72	1.65	0.89	0.79
	P	1.52	2.94	1.49	3.17	0.82	1.57
	Y	634	132	879	194	932	200
Chhattisgarh	A	*		0.96	0.92	2.38	2.12
	P			0.31	0.66	0.83	1.57
	Y			130	29	347	74

(Table 1.14. continued.)

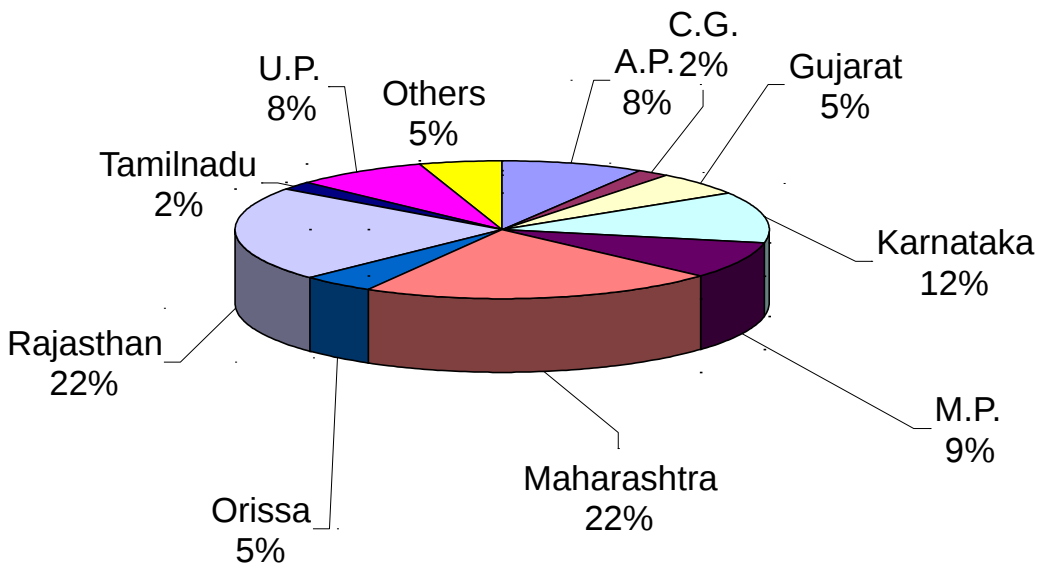
State		Eighth Plan	% to Country	Ninth Plan	% to Country	Tenth plan (T.E.2005-06)	% to Country
Gujarat	A	7.79	7.24	6.78	6.52	6.15	5.48
	P	4.82	9.31	3.82	8.12	4.18	7.96
	Y	617	128	555	122	678	145
Haryana	A	0.54	0.50	0.40	0.38	0.63	0.56
	P	0.48	0.93	0.30	0.63	0.41	0.77
	Y	876	182	689	152	655	140
Jharkhand	A	*		0.32	0.31	2.15	1.91
	P			0.26	0.55	1.12	2.13
	Y			319	70	521	112
Karnataka	A	10.86	10.10	12.70	12.20	13.45	11.98
	P	4.20	8.10	4.70	9.99	5.09	9.69
	Y	389	81	364	80	375	80
Madhya Pradesh	A	11.82	10.98	10.25	9.85	9.79	8.72
	P	6.01	11.59	4.83	10.26	4.83	9.21
	Y	509	106	470	104	493	106
Maharashtra	A	25.63	23.81	25.37	24.38	24.18	21.54
	P	13.95	26.91	13.27	28.19	12.99	24.74
	Y	545	113	524	116	537	115
Orissa	A	6.12	5.68	5.13	4.93	5.08	4.52
	P	3.06	5.90	1.79	3.79	1.97	3.75
	Y	485	101	347	77	387	83
Punjab	A	0.70	0.65	0.51	0.49	0.28	0.25
	P	0.56	1.08	0.31	0.67	0.22	0.43
	Y	801	167	620	137	791	169
Rajathan	A	20.17	18.74	18.66	17.93	25.00	22.27
	P	4.93	9.52	3.94	8.38	7.89	15.03
	Y	244	51	199	44	305	65
Tamil Nadu	A	4.08	3.79	3.19	3.07	2.00	1.78
	P	1.71	3.30	1.40	2.96	0.76	1.45
	Y	410	85	439	97	379	81
Uttar Pradesh	A	7.77	7.22	7.57	7.27	8.98	8.00
	P	6.44	12.41	6.24	13.26	5.66	10.78
	Y	828	172	826	182	630	135
West Bengal	A	0.77	0.71	0.65	0.63	0.53	0.47
	P	0.42	0.80	0.37	0.79	0.34	0.65
	Y	540	112	568	125	646	138
All India	**A**	**107.62**		**104.06**		**112.27**	
	P	**51.84**		**47.08**		**52.49**	
	Y	**481**		**453**		**467**	

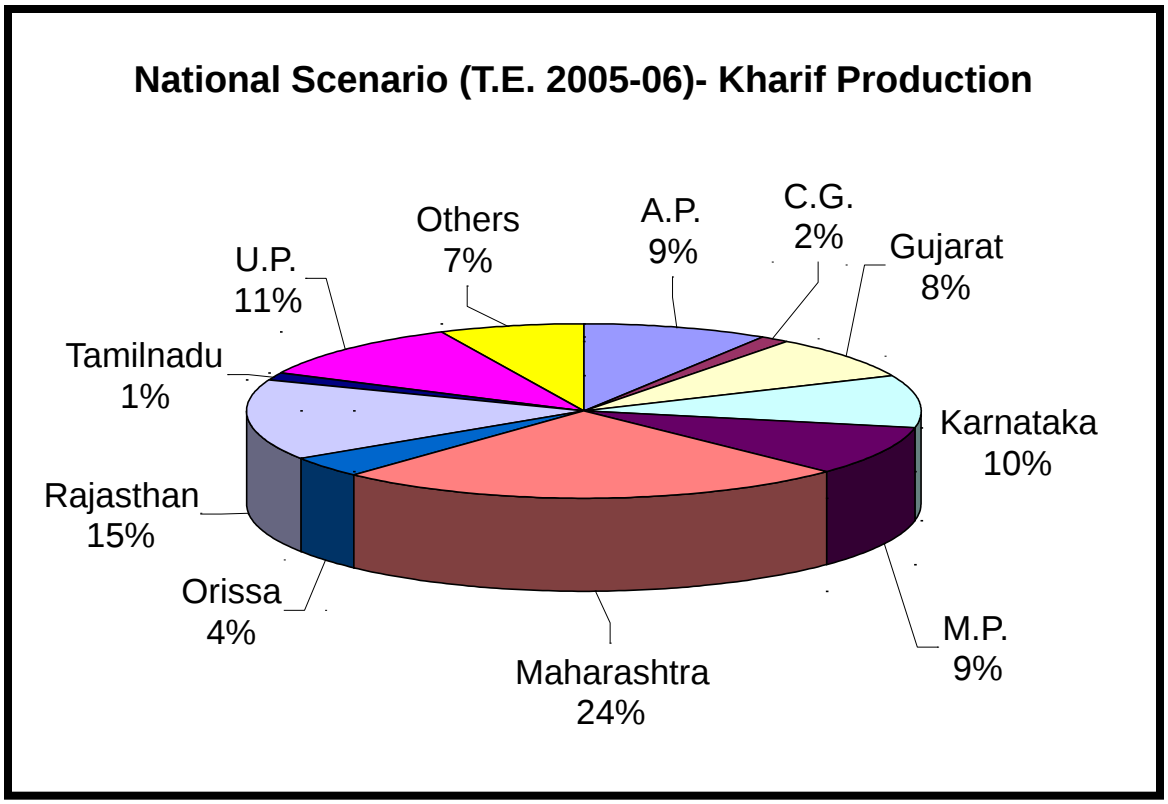
** States carved out during 2000*

National Scenario: Kharif Pulses (APY)



National Scenario (T.E. 2005-06)- Kharif Area





b. Rabi /Summer Pulses

***Eighth Plan (1992-97)*:** Total area of 117.40 lakh hectares and production of 81.74 lakh tonnes of Rabi pulses were observed during the Eighth plan in India. Out of these, 32.2% of area (37.83 lakh hectares) and 32.7% of production (26.74 lakh tonnes) were contributed by Madhya Pradesh alone which ranked first. Uttar Pradesh which ranked second, could cover 17.7% of the total area (20.78 lakh hectares) and produce 22.2% of production (18.12 lakh tonnes) while Rajasthan which trailed at third place could hardly cover 12.9% (15.17 lakh hectares) of the country's total Rabi pulse area with 13% (10.66 lakh tonnes) of production during the plan period.

***Ninth Plan(1998-2002)*:** The total area and production under Rabi pulses during the ninth plan were 115.63 lakh hectares and 84.42 lakh tonnes respectively. Madhya Pradesh ranked first both in area and production with 35.15 lakh hectares and 27.53 lakh tonnes which are 30.41% and 32.61% of the country's total rabi pulse acreage and production respectively followed by Uttar Pradesh with 17% and 20.43% (19.68 lakh hectares and 17.25 lakh tonnes) and Rajasthan with 13.69% and 14.58% (15.82 lakh hectares and 12.31 lakh tonnes) respectively.

The highest state average yield exhibited in Uttar Pradesh (877 kg/ha) followed by Bihar (817 kg/ha) and Madhya Pradesh (781 kg/ha) has been above the National average yield of 729 kg/ha.

***Tenth plan (TE 2005-06)*:** In India, the area under Pulses and their productions are more in Rabi season than Kharif. During the Triennium ending 2005-06 total all India Rabi pulse acreage and production has been recorded at 116.44 lakh hectares and 85.57 lakh tonnes. Madhya Pradesh stood at first in area and production, covering 34.85 lakh hectares (30%) with a production of 29.00 lakh tonnes (34 %). Uttar Pradesh ranked second with 18.53 lakh hectares of area (16%) and 17.70 lakh tonnes (20.7%) of production. Rajasthan which covered 11.25 lakh hectares of area (9.66%) with 7.16 lakh tonnes (8.36%) of production shared the fourth rank in production. Andhra Pradesh with 8.77% of the country's production (7.51 lakh tonnes) ranked third at National level (Table 1.15).

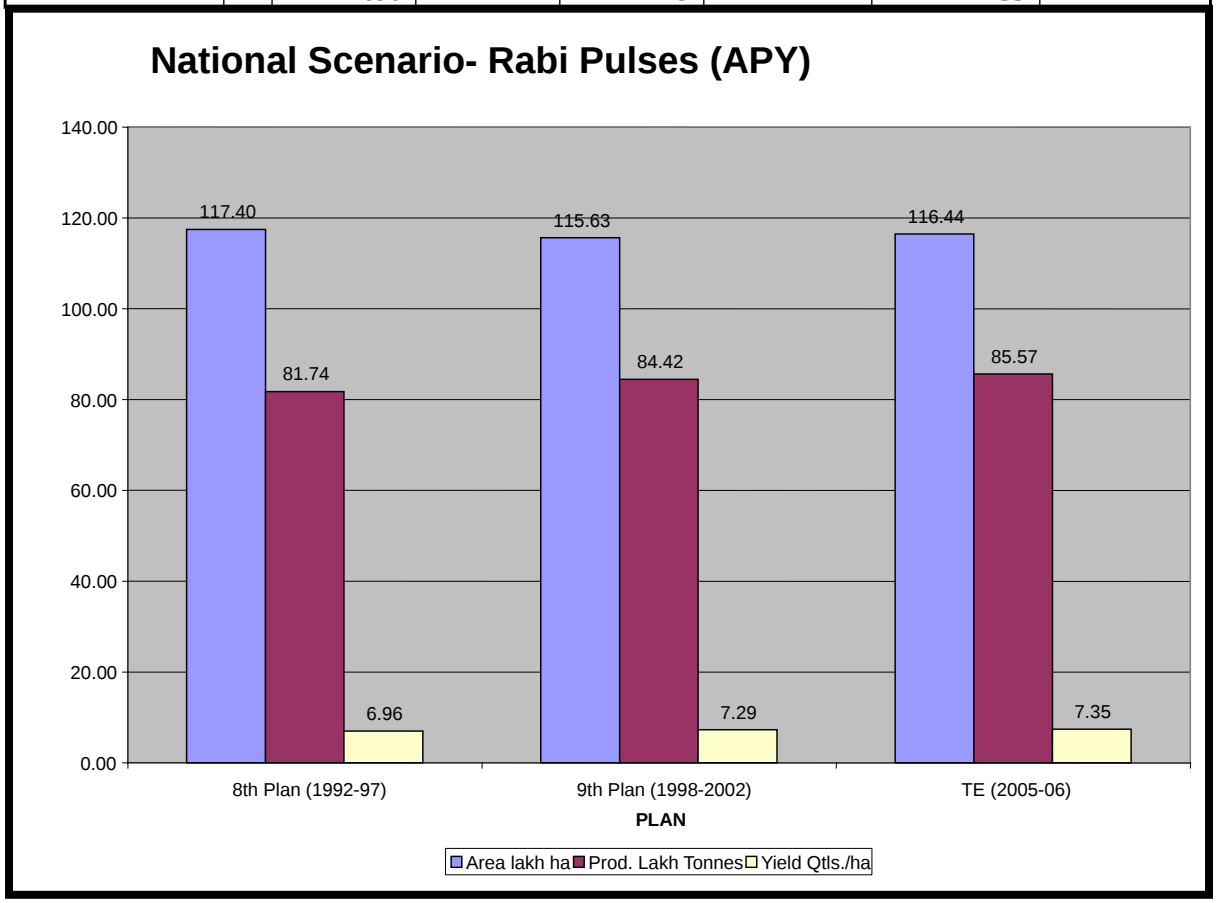
Table 1.15 - Plan-wise Scenario (APY)- States (rabi Pulses) (Area lakh ha, Prod. Lakh Tonnes, Yield Kg/ha)

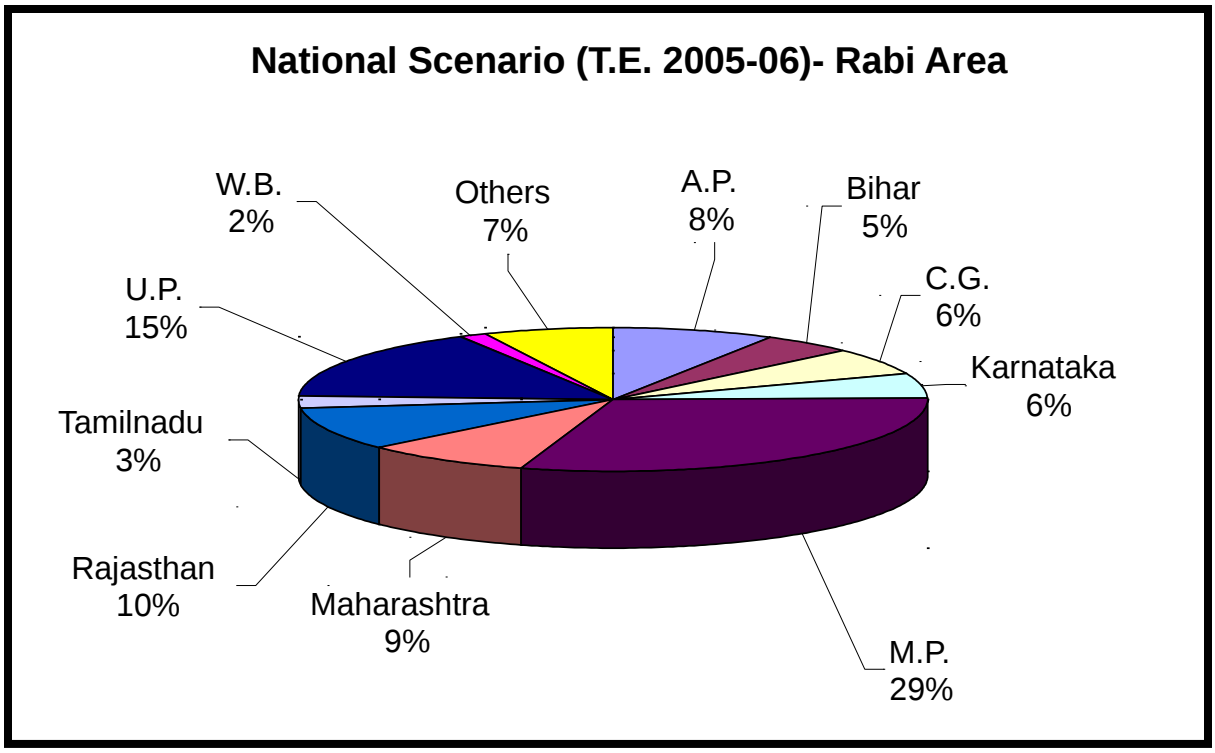
STATE		Eighth Plan	% to Country	Ninth Plan	% to Country	Tenth plan (T.E.2005-06)	% to Country
Andhra Pradesh	A	7.89	6.72	8.44	7.31	9.69	8.32
	P	4.18	5.12	5.29	6.26	7.51	8.77
	Y	530	76	616	84	779	106
Bihar	A	7.20	6.13	6.44	5.57	5.60	4.81
	P	5.57	6.81	5.25	6.22	4.10	4.79
	Y	772	111	817	112	730	99
Chhattisgarh	A			2.11	1.83	7.08	6.08
	P			1.12	1.33	3.85	4.50
	Y			207	28	542	74
Gujarat	A	1.26	1.07	0.87	0.75	1.58	1.36
	P	0.83	1.01	0.62	0.74	1.32	1.54
	Y	549	79	655	90	829	113
Haryana	A	3.96	3.38	2.26	1.96	1.28	1.10
	P	3.62	4.43	1.81	2.14	0.95	1.11
	Y	909	131	757	104	749	102
Karnataka	A	5.38	4.58	6.02	5.21	6.43	5.52
	P	2.26	2.76	2.90	3.43	2.66	3.11
	Y	423	61	420	58	421	57
Madhya Pradesh	A	37.83	32.22	35.15	30.41	34.85	29.93
	P	26.74	32.72	27.53	32.61	29.00	33.89
	Y	707	102	781	107	832	113
Maharashtra	A	8.39	7.15	9.24	7.99	10.02	8.61
	P	4.87	5.96	5.06	5.99	5.78	6.75
	Y	576	83	541	74	569	77
Orissa	A	2.66	2.27	1.89	1.63	2.14	1.84
	P	1.11	1.35	0.81	0.96	0.89	1.04
	Y	411	59	431	59	414	56
Punjab	A	0.31	0.27	0.19	0.16	0.12	0.10
	P	0.26	0.32	0.16	0.19	0.10	0.12
	Y	827	119	866	119	852	116
Rajasthan	A	15.17	12.92	15.82	13.69	11.25	9.66
	P	10.66	13.04	12.31	14.58	7.16	8.36
	Y	694	100	755	104	637	87

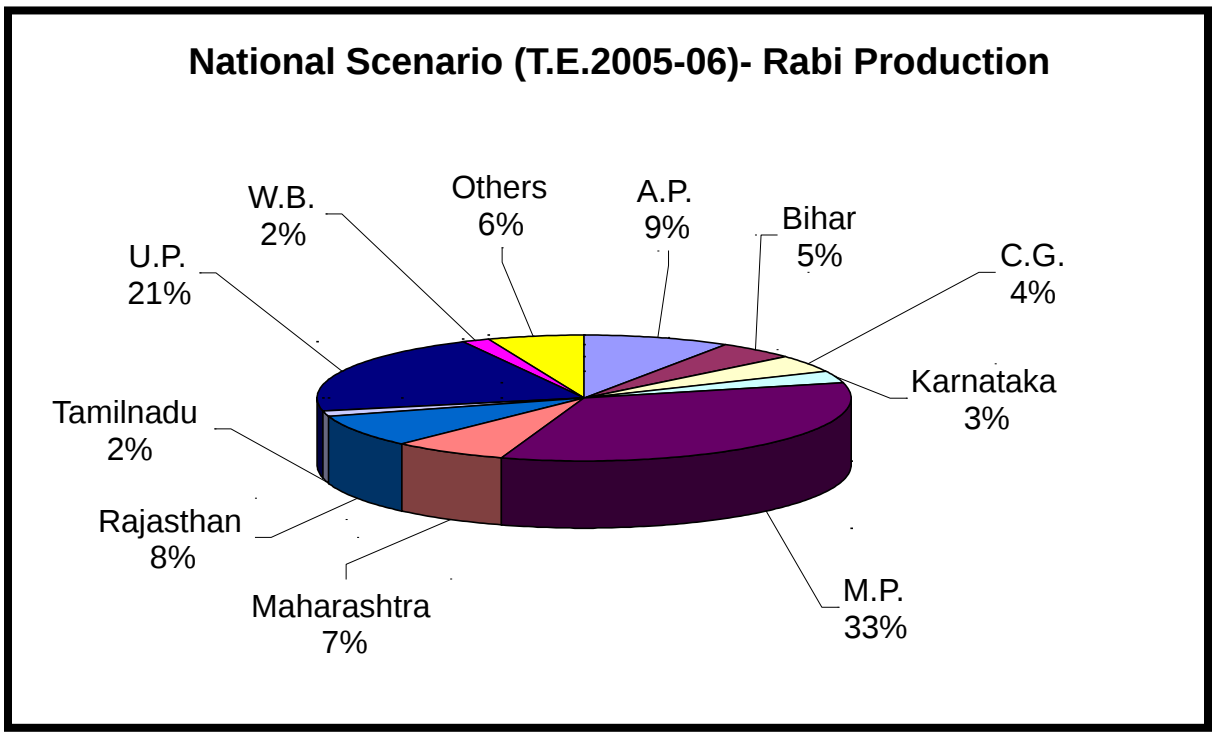
(Table 1.15 continued)

STATE		Eighth Plan	% to Country	Ninth Plan	% to Country	Tenth plan (T.E.2005-06)	% to Country

Tamil Nadu	A	3.08	2.62	3.85	3.33	3.54	3.04
	P	1.25	1.53	1.70	2.01	1.32	1.54
	Y	449	65	447	61	371	50
Uttar Pradesh	A	20.78	17.70	19.68	17.03	18.53	15.92
	P	18.12	22.16	17.25	20.43	17.70	20.68
	Y	872	125	877	120	955	130
West Bengal	A	1.69	1.44	1.79	1.55	1.80	1.55
	P	1.26	1.54	1.40	1.66	1.50	1.76
	Y	746	107	770	106	830	113
All India	**A**	**117.40**		**115.63**		**116.44**	
	P	**81.74**		**84.42**		**85.57**	
	Y	**696**		**729**		**735**	




National Scenario (T.E. 2005-06)- Rabi Area
W.B. 2%
Others 7%
A.P. 8%
Bihar 5%
C.G. 6%
U.P. 15%
Karnataka 6%
Tamilnadu 3%
Rajasthan 10%
Maharashtra 9%
M.P. 29%


National Scenario (T.E.2005-06)- Rabi Production
W.B. 2%
Others 6%
A.P. 9%
Bihar 5%
C.G. 4%
U.P. 21%
Karnataka 3%
Tamilnadu 2%
Rajasthan 8%
Maharashtra 7%
M.P. 33%

CHICKPEA

Botanical Name – *Cicer arietinum*
Synonym – Chickpea, Bengalgram, Chana and Gram
Origin – South West Asia – probably Afganisthan and/or Persia.
Chromosomes – 2n = 16

1. **ECONOMIC IMPORTANCE**: Most important pulse crop of India contributing about 30 % of total pulse acreage and about 40 % of total pulse production of the nation. It is mainly consumed as 'Dal' (split cotyledons) and chhole. Many attractive dishes viz – sweets, snacks and namkeen are also prepared from its floor called besan. Also eaten as whole fried or boiled and salted. Fresh green leaves (sag) are used as vegetables and green grains as hare chhole or chholia. Straw of gram is an excellent fodder while both husk and bits of 'Dal' are valuable cattle feed. Leaves consist of mallic and citric acid and are very useful for stomach ailments and blood purifier.

Nutritive value

Protein	–	18-22%	Calcium	–	280 mg/100 g
Carbohydrate	–	61-62%	Iron	–	12.3 mg/100 g
Fat	–	4.5 %	Phosphorus	–	301 mg/100 g
Calorific value	–	396			

Agronomic significance: Leaving about 30-50 kg N/ha for successive crops, especially cereals. Intercrop cereals also get benefited through 'N' supplied by way of fixation in gram.

2. CROP STATUS

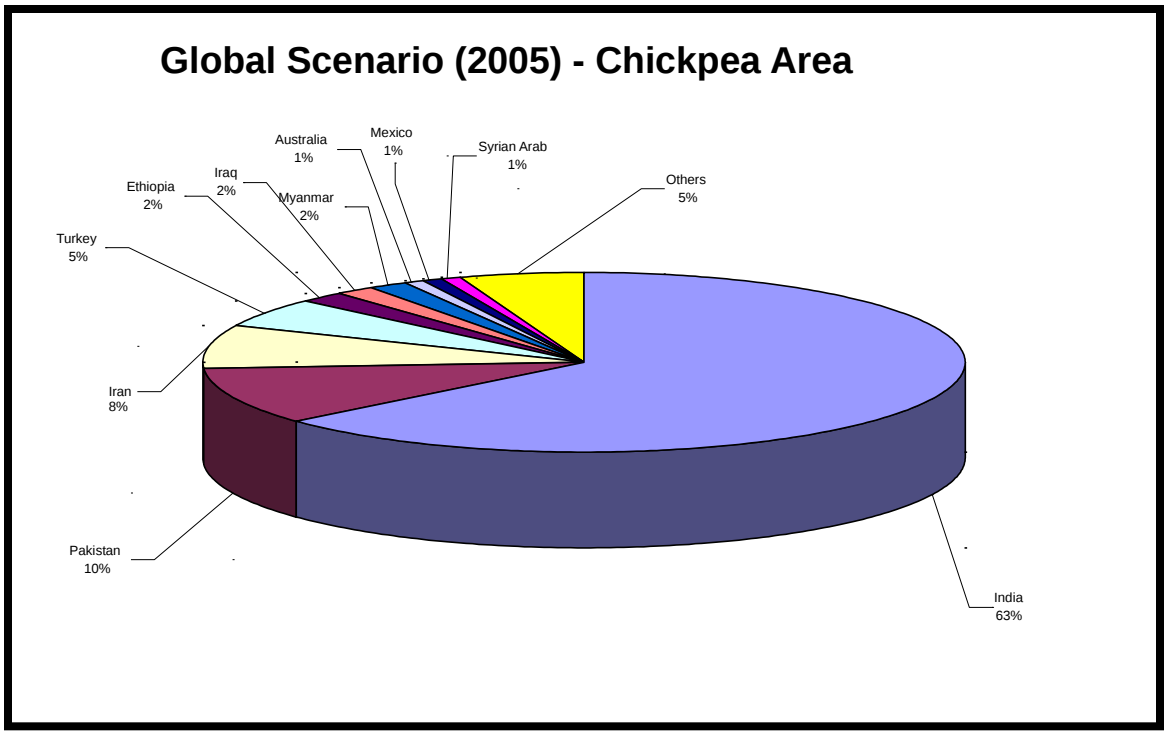
2.1. Global Scenario

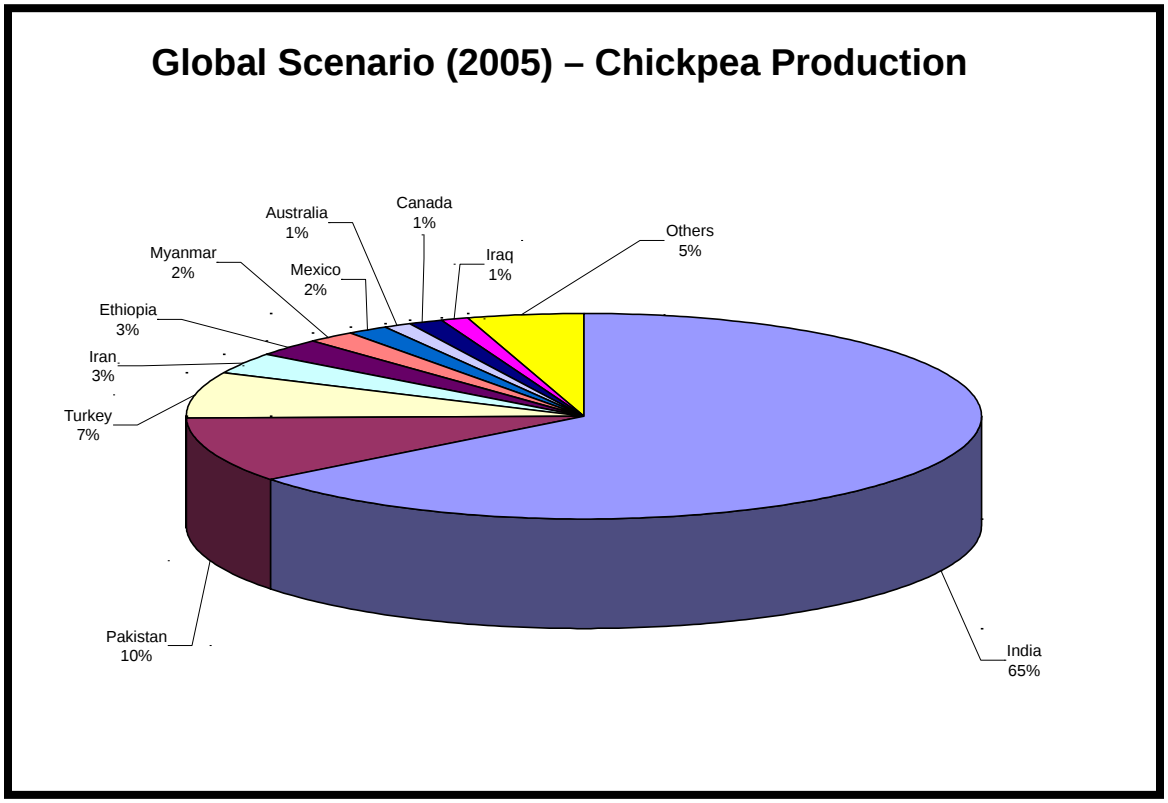
India ranked first in area and production in the world, followed by Pakistan, Turkey and Iran. The highest productivity of 4942 kg/ha is observed in China followed by Cyprus, Jordan and Bosnia. India stands at 30th position with 815 kg/ha yield.

Table - 2.1. Global ranking in area, production and Yield : Major countries

Rank	Country	Area (lakh ha)		Country	Production (lakh tonnes)		Country	Yield (Kg/ha)
		Area	% to World		Prod.	% to World		
I	India	67.14	63.60	India	54.69	64.57	China	4942
II	Pakistan	10.94	10.36	Pakistan	8.68	10.25	Cyprus	4550
III	Iran	8.02	7.59	Turkey	6.00	7.08	Jordan	2770
IV	Turkey	5.58	5.28	Iran	2.92	3.46	Bosnia Herzegovina	2667
V	Ethiopia	2.11	2.00	Ethiopia	2.17	2.56	Yemen	2081
VI	Iraq	1.75	1.66	Myanmar	1.72	2.03	Egypt	2011
VII	Myanmar	1.72	1.63	Mexico	1.34	14.57	Israel	1982
VIII	Australia	0.98	0.93	Australia	1.16	1.37	Kazakhstan	1904
IX	Mexico	0.98	0.93	Canada	1.04	1.23	Sudan	1785
X	Syrian Arab	0.86	0.82	Iraq	0.95	1.12	Moldova	1500
XXX	-	-	-	-	-	-	**India**	**815**
	World	105.57		**World**	**84.70**		**World**	**802**

Source: FAO Statistics





2.2. National scenario

2.2.1. Area and Production trends - Plan Periods

Eighth Plan(1992-97)*:* A total of 68.64 lakh hectares of area and 52.76 lakh tonnes of Gram production were observed in the country during the plan. Madhya Pradesh ranked first in terms of both area and production (36.7 and 39.7%) followed by Rajasthan with 21.6 % and 19.2 % of total area and production. Uttar Pradesh with a mere 14.7 % and 16.6 % of area and production, was placed third during the plan under report (Table-2.3).

Ninth Plan*(1998-2002)*: A total of 67.56 lakh ha of area and 54.76 lakh tonnes of gram production were observed in the country during the plan. M.P. ranked first in terms of area and production (36.6% and 41.9%) followed by Rajasthan with 22.6% and 21.2% and Uttar Pradesh with 12.6% and 13.9%, respectively. Bihar has recorded an yield of 961 kg/ha followed by M.P. with 923 kg/ha.

Tenth plan (TE 2005-06)*:* The total area and production of gram in the country were 68.96 lakh hectares and 55.96 lakh tonnes respectively. Madhya Pradesh outshone in area coverage and production of gram (39% and 44.7% of the total area and production of the country), followed by Rajasthan (15.6% and 11.7%) and Uttar Pradesh (10.8% and 12.6%) respectively, during the Triennium period (Table-2.3).

Table - 2.2. Chickpea share to total pulse commodity-Area/Production

Crop	Season	Area* (Lakh ha)	Production* (Lakh tonnes)	% Share	
				Area	Production
Chickpea	Rabi	66.02	52.99	30	40
Total Pulses		222.23	131.82	100	100

** Normal Area (Ave. of 5 years (2001-02 to 2005-06)*

Table - 2.3. Plan-wise chickpea scenario - States

(A= Area lakh ha, P= Production Lakh Tonnes, Y= Yield Kg/ha)

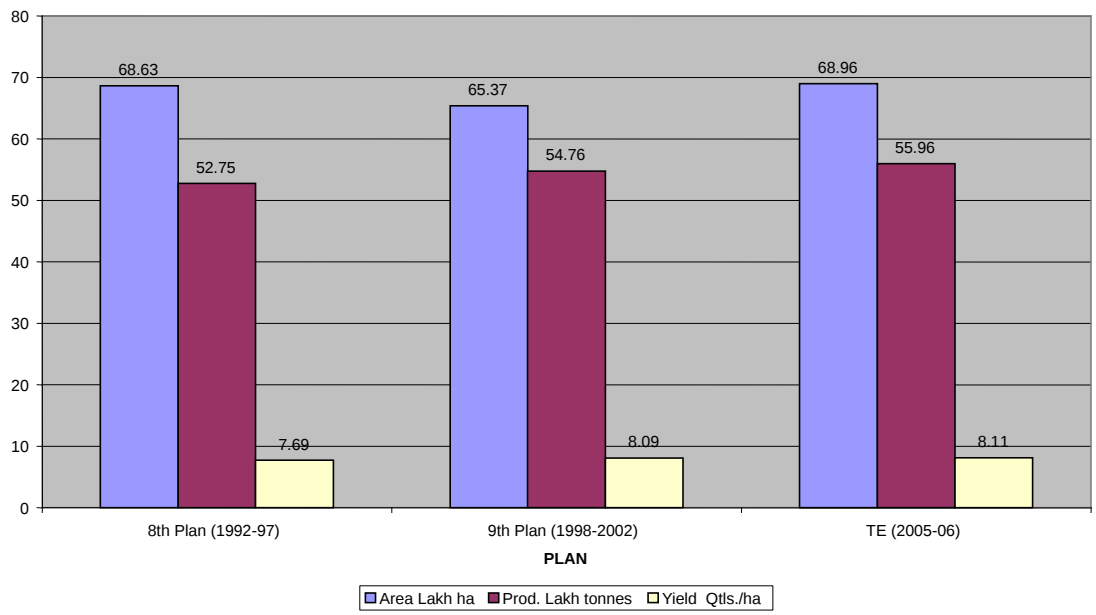
STATE		Eighth Plan	% to Country	Ninth Plan	% to Country	Xth Plan (T.E.2005-06)	% to Country
Andhra Pradesh	A	1.07	1.56	1.88	2.79	3.86	5.59
	P	0.78	1.48	1.75	3.20	4.76	8.51
	Y	698	91	857	106	1229	151
Bihar	A	1.34	1.95	0.95	1.40	0.72	1.04
	P	1.25	2.37	0.90	1.64	0.65	1.16
	Y	937	122	961	119	905	112
Chhattisgarh	A	*		0.62	0.92	2.16	3.13
	P			0.39	0.72	1.58	2.83
	Y			250	31	737	91
Gujarat	A	1.18	1.72	0.83	1.23	1.46	2.12
	P	0.80	1.52	0.60	1.10	1.24	2.22
	Y	661	86	653	81	846	104
Haryana	A	3.83	5.59	2.16	3.20	1.20	1.74
	P	3.52	6.68	1.73	3.16	0.88	1.57
	Y	915	119	755	93	739	91

(Table 2.3.continued)

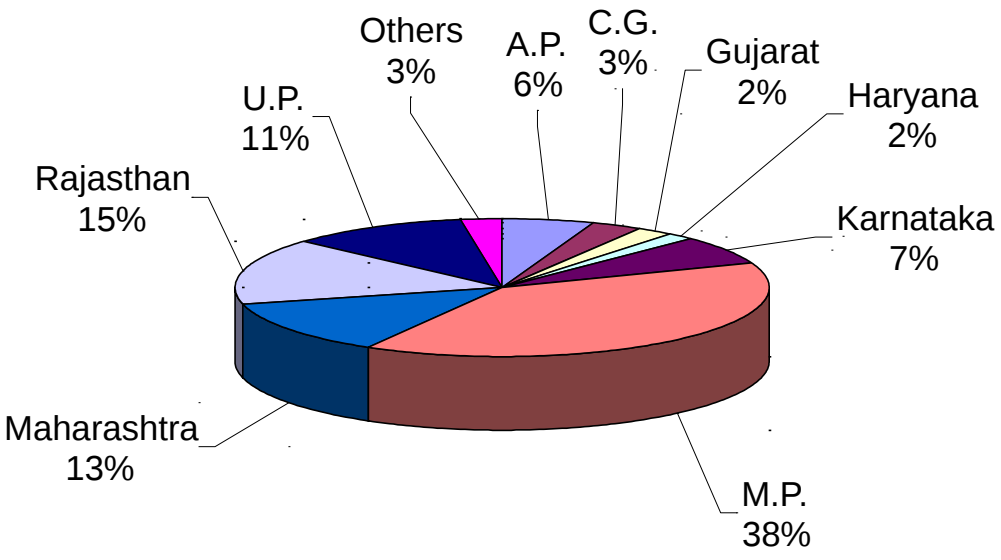
STATE		Eighth Plan	% to Country	Ninth Plan	% to Country	Xth Plan (T.E.2005-06)	% to Country
Karnataka	A	3.16	4.61	3.72	5.51	4.49	6.50
	P	1.53	2.89	2.03	3.70	2.08	3.72
	Y	470	61	539	67	473	58
Madhya Pradesh	A	25.20	36.72	24.70	36.57	27.00	39.15
	P	20.96	39.73	22.94	41.88	25.02	44.70
	Y	830	108	923	114	927	114
Maharashtra	A	7.00	10.20	7.97	11.79	8.82	12.79
	P	4.28	8.10	4.51	8.23	5.31	9.48
	Y	608	79	557	69	594	73
Orissa	A	0.33	0.49	0.30	0.44	0.32	0.47
	P	0.20	0.38	0.17	0.30	0.20	0.36
	Y	603	79	551	68	624	77
Rajasthan	A	14.79	21.55	15.29	22.64	10.78	15.64
	P	10.15	19.23	11.62	21.21	6.53	11.67
	Y	680	89	730	90	608	75
Tamil Nadu	A	0.08	0.12	0.07	0.11	0.06	0.09
	P	0.06	0.11	0.05	0.09	0.04	0.08
	Y	672	88	655	81	667	82
Uttar Pradesh	A	10.07	14.68	8.53	12.62	7.46	10.82
	P	8.76	16.61	7.64	13.95	7.07	12.63
	Y	870	113	896	111	946	117
West Bengal	A	0.25	0.36	0.36	0.54	0.42	0.60
	P	0.23	0.43	0.32	0.58	0.41	0.73
	Y	903	118	815	101	988	122
All India	**A**	**68.64**		**67.56**		**68.96**	
	P	**52.76**		**54.76**		**55.96**	
	Y	**767**		**809**		**811**	

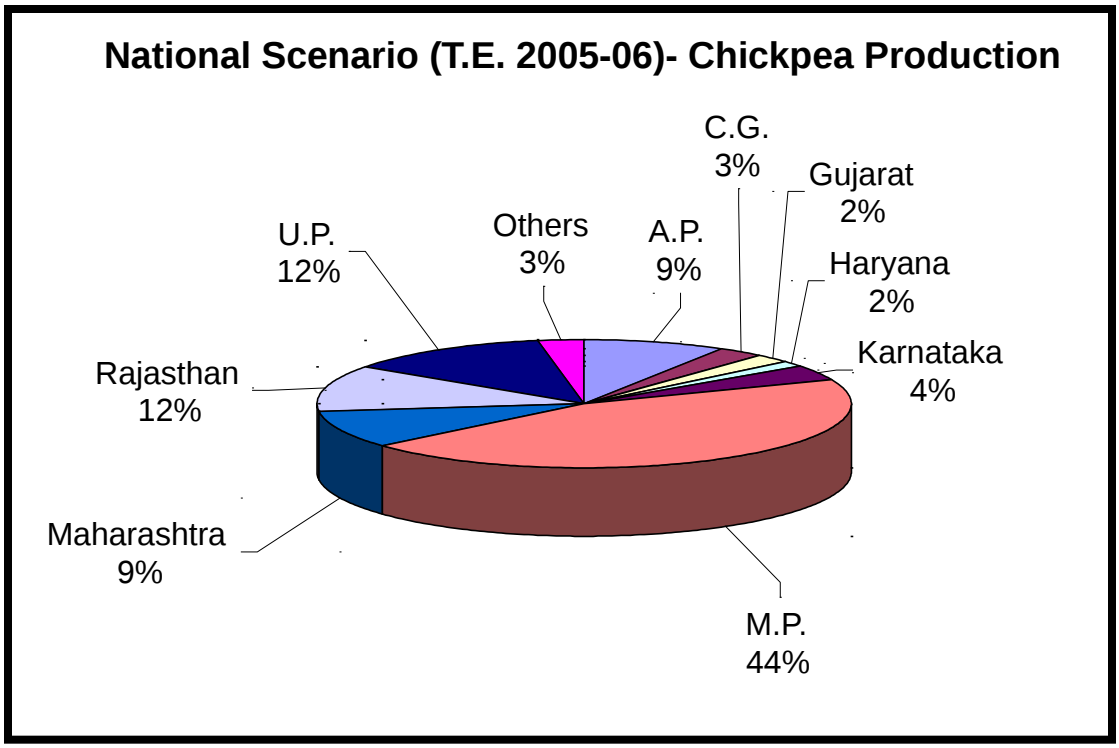
** New states carved out during 2000*

National Scenario- Chickpea (APY)



National Scenario (T.E. 2005-06)- Chickpea Area



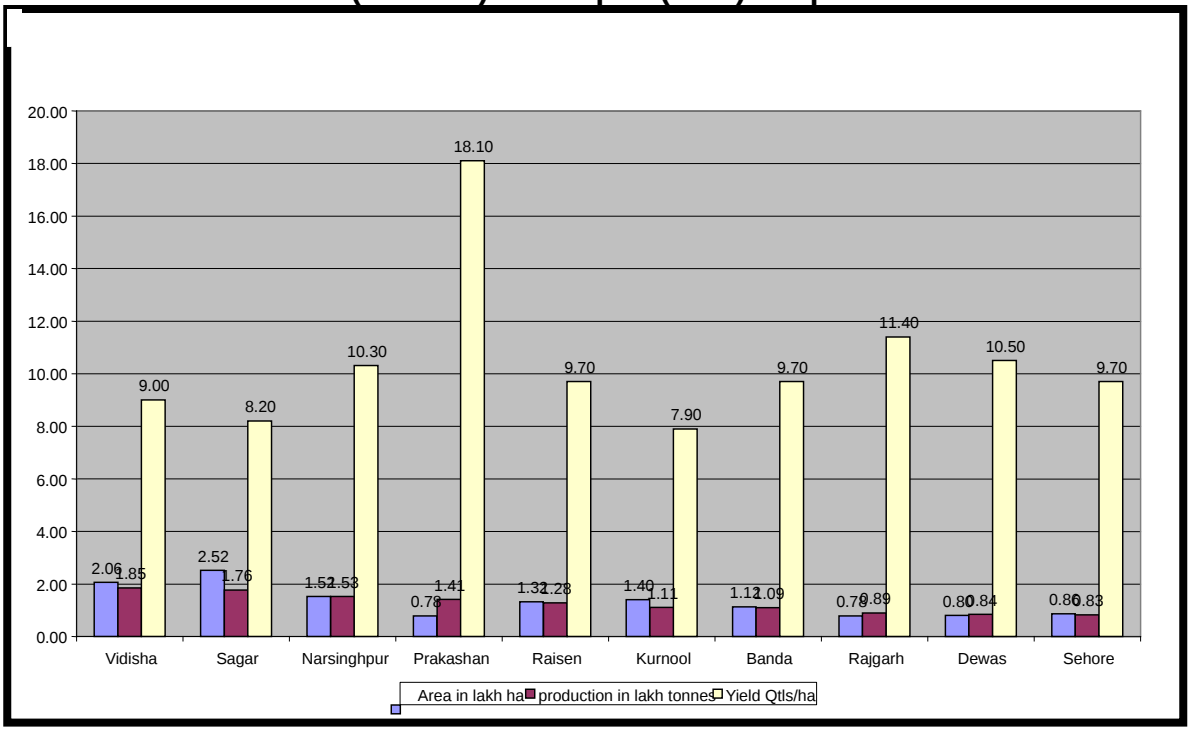


2.2.3. Potential districts (2003-04) The intra-regional analysis at the district level as depicted in **table-2.4.** revealed the highest production in Vidisha (3.23%) followed by Sagar (3.09%) and Narsinghpur (2.67%) of M.P.state. District-wise area, production and yield of top ten district of India in respect of production are presented below which contributed 18.67 per cent and 22.01 per cent of total area and production of chickpea in the country.

Table - 2.4. Top potential districts (2003-04)

Sr. No.	Name of District	State	Area (lakh ha)		Prod. (lakh Tonnes)		Yield (Kg/ha)	
			Area	% to India	Prod.	% to India	Yield	YI
I	Vidisha	M.P.	2.062	2.93	1.848	3.23	900	111
II	Sagar	M.P.	2.515	3.57	1.764	3.09	820	101
III	Narsinghpur	M.P.	1.523	2.16	1.527	2.67	1030	127
IV	Prakashan	A.P	0.780	1.11	1.410	2.47	1810	223
V	Raisen	M.P.	1.319	1.87	1.278	2.24	970	120
VI	Kurnool	A.P	1.400	1.99	1.110	1.94	790	97
VII	Banda	U.P	1.123	1.59	1.093	1.91	970	120
VIII	Rajgarh	M.P.	0.779	1.11	0.889	1.55	1140	141
IX	Dewas	M.P.	0.799	1.13	0.837	1.46	1050	129
X	Sehore	M.P.	0.858	1.22	0.829	1.45	970	120
	Total above		**13.158**	**18.67**	**12.585**	**22.01**	**956**	118
	All India		**70.481**		**57.175**		**811**	

District Scenario (2003-04): Chickpea (APY) –Top ten districts



3. ECONOMIC CLASSIFICATION

i. **Desi or brown gram** (*C arietinum*): Colour of seed coat ranges yellow to dark brown, usually small in seed size but some large size varieties are also found. Plants are small with good branching ability, especially suited for late sown and rice fallow areas (Ch.No. 2n = 14,16). Most widely cultivated group in India (90% of total world).

ii. **Kabuli or white gram** (*C. Kabulianum*): Colour of seed coat white with bold and attractive seed size. Plants are taller than desi and stand more or less erect. Yield potential is poor on account of poor branching as compare to 'desi'. (Ch.No. 2n = 16). Some small seeded white coloured grain also comes under this category.

4. BOTANICAL DESCRIPTION

It is a small herbaceous branched plant with maximum height of 45-60 cm. Roots include a strong central tap root with extensive lateral branches spread out in all directions in upper soil layers. There are numerous bacterial nodules found on primary and secondary roots, used as a site of atmospheric 'N' fixation.

Stem is branched with numerous granular hairs on it. Flowers are typical Papilionaceous consisting of five sepals, five petals (consists of one *standard*,

two *wings* and two *keels*), ten stamens (nine fused to form one staminal column and one free) and a *carpel* with the *style* borne laterally on the *ovary*. They are singly, axillary, racemes usually solitary having pink or white colour with pink or blue shades. Anthesis takes place between 9 am to 3 pm. Self- fertilization before opening is the rule but cross pollination upto 5-10% extent also takes place by insect. Pods are rectangular, swollen structure, about 2 cm long and usually contain 2 seed in them. A single plant produces approximately 50-150 pods. Seeds are spherical in shape, wrinkled or smooth with a pointed beak. **Its head is similar to chicken's head with a characteristic 'beak' hence called as chickpea**.

5. PRODUCTION TECHNOLOGY

5.2. Climatic requirement: Being a winter season legume, it requires fairly cold and dry climate. But severe cold and frost, especially at flowering, are injurious for developing flowers to develop into seed or by killing the seed inside the pod. Best suited to the areas having 60-90 cm rainfall per annum. However, excessive rains, soon after sowing or at flowering and fruiting or hailstorms at ripening, cause heavy losses.

5.2. Varieties – Selection of variety, as per the adaptability to the region, time of sowing, use of inputs and purpose of cultivation, etc; from the list (table – 2.5). However, some varieties for specific situations are as under:

Kabuli – KAK-2 (>40 g/100seeds), Pusa Chamatkar (BG-1053), ICCV-2, Pusa Kabuli 1003 (BG-1003), JGK-1, Haryana Kabuli Chana-1. **Rice-Chickpea cropping system** (late sown up to end of December) – Udai (KPG-59), Pusa-372, RSG-963, PBG-1, Pant G-186 and JG-74, **mild saline soil** – Karnal Chana 1 (CSG-8962), **drought prone areas** – RSG-888, Annegiri, **high fertile and high rainfall/irrigated areas** – DCP-92-3

5.3 Soil and its preparation: Grown in a wide range of soils viz light sandy loam to moderately heavy loam in north to black cotton soils of Central Plateau. However, sandy loams to clay loam soil, free from excessive salt and neutral in reaction with drainage facility, are best for gram. In no case suited to soil having more than 8.5 P^H. It requires clodded and rough seed bed for good aeration in root zone, obtained by one deep ploughing and a cross harrowing.

Cropping system: Gram is sown after the harvest of kharif crops. Gram in rotation with cereal crops helps in controlling soil-borne diseases. The most common cropping system based on chickpea are as below:

a) **Rotation:** (i) Kharif fallow – Gram (in barani areas), (ii) Paddy – Gram, (iii) Maize – Gram, (iv) Bajra – Gram, and (v) Jowar – Gram

b) **Inter cropping**: (i) Chickpea + Mustard (2:1 to 4:1), (ii) Chickpea + Linseed (2:2), (iii) chickpea + wheat/Barley (2:2), (iv) Chickpea + Safflower (2:2), and (v) Chickpea + Coriander (2:2)

5.4. Seed and sowing

i Sowing time:

Rainfed – First fortnight of October in central and south India and second fortnight of October in North India.

Irrigated – First fortnight of November in North India and second fortnight of October in central and southern India.

Late sowing – First week of December in rice fallows of NEPZ or in irrigated conditions, where field are vacated very late by kharif crops.

ii Seed rate: *Small seeded* – 50-60 kg/ha; *Bold seeded and late sowing* – 80-90 kg/ha (Small seeded varieties are recommended for late sown conditions).

iii Spacing: *Rainfed* – 30cm x 10cm; *Irrigated* – 45cm x 10cm; *Late sowing* – 25cm x 10cm

iv Seed treatment: Treat the seed with thiram or carbendazim @ 2 g/kg of seed before 3 days of sowing followed by seed inoculation with a solution/jaggery having dual culture of Rhizobium and PSB. One packet of both the culture is enough for 10kg seed.

5.5. Plant nutrient management: About 5 t FYM or compost or biogas spent slurry with 50 % recommended dose of fertilizers (RDF) plus rhizobium inoculation for better yields and FUE. Recommended fertilizer dose is 15-20 kg N and 40kg P_2O_5 per ha as basal dressing in separate furrow bands before sowing chickpea. In late sown chickpea after rice, apply 40 kg N per ha as basal dose. On S deficient soils, use 20 kg S as gypsum, iron pyrites or single super phosphate to meet the S demands of chickpea. Application of 25 kg zinc sulphate and 10 kg borax per ha has positive effect on root growth, BNF and yield.

Seed treatment with rhizobium @ 5 g per kg seed and soil inoculation of phosphate solubilizing bacteria @ 500 g per ha by mixing with 50 kg well decompose FYM just at the time of sowing improves the FUE. For correcting Zn deficiency, foliar spray of 0.5 kg $ZnSO_4$ with 0.25 kg lime or soil application of $ZnSO_4$ @ 25 kg per ha to one crop on Zn deficient soils is helpful to both the crop of pulse based cropping system. Mo deficiency can be corrected by applying 1 kg sodium molybdate per ha and for boron deficient soils foliar spray of B @ 1.0 – 1.5 kg B per ha or soil application of 4 kg borax. Spray 1.0 per cent $FeSO_4$ to recoup the crop from Fe deficiency

5.6. Water management: 'Gram' grown as rainfed crop in general in India, invariably suffers from moisture stress as 'terminal drought, at most critical pod development stage due to high atmospheric and soil temperature coupled with high wind velocity. So, to minimize transpiration loss and conserving residual soil moisture for longer time, a foliar spray of 2% KCL is giving promising results.

However, under assured irrigation, one irrigation each at maximum branching and pod development resulted in 25-70% increase in yield in absence of winter rain. In no case, irrigation should be given earlier than four weeks after sowing and during active flowering because earlier situation is harmful for maximum 'N' fixation as the Rhizobial bacteria work only in aerobic conditions and later, excess irrigation may reverse the crop again to vegetative phase with severe depression in yield due to ultimately shorter reproductive phase.

5.7. Weed management- Major weeds infesting gram are *Chenopodium spp*. (Bathua), *Fumaria parviflora* (gajri), *Lathyrus aphaca* (Chatri matri), *Vicia sativa* (ankari), *Crisium arvense* (Kateli), *Melilotus alba* (senji), *Asphodelus enuifolius* (jungli piaji), *Convolvulus agvensis* (Krishan neel), *Phalaris minor* and *Avena Wdoriciana*.

Gram, being a dwarf stature crop, suffers adversely by heavy weed infestation up to 30-45 days after sowing (DAS), the critical period. One hand weeding/inter culture with hand hoe or wheel hoe at 30 DAS and another at 55-60 DAS, if second flush of weeds appear heavily other-wise crop will suppress the weed by it self.

A mechanical operation is always better than the herbicide based as later also provides aeration to the roots for maximum efficacy of 'N' fixing bacteria as well as soil moisture conservation for its longer availability by breaking soil capillaries and creating dust mulch.

However, an alternate Integrated weed management practice is application of either of Fluchoralin (Basalin) as pre plant incorporation or Pendimethalin (Stomp) as Pre emergence @ 0.75 kg a.i./ha and one hand weeding in between 30-45 DAS, depending on sowing time, gives maximum grain yield.

5.8. Plant protection measures – Refer Table - 2.6.

5.9. Harvesting, threshing and storage- Crop become ready for harvest when leaves begin to fall, stem and pod turn brown or straw in colour and seeds are hard and rattle (most important) with 15% moisture inside them. Over ripening may lead to fall of pods as well as shattering and seed cracking if seed moisture falls below 10% due to delay in harvesting.

The crop is allowed to dry for 2-4 days on threshing floor (depending on situation) and threshed by manually or bullock/power drawn thresher followed by winnowing.

The clean seed should be sun dried for 3-4 days to bring their moisture content at 9-10%. Now they should be safely stored in appropriate bins and fumigated to protect them from bruchids.

5.10. Yield- by adopting good management practices, as described above, an average yield of 15-20 Q/ha can easily be obtained.

Table – 2.5. Recommended varieties of chickpea/characteristics

Variety	Source	Year of Release/ Notifi-cation	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristics
L-550 (Kabuli)	PAU	1978	All zones	17-20	136-140	Seed bold, salmon white
K-850	CSAUAT	1982	U.P.	25-28	145-150	Bold Seed, Redish brown
Radhey	CSAUAT	1982	U.P.	20-25	150-155	Late sown, seed bold
GL-769	PAU	1982	Punjab	17-20	160-165	Late sown, seed brown
JG-315	JNKVV	1984	CZ	19-20	125-130	Wilt resistant, seed brown &wrinkled
Mahamaya-2 (B 115)	BCKV	1984	West Bengal.	20-21	130-135	Early and late sown, Mod. res. to Wilt
Gaurav (H 75-35)	CCS HAU	1985	NWPZ	18-20	150-155	Bold seed, dark brown, Aschochyta blight resistant
ICCC-32 (kabuli)	ICRISAT	1985	CZ, NWPZ	24-26	130-150	Seed medium size, resistant to wilt (race 1 and 4)
RSG-44	RAU, Rajasthan	1985	Rajasthan	20-23	135-150	Tol. to drought and frost, Suitable for rainfed , irrigated and late sown conition.
Pusa-256	IARI	1985	NEPZ	18-20	135-145	Bold seed, light brown
Phule G 5 (Vishwas) (Bold)	MPKV	1986	CZ	18-20	130-135	Bold seeded
Avrodhi	CSAUAT	1987	U.P.	22.0	150-155	Wilt resistant, seed brown
PBG-1	PAU	1988	NWPZ	16-18	156-160	Tolerant to Aschochyta blight
Kranti (ICCC-37)	ICRISAT	1989	CZ , SZ	19-20	110-125	Tolerant to wilt, seed small
Haryana Chana No.1	CCS HAU	1990	NWPZ	22-23	145-150	Late sowing, Tolerant to wilt, seed small
JG-74	JNKVV	1991	M.P	11-13	110-115	Wilt resistant, late sown, seed yellowish brown
RSG-44	RAU, Durgapura	1991	Rajasthan	23.0	135-150	Tol. to drought and frost, double podded
KPG-59 (Uday)	CASUAT	1992	NWPZ	20.0	135-140	Tol. to root rot & wilt stunt. Tol. to pod borer. Bold seeded. *(late sown)*
Bharati (ICCV-10)	ICRISAT	1992	SZ , CZ	18-20	95-100	Resistant to Fusarium wilt & dry root rot.
Sadabahar	CSAUAT	1992	Uttar Pradesh	21-23	145-150	Tolerant to wilt.
Pusa-372 (BG-372)	IARI	1993	NEPZ NWPZ CZ	14-15	110-140	Moderately resistant to wilt, blight & root rot., Small seed, light brown, suitable for *late sown conitions* after paddy harvest

Sweta (ICCV-2)	ICRISAT	1993	Maharashtra A.P	12-13	80-90	*Kabuli gram variety.* Resistant to wilt & Botrytis grey mould.
Pusa 329	IARI	1993	NWPZ	21-23	145-155	Moderately resistant to Wilt, bold seeeded

(Table – 2.5. continued)

Variety	**Source**	**Year of Release/ Notifi-cation**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Duration**	**Characteristics**
Vijay (Phule G-81-1-1)	MPKV	1994	CZ	19-21	105-110	Resistant to wilt, Tolerant to terminal moisture stress.
Pragati (K-3256)	CSAUAT	1994	Uttar Pradesh	17-20	140-150	Tolerant to wilt.
Vardan (GNG-663)	RAU, Sriganga-nagar	1995	NWPZ	22-25	150-155	Resistant to wilt. Tol. to Aschochyta blight, seed small
GPF-2 (GF-89-36)	PAU	1995	NWPZ	21-23	152	Res.to wilt & tol. to Ascochyta blight. Seed yellowish brown
Pusa-362 (BG-362)	IARI	1995	NWPZ	23-24	145-150	Tolerant to wilt, Bold seeded.
KWR-108	CSAUAT	1996	NEPZ	20-23	130-135	Resistant to wilt, Seeds are dark brown and small.
JG-218	JNKVV	1996	MP	18-19	115-120	Early maturing, Tolerant to wilt.
Vishal (Phule G-87207)	MPKV	1996	CZ	20.00	110-115	Resistant to wilt, Tolerant to pod borer, Early maturing.
Alok (KGD-1168)	CSAUAT	1996	NWPZ	19-21	140-150	Med. Bold, Res. to Wilt & Root rot
Pant G-186	GBPUAT	1996	Uttar Pradesh	18-20	135-140	Tolerant to wilt & late sown. Small seeded
Hirwa Chaffa (AKGS-1)	PKV	1996	Maharashtra	15-17	105-110	Green seeded
Samrat (GNG-469)	RAU, Sriganga-nagar	1997	NWPZ	20-22	145-150	Res.to Ascochyta blight. Tol. to wilt and root rot. Suitable for rainfed and irrigated areas.
Pusa-391 (BG-391)	IARI	1997	CZ	17-18	110-120	Moderately resistant to wilt & root rot. Bold seeded. Light brown
PDG-3 (GF 89-133)	PAU	1997	Punjab	15-17	160-165	Tolerant to pod borer.
Karnal Chana-1 (CSG 8962)	CSSRI, Karnal	1997	NWPZ	22-25	140-147	Recommended for salt affected areas; Wilt resistant.
DCP-92-3	IIPR	1997	NWPZ	19-20	145-150	Lodging and wilt resistant. Yellowish brown and medium bold seeds. Suitable for high fertility and excessive moisture conditions.

JGG-1	JNKVV	1997	M.P.	13-15	120-125	Seed pink
(BG-1003) (Pusa Kabuli)	IARI	1998	NEPZ	17-19	140-150	White bold seeded, tolerant to wilt.
JG-11	ICRISAT/ PKV/ JNKVV	1999	SZ	15-17	95-100	Resistant to wilt, moderately resistant to root rot. Bold seeded

(Table – 2.5. continued)

Variety	**Source**	**Year of Release/ Notifi-cation**	**Area of adoption Zone/ State**	**Ave. yield (Q/ha)**	**Duration**	**Characteristics**
JAKI 92-18		1999	CZ	18-20	-	Bold seeded, wilt resistant
Gujarat Gram-1	GAU	1999	CZ	17-22	105-110	Wilt resistant, Dark brown, medium bold.
Dharwad Pragati (BGD 72)	IARI	1999	CZ	25-30	115-120	Resistant to wilt & root rot, bold seeded
CO-3	TNAU	1999	TN	9-11	80-85	Bold seeded, Resistant to wilt & Collar rot
CO-4	TNAU	1999	TN	9-11	80-85	Bold seeded
JG-322	JNKVV	1999	MP	18-20	110-115	Suitable for wilt prone areas.
WCG-2 (Surya)	Meerut University	1999	UP	20-25	135-150	Res.to rot, tol. to stunt & dry root rot
L-551 (Kabuli)	PAU	1999	Punjab	18-20	135-140	Wilt tolerant.
Gujarat Gram 2 (GCP-107)	GAU	1999	Gujarat	22-24	95-100	Tolerant to wilt and bold seeded
Pusa Chamatkar (G 1053) kabuli	IARI	1999	NWPZ	17-19	140-150	Tolerant to wilt
Gujarat Gram-4 (GCP-105)	GAU	2000	NEPZ	18-20	135-130	Resistant to wilt. Seeds are dark brown.
PKV Kabuli-2 (KAK 2)	PKV	2000	CZ	17-18	125-130	Bold seeded
SAKI-9516 (Jawahar gram 16)	JNKVV	2001	CZ	18-20	110-120	Resistant to wilt.
Vaibhav (RG 2918)	IGKV	2001	Chattisgarh	14-15	110-115	Seeds wrinkled and bold
WCG-10 (Pant G-10)	GBPUAT	2001	MS, Hary., U.P.	21	147	Res. to foot rot, Mod. res. to stunt virus, wilt, root rot
Haryana Kabuli 1 (HK- 89-131)	CSSHAU	2002	Haryana	20	142	Resistant to wilt
Virat (Kabuli) (Phule G-95418)	MPKV	2002	Maharashtra	20	108-118	Resistant to wilt
JG-130 (Jawahar gram)	JNKVV	2002	Madhya Pradesh	15-16	110-115	Bold, Res.to wilt.
Jawahar Gram-1 (JGK 1)	JNKVV	2002	CZ	15-18	110-115	Mod. Resistant to wilt
Vihar (Phule G-95311)	MPKV	2002	Karnataka, A.P., TN, Orissa	16-18	90-100	Seed Bold, Resistant to wilt
Anubhav (RSG 888)	RAU	2003	NWPZ	20-22	130-135	For rainfed, Moderately resistant to wilt, root rot & drought

Pusa 1088	IARI	2003	Delhi	25-30		Res. to wilt and root rots diseases.
Pusa 1103	IARI	2004	Delhi	19-23		Resistant to root diseases.
Pusa 1105	IARI	2004	Delhi	25-30		Mod. Res.to root diseases.
Asha (RSG 945)		2005	Rajasthan	17	75-80	Mod. Res. to dry root rot and wilt.

(Table – 2.5. continued)

Variety	**Source**	**Year of Release/ Notifi-cation**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Duration**	**Characteristics**
PGC-1 (Pratap Channa-1)		2005	Rajasthan	12-14	90-95	Mod. Resistant to wilt & pod borer.
Arpita (RSG-895)		2005	Rajasthan	14	125-130	Mod. Res.to dry root rot, wilt&B.G.M.
Haryana Chana-5 (H 96-99)		2005	Haryana	20		Res. to Fusarium wilt and root rots
Aadhar (RSG-963)		2005	Raj, Hary, Punjab, J & K, Uttrakhand and U.P	16-17	125-130	Suitable for late sown condition
Abha (RSG-973)	ARS Durgapura	2006	Rajasthan	15-16	120-125	Moderate resistant to wilt, dry root rot
Abha (RSG-807)	ARS Durgapura	2006	Rajasthan	18	120-125	Moderate resistant to dry root rot
Himachal chana-2 (HK-94-134)	CSK HP	2006	Himachal Pradesh	19		Resistant to wilt, Moderately resistant to root rot & collar rots, tolerant to ascochyta blight
Digvijay	MPKV	2006	Maharashtra	19	105-110	Resistant to fusarium wilt
JAKI-9218	PKV	2006	Maharashtra	15-16	93-125	Resistant to Fusarium wilt, root rot and collar rot
Akash (BDNG-797)	MPKV	2007	Maharashtra	15-16	102	Resistant to wilt, tolerant to pod borer
Rajas (Phule-G-9425-9)	MPKV	2007	Punjab, Har., Uttarakhand, Delhi, Raj. and Jammu	18	136	Resistant to fusarium wilt
JGK-2	JNKVV	2007	M.P.	15	95-110	Resistant to collar rot, root rot, Mod. Res. to wilt and dry root rot
Lam shanaga (LBG 7)	ANGRAU	2007	M.P.	20-25	90	
JGK-3 (JGK 19)	JNKVV	2007	M.P.	14-15	92-121	Resistant to wilt
Jawahar Gram 226 (JG 226)	JNKVV	2007	M.P.			Resistant to wilt and root rot complex
GNG 421 (Gauri)	ARS, Sriganganagar	2007	Rajasthan	18	127-160	Tol .to dry root rot, stunt and wilt
GNG 1488 (Sangam)	ARS, Sriganganagar	2007	Rajasthan	18	99-157	Tol .to dry root rot and stunt
RSG 991(Aparna)	ARS, Duragapura	2007	Rajasthan	12-15	130-135	Mod. Res. to dry root rot, wilt, collar rot
RSG 896 (Arpan)	ARS, Duragapura	2007	Rajasthan	12-15	130-135	Mod. Res. to dry root rot, wilt, pod borer
(RSG 902	ARS, Duragapura	2007	Rajasthan	15-20	130-135	Mod. Res. to dry root rot, wilt, pod borer

(Aruna)						

NHZ-North Hilly Zone (H.P.,J.K & U.P.hills), CZ- Central Zone (MP.,Maharashtra, Chhattisgarh, Gujarat) , SZ- South Zone (A.P., Karnataka, Tamil nadu, Orissa) NEPZ-North East plane Zone (East Uttar Pradesh, Bihar, Jharkhand, West Bengal).NWPZ- North West Plane Zone (Punjab, Haryana, Delhi, West UP & North Rajasthan) Res.= Resistant, Tol.= Tolerant, Mod.= Moderately, BGM- Botrytis grey mould

Table – 2.6. Pest and diseases in chickpea and their management

Insect Pest/ Disease/ Causal Organism	**Nature of Damage/ Symptoms**	**Control Measures**
i. Cutworm	The catterpillar cut the plants or branches during night. The pest is active during night time and during day time. Larvae hide themselves under the clods	Endosulfan 35 EC @ 0.07% or Monocrotophos 36 WSC @ 0.04%.
ii. Gram pod borer	It is a polyphagous found through out the country and may cause very heavy damage (upto 20-60%). Normally larvae remain hidden in the foliage of crop unnoticed till the formation of pods. After pod formation, they feed on developing seeds after making a round hole in the pod and putting its head inside.	Endosulfan 35 @ 0.05% and/or 0.04%. Monocrotophos 36 EC or NPV @ 250 LE/ha. BT formulation @ 1.0-1.5 kg/ha.
iii. Wilt (*Fusarium oxysporum*)	Seedling gets affected first but in advance stages symptoms of disease may also appear. The plant becomes yellowish and finally dries out. Roots become black and ultimately decompose.	i. Sowing should not be done when temperature is high. ii. Soil Solarization. iii. Seed tretment with BenlateT @ 1.5 g/Kg seed.
iv. Ascochyta Blight (*Ascochyta rabiei*)	The infected plant shows yellowish appearance, which become brown after some time and finally dryout. Brown coloured spots with white cottony growth of fungus may also be seen.	i. Seed treatment with Calaxin M or Thiobendazole @ 3 Kg of seed. ii. Chlorothalonil @ 3 ml/litre water should be sprayed on the crop. iii. Use disease free seed.
v. Botrytis Greymold (*Botrytis cinerea*)	The disease is most prevalent during humid weather. Grey to dark brown lesions may formed on the stem, leaves, branches and pods.	i. Seed treatment with Thiram + Bavistin (1:1) @ 3 Kg of seed. ii. Adopt wider spacing. iii. Inter-cropping with linseed.
vi. Rust (*Uromyces ciceris*)	Small rounded, oval postules of dark brown-black colour are formed on the stem, leaves. Young leaves show mid vein yellowing and mild mottling Later on leaf tips necrose and drop giving an impression of wilting.	i. Dithane M-45 @ 2% at interval of 10 days. ii. Grow resistant varieties.
vii. Stunt virus		i. Close spacing should be adopted. ii. Vector should be controlled.

PIGEONPEA

Botanical Name	-	*Cajanus cajan* (L.) Millsp.
Synonym	-	Red gram, Tur
Origin	-	Africa
Chromosomes	-	2n = 22

1. ECONOMIC IMPORTANCE- Pigeonpea (Arhar) commonly known as red gram or tur is a very old crop of this country. After gram, arhar is the second most important pulse crop in the country. It accounts for about 11.8% of the total pulse area and 17% of total pulse production of the country. It is a rich source of protein and supplies a major share of the protein requirement of the vegetarian population of the country. It is mainly eaten in the form of split pulse as 'dal': Seeds of arhar are also rich in iron, iodine, essential amino acids like lycine, tyrocene, cystine and arginine. The outer covering of its seed together with part of the kernel, provides a valuable feed for milch cattle. The husk of pods and leaves obtained during threshing constitute a valuable cattle feed. Woody parts of the plant are used for fuel. It is a legume crop and, consequently, possesses valuable properties as restorer of nitrogen to the soil.

Nutritive value

Protein	–	22.3 %	Calcium	–	73 mg/100 g
Fat	–	1.7 %	Phosphorus	–	304 mg/100 g
Minerals	–	3.5 %	Iron	–	5.8 mg/100 g
Fiber	–	1.5 %	Calorific value	–	335
Carbohydrate	–	57.6 %	Moisture	–	13.4%

Agronomic Significance: Deep roots improve physical properties of the soil and pulverise the soil. The plants shed large amount of leaves, this biomass add organic matter to soil. Besides, it also leaves 30-50 kg 'N' to the succeeding crop and also benifiting the inter-cropped cereals through increased 'N' supply.

2. CROP STATUS

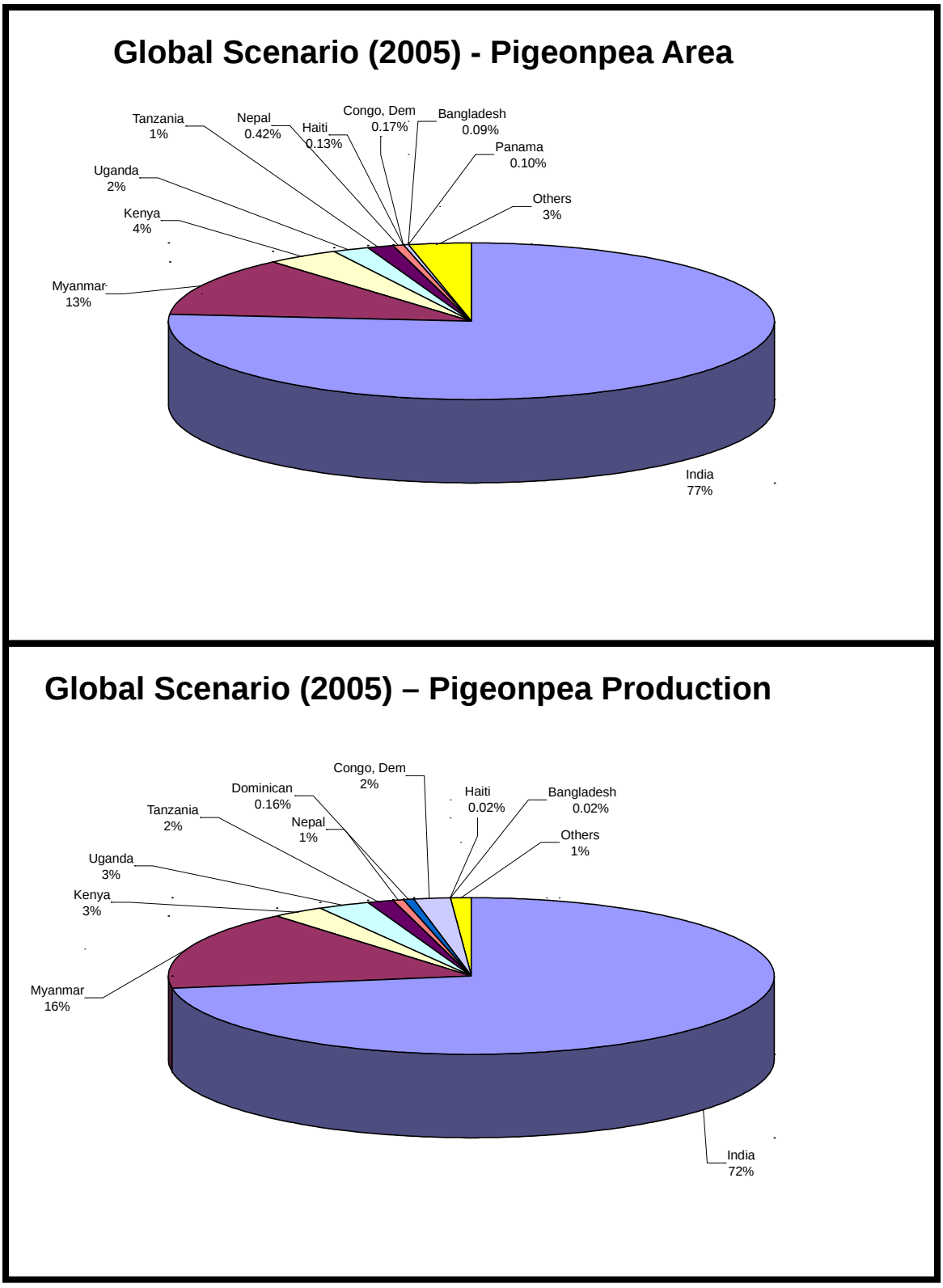
2.1. Global scenario

India ranked first in area and production in the world with 76% and 72% of world area and production respectively. In productivity, Trinidad ranked first with 2381 kg/ha followed by Philippines and Jamaica. India stands 15th position in the world as far as average productivity is concerned.

Table – 3.1. Global ranking in area, production and yield: Major countries

Rank	Country	Area (Lakh ha)		Country	Production (Lakh tonnes)		Country	Yield (Kg/ha)
		Area	% to World		Prod.	% to World		
I	India	35.19	76.46	India	23.47	72.41	Trinidad & Tobago	2381
II	Myanmar	5.60	12.17	Myanmar	5.30	16.35	Philippines	1300
III	Kenya	1.80	3.92	Kenya	0.96	2.96	Jamaica	1182
IV	Uganda	0.85	1.85	Uganda	0.85	2.62	Uganda	1000
V	Tanzania	0.68	1.48	Congo	0.59	1.81	Grenada	962
VI	Nepal	0.19	0.42	Tanzania	0.50	1.54	Myanmar	946
VII	Congo	0.08	0.17	Nepal	0.18	0.55	Dominican Republic	945
VIII	Haiti	0.06	0.13	Dominican Republic	0.16	0.50	Nepal	922
IX	Panama	0.05	0.10	Haiti	0.02	0.07	Burundi	900
X	Bangladesh	0.04	0.09	Bangladesh	0.02	0.06	Puerto Rico	801
XV.	-	-	-	-	-	-	**India**	**667**
	World	**46.02**		**World**	**32.41**		**World**	**704**

***Source**: FAO Statistics*



2.2. National Scenario

Eighth Plan (1992-97:- The Country's total area coverage and production of tur were 34.76 lakh hectares and 24.26 lakh tonnes respectively. The State-wise contribution towards area coverage and production shows that Maharastra ranked first both in area and production (30% & 26.4%), followed by Uttar Pradesh (14.8% & 22.1%). In area coverage, Gujarat and Karnataka each were placed third (11.4%) and in production, Madhya Pradesh stood third (14%).

Ninth Plan (1998-2002): The country's total area coverage and production of tur were 34.37 lakh hectares and 23.52 lakh tonnes respectively. The state-wise trend shows that Maharashtra ranked first both in respect of area and production (30.10% and 29.47%) followed by U.P. (12.2% and 21.1%). The third place occupied by Karnataka in area (14.4%) and M.P. (11.4%) in production. The highest yield recorded by Bihar (1306 kg/ha) followed by U.P. (1184 kg/ha) and M.P. (784 kg/ha).

Tenth Plan (TE 2005-06): The Country's total area coverage and production of tur were 35.38 lakh hectares and 24.80 lakh tonnes respectively. Maharashtra ranked first both in area coverage (30.43%) and production (28.8%) followed by Uttar Pradesh (16%) and Karnataka (12.4%). As regards area, Karnataka ranked second (16%) followed by A.P. with 14.09% coverage.

Table – 3.2. Plan-wise Pigeonpea Scenario - States

A= Area lakh ha, P= Production Lkh Tonnes, Y= Yield Kg/ha)

STATE		Eighth Plan	% to Country	Ninth Plan	% to Country	Xth Plan (T.E.2005-06)	% to Country
Andhra Pradesh	A	3.20	9.22	4.16	12.09	4.98	14.09
	P	1.04	4.27	1.58	6.71	2.46	9.92
	Y	322	46	369	54	494	71
Bihar	A	0.71	2.05	0.56	1.64	0.36	1.02
	P	0.71	2.94	0.74	3.16	0.45	1.82
	Y	998	143	1307	191	1254	179
Chhattisgarh	A			0.20	0.58	0.57	1.60
	P			0.08	0.35	0.29	1.18
	Y			166	24	519	74
Gujarat	A	3.97	11.43	3.53	10.27	2.68	7.59
	P	3.24	13.35	2.45	10.41	2.58	10.40
	Y	809	116	683	100	967	138
Haryana	A	0.41	1.19	0.24	0.70	0.29	0.82
	P	0.42	1.74	0.25	1.06	0.32	1.28
	Y	992	142	945	138	1100	157
Jharkhand	A	*		0.08	0.23	0.83	2.35
	P			0.09	0.37	0.49	1.97
	Y			436	64	591	84
Karnataka	A	3.96	11.41	4.94	14.37	5.65	15.97
	P	1.58	6.52	2.04	8.68	3.09	12.45
	Y	401	58	406	59	539	77
Madhya Pradesh	A	3.92	11.27	3.40	9.89	3.22	9.09

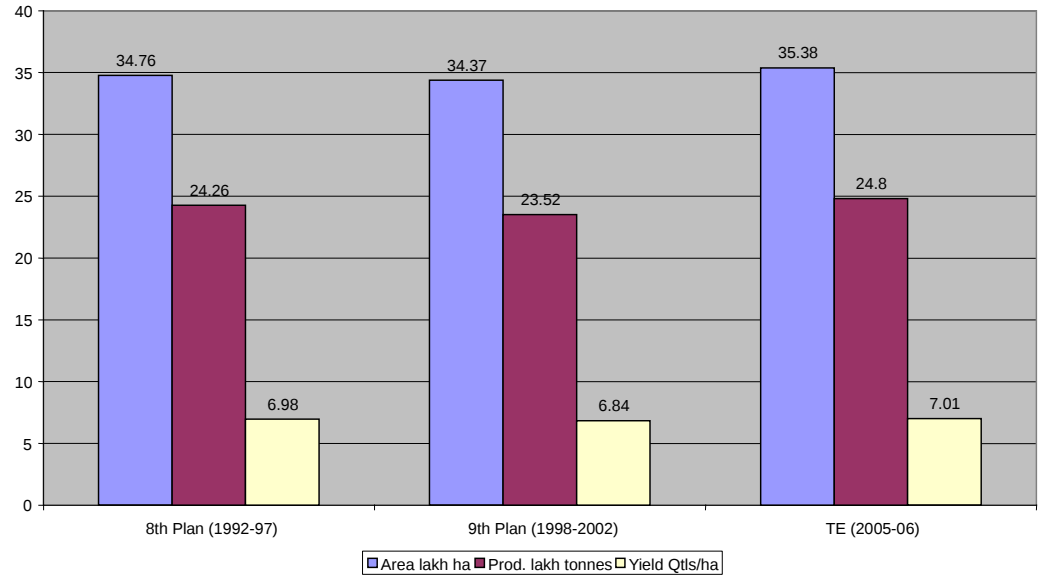
	P	3.39	13.99	2.67	11.36	2.50	10.10
	Y	864	124	784	115	778	111
Maharashtra	A	10.41	29.95	10.34	30.10	10.77	30.43
	P	6.41	26.43	6.93	29.47	7.15	28.83
	Y	736	106	670	98	664	95
Orissa	A	1.55	4.46	1.39	4.06	1.33	3.76
	P	1.13	4.67	0.81	3.43	0.94	3.81
	Y	722	104	581	85	708	101
Punjab	A	0.11	0.31	0.09	0.27	0.09	0.25
	P	0.10	0.40	0.07	0.31	0.08	0.32
	Y	896	128	790	116	893	127
Rajasthan	A	0.23	0.67	0.29	0.85	0.19	0.54
	P	0.12	0.51	0.22	0.92	0.14	0.56
	Y	505	73	735	107	736	105
Tamil Nadu	A	0.95	2.74	0.72	2.09	0.41	1.16
	P	0.62	2.56	0.46	1.97	0.24	0.98
	Y	661	95	642	94	592	84
Uttar Pradesh	A	5.14	14.80	4.22	12.27	3.79	10.73
	P	5.36	22.09	4.98	21.16	3.88	15.64
	Y	1042	150	1184	173	1023	146

* *New states carved out during 2000*

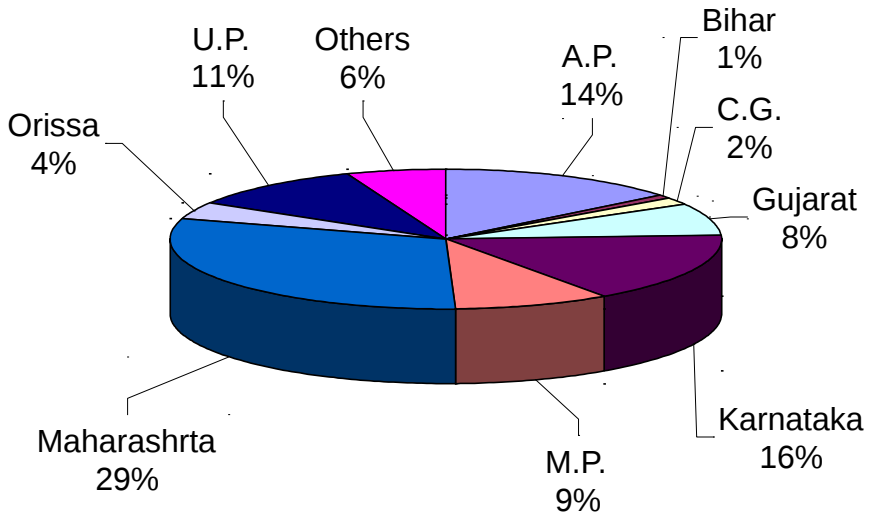
(Continued)

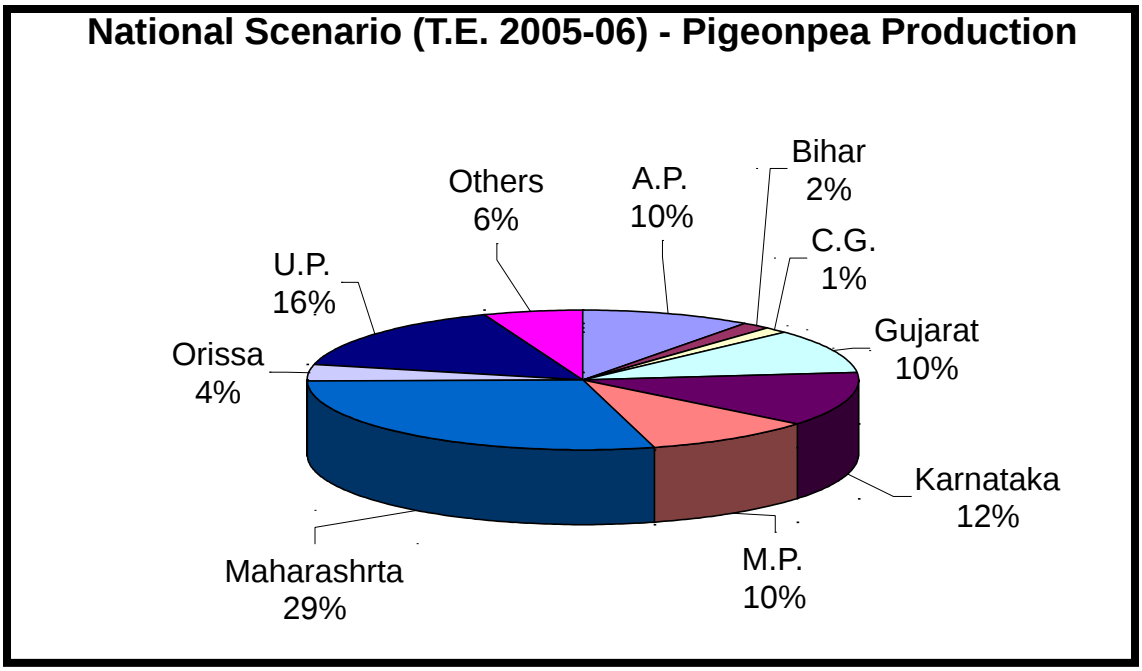
STATE		**Eighth Plan**	**% to Country**	**Ninth Plan**	**% to Country**	**Xth Plan (T.E.2005-06)**	**% to Country**
West Bengal	A	0.04	0.13	0.04	0.13	0.02	0.06
	P	0.04	0.15	0.03	0.13	0.02	0.08
	Y	794	114	703	103	874	125
All India	**A**	**34.76**		**34.37**		**35.38**	
	P	**24.26**		**23.52**		**24.80**	
	Y	**697**		**684**		**701**	

National Scenario- Pigeonpea (APY)



National Scenario (T.E. 2005-06)- Pigeonpea Area

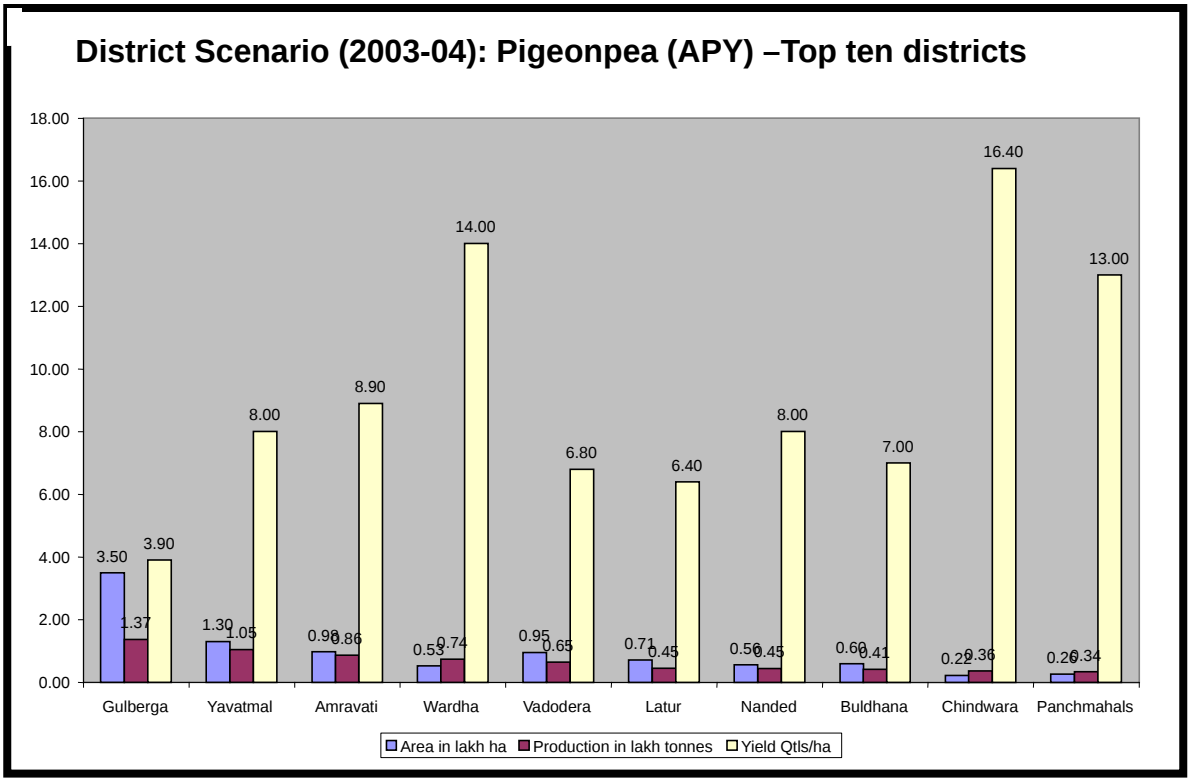




2.3. Potential districts (2003-04) - The intra-state analysis at the district level is presented in table – 3.3. Inter-district analysis across the country revealed that the highest area and production of pigeonpea is in Gulberga district of Karnataka which are 9.95 per cent and 5.80 per cent respectively of country's total tur area and production followed by Yavatmal (3.70% and 4.44%), Amrawati (2.77% and 3.66%), Wardha (1.5% and 3.13) of Maharashtra state and Vadodera (2.70% and 2.75%) of Gujrat. Rest of the districts, having less then 2 percent of production of the country. District-wise area, production and yield of top ten districts of India in respect of production are presented below which together contribute to 27.29 per cent and 28.33 per cent of area and production of the country (table 3.3).

Table – 3.3. Top potential districts (2003-04)

S. No	Name of District	State	Area (lakh ha)		Prod. (lakh tonnes)		Yield (Kg/ha)	
			Area	% to India	Prod.	% to India	Yield	YI
I	Gulberga	Karnataka	3.499	9.95	1.366	5.80	390	58
II	Yavatmal	MS	1.302	3.70	1.047	4.44	800	119
III	Amravati	MS	0.975	2.77	0.863	3.66	890	133
IV	Wardha	MS	0.526	1.50	0.737	3.13	1400	209
V	Vadodera	Guajrat	0.948	2.70	0.649	2.75	680	101
VI	Latur	MS	0.708	2.01	0.452	1.92	640	96
VII	Nanded	MS	0.558	1.59	0.446	1.89	800	119
VIII	Buldhana	MS	0.595	1.69	0.414	1.76	700	104
IX	Chindwara	M.P.	0.222	0.63	0.364	1.54	1640	245
X	Panchmahals	Gujarat	0.261	0.74	0.338	1.43	1300	194
		Total	**9.594**	**27.29**	**6.676**	**28.33**	**696**	**104**
	All India		**35.156**		**23.564**		**670**	



3. BOTANICAL DECRIPTION: The plant is an erect shrub with considerable variation in height from 1-4 metre, depends upon variety, growing season and management practices adopted. Branching mostly begins from 6th to the 10th node i.e. from 15-25 cm above ground. Leaves are trifoliately compound with central leaflets, longer than laterals.

Inflorescence: It is axillary raceme often forming a terminal panicle. They open in the evening and remain open for whole night and up to noon of the next day. Self pollination is a general rule before opening the flowers. However, cross pollination may also occur to some extent.

Pod: Length varies from 5-10 cm and width from 0.6 to 0.9 cm and colour variation from green to dark brown.

Seeds: Seeds are round or lens shaped, the colour of the seed coat varied dirty white to silver white, light brown to chestnut brown and dark mottled brown to pinkish black with yellow cotyledons.

Root System: It consists of a well developed central tap root with numerous secondary and lateral branches bearing nodules on them like other legumes. Usually tall and upright variety produce longer and more deeply penetrating roots whereas spreading type produce shallower, more spreading and denser roots

4. BOTANICAL CLASSIFICATION: Based on plant and pod character and maturity duration, Arhar belongs to two groups

i) *Cajanus cajan var. bicolor:* They are late maturing, plants grow very tall and bushy. Flowers are yellow with purple streaked at the end of the branch. The standard which is largest of five petals in the flower possesses red veins on the

dorsal side. Pods are relatively longer dark in colour with 4-5 seeds inside.

ii) *Cajanus cajan var. flavus*: This group includes early maturing varieties with shorter bushy plant types having flowers at several points along the branches. Flowers are yellow and pods are plain, shorter with 2-3 seeds inside.

On the basis of maturity, there are three distinct groups: (i) early-maturity group- 100 to 150 days, (ii) medium-maturity group - 150-180 days, and (iii) late-maturity group - 180-300 days duration.

5. PRODUCTION TECHNOLOGY

5.1. Climatic requirement: Arhar grows well in warm tropical and subtropical climate. The crop prefers a fairly moist and warm climate during the periods of its vegetative growth. During the flowering and ripening stages, it requires bright sunny weather for setting of fruits. Accordingly, temperature requirement is 30-35^{0}C for germination, 20-25^{0}C for active growth, 15-18^{0}C during flowering and pod setting and 35-40^{0}C at maturity. It is highly susceptible to frost at the time of flowering. Cloudy weather and excessive rainfall at flowering time damage the crop to a great extent.

5.2. Varieties: Selection of variety as per the adaptability to the region, time of sowing and purpose of cultivation etc; (**table – 3.7)** However, *some specific situation –wise* varietiesfor early duration (150-160 days) suited for Pigeonpea-wheat cropping system eg.UPAS-120, Paras, Pusa-855, 992, PPH-4, Manak, Jagrity (ICPL-151) and for Post rainy season (pre Rabi planting) varieties like Sharad, Pusa-9 and Bahar.

5.3. Soil & field preparation: Being a deep rooted crop, soil must be very deep, well drained, free from soluble salts and neutral in reaction. One deep ploughing with soil turning plough (20-25 cm) followed by 2-3 harrowing and proper leveling by planking after each ploughing, to make the field deep and well pulverized, free from weeds and clods, is must.

5.4. Cropping system: The crop is generally grown with wide row spacing with slow initial growth, the grand growth starts after 60-70 days of sowing. A lot of inter-row spaces, therefore, remain vacant during the early stages and get infested by weeds. The space between the rows could be profitably utilized by growing short duration crops such as urd, moong, cowpea, etc; *Important cropping systems* followed are:
(i) Maize–Pigeonpea (Rabi), (ii) Pigeonpea-Urd-Wheat, (iii) Pigeonpea-Sugarcane, (iv) Mung+Pigeonpea-Wheat, and (v) Pigeonpea (early)-Potato-urdbean

Recommended intercropping: Nearly 80-90% of country's area under mid and late varieties of pigeon pea usually put to inter-crop giving 4-7 Qtls/ha additional yield without affecting the yield of the main crop of arhar. The recommended inter-croppings are at table 3.4:

Table 3.4. State-wise recommended inter-cropping

States	Inter-cropping	
i. Central & southern States	Pigeon pea + Sorghum	(1:2 ratio)
ii.Upland plateau of Bihar & Jharkhand	Pigeon pea + Rice	(1:2 ratio)
iii.Gujarat, A.P., and Maharashtra	Pigeon pea + Groundnut	(1:3 ratio)
iv.M.P., A.P., MS., and Gujarat	Pigeon pea + Cotton	(1:1 ratio)
	Pigeonpea + Soybean	(2:2 ratio)
v. Rajasthan and Eastern India	Pigeon pea + Maize/Bajra	(1:1 ratio)

5.5. Seed and sowing- Early arhar should be sown in first fortnight of June with pre-sowing irrigation, so that the succeeding crop can be sown with the least delay. Late sowing crop is more likely to be damaged by frost in northern parts of India. However, under rainfed conditions sowing may be done immediately after soil saturating rains (10-15 cm) have started. In *diara lands* which are prone to flood, sowing must be delayed by mid September.

Seed should be sown behind the plough or with the help of seed drill at a row spacing of 60-75 cm keeping 15-20 cm distance from plant to plant. A seed rate of 12-15 kg per ha is sufficient. In mixed cropping seed rate is adjusted according to the proportion of arhar and companion crops to be grown. In intercropping seed rate remains same as for pure crop.

5.6. Plant Nutrient Management:

Apply 25-30 kg N, 50-75 Kg P_2O_5, 30 kg K_2O and 10-15 kg $ZnSO_4$ in one ha area as dose. Apply 20 kg S per ha in addition to NP at the time of sowing. For correcting Zn deficiency, foliar spray of 0.5 kg $ZnSO_4$ with 0.25 kg lime or soil application of $ZnSO_4$ @ 25 kg per ha to one crop on Zn deficient soils is helpful to both the crop of pulse based cropping system. Mo deficiency can be corrected by applying 1 kg sodium molybdate per ha and for boron deficient soils foliar spray of B @ 1.0 – 1.5 kg B per ha or soil application of 4 kg borax. Spray 1.0 per cent $FeSO_4$ to recoup the crop from Fe deficiency

Nutrient management in intercropping: Application of full dose of nutrients to cereal component of pigeonpea intercrop ($N_{60}P_{40}$) along with full dose of fertilizers for pigeonpea ($N_{18}P_{40}$), has been found beneficial. In irrigated pigeonpea-cereal intercrop, the N should be split into two doses.

5.7. Water management: Being a deep rooted crop, it can tolerate drought. In crop planted in June, one or two pre-monsoon irrigations should be given as per requirement. After the start of monsoon, there is no need to irrigation but in case of prolonged drought during the reproductive period of growth, one or two irrigations may be needed.

A pre-requisite for the success of arhar is proper drainage. *Ridge planting* is effective in areas where *sub-surface drainage is poor*. This provides enough aeration for the roots during the period of excess rainfall. During rainy season, water should not stand anywhere in the field.

5.8. Weed management: Weeds poses serious problem during rainy season by robbing the crop of precious nutrients and moisture and also give shelter to various insects and pests. The period of early 60 days is very critical for weed management point of view. Therefore, field should be kept free from weeds by giving two weeding through hand or wheel hoe at 25-30 and 45-50 days after sowing, respectively. If manual weeding is not possible either due to continuous rains or non availability of labour etc., weeds can also be manage successfully by using either of any one herbicides @ of 1 kg a.i./ha viz. Metachlor, Oxadiazon and Pendimithalin as pre-emergence spray or Basaline as pre-plant incorporation in soil.

Weed management in intercropping system: An initial 45 and 30 days after sowing period is found very critical for severe weed crop competition causing a loss of about 46.1% and 34% in NWPZ, 73% and 81% in CZ and 43 and 56% in NEPZ for pigeonpea intercropping with cereals and short duration pulses like green gram/black gram/cow pea/soybean, respectively.

Besides manual weeding with hand or wheel hoe, weeds may also be effectively controlled in pigeonpea intercropping system with pre-emergence application of Pendimethalin @ 0.5 – 1 kg a.i./ha depending upon weed intensity and soil type.

5.9. Plant protection - Refer Table -3.8.

5.10. Harvesting, threshing & storage: With two third to three fourth pods at maturity judged by changing their colour to brown is the best harvesting time. The plants are usually cut with a sickle within 75-25 cm above the ground.

Harvested plants should be left in the field for sun drying for 3-6 days depending on season. Threshing is done either by beating the pods with stick or using Pullman thresher. The proportion of seed to pods is generally 50-60%

The clean seeds should be sun dried for 3-4 days to bring their moisture content at 9-10% to safely store in appropriate bins. To avoid further development of bruchids and other storage pests, it is recommended to fumigate the storage material before onset of monsoon and again after the monsoon with ALP @ 1-2 tablets per tonne. The small quantity of the produce can also be protected by mixing inert material (soft stone, lime, ash, etc) or by smearing edible/non-edible vegetable oils or by mixing plant products like neem leaf powder at the rate of 1-2% w/w basis.

5.11. Yield: 15-30 qtls of grain (depending upon maturity group of variety and climate) and 50-60 qtls of sticks for fuel, as well.

6. HYBRID PIGEONPEA

Pigeonpea is the only pulse crop which bestowed with the mechanism of cross pollination, a number of scientists during working with pigeonpea have witnessed high degree of cross pollination, consequently, pigeon pea is considered as partially cross pollinated crop and traditionally high yielding purelines vis-a-vis single plant selections of different maturity groups has been developed through exploitation of pedigree selection. But in pigeonpea, genetics of yield and yield

governing traits offer new niches for exploitations of hybrid-vigour. For commercial hybrid seed production in crop, there are two main prerequisites: (i) efficient mass pollen transfer mechanism; and (ii) stable male-sterile source.

6.1. GMS based hybrids: Natural cross-pollination in pigeonpea was witnessed as early as 1919 but could not be exploited in commercial hybrid seed breeding due to non-availabilty of suitable male sterile source. In the recent past the genetic male sterlity system in Pigeonpea has been identified and exploited for commercial hybrid by public sector. Following GMS based hybrid developed are indicated in Table – 3.5**.**

Table 3.5. GMS based pigeonpea hybrids

Hybrid	**Source/Public sector Institution**
ICPH-8	ICRISAT, Hyderabad
PPH 4	PAU, Ludhiana
COPH1	TNAU, Coimbatore
AKPH 4101	PDKV, Akola
AKPH 2012	PDKV, Akola

The above hybrids, however, could not be popularized due to seed production constraints, besides problem related to seed purity concern and economic feasibility. As an ongoing programme on agriculture research and development, sincere efforts have been made in 1994, when the work of identification of CGMS system under ICAR and NATP programme has been initiated.

6.2. CGMS based Hybrids: Stable Cytoplasmic Genetic Male sterile lines ("A" lines) along with their maintainer line ("B" lines) and appropriate fertility restorer lines, with better combining ability for yield, have already been developed ("R" lines). By exploiting A, B and R lines, biotic and abiotic stresses resistant hybrids with yield superiority over best check are being developed.
These hybrids have given better results in terms of yield and earlyness. It is beyond doubt that the area, production and productivity shall enhance by adoption of hybrids based on CGMS systems. CGMS based Hybrid GTH-1 developed by SKAU, SK Nagar (Gujarat), has recently been released for cultivation.

Scope and economics of Hybrid
It is believed that hybrids have more canopy than traditional variety consequently less per hectare seed rate compensating higher cost of hybrid seed The hybrids have tremendous scope of popularization in northern India and other parts where wheat crop can be taken after harvest of hybrid pigeonpea. Similarly in central and south India, early and medium duration pigeonpea hybrids will play important role in summing-up the additional area by way of replacement of traditional poor performers. With the adoption of hybrids, the cost of cultivation would also be within the reach of farmer. Economics of CGMS based hybrid pigeonpea is given in **table 3.6.**

Table – 3.6. Production economics of hybrid pigeonpea cultivation

Sl. No	Particulars	Rates	Cost (Rupees)
I	Seed cost	(i) Female 18 kg @ Rs 50.00 (ii) Male 3 kg @Rs. 50.00	900.00 150.00
II	Cultivation	3 hrs @ Rs. 300.00	900.00
III	Sowing	2 hrs @ Rs.300.00	600.00
IV	Fertigation (including transportation cost)	Dose 25:50:00 NPK kg/ha	1200.00
V	Irrigation	5 @ Rs. 800.00	4000.00
VI	Plant protection measures	SOS	1500.00
VII	Weeding/Rouging(Three)	3 @ Rs.300.00	900.00
VIII	Harvesting	12 labours @ 150.00	1800.00
IX	Threshing	(i)2 labour @ 100.00 (ii) 3 hrs thresher @ Rs 300.00	200.00 900.00
X	Grading	5 labours @ Rs. 100.00	500.00
XI	Packing	350 bag @ Rs 10.00	3500.00
	Total expenditure		**16450.00**

Profit

Particulars	Rates	Income (Rupees)
Hybrid seed production 1750-1850 kg/ha	1750 kg@ Rs.50/-	87500.00
Male Seed Production	300 kg @ Rs. 20/-	6000.00
Total		93500.00
Net profit = Rs. 93500.00-Rs. 16450.00=Rs77050.00*		
*Minimum Tentative Profit Rs. 75000.00-80000.00 per hectare		

7. SITUATIONS/SEASON OF CULTIVATION

7.1. Rabi Pigeonpea

This is practiced in flood prone areas where fields get flooded or waterlogged during rainy season. The states of U.P. (eastern parts), Bihar, West Bengal, Orissa, Gujarat and M.P. may exploit this potential with following practices/recommendations, for successful cultivation of rabi pigeonpea.

- The sowing must be done in II/III week of September. The crop can also be taken after harvest of early maize or paddy.
- Sowing at closer spacing (30 x 20 cm) having up to 2 lakh plants/ha
- High seed rate of 40-50 kg/ha should be followed.
- Sowing depth should not exceed 5 cm. The seed should be treated with culture.
- Apply $N_{30}P_{50}$ ($N_{20}P_{50}$ basal and N_{10} top dressing at 30 days after sowing) and also apply 20 kg $ZnSO_4$ and 10 kg sulphur if previous crop is not supplied with Zn and S.
- The crop should be irrigated thrice i.e. at branching (30 DAS), pre-flowering (70 DAS) and pod filling (110 DAS) stages.

- Heptachlor 6% @ 25 kg/ha should be mixed in soil at the time of last tillage operation before sowing.
- Lasso/Tok E-25 should be applied @ 1 kg/ha soon after sowing to wardoff weeds.
- Spraying of Endosulfan @ 0.07%, Malathion 0.05% or carbaryl 0.1% at pod formation stage, controls pod borers.

7.2. Summer Pigeonpea

An alternate best way for increasing cropping intensity and timely wheat planting under *pigeonpea - wheat cropping system* of Northern India with approximately 2 lakh ha area, is summer sowing of pigeonpea alongwith summer moong. Under this situation, advanced sowing of pigeonpea may be done during mid-April keeping row-to-row spacing of 90 cm, intercropped with 3 rows of greengram at 20cm row spacing. Greengram become ready for harvest by the end of June after two pickings. Immediately in the space vacated by green gram, inter planting of black gram ('T-9') can be done between pigeonpea rows. While blackgram will be ready for harvest by end of September, pigeonpea attain maturity to be harvested by the mid November. Early harvest of pigeonpea thus facilitates wheat sowing at optimum time to harness the best yield. Thus, summer sown pigeon pea may be harvested alongwith other kharif crops in November and short statured crops of greengram and blackgram will be an additional source of income.

Table – 3.7. Recommended pigeonpea varieties/characteristics

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristcs
UPAS-120	GBPUAT	1976	UP	11-15	125-150	Early maturing
BDN-2	MAU	1978	Maharashtra	10-12	150-160	Indeterminate, white seed , tol. to wilt
HY 3C	IARI	1982	AP	17.0	170-180	White bold seeded
LRG-30 (Palandu)	ANGRAU	1982	AP	17-19	170-180	Medium maturing
C 11	PKV	1982	Maharashtra	15-20	190-200	Tolerant to wilt
TT 6 (Vishakha-1)	BARC	1983	CZ , SZ	10-17	130-140	Compact, medium bold seeded
T 15-15	GAU	1985	Gujarat	15-20	200-210	Medium maturing
CO 5	TNAU	1985	Tamil nadu	8-12	100-115	
Manak (H 77-216)	CCSHAU	1985	NWPZ	18-20	120-130	Early maturing
Pusa 84	IARI	1985	NWPZ	15-16	140-150	Determinate plant
Bahar	RAU,Dholi	1986	Bihar, U.P.	20-25	230-250	Res. to SMD, seed bold and pale brown
Pragati (ICPL-87)	ICRISAT	1986	CZ, SZ	11-19	116-125	Determinate plant, seed light brown
Maruti (ICPL-8863)	ICRISAT	1986	A.P, Karnataka	10-12	155-160	Resistant to wilt
TTB 7	UAS, Bangalore	1988	Karnataka	15-17	160-170	Semi-spreading
Pusa 33	IARI	1988	NWPZ, CZ	18-20	120-150	Indeterminate plant

Jagriti (ICPL-151)	ICRISAT	1989	NHZ , NWPZ, CZ	18-20	120-140	Determinate plant, seed cream colour

Table – 3.7. continued)

Variety	**Source**	**Year of Release/ Notification**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Duration**	**Characteristcs**
Abhaya (ICPL-332)	ANGRAU/ ICRISAT	1989	Andhra Pradesh	18-20	170-175	Resistant to pod borer
BSMR-175	MAU	1991	Maharashtra	11-12	165-170	White seeded, res. to Sterility Mosaic & Wilt
JA-4	JNKVV	1991	M.P	16-18	180-200	Tolerant to wilt & SMD
Birsa Arhar 1	BAU	1992	Bihar	10-15	180-200	Wilt Resistant
Gujarat Tur-100	GAU	1992	Gujarat.	16-18	120-135	Tolerant to wilt &SMD white, bold- seeded.
Vamban 1	TNAU	1993	Tamil Nadu	8-10	95-100	Suitable for inter cropping with Peanut
Asha (ICPL-87119)	ICRISAT	1993	CZ&SZ	16-18	160-170	Resistant to wilt & SMD, Bold seeded, Indeterminate
Pusa-855		1993	NWPZ	24-25	145-150	Indeterminate, Med.bold
Pusa-9	IARI	1993	NEPZ	22-26	210-248	Tol. to *Alternaria* & SMD, Tall & bold- seeded, *pre-rabi.*
CO-6	TNAU	1993	Tamilnadu	8-10	170-180	Tolerant to Pod borer. Indeterminate
Sharad (DA 11)	RAU, Dholi	1993	Bihar	18-20	240-250	Alternaria blight & Sterility Mosaic Resistant
Sarita (ICPL 85010)	ICRISAT	1994	A.P.	10-12	130-140	Determinate.
TS-3	UAS	1995	Karnataka	14-16	180-190	White, bold , res. to Wilt
Madhira 66	ANGRAU	1995	A.P.	-	-	
AL-201	PAU	1995	Punjab.	15-16	140-150	Indeterminate variety.
Durga (ICPL84031)	ICRISAT	1995	Andhra Pradesh.	8-10	120-125	Determinate.
Jawahar (KM-7)	JNKVV	1996	CZ , SZ	18-20	173-180	Tol. wilt & Phytophthora blight. Seeds dark brown
BSMR-736	MAU	1996	Maharashtra	12-18	180-185	Res. to wilt and SMD. Brown seeded. Indeterminate
Narendra Arhar-1 (NDA-88-2)	NDUAT	1997	Uttar Pradesh.	20-22	240-260	Resistant to SMD and tolerant to wilt and Phythopthora blight.
Amar (KA 32-1)	CSAUAT	1997	Uttar pradesh.	16-20	250-270	Compact, res. to SMD. Tol. to wilt, Seed brown
H 82-1(Paras)	CCSHAU	1998	Haryana	15-20	133-145	Indeterminate
Malviya Vikalp (MA-3)	BHU	1999	CZ	20-22	178-162	Spreading, Constricted Pod, resistant to pod fly.
Azad (K 91-25)	CSAUAT	1999	U.P. & Bihar	20-22	250-260	Wilt tol., Sterility Mosaic res.
AKT-8811	Akola	2000	Mahrashtra	13-14	145-150	Indeterminate
Laxmi (ICPL-85063)	ICRISAT	2000	Andhra Pradesh	18-20	160-200	Pre-rabi
Vaishali (BSMR-853)	MAU	2002	Maharshtra	16-17	165.170	Resistant to wilt and SMD.
Sel-31		2002	Karnataka	12	100-110	
Pusa-992	IARI	2002	NWPZ	18-20	130-140	Indeterminate, for Pigeon-Wheat cropping system

MA-6	BHU	2002	Central & Eastern U.P.	20-23	248-267	Late, Spreading type

Table – 3.7. continued)

Variety	**Source**	**Year of Release/ Notification**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Duration**	**Characteristcs**
Pusa 991	IARI	2003	Delhi	16-20	140	Tol.to wilt, Phytophthora blight and SMD
Pusa-992	IARI	2004	NWPZ	17	119-162	Tolerant to SMV and wilt
GT-101	GAU	2004	Gujarat	13	Early	Tolerant to wilt and SMD
Malviya chamatkar (MAL-13)	BHU	2005	UP & W.B.	27-29	226-271 (Kh) 189-248(Pre–rabi)	Moderately resistant to wilt and SMV
VL Arhar-1	VPKAS, Almora	2006	Uttarakhand	19	150	Res.to wilt, Alternaria leaf blight and rot
CORG-9701	TNAU	2006	Tamil Nadu, Karnataka, A.P., Orissa	11	120-130	Tol. to wilt, Sterility Mosaic & phytophthora blight, Tol. to pod borer & pod fly
Amol (BDN 708)	ARS Badnapur	2007	Maharashtra	15	160-165	Mod. res. to wilt & sterility mosaic,
Vipula	MPKV	2007	Maharashtra	16	145-160	Res.to Fusarium wilt, Mod. res. to sterility mosaic disease
Lam-41	ANGRAU	2007	A.P.	12	Medium	Tol. to *Helicoverpa* pod borer
Jawahar (JKM-189)	JNKVV	2007	M.P.	21	116-124	Res. to wilt, Moderately resistant to sterility mosaic and Phytopthora blight
GTH-1 (SKNPCH-10)	SDAU	2007	Gujarat	18	135-145	
TT-401	BARC	2007	M.P., MS Gujarat & CG	16	138-156	Tolerant to pod borer & tolerant to wilt

Res.= Resistant, Tol.= Tolerant, Mod.= Moderately, SMD= Sterility Mosaic Disease

Table – 3.8. Pest and diseases in pigeonpea and their management

Insect Pest/Disease/ Causal Organism	**Nature of Damage/ Symptoms**	**Control Measures**
i. Pod borer	The larva feeds on tender leaves, twigs and at pod formation; they puncture the pod and feeds on developing grains.	Spraying with Monocrotophos (0.04%) or Endosulfan (0.07%) or Chloropyriphos (0.05%) or Fenvalerate (0.004%) or Cypermethrin 0.004%) or NPV @ 200-300 LE/ha.
ii. Tur pod fly	Larvae feed on soft grains within the pod making them unfit for consumption.	Monocrotophos (0.04%) or Dimethioate (0.03%).
iii. Tur plume moth	The larvae damage the seeds as well as cause flowers, buds and pods to drop.	Endosulfan 35 EC @ 2 ml in 1 litre of water.
iv. Hairy caterpiller	The hairy caterpillars damage the crop at seedling stage. It feeds on leaves eating away the green matter of the leaves.	Endosulfan (0.07%) or Chloropyriphos (0.05%) or Fenvelerate (0.004%) or Quinolphos (0.05%).
v. Beetle	The adult beetle stipples the leaves with small	Endosulfan 2% dust at 25 to

	and more or less circular holes. Severe attack adversely affects the vigour & growth of the plant.	30 Kg/ha or Thimet 10% granules @ 10 Kg/ha.

Table – 3.8. continued)

Insect Pest/Disease/ Causal Organism	**Nature of Damage/ Symptoms**	**Control Measures**
vi. Fusarim wilt (*Fusarium udum*)	The leaves on lower branches of the affected plants turn yellow, drop and finally the whole plant dry out. The withering and drying up symptoms appear as if the plants were suffering from drought.	i. Carbendazim (1g) + Thiram 2 g/Kg ii. Solarize the field during summer. iii. Mixed cropping/inter cropping of pigeonpea with sorghum Metalaxyl (6g/kg seed) + ridge planting. iv. Rogueing of infected plants and destroying them.
vii. Phytophthora blight (*Phytophthora cajani*)	Brown to dark brown lesions are formed on the stem near the soil surface. These lesions rapidly girdle the whole stem due to which plant starts drying. High humidity, rainfall and storm, water stagnation during the monsoon favour disease spread.	i. Seed treatment with Ridomil MZ @ 3 g/Kg seed. ii. Waterlogging should be avoided. iii. Inter row spacing should be increased.
viii. Sterility mosaic Virus	The affected plants become light greenish in colour, stunted and branch profusely due to that they appears bushy. Upright vegetative growth and lack of flowering branches resulting in loss of total yield.	i. Grow resistant varieties. ii. Control of vector mites through Kelthane or Metasystox @ 0.1% iii.Destroy infected plants at early stage.
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GREEN GRAM

Botanical Name	-	*Vigna radiata* (L.) Wilczek
Origin	-	India and Central Asia
Chromosome	-	2n = 24
Synonym	-	Moong

1. ECONOMIC IMPORTANCE: Green gram is an excellent source of high quality protein with easy digestibility, consumed as whole grains, dal and sprouted in variety of ways. As value addition, split and dehusked, fried in fat, fetch good value as snacks. After harvesting the pods, green plants are fed to the cattle. The husk of the seed also used as cattle feed.

Nutritive value

Protein	-	24-25%	Calcium	–	124 mg/100 g
Fat	–	1.3%	Phosphorus	-	326 mg/100 g
Minerals	–	3.5%	Iron	–	7.3 mg/100 g
Fiber	–	4.1%	Calorific value	-	334
Carbohydrate	–	56%	Moisture	–	10%

Agronomic Importance: Short duration and photo insensitive varieties fit well in many intensive cropping systems accross the country. Summer greengram is especially help in sustaining the productivity levels of *rice-wheat* cropping system of Indo-Gangetic belt of northern India without any competition to rice or wheat, with additional yield of 10-15 qtls/ha.

2. CROP STATUS

2.1. National scenario

***Eighth Plan (1992-97)*:** During the eighth plan, the total area under Moong in India was 29.21 lakh hectares with a production of 12.07 lakh tonnes. Amongst the states, Maharastra ranked first with 24.8 % of the total area and 30 % of the total production followed by Andhra Pradesh (17.1 % and 17.1 %) while, Rajasthan trailed in the third place with 15.2 % and 10.7 % of the total area and production. Taking into account the season-wise scenerio, Maharashtra (30.6% & 37.8%), Rajasthan (19.3% & 14%) and Andhra Pradesh (15.4% & 16.6%) were placed at the first, second and the third positions respectively during kharif season's area coverage and productions. However, in Rabi season, Bihar ranked first both in area coverage and production (30 % & 37.5 %), followed by Andhra Pradesh (23.2% &18.8 %). Orissa ranked third (15.8 %) in area. In the production, Uttar Pradesh was trailing as a poor third with 19 %.

Ninth Plan (1998-2002): The total area under Moong during ninth plan was 30.14 lakh hectares with production of 10.61 lakh hectares. Rajasthan stands first in respect of area (22.9%) followed by Maharashtra (22.5%) and A.P. (15.8%). The maximim contribution of production was in the state of Maharashtra (27%) followed by A.P. (17.03%) and Rajasthan (13.67%). Looking into season-wise contribution, in Kharif Maharashtra stands first in area & production (27.7% and 35%). The state of Rajasthan ranked second in respect of area (22.9%) followed by Andhra Pradesh (14.0%). In production, Andhra Pradesh stands first (16.7%) followed by Rajasthan (13.67%). In Rabi, Bihar stands first in area & production (29.4% & 38.8%) followed by Andhra Pradesh (22.6% & 18.0%).

Tenth Plan (TE 2005-06): The total area covered under moong in India was 33.33 lakh hectares with a total production of 12.35 lakh tonnes. Moong is a common crop grown in most of the states. The share of area and production are some what homogeneous in the Moong growing states. However, during the triennium ending 2005-06, the coverage of area and its production was maximum in Rajasthan (23.8% & 22.9% of the total area and production). Maharashtra ranked second in area coverage (19.2%) and production (22.1 %). Andhra Pradesh ranked third in area (15.2%) and production (17.2 %). The season-wise contribution showed that the state of Rajasthan stands first in area and production (29.5 and 29.0%) during kharif followed by Maharashtra (23.4 and 27.6%) and A.P. (12.8% and 16.3%). In Rabi, Bihar stands first with area (27.6%) and production (36.00%) followed by A.P. (25.2% and 20.31%).

Table 4.1 Plan-wise green gram scenario- States

(A=Area Lakh ha, P=Production Lakh tonnes, Y= Yield Kg/ha)

State		Eighth Plan	% to Country	Ninth Plan	% to Country	Xth Plan (T.E.2005-06)	% to Country
Andhra Pradesh	A	4.98	17.06	4.76	15.80	5.07	15.20
	P	2.06	17.09	1.81	17.03	2.13	17.23
	Y	414.00	100	380.10	108	414	113
Bihar	A	1.89	6.46	1.85	6.14	1.85	5.55
	P	1.05	8.68	1.03	9.75	0.98	7.96
	Y	555.20	135	559.31	159	532	145
Chhattisgrah	A	*		0.06	0.20	0.17	0.52
	P	*		0.02	0.15	0.04	0.36
	Y	*		107	30	254	69
Gujarat	A	1.70	7.33	1.56	6.45	1.84	6.85
	P	0.63	6.72	0.62	7.74	0.82	8.42
	Y	443	110	384	115	436	122
Haryana	A	0.10	0.44	0.14	0.58	0.23	0.85
	P	0.05	0.55	0.04	0.49	0.07	0.73
	Y	509	126	278	83	325	91
Karnataka	A	2.24	7.68	3.37	11.18	3.99	11.96
	P	0.64	5.30	0.97	9.18	0.72	5.83
	Y	293	71	270	77	180	49
Madhya Pradesh	A	1.31	4.50	1.03	3.43	0.87	2.60

	P	0.43	3.54	0.32	3.04	0.29	2.34
	Y	326	79	311	88	333	91
Maharashtra	A	7.24	24.79	6.80	22.56	6.41	19.22
	P	3.62	29.97	2.87	27.00	2.73	22.10
	Y	497	121	421	120	419	114

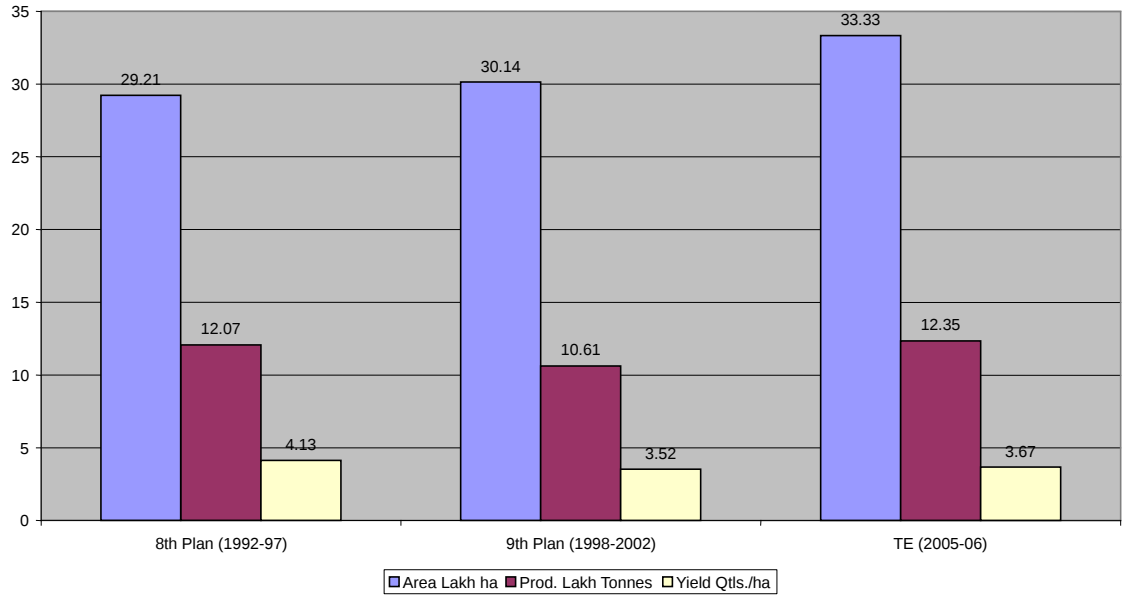
(continued)

(Table 4.1 continued)

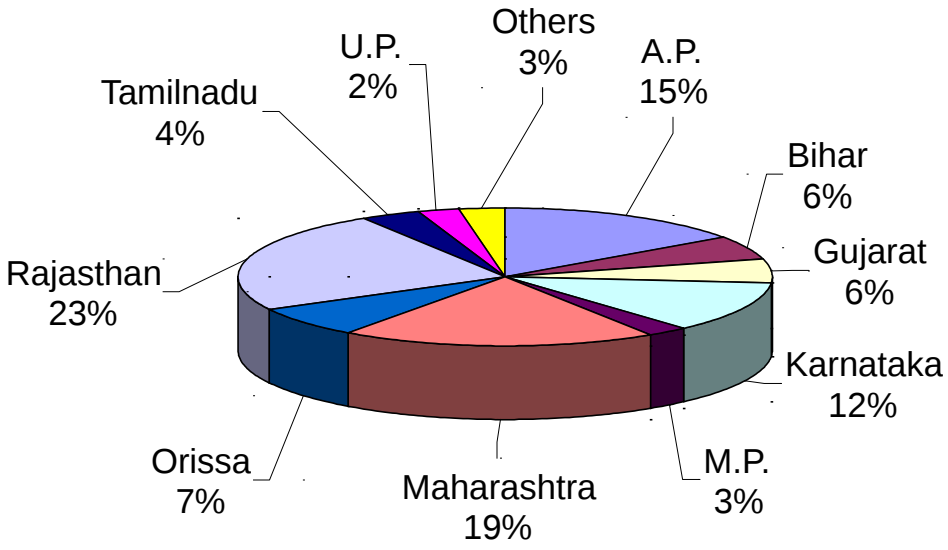
State		**Eighth Plan**	**% to Country**	**Ninth Plan**	**% to Country**	**Xth Plan (T.E.2005-06)**	**% to Country**
Orissa	A	2.34	8.01	2.05	6.79	2.37	7.10
	P	0.68	5.65	0.43	4.05	0.57	4.59
	Y	283	69	210	60	238	65
Punjab	A	0.52	2.25	0.37	1.51	0.15	0.57
	P	0.43	4.63	0.22	2.73	0.13	1.29
	Y	832	207	589	176	814	227
Rajasthan	A	4.45	15.23	5.54	18.38	7.94	23.82
	P	1.30	10.77	1.10	10.37	2.83	22.91
	Y	284	70	186	56	352	98
Tamil Nadu	A	1.08	3.68	1.33	4.41	1.28	3.85
	P	0.45	3.77	0.60	5.68	0.51	4.12
	Y	420	102	452	128	398	109
Uttar Pradesh	A	1.08	3.69	0.97	3.22	0.80	2.40
	P	0.58	4.84	0.42	3.95	0.38	3.05
	Y	538	131	429	122	475	129
West Bengal	A	0.13	0.44	0.14	0.46	0.11	0.34
	P	0.05	0.45	0.06	0.61	0.05	0.37
	Y	425	103	473	134	403	110
All India	**A**	**29.21**		**30.14**		**33.33**	
	P	**12.07**		**10.61**		**12.35**	
	Y	**412**		**352**		**367**	

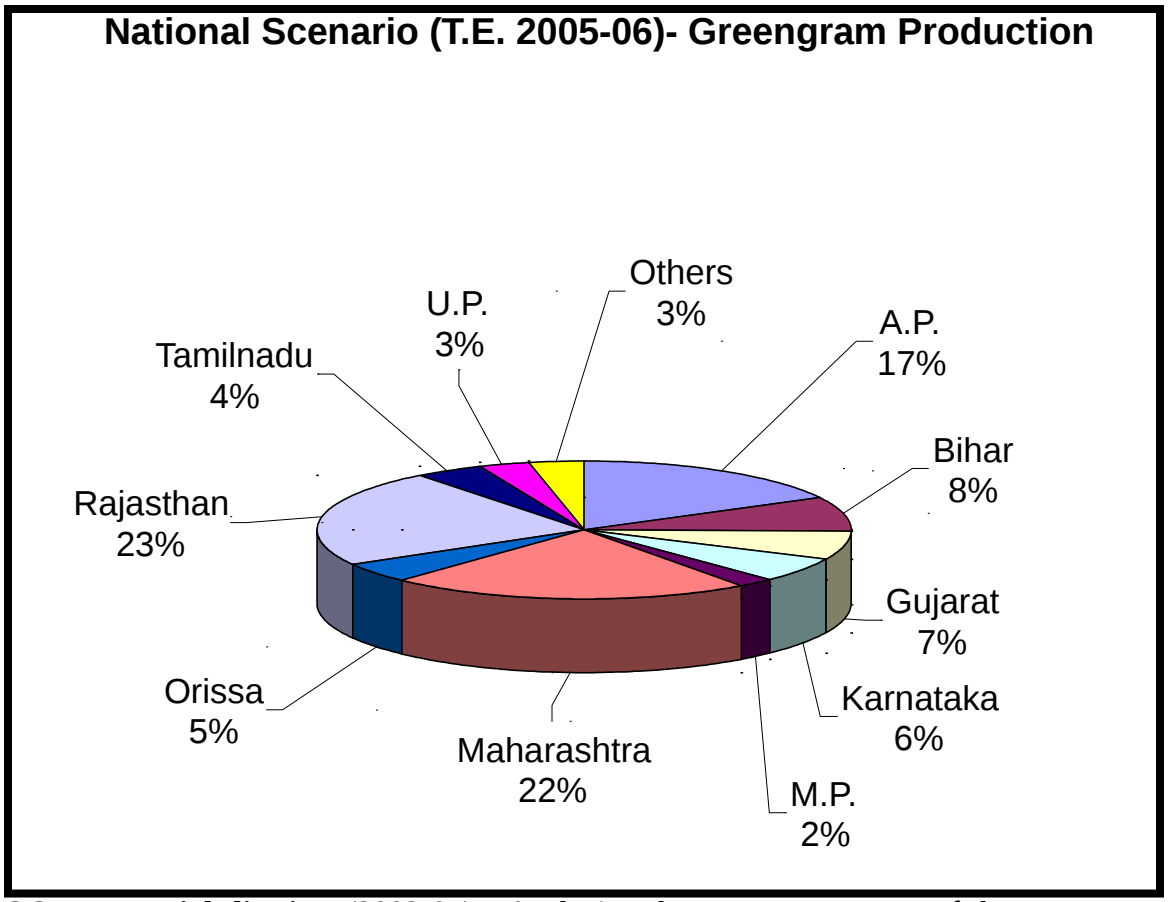
** New states carved out during 2000*

National Scenario- Greengram (APY)



National Scenario (T.E. 2005-06)- Greengram Area





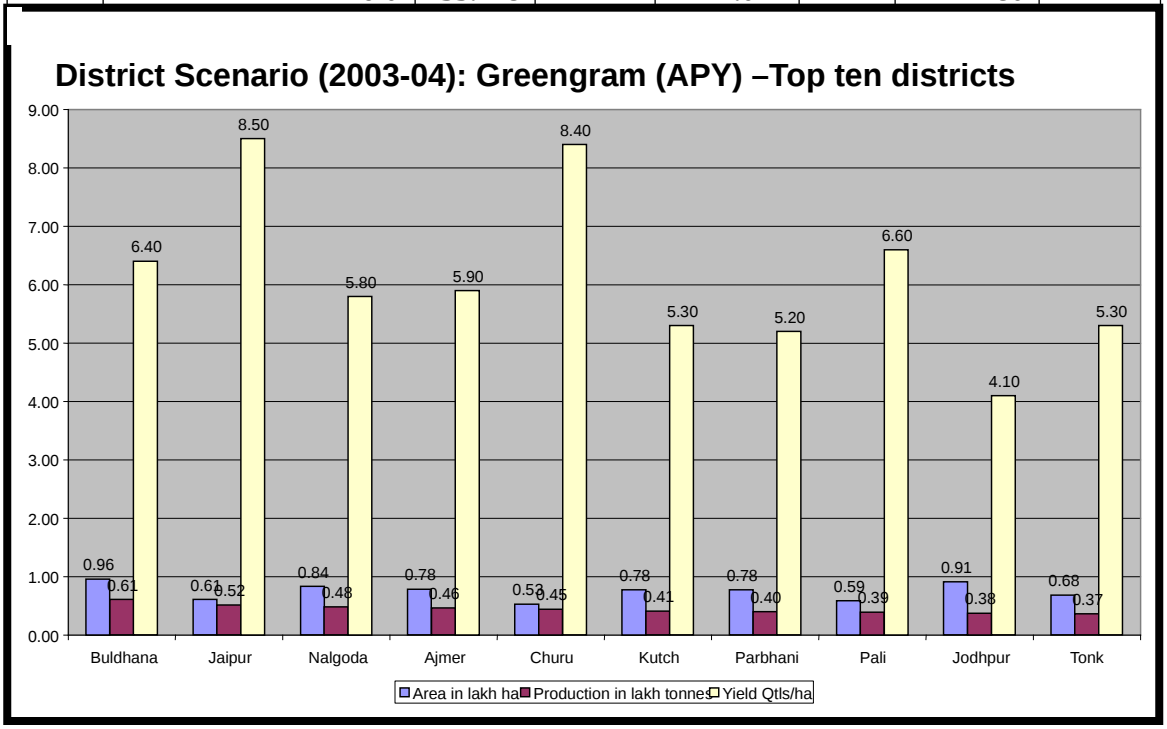
2.2. Potential districts (2003-04) - Analysing the Intra-state, status of the moong crop, district Buldhana of Maharashtra with 2.70 percent area and 3.58 percent production tops in the country whereas, Jaipur of Rajsthan(3.03%), Nalgoda of A.P. (2.84%) and Ajmer of Rajasthan (2.72%) ranks second, third and fourth in terms of production.

District-wise area, production and yield of top ten district of India in respect of production, are presented below which contributed 21.01 percent and 26.22 percent of area and production of the country **(Table – 4.2.)**

Table – 4.2. Top potential districts (2003-04)

S. No.	Name of District	State	Area (lakh ha)		Production (lakh tonnes)		Yield (Kg/ha)	
			Area	% to India	Prod.	% to India	Yield	YI
I	Buldhana	MS	0.958	2.70	0.610	3.58	640	133
II	Jaipur	Rajasthan	0.609	1.72	0.516	3.03	850	177
III	Nalgoda	A.P.	0.836	2.36	0.484	2.84	580	121
IV	Ajmer	Rajasthan	0.784	2.21	0.463	2.72	590	123
V	Churu	Rajasthan	0.530	1.49	0.446	2.62	840	175
VI	Kutch	Gujarat	0.777	2.19	0.409	2.40	530	110
VII	Parbhani	MS	0.775	2.18	0.401	2.36	520	108
VIII	Pali	Rajasthan	0.591	1.67	0.393	2.31	660	138
IX	Jodhpur	Rajasthan	0.911	2.57	0.376	2.21	410	85

X	Tonk	Rajasthan	0.684	1.93	0.365	2.14	530	110
		Total above	**7.455**	**21.01**	**4.463**	**26.22**	**599**	**125**
		All India	**35.478**		**17.021**		**480**	



3. BOTANICAL DESCRIPTION - It is a small herbaceous annual plant growing to a height of 30 to 100 cm with a slight tendency to twining in the upper branches. Depending upon the plant type and nature of crop being grown, central stems are more or less erect while side branched are semi erect, leaves are trifoliate with long petioles. Both the stem and leaves are covered with short hairs, generally shorter than urd. Flowers are various shades of yellow colour produced in cluster of 10-20 in axillary racemes. Crop is fully self-fertile. Pods are 6-10 cm long, hairy and round having 7-10 seeds inside. Hilum is white and flat. Germination type epigeal and colour of cotyledons is yellow.

4. PRODUCTION TECHNOLOGY

4.1. Climatic requirements: The crop needs high temperature, less humidity and moderate rainfall of about 60-80 cm. Water logging is fatal for root development and nitrogen fixation during early vegetative stage. Crop is generally grown as rain fed but under assured irrigation during summer in Indo Gangetic plains of Northern India.

4.2. Varieties : Selection of variety as per the adaptability to the region, time of sowing and purpose of cultivation etc; from **Table- 4.3.** However some specific situation –wise varieties are as under:

i. *Spring* – PDU-1 (Basant Bahar), Azad Urd-1, Pant U-35, Mash-218, KU-300 and T-9.

ii. *Rabi (Rice fallows)*–LBG-648, LBG-402, LBG-685, TU-94-2, KU-301, LBG- 645, LBG-420, LBG-17

4.3. Soil and land preparation: A well-drained loamy to sandy loam soil free from soluble salts and neutral in reaction is best suited. In no case, it should be cultivated on saline and alkaline soils. Field should be properly ploughed to pulverised land.

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4.4. Cropping systems: The important crop rotations with moongbean are given as under:

Rice-Wheat-Moong (*summer*) Maize+Moong-Wheat-Moong Maize (early)-Potato (early)-wheat-Moong, Sugarcane+Moong (*summer 1:2*) Cotton + Greengram (1:3 in *Central India* 60/90 cm paired row)	Rice-Rice-Greengram (*south India*) Moong-Wheat/Barley Sunflower+Moong (*summer 2:2*) Moong+Pigeonpea (2:1)

4.5. Cultivation practices (for different seasons) It is cultivated as a catch crop in summer /spring in between rabi and kharif crops, after the harvest of rabi crops, like wheat, potato, mustard, sugarcane, etc., under irrigated conditions.

a. Kharif greengram- The kharif crop is grown both as a sole and as an intercrop. Since it is largely grown as a rainfed crop, the sowing time usually depends on the onset of the monsoon in the different regions. *Normally the sowing is done from mid-June to second week of July*, which is considered optimum. Delayed sowings would result in progressive decline in yields.

Soil: It has been observed that the crop thrives best on lighter soils with good drainage.

Climate: In India, it is grown from sea level up to an altitude of 2,000 m largely as a dryland crop. Although fairly drought-resistant, the crop is susceptible to water logging and frost.

Seeding technique: 30 cm x 10 cm. row spacing is considered optimum, for modern varieties. By and large, a spacing of 25-30 cm between rows depending on the canopy development of the variety and date of sowing, is adequate. The plant-to-plant distance should be maintained.

Seed rate: A seed rate of 15-20 kg/ha depending on the seed size of the variety is optimum. For very bold-seeded types, a seed rate as high as 30 kg/ha may be required.

Plant nutrient management: The response to phosphorus is highest on red and laterite soils. Application of P_2O_5 @ 30-40 kg/ha along with a starter dose of 10-15 kg nitrogen is adequate. Phosphorus application has always a significant effect in increasing the yields. Seeds should be treated with an efficient Rhizobium culture for obtaining higher yields. Rhizobial inoculation may reduce the nitrogen requirement of the crop.

Weed management: the highest crop yield was obtained when weeds were removed 35 days after sowing. Any further delay in weed removal results in a corresponding decrease in yield. A maximum of 2 hand-weedings in the initial stages of crop growth up to 30-35 days, is adequate to take care of the weed problem. However, whenever labour is in short supply or the rainfall pattern does not allow early hand-weeding, herbicides need to be used. Pre-emergence application of Lasso or Tok E-25 @ 2kg ai/ha in 1,000 litres of water ensures complete weed control.

Irrigation: Greengram does not require any irrigation if the monsoon rainfall is well distributed. However, for good crop growth, one irrigation under drought situation for longer period at flowering stage, particularly in sandy loam soil, is recommended.

b. Summer greengram- The optimum sowing time for mungbean in the northern plains ranges from *15 March to 15 April*, as this also enables the crop to be harvested safely before the onset of the monsoon. A fine balance has to be achieved in choosing the correct sowing time which will avoid the relatively low temperature of winter and at the same time would not delay harvest for timely sowing of the kharif crop. Also, a late-sown crop could be caught in the pre-monsoon showers towards the end of June. *Late March or early April sowings* are most appropriate *for north-Indian conditions*. However, for optimum yields the sowing is to be advanced to the early part of March. *Sowing time for the summer crop* is late *January in Tamil Nadu*, *Andhra Pradesh* and *Karnataka; February in Orissa* and *West Bengal*; *March in Bihar*, *Madhya Pradesh and Rajasthan*; and *first fortnight of April in Uttar Pradesh*, *Haryana and Punjab*.

Soil and Field Preparation: summer greengram can be grown after harvesting of wheat crop without any preparatory tillage. It could be seeded by opening a small furrow in between the rows of wheat stubble and irrigated immediately thereafter. These operations would require minimum tillage as well as time and operational costs. However, in order to obtain a good crop, a very heavy pre-sowing irrigation (double palewa) may be given and the field ploughed twice with harrow to give a good tilth.

Spacing: A distance of 20-25 cm between rows and 5 cm between plants is optimum. The highest yield of summer mungbean can be achieved when seed rate is about 25 kg/ha or even more. General recommendation is 25-35 kg/ha depending on seed size and sowing time.

Plant nutrient management: A starter dose of 10 kg of nitrogen/ha along with 40 kg P_2O_5 /ha is optimum for summer greengram. In a 3-crop sequence of maize-wheat-summer greengram, the greengram need not be given any nitrogenous or phosphatic fertilizer, if the previous 2 cereal crops had received the recommended

doses of nitrogen and phosphorus. The fertilizers may be drilled in furrows drawn 25-30 cm apart with the seed, 5-6 cm below the seed, through seed drill. It is also necessary to treat the seed with an efficient Rhizobium culture.

Weed control: Two hand-weedings, the first 25 days after sowing and the second 45 days after sowing, are adequate to check weed infestation. Subsequently, greengram grows rapidly and the weeds are smothered. Alternatively, any one of the pre-emergence weedicides among pendimethalin, Tok E-25 or Lasso 1 litre in 1,000 liters of water may be sprayed in a hectare, just after sowing. However, weedicides control only broad-leaved weeds whereas motha (*Cyprus rotundus*) is the major problem in the summer season. Therefore, one hand-weeding, preferably before the first irrigation will take care of this problem.

Irrigation: The number of irrigations and time of application vary according to seasonal conditions. At least 3 irrigations, the first at pre-flowering stage (20-25 days), the second at flowering (25-40 days) and the third at grain-filling stage, are necessary. Pre-sowing irrigation is a must to ensure adequate soil moisture for germination. The availability of water is generally scares in the canals during the summer months but there is a great scope of growing summer mungbean around tube wells.

Advantages of summer cultivation

- The crop has very little or no infestation of insect-pest and diseases due to high temperature and desicating winds.
- The crop/varieties take lesser time to mature (normally 60-65 days).
- It suits well after wheat, mustard, potato and late rice in West Bengal.
- The cropping intensity can be increased.
- The area and production can be increased under pulses without eliminating other crop to be grown during kharif season.
- It utilizes the residual soil fertility when grown after heavily fertilized crops like potato, wheat and winter maize.
- In return, it adds at least 30-35 kg available nitrogen/ha through Rhizobium fixation which may be adjusted while applying fertilizers in following kharif season crop.
- After picking pods, the foliage can be incorporated into soil as green manure *in- situ* to add organic matter into the soil as bonus for boosting soil fertility and improving physical conditions of the soil.
- It controls the weeds and checks wind erosion during summer.

c. Rabi greengram

Rabi greengram is grown in the states of Orissa, West Bengal, Andhra Pradesh, Karnataka, Tamil Nadu and Kerala. There is a great scope of increasing the area under rabi greengram under in rice fallows on residual moisture or under irrigated conditions in the southern states.

Recommendations for successful cultivation of rabi greengram

- Select high yielding varieties resistant to YMV, leaf curl, powdery mildew and drought.

- Use only duel inoculated (Rhizobium + PSB) seeds for better root development and harnessing maximum 'N' fixation.
- Treat the seed with Emidacloprid @ 5ml/kg followed by Mancozeb @ 3g/kg, two days before seed inoculation, as protection against incidence of seedling pest and diseases.
- Use a seed rate of 12-15 kg/ha for upland and 30 kg/ha for rice fallow areas.
- Use basal application of 20 kg N + 50 kg P_2O_5 + 200 kg Gypsum/ha during field preparation, 3-4 cm below and side of the seeds.
- Keep the field free from weeds up to 30 DAS by one hand hoeing.
- In Rice fallow area, Echinochloa (barn yard grass) is the major weed, can be control by mixing Benthiocarb @ 5 L in 50 kg dry sand as broadcast, 3 to 4 days before harvest of paddy.
- For control of Cuscuta spp; post emergence, sand mix application of Pendimethalin and flucholarlin at 2.0 L + 1.5 L respectively in 50 kg sand gives best results.
- One irrigation at 35 DAS and 2% spray with urea or DAP at pre-flowering, flowering and pod development, is often associated with high jump in grain yield.

4.6. **Plant protection:** Refer Table – 4.4.

4.7. **Harvesting and threshing** - Mung should be harvested when more than 80 per cent pods mature. One or two rounds of picking of pods are also recommended to avoid losses due to shattering. The plants are cut with the sickle and dried on the thresing floor. These are then threshed by beating with sticks or by trampling with bullocks.

4.8. **Yield:** A well-managed crop, may yield about 15-20 quintals of grain per ha.

Table 4.3. Recommended greemgram varieties/characteristics

Variety	Source	Year of Release/ Notifi-cation	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristics
Pusa Baisakhi	IIRI	1974	NWPZ	8.0	60-65	Early, for spring/summer, erect type
PS-16	IIRI	1980	NWPZ NEPZ, CZ	8.0	60-70	Early, for spring/summer, erect type
K-851	CSAUAT	1982	All Zones	8.0	75-80	Wide adaptability, semi-spreading
ML-131	PAU	1982	CZ , SZ	14.0	85	YMV resistant, seed small
KM-2	TNAU	1982	Tamilnadu	6-8	65-70	erect & compact type
Jalgaon 781	MPKV	1982	Maharashtra	6-8	65-70	Tolerant to stresses, seed bold
SML-32	PAU	1982	Punjab	8.0	65-70	Early, for spring/summer, seed dull green
Pant mung 2	GBPUAT	1983	NEPZ, CZ	8-10	65-70	YMV resistant, seed small
Pant mung 3	GBPUAT	1985	NWPZ	11.0	75-85	YMV resistant, seed small
Paiyur 1	TNAU	1985	Tamil Nadu	7-8	85-90	Tolerant to YMV, seed dull green
ML-267	PAU	1987	NWPZ	10-11	75	YMV resistant, seed small
PDM-11	IIPR	1987	CZ	8.5	75	YMV res., spring/summer

PDM-54	IIPR	1987	NEPZ , SZ	9.5	65	YMV resistant, seed medium bold
Pusa 105	IARI	1987	NWPZ , CZ	10.0	75	YMV resistant, seed deep green
Vamban 1	TNAU	1989	Tamilnadu	8.0	65	YMV tolerant, seed medium bold
RMG 62	RAU, Durgapura	1991	Rajasthan	7.0	65-70	Tolerant to stresses, erect type
ADT-3	TNAU	1991	Tamil Nadu	10.7	65-70	Tolerant to YMV. Seed small
Co-5	TNAU	1991	Tamil Nadu	9.0	70-75	Tolerant to YMV. Seed small
MUM-2	Meerat University	1992	NWPZ	12.0	60-70	Res. to YMV, small seeded, early
BM-4	MAU	1992	CZ	10-12	65	Early, Tol.to YMV and PM, Bold Seeded
Phule M 2	MPKV	1992	Maharashtra	6.9	65	Tol. YMV, early, small seed
AKM-8803	PKV	1992	Maharashtra	10.5	65-70	Tolerant to YMV. Seed small
Narendra Mung-1	NDUAT	1992	Uttar Pradesh.	10.0	60-70	Tolerant to YMV.
AKM-8803	PKV	1992	Maharashtra	10.5	65-70	Tolerant to YMV.
Asha	CCSHAU	1993	Haryana.	12.0	75-80	Tolerant to YMV.
TARM-2	BARC/ PKV	1994	Maharashtra	9.5	65	Tolerant to PM.
Pusa-9072	IARI	1995	SZ.	8-10	65-75	Tol. to PM. Rabi
Warangal-2 (WCG-2)	ANGRAU	1995	Andhra Pradesh.	14.0	65-70	Suitable for all Season, Tolerant to YMV
Madhira-295	ANGRAU	1995	AP	14.0	65-70	Tolerant to YMV
LGG-407 (Lam 407)	ANGRAU	1995	Andhra Pradesh.	14.0	70-75	Tolerant to YMV.

(Table 4.3. continued)

Variety	**Source**	**Year of Release/ Notifi-cation**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Duration**	**Characteristics**
JM-721	JNKVV	1996	Madhya Pradesh.	12.4	70-75	Tolerant to PM.
ML-613	PAU	1996	Punjab.	13.0	84	Res. to YMV, BLS and Pod leaf spot. Seed med. bold
PDM-84-178		1996	Andhra Pradesh.	8.1	65-70	Tol. to YMV & PM, suitable for summer and early kharif.
SML-134	PAU	1996	Punjab.	11.0	68	For summer/spring.
TARM-1	BARC/ PKV	1997	Maharashtra	8-12	85	Res.to PM, Suitable for Rabi. Small seed
Pant Mung-4	GBPUAT	1997	NEPZ	7.5	68	Resistant to YMV.
HUM-1	BHU	1999	CZ, SZ	8-9	60-65	Res. to YMV, Summer season
CO-6	TNAU	1999	Tamil Nadu	10.0	65	All season, Res. to YMV.
Pusa-9531	IARI	2000	CZ, NWPZ	10-12	60	Res. to YMV, summer.
Pusa Vishal	IARI	2000	NWPZ	11.0	62	Res. to YMV, summer, very bold seeded (6 g/100 seed)
LAM-460	ANGRAU	2001	Andhra Pradesh	12.0	70-75	Tolerant to YMV

Samrat (PDM 139)	IIPR	2001	Uttar Pradesh.	12-15	50-60	Summer season, Mod.Res. to YMV
Ganga-8 (Gangotri)	RAU, Sriganganagar	2001	NWPZ	9.2	72	Kharif, tolerant to stem fly and pod borer.
OUM-11-5	OUAT	2002	SZ	7.3	62	Kharif, Moderately resistant to diseases
Malviya Jagriti (HUM-12)	BHU	2003	NEPZ	11-12	66	Mod. res. MYMV, CLS, Summer Season
IPM 99-125	IIPR	2004	NEPZ	9.8	66	Res. To YMV, Summer Season
Muskan (MH-96-1)	CCS HAU	2004	Haryana	15.0	70-75	Resistant to YMV, Anthracnose and Leaf Crinkle
Ganga-1 (Jamnotri)	ARS, Sriganganagar	2004	Rajasthan	14	76	Mod. Res. to YMV, CLS, PM, anthracnose, Bacterial leaf blight, Macrophomina & web blight & Rhizopus,
TM 99-37	BARC	2005	NEPZ	11.0	65	Mod. Res. To YMV, Summer
COGG 912	TNAU	2005	SZ	8.0	62	Res. To YMV, CLS, Kharif
Shalimar Moong-1	SKUAST	2005	J & K	9	105-115	Res. To leaf spot, pod blight
BM-2002-1	ARS, Badnapur	2005	Maharashtra	10-12	65-70	Moderate resistant to PM
HUM 16 (Malviya Jankalyani)	BHU	2006	NEPZ	14-16	55-58	Summer, Resistant to YMV, Root Knot and Leaf Crinkle
Tromday pesara (TM-96-2)	ANGRAU	2006	Andhra Pradesh	6	69-73	Rabi & summer, Res. To PM and Corynospora leaf spot
Tromday Jawaher mung-3 (TJM-3)	JNKVV	2006	MP	8-10	61-75	Kharif & summer, Resistant to YMV, PM and Rhyzoctonia root rot

Res.= Resistant, Tol.= Tolerant, Mod.= Moderately, YMV= Yellow Moasaic Virus, CLS= Cercospora leaf Spot, PM= Powdery Mildew, BLS- Bacterial leaf spot

Table – 4.4. Pest and diseases in greengram and their management

Insect Pest/Disease/ Causal Organism	**Nature of Damage/ Symptoms**	**Control Measures**
i. Hairy caterpillar	The young caterpillars feed on the leaf tissues having chlorophyll and skeletonise the leaf.	Endosulfan (0.07%) or Chloropyriphos (0.05%) or Monocrotophos (0.04%).
ii. Jassids	The adults and nymphs suck the sap from leaves and as a result leaves turn brown and leaf surface become uneven. In severe infection leaves dry up and fall and weaken the plants.	Monocrotophos 40 EC @ 0.04% or Confid or 200 SL @ 7.5 ml/10 litre of water.
iii. White fly	This pest causes damage by sucking the plant sap.	Monocrotophos (0.04%) or Dimethoate (0.03%).
iv. Galerucid beetle	The adult beetle stipples the leaves with small and more or less circular hole.	Endosulfan (0.07%) or Thimet 10% G @ 10 Kg/ha.
v. Cercospora leaf spot (*Cercospora canescens*)	Small round spots, violet red in colour is observed on leaves. Such spots are also observed on pods which turned into black colour.	i. Seed treatment with Thiram or Captan @ 2.5 g/Kg of seed. ii. Spray with Bavistin (0.025%) at 30 and 45 days after sowing.
vi. Yellow Mosaic	The symptoms firstly appear on young	i. Grow resistant varieties.

Virus Vector – white fly	leaves in the form of yellow, diffused, round spots scattered on the leaf lamina. The infected leaves turn necrotic. The diseased plants usually mature later and bear relatively few flowers and pods. The pods are stunted and mostly remain immature but whenever seeds are formed they are small in size.	ii. Destroy the infected plants. iii. Apply Phorate or Disulfoton granule @ 1 Kg a.i./hectare at the time of sowing. iv. Spray the crop with Metasystox @ 1 ml per litre of water to control vector population.
vii. Powdery Mildew (*Erysiphe polygoni*)	White, powdery growth is developed on the leaves. In case of severe infection, defoliation occurs and failure of pod development.	Spray the crop with wettable Sulphur @ 3 g/litre of water or Dinocap @ 1 ml/litre water.
viii. Macrophomina blight (*Macrophomina phaseoli)*	The symptoms of this disease are root and stem rottings. The rotting starts from the roots and proceeds towards the stem due to which reddish brown to black coloured spots are formed near the soil surface. At the end, affected stem turns black.	i. Seed treatment with Thiram or Captan @ 3 g/Kg of seed. ii. Spray the crop with Bavistin @ 0.05 g/litre of water at 15 days interval.
ix. Leaf Curl Virus	First symptoms appear on young leaves in the form of chlorosis around veins near the margin. Affected leaves show curling of margins downwards while the veins on the under surface of the leaf show reddish brown discolouration. Plants remain stunted and die due to top necrosis.	i. Grow resistant varieties. ii. Control of vector through Metasystox (0.1%), two to three spray at 10 days interval.

BLACK GRAM

Botanical Name - *Vigna mungo*
Origin - India
Chromosome - 2n = 24
Synonym - Urd, Biri, Mash

1. **ECONOMIC IMPORTANCE**: Black gram is one of the important pulse crops grown throughout India. It is consumed in the form of 'dal' (whole or split, husked and un-husked) or perched. Urd differs from other pulses in its peculiarity of attaining a mucilaginous pasty character when soaked in water, In the south, It is consumed in variety of ways accross the form north to south in preparation of differnent regular and popular dishes like *vada*, *idli*, *dosa*, *halwa*, *imarti* in combination with other foodgrains. Also used as a nutritive fodder for milch cattle.

Nutritive value

Protein	-	24%	Calcium	-	154 mg/100 g
Fat	-	1.4%	Phosphorus	-	385 mg/100 g
Minerals	-	3.2%	Iron	-	9.1 mg/100 g

Fiber	-	0.9%	Calorific value	-	347
Carbohydrate	-	59.6%	Moisture	-	10.9%

and is the richest among the various pulses in phosphoric acid, being five to ten times richer than in others.

Agronomic significance: Short duration and photo insensitive varieties, fit well in different cropping situations, especially intensive crop rotations. The pulse legume, used as a green manuring after picking the pods and with its characteristics to fix the atmospheric nitrogen. The plant with deep tap roots binds soil particles and helps in conservation of soil.

2. CROP STATUS

2.1. National scenario

Eighth Plan (1992-97): The country's total area of Urad (Kharif + Rabi) during the eighth plan was 29.30 lakh hectares with a total production of 13.68 lakh tonnes during both the seasons. Madhya Pradesh ranked first in area coverage (23.2 %) during Kharif season of the eighth plan followed by Maharastra (22.6%) and Uttar Pradesh (10.6 %). Maharastra was the top producer with 29.1 % of the total production of the country in Kharif, followed by Madhya Pradesh (16.9 %) and Uttar Pradesh (10 %). In respect of area during Rabi season of the plan period ,Andhra Pradesh outperformed by covering 58 % of the total area with 64.6 % of the country's urad production.Tamil Nadu was placed second for both area and production (13.8 % and 14.8 %) followed by Uttar Pradesh (9.7 % and 8.4 %). For both the seasons taken together, Madhya Pradesh ranked first in area (18.3 %) and co-ranked second by Andhra Pradesh and Maharastra (17.4 % each).

Ninth Plan (***1998-2002)*****:** The total area of urd (Kharif + Rabi) during the ninth plan was 30.47 lakh ha with a total production of 13.52 lakh tonnes. Season-wise contributing states showed that Maharashtra state stands first in area and production (18.5% and 19.3%) during kharif followed by M.P. (21.8% and 17.5%) and U.P. (13.5% and 13.0%) respectively. During Rabi season, Andhra Pradesh performed outstanding both in respect of area and production (54% and 61%) of the country's share followed by Tamil Nadu (24.3% and 19.4%) and Uttar Pradesh (7.9% and 6.9%). For both seasons, Maharashtra ranked first in area (19%) followed jointly by Andhra Pradesh and Madhya Pradesh (17% each), in production Andhra Pradesh stands first (23%) followed by Maharashtra (19%) and Madhya Pradesh (12%).

Tenth Plan (TE 2005-06)**:** The total urd production during the triennium ending of tenth plan was 13.48 lakh tonnes on an area of 31.87 lakh hectares. During kharif, Maharashtra ranked first in area coverage and production (21 % & 25 % of the total area and production) followed by Madhya Pradesh (19.3 % & 16.7% respectively). During rabi, Andhra Pradesh remarkably ranked first in area and production (52.6% & 57.4%) followed by Tamil Nadu (24.8% and 19.1%) and

U.P. (8.3% & 8.8%). As regards the total contribution from states, Madhya Pradesh stand first in respect of area (17.07%) followed by U.P. (17.05%) and Maharashtra (17.04%), whereas in production Maharashtra stands first (19.5%) followed by U.P. (14.7%) and M.P. (14.5%).

Table - 5.1. Plan-wise blackgram scenario - States

(A=Area Lakh ha, P=Production Lakh tonnes, Y= Yield Kg/ha)

State		Eighth Plan	% to Country	Ninth Plan	% to Country	Xth Plan (T.E.2005-06)	% to Country
Andhra Pradesh	A	5.09	17.35	5.15	16.90	4.29	13.46
	P	2.97	21.75	3.09	22.85	2.37	17.55
	Y	580	125	599	135	553	131
Assam	A	0.35	4.70	0.40	5.18	0.38	5.73
	P	0.18	4.42	0.22	4.89	0.19	5.85
	Y	506	93	538	95	518	102
Bihar	A	0.82	3.73	0.55	2.44	0.24	0.97
	P	0.42	4.34	0.38	4.14	0.18	1.82
	Y	514	117	674	168	753	189
Chhattisgarh	A	*		0.48	1.58	1.20	3.78
	P			0.14	1.04	0.34	2.53
	Y			117	26	283	67
Gujarat	A	1.25	5.70	1.13	4.97	1.00	3.94
	P	0.67	6.92	0.57	6.29	0.52	5.13
	Y	531	121	489	122	516	129
Haryana	A	0.02	0.08	0.01	0.05	0.03	0.11
	P	0.01	0.09	0.01	0.07	0.01	0.08
	Y	477	108	259	65	286	72

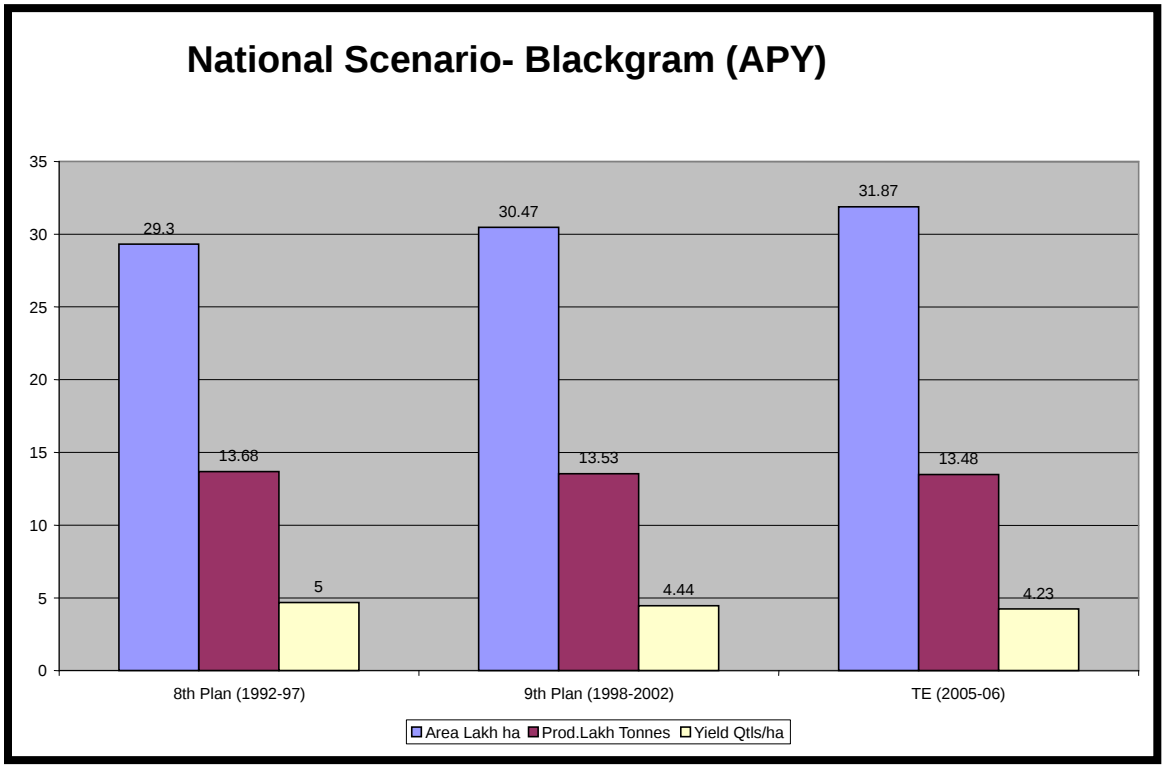
(Continued)

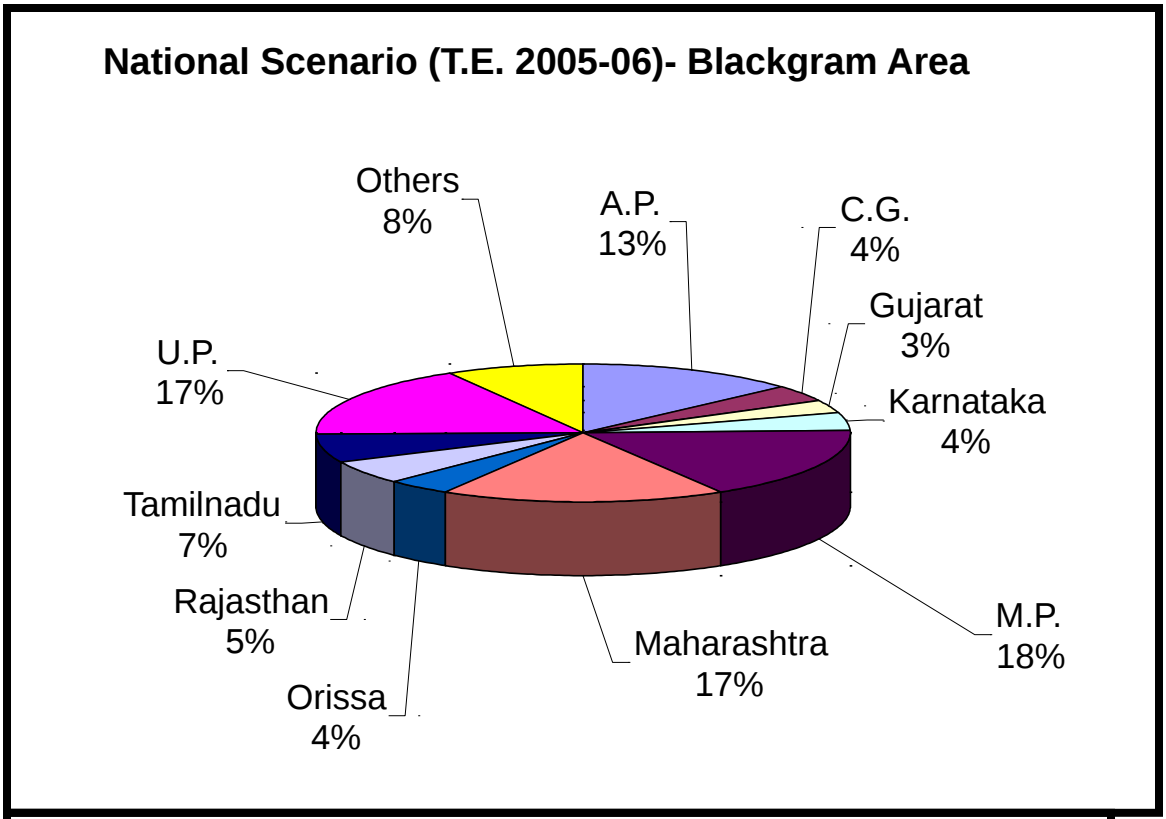
(Table 5.2. continued)

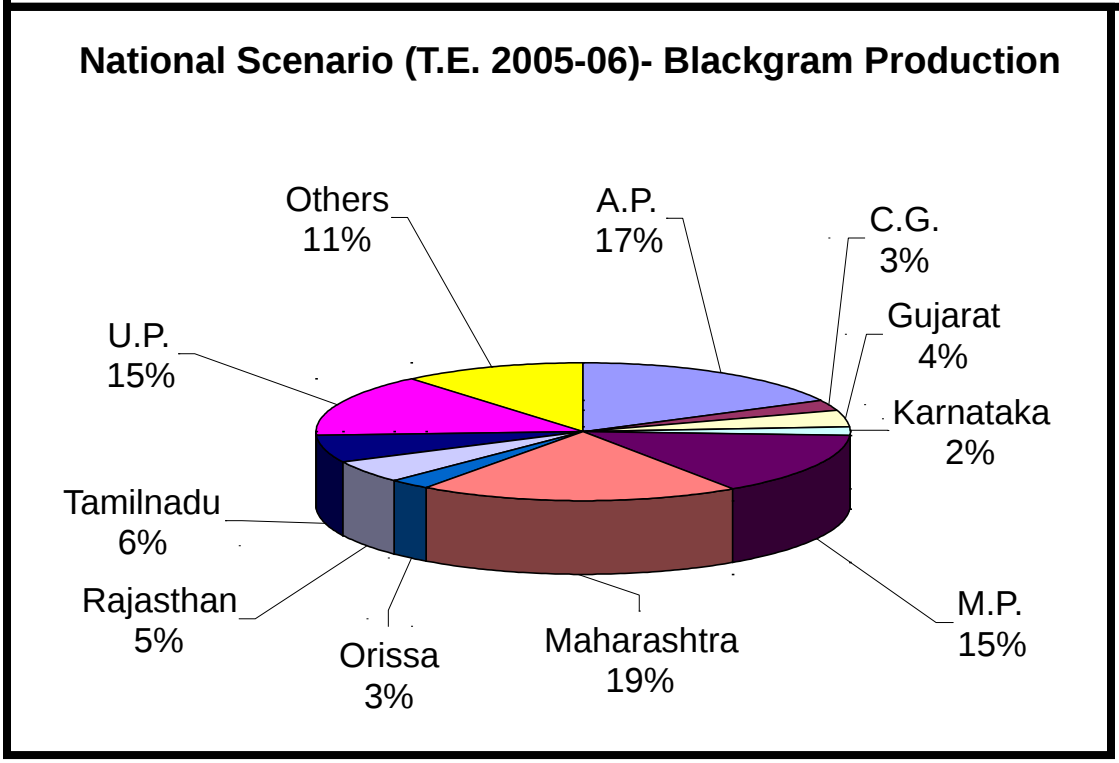
State		Eighth Plan	% to Country	Ninth Plan	% to Country	Xth Plan (T.E.2005-06)	% to Country
Jharkhand	A	*		0.09	0.39	0.72	2.83
	P			0.06	0.67	0.37	3.65
	Y			273	68	518	130
Karnataka	A	1.26	4.28	1.46	4.78	1.28	4.02
	P	0.58	4.26	0.49	3.61	0.27	1.99
	Y	474	102	335	76	208	49
Madhya Pradesh	A	5.37	18.33	5.09	16.70	5.44	17.07
	P	1.72	12.55	1.63	12.06	1.96	14.56
	Y	320	69	319	72	360	85
Maharashtra	A	5.10	17.40	5.65	18.54	5.43	17.04
	P	2.88	21.06	2.61	19.29	2.63	19.54
	Y	565	121	463	104	478	113
Orissa	A	1.65	5.63	1.35	4.44	1.31	4.12
	P	0.63	4.57	0.34	2.50	0.35	2.56
	Y	352	76	246	55	263	62
Punjab	A	0.06	0.28	0.04	0.19	0.04	0.15

	P	0.02	0.23	0.02	0.20	0.02	0.17
	Y	3720	846	1110	277	472	118
Rajasthan	A	1.68	7.69	1.59	7.01	1.75	6.90
	P	0.58	6.02	0.57	6.24	0.71	7.00
	Y	346	79	343	86	379	95
Tamil nadu	A	2.25	7.67	2.51	8.24	2.12	6.65
	P	1.02	7.44	1.17	8.62	0.83	6.15
	Y	447	96	468	105	391	92
Uttar Pradesh	A	3.03	10.35	3.70	12.13	5.43	17.05
	P	1.31	9.55	1.49	11.04	1.99	14.76
	Y	430	92	403	91	367	87
Uttarakhand	A	*		0.04	0.16	0.26	1.03
	P			0.02	0.21	0.16	1.58
	Y			207	52	618	155
West Bengal	A	1.03	3.51	0.75	2.47	0.61	1.91
	P	0.57	4.16	0.45	3.34	0.41	3.06
	Y	543	116	601	135	680	161
All India	**A**	**29.30**		**30.47**		**31.87**	
	P	**13.68**		**13.53**		**13.48**	
	Y	**466**		**444**		**423**	

** New states carved out during 2000*





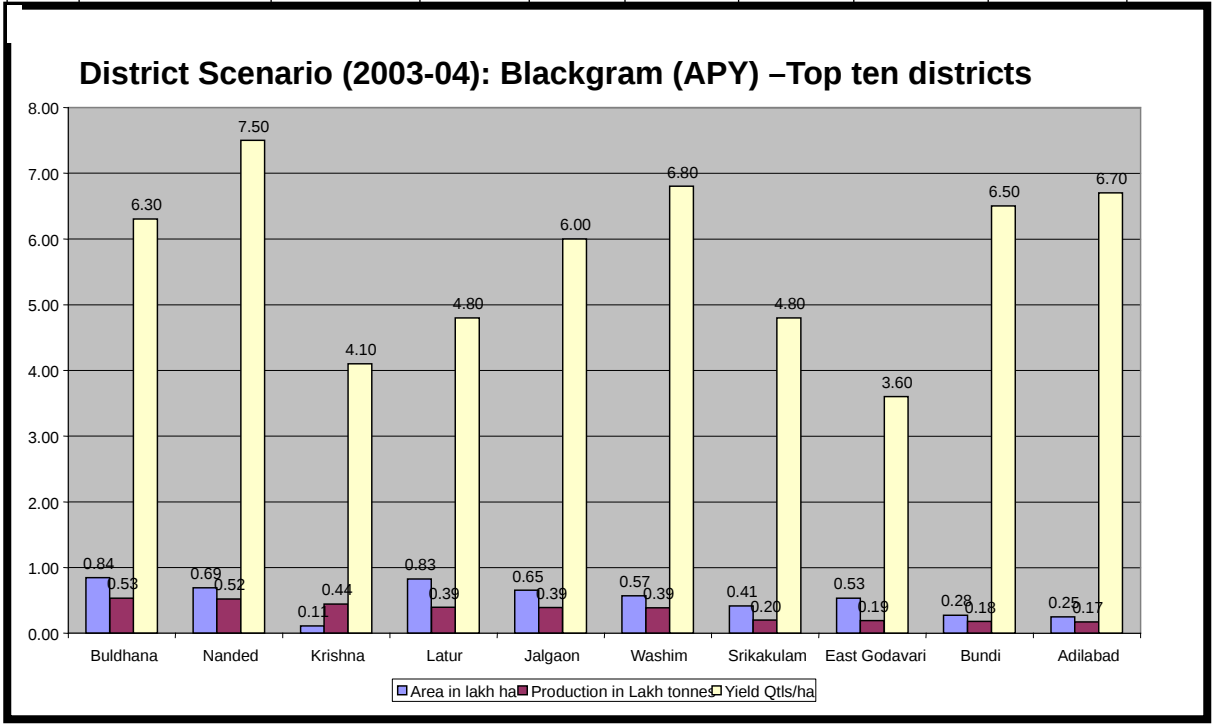


2.2. Potential districts (2003-04): Analysis of the districts within the country revealed that the Buldhana district of Maharastra with 2.46 per cent of area and 3.62 per cent of production followed by Nanded of Maharastra with 2.02 per cent area and 3.53% of production.

The district Krishna of A.P., however, ranked third in terms of production with 3.01 percent. District-wise area, production and yield of top ten districts of India in respect of production are presented below which contributed 15.06 percent and 23.11 percent of area and production of the country.

Table – 5.2. Top potential districts (2003-04)

Sr. No.	Name of District	State	Area (lakh ha)		Production (lakh tonnes)		Yield (Kg/ha)	
			Area	% to India	Prod.	% to India	Yield	YI
1	Buldhana	MS	0.844	2.46	0.533	3.62	630	147
2	Nanded	MS	0.691	2.02	0.520	3.53	750	175
3	Krishna	AP	0.109	0.32	0.443	3.01	410	96
4	Latur	MS	0.825	2.41	0.392	2.66	480	112
5	Jalgaon	MS	0.652	1.90	0.390	2.65	600	140
6	Washim	MS	0.566	1.65	0.387	2.63	680	159
7	Srikakulam	AP	0.414	1.21	0.197	1.34	480	112
8	East Godavari	AP	0.531	1.55	0.190	1.29	360	84
9	Bundi	Rajasthan	0.275	0.80	0.179	1.22	650	152
10	Adilabad	AP	0.249	0.73	0.168	1.14	670	156
	Total above		**5.156**	**15.06**	**3.399**	**23.11**	**659**	**154**
	All India		**34.241**		**14.711**		**429**	



3. BOTANICAL DESCRIPTION: It is an annual herbaceous plant attaining a height of 30 to 100 cm. The leaves are large, trifoliate and hairy, generally with a purplish tinge. The inflorescence consists of a cluster of five to six flowers at the top of a long hairy peduncle. The flowers of urd start opening early in the morning and are completely open between 7 am and 8 am. Self fertilization is

the general rule in urd crop. The pods are long and cylindrical being about 4-6 cm in length. There are four to ten seeds in a pod. The seeds are generally black or very dark brown. The split seed of black gram is white in clolour. The germination of seed is of epigeal type.

4. BOTANICAL CLASSIFICATION: Black gram is divided into two sub species

i) *V. mungo var. niger*: Matures early, having bold seeds & black colour, and

ii) *V. mungo var. viridis*: A group of longer maturity duration having small seed size with green colour.

5. PRODUCTION TECHNOLOGY

5.1. Climatic requirements: Being a crop of tropical region, it requires hot and humid climate for best growth. Due to this reason it is grown as summer and rainy season crop in Northern India and in both the main seasons in Eastern and Southern India where temperature in winter is quite high. Water logging is fatal for root development and nitrogen fixation during early vegetative stage. Crop is generally grown as rain fed but under assured irrigation during spring in Indo Gangetic Plains of Northern India.

5.2. Varieties- Selection of variety as per the adaptability to the region, time of sowing and purpose of cultivation etc, from **Table – 5.3**.

5.3. Soil and Land Preparation: A well-drained loamy to sandy loam soil free from soluble salts and neutral in reaction is best suited. In no case it should be cultivated on saline and alkaline soil. Land is prepared like any other kharif season pulse crop. However during summer it requires a thorough preparation to give a pulverized free from stubbles and weeds completely.

5.4 Cropping systems: The important crop rotations with urd are (i) Maize+urd-wheat, (ii) Maize-potato-urd, (iii) Maize-Mustard-urd, (iv) Sorghum+urd-chickpea (Central & South India), (v) Maize-wheat-urd, (vi) Rice-urdbean (Rice fallow of Central & Southern Area), (vii) Paddy-wheat-urd (Summer) North India, (viii) Pigeonpea+Urd-wheat-urd (Summer) North India and, ix) Sugarcane + urdbean (1:2) (Spring) North India

5.5. Seed and sowing

i. Time of sowing

Kharif: In kharif season sowing is done with the onset of monsoon in later part of June or early part of July. **Rabi**: Second fortnight of October (upland) second fortnight of November (Rice fallow) and **Summer**: the sowing could be done from the third week of February to first week of April. Sowing done thereafter yields low due to rains at the time of maturity.

ii. Seed Rate and Spacing

a) **Kharif**: During kharif season 12-15 kg seed is sufficient for sowing of one

ha area. Vegetative growth of the plants is more due to favourable climate during kharif season, hence wider spacing is used. The crop should be sown at a distance of 30-45 centimeter with 10 cm plant spacing.

b) **Rabi**: About 18-20 kg seed/ha for upland and 40 kg/ha for Rice fallows with a crop geometry of 30 cm x 15 cm. Higher seedrate in rice fallow is used due to delayed in sowing.

c) **Summer**: About 30-35 kg seed is required for sowing of one ha area. Sowing should be done in furrows opened at a distance of 20-25 cm. Seed drill could be used for this purpose. Plant to plant spacing should be kept at 5-8 cm depending upon sowing time and varietal behaviour.

Before sowing, seed should be treated with thirum @ 2.5 g per kg of seed. Seed should also be inoculated with suitable Rhizobium culture, if urd is being taken for the first time in the field or after a long duration.

5.6. Plant nutrient management: Being a leguminous crop, urd needs a small quantity of nitrogen for early growth period on the soils poor in organic matter. Such soils should get about 15-20 kg nitrogen per ha as a starter dose. However, phosphatic and potassic fertilizers should be applied as per soil test values. In case, soil test facilities are not available, one can apply 50-60 kg P_2O_5 and 30-40 kg K_2O per ha. The fertilizers should be applied by drilling at the time of sowing in such a way that they are placed about 5-7 cm below the seed.

5.7. Water management: for rainy season crop, irrigation is not needed but good drainage is essential. Irrigation facilities should be available for raising the crop during summer season. Number and frequency of irrigation depend upon the soil type and weather, prevailing during the growth period. Generally, the crop should get irrigation at an interval of 10-15 days. From flowering to pod development stage, there is need of sufficient moisture in the field.

5.8. Weed control: One or two hand weedings should be done up to 40 days of sowing depending upon the weed intensity. Weeds can be controlled by the use of chemicals too. Use Basalin 1 kg a.i. per ha in 800-1000 liters of water as pre-planting spray. It should be well incorporated in the soil before sowing.

5.9. Plant protection: Refer Table 5.4.

5.10. Harvesting and threshing: Urd should be harvested when most of the pods turn black. Over maturity may result in shattering. Harvested crop should be dried on threshing floor for few days and then threshed. Threshing can be done either manually or by trampling under the feet of bullocks.

5.11. Yield: 15-20 quintals of grain per ha.

Recommendation for successful cultivation of rabi urdbean:

- Select high yielding varieties resistant to YMV, leaf curl, powdery mildew and drought.
- Use only dual inoculated (Rhizobium+PSB) seeds for better root development and

harnessing maximum 'N' fixation.

- Treat the seed with Emidacloprid @ 5 ml/kg followed by Macozeb @ 3 g / litre, two days before seed inoculation, as protection against incidence of seedling pest and diseases.
- Use a seed rate of 18-20 kg/ha for upland and 40 kg/ha for rice fallow areas.
- Use basal application of 20 kg N + 50 kg P_2O_5 + 200 kg Gypsum/ha during field preparation, 3-4 cm below and side of the seeds.
- Keep the field free from weeds up to 30 DAS by one hand hoeing.
- In Rice fallow area, Echinochloa (barn yard grass), a major weed can be controlled by mixing Benthiocarb @ 5 L in 50 kg dry sand and applied it as broadcast 3 to 4 days before harvest of paddy.
- For control of Cuscuta spp; post emergence sand mix application of Pendimethalin and flucholarlin at 2.0 L + 1.5 L respectively in 50 kg sand gives best results.
- One irrigation at 35 DAS and 2% spray with urea or DAP at pre-flowering, flowering and pod development is often associated with high jump in grain yield.
- Monitor the crop on field bund cercospora leaf spot (a major problem during rabi in rice fallows) to take effective corrective measures by spraying the crop with mancozeb or copper oxychlorid @ 3 g/liter at 35 and 45 DAS

Table – 5.3. Recommended blackgram varieties/characteristics

Variety	Source	Year of Release/ Notifi-cation	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristics
T 9	CSAUAT	1975	All Zones	8-10	70-75	Wide adaptability , erect
Pant U 19	GBPUAT	1982	NEPZ	8-10	85	Resistant to YMV, erect
Pant U-30	GBPUAT	1982	CZ ,SZ	8-10	75	Resistant to YMV, erect
Sarala	OUAT	1985	Orissa	9	75	Tolerant to YMV, seed brownish black
Jawahar Urd 2	JNKVV	1987	MP	13.0	67	Tol. to Macrophomina, , CLS & YMV
Jawahar Urd 3	JNKVV	1987	MP	13.0	70	Tol. to Macrophomina, , CLS & YMV
Pant U-35	GBPUAT	1987	UP	10.8	75-80	Pods hairy
Basant Bahar (PDU 1)	IIPR	1991	NWPZ, NEPZ, CZ	13.0	70-80	For spring season, erect, Resistant to YMV
Teja (LBG-20)	ANGRAU	1991	Andhra Pradesh	14.0	70-75	Tol. To YMV and Powdery Mildew
Vamban-1	TNAU	1991	Tamil Nadu.	8.0	65-70	Tol. To YMV
ADT-4	TNAU	1991	Tamil Nadu.	8-9	65-70	Tol. To YMV
ADT-5	TNAU	1991	Tamil Nadu.	8.0	65-70	Tol. To YMV, dwarf & erect
Prabha (LBG 402)	ANGRAU	1991	SZ	10.8	78	*Rabi*, seed bold & dull black
TPU-4	BARC/ MAU	1992	CZ	7.5	75	Plant erect, medium tall. seed bold & dull black
TAU-2	BARC/ PKV	1993	Maharashtra	10.0	70	seed bold & purplish black

Narendra Urd-1 (NDU-88-8)	NDUAT	1993	Uttar Pradesh.	10.0	60-70	Resistant to YMV, Black, medium bold seeded.
LBG-611	ANGRAU	1995	AP.	14.0	85-90	Resistant to wilt.
WBU-108	BCKV	1996	NWPZ, SZ	12	85	Tolerant to YMV, kharif
Mush-338	PAU	1996	Punjab.	9.0	85-90	Tolerant to YMV. seed bold
Mash-414	PAU	1996	Punjab.	9.6	72	To. to root rot. *Spring*
Birsa Urd-1	BAU	1996	Bihar.	11.0	80	Tolerant to YMV.
Melghat (AKU-4)	PKV	1996	Maharashtra	10.0	93	Tolerant to stress, for *rabi season.*
KBG-512	TNAU	1997	Tamilnadu.	7-8	70-75	Tolerant to Stemfly, pods hairy.
Vamban-2	TNAU	1997	Tamilnadu.	12	70	Tolerant to YMV & drought.
KU-301	CSAUAT	1998	SZ	12	70	Res. To YMV, *Rabi*
TU-94-2	BARC	1998	SZ	15.0	69	YMV resistant early, *rabi*
Azad Urd-1 (KU-92-1)	CSAUAT	1999	NEPZ	10.0	80	*Spring*, Res. To YMV
WHG-26	ANGRAU	1999	SZ	10	70	Res. to PM
Barkha (RBU-38)	RAU, Bansawara	1999	CZ	12.0	75	Bold seeded, Res. to CLS
IPU-94-1 (Uttra)	IIPR	1999	NWPZ, NEPZ	11-12	85	Resistant to YMV, *kharif season.*
Shekhar 2 (KU-300)	CSAUAT	2001	NWPZ	11-12	70	Resistant to YMV, *spring*

(Table – 5.3. continued)

Variety	**Source**	**Year of Release/ Notifi-cation**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Duration**	**Characteristics**
NDU 99-3	NDAUT	2003	NHZ	9.5	85	Res. To YMV, *Kharif Season*
KU 96-3	CSAUAT	2003	CZ	8.0	73	Res. To YMV, *Kharif Season*
Goutam (WBU-105)	ARS Berhanpur	2004	West Bengal	13-15	69-90	Resistant to YMV, Mod. Res. To Cercospora leaf spot
Shekhar 3 (KU 309)	CSAUAT	2004	U.P	10	66-84	Kharif, Resistant to YMV, leaf crinkle, CLS
Mash 1008	PAU	2004	Punjab	12	72	Early, Resistant to MYMV & leaf Crinkle virus
Gujarat urd-1		2004	Gujarat	12	late	Late, Moderately resistant to PM & CLS
AKU-15	PDKV	2006	Maharashtra	10-12	65-83	Kharif, Tolerant to PM
Lam 709	ANGRAU	2006	AP	14		Tolerant to YMV

NHZ- North Hilly Zone ((H.P.,J.K & U.P.hills), CZ- Central Zone (MP.,Maharashtra, Chhattisgarh, Gujarat) , SZ- South Zone (A.P., Karnataka, Tamil nadu, Orissa) NEPZ-North East plane Zone (East Uttar Pradesh, Bihar, Jharkhand, West Bengal). NWPZ- North West Plane Zone (Punjab, Haryana, Delhi, West UP & North Rajasthan)
Res.= Resistant, Tol.= Tolerant, Mod.= Moderately, YMV= Yellow Moasaic Virus, CLS= Cercospora leaf Spot, PM= Powdery Mildew.

Table – 5.4. Pest and diseases in blackgram and their management

Insect Pest/Disease/	**Nature of Damage/ Symptoms**	**Control Measures**

Causal Organism		
i. Hairy caterpillar	The young caterpillars feed on the leaf tissues having chlorophyll and skeletonise the leaf.	Endosulfan (0.07%) or Chloropyriphos (0.05%) or Monocrotophos (0.04%).
ii. Jassids	The adults and nymphs suck the sap from leaves and as a result leaves turn brown and leaf surface become uneven. In severe infection leaves dry up and fall and weaken the plants.	Monocrotophos 40 EC @ 0.04% or Confid or 200 SL @ 7.5 ml/10 litre of water
iii. White fly	This pest causes damage by sucking the plant sap.	Monocrotophos (0.04%) or Dimethoate (0.03%).
iv. Galerucid beetle	The adult beetle stipples the leaves with small and more or less circular hole.	Endosulfan (0.07%) or Thimet 10% granules @ 10 Kg/ha.
v. Cercospora leaf spot (*Cercospora canescens*)	Small round spots, violet red in colour is observed on leaves. Such spots are also observed on pods which turned into black colour.	i. Seed treatment with Thiram or Captan @ 2.5 g/Kg of seed. ii. Spray with Bavistin (0.025%) at 30 and 45 days after sowing.

(Table – 5.4. continued)

Insect Pest/Disease/ Causal Organism	**Nature of Damage/ Symptoms**	**Control Measures**
vi. Yellow Mosaic Virus Vector – white fly	The symptoms firstly appear on young leaves in the form of yellow, diffused, round spots scattered on the leaf lamina. The infected leaves turn necrotic. The diseased plants usually mature later and bear relatively few flowers and pods. The pods are stunted and mostly remain immature but whenever seeds are formed they are small in size.	i. Grow resistant varieties. ii. Destroy the infected plants. iii. Apply Phorate or Disulfoton granule @ 1 Kg a.i./hectare at the time of sowing. iv. Spray the crop with Metasystox @ 1 ml per litre of water to control vector population.
vii. Powdery Mildew *(Erysiphe polygoni)*	White, powdery growth is developed on the leaves. In case of severe infection, defoliation occurs and failure of pod development.	i. Spray the crop with wettable Sulphur @ 3 g/litre of water or Dinocap @ 1 ml/litre water.
viii. Macrophomina blight (*Macrophomina phaseoli)*	The symptoms of this disease are root and stem rottings. The rotting starts from the roots and proceeds towards the stem due to which reddish brown to black coloured spots are formed near the soil surface. At the end, affected stem turns black.	i. Seed treatment with Thiram or Captan @ 3 g/Kg of seed. ii. Spray the crop with Bavistin @ 0.05 g/litre of water at 15 days interval.
ix. Leaf Curl Virus	First symptoms appear on young leaves in the form of chlorosis around veins near the margin. Affected leaves show curling of margins downwards while the veins on the	i. Grow resistant varieties. ii. Control of vector through Metasystox (0.1%), two to three spray at 10 days

	under surface of the leaf show reddish brown discolouration. Plants remain stunted and die due to top necrosis.	interval.

LENTIL

Botanical Name	-	(*Lens culinaris Medikus subsp. culinaris*)
Synonym	-	Masur, Malka (bold seeded), lentille (French) linse (German), Lenteja (Spanish) and Mercimek (Turkish).
Origin	-	Turkey to South Iran
Chromosome	-	2n = 14

1. **ECONOMIC IMPORTANCE**: It is a valuable human food, mostly consumed as dry seeds (whole decorticated, seed decorticated and split). In Indian sub continent it is mostly consumed as 'Dal' by removal of outer skin and separation of cotyledons, snacks and soup preparation etc. It is easy to cook and easily digestible with high biological value, hence also referred to patient. Dry leaves, stems, empty and broken pods are used as valuable cattle feed.

   Bold seeded, attractive shaped grains have high demand for export at premium prices

Nutritive value

Protein	-	24-26%	Carbohydrate	-	57 – 60%
Fat	-	1.3%	Fibre	-	3.2%
Phosphorus	-	300 mg/100 g	Iron	-	7mg/100 g
Vitamin C	-	10-15 mg/100 g	Calcium	-	69 mg/100g
Calorific value	-	343			

Vitamin A (450 IU) and Riboflavin

Agronomic significance: The crops leaves a reasonable good amounts of atmospheric 'N' in readily available form (upto 30-40 kg/ha) to the succeeding crop. Associated intercrop (other than legume) also gets benefited by 'N' transfer from lentil roots up to some extent. It also contributes to sustain production system through physical, chemical and biological improvements of soil properties, as a rotation effect.

It offers good scope in late vacated paddy fields either as *Utera* or succeeding crop (if soil is workable after paddy harvest) as delayed sowing does not affect as adversely as in chickpea and pea due to its high cold tolerant nature. By this reason, this crop is preferred over gram in the regions having cold winters like plains of North and lower Himalayan Hills. It is also a good substitute of chickpea in areas which may be too dry due to shorter duration. The crop is also used as cover crop to check soil erosion in problem areas

2. CROP STATUS

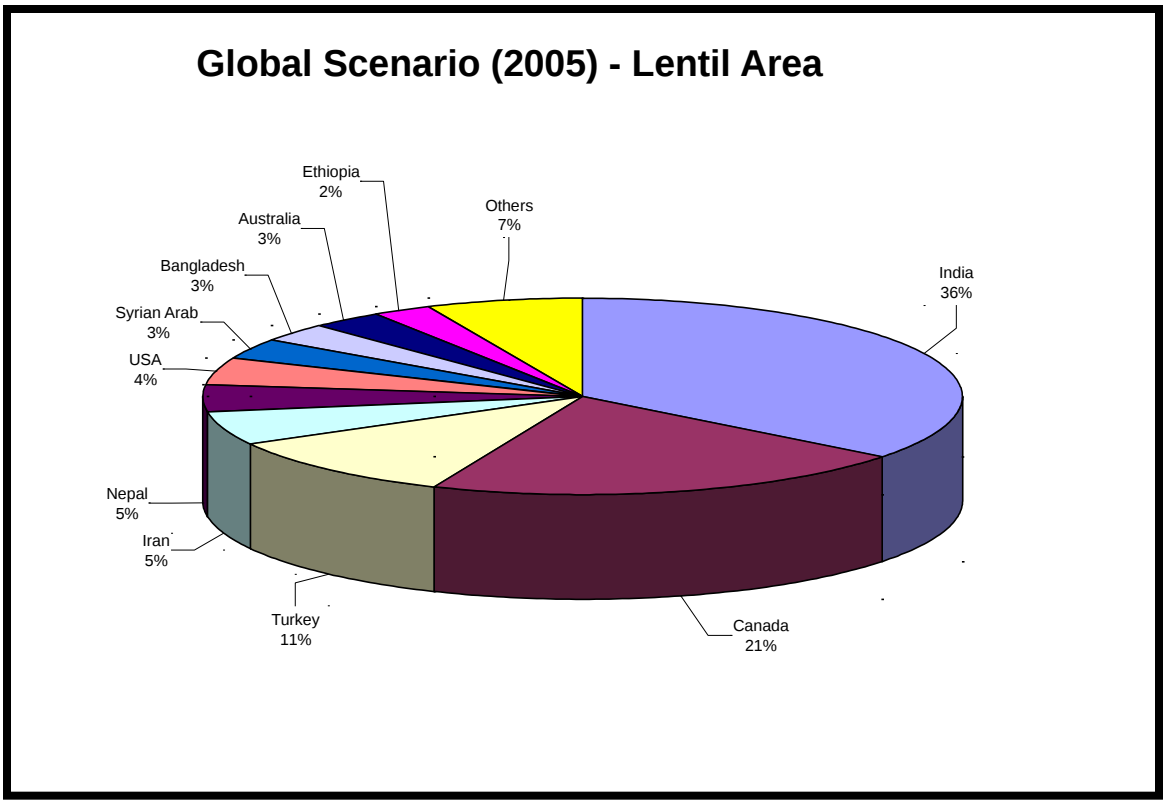
2.1. Global scenario

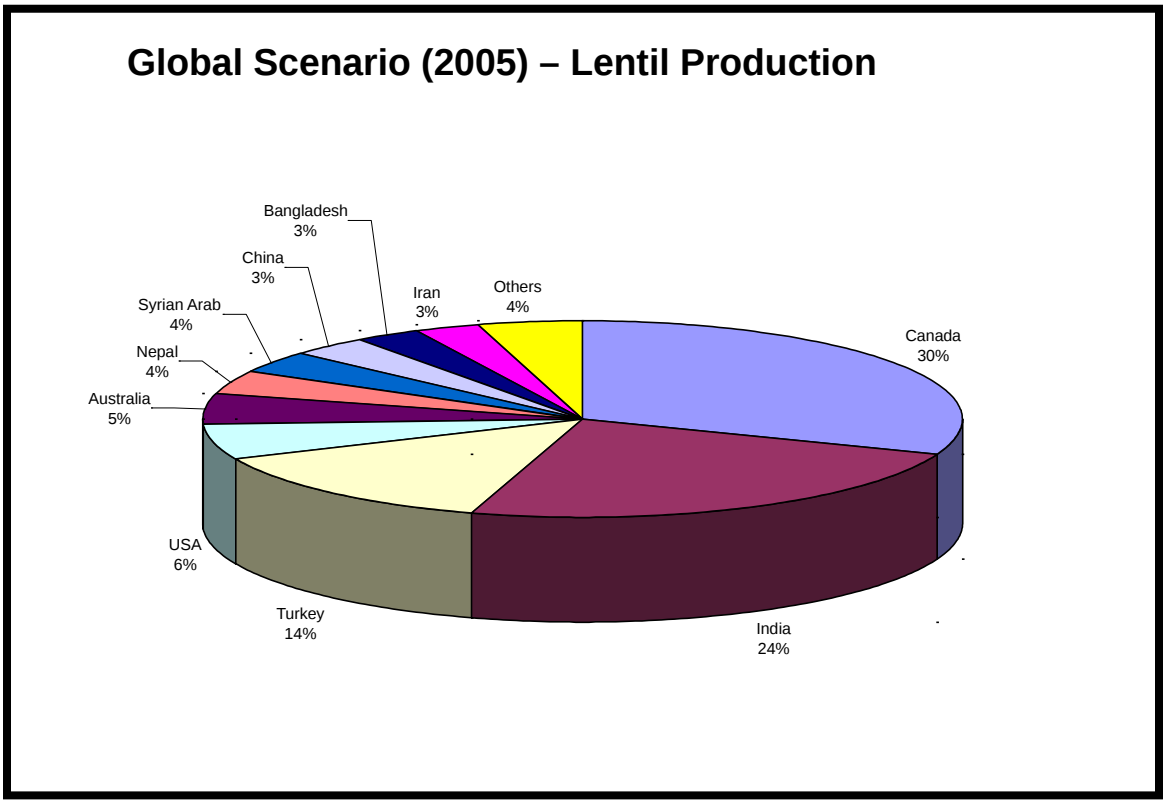
India ranked first in the area and second in the production with 36% and 21% of world area and production respectively. In case of productivity, India ranked 30th in the world. The highest productivity is recorded in Armenia (2181 Kg./ha) followed by China. Canada rank first in production due to very high level of productivity (1482 kg/ha) as compared to India (675 kg/ha) (table 6.1).

Table – 6.1. Global ranking in area, production and yield : Major countries

Rank	Area (Lakh ha)			Production (Lakh tonnes)			Yield (Kg/ha)	
	Country	**Area**	**% to World**	**Country**	**Prod-uction**	**% to World**	**Country**	**Yield**
I	India	14.73	35.57	Canada	12.78	30.77	Armenia	2181
II	Canada	8.62	20.81	India	9.94	23.94	China	1978
III	Turkey	4.40	10.62	Turkey	5.70	13.72	New Zealand	1866
IV	Iran	2.26	5.45	USA	2.34	5.64	Azerbaijan	1817
V	Nepal	1.89	4.56	Australia	2.10	5.06	Egypt	1770
VI	USA	1.78	4.29	Nepal	1.61	3.87	Australia	1650
VII	Syrian Arab	1.43	3.45	Syrian Arab	1.54	3.70	France	1580
VIII	Bangladesh	1.30	3.14	China	1.38	3.33	Kenya	1520
IX	Australia	1.27	3.07	Bangladesh	1.18	2.84	Canada	1482
X	Ethiopia	0.96	2.33	Iran	1.13	2.73	Argentina	1333
XXX	-	-	-	-	-	-	**India**	**675**
	World	**41.41**		**World**	**41.53**		**World**	**1003**

Source : FAO statistics 2005





2.2 National Scenario

Eighth Plan(1992-07): The total area under Lentil in India were 12.35 lakh hectares with a total production of 8.00 lakh tonnes .During this period, Uttar Pradesh was ranking first in area and production (41.1 % and 47.2 %) followed by Madhya Pradesh (35.86% and 26.20 %) and Bihar which accounted for 13.9 % of total area coverage and 17.3 % of the country's Lentil Production.

Ninth Plan(1998-02): The area under lentil were 14.17 lakh hectares with the total production of 9.42 lakh tonnes. The highest area and production contribution was made by U.P. (41.1% and 45.7%) followed by M.P. (35.5% and 25%) and Bihar (12.4% and 16.8%).Rajasthan with highest yield record of 1118 kg/ha against the all India yield of 664 kg/ha.

Tenth Plan(TE 2005-06): The country's area under Lentil was 14.58 lakh hectares with a production of 9.93 lakh tonnes.Area and production of the crop was maximum in Uttar Pradesh (40.6 % and 48.4 %) followed by Madhya Pradesh (35.2 % and 26.0 %) and Bihar (12 % and 13.5 %) respectively.

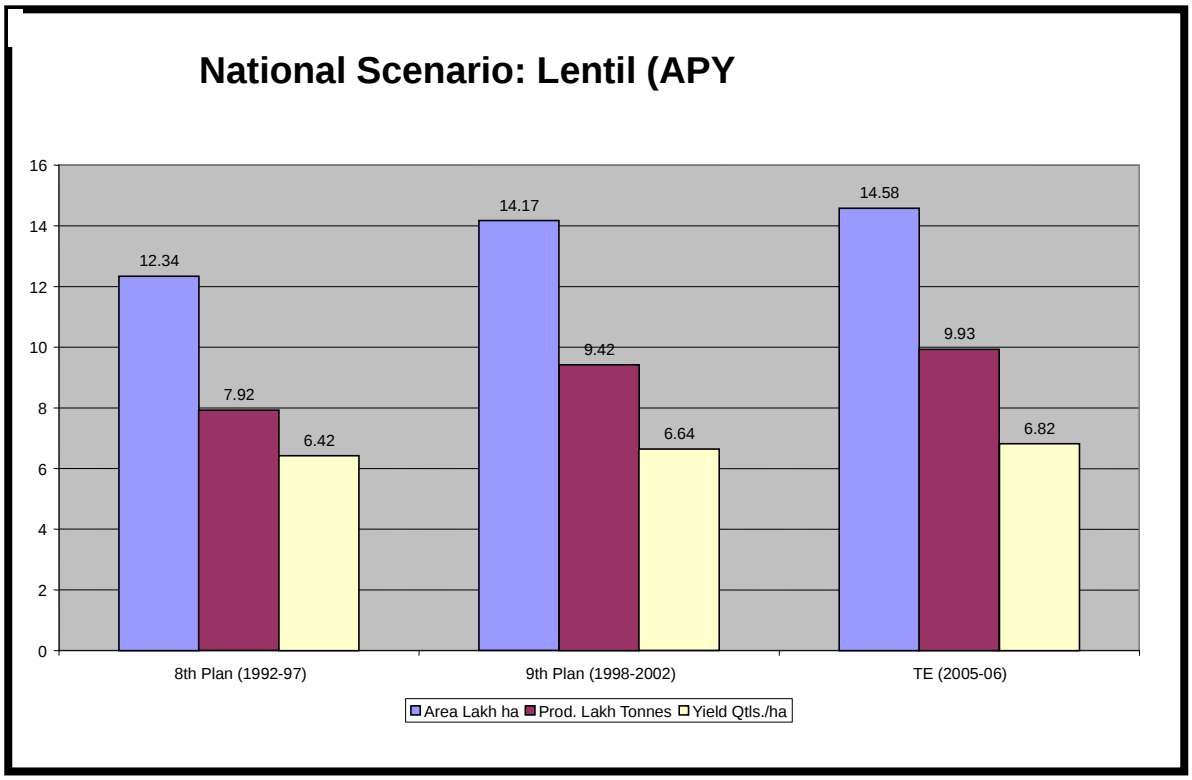
Table - 6.2. Plan-wise lentil scenario - States

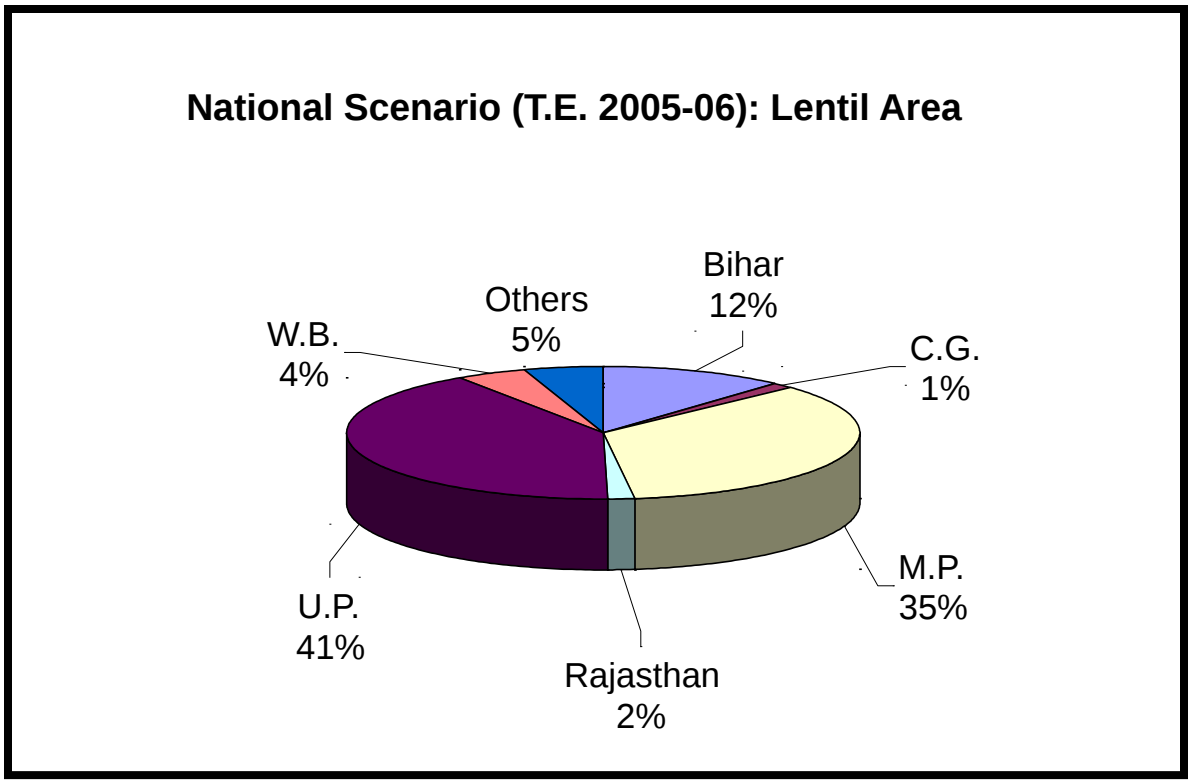
(A=Area Lakh ha, P=Production Lakh tonnes, Y= Yield Kg/ha)

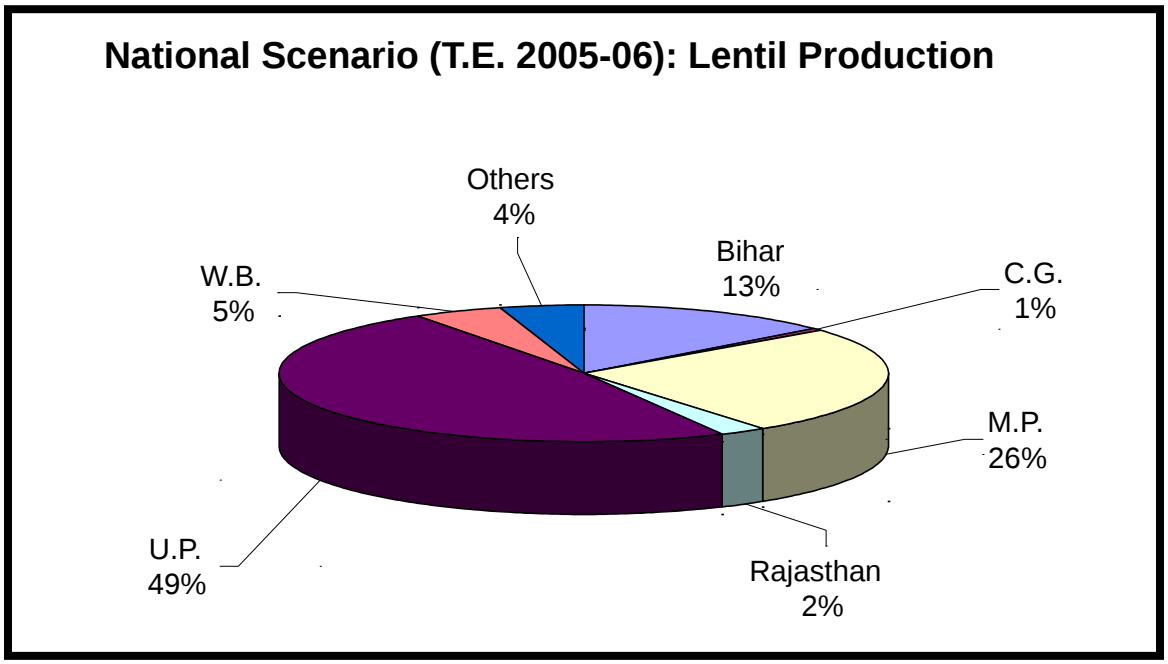
STATE		Eighth Plan	% to Country	Ninth Plan	% to Country	Xth Plan (T.E.2005-06)	% to Country
Assam	A	0.14	1.10	0.22	1.52	0.20	1.40
	P	0.08	1.06	0.11	1.20	0.11	1.12
	Y	1373	212	525	79	546	80
Bihar	A	1.71	13.88	1.76	12.39	1.71	11.71
	P	1.39	17.34	1.59	16.85	1.34	13.47
	Y	810	125	903	136	784	115
Chhattisgarh	A	*		0.06	0.40	0.18	1.23
	P			0.02	0.18	0.06	0.56
	Y			119.40	18	308	45
Harryana	A	0.11	0.90	0.09	0.64	0.07	0.46
	P	0.08	0.96	0.07	0.75	0.06	0.59
	Y	697	108	757	114	853	125
Madhya Pradesh	A	4.43	35.86	5.03	35.52	5.14	35.22
	P	2.10	26.20	2.35	25.00	2.59	26.04
	Y	473	73	467	70	503	74
Maharashtra	A	0.11	0.91	0.07	0.52	0.07	0.51
	P	0.05	0.57	0.03	0.34	0.03	0.27
	Y	405	63	430	65	348	51
Rajasthan	A	0.18	1.49	0.33	2.29	0.24	1.68
	P	0.17	2.08	0.37	3.92	0.25	2.49
	Y	878	136	1118	168	1001	147
Uttar Pradesh	A	5.08	41.11	5.83	41.12	5.93	40.64
	P	3.77	47.14	4.31	45.72	4.80	48.38

	Y	741	115	740	112	813	119
Uttarakhand	A	*		0.06	0.43	0.16	1.12
	P			0.04	0.44	0.08	0.84
	Y			270	41	520	76
West Bengal	A	0.49	3.95	0.67	4.69	0.65	4.43
	P	0.33	4.10	0.49	5.18	0.46	4.64
	Y	671	104	724	109	712	104
All India	**A**	**12.35**		**14.17**		**14.58**	
	P	**8.00**		**9.42**		**9.93**	
	Y	**647**		**664**		**682**	

* Newly carved states during 2000







2.3. Potential districts (2003-04)

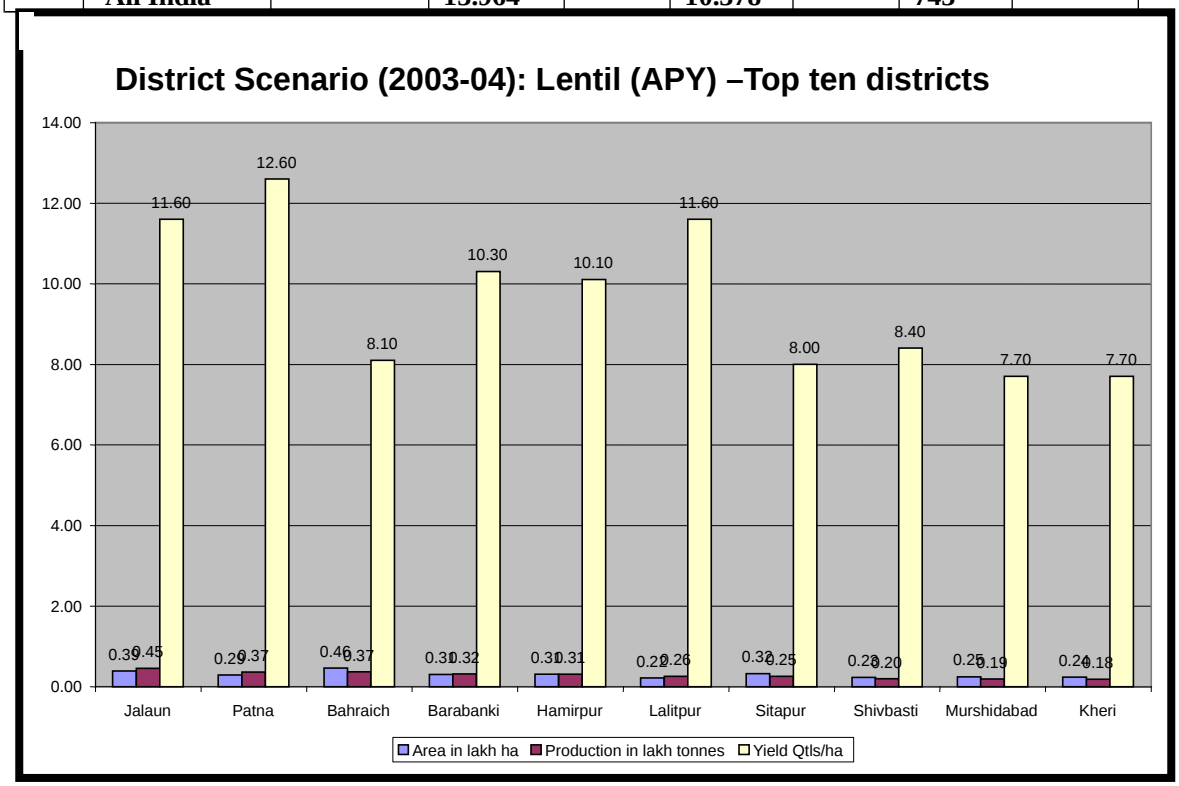
Analysis of the intra-state status of Lentil crop, is presented in table 6.3. Inter district analysis revealed that district Jalaun of U.P. with 4.36% of production has the highest share followed by Patna of Bihar (3.52%), Bahraich (3.57%), Barbanki (3.04%) and Hamirpur (3.00%) of U.P. Other districts have less than 3 percent of the country‘s lentil contribution. District-wise area, production and yield of top ten

district of India in respect of production are presented below which contributed 21.58 per cent and 27.86 per cent of area and production of the country.

It may be concluded that these districts may be targeted specifically to tap the potential through important inputs and technological back-up with aggressive extension programmes.

Table – 6.3. Top Potential districts (2003-04)

Sr. No.	Name of District	State	Area (lakh ha)		Production (lakh tonnes)		Yield (Kg/ha)	
			Area	% to India	Prod.	% to India	Yield	YI
I	Jalaun	UP	0.389	2.79	0.452	4.36	1160	156
II	Patna	Bihar	0.289	2.07	0.365	3.52	1260	170
III	Bahraich	UP	0.460	3.29	0.371	3.57	810	109
IV	Barabanki	UP	0.307	2.20	0.315	3.04	1030	139
V	Hamirpur	UP	0.308	2.21	0.311	3.00	1010	136
VI	Lalitpur	UP	0.219	1.57	0.255	2.46	1160	156
VII	Sitapur	UP	0.318	2.28	0.254	2.45	800	108
VIII	Shivbasti	UP	0.234	1.68	0.196	1.89	840	113
IX	Murshidabad	WB	0.246	1.76	0.191	1.84	770	104
X	Kheri	UP	0.235	1.68	0.181	1.74	770	104
	Total above		**3.005**	**21.52**	**2.891**	**27.86**	**962**	**129**
	All India		**13.964**		**10.378**		**743**	



4. ECONOMIC CLASSIFICATION: Lentil, based on the seed size and test weight, is classified into two main groups–

i) **bold seeded**: Includes sub sp. *macro-sperma*, with the test weight of more than 25 g. also known locally as *Masur* or *Malka Masur* and mainly cultivated in Bundelkhand region of UP/MP and Maharashtra state.

ii) **small seeded**: Sub sp. *micro-sperma*, test weight, less than 25 g, locally known as *masuri* and primarily grown in Indo Gangtic plains of NEPZ (UP, Bihar, West Bengal and Assam).

5. BOTANICAL DESCRIPTION: It is an herbaceous annual plant mostly erect and bushy type with four to six primary branches, plant height not exceeding 50-60 cm in general. It has a well developed root system including a central tap root with several lateral branches, spreading in all directions. Root nodules, the site of atmospheric 'N' fixation, are mainly concentrated on primary root. The stem is weak and quadrangular and ends of leaflets some time forms tendrils. Inflorescence is a raceme of two to four flowers. Flowers are small and white with blue, violet or pink tinged. Ovary is short with one or two ovules hence, pods are one to two seeded. Anthesis takes place in buds sometimes before opening of flowers in the next morning. Hence, self pollination is a general rule.

Pods are one to one and half cm in length with a curved beak. Grains are often light brown in colour with lens shaped.

6. PRODUCTION TECHNOLOGY

6.1. Climatic requirements: Being a winter season crop, require cold climate. Being very hardy in nature, it can tolerate frost and severe winter to a larger extent. The range of cultivation with regard to climate is very wide. It requires cold temperature during vegetative growth and comperatively warm temperature during maturity, with the optimum temperature range of 18-30^{0}C. Unlike Bengalgram, it can thrive well under stress conditions of frost and winter rains, even at flowering and fruiting stage.

6.2. Varieties: Based on the region, time of sowing and purpose of cultivation, recommendations etc, selection of variety from **table 6.4**. However situation specific varieties for Rice-lentil cropping system are i) *Utera cultivation* - PL-406, PL-639, Arun and, ii) *Late sowings* – PL-406, PL-639, IPL-15, Narendra Masoor-1

6.3. Soil and its preparation: Well drained loamy soils with neutral reaction, are best, though can also be grown successfully in low lying paddy soils of poorer type, even tolerate moderate alkalinity conditions. Lime treatment (either seed pelleting or soil amendments) is must, prior to its cultivation in acidic soil.

Like gram, it also require good aeration for nodule development, achieved by one deep ploughing followed by one cross harrowing.

6.4. Cropping systems

6.4.1. Sequential: Lentil is generally grown after the harvest of kharif crops or also as the sole crop of the year. The most common rotations under sequential cropping are:

i. Kharif fallow – lentil (rainfed areas)
ii. Paddy – lentil
iii. Maize – lentil
iv. Cotton – lentil
v. Bajra – lentil
vi. Jowar – lentil
vii. Groundnut – lentil

6.4.2. Intercropping: Most common inter cropping systems are:

i. Lentil + Sugarcane (Autumn) with two rows of lentil at 30cm row spacing in between two rows of sugarcane ii. Lentil + Linseed (2:2) and iii. Lentil + Mustard (2:1)

6.5. Seed and sowing

6.5.1. Sowing Time: Recommended sowing time for **Rainfed** is First fortnight of October in Central and South India and second fortnight of October in North India; under irrigated condition first fortnight of November in North India and for **Late sowing** – First week of December in rice fallows of NEPZ or on fields vacated very late by kharif crops under irrigated condition.

6.5.2. Seed rate: For small seeded 40-45 kg/ha; bold seeded varieties and, late sown condition 50-60 kg/ha and under utera cropping 60 kg/ha seed is recommended.

6.5.3. Seed treatment: Treat the seed with thiram or carbendazim @ 2 g/kg of seed before 3 days of sowing followed by dual seed inoculation (culture of Rhizobium + PSB, one packet each for 10kg seed.)

6.6. Plant nutrient management: Being a legume it does not respond to nitrogen except for some types for initial boosting of growth whereas response to potash is inconsistent due to good 'K' supply status of most of the Indian soils. However, phosphorus definitely plays a vital role in root development, nodulation and growth and yield of the crop. General recommendation is 15-20 kg N and 50-60 kg 'P' as basal placement at soil depth of 10-15 cm during sowing/ last ploughing could be met easily through 100 kg DAP/ha.

Lentil also respond positively to 'S' (20-40 kg/ha) giving an average nutrient use efficiency of 10-15 kg grain/kg S especially in light textured sandy loam soils of Northern India. SSP is the best source of 'P' followed by Gypsum and 'Pyrite'.

Among micro-nutrient, Zn is most critical in intensive Rice-Wheat cropping system areas of Punjab, Haryana, Rajasthan (Eastern) U.P. and Bihar General recommendation is 25 kg zinc sulphate as basal, a foliar spray of 0.5% ZnSO4 + 0.25% lime (5 kg zinc sulphate + 2.5 kg lime in 1000 lt. of water per ha). 'Mo' and 'Fe' are the integral components of enzyme 'nitrogenous' for 'N' fixation. Mo deficiency may create twin deficiency of 'N' and 'Mo'. 'Boron' and 'Mo' is found deficient in acidic soil of Eastern India hence 10 kg borax and 1 kg ammonium molybdate as soil application and foliar spray of 2% each of DAP and 'KCL' at pre flowering and pod development enhance yield by 10-15% along with increasing its ability to resist terminal drought.

Tips for low input INM

- Application of 2-2.5 tonnes 'vermicompost' or 5 t FYM to the 'kharif' crop in rotation and seed inoculation with efficient strain of Rhizobia takes care about initial nitrogen requirement and no need to apply 'N' as booster (required especially in low fertile and paddy soils).
- Dual inoculation with 'Rhizobium' and 'PSB' takes care of 'N' as well as reduces 25-30% of phosphorus requirement by making available the initial fixed soil 'P' to the plants
- Rhizobium inoculation is must after paddy as it is aerobic bacteria and most of its population dies during flooding and compaction for want of oxygen.
- In-situ management of rice straw/residues takes care of Zinc and other micronutrient and no need to apply them separately.

6.7. Water Management: Most critical stage for moisture stress is pod formation followed by flower initiation. In absence of winter rains and where contribution of soil moisture is negligible viz in Central India, two light irrigations may be applied for significant yield improvement.

6.8. Weed Management: Major weeds are *Chenopodium spp*. (bathua), *Fumaria parviflora* (gajri), *Lathyrus aphaca* (chatri matri), *Vicia sativa* (ankari), *Crisium arvense* (kateli), *Melilotus alba* (senji), *Asphodelus enuifolius* (jungli piaji), *Convolvulus avensis*, *Phalaris minor* and *Avena ludoriciana*. Orobanche, a parasitic weed is also seen as major problem at some places. Similarly *V sativa* adultrate the grain due to its size, shape and colour.

One hand weeding/inter-culture at 30 DAS and another at 55-60 DAS, depending upon the intensity of weed infestation, provides efficient soil oxygen environment to rhizobium bacteria along with soil moisture conservation breaking soil capillaries, creating dust mulch.

6.9. Plant protection measure - Refer table -6.5.

6.10. Harvesting, threshing, storage and yield

Crop become ready for harvest when leaves begin to fall, stem and pod turn brown or straw in colour and seeds are hard and rattle with 15% moisture inside them. Over ripening may lead to fall of pods as well as shattering and seed cracking if seed moisture fall below 10% due to delay in harvesting.

The crop should be allowed to dry for 4-7 days on threshing floor and threshed by manually or bullock/power drawn thresher.The clean seed should be sun dried for 3-4 days to bring their moisture content at 9-10%. The seed should be safely stored in appropriate bins and fumigated to protect them from bruchids.

6.11 Yield- 10-15 q/ha .

Table – 6.4. Recommended lentil varieties/characteristics

Variety	Source	Year of Release/ Notifi-cation	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristics
Pant L 406	GBPUAT	1980	NWPZ NEPZ	12-16	140	Rust resistant, small seeds
Asha(B77)	BCKV	1980	West Bengal	12-17	122-125	Rust resistant, small seeds
Pant L 639	GBPUAT	1980	NWPZ NEPZ	12-16	140	Rust resistant, small seeds
Vipasha	HPKV	1982	HP	10	170-180	Rust res., bold seeds
LL 56	PAU	1983	Punjab	12-17	150-155	Rust resistant, small seeds
Ranjan	BCKV	1984	West Bengal	15-16	120-125	Small seeds
Mallika(K 75)	CSAUAT	1986	NEPZ & CZ	14	135	Bold seeds
Arun	RAU,Dholi	1986	Bihar	12	130	Bold seed, tol. to rust
L 147	PAU	1988	Punjab	14	140	Small seed Rust resistant
JL 1	JNKVV	1991	MP	8.0	120-125	Early, Tol. to wilt, *Seed bold*
Sapana (LH 84-8)	CCSHAU	1991	NWPZ	15.0	135-140	Tolerant to Rust & Bold Seeded

(Table – 6.4. continued)

	Source	Year of Release/ Notifi-cation	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristics
VL Masoor 4	VPKAS	1991	Uttarakhand	12.5	168	Tol. to wilt & Rust, *Small seeded & black.*
Pant lentil-4 (PL-81-17)	GBPUAT	1993	NWPZ	16.0	140-145	Resistant to Rust & tolerant to wilt.
Lens-4076	IARI	1993	NWPZ CZ	14.0	130-135	Tolerant to wilt & Rust. *Seed bold*
DPL-15 (Priya)	IARI	1995	NWPZ	15-18	130-135	Tolerant to wilt & Rust, *bold seeded***.**
Pusa Vaibhav (L-4147)	IARI	1996	NWPZ	20-24	130-135	Res. to Rust & Tol. to wilt, *small seeded*.
Garima (LH-84-6)	CCSHAU	1996	Haryana.	15-20	135-140	Tol. to Rust, wilt & Blight. *bold seeded.*
Narendra Masoor-1	NDAUT	1997	Uttar Pradesh.	14.0	125-130	Resistant to Rust & Tol. to wilt.
DPL-62 (Sheri)	IIPR	1997	NWPZ	17.0	130-135	Resistant to Rust & wilt, *bold seeded***.**
Subrata	BCKV	1998	West bengal	12-18	120-125	Tolerant to Rust, *bold seeded***.**
JL-3 Jawahar lentil-3	JNKVV	1999	CZ	15-19	115-120	Tolerant to wilt, *bold seeded.*
VL Masoor 103	VPKAS	2000	Uttarakhand	12-14	1645	Tolerant to Rust, *small seeded***.**

Pant Lentil-5	GBPUAT	2001	Uttarakhand	15-18	135	Resistant to Rust, *bold seeded.*
Noori (IPL-81)	IIPR	2000	CZ	17-18	110-120	Tolerant to Rust, wilt, *bold seeded*
KLS 218	CSAUAT	2005	NEPZ	14-15	125-130	Tolerant to Rust, wilt, small seeded
Malaviya Vishwanath (HUL 57)	BHU	2005	NEPZ	14.0	130	Resistant to rust & wilt, *small seeded***.**
VL-Masoor-507	VPKAS, Almora	2006	J&K, H.P., Uttarakhand, North Eastern Hills	10-12	140-209	Resistant to wilt
Haryana Masar-1 (LH-89-48)	CCSHAU	2006	Haryana	14	138	Moderate resistant to all disease
VL Masoor 125	VPKAS, Almora	2006	Uttarakhand	20		Resistant to wilt
VL Masoor 126 (VL-126)	VPKAS, Almora	2007	Uttarakhand, H.P., J&K and North Eastern Hills	12-13	126-212	Resistant to GM and Moderately resistant to wilt and rust
IPL-406 (Angoori)	IIPR	2007	NWPZ	17	120-155	Resistant to rust and wilt

CZ- (MP.,Maharashtra, Chhattisgarh, Gujarat) , SZ- (A.P., Karnataka, Tamil nadu, Orissa) NEPZ-North East plane Zone (East Uttar Pradesh, Bihar, Jharkhand, West Bengal). NWPZ- North West Plain Zone (Punjab, Haryana, Delhi, West UP & North Rajasthan) Res.= Resistant, Tol.= Tolerant, Mod.= Moderately,

Table – 6.5. Pest and diseases in lentil and their management

Insect Pest/Disease/ Causal Organism	**Nature of Damage/ Symptoms**	**Control Measures**
i. Pod borer	The caterpillar defoliates the tender leaves and also bores the green pods and feeds upon the ripening grains.	Cypermethrin (0.02%) or Endosulfan (0.07%) or Monocrotophos (0.04%).
ii. Aphids	Aphids suck the sap and in case of severe damage the growth is suppressed.	Metasystox or Monocrotophos (0.04%).
iii. Wilt *(Fusarium lentis)*	The growth of the plant is checked due to yellowing of leaves, drying of plants. The roots of affected plants remain under-developed and looks light brown in colour.	i. Seed Treatment with Thiram + Benomyl (1:1) @ 3 g/Kg of seed. ii. Adopt crop rotation. iii. Use healthy seeds.
iv. Rust *(Uromyces fabje)*	Pink to brown pustules appear on leaves and stems. In severe attack, the affected plants may dry.	i. Grow early maturing/ duration variety. ii. Seed Treatment with Agrosan GN @ 2.5 g/kg seed. iii. Spray the crop with Maneb, Zineb or Ferbam @ 2.5 g/litre of water.

PEAS

Botanical Name	-	*Pisum sativum* (L.)
Synonym	-	Matar, Pea
Origin	-	Mediterranean Region of Southern Europe and Western Asia
Chromosomes	-	2n = 14

1. ECONOMIC IMPORTANCE: Pea is the third most important pulse crop at global level, after dry bean and chickpea and third most popular rabi pulse of India after chick pea and lentil. It provides a variety of vegetarian diet hence liked throughout the world. The mature seeds are used as whole or split into dal and put to use in various ways for human consumption. Beside vegetable purposes, it is also grown as a forage crop for cattle and cover crop to prevent soil erosion but mainly for matured seed for human consumption.

Nutritive value

Protein	-	22.5%	Calcium	-	64 mg/100g
Fat	-	1.8%	Iron	-	4.8 mg/100g
Carbohydrate	-	62.1%	Moisture	-	11%

Agronomic significance: Being leguminous crop leaving 25-30kg N/ha to the succeeding crops.

2. CROP STATUS

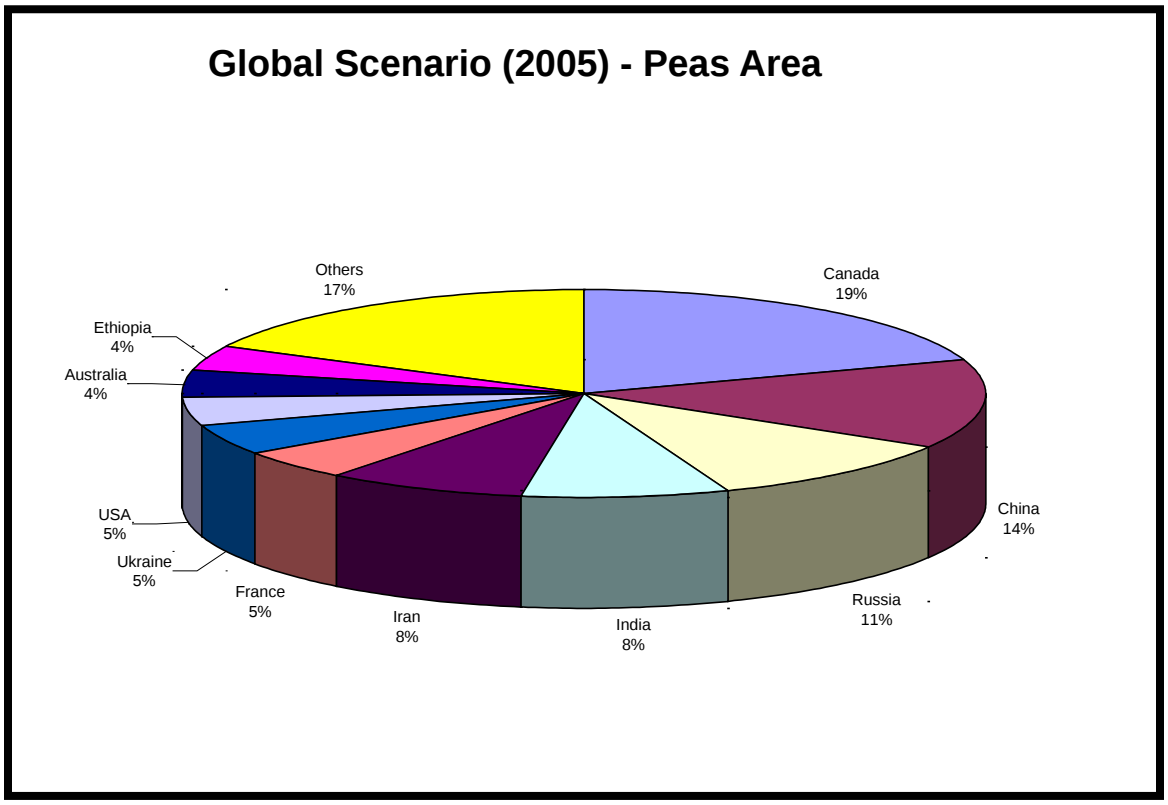
2.1. Global Scenario

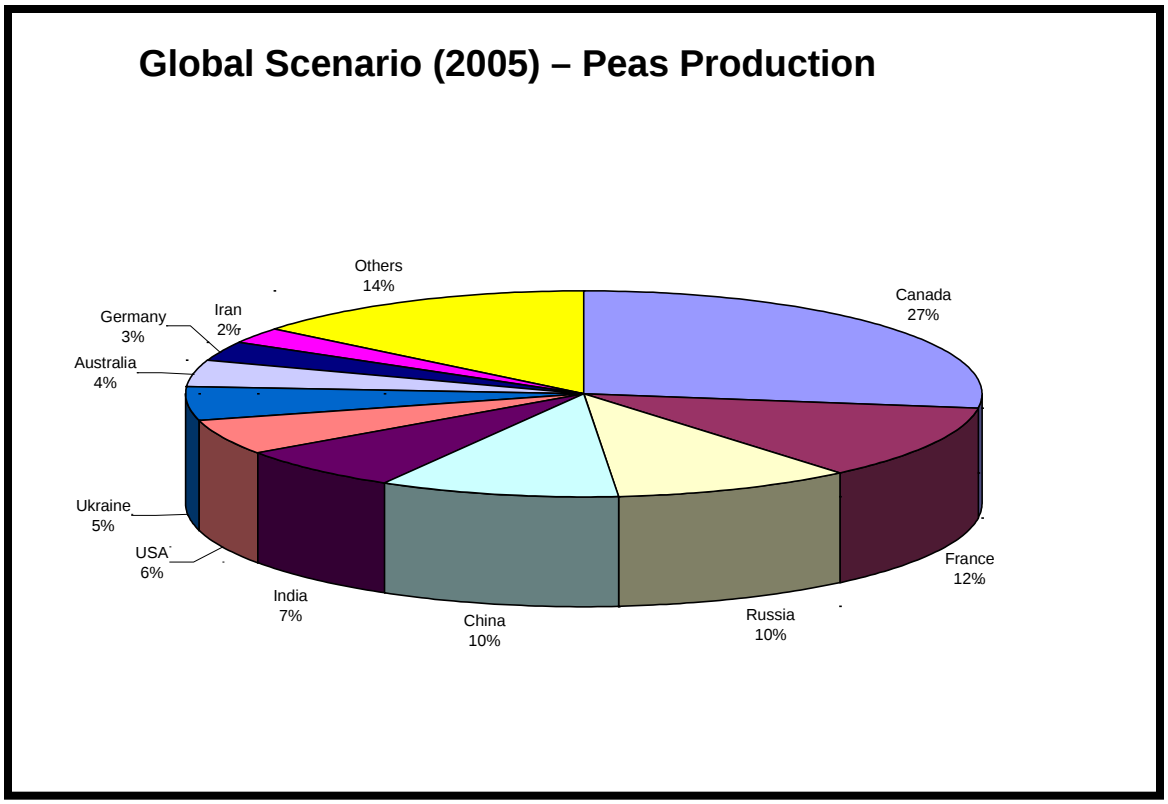
Canada rank first in area (20%) and production (315) at Global level while china and France stand second for area and production respectively. India occupy only 8.2% of area and 6.8% of production. Highest productivity is recorded in France (4210 kg/ha) followed by Ireland (4000 kg/ha), UK and Switzerland while India's productivity is only 1418 kg/ha.

Table – 7.1. Global ranking in area, production and yield: Major countries

Rank	Country	Area (Lakh ha)		Country	Production (Lakh tonnes)		Country	Yield (kg/ha)
		Area	% to World		Prod.	% to World		
I	Canada	13.19	19.72	Canada	30.99	27.16	France	4210
II	China	9.30	13.90	France	13.31	11.67	Ireland	4000
III	Russia	7.12	10.64	Russia	11.27	9.87	UK	3744
IV	India	5.50	8.22	China	11.03	9.67	Switzerland	3715
V	Iran	5.38	8.03	India	7.80	6.83	Belgium	3425
VI	France	3.16	4.73	USA	6.35	5.57	Netherlands	3404
VII	Ukraine	3.11	4.65	Ukraine	6.16	5.40	Luxembourg	3272
VIII	USA	3.10	4.63	Australia	4.78	4.19	Denmark	3248
IX	Australia	2.80	4.19	Germany	3.46	3.03	Romania	3178
X	Ethiopia	2.53	3.78	Iran	2.65	2.32	Germany	3140
XLVI							**India**	**1418**
	World	**66.90**		**World**	**114.12**		**World**	**1705**

Source : FAO statistics





2.2 National Scenario

Eighth Plan(1992-97): The area and production during the plan were 7.11 lakh ha and 6.43 lakh tonnes respectively. The state of Uttar Pradesh ranked first in area and production (58.7% and 76%) followed by Madhya Pradesh (22.6% and 9.6%). In area Assam ranked third (4.3%) and in production, Bihar ranked third (2.8%).

Ninth Plan(1998-02):During ninth plan, the area and production were 7.38 lakh hectares and 6.65 lakh hectares respectively. U.P. stands first in respect of area and production (54.7% and 70.4%) followed by M.P. (25.2% and 12.2%) and Orissa (5.2% and 3.6%).

Tenth Plan (TE 2005-06): A total area of 7.64 lakh hectares and a total production of 7.40 lakh tonnes were recorded. Uttar Pradesh ranked first both in area and production (53.8% and 71%) followed by Madhya Pradesh (28.4% and 14.2%) and Bihar (3.1% and 2.8%).

Table - 7.2 Plan-wise pea Scenario -States

A=Area Lakh ha, P=Production Lakh tonnes, Y= Yield Kg/ha

State		Eighth Plan	% to Country	Ninth Plan	% to Country	Xth Plan (T.E.2005-06)	% to Country
Assam	A	0.31	4.35	0.26	3.59	0.22	2.90
	P	0.16	2.52	0.16	2.35	0.14	1.84
	Y	522	58	589	65	616	63
Bihar	A	0.29	4.14	0.27	3.73	0.24	3.10
	P	0.18	2.82	0.21	3.22	0.21	2.88

	Y	619	68	790	88	904	92
Chhattisgarh	A	*		0.04	0.57	0.17	2.29
	P	*		0.02	0.23	0.06	0.82
	Y	*		146	16	349	36
Haryana	A	0.02	0.26	0.01	0.13	0.01	0.17
	P	0.02	0.28	0.01	0.14	0.02	0.21
	Y	990	109	915	102	1200	123
	A	1.61	22.67	1.85	25.24	2.16	28.44
Madhya Pradesh	P	0.62	9.60	0.81	12.26	1.05	14.19
	Y	380	42	436	48	484	50
Maharashtra	A	0.13	1.77	0.17	2.28	0.17	2.20
	P	0.05	0.85	0.08	1.14	0.06	0.86
	Y	418	46	447	50	368	38
Orissa	A	0.28	3.90	0.38	5.19	0.00	0.00
	P	0.17	2.58	0.24	3.59	0.00	0.00
	Y	592	65	623	69	0.00	0
Punjab	A	0.05	0.76	0.05	0.62	0.04	0.49
	P	0.05	0.79	0.04	0.62	0.04	0.56
	Y	947	105	884	98	1108	113
Rajathan	A	0.09	1.33	0.12	1.68	0.13	1.69
	P	0.18	2.78	0.26	3.88	0.28	3.84
	Y	1842	204	2075	231	2202	225

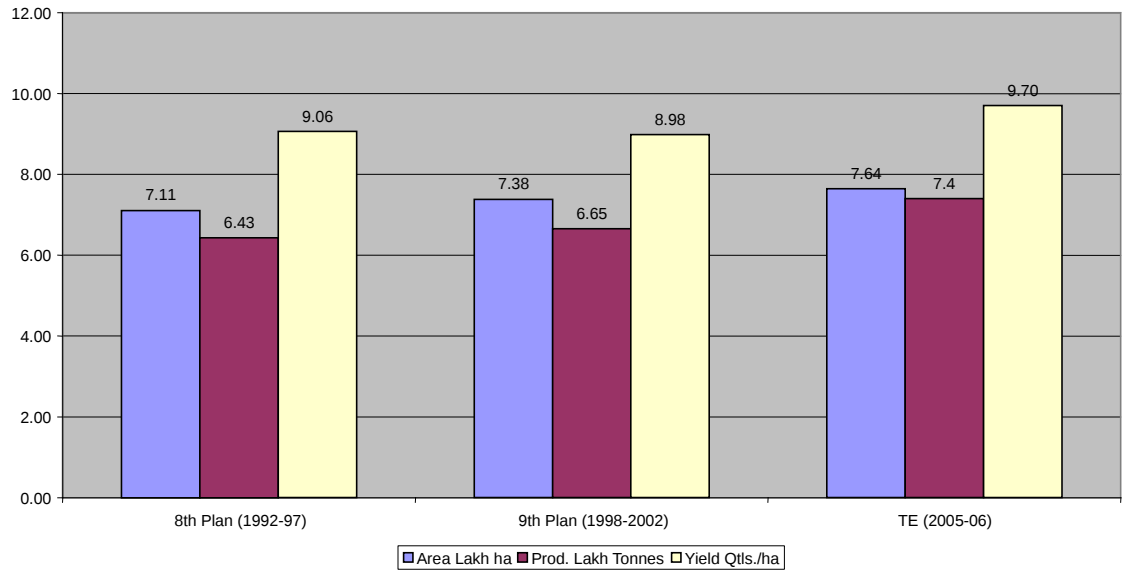
(continued)

(Table 7.2.continued)

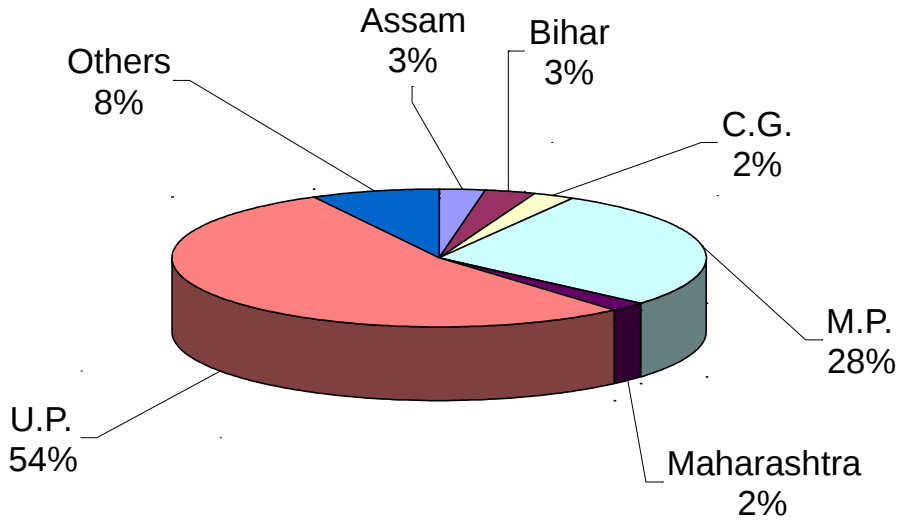
STATE		**Eighth Plan**	**% to Country**	**Ninth Plan**	**% to Country**	**Xth Plan (T.E.2005-06)**	**% to Country**
Uttar Pradesh	A	4.17	58.83	4.01	54.67	4.09	53.82
	P	4.89	76.18	4.66	70.45	5.24	70.98
	Y	1175	130	1163	129	1284	131
Uttarakhand	A	*		0.01	0.19	0.04	0.57
	P	*		0.02	0.25	0.04	0.59
	Y	*		485	54	1010	103
West Bengal	A	0.08	1.06	0.09	1.29	0.14	1.84
	P	0.04	0.60	0.07	1.12	0.13	1.72
	Y	508	56	774	86	904	92
All India	**A**	**7.11**		**7.38**		**7.64**	
	P	**6.43**		**6.65**		**7.40**	
	Y	**906**		**898**		**970**	

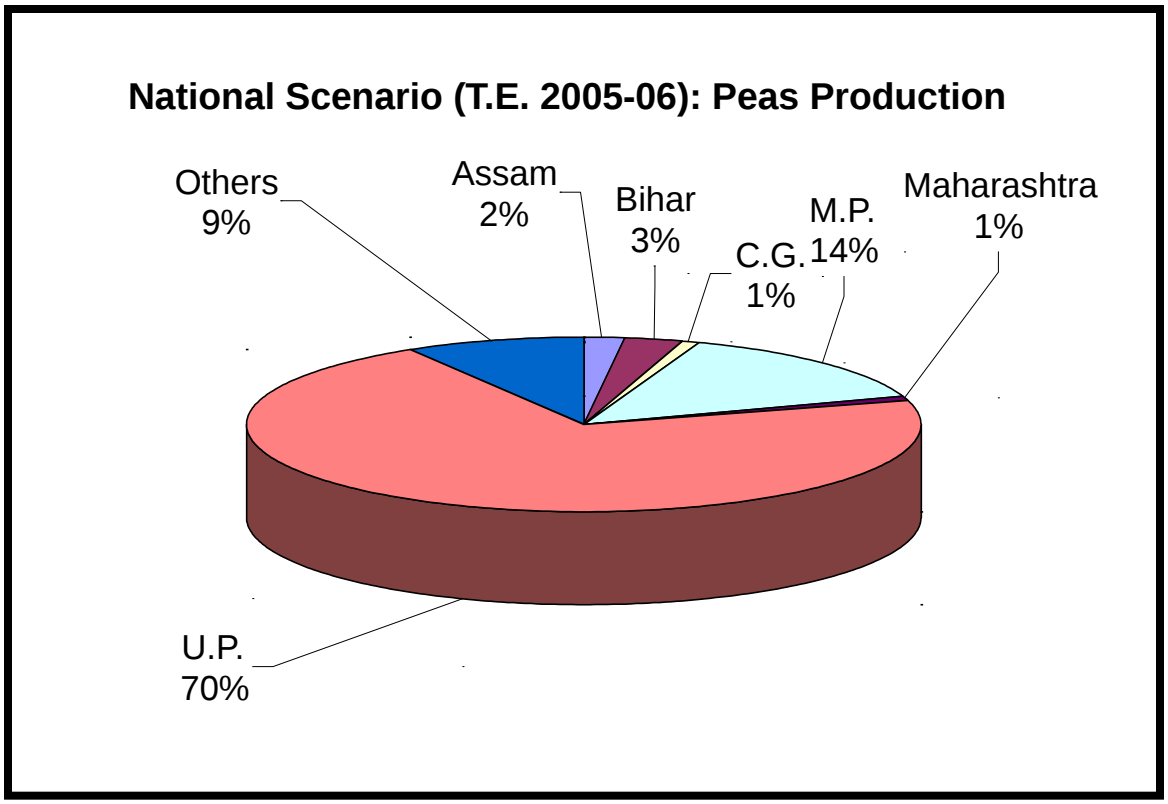
***States** carved out during 2000

National Scenario: Peas (APY)



National Scenario (T.E. 2005-06): Peas area





3. ECONOMIC CLASSIFICATION: Two types of peas are generally cultivated all over the world as given below:

i) **Garden pea** (*Pisum sativum var. hortense*) - also called as table pea, young green seeds are used mostly as vegetables and also for canning purposes. Seeds are bold and wrinkled. Flowers are generally white.

ii) **Field Pea** (*Pisum sativum var. arvense*) - this group contain ripe, matured seeds and mostly used for dal, some times they are also grown for forage and green manuring purposes. The plants are hardy and grown mostly as rainfed without any irrigation. They are also able to withstand frost. Seeds are round and white, grayish green to grayish yellow. Flowers are coloured.

4. BOTANICAL DESCRIPTION: It is an annual herbaceous, semi erect to erect, succulent plant with a tendency to climb when support is available, grow up to a height of 30-200 cm. Plants bear tap root system with nodules on the surface. Leaves are typically compound, with each leaf has one to three pairs of leaflets and terminal branched tendrils. Inflorescence is axillary raceme. Peas are generally self fertilized but cross pollination may also occur up to some extent. Fruit is a typical pod varying 5-9 cm in length containing 5-10 seeds inside them. Seed germination is hypogeal when cotyledons remain below the ground surface during emergence.

5. PRODUCTION TECHNOLOGY

5.1. Climatic requirement: Being a winter season crop it requires a cool growing season with moderate temperature throughout the life. High temperature is more

injurious to pea crop than frost. Frost can damage the plants during flowering stage. High humidity associated with cloudy weather results into spread of fungal diseases like damping-off and powdery mildew. Optimum monthly temperature suitable for growth is 13-18^{0}C.

5.2. Varieties–Selection of variety as per the adaptability to the region, recommendation, time of sowing, purpose of cultivation and use of inputs etc from table 7.3.

5.3. Soil and field preparation: A well-drained loamy soils free from excessive soluble salts with neutral pH range of 6.5 to 7.5 is suitable for successful cultivation of the crop. Prepare a level field for even distribution of irrigation water, free from stubbles and crop residues of previous crops by one deep ploughing through disc or mouldboard plough followed by 2-3 harrowing and planking after each operation. To ensure good drainage and aeration in the field, powdery seedbeds must be avoided.

5.4. Cropping System: In general, peas are sown after harvest of kharif crops. The most common rotations are maize – pea; paddy – pea – wheat – (being popular in Northern India); cotton – pea; jowar – pea; and bajra – pea,

Intercropping: It can be sown as intercrop with autumn sugarcane as two rows of pea at 30 cm row spacing in the centre of two sugarcane rows at 90 cm apart.

5.5. Seed and Sowing

Sowing time: Second fortnight of October in north Indian condition and first week of October in Central India is the optimum sowing time for rain fed conditions.

Seed Rate: 50-60 kg/ha for small seeded (13-16 g/100 seeds) and 80-90 kg/ha for bold seeded (20 g/100 seeds) and late sown conditions.

Spacing: i. 25-30 cm (row to row) and 8-10 cm (plant to plant) for dwarf genotypes like Aparna

ii. 30-40 cm (row to row) and 10-12 cm (plant to plant) for tall varieties like Rachna

5.6. Plant nutrient management: Apply 2.5-5 t biogas slurry/compost per ha, apply 60 kg P_2O_5 per ha as basal dose in furrow bands for higher P use–efficiency for which single super phosphate (contains 12 % S) to di-ammonoum phosphate should be prefered. On light tectured soils of northern region, application of 0.5 kg molybdenum (1 kg sodium molybdate) per ha has additional effect on yield of fieldpea. Foliar spray of B @ 1-1.5 kg B per ha or soil application of 4 kg borax per ha is recommended on boran deficient soils. Apply 20 kg K_2O per ha. alongwith NP is beneficial in K deficient areas.Apply 20 kg sulphur per ha. In acid soils, rhizobium innoculated seed should be treated with 1.5 kg of finaly powdered lime ($CaCO_3$, 300 mesh)

For correcting Zn deficiency, foliar spray of 0.5 kg $ZnSO_4$ with 0.25 kg lime or soil application of $ZnSO_4$ @ 25 kg per ha to one crop on Zn deficient soils is helpful to both the crop of pulse based cropping system

5.7. Water management: Fieldpea is mostly grown as rainfed/un-irrigated on residual soil moisture and can sustain drought conditions up to some extent. One or two irrigations at 45 DAs and if needed, at pod filling stage, may be the best recommended irrigation schedule.

5.8. Weed management: One weeding 30-45 DAS, depending upon the field conditions. Application of solution MCPB or 2,4D-B @ 1.2 kg a.i./ha in 500-600 liters of water after 6 weeks of sowing, as post emergence, is effective in sandy loam soils. Application of Pendimethalin (STOMP) 30 EC @ 1 kg a.i./ha as pre-emergence application can also be used to control the weeds up to 50 days.

5.9. Plant Protection: Refer table 7.4.

5.10. Harvesting, threshing and storage: Field peas should be harvested when they are fully ripe and threshed after sufficient drying in the sun. The clean seed should be sun dried for 3-4 days to reduce their moisture content up to 9-10% to be safely stored in appropriate bins. To avoid further development of bruchids and other storage pests, it is recommended to fumigate the storage material before onset of monsoon and again after the monsoon with ALP @ 1-2 tablets per tonne. The small quantity of the produce can also be protected by mixing inert material (soft stone, lime, ash, etc) or by smearing edible/non-edible vegetable oils or by mixing plant products like neem leaf powder at the rate of 1-2% w/w basis.

5.11. Yield: 20-25qtls of grain and straw per ha (irrigated) and 10-15qtls grains per ha (rain fed).

Table – 7.3. Recommended varieties of peas/characteristics

Variety	Source	Year of Release/ Notifi-cation	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristics
Rachna	CSAUAT	1982	All zones	20-25	120-125	Res.to PM, seed white, round and bold
RPG 3	RAU, Durgapura	1987	Rajasthan	15	120	Tolerant to stresses
Pant P 5	GBPUAT	1987	NWPZ	20	140	Resistant to PM
Aparna (HFP 4)	CCSHAU	1988	NWPZ	26	145	Dwarf, Resistant to PM
Malviya Matar2	BHU	1988	NEPZ	21	120-140	Resistant to PM
JP-885	JNKVV	1992	CZ	21.0	120-140	Resistant to PM.
KFP-103 (Shikha)	CSAUAT	1993	NWPZ	15-20	130-140	Resistant to PM.
DMR-7 (Alankar)	IARI	1996	NWPZ	20-25	115-135	Resistant to PM.
Uttra (HFP-8909)	CCSHAU	1996	NWPZ	20-25	120-140	Resistant to PM., dwarf
Sapna (KPMR-144-1)	CSAUAT	1997	Uttar Pradesh.	20-25	120-130	Resistant to PM. dwarf

Jayanti HFP-8712	CCSHAU	1998	Haryana	20-25	120-140	Res,. to PM., Bold Seeded
Swati (KFPD-24)	CSAUAT	1999	U.P.	25-30	110-125	Res. to PM. & tol.. to rust, Dwarf, escapes leaf minor
Malviya Matar-15 (HUDP-15)	BHU	1999	NEPZ, NHZ	25-30	110-130	Resistant to PM., rust and leaf miner
DDR-23 (Pusa Prabhat)	IARI	2000	NEPZ	15.0	95-115	Extra early, Resistant to PM
Ambika	IGKV	2000	CZ	15-20	100-125	Res. to PM, Tall
DDR-27 (Pusa Panna)	IARI	2001	NWPZ	18.0	100-115	Very early, Resistant to PM
Indra (KPMR-400)	CSAUAT	2001	CZ	20.0	105-115	Dwarf type, Resistant to PM
Shubhra (IM-9101)	IGKV	2001	Chhattisgarh	15-20	90-95	Resistant to PM
Jay (KPMR-522	CSAUAT	2001	NWPZ	23.0	120-140	Dwarf type, Res. to PM
IPF 99-25	IIPR	2002	CZ	23	110-115	Res.to Powdery Mildew
Vikas (IPFD 99-13)	IIPR	2005	H.P.& CZ	23	102	Resistant to PM and tolerant to rust
Prakash (IPFD-1-10)	IIPR	2006	CZ, J&K, H.P. and Utt.	21	94-121	Resistant to PM and tolerant to rust
Paras	IGAU,	2006	Chattisgarh	18-24	92-119	Res. to powdery mildew
Pant P-14	GBPUAT	2006	Uttarakhand	15-22		Resistant to rust and powdery mildew
VL-Matar-42	VPKAS, Almora	2007	NEPZ	20	108-155	Resistant to PM, Moderate resistant to rust
Hariyal (HFP-9907 B)	CCSHAU	2007	NWPZ	17-20	128	Resistant to PM & tolerant to rust

Res.= Resistant, Tol.= Tolerant, Mod.= Moderately, PM= Powdery Mildew,

Table – 7.4. Pest and diseases in peas and their management

Insect Pest/Disease/ Causal Organism	**Nature of Damage/ Symptoms**	**Control Measures**
i. Pea Stem fly	The maggot of the insect damages the internal tissue, consequently the entire plant dies. The damage is more acute when crop is sown early.	Endosulfan (0.07%) or Thimet granules @ 10 kg/ha.
ii. Leaf miner	Larvae of the insect makes tunnel in the leaf causing severe damage. The damage is more during the month of Dec.to Mar.	Metasystox 20 EC (1 litre in 1000 litre of water) per ha.
iii. Pea Aphid	The aphids suck the cell sap, resulting yellowing of leaves, Ultimately plant growth get stunted.	Metasystox (1 litre in 1000 litre of water).
iv. Spiny Pod borer	It is a polyphagous insect. Caterpillar makes hole in pods feed upon developing seed. Late varieties are prone to more damage than earlier one.	Endosulfan 35 EC @ 0.05% and/or Monocrotophos 36 EC or NPV @ 250 LE/ha.
v. Powdry Mildew (Erysiphe polygoni)	White circular powdery spots are formed on the upper surface of leaf. It also appeared on stem petiole and pod. During prevalent stage whole plant get	i. Adopt early duration var. ii. Spraying with wettable sulphur @ 3 gm/litre or Dinocap @ 1 ml/litre of

	covered by a powdery mass.	water.
vi. Wilt (Fusarium oxysporum)	The symptoms are premature yellowing and withering of young leaves during seedling stage and advance stage. Disease caused maximum loss if crop is early sown.	i. Seed Treatment with Thiram + Benomyl (1:1) @ 3 gm/kg of seed ii. Adopt crop rotation iii. Use healthy seeds
vii. Rust (Uromyces fabae)	During advance stages affected plants dries out	i. Adopt early duration varieties. ii. Spray with Maneb @ 2 gm/litre of water.

MOTHBEAN

Botanical Name - *Vigna acontifolia*
Origin - India
Synoym - Moth
Chromosome - 22

1. **ECONOMIC IMPORTANCE**: Mothbean (*Vigna acontifolia*) is a native crop of hot and dry habitats of northern and western parts of India. In severe soil moisture deficit situations, encountered with exceeding evaporative demands, this crop is rated as most economic and useful annual grain legume. This is probably due to genetic buffering embeded in this arid legume to quickly adjust and adapt to the fast fluctuating situations starved due to soil moisture depletion and nutritional deficiency. These very adjusting abilities have rendered this crop as an indispensable component of cropping system prevailing in arid regions.
   Thus, boosting the productivity of this very drought hardy crop in major growing state like Rajasthan, might help in breaking the ceiling of pulse production stagnated in India for last six decades.

It is most commonly recognized as the potent source of several confectionary items like Papad, Bhujia, namkeen, wada etc. used as daily snaks by the people along with its main use as 'Dal'.

This crop is used as a source of food, feed, fodder, green manuring and green pasture. Green pods are delicious source of vegetables. Being a pulse, it is a cheap source of vegetable protein for balancing nutritional deficiency. Mostly common on less productive soils on which financially less equipped people having been depending for their livelihood. Mothbean is known for higher proportion of albumin and glutamin fractions of protein alongwith a good source of lysine and leucine amino acids.

Agronomic significance: Mothbean with deep fast penetrating root system concomitant with drought avoidance capabilities can thrive and survive upto 40-50 days in open fields exhibiting fast depletion of soil moisture and right from seedling emergence, atmospheric temperature heighting to more than 40 ºC. These adoptive features embodied in mothbean against harsher, harder and unhospital growing situations for unspecified intervals have led this crop to be recognized as arid legume. It also endowed with broad canopy; wing and semi training growth habit also prove useful in keeping the soil moist and lowering soil temperature besides help in reducing the possibilities of soil erosion. Thus, it is a biological means of soil and moisture conservation as temporary in situ shetlter belts. These multi adoptive and adjusting natures have scaled mothbean as the only alternative annual crop of sand dunes, requiring no inputs and physical care. This crop is an essential component of sub segments of cropping systems prevalent and common in arid zone like agri-hortic, silvi-pasture, agro forestry, mix cropping, inter cropping and sole cropping, as well. It is, therefore, part of all systems including texturally common poor lands representing the holding of common people, characterized with poor, physical and financial resources. It grows well under uniform rainfall upto 750 mm per annum.

2. CROP STATUS

2.1. National Scenario

Eighth Plan (1992-97)**:** The area coverage and production were 14.36 lakh hectares and 3.21 lakh tonnes respectively, during the eight plans. Rajasthan ranked first both in area (88.28 %) and production (80.45 %) followed by Maharashtra (7.98 % and 10.92 %) and (3.36 % and 8.87 %) (table 8.1).

Ninth Plan(1998-02): During ninth plan, the area and production of moth was 11.12 lakh hectares and 2.12 lakh tonnes respectively. Rajasthan occupied first position accounting 90% area and 83% production share followed by Maharashtra (7.39% and 13.45%) and Gujarat with 2% area and 1.8% production share in the country.

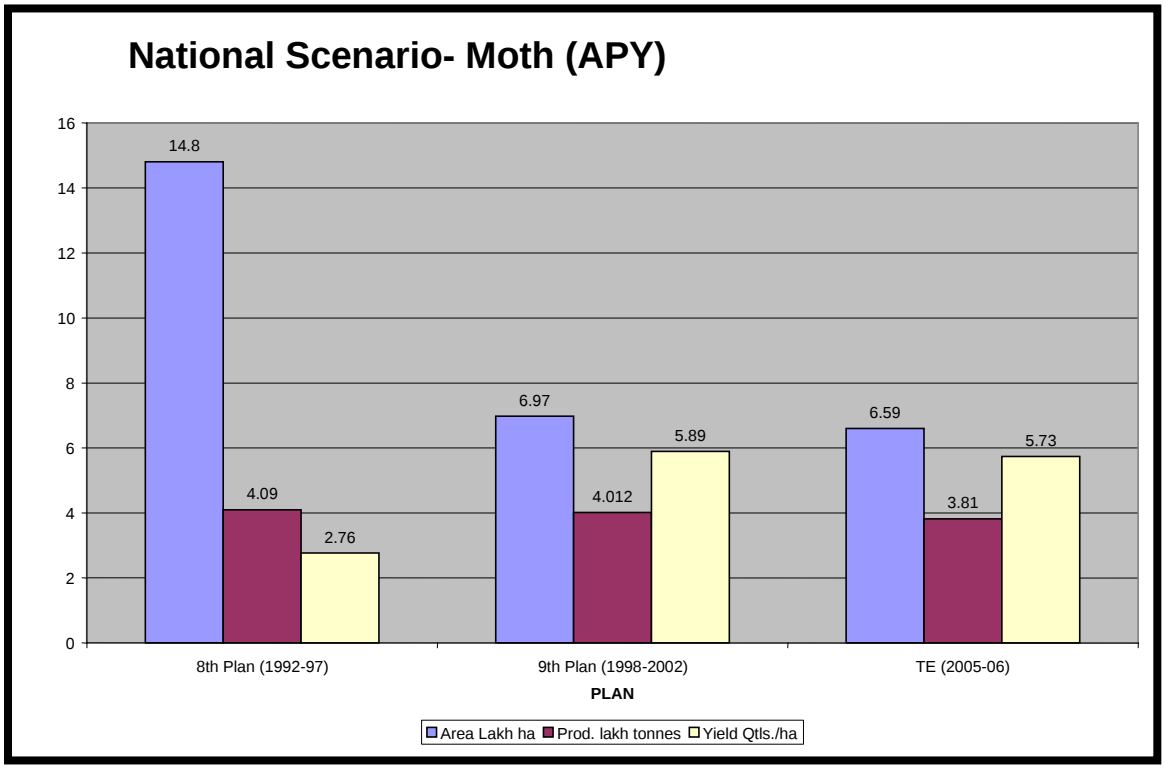
Tenth Plan (TE 2005-06): A total of 14.8 lakh hectares and 4.09 lakh tonnes of Moth production were recorded in the country during the triennium ending 2005-06 in India. Area and production of mothbean was maximum in Rajasthan contributing the lion's share accounting for 93.4 % of the country's total area and 91.9 % of the total production followed by Maharashtra (3% and 2.95%) and Gujarat (2.9 % and 4.3 %).

It was negligible in respect of other states vis-à-vis area and production of the crop during this period.

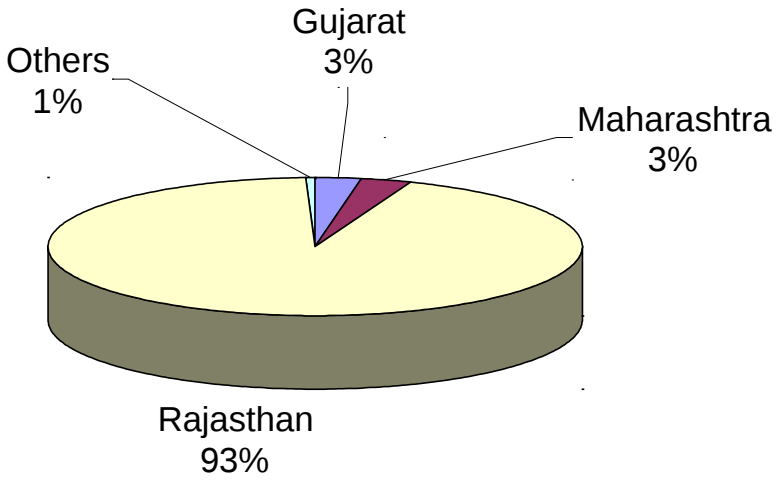
Table - 8.1. Plan-wise mothbean scenario - States

(A=Area Lakh ha, P=Production Lakh tonnes, Y= Yield Kg/ha)

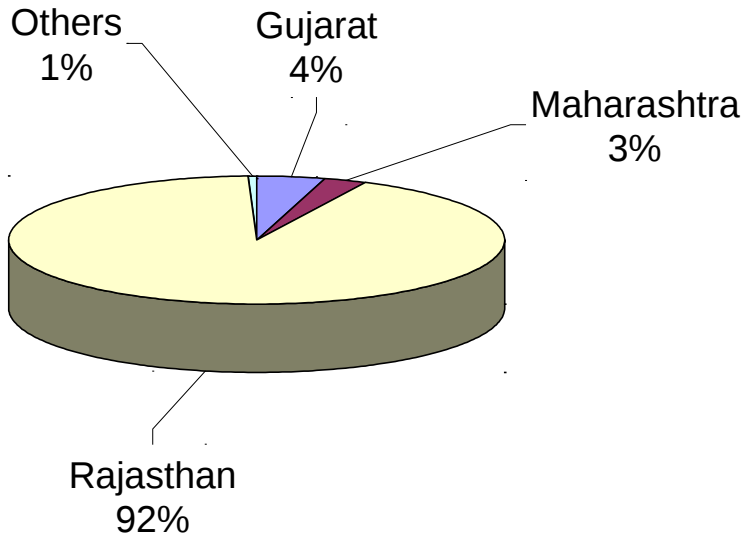
State		Eighth Plan	% to Country	Ninth Plan	% to Country	Xth Plan (T.E.2005-06)	% to Country
Gujarat	A	0.48	3.36	0.23	2.03	0.43	2.90
	P	0.28	8.87	0.04	1.87	0.18	4.30
	Y	494	220	96	54	400	151
Haryana	A	0.00	0.02	0.00	0.02	0.06	0.42
	P	0.00	0.03	0.00	0.04	0.01	0.17
	Y	467	208	400	222	125	47
Maharashtra	A	1.15	7.98	0.82	7.39	0.45	3.01
	P	0.35	10.92	0.29	13.45	0.12	2.95
	Y	376	168	339	188	268	101
Rajathan	A	12.68	88.28	10.07	90.58	13.85	93.41
	P	2.58	80.45	1.76	83.19	3.76	91.96
	Y	204	91	161	90	261	98
All India	**A**	**14.36**		**11.12**		**14.83**	
	P	**3.21**		**2.12**		**4.09**	
	Y	**224**		**180**		**266**	



National Scenario (T.E. 2005-06)- Moth Area



National Scenario (T.E. 2005-06)- Moth Production



3. MAJOR CONSTRAINT IN PRODUCTION- Besides low productivity, crop is known for plant types of primitive nature, conferring its evolution for survival but not for productive gains. Therefore, treated as neglected crop having marginal and secondary choice.

Abiotic Stresses of Mothbean

(i) Mechanical injury: in desert Rajasthan due to hot (>40^0c temp.) desicating wind causing removal of epidermis wilting and death.

(ii) Jhola (Hot streaming): When plants are 30-40 days old, 43^0c or more temp in concosmitant with high wind velocity, in September causes physiological disruption of growth, may lead to plant death.

Remedy to over come constraint

Alteration in plant type which should be high yielding and physiological efficient i.e. early partitioning, early maturing and semi erect to erect growth habits along with high Harvest Index, resistance to YMV and Bacterial leaf spot for yield proliferation. Insect pests, particularly Jassids, whiteflies, grubs, and storage pests also deserve special management strategies so that yield losses could be brought at the minimum.

4. PRODUCTION TECHNOLOGY

4.1. Climate: It can tolerate high temperature without any adverse effect on flowering and fruit development. Optimum temperature requirement for growth and development is 25-37ºc. Bulk of the cultivation is, confined to drylands of arid zone with 250-500 mm rainfall requirement with arrangement of proper drainage.

4.2. Varieties: Other than the following specific, varieties may be selected from **Table 8.2.**

a) **Normal maturity group** (> 90 days) Moth Guj. 1 (MG-1), Jadra (IPCMO 943), Jwala (IPCMO-926) , IPCMO 880 (26% Protein) b) **Medium maturity group** (70-90 days) with uniform rainfall throughout season (i) IPCMO 912 (ii) CZM 1 (both 75-80 days duration) c) **Early maturity group 60-65 days,** higher yield, escape terminal drought especially suitable for lat season, drought areas, resistant to YMV

(i) RMO-40 (62-65 days) (ii) RMO 257 (65 days) (iii) FMM 96 extra early (58-60 days), 5-7 Q/ha short statured + 18-20 Q Fodder (25-30 cm) and non spreading with synchronus maturity (iv) Maru Vardan (RMO 225) (v) Maru Bahar (RMO 435) - 15% high yield over RMO 257.

4.3. Seedbed preparation - preparation of soil aims at to store maximum soil moisture and to reduce subsequent requirement of tillage operations especially when sowing time is limitted. In a good rainfall year, one ploughing with mouldboard plough and a cross harrowing serve the purpose in arid conditions

of western Rajasthan. Other alternative is Sweep Cultivation with a ferti seed drill (developed at CAZRI) that can also be used for inter cultivation in wide spaced crop.

4.4 **Seed & Sowing**

Sowing Time: With the onset of monsoon. Generally start with first soaking rain to second rain after onset of monsoon. Optimum sowing time-II to III week of July. Delay in sowing may result in poor growth, poor germination, increased seedling mortality and incidence of pest and diseases and more conspicuously moisture stress at the flowering, the most critical stage.

Seed rate: 10-15 kg/ha (short staured, sprealing to erect RMO-40 type).

Spacing : 30-45 cm x 15 cm.

4.5. Cropping system

- Generally grown as single (mono) crop in a year mixed or as a sole crop. However, in a year of good rainfall, it can be rotated with mustard.
- Mixed cropping with pearlmillet, cluster bean, cowpea, mung & sesame in risk prone areas during monsoon. Varieties recommended are RMO 40 & FMM 96 of mothbean and HHB 67 of Bajra.
- Inter cropping (2:1) - 2/3 rows of mothbean in between two rows of pearl millet.

4.6. Tillage

Apply emergency tillage for stopping/reducing drafting of surface soil by increasing degree of surface run off that will reduce the surface wind velocity. (Emergency tillage-Making of rough strips on the filed at right angle to the wind direction to temporarily halt the surface movement). Practices for better soil moisture conservation like

Dust mulch by sweep cultivator, making staggering trenches with Pitter dicker (CAZRI) and Water harvesting contour bunding soil amendments, soil cultivator & mulching should be followed.

4.7. Plant nutrient management: Besides their N-fixing capacity they have greater power for absorbing less soluble form of 'P'. Roots have greater CEC hence capable of absorbing divalent catious like Ca++ and Mg++ but can not complete with cereals for monovalant K+. Recommendation is 20-25 t FYM for improving physical condition and improving water holding capacity of soil along with 10 kg N + 40 kg P_2O_5/ha as basal at the time of sowing or last preparation.

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4.8. Weed management: One hand weeding at 30 DAS + pre plant incorporation of fluchloralin (Basalin) @ 0.5 to 1 kg a.i./ha effectively controlled the weeds in mothbean.

4.9. Plant protection measures: Refer to **table 8.3**

4.10. Harvesting and storage: Crop is ready to harvest when pods get mature and turn brown. Plant show drying symptom or yellowing of leaves. Estimated Post harvest losses are 9-10% during threshing transportation, processing and storage. Sun drying, heat treatment, and storage at low temperature with low moisture percentage in seeds (8-9%), is recommended.

4.11. Yield: Fodder 12-25 Q/ha, Grain 3-8 Q./ha

Table – 8.2. Recommended varieties of moth/characteristics

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristics
Gujarat Moth-1	GAU	1978	Gujarat	7	110-115	Seed chocolate colour
Jadra	RAU	1980	Rajasthan	5	80-90	Seed dark brown
Jwala	RAU	1985	Rajasthan	6	85-102	Seed light brown
Maru Moth-1	CAZRI	1988	Rajasthan	7	80-85	Tolerant to YMV
Moth-880	RAU	1989	Rajasthan	8	90-100	Tolerant to YMV
Rajasthan Moth-40	RAU	1994	Rajasthan	8	60-70	Seed light brown
FMM-96	RAU Fatehpur	1996	Rain fed areas	5.5	58-60	Early maturing, erect
Maru Vardhan (RMO-225)	RAU Bikaner	1999	Rajasthan, Gujarat and Maharashtra	5.5	62-64	Early erect
CAZRI Moth -1 (CZM-79)	CAZRI	1999	For low rainfall areas (300-400mm)	6	70-72	Semi-erect, resistant to YMV

(Table – 8.2 continued)

Variety	Source	Year of Release/ Notifi-cation	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristics
Maru Bahar (RMO-435)	RAU	2002	Rajasthan, Gujarat, MS	6-6.5	65-67	Early maturing
CAZRI Moth 2	CAZRI	2003	Rainfed areas	5-7	70-72	
CAZRI Moth 3	CAZRI	2004	Rainfed areas	6-5	62-64	Erect, upright growth lush green foliage
RMO-257	RAO	2005	Rajasthan	6-7	63-65	Semi erect
Cazri moth-3	CAZRI, Jodhpur	2005	Rajasthan	6	60-88	Resistant to YMV and dry root rot
TMV (Mb)1	TNAU	2007	T.N.		65-70	
Rajasthan moth (RMO 257)	RAU, Bikaner	2007	Rajasthan	5-6	66	Tolerant to YMV

YMV= Yellow Moasaic Virus

Table – 8.3. Pest and diseases in mothbean and their management

Sl. No.	Common Name	Active Period	Incidence	Control Measures
	Sucking Pest			
i.	Jassids	II week of August to harvest	Regular	- Early sowing - Inter-croping with Pearl Millet (1:4).

ii.	White fly	II week of August to harvest	Regular	- Application of Phorate or aldicarb @ 1.25 kg a.i. effective upto 4 week. - Spray with monocrotophos @ 25 kg a.i./ha or dimethoate @ 0.15 kg a.i./ha.
iii.	Thrips	II week of August to harvest	Regular	
iv.	Aphid & mite	II week of Aug. to I week of Sept.	Sporodic minor pest	
	Soil/Foliage Pest			
v.	White grub	II week of August to harvest	Sporodic minor pest	Soil application of Phorate or aldicarb @ 1.25 a.i./ha before sowing.
vi	Termite	Entire cropping Season	Sporodic minor pest	Soil application of Phorate or aldicarb @ 1.25 a.i./ha before sowing.
vii.	Root Knot Nematode		Use	Aldicarb @ 1 kg a.i./ha or carbofuran @ 2 kg a.i./ha.
	Storage Pest			
viii.	Pulse beetle *calosobruchus chinensis*	During storage	Regular	- Carry Seed moisture level below 10% before storing. - Fumigation. Mixing/Smearing with neam leaves/cake & edible oils.

Name of Disease/ Causal Organism	**Disease Symptoms**	**Control Measures**
Anthracnose *(Collectotrichum spp.)*	Circular, black sunken spots with dark centres and bright red or orange margins on leaves and pods. In severe infection affected parts wither off.	i. Seed treatment with Thiram 3 m/kg of seed. ii. Spraying the crop with Dithane M- 45 @ 2.5 gm/litre of water.

HORSE GRAM

Botanical Name - *Macrotyloma uniflorum (Lam) Verdc*
Synonym - Kulthi
Origin - Peninsular India
Chromosome - 2n = 24

1. ECONOMIC IMPORTANCE - Horse gram is an important crop of south India. Its grain is used for human consumption as 'dal' as well as in preparation of so called 'rasam' and also as a concentrated feed for cattle. It may also be used as green manure. This crop is generally grown when the cultivator is unable to sow any other crop for want of timely rains and also grown in vacant space of citrus orchard. Horse gram is mainly cultivated in the states of Karnataka, Andhra Pradesh, Orissa, Tamil Nadu, M.P., Chattisgarh and in foot hills of Uttaranchal and H.P., in India. It is also cultivated in other countries mainly Sri Lanka, Malaysia, West Indies etc.

2 **CROP STATUS**

Eighth Plan(1992-97): During the Eighth Plan, the total area coverage of Kulthi in the country (Kharif and Rabi) was 10.98 lakh hectares with a total production

of 4.3 lakh tonnes. Karnataka ranked the first both in area and production with 33.1 % of the total area and 37 % of the total production followed by Maharastra (15.8 % and 15 % of area and production), at second while, Madhya Pradesh held third position in area (13%) and Tamil Nadu at third position in terms of production by contributing 11.1% of production.

Ninth Plan(1998-02): The total area and production during Ninth plan was 9.28 lakh hectares and 3.84 lakh tonnes respectively, Karnataka stands first in respect of area and production with 35.7% and 40.5% respectively. The second position in respect of area is occupied by Tamil Nadu (11.5%) followed by A.P. (10.37%) in production Tamil Nadu occupied second position with (13%) production followed by Bihar (12.1%).

Tenth Plan(TE 2005-06): In India, the total area under Horsegram and its production during the triennium ending 2005-06 was 6.99 lakh hectares and 2.57 lakh tonnes respectively.In terms of area and production, Karnataka topped the rank on all India basis contributing 39.4% and 42.4% respectively. Orissa rank second (12%) for area and A.P. for production (11%) while Tamil Nadu stand on third place both for area and production, contributing approximately 11% of area and 10.4% of production.

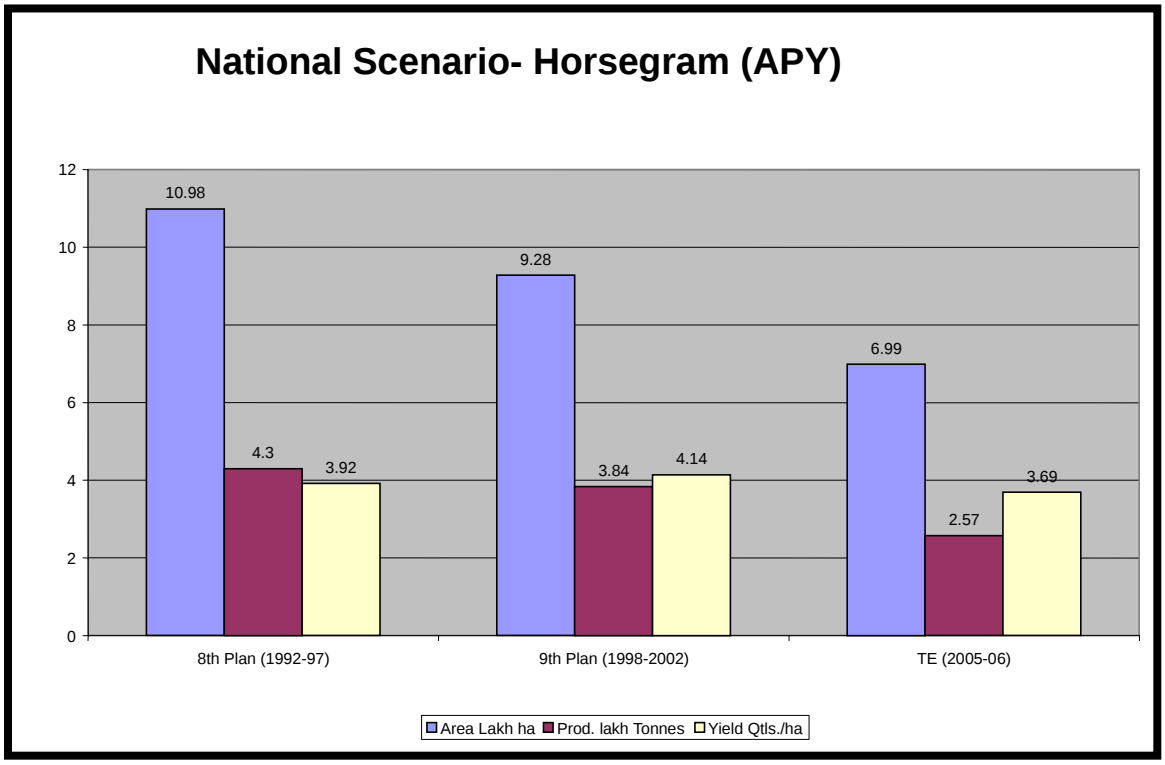
Table -9.1. Plan-wise horsegram scenario - States

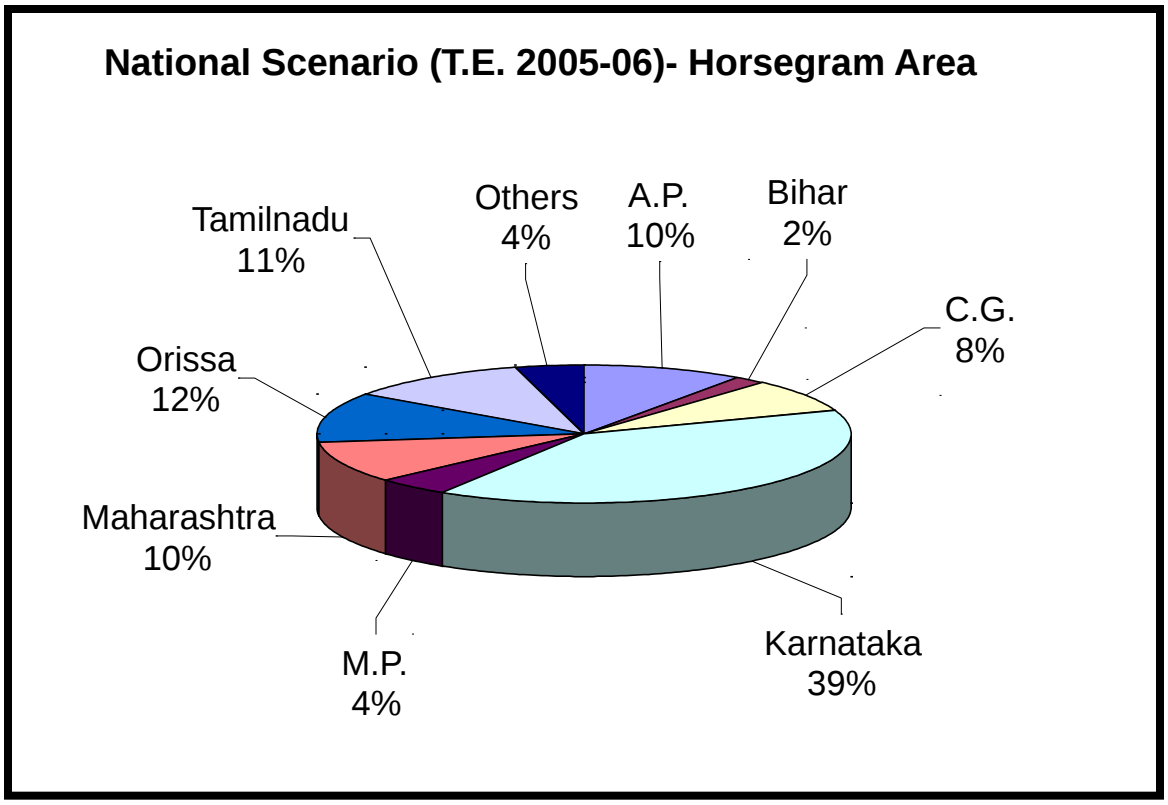
(Area Lakh ha, P=Production Lakh tonnes, Y= Yield Kg/ha)

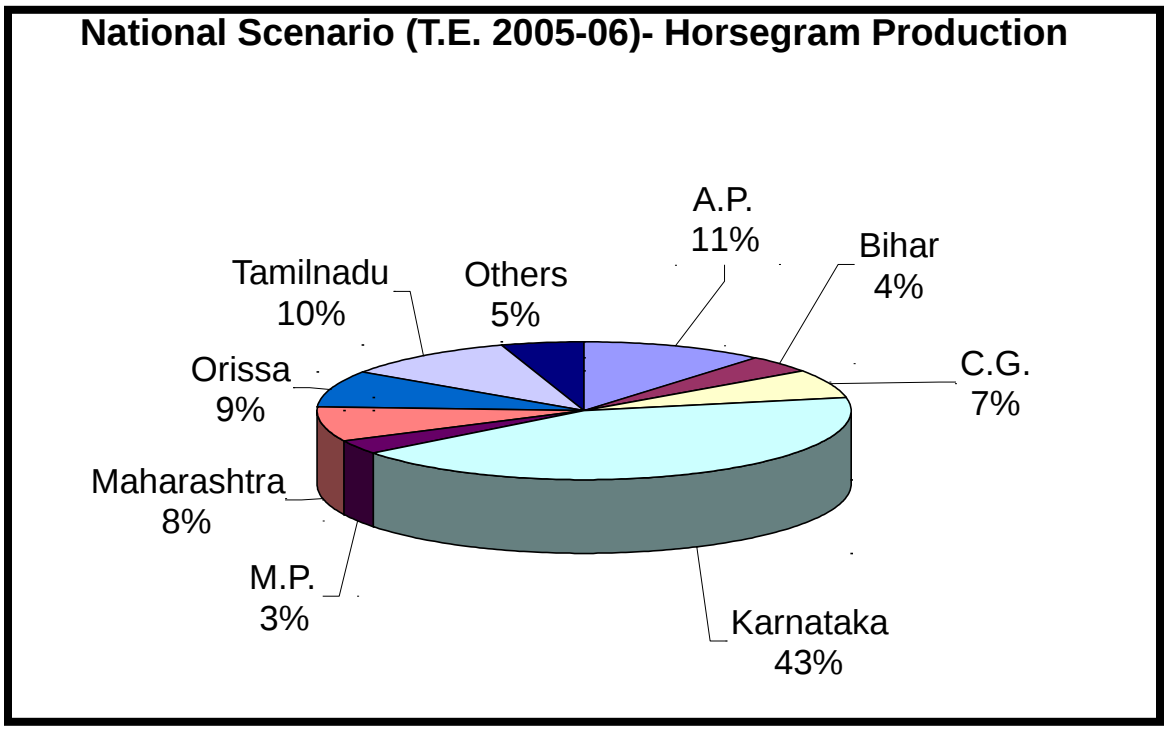
State		Eighth Plan	% to Country	Ninth Plan	% to Country	Xth Plan (T.E.2005-06)	% to Country
Andhra Pradesh	A	1.31	11.91	0.96	10.37	0.68	9.68
	P	0.45	10.59	0.35	9.18	0.28	11.05
	Y	350	90	367	89	412	112
Bihar	A	0.50	6.86	0.41	7.05	0.14	3.38
	P	0.24	8.24	0.28	12.19	0.11	7.14
	Y	455	116	719	180	802	212
Chhattisgarh	A	*		0.25	2.72	0.55	7.88
	P			0.08	2.07	0.17	6.69
	Y			126.29	31	312	85
Jharkhand	A	*		0.10	2.36	0.18	4.29
	P			0.08	4.86	0.07	4.54
	Y			282	74	400	106
Karnataka	A	3.64	33.12	3.32	35.78	2.76	39.42
	P	1.59	37.04	1.55	40.46	1.09	42.43
	Y	439	112	470	114	396	107
Kerala	A	0.14	3.86	0.09	2.44	0.03	1.13
	P	0.12	8.55	0.07	4.70	0.03	2.75
	Y	867	221	836	209	864	243

Madhya Pradesh	A	1.43	13.04	0.88	9.51	0.31	4.40
	P	0.43	10.00	0.24	6.14	0.09	3.45
	Y	300	77	252	61	288	78
Maharashtra	A	1.74	15.83	0.93	9.98	0.67	9.59
	P	0.64	14.97	0.32	8.42	0.21	8.00
	Y	373	95	345	83	306	83
Orissa	A	0.90	8.18	0.94	10.11	0.82	11.80
	P	0.27	6.39	0.24	6.38	0.22	8.65
	Y	323	83	257	62	270	73
Tamil Nadu	A	1.09	9.93	1.07	11.52	0.77	11.04
	P	0.48	11.09	0.50	13.06	0.27	10.43
	Y	426	109	474	115	341	92
West Bengal	A	0.07	1.91	0.05	1.51	0.03	1.12
	P	0.03	2.38	0.03	1.79	0.01	1.41
	Y	486	124	544	136	444	125
All India	**A**	**10.98**		**9.28**		**6.99**	
	P	**4.29**		**3.84**		**2.57**	
	Y	**391**		**414**		**369**	

* *New states carved out during 2000 (IXth plan)*







3. BOTANICAL DESCRIPTION - It is an annual herb, slender, with slightly twinning branches, semi-erect, low growing habit 30-50 cm height. Leaves are trifoliate yellowish green to green in colour. Pods are short, 3-5 cm long, linear,

with secured beak and 5-7 seeds. Seeds are flattened, 3-6 mm long, light red brown, black or mottled with hard seed coat.

4. PRODUCTION TECHNOLOGY

4.1. Climate: The crop is grown as dry land crop under low rainfall areas (100 cm) in both the major season kharif and rabi in southern states and in kharif in northern states, when most ideal temperature for its growth i.e. 20-34^{0}C prevails.

4.2. Soil: Generally grown on lateritic soil (poor in fertility) in south India. The crop can be grown on wide range of soils which are free from alkalinity.

4.3. Cropping System: Crop is grown as pure crop as well as mixed crop with sorghum, pearl millet, pigeon pea, sesame or niger.

4.4. Cultivation Practices

a) **Selection of varieties**: Select a best variety as per the growing season and purpose of cultivation from **Table – 9.2.**

b) **Field Preparation**: The crop needs minimum field preparations. Only 1-2 ploughings followed by planking provides desirable seed-bed.

c) **Sowing time**: The main season for sowing horse gram is late August-November. As a fodder crop it is sown during June-August. In Tamil Nadu, it is sown in September-November. In Maharashtra, horse gram is sown as a kharif crop, mixed with bajra or sometimes Niger and also in the Rabi in rice fallows. In M.P. it is a Rabi crop. In northern parts it is grown as **kharif** crop. In West Bengal the sowing period is October-November.

d) **Seed Rate**: Generally sown as broadcast with 40 kg/ha seed rate for dual purpose i.e. grain and fodder. For line sowing 22-30 kg/ha is enough for grain crop.

e) **Row Spacing**: 40-45 cm during kharif and 25-30 cm during Rabi.

f) **Fertility Management**: 10 kg nitrogen and 20 kg P_2O_5 per ha as basal application at the time of sowing 2-5 cm below and in the side of the seed with the help of ferti.-seed drill is enough for good management of crop.

g) **Water Management:** Grown as rain fed.

h) **Weed Management**: Due to luxuriant growth an early weeding/hoeing is enough for weed management in kharif.

4.5. Plant Protection: Refer table 9.3

4.6. Harvesting, **threshing & storage**: As usual with other kharif pulses of Vigna group, clean seed should be sun dried for 3-4 days to bring their moisture content at 9-10% to be safely stored in appropriate bins. To avoid further development of bruchids and other storage pests it is recommended to fumigate the storage material before onset of monsoon and again after the monsoon with ALP @ 1-2 tablets per tonne. The small quantity of the produce can also be protected by mixing inert material (soft stone, lime, ash, etc) or by smearing edible/non-edible vegetable oils or by mixing plant products like neem leaf powder at the rate of 1-2% w/w basis.

4.7. Yield: By adopting improved package of practices one can harvest 6-10qtls of grain/ha depending upon the monsoon behavior.

Table – 9.2. Recommended varieties of horsegram/characteristics

Variety	Source	Year of Release/ Notifi-cation	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristics
Madhu	BAU	1978	Bihar	15	108	Seed creamy with red spots
Dapoli-1	KKV	1986	Mahatashtra			
Deepali (HPK-6)	HPKVV	1988	Himachal Pradesh			
Marukulthi-1	CAZRI	1989	Rajasthan	7	93	Seed light brown
Man	MPKV	1989	Maharashtra	7	105	
KS 2	RAU	1991	Rajasthan			Early maturing, seed brown
Palem 1	ANGRAU	1998	A.P	10-12	80-85	Early maturing, Semi-spreading
Palem 2	ANGRAU	1998	A.P	8-9	100-105	Med. maturing
Arja Kulthi 21 (AK-21)	MPUAT Bhilwara)	1998	Rainfed areas of NW parts	8-9	70-105	Early maturing
Paiyur 2	TNAU	2001	SZ	8-9	100-106	For Sept- Oct sowing
PHG 9	UAS	2001	SZ	7-9	100-105	Semi spreading thick foliage

(Table – 9.2. continued)

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristics
Pratap Kulthi -1 (AK 42)	MPUAT	2004	North Western parts	10-12	83-87	Protein 30% lush green foliage with wax deposition
VL Gahat-10	VPKAS, Almora	2007	Uttarakhand	10	110-115	Resistant to yellow mosaic, root rot and leaf spot disease

SZ- South Zone (A.P., Karnataka, Tamil nadu, Orissa)
NWPZ- North Western Plane Zone (Punjab, Haryana, Delhi, West UP & North Rajasthan)

Table – 9.3. Pest and diseases in horsegram and their management

Insect Pest/Disease/ Causal Organism	Nature of Damage/ Symptoms	Control Measures
i. Aphids	The adults and nymphs suck the juice from the leaves as a result turn brown and crumpled and the plants look sick.	Monocrotophos @ 0.04% or Metasystox.
ii. Jassids	The adults and nymphs suck the juice from the leaves as a result leaves turn brown an leaf surface become uneven. In severe infection leaves dry up and fall and weaken the plants.	Monocrotophos 40 EC @ 0.04% or conc or confidor 200 SL @ 7.5 ml/10 litre of water.

iii. Pod borer	It is a polyphagous insect. Caterpillar makes hole in pods, sometime also feed seed.	Endosulfan 35 EC @ 0.05% and/or Monocrotophos 36 EC or NPV @ 250 LE/ha.
iv. Yellow Mosaic Virus vector-white fly	The symptoms firstly appear on young leaves in the form of yellow, diffused, round spots scattered on the leaf lamina. The infected leaves turn necrotic. The diseased plants usually mature later and bear relatively few flowers and pods. The pods are stunted and mostly remained immature but whenever seeds are form they are small in size.	i. Grown resistant varieties. ii. Destroy the infected plants. iii. Apply Phorate or Disulfoton granules @ 1 kg a.i. per ha. at the time of sowing. iv. Spray the crop with Metasystox @ 1 ml per litre of water to control Vector population.
v. Root rot (Rhizoctonia olani)	Roots rot and plants show yellowing of the lower-most leaves followed by wilting.	i. Seed treatment with 2 g captan/kg of seed. ii. Avoid early sowing in infested areas

LATHYRUS

Botanical Name - *Lathyrus sativus* L.
Synonym - Grass pea, Chickling pea, Khesari, Teora, Kasari (bengali)
and Kisara (Nepali)
Origin - South Europe and Western Asia
Chromosomes - 2n =14

1. ECONOMIC IMPORTANCE - Lathyrus is considered as drought-tolerant hardy crop, and is grown in low-rainfall regions under rainfed conditions, during winter when lentil and chickpea are not expected to give good yields. The crop has unique tolerance ability against stress environmental conditions not only drought but also for water logging. In addition to use as dal and chapatti, it is usually grown as fodder crop. Lathyrus leaves about 36-48 kg/ha nitrogen economy for the succeeding cereal.

Nutritive value

Protein	-	31.9%	Fat	-	0.9%
Carbohydrate	-	53.9%	Ash	-	3.2%

2. BAN ON CONSUMPTION/SALE OF LATHYRUS

2.1. A POLICY ISSUE

Its grain and other parts contain a neurotoxin called ODAP (β-N-Oxalyl-L-α, β-diaminopropionic acid), which is supposed to cause lathyrism, characterized by paralysis of lower limbs to human beings if regularly consumed.

Khesari Dal (lathyrus sativus) has been a subject of controversy among the agricultural scientists, nutrition experts and the farming community in the country for many decades. Though, admittedly a high protein pulse, its sale was banned by the Government as early as in 1961, under the Prevention of food Adulteration Act, 1954, on the ground that its consumption was harmful to health. The controversy arose from the conclusions of certain studies conducted in the past that it contains a toxic element called BOAA (B-N-oxalyl-aminoalanine), now ODAP, which causes a crippling affliction of the central nervous system called Lathyrism. The ban has been prevailling in all the States/Union Territories except states of Madhya Pradesh, Chhattisgarh, Bihar and West Bengal. Since, there is no provision under PFA to ban its cultivation, khesari Dal still continues to be grown.

2.2 BRAIN STORMING SESSION ON LATHYRUS
- An initiative to sort-out issues on ban

A Brain storming session on lathyrus dated 20.12.2005 was convened under the Chairmanship of Mrs. Radha Singh, the then Secretary (A&C) specifically for two reasons:

i) Academy of Nutrition Improvement, Nagpur, {Soyamilk Complex, Sitabuldi, Wardha Road, Nagpur–440 012 (MS)}, an NGO has been making complaints/putting the case before the Department of Agriculture & Cooperation for lifting of the ban on sale of lakh/lakhodi dal imposed in 1961 by the State Government of Maharashtra in pursuance to Ministry of Health & Family Welfare circular under PFA rule, 1955 on the ground that its consumption is associated with the disease “Lathyrism” causing “Crippling paralysis” due to presence of Beta-n-oxalyl-aminoalanine (BOAA) content, now termed as ODAP.

ii) Rule 44-A-Sale of khesari grain prohibited:- The Ministry of Health & Family Welfare says “No person in any state shall with effect from such date as the State Government concerned may, by the Notification in official Gazette specify in this behalf, sell or offer or expose for sale, or have in his possession for the purpose of sale, under any description or for use as an ingredient in the preparation of any article of food intended for sale of khesari grain and its mixture”.

The concerned State Governments, based on the consumption behavior vis-a-vis incidence of lathyrism causing crippling analysis, in consultation with the State Health & Family Welfare Department promulgated the advice of the Ministry of H&FW under the provision of the PFA 1954.

iii) The States of Chattisgarh, Jharkhand and West Bengal did not issue any ban notification on the sale of the produce of this crop, whereas, the State Agriculture Departments of M.P. and Orissa, also confirmed of non-imposition of such ban. Thus, as on date 05 states are out of purview of the ban.

High Power Committee on lathyrus:

On consistant request from the Maharashtra based NGO, ANI, (Nagpur) for lifting of ban on sale in their state, the Parliamentary Standing Committee on Agriculture constituted a 'High Power Committee' under the Chairmanship of Secretary DARE – cum-DG, ICAR, with the approval of Agriculture Minister. The other Members of the Committee were the Secretaries of Agriculture and Health, Government of India; State Agriculture Secretaries of Government of M.P., MS, Orissa and West Bengal; Directors from NIN, Hyderabad; IARI New Delhi; ITRC, Lucknow; Pulses Research Institute (Now IIPR, Kanpur); Directors of Research BCKVV, West Bengal; OUAT, Orissa; IGKVV, M.P.; DG Maharashtra Council of Agriculture Research, Pune; DDG, Crop Sciences (ICAR); Director – DG – ICMR, New Delhi including Dr. S.L. Kothari, the president of the Maharashtra based NGO, ANI, Nagpur.

- The High Powered Committee, in its recommendation revealed that continued consumption of khesari (*Lathyris sativus*) which contains BOAA, causes lathyrism. The Committee, however, did not give any "threshold levels" to precisely establish to determine in a specific quantitative terms and inter alia recommended further research/data generation to determine the threshold doses from where the real risk starts. The 'Parliamentary Standing Committee' on Agriculture unanimously adopted the recommendation report of the High Powered Committee in its sitting dated 8th November, 2001.
- Accordingly, the Ministry of Agriculture on the recommendation of this Committee and also of the Ministry of Health & Family Welfare, had funded a study to NIN, Hyderabad on project proposal on 'Experimental Neuro lathyrism in goats/sheep' to determine the threshold doses of consumption of khesari dal for Rs.11,89,400/- for a period of two years (2002-03 to 2003-04).
- As regards the cultivation of khesari as a crop in the existing cropping system of paddy fallow/utera conditions/some rainfed ecosystems, etc is concerned, the practice is traditional due to hardy nature of crop and its suitability etc. It is also an accepted fact that almost all the State Governments are discouraging its production through replacement of lentils. The replacement programme may further be pursued under the existing ISOPOM programme by replacement of old varieties through new bred Ratan (BIO-L-212) and Prateek (BIO-L-208) varieties having low ODAP content (0.05%).

As per the information, more than 20 year's old-age traditional consumption behavior of this pulse has also changed and the khesari is no

more being consumed as staple food probably this factor need to be viewed by the Ministry of Health in its totality, to take a policy decision on its more than 46 years old ban notification.

3. CROP STATUS

Eighth Plan (1992-97)*: T*he total area and production of Khesari was 9.29 lakh hectares and 5.4 lakh tonnes respectively. Out of these, Madhya Pradesh ranked first in both production and productivity (71.3% and 60 %) followed by Bihar (20.8 % and 30.5 %). and Maharashtra third (4.5 %) in area while West Bengal ranked third in production (6.2 %).

Ninth Plan (1998-2002)***:*** The total area and production of lathyrus were 6.97 lakh hectares and 4.01 lakh tonnes. M.P. stands first in respect of area and production (47.5% and 34.0%) followed by Bihar (23.6% and 37.1%) respectively.

Tenth Plan (TE 2005-06): The total area and production of Khesari were recorded at 6.59 lakh hectares and 3.81 lakh tonnes respectively. Chattisgarh ranked the first position both in area and production (66.5 % and 55.2 %), followed by Bihar (17.4 % and 24.6 %) and Madhya Pradesh (6.7 % and 8.2 %), respectively.

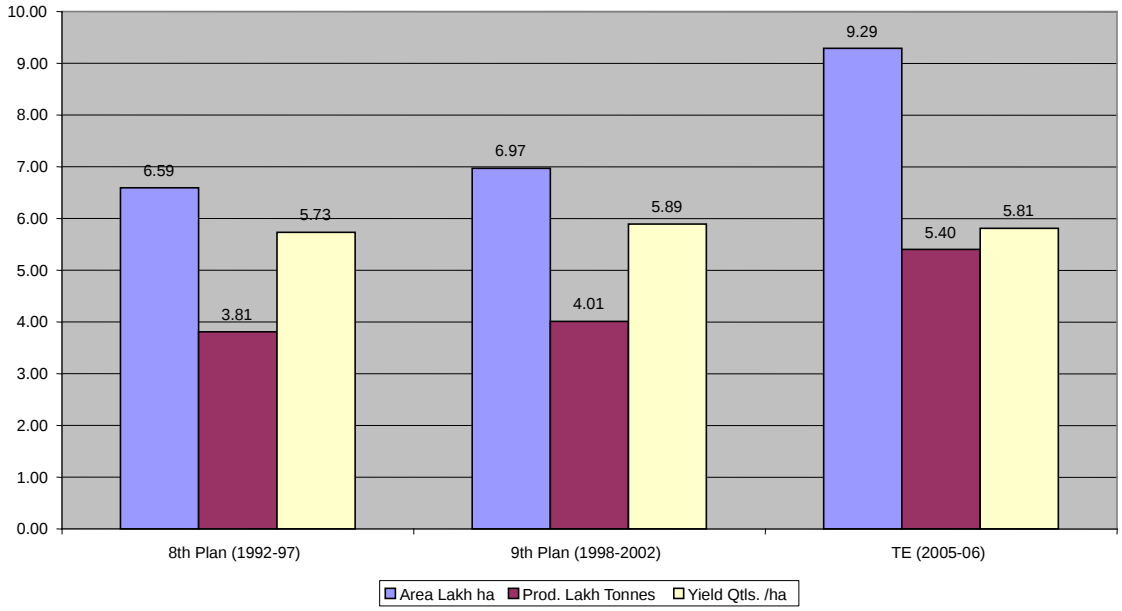
Table - 10.1. Plan-wise lathyrus scenario - States

(A=Area Lakh ha, P=Production Lakh tonnes, Y= Yield Kg/ha)

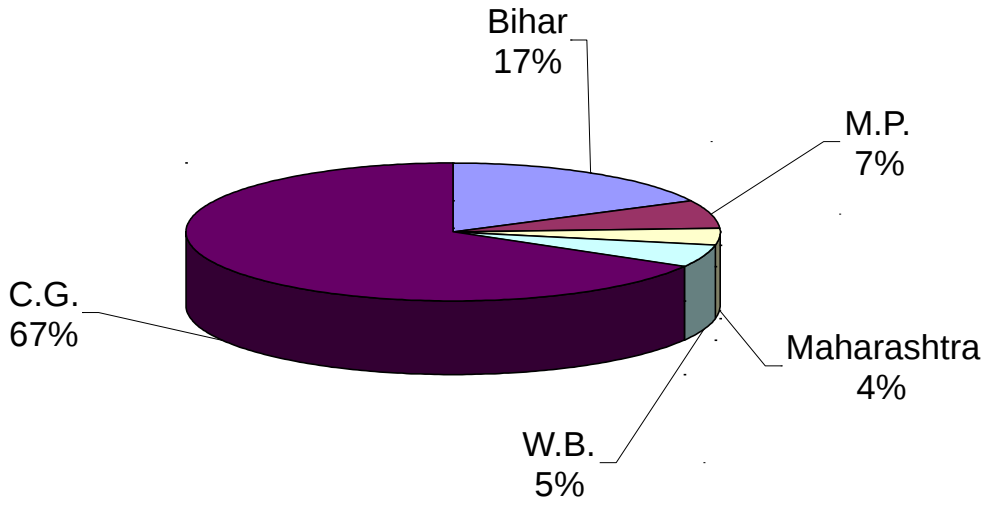
State		Eighth Plan	% to Country	Ninth Plan	% to Country	Xth Plan (T.E.2005-06)	% to Country
Bihar	A	1.94	20.85	1.65	23.64	1.14	17.37
	P	1.65	30.52	1.49	37.15	0.94	24.58
	Y	847	146	904	153	816	142
Madhya Pradesh	A	6.62	71.30	3.31	47.46	0.44	6.70
	P	3.24	59.96	1.37	34.07	0.31	8.16
	Y	489	84	513	87	701	122
Maharashtra	A	0.41	4.45	0.36	5.10	0.27	4.09
	P	0.18	3.32	0.16	3.93	0.11	2.85
	Y	427	74	441	75	390	68
West Bengal	A	0.31	3.36	0.32	4.61	0.35	5.26
	P	0.33	6.19	0.32	8.00	0.35	9.15
	Y	983	169	997	169	1003	175
Chhattisgarh	A	*		1.34	19.16	4.39	66.58
	P			0.68	16.93	2.10	55.21
	Y			197	34	476	83
All India	**A**	**9.29**		**6.97**		**6.59**	
	P	**5.40**		**4.01**		**3.81**	
	Y	**581**		**589**		**573**	

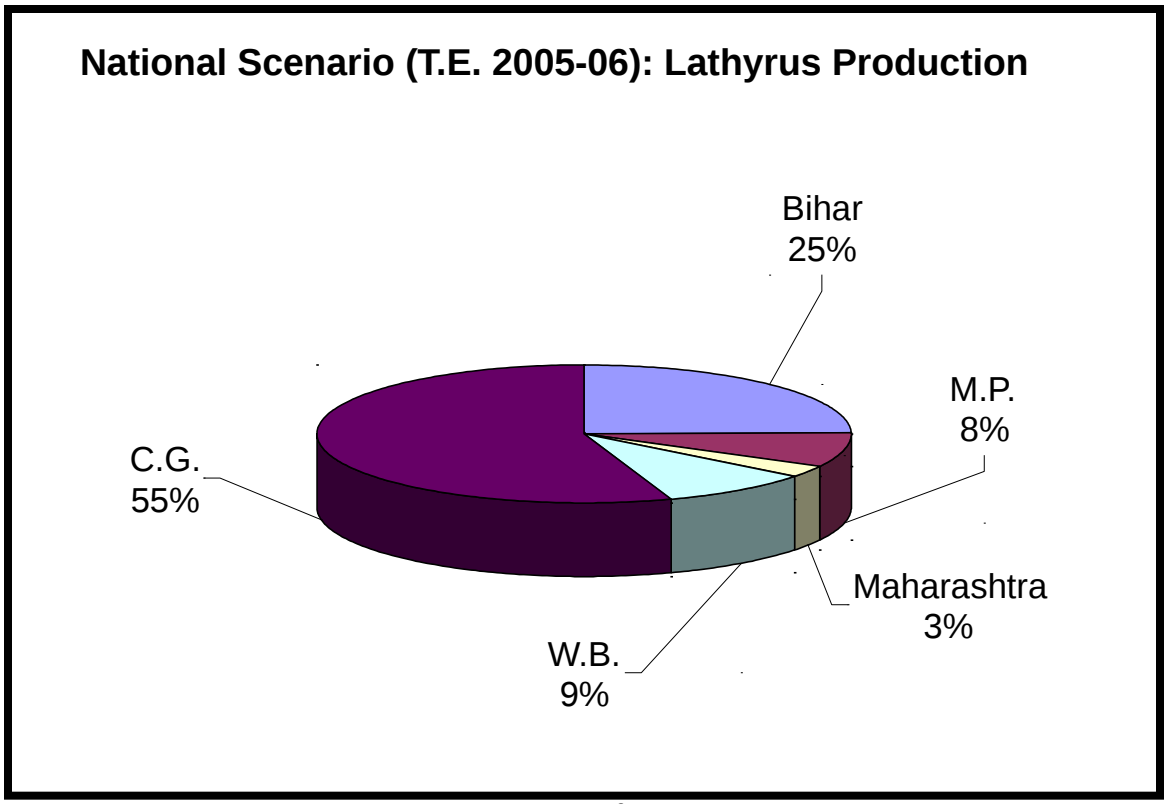
** Newly carved state during 2000*

National Scenario: Lathyrus (APY)



National Scenario (T.E. 2005-06): Lathyrus Area





4. BOTANICAL DESCRIPTION: Plant of lathyrus is herbaceous annual with slender, glabrous, well branched, winged procumbent stems. Pods are flattened, oblong, up to 4 cm long; two winged dorsally, up to five seeded. Seeds are wedge shaped, angular, white or brown sometimes mottled. Germination is hypogeal.

5. PRODUCTION TECHNOLOGY

5.1. Climate: Being a winter season crop it prefers temperate climate with good adoption under climatic extremities.

5.2. Varieties: Refer table 10.2.

5.3. Soil and its preparation: Thrive well in all types of soils except of very acidic nature. It prefers heavy soils belonging to low lying areas which are not suited to other crops. It grows abundantly in loamy and deep black soils and produce excellent crop. For cultivation of lathyrus under *utera* system (relay cropping), no tillage is required. However, for planting after harvest of rice, one deep ploughing followed by cross harrowing and planking is necessary.

5.4. Cropping System: It is grown as single crop of the year in areas where water gets accumulated during rainy season or as a relay crop after paddy often as utera / paira crop in standing paddy, due to its ability to withstand in high moisture conditions at sowing time and moisture stress during growth period.

5.5. Seed & Sowing

Sowing Time: Crop is sown on residual soil moisture after harvest of kharif during last October to early November as pure crop. In utera cropping last week of September or first week of October.

Seed Rate: 70-80 kg/ha for broadcasted sowing in utera system and 40-60 kg/ha in line sowing is required.

Spacing : Under utera cropping sown as broadcasted in-between the rice rows. Whereas normal spacing 30 cm x 10 cm is recommended.

Utera/Paira cultivation: In utera cropping seeds of small seeded lathyrus is generally broadcasted in standing paddy crops (2-3 weeks before its harvest, after draining the excess water by the end of September or early October). However, planting time largely depend upon cessation of monsoon rains and maturity of rice crops. Seed must be inoculated with Rhizobium and PSB before broadcasting.

5.6. Plant Nutrient Management

Under utera cropping the crop is grown on residual fertility of rice. However, it respond well to phosphorus up to 40-60 kg /ha except in the case if grown on highly phosphorus fertilized paddy field. For normal crop 100 kg DAP + 100 kg gypsum/ha is a optimum dose of fertilizer applied as basal dose 2-3 cm side and below the seed with the help of ferti-seed drill, is recommended.

5.7. Water Management: the crop is grown as rain fed crop on residual moisture. However, under high moisture stresses one irrigation at 60-70 days after sowing may be remunerative in terms of production.

5.8. Weed Management: For normal sown crops one hand-weeding at 30-35 days after sowing (if soil condition permit). Weeds can also be managed effectively by spray of fluchloralin (Basalin) 35 EC @ 1 kg a.i./ha in 500-600 liters of water as pre-plant incorporation.

5.9. Plant Protection: Refer table.10.3.

5.10. Harvesting, threshing & storage: Harvest the crop with the help of sickle when colour of pods change to brown and grains are at dough stage having approximately 15% moisture in-side them. Harvested produce may be allowed to dry in sunlight for a week. Harvested produce after 3-4 days sun drying is roaped in the bundles and transferred to threshing floors. Threshing is done by beating with sticks or trampling under the feet of bullocks. The clean seed should be sun dried for 3-4 days to reduce their moisture content up to 9-10%. Now the produce should be safely stored in appropriate bins. The small quantity of the produce can also be protected by mixing inert material (soft stone, lime, ash, etc).

5.11. Yield: A well managed crop can easily give 8-10qtls/ha yields under direct sowing and 3-4qtls under utera cultivation.

Table – 10.2. Recommended varieties of lathyrus/characteristics

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristics
Bio L-212 (Ratan)	IARI	1997	NEPZ	15.0	108-116	Tolerant to stress, Low ODAP, Bold seed, Blue flower.
Prateek		2001	M.P	6-9 (utera) 11-15 (sole)	110-115	Tolerant to Downey mildew & Moderately resistant to Powdery mildew

CZ- Central Zone (MP.,Maharashtra, Chhattisgarh, Gujarat) NEPZ-North East plane Zone (East Uttar Pradesh, Bihar, Jharkhand, West Bengal).ODAP= β-N-Oxalyl-L-α, β-diaminopropionic acid

Table – 10.3. Pests and diseases in lathyrus and their management

Insect Pest/Disease/CO	Nature of Damage/ Symptoms	Control Measures
i. Aphid	The adults and nymphs suck the juice from the leaves as a result, leaves turn brown and crumpled and the plant look sick.	Monocrotphos @ 0.04% or Metasystox.
ii. Rust *(Uromyces fabae)*	Pink to brown pustules appeared on leaves and stems. In severe attack, the affected plants amy dry.	i. Grow early maturing variety. ii. Seed Treatment with Agrosan GN @ 2.5 g/kg seed. iii. Spray the crop with Maneb, Zined or Ferbam @ 2.5 g/litre.
iii. Downy Mildew *(Peronospora spp.)*	Brownish cottony growth of fungus may be seen on the lower surface of leaf. Inside growth yellow to greenish spots are also visible.	Spray with Agrosan GN 0.25%)
iv. Powdery Mildew *(Erysiphe polygoni)*	Symptoms first appeared on all the aerial part of plant. While powdery masses of spores formed on leaves which may collapse and cover the whole leaf with powdery growth.	Wettable Sulphur @ 3 gm/ litre or Dinocap @ 1 ml/litre of water.

RAJMASH

Botanical name - *Phaseolus vulgaris L.*
Synonym - Kidney bean, common bean, haricot bean, snap bean and French bean
Origin - Central America and south Mexico
Chromosome no. - 2n = 22

1. ECONOMIC IMPORTANCE – Rajmash, an important pulse crop, with high yielding ability as compared to gram and pea, require focussed attention both at the development and policy front. It is grown in Maharahstra, H.P., U.P., J&K., and NE states covering 80-85 thousand ha area. However, its cultivation during rabi and summer is also gaining popularity in northern Indian plains. Traditionally Rajmash is grown during kharif in Hills of Himalayas, however; high yield is attainable in Rabi in plains due to better management.

Nutritive value:

Protein	-	22.9%	Calcium	-	260 mg/100g
Fat	-	1.3%	Phosphorus	-	410 mg/100g
Carbohydrate	-	60.6%	Iron	-	5.8 mg/100g

2. BOTANICAL DESCRIPTION - Plants may be bushy or climbing type. Bushy cultivars are day neutral, early maturing, dwarf plants, 20-60 cm tall with lateral and terminal inflorescence and consequently determinate growth habit. Climbing cultivars are indeterminate, and may grow 2-3 m tall if they have support to climb

by twining. The pods are slender, 10-20 cm long, straight or curved and terminated by a pointed beak. They contain 4-6 seeds which vary greatly in size and colour. Germination is epigeal.

3. PRODUCTION TECHNOLOGY

3.1. Climate: In the hilly region it is grown during kharif and in lower hills/tarai region, sown as spring crop. In north-east plains and hilly tracts of Maharashtra, it is cultivated during rabi. It is highly sensitive to frost and water logging. The ideal temperature range for proper growth of this crop is 10-27^{0}C. Above 30^{0}C, the flower drop is a serious problem. Similarly, below 5^{0}C the flowers and developing pods and branches are damaged.

3.2. Soil: The crop can be grown in light loamy sand to heavy clay soil under adequate moisture. Among various pulses, Rajmash is most sensitive to salt stress and sodicity. Therefore, soil must be free from excessive soluble salts and neutral in reaction.

3.3. Cropping System: In hills, it is grown as intercrop with maize in 1:2 ratios. In-between two rows of maize sown at 90 cm apart, two rows of Rajmash are adjusted at 30 cm spacing with the plant population of 120000 of Rajmash and 40000 of maize. It is also grown mixed with maize and soybean.

In plains it is grown as spring season crop after harvesting of potato and mustard. It is also found quite compatible for intercropping with early potato due to its high nitrogen requirement and wet moisture regime in 2:2 or 2:3 row ratios.

3.4 Varieties: Selection of varieties as per the growing season and purpose of cultivation from **table – 11.1.**

3.5. Field Preparation: Rajmash having bold and hard seed coat needs a good seed bed accomplished by thorough primary tillage like ploughing, harrowing or discing and planking. A good seed bed have friable but compact soil adequate moisture and free from weeds and plant debris of earlier crop. Acidic soils of the hills must be treated with lime before sowing.

3.6. Seed and Sowing

Sowing time:

Kharif (Hills) last week June to first of July; Rabi (Plains) 2nd fortnight of October and for spring (Lower hills) 2nd fortnight of March

Seed Rate for small seeded 70-75 kg/ha and for bold seeded 100-125 kg/ha

Plant Spacing:

Kharif (Hills) - 45-50 cm x 8-10 cm; Rabi & Spring - 40 cm x 10 cm (irrigated)

30 cm x 10 cm (Rain fed)

3.7. Plant nutrient management:

Unlike other Rabi pulses, Rajmash is very inefficient in biological nitrogen fixation owing to poor nodulation due to non availability of suitable and efficient Rhizobium strain for Indian plains. Hence, it requires relatively higher doses of fertilizer N. For enhanced productivity, application of 90-120 kg N ha^{-1} has been found optimum. Half of the nitrogen should be applied as basal during sowing and rest half as top dressing after first irrigation.

Rajmash responds well to phosphorus application like cereals. Its P requirement is distinctly higher than other pulse crops, significant response to P application has been obtained up to a level of 60-80 kg P_2O_5 per ha.

3.8. Water Management: Rajmash is the most irrigation responsive pulse crop due to its shallow root system and high nutrient requirements. It requires 2 to 3 irrigations in NEPZ and 3 to 4 irrigation in CZ for achieving highest productivity. Irrigation at 25 days after sowing is most critical followed by irrigation at 75 days after sowing.

3.9. Weed Management: One hand weeding/hoeing at 30-35 days after sowing or application of a pre-emergence herbicide like pendimethalin @ 1 to 1.5 kg a.i./ha in 500-600 liters of water immediately after sowing helps to keep the losses by weeds below ETL (Economic Threshold Level).

3.10. Harvesting, threshing & storage: The crop mature in 125-130 days. Plants are cut with sickles after attaining full maturity judged by severe leaf fall, changing colour of pods and hardness of the grains.

Harvested materials, after 3-4 days sun drying, is collected in bundles to the threshing floors. Threshing is done by beating with sticks or trampling under the feet of bullocks.

The clean seed should be sun dried for 3-4 days to bring their moisture content at 9-10%. To avoid further development by bruchids and other storage pests it is recommended to fumigate the storage material with ALP @ 1-2 tablets per tonne before onset of monsoon and again after the monsoon. The small quantity of the produce can also be protected by mixing inert material (soft stone, lime, ash, etc) or by smearing edible/non-edible vegetable oils or by mixing plant products like neem leaf powder at the rate of 1-2% w/w basis.

3.11. Yield: A well managed crop can easily give 20-25qtls/ha yields under irrigated conditions of plain and 5-10qtls/ha under rain fed conditions of hill with 40-50qtls/ha of straw for cattle's.

Table – 11.1. Recommended varieties of rajmash/characteristics

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristics
Him 1	HPKVV	1978	HP	15-20	75-80	Seed light pink and red
VL 63	VPKAS	1982	UP Hills	12	73	Seed light red with deep patches

Uday (PDR 14)	IIPR	1987	NEPZ	18	125	Seed red white variegated
Malviya Rajmash 15	BHU	1989	NEPZ	15	120	Seed white
HUR-137 (Malviya Rajmash-137)	BHU	1991	NEPZ	18-22	112-120	Erect semi dwarf, Red.
HPR-35	HPKVV	1992	Maharashtra	14-15	73	Seed red with Purple strips.
Varun (ACPR 94040)	IIPR	2002	Maharashtra	14-16	66-68	Tol. to Anthracnose
IPR 96-4 (Amber)	IIPR	2002	NEPZ	15-16	139	Res.to BCMV & Leaf Curl. Red
Ankur (RSJ-178)		2005	Rajasthan	12	110-120	Moderately resistant to root rot, leaf crinkle and leaf spot dry root rot.
Gujarat Rajma-1		2006	Gujarat	20		Moderate resistant to bean common mosaic virus

NEPZ-North East plane Zone (East Uttar Pradesh, Bihar, Jharkhand, West Bengal).

COWPEA

Botanical Name - *Vigna anguiculata*
Synonymous - Lobia, Barbati, Black eyed pea
Origin - Africa
Chromosome - 2n = 22

1. ECONOMIC IMPORTANCE - This crop is known as drought hardy nature, its wide and droopy leaves keeps soils and soil moisture conserved due to shading effect. Initial fast growth with fast penetrating root system and strong stomatal sensivity justify its initial establishment in soil moisture deficit conditions. It is also known as Cowpea, black-eyed pea or southern pea etc. and has multiple uses like food, feed, forage, fodder, green manuring and vegetable. Cowpea seed is a nutritious component in the human diet, and cheap livestock feed as well. Choice of cowpea as vegetable is due to being palatable, highly nutritious and relatively free of metabolites or other toxins. Fresh leaves and fast growing twigs are often picked up and eaten like spinach. Immature shaped pods are used in some way as snap beans often being mixed with other foods. Both the green and dried seeds are suitable for canning and boiling as well.

Nutritive value:
Protein - 22-24% Iron - 0.005%
Calcium - 0.08 – 0.11 %
Essential amino acids (lysine, leucine and phenylalanine)

Agronomic Importance- An important component of farming system in resource constraints agriculture, this legume has great potential in India for successful cultivation in kharif and summer in northern India and throughout the year in peninsular India. It also leave 30-40 Kg N/ha in the soil for the succeeding crop.

2. CROP STATUS

It is widely grown in tropics and subtropics of Asia, Africa, central and southern America and parts of southern Europe and USA. However, central and western Africa alone account for more than 60% of world acreage with marginal and sub marginal farmers in the semi-arid and sub-humid regions. According to an FAO estimate, Nigeria alone produces 2.1 mt of dry grain out of 3.3 mt of total worldwide, in 2000. During the same year, global area sown to cowpea was 9.8 mha (9.3 mha in West Africa) with average productivity of 337 Kg/ha whereas, productivity of Nigeria was comparatively higher (417 Kg/ha).

In India, cowpea is grown as sole, inter-crop, mix-crop and in agro-forestry combinations. Exact statistics on its area is not available but, is estimated to be cultivated in almost half of 1.3 m ha of area occupied by Asian region. Other Asian countries are Sri Lanka, Bangladesh, Myanmar, Indonesia, China, Korea, Pakistan and Nepal. In Indian context, it is a minor pulse cultivated mainly in arid and semi arid tracts of Rajasthan, Karnataka, Kerala, Tamilnadu, Maharashtra and Gujarat. In North India, it is grown in pockets of Punjab, Haryana, Delhi, and West UP alongwith considerable area in Rajasthan.

3. PRODUCTION TECHNOLOGY

3.1. Climatic requirements- Being a warm weather crop, can withstand considerable degree of drought and has a promise as an alternate pulse crop in dry land farming. It has more tolerance to heavy rainfall than other pulses. Optimum temperature required for germination is 12-15 degree centigrade and for rest period 27-35 degree centigrade. It can grow under shade of tree but can not tolerate cold or frost.

3.2. Varieties – Varieties is given in table -12.1 other than the specific as follows

a) Grain: C-152, Pusa Phalguni, Amba (V 16) (M), Ramba (V240)(M), Swarna (V-38)(M), GC-3, Pusa Sampada(V-585), Shreshtha (V-37)(M)

b) Fodder: GFC 1, GFC 2, GFC 3,-Kharif season, GFC-4 Summer (25-35 tonnes/ha), Bundel Lobia-1,UPC-287 and UPC-5286 , Russian Giant, K-395, IGFRI-5450(Kohinoor), C-88(20-35 tonnes/ha in Punjab), UPC 5287, UPC-4200(NE India)

3.3. Soil: Well drained loam or slightly heavy soil are best suited. In colder climate somewhat sandy soil preferred as crop mature earlier in them. It can grow successfully in acidic soil but not in saline/alkaline soil.

3.4. Cropping system

Grain/vegetable	Fodder
Cowpea-Wheat-Mung/Cheena	Sorghum + cowpea-berseem-maize+cowpea
Cowpea-Potato-urd/bean	Maize-berseem/oat- maize+cowpea
Maize/Rice-Wheat-Cowpea	Sudan grass- berseem/oat- maize+cowpea
Maize-Toria-Wheat-Cowpea	Cowpea-berseem-maize+cowpea

Rice-Rice-Cowpea Rice-Cowpea Rice-Mustard-Cowpea	

Inter cropping: Growing one or two rows of cowpea in widely spaced crops and in-corporating the biomass after picking pods can increase soil fertility and yield of companion crop. The improvement in this system can further be made by pairing the rows of main crops and taking one or two rows of cowpea in between two paired rows of either of pigeonpea, maize and sorghum. Here, we can get 5-7 qtl/ha grain yield of cowpea without any adverse effect on main crop yield.

It can also be grown as floor crop in coconut garden and intercrop in tapioca in Kerala and as sole crop in single or double crop rice fallows in rabi or summer season respectively.

3.5. Field preparation and mulching: In hard soil, one deep ploughing followed by two or three harrowing and planking are sufficient. In normal soil only two harrowing & planking is enough. However, field leveling is must to avoid water logging. However, reduced and zero tillage method can also be followed if effective weed control is assured through chemical herbicides.

Addition of grass mulch increase soil moisture in the root zone (0-15 cm soil depth) and significantly decreases maximum temp of soil along-with diurnal fluctuation. This provides a stable environment for seedling establishment and growth than the unmulched soil. A combination of minimum tillage and straw mulch as the least risky and hence, most appropriate soil management system for dry season Cowpea in rice fallows. However, growth and yield of cowpea grown after rice do not affect significantly by tillage or no tillage but the mulch application significantly increase growth and yield due to better ability or mulched plot in storing soil moisture during the growing seasons.

3.6. Sowing

Sowing time: *Kharif*- With onset of monsoon ranging from early June to end of July, *Rabi*- October-November (southern India), *Summer* - 2nd to 4th week of March (grain), February (Fodder), Hills: April-May, Green manuring- Mid June to 1st week of July

Seed rate: For pure crop: 20-25 Kg.ha(grain), for fodder and Green Manure-30-35 kg./ha. During summer 30 kg/ha for grain and 4- kg/ha for fodder and green manuring

Sowing method: Broadcasting, in centre of furrow areas then modified into ridges after a month. Draw 30 cm wide and 15 cm deep drainage channel at 2 meter interval to drain excess rainwater after sowing. Sowing on rice bund on either side on the day of paddy transplanting during second season. Sowing by broadcasting immediately after paddy harvest in summer. Seed depth should be 3-5 cm.

Spacing: Row to row—30(Bushing) to 45 cm (spreading), Plant to Plant-10 (Bushing) to 15 cm (spreading)

3.7. Plant nutrient management

Apply FYM/compost- 5-10 t/ha as basal with last ploughing. Both these bulky organic manure can be substituted by humic substances granule. 15-20 kg N/ ha

as starter dose in poor soils (organic carbon<0.5%), 50-60 kg/ha P_2O_5 and 10-20 kg. K_2O/ha to promote growth and to mitigate the impact of water stress in plants when subjected to sub optimal soil stress. In acidic soil, lime pelleting of seed is beneficial alongwith Rhizobium inoculation. Add finely powdered (300 mesh) calcium carbonate to moist freshly Rhizobium treated seeds and mix for 1-3 minutes until each seed is uniformly pelleted. Lime requirement varied from 0.05 Kg to 1 Kg/ 10 Kg seed depending on seed size.

3.8. Weed management: Weed can reduce crop yield upto 50-62%. Integrated approach includes agronomic (improved) practices like sowing at proper time, proper cropping geometry, optimum plant density, intercropping, intercultivation, irrigation and the need based supplement, use of chemical herbicides. One hand weeding at 20-30 DAS-followed by one more weeding after 20-25 DAS if required.

Chemically, weed can be controlled by pre-planting spray of Basalin @ 1 kg a.i./ha as pre emergence in 800-900 litres of water. Application of pendimethaline @ 0.75 kg.a.i./ha combined with one hand weeding at 35 DAS resulted in two fold increase in marginal benefit cost ratio and highest weed control efficiency.

3.9. Water Management:-For rainy season crop drainage is more essential than irrigation. Crop can tolerate flooding upto 2 days at flowering and pod setting thereafter, a marked decrease in yield and its attribute. Early sown rainy season crop may require one or two irrigation in pre monsoon/delayed onset of monsoon.

For summer crop, irrigation is most critical among all inputs followed by weeding and fertilizer. Generally, crop required 5-6 irrigation depending on soil, prevailng weather conditions etc, at an interval of 10-15 days. Increasing moisture regime from dry to medium wet, result in significant yield improvement. The response to irrigation is in order of flowering> pod filling>vegetative.

3.10. Abiotic stress management: Salinity, water logging, toxicity or deficiency of minerals are common abiotic stress. The crop is more sensitive to drought at onset of flowering and during reproductive phase.

Maintenance of adequate ‘K’ in soil improves plant water relations , photosynthesis and yield and overcoming soil moisture stress alongwith improving carbon partitioning in cowpea.

Seed treatment with thiourea (seed soaking in 500 ppm soln) followed by two foliar spray at vegetative and flowering phase is another option to avoid moisture stress through enhancement of photosynthesis efficiency and nitrogen metabolism there by giving higher yield.

Crop improvement and breeding programme are needed for varieties with dwarf and erect growth habit, extra-earliness (65-90 days) with synchronous maturity, development of multipurpose varieties, breeding for insect-pest and disease resistance, tolerance to drought, high nutritional quality.

3.11. Plant protection – Refer **table -12.2.**

3.12. Yield - By adopting improved management practices yields up to 12-15 Q/ha could be realised.

Table – 12.1. Recommended varieties of cowpea/characteristics

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristics
Pusa 152	IARI	1978	SZ	15-20	90-100	Seed brown
Kalnakmani	TNAU	1980	Kerala	14	75-80	Seed maroon
S 488	UAS	1980	Karnataka	14-15	65-70	Seed grey
Amba (V 16)	IARI	1984	All zones	10	85-95	Resistant to bacterial blight
Gujarat Cowpea 2	GAU	1985	Gujarat	11-12	65-75	Seed yellowish
Krishna Mani	TNAU	1985	Kerala	8	75-80	Seed black
Paiyur	TNAU	1986	Tamil Nadu	7-8	85-90	Seed brick red
CO 5	TNAU	1986	Tamil Nadu	15	85	
RC 19	RAU, Durgapura	1987	Rajasthan	10-12	65	Seed brownish white
Gujarat Cowpea-3	GAU	1990	CZ	12-14	65-85	
V-240	IARI	1993	All Zones	14.0	80	Tall, Indeterminate, seed red

(Table – 12.1 continued)

Variety	Source	Year of Release/ Notifi-cation	Area of adoption Zone/State	Ave. yield (Q/ha)	Duration	Characteristics
Vamban - 1	TNAU	1997	Tamil Nadu	9.5	65	Erect, dwarf, seed white
Gujarat Cowpea-4	GAU	1999	Gujarat	8-5	80-90	Seed bold, amber colour
KBC-2	UAS	2001	Karnataka	9.5	95-105	Semi-determinate, seed light brown
RC-101	RAU, Durgapura	2001	Rajasthan	8.5	85-90	Early, Determinate, seed white
CO-6	TNAU	2001	Tamil Nadu	14.0	85-90	Early, bold seeded
V 578 (Pusa 578)	IARI	2004	Delhi	12		Early, Resistant to yellow mosaic virus
CL-367	PAU	2006	Punjab	12	95-100	Tolerant to YMV
RCp-27 (FTC-27)	RAU	2006	Rajasthan	6-13	69-79	Resistant to YMV

CZ- Central Zone (MP.,Maharashtra, Chhattisgarh, Gujarat), SZ- South Zone (A.P., Karnataka, TN, Orissa)

Table -12.2. Pest and diseases in cowpea and their management

Insect Pest/Disease/ Causal Organism	Nature of Damage/ Symptoms	Control Measures
i. Hairy caterpillar	The caterpillar eats away all the green matter of the leaves.	Endosulfan @ 0.07% or Chloropyriphos @ 0.05% or Monocrotophos @ 0.04%

ii. Aphid	The adults and nymphs suck the juice from the leaves as a result, leaves turn brown and crumpled and the plants look sick	Monocrotophos @ 0.04% or Metasystox.
iii. Bacterial Blight (Xanthomonas Viginicola)	Disease firstly witnessed at the cotyledens and tender leaves. Necrotic spots may be seen on the terminal of leaf. Cankers may also be found on stem.	i. Grow resistant variety ii. Use Disease-free seeds. iii. Use Bactericide for control of pathogen.
iv. Mosaic Virus	A viral disease transmitted by aphid affects the leaves first. Pale yellow leaves shows mottling, crunckling and reduction in its size.	i. Use resistant varieties. ii. Control of vector through spraying Metasystox 0.1 ml/litre of water.
v. Powdery Mildew (Erysiphe polygoni)	Symptoms first appeared an all the aerial parts of plant. White powdery masses of spores formed on leaves which may collaps and cover the whole leaf with powdery growth.	Wettable sulphur @ 3 g/litre or Dinocap @ 1 ml/lite of water.
vi. Rust (Uromyces appendiculatus)	Symptoms clearly visible from the lower surface of leaves in the form of small white pustules. These brown coloures spots are Uridii which may be replaced with black coloured tilia.	i. Grow early maturing var. ii. Seed Treatment with Agrosan GN @ 2.5 gm/kg seed.

A. BROAD-BEAN

Botanical Name - ***Vicia faba*** L.
Synonymous - Bakla,Fababean
Origin - Mediterranean Region of Southern Europe and Western Asia
Chromosome - 2n = 24

1. INTRODUCTION- Broad-bean has high yield potential. In many countries this species is the main food legume. This crop is presently being grown sporadically in our country as a minor vegetable. However, dry seeds are also used as 'Dal'. Its seed is edible and nutritive. There appears to be every possibility of popularizing broad-bean as a new pulse crop in India. Broad-bean has shown response to inputs and better management practices and hence can be fitted into intensive cropping systems.

2. BOTONICAL DESCRIPTION-Strong, erect annual herb with the plant height up to 1.5 meter. Roots like other legume. Inflorescence – axil with 6 flowers of 3-7 cm long, mostly white in colour. Self pollination is a rule but cross pollination by insect may also occur. Pods are strong and semi-cylendrical up to 30 cm in length. Seeds are greenish or brownish white to black. Test weight vary from 10-40 g/100 seed weight.

3. PRODUCTION TECHNOLOGY

3.1. Climate: Spring season with mild summer is best

3.2. Soil: Like other legumes (Rajmash) lime addition in acidic soil gives best results.

3.3. Field Preparation: Like Rajmash (1 deep ploughing + 2 harrowing followed by planking)

3.4. Seed & Sowing *Spring*: April (first fortnight)/Rabi: October (IInd Fortnight – 1st week of November) with crop spacing as row to row 30 – 35 cm and plant to plant 10 cm with sowing depth of 7.5 – 10 cm

Seed rate: 70-100kg/ha

3.5. Cropping system: Maize-Broadbean, Pearlmillet/Maize-Potato-Broadbean

3.6. Plant nutrient management: 20 kg N + 40-50 kg P_2O_5/ha

3.7. Weed management: Two howing at 30 and 60 DAS. Alternatively, Fluchloralin or Pendimethalin (Pre emergence) @ 1 kg a.i./ha can be used for effective weed management.

3.8. Diseases: Root rot, Aschochyta blight, Botrytis grey mold, Cercosporal Leaf spot & Rust. (Control measures like gram)

3.9. Insect: Aphid, Leaf minor, Leaf Loeevil, Stem borer (control measures like lentil)

3.10. Harvesting, threshing: Similer to lentil

3.11. Yield: 10-40 Q/ha.

B. RICE-BEAN

Botanical Name	-	***Vigna umbellate*** (Thunb.) Ohwi & Ohashi}
Origin	-	Himalayin region of North east
Synonimus	-	Japanese Rice bean, bomboo bean, climbing bean and mountain bean,
Chromosome	-	2n = 22

1. IMPORTANCE - One of the important minor food legumes can be grown under a wide range of soil and climatic conditions in the hilly areas of Himachal Pradesh, Uttrakhand and north-east hill regions, generally as dual purpose. **Its grains are also cooked in place of rice that's why it is known as rice bean**. It is also grown as green manure crop. Its grain production potentiality is considerably high and can serve as a good pulse crop. It has the potential to yield as high as 15-25q/ha. All the pods on a plant mature almost simultaneously and can be harvested in a single operation. There are many types and varieties of rice-bean differing in maturity, plant type and seed characteristics. Some varieties are completely free from fungal and viral diseases during kharif.

Nutritive value: Rice-bean has a protein content of 14 to24% and is free from anti-nutritional factors. Thus, rice-bean offers itself for cultivation during the monsoon season, when green gram and other pulses suffer greatly from diseases.

2. **BOTANICAL DESCRIPTION -** It is an annual, deep rooted herb with plant height of 30-100 cm with fast spreading habit surrounding 100-120 cm. Leaves are oval and trifoliate with 6-9 cm long. Inflorescences are 4-7 cm long with 10-18 bright yellow flowers. Flowering in 100 days. Pod length vary 12-18 cm with 6-10 grain inside them. Grain colours vary from yellow, brown, black or straw with epigeal germination and white hilum.

3. PRODUCTION TECHNOLOGY

3.1. Climate: Tropical climate of kharif. It can be grown successfully in high rainfall areas with good drainage where other pulses are failed due to excessive growth and diseases and pest attack.

3.2. Soil: Generally grown on slopy hilly land with poor fertility.

3.3. Land preparation: One normal ploughing is enough as excess field preparation can accelerate the rate of soil erosion.

3.4. Seed & Sowing IInd fortnight of August for grain, however, can be grown up to September for fodder with spacing**:** 45-60 cm row to row, 5-10 cm plant to plant **Seedrate**: 40-50 kg/ha for grain & 60-75 kg/ha for fodder.

3.5. Varieties: Pant rice bean 1, Pant rice bean 2, K-1, Bidhan rice bean-2 (KRB-4)

3.6. Cropping system: Grown as mixed with Jute, Maize and Finger millet on Hills. Also grown commonly in kitchen gardens for meeting vegetables pulse and forage need of house hold.

3.7. Plant nutrient management: Grown on residual soil fertility.

3.8. Water management: Grown as rainfed in high rainfall areas hence instead of irrigation, drainage is important.

3.9. Weed management: One hoeing 30 DAS is enough.

3.10. Plant Protection: No need to do any spray as very rare infestation of pest & diseases is observed.

3.11. Harvesting: August sown crop ready to harvest in Feb. last (Duration 120-130 days)

3.12. Threshing: Like moong

3.13. Yield: 10 qtl/ha

SEED PRODUCTION

Seed is the key input of agriculture which plays a vital role in speeding and sustaining the crop productivity. The quality of seed alone is known to share atleast 10-15% increase in the total production of any crop. Pulses are not beyond this fact. In the absence of quality seed, the inputs like fertilizer, water, pesticides etc; do not pay the desirable return. Lack of quality seed continues to be one of the greatest hurdles in reducing the vast yield gap between farmers' field and experimental plots. It is established fact that pulses productivity can be increased if the availability of quality seed is ensured in time. Concerted efforts and proper planning along with realistic execution are required to produce the quality seed of improved varieties and phase out the old seed of obsolete varieties.

1. SEED REQUIREMENT: To achieve the targeted 25% Seed Replacement Rate, the requirement of breeder, foundation and certified seed by the end of 2011-12 is as under

Table – 14.1. Seed requirement at 25% SRR – eleventh plan

Crop	**Targeted Area (hectares)**	**Seed Requirement (25% SRR) (qtls.)**		
		Breeder Seed	**Foundation Seed**	**Certified Seed**

Pigeonpea	4100000	103	5125	205000
Urd (kh)	2700000	225	4500	135000
Moong (kh)	2800000	233	4667	140000
Other (kh)	2500000	208	4167	125000
Total kharif	**12100000**	**769**	**18458**	**605000**
Chickpea	7800000	10400	104000	1560000
Urd (rabi)	1500000	125	2500	75000
Moong (rabi)	1500000	125	2500	75000
Other (rabi)	4500000	1125	22500	450000
Total rabi	**15300000**	**11775**	**131500**	**2160000**
Total Pulses	**27400000**	**12544**	**149958**	**2765000**

2. CLASS OF SEED AND THEIR PRODUCTION

2.1. Nucleus Seed

- Basic seed of variety should be sown in optimum area approximately 200 $m^{2.}$ Field should qualify the norms in terms of topography, moisture availability and fertility. Recommended spacing (plant to plant and row to row) should be maintained through dibbling or thick rowing, followed by thinning.
- Select 500-1000 plant which exactly conforms the varietal descriptors. Number of plants to be selected will depend upon the seed production ability of individual plant i.e. yield per plant, if yield per plant is higher less number of plants selected and tagged.

- The tagged plants should be harvested separately. Seed of individual plants should be carefully examined and if the seed/plant produce is not conforming to the discriptors of the variety, the seed lots produce of individual plants should be rejected.
- The seed collected should be dried, treated and stored.
- During next cropping season, the individual plant progenies should be grown in standard and homogenous field. Row to row spacing should be wide than the normal recommendation of the crop. The main objective of spaced planting is to ensure genetic purity, otherwise the higher productivity per unit area. Here the row length may vary from one to three meters, depending upon the quantity of produce of individual plant.
- Due care should be taken for all the agronomic practices of the crop to ensure high seed to seed ratio.
- Individual plant progenies should be regularly visited by breeder, right from germination to harvesting.
- If any individual plant is not true to type and /or sister progeny are showing disease incidence, plant should be completely removed from the field, besides entire off type/diseased progeny should be discarded completely.
- From the remaining progenies, 500-1000 plants should be tagged for next year planting of single plant progenies.

- Individual plant should be harvested separately, as during the previous season and necessary steps, as enumerated above, should be strictly followed for next year planting, as well.
- After harvesting these 500-1000 plants, the individual plant progenies should be harvested separately.
- The seed lot of individual progenies should be examined for size, shape colour etc. of the seed. Any progeny exhibiting mixture or deviating from the seed descriptors of the original variety or sister progeny should be discarded.
- Remaining progenies left after rejection both at pre and post harvest stage should be bulked, this bulk produce of selected progenies (bulk produce of 400 progenies out of 500 plants) is known as Nucleus Seed.
- The nucleus seed is used for production of breeder seed. Special care must be given to this seed during storage.

2.2. Breeder Seed

All stake holders who deal in seed viz. NSC, SFCI, State Deptt. of Agri., SAUs, SSC and private sectors, place their breeder seed indent to seed Division, Govt. of India, Ministry of Agriculture(DAC). The indent, in compiled form, is given to ICAR by DAC for production of breeder seed. The ICAR organizes breeder seed production of various varieties of different crops through ICAR Institutes, SAUs and other organizations like NSC, SFCI etc. The different breeder seed production proformae are enumerated below:

BSP-1: In view of indents received, project coordinator unit formulate BSP-1 after detailed discussion in concerned crop group meet. This proforma accounts for crop, variety, name of breeder to whom breeder seed production was allocated, DAC indent, allocation and indentors. BSP-1 proforma is issued by Principal Investigatior BSP/PC to concerned crop breeder.

BSP-II: After receiving the BSP-I proforma from PC unit, the breeder of SAUs/ICAR institutes sow the nucleus seed/basic seed for breeder seed production .BSP-II proforma is submitted by concerned crop breeder to PC unit after compilation of sowing of breeder seed production plot.

BSP-III: The BSP-III proforma is submitted by the breeder to PC unit after completion of monitoring by monitoring team. The team comprises breeders; in charge National Seed Programme, NSC representative and officer from State Seed Certification Agency.

BSP-IV: This proforma is issued by breeders after harvesting, threshing, cleaning and grading of breeder seed. It contains information on actual breeder seed of different varieties produced by the concerned crop breeder. On the basis of this proforma, DAC arranges lifting of the breeder seeds by indentors.

BSP-V: After listing of breeder seed by indentors, this proforma is submitted by breeders to PC unit and contains information on lifting of breeder seed by indentors

2.3. Certified Foundation Seed: This is the seed which is certified by a State Seed Certification agency notified under section 8 of Indian Seed Act 1966 or by any other foreign certification agency provided that the agency is recognized by Govt. of India through notification in official gazette. The certified seed consist of two classes:

Certified Foundation Seed Stage I and II: CFS is the progeny of breeder seed or certified foundation seed it self. When seed is progeny of breeder seed, it is called foundation seed stage I, while it is called foundation seed stage II when it is the progeny of certified foundation seed stage I it is important to note that only certified foundation seed stage I can be multiplied to generate certified foundation seed stage III.

Certified foundation seed stage II cannot be used to produce foundation seed; it can only be used to produce certified seed. The minimum seed standard for both foundation seed stage I and foundation seed Stage II are similar unless otherwise prescribed.

Production of foundation seed stage II is undertaken only when it is clearly stated by Seed Certification Agency that the breeder seed of a particular variety is in short supply and Stage II foundation seed has to be produce to meet the seed demand. Bags of foundation seed carry white coloured tags.

2.4. Certified Seed: This seed is progeny of foundation seed and it is produced under conformity of specific genetic identity and purity standard as prescribed for the crop being certified.
The certified seed can be progeny of certified seed provided this multiplication does not exceed three generation beyond foundation seed stage-I. Certified seed produced from foundation seed is called certified seed stage I while that produced by multiplication of certified seed itself is called certified seed stage II. Certified seed stage II can not further be used for multiplication.
The tag of certified seed is of **blue colour** (Shade ISI No. 104 *azure blue*) besides carrying all relevant information about the certified seed inside the bag.

POST-HARVEST TECHNOLOGY AND MANAGEMENT

1. HARVESTING PRECAUTIONS

To minimize quantitative and qualitative losses, besides harvesting the crop at 8 per cent of total pods maturity stage, under mentioned should also be taken care of.

- Harvesting prior to physiological and proper maturity usually result in lower yields, higher proportion of immature seeds, poor grain quality and resulting in susceptibility to infestation during storage. To fetch better prices and consumer acceptance, proper harvesting judgement is required.
- Avoid harvesting during adverse weather conditions i.e. rains and overcast weather, however, delay in harvesting may results in shattering pods and losses caused by birds, rats, insects etc. Rogue out the admixtures prior to harvesting
- The harvested produce should be stacked in a dry, clean place in cubical way to facilitate circulation of the air around and keep the bundles for drying in the field after cutting on threshing floor.

2. GRADING

Sorting of the homogenous lots of the produce according to the fixed grade standard in accordance with various quality factors is important. Grading of the produce before sale enables farmers to get better price and helps the consumers to get standard quality produce at fair price vis-a-vis facilitate the consumer to compare the prices of different qualities of a produce in the market. Grading assures the quality of the produce and also reduces the cost of the marketing and transportation

3. STORAGE/PACKAGING

The good packaging material must protect quality and quantity, prevent spoilage during transit and storage and should display about grade/quality, variety, date of packing, weight and price etc. It must also be convenient in handling operations, convenient to stack, cheap, clean and attractive.

Impotant packaging materials are (i) Jute bags, (ii) HDPE/pp bags, (iii) polythene impregnated Jute bags, (iv) poly pouches, and (v) cloth bags. About 10-15 per cent moisture is safe for storage of pulses. For small-scale storage, preferably air-tight metallic bins, and for large scale storage of pulses, large silos are commercially available. The storage affects the cooking quality of whole and split pulses (dal)

4. MAJOR STORED GRAIN PESTS

Post-harvest protection of pulses assumes a greater importance in overall crop protection system as pulses are more susceptible to storage losses. Traditionally the produce is essentially stored for longer or shorter duration, either for consumption or as seed for sowing during the next cropping season.

The various factors responsible for deterioration of stored grains/seeds are broadly classified under two categories, biotic factors (insect, rodents, birds, fungi, mites and bacteria); Abiotic factors (moisture content/relative humidity, temperature)

Pulse beetle (*Callosobrucus maculatus* (Lin), (Bruchid) in whole grain and *Tribolium castaneaum*, *Tribolium confusum* in milled product (besan), are the major stored insect.

4.1. Prophylactic and curative measures

Selection of site, storage structure, cleaning and drying of structures/site/bags is important. The site/structure should be given *prophylactic treatment* by spray of Malathion 50% EC (1:100) one per cent solution @ 3 litres per 100 sqmt.

For *curative treatment*, fumigation through aluminium phosphide @ 3g pallet per 5-10 qtls whole grain is recommended; Rodents are the other important pest to damage the stored grain. Control of rodents should be done through i) Multi-dose anti-coagulant (cumarin compounds) eg. *rodaferin*, *warferin* (proportion 1:19) ii) single dose anti-coagulant eg. Promadiotone (proportion 2:98) and iii) single dose acute poison eg. *Zinc phosphide* (proportion 2:98)

5. STORAGE STRUCTURES

Producers store pulses in bulk at farm godown or own house using various types of traditional and improved structures. Generally, these storage containers are used for short period. Different organisations/institutions have developed improved structures for pulses storage with various capacities like Hapur Kothi, Pusa bin, Nanda bin, PKV bin, etc. Different storage structures are also used for this purpose like bricks-built rural godown, mud stone godown etc. Producers also use flexible PVC sheets covering for temporary storage. Some producers also pack pulses in jute gunny bags or in gunny bags lined with polythene and stack in room.

Prevalent storage structure may be classified into two categories as domestic and commercial (Table 15.1)

Table 15.1 – Categories of prevalent storage structures

Domestic	Commercial
Traditional structures	
i Mud-binds or Kachchi Kothi	
ii Metal drums	
iii Thekka	
iv Gunny bags	i. Warehouse
Improved/scientific structures	ii. CAP Storage (cover and plinth storage)
i Pusa Kothi	iii. Soils
ii Nanda bins	
iii. Hapur Kothi	
iv PAU bins	
v PKV bins	
vi Chittore stone bins	

5.1. Storage Infrastructure/programmes/facilities

5.1.1 Rural godowns

Considering the importance of rural storage in marketing of agricultural produce, Govt. of India, Ministry of Agriculture, Directorate of Marketing and Inspection, initiated a Rural Godowns Scheme, in collaboration with NABARD and NCDC. Its objective is to construct scientific storage godowns with allied facilities in rural areas and to establish a network of rural godowns in the States and Union Territories.

Eligibility: The project for construction of rural godowns can be taken up by individuals, farmers, group of farmers/growers, partnership/ proprietary firms, non-government organizations (NGO's), self help groups (SHGs), Companies, corporations, Co-operatives, Agricultural Produce Marketing Committees, Marketing Boards and Agro Processing Corporations in the entire country. However, assistance for renovation/ expansion of rural godown is restricted to the godowns constructed by cooperatives only.

Location: Under the scheme, the entrepreneur will be free to construct godown at any place and of any size as per his commercial judgment except for the restrictions that it would be outside the limits of Municipal Corporation area and be of a minimum capacity of 100 MT.

5.1.2. Mandi godowns

Most of the States and Union Territories have enacted Agricultural Produce Market (Regulation) Act. The reduction of loss of produce was aimed in the scheme of regulated market. The regulated markets developed modern market yard with necessary infrastructural facilities. The APMCs have constructed godowns so that the agricultural produce brought into the market should be stored safely by market committees. The produce is weighed in the presence of producer/seller at the time of keeping the produce in the godown after grading for storing and receipt is issued indicating the quality and weight of produce to be stored. The receipt is issued by the licensed general commission agents or brokers depending upon the case. The CWC, SWC and Co-operative societies have also constructed godown in the market yards.

In most of the secondary and terminal regulated markets, central and state warehousing corporations also provide scientific storage facilities at prescribed storage charge and issue warehousing receipt against pledge of produce, which is a negotiable document for obtaining finance from the scheduled banks.

5.1.3 Central Warehousing Corporation (CWC)

CWC was established during 1957. It is the largest public warehouse operator in the country. Apart from storage, CWC also offers services in the area of clearing and forwarding, handling and transportation, distribution, disinfestation, fumigation and other ancillary services like safety and security, insurance, standardization and documentation. The CWC has also introduced a scheme, called the Farmers' Extension Service at selected centres to educate farmers about the benefits of a scientific storage. The CWC is also operating custom bonded warehouses. These bonded warehouses are specially

constructed at a seaport or airport and accept imported commodities for storage till the payment of customs duties by the importer of the commodities.

5.1.4 State Warehousing Corporations (SWCs)

Different states have set up their own warehouses in the country. The area of operation of the state warehousing corporations is district places of the state.The total share capital of the state warehousing corporations is contributed equally by the Central Warehousing Corporation and concerned State Government. The SWCs are under the dual control of the State Government and the CWC.

5.1.5. Co-operatives

Cooperative storage facilities are provided to the producer at cheaper rates, which reduces the storage cost. These cooperatives also provide pledge loan against the produce and storage is more systematic and scientific than traditional storage. Financial assistance and subsidies are provided by government organisations/banks to build cooperative storage. To meet the increasing need for storage capacity, the National Cooperative Development Corporation (NCDC) encourages construction of storage facilities by cooperatives, particularly at rural and market level.

6. MARKETING CHANNEL

The production of a produce is complete only when it reaches the hands of consumers. Marketing channels are the routes through which agricultural products move from producers to consumers. A flow of pulse produce from farmers to consumer under organised and un-organised channel is exhibited under table 15.2.

Table- 15.2. Processes of marketing of raw produce.

Private	**Institutional**
i) Producer → Dal Miller → Consumer ii) Producer → VillageTrader → Dal Miller → Wholesaler → Retailer → Consumer iii) Producer → Dal Miller → Retailer → Consumer iv) Producer → Wholesaler → Dal Miller → Retailer → Consumer v) Producer → Wholesaler → Dal Miller → Wholesaler → Retailer → Consumer vi) Producer → Wholesaler → Retailer → Consumer (For whole Green gram) vii) Producer →Commission Agent → Dal Miller → Wholesaler → Retailer → Consumer	i) Producer → Procuring Agency → Dal Miller → Consumer ii) Producer → Procuring Agency → Dal Miller → Wholesaler → Retailer → Consumer iii) Producer → Procuring Agency → Dal Miller → Retailer → Consumer

7. PROCESSING AND VALUE ADDITION

Promoted by the western habits, food consumption habit is under radical change in India. Export of value added products has retained the upward ladder .Food Processing industry is still at the category of small or cottage industries. The Industry has to be popularized due to the wide range of consumption of processed items of foodstuffs in the country. A close study on the issue imperatively amounted to a conclusion that the industry is not less important than the bigger industrial units on various consumer and non-consumer goods. Due emphasis has to be paid to the agro-industries based on the prevailing nature of perishable crops including pulses.

Lack of Processing Technologies of applied nature has a far negative reaching implication vis-à-vis, value addition and by-product utilization of pulses. There is a great scope of canning fresh peas, but lack of facilities for preservation has not made much headway, particularly in the rural sector where all types of infrastructures are not available. The produces of the farmers are sold in situ at low prices hardly meeting the economical aspirations of the farmers themselves. Middlemen involved in the process of transporting the pulse grains exploit the rights of the farmers to sell them at reasonable prices. Lack of processing plants in the vicinity of the farmers' field have encouraged these the middlemen to interfere for converting the raw and fresh pulses into various processed food items and their by- products, where value additions are the prime target.

In an effort to increase the value of foodstuffs in pulses, research & development on Post Harvest Technologies (PHT) would come to play a major role. The large loss of pulse grains during harvest operation and post harvest storage (25-30%) is a major concern. PHT is thus, an indispensable part of operation when food processing and value addition of pulse crops are concerned.

7.1. Domestic pulse milling in rural sector : Scope

Setting up small scale pulse milling units in rural sector need to be expoited to boost-up the pulse sector. Although dal milling is an agro-based industry, the rural sector is rather deprived of this. It may be due to the following reasons common to the rural areas of the country:

- Non-availability of infrastructural facilities in rural sector.
- Inefficient methods of milling in rural sector. (incompetent methods and machines for processing dal in rural sector)
- Non-availability of suitable cottage scale milling machines which are economical and can be easily adopted in rural sector with the existing methods of processing.

Moreover, the capital investments, taxation policies, lack of skilled labour are coming in way of setting up a dal mill in rural sector. The producer, therefore, is almost forced to sell the pulses to the agent-cum-dal miller in large scale sector and in turn purchase dal from him, thereby giving him major share of profit.

Keeping in view these difficulties some organization like CFTRI (Mysore), PKV (Akola, Maharashtra), IARI (CIAE, Bhopal), have come up with several designs of small

scale/cottage scale pulse dehusking machines, with capacities ranging from 40 kg – 200 kg per hr. These low cost, low capital investment machines will help the producer to get value added product (dal), and useful by product –Chunni-and husk for his cattle. These machines can be easily operated and maintained by a single family or by a village based small cooperative society either for their own use or as custom milling systems, thereby giving chance for more rural employment. This may have an impact on the overall village economy especially in the major pulse growing regions.

7.2. **Small scale processing units inrural sector**: **Advantages**

Benefits of small machines in rural sector, due to following:

- Simple technology and machines easy to operate maintain and repair by villagers.
- Low cost of processing and less power consumption.
- Low capital requirement, hence, can come within the limits of state financial corporations or KVIB of states.
- Can attract subsidy by State Governments and avoid taxation to some extent.
- Long distance transportation is not required, since raw material purchase and product sale are confined to local markets.

The scope for setting up such small scale pulse dehusking machine is based on (i) the type and utility of the machine for the pulses grown and (ii) the status of pulse milling industry in that area. It is assumed that a small scale pulse dehusking unit like CFTRI mini dal mill processes about 5 quintals of pulses in a day on an average. If it works for 150 days in season (December to May), it can process 75 tonnes of pulses in one year. Assuming 50% of the produce is retained and processed to dal in rural sector, 6 such units can be set up in a district where the production is about 1000 tonnes (500 tonnes available for small scale). The number of such small scale units suggested to be set up in a district is based on the above assumption.

8. PROCESSING TECHNOLOGY

India is the largest producer and consumer of pulses in the world. Processing of dal is unique and indigenous to India. This is due to the fact that, substantial quantities of pulses are consumed in the country in the form of dal – the dehusked split form. Though pulse milling is the third largest grain processing industry in the country, next only to rice and wheat, processing still remains largely traditional and employs empirical methods of processing which leads to inefficient processing and wastage of precious raw materials**.**

Processing of pulses into dal or a variety of primary and secondary products adds more values to consumers. However, the operation is being coupled with losses and wastage estimated to be about 10-25%, depending on the technology adopted and machines used. Still, the processing of pulses is on the rise due to the consumers' needs and the sound market price of processed pulse products. In India, more than three fourths ($3/4^{th}$) of pulses produced are processed into dal. During the processes of milling only the losses (as powder and brokens) are estimated to be about 10-15%. Excessive scouring of pulse grains not only results in quantitative loss, but also qualitative loss since the peripheral

layers contain substantial quantity of proteins. It is therefore, due to this that care must be taken to minimize the losses by using improved machineries and processing techniques.

8.1. Large scale processing

As the traditional methods are laborious, time consuming and dependent on climatic conditions, attempts have been made to develop new technologies for efficient and economic milling of pulses. An improved method and machinery was developed by CFTRI in eighties which aims at minimizing the difficulties faced by traditional large scale pulse processors. The improved method gives a higher yield of dal in lesser time and at a lower cost of processing. The process is accomplished in two steps. In the first step, loosening of husk is achieved by an incipient toasting followed by tempering and the removal of husk and splitting is achieved by improved processing machines. The method consists of exposing the cleaned and size graded pulse, followed by tempering in bins to a critical moisture level. Removal of husk is done in an improved pearling machine in a single operation. The gota is split in an impact splitter after moisture treatment and aeration under controlled conditions. The method is independent of climatic conditions and can function throughout the year resulting in increased productivity. The technology has already been released to the industry.

8.2. Small scale processing

In order to revive the now-defunct traditional village level industry and to place the rural dal processor on a competent and sound economic and technological footing, CFTRI has recently developed **an integrated small scale pulse processing unit –Mini dal Mill. This consists of a dehusking unit, an aspirator and a reciprocating sieve, all run by a 1 HP motor.** The mini dhal mill can process 100-150 kg of pre-conditioned pulse per hour without causing much breakage and powdering. Dehusked split dal husk and brokens are collected at different points as in big dal mill. The product quality is comparable to that of commercial dhal mill and dal yield is 78-82%. The cost of processing is also low. This unit is highly suitable for dehusking of bolder grains like arhar (tur), bengal gram, peas, soybean, field bean etc, while only splits (unhusked dal) could be obtained from green gram and black gram.

The pre-milling treatment as practiced in rural technology (soaking and sun-drying) is retained, since it is easily carried out on rural surroundings. However, duration of soaking is standardized to suit the variety of pulse. Since not all the grains soak uniformly, separation of soaked and swollen grains is essential in order to get good quality product. For this a specially designed grader also has been developed for grading the soaked pulse which can also be used as a pre-cleaner-cum-grader. This unit is run by a half HP motor.

9. DOMESTIC MACHINERIES DEVELOPED

Under the R & D in PHT on Oilseeds, Pulses and maize (TMOP, Mini Mission II), domestic processing machines developmed, their features and advantages area enumerated below:

Table 15.3. Processing technology developed under R&D in PHT - TMOP

Name of the domestic Machinary	Brief Features	Advantages
Mini Dal Mill	* Application - Promotion of village dal milling by traditional rural processors * Capacity-100 to 150 Kg / hr. * Space - 2 x 4 meters * Power: - Mill - 1.0 HP - Grader - 0.5 HP * Yield of dal - 76-78 % * Suitable for bolder Pulses	* Easy to operate, maintain and repair * Simple pre-milling treatment * Low capital investment * Ideal for Cottage scale rural industry * By-products useful as cattle feed * Low cost processing
Versatile Dal Mill	* Capacity: 250-300 Kg / hr. * Power required: 15 HP * Space Required: 8 x 12 Meters * Utility: Can process all types of pulses * Dehulling: 98-99% * Yield of dal: 75-78% * Breakage: 2-3%	* Suitable for small scale processing * Good quality dal at competitive price * By-products – valuable animal feed * Transportation cost reduced * Employment generation * Filling to advance technology base for rural processing
Modern Dal Mill	* Capacity: One tonne per hr. * Power: 100 HP (Including 60 HP for Electrical for Heating and conditioning) * Space: 15 x 30 Meters * Utility: Can process all types of pulses * Processing Time: Less than 2 days * Yield of dal: 77-80% * Dehusking: 98-99%	* Independence from climatic conditions * Higher recovery of dal * Automatic process for round the clock production * Reduced time of processing
(Table Gota Separator	* Utility: Can separate gota (pearled tur from whole grain) * Principle: Works on surface resilience differences of grains * Capacity: 500 kg/hr. * Power: 2 KW * Space required: 4 x 4 meters	* Suitable for incorporation in large scale dal mills * Additional annual recovery of 8 tonnes of first grade dal.Valued Rs.2 lakhs. * Saving of power to the tune of 20%

10. MILLING METHODS OF PULSES

In India there are two conventional pulse milling methods; (i) **wet milling method, and (ii) dry milling method.** The latter is more popular and used in commercial mills.

10.1. Traditional dry dal milling method

There is no common processing method for all types of pulses. However, some general operation of dry milling method such as cleaning and grading, rolling or pitting, oiling moistening, drying and milling have been described below:

10.1.1 Cleaning and grading: Pulses are cleaned from dust, chaff, grits, etc., and graded according to size by reel type or rotating sieve type cleaner.

10.1.2 Pitting: The clean pulses are passed through an emery roller machine. In this unit, husk is cracked and scratched. This is to facilitate the subsequent oil penetration process for the loosening of husk. The clearance between the emery roller and cage (housing) gradually narrows from inlet to outlet. As the material is passed through the narrowing clearance, mainly cracking and scratching of husk takes place by friction between pulses and emery. Some of the pulses are dehusked and split during the operations which are then separated by sieving.

10.1.3 Pre-treatment with oil: The scratched or pitted pulses are passed through a screw conveyor and mixed with some edible oil like linseed oil (1.5 to 2.5 kg/tonne of pulses). Then they are kept on the floor for about 12 hours for diffusion of the oil.

10.1.4 Conditioning: Conditioning of pulses is done by alternate wetting and drying. After sun drying for a certain period, 3-5 per cent moisture is added to the pulses and tempered for about eight hours and again dried in the sun. Addition of moisture to the pulses can be accomplished by allowing water to drop from an overhead tank on the pulses being passed through a screw conveyor. The whole process of alternate wetting and drying is continued for two to four days until all pulses are sufficiently conditioned. Pulses are finally dried to about 10 to 12 per cent moisture content.

10.1.5 Dehusking and splitting: Emery rollers, known as Gota machine are used for the dehusking of conditioned pulses. About 50 per cent pulses are dehusked in a single operation (in one pass). Dehusked pulses are split into two parts also. The husk is aspirated off and dehusked, split pulses are separated by sieving. The tail pulses and unsplit dehusked pulses are again conditioned and milled as above. The whole process is repeated two to three times until the remaining pulses are dehusked and split.

10.1.6 Polishing: Polish is given to the dehusked and split pulses by treating them with a small quantity of oil and/or water.

Flow-diagram of milling process is indicated in box

Flow diagram of dry milling of pulses

Pulses

↓

Cleaning → Chaff, dirts etc.

↓

Pitting → Mixture of husk and brokens (feed)

↓

Pre-treatment with oil

↓

Conditioning

↓

Dehusking and splitting → Mixture of husk + brokens + powder (feed)

↓

Grading

↓

Polishing

↓

Grade - I Pulses

10.2. Milling techniques of different pulses

Pulses like tur, black gram, green gram and horse gram are generally difficult to dehusk while pulses like bengal gram, peas, lentil and khesari are easy to dehusk. This difference in milling behavior is mainly due to the extent of adherence of the husk to the cotyledon. Actual commercial practices generally followed for some of the individual pulses are described as follows:

10.2.1 Dehulling of tur (arhar)

Arhar poses greatest difficulty in milling since the husk is tightly adhered to the cotyledons. Generally only dry method is followed throughout the country for milling of arhar or tur. **Fig. 1** gives a flow chart for its milling. The cleaned and size graded grains are pitted in smooth roller machines smeared with oil (0.2 – 0.5%) (linseed, cashew or any other cheap oil) tempered for about 12-24 hours, sun dried for 1-3 days, followed by spraying with water (2-3%), thoroughly mixed, heaped overnight and then passed through the rollers for dehusking. This type of operation is repeated 3-4 times. After each dehusking operation, the husk, powder and brokens are separated from dhal and gota (mixture of dehusked and unhusked grains). The dhal thus obtained is considered as II grade since its edges are rounded-off due to scouring. The gota obtained is again mixed with water as above, equilibrated and sun dried. The sun dried gota is either passed

through the roller machine or split in horizontal or vertical chakki or using a patka machine. The dhal obtained from the gota is considered as I grade dhal since it does not have any chipped edges and has a better consumer appeal. In some places both I and II grade dals are mixed and marketed. The yield of dhal varies from 70 to 75% depending upon the variety and the method followed. The present survey has revealed that in large scale mills sun drying is being replaced gradually with batch type bin drier. As a result these units are able to work throughout the year.

Arhar is mainly processed in the states of Madhya Pradesh, Uttar Pradesh, Maharashtra, Gularat, Karnataka, Tamilnadu and Bihar.

10.2.2 Dehulling of tur – large scale

Process diagram for processing of tur in large scale is given below (fig.1)

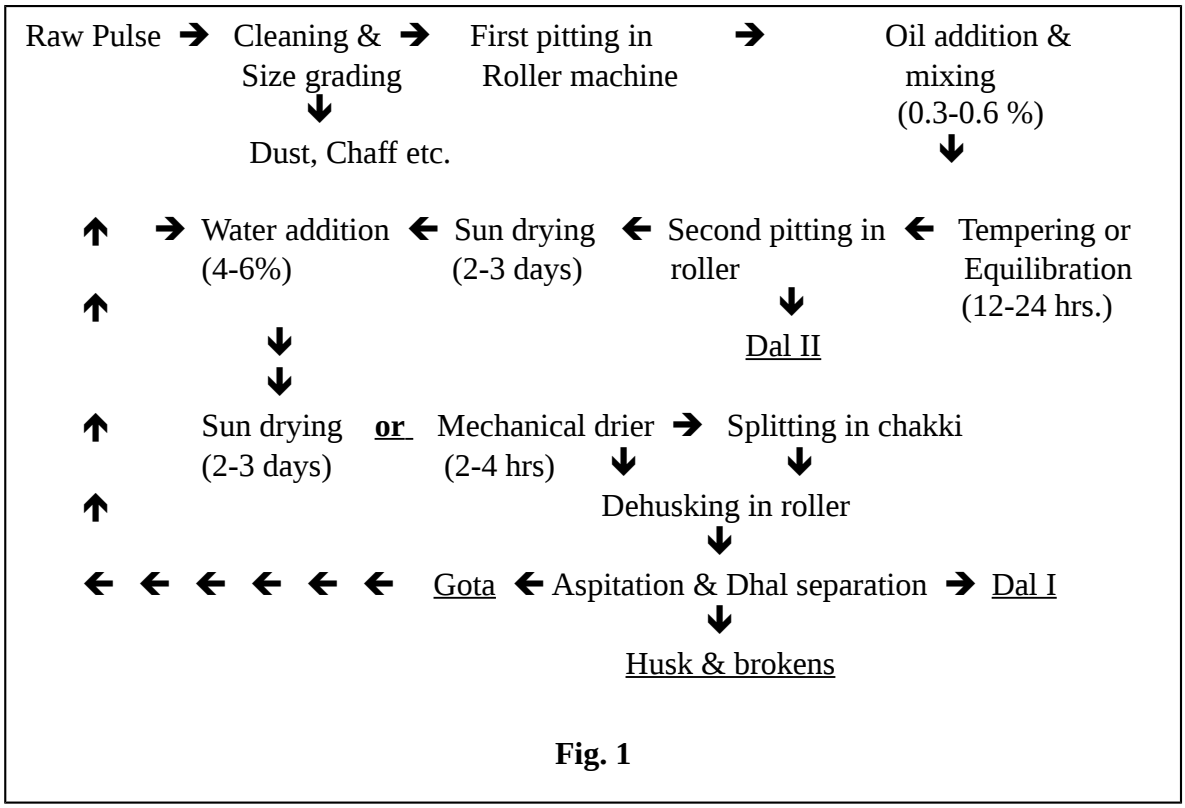


Fig. 1

Fig. 1 Dehulling of tur-large scale

10.2.3. Dehulling of tur-small scale

Small scale duhulling of tur are following the two process viz. (i) dry method and (ii) wet method. Dry and wet method at small scale is exibited under flow-diagram fig. 2 and fig 3

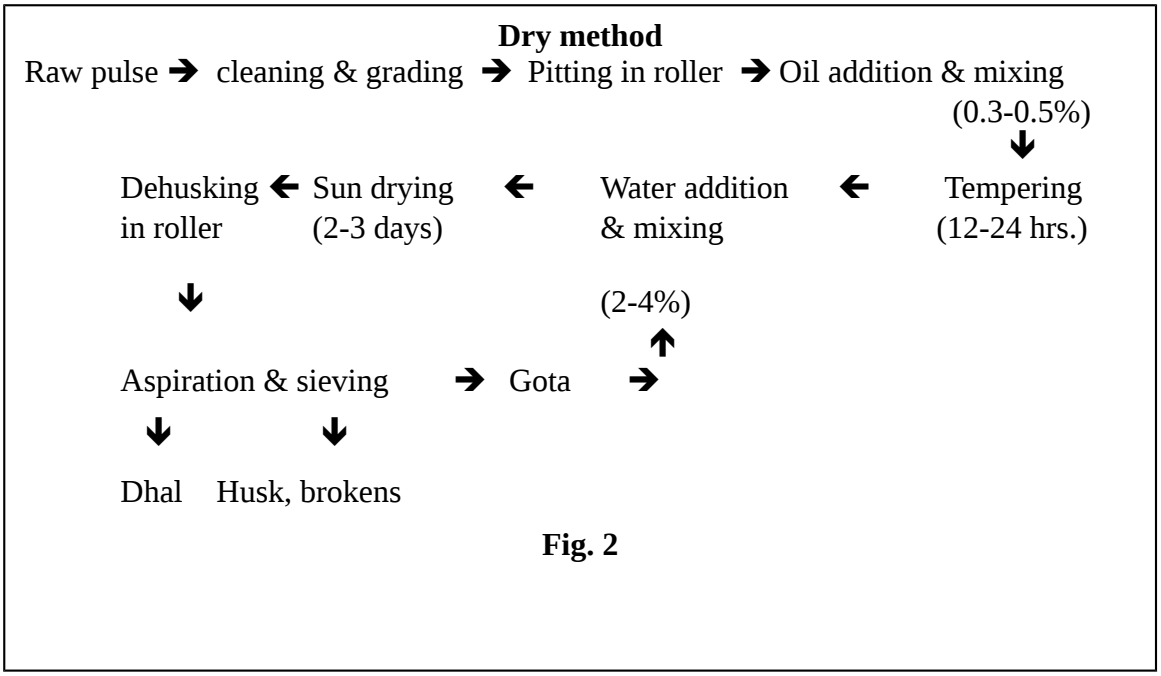


Fig. 2

Fig 2 Dehulling of tur- dry method

b) Fig 3 Dehulling of tur- wet method

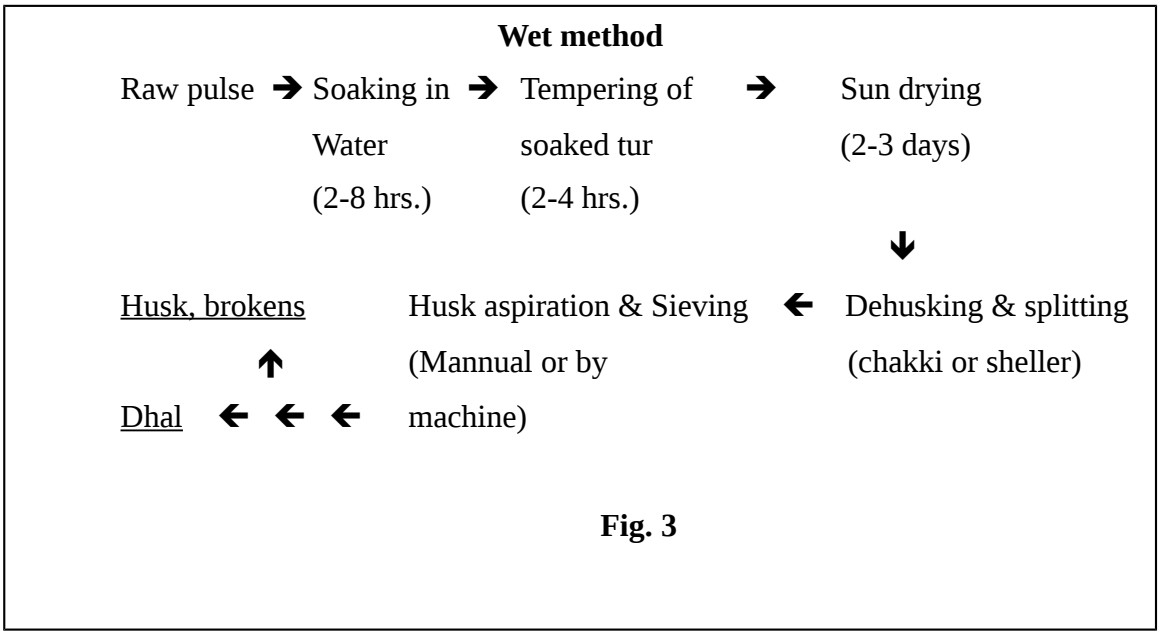


Fig. 3

10.3. Dehulling of bengal gram (Chickpea)

This pulse is comparatively easy to mill. The cleaned and size graded grains are pitted in smooth rollers at low peripheral speed. After pitting the grains are mixed with about 5% water in a mixer and heaped for a few hours to allow the water to seep in. The wetted grains are sun dried for a day or two. The dried pulse is then passed through either horizontal or vertical chakki. Here dehusking and splitting take place simultaneously. The dhal is separated from the husk and brokens. Any remaining unhusked grains are dehulled by repeating the above operation till all the grains are dehulled. Processing of bengal gram is confined mainly to Uttar Pradesh, Rajasthan and Madhya Pradesh (**Fig.4**).

Fig. 4 Process for dehulling of bengal gram

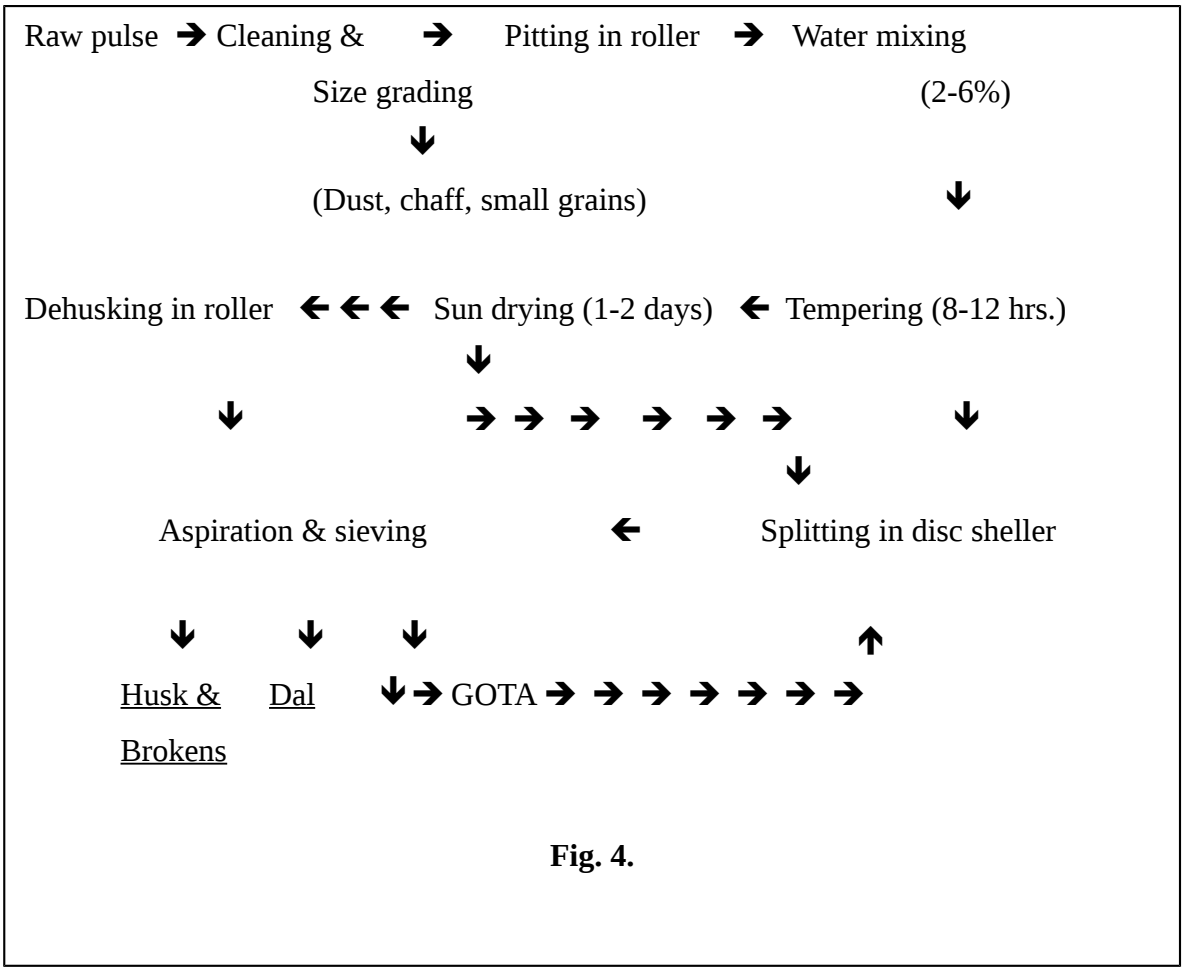


Fig. 4.

10.4. Dehulling of black gram

The cleaned and size graded grains are pitted using emery rollers in 2 or 3 passes, so that complete pitting is effected. After each pitting operation the husk and powder is separated. The pitted grains are then mixed with about 0.5% oil and heaped overnight for absorption. The grains are then sun dried for 2 days. In some mills mechanical dryers are used. After drying, the grains are given a spray of water (2 to 3%), equilibrated and passed through the rollers twice for dehusking. The split dhal obtained is termed as II grade dhal. The dehusked gota is passed through Burr mill for splitting. The dhal obtained from gota is considered as I grade dhal. The split dhal is "polished" with soapstone powder at the final stages. This is believed to give luster to the dhal and enhance their market value.

This pulse is mainly processed in the states of Andhra Pradesh, Orissa, Tamilnadu, Karnataka and Bihar.

Fig. 5 Process for milling green gram and blackgram

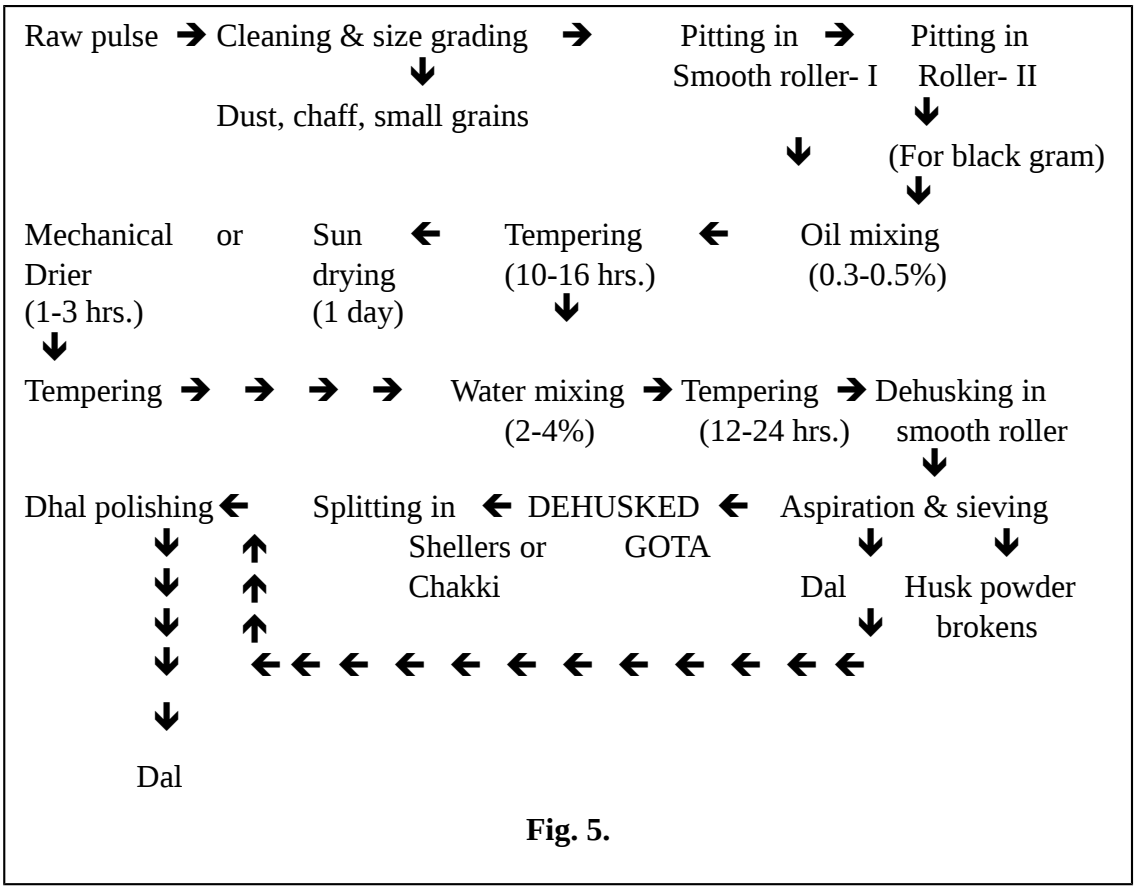


Fig. 5.

10.5. Dehulling of green gram

The husk of green gram is thin, soft and slippery. While the husk is tightly adhering to the grain surface, the two cotyledons are loosely attached and separate out easily. Hence, splitting into dhal occurs even before good dehusking can be effected. During the dehusking operation, there is also scouring of the cotyledons resulting in large losses in the form of broken and powder. The method generally followed is pitting, oiling (0.2-0.5%), sun drying followed by dehulling and splitting in roller machines (fig.5). In some states like West Bengal, because of the demand for smaller sized Dhal, general practice is to go on scouring the Dhal which results in loss of valuable proteinaceous material in the form of powder.

Processing of green gram is largely done in West Bengal, Uttar Pradesh, Andhra Pradesh, Orissa, Maharashtra and Rajasthan

Fig 6 Green gram/black gram splits-flow chart

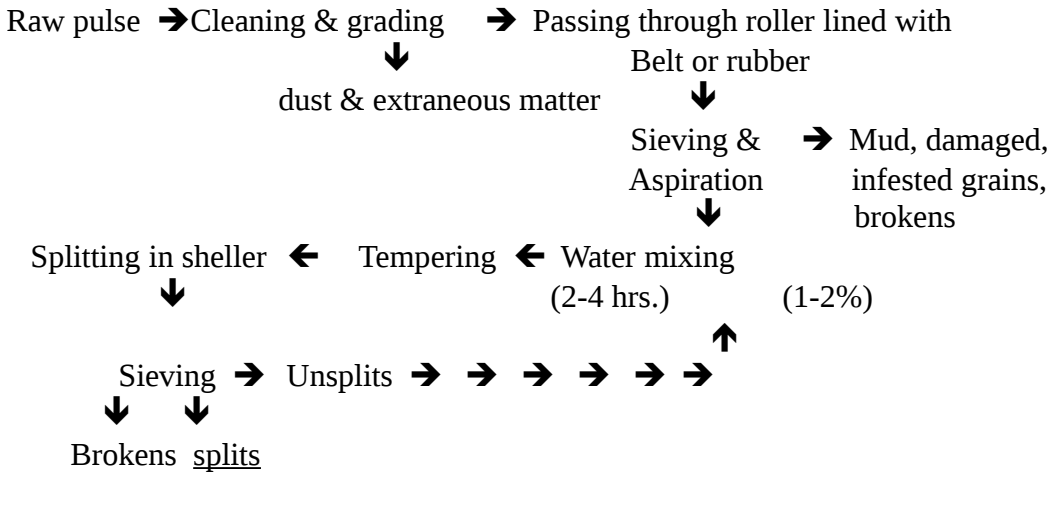


Fig. 6

10.6 Dehulling of peas, lentil and khesari

Processing of these pulses is fairly easy as in the case of bengal gram. General practice involves initial scouring, moisture application, heaping and sun drying, followed by dehusking and splitting in roller machines. After separating the Dhal, the unhusked grain is treated a second time as in the first pass, and repeated till all grain are dehusked and split (Fig.7,8,9).

Processing of lentil is generally practised in Uttar Pradesh, Bihar, West Bengal and Madhya Pradesh while milling of peas is restricted to the state of Uttar Pradesh only. Khesari pulse is processed mainly in Madhya Pradesh and Bihar States.

Fig 7 Process for dehulling peas

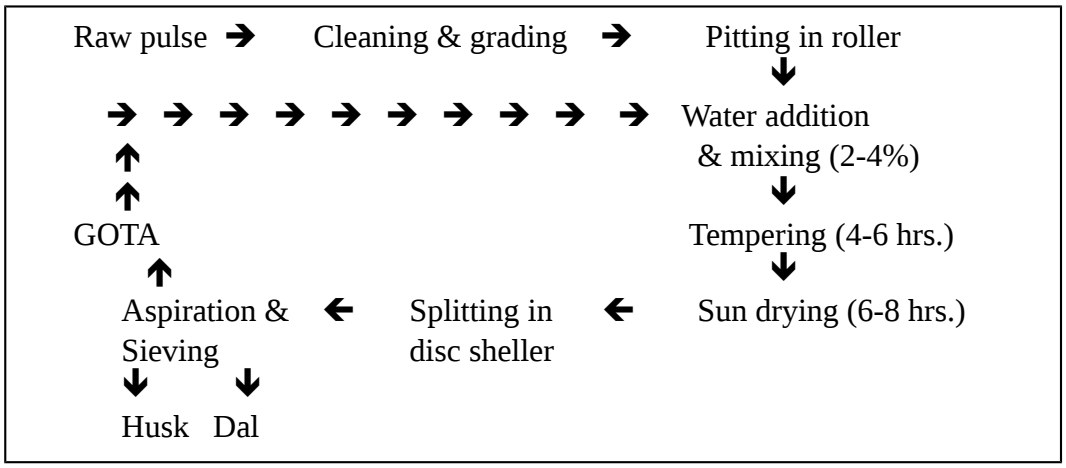


Fig 8. Process for milling of masoor (lentil)

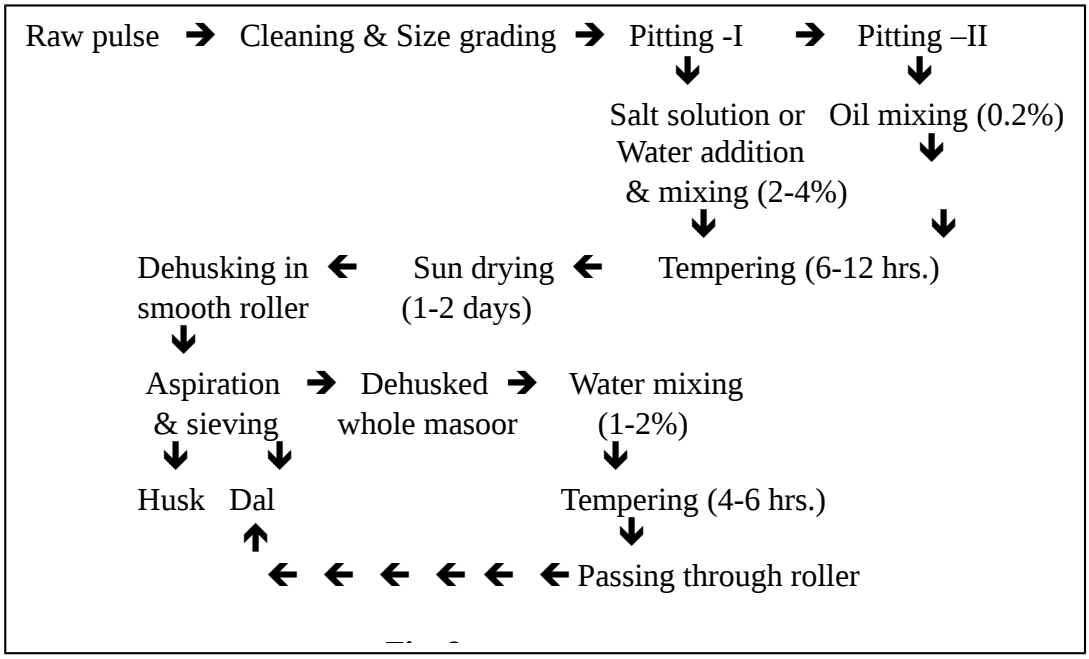
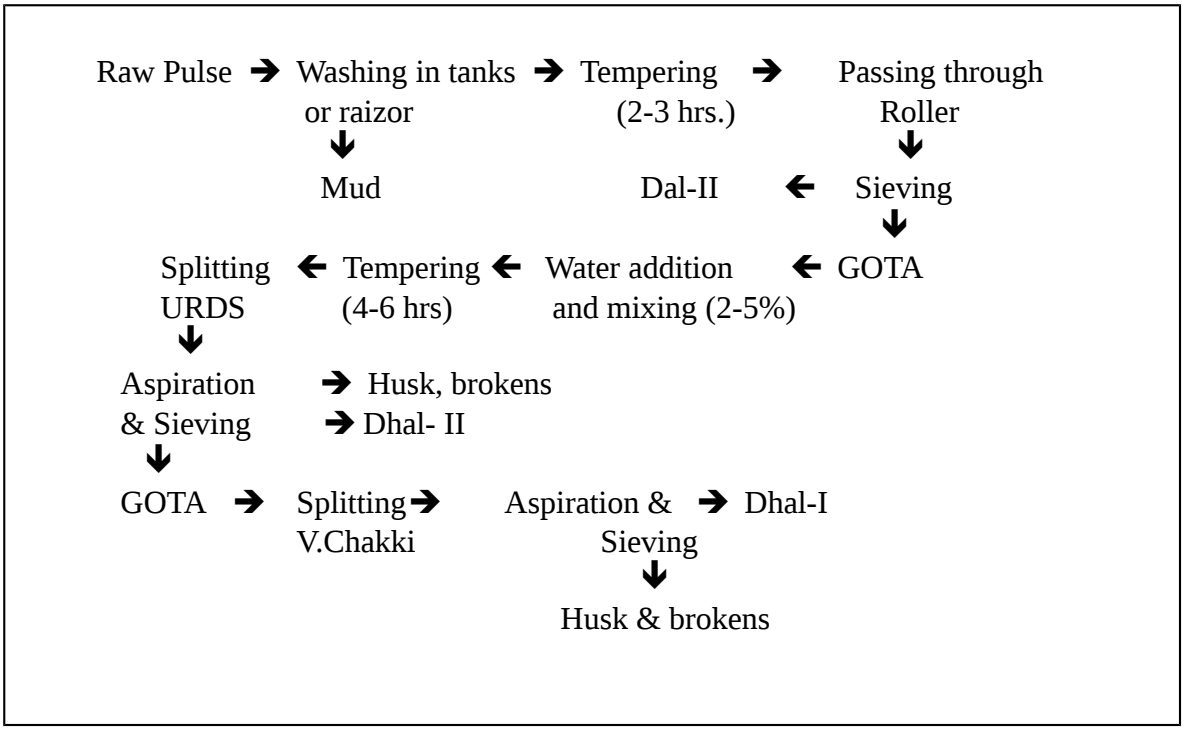


Fig 9 Process for dehulling khesari pulse (lakh)



CONSTRAINTS AND SUGGESTIONS

Based on the review of the planned agricultural development programmes on pulses (NPDP, ISOPOM) and NALMOT visits by the Directorate of Pulses Development, Bhopal, states' programme implementation reports, NPDP evaluation by the Agriculture Finance Corporation (AFC) and the recent independent evaluation study by AMITY Humanity Foundation 2007 for ISOPOM, reasons for low production, coverage and productivity in pulses may be attributed to four major categories viz constraints related to Production, Inputs, Marketing and Technology dissemination:-

1. **CONSTRAINTS ASSOCIATED WITH PRODUCTION OF PULSES**

1.1. **Production related**

The production potential exhibited under the FLDs conducted by the All India Co-ordinated Research Project (AICRP) in various states during 2002-2006 could be tapped, given to adaptation of complete package technology (integration of all components viz. timely sowing, high yielding varieties, fertilizer management (including foliar nutrition), rhizobium inoculation, weed management, IPM etc.

i) Low level national average yields as against the yield already recorded under frontline demonstration as per the details given below; indicate production related technological gap

Table. 16.1 Technological (Yield) Gap exhibiting the production related constraints

S.No.	Crop	All India Average yield (2005-06)	Yield recorded in FLDs	Gap	
				Kg/ha	%age
1.	Gram	808	1400	592	73
2.	Lentil	629	1155	526	84
3.	Pea	913	1466	553	61
4.	Urd	419	772	353	84
5.	Mung	305	741	436	143
6.	Lathyrus	552	1054	502	91
7.	Rajmash	-	1147	-	-
8.	Moth	133	1339	1208	907
9.	Pigeonpea	765	1878	1113	146

Source: FLD report IIPR (2002-2007); DES, Ministry of Agriculture

ii) Being proteinous/nutritious crop-groups, prone to natural vagaries, exposed to numerous biotic and abiotic stresses, soil alkalinity, salinity, sensitiveness to extreing of temperatures, water-logging etc. These results in failure of crops due to erratic monsoon behaviour, moisture stress, and repeated sowings due to poor germination.

iii) Grown mainly under rain fed conditions (only 14% of total pulse area under irrigation) on marginal and sub-marginal lands characterized by moisture stress and low level of organic matter content.

iv) High incidence of wilt in pigeonpea, chickpea, lathyrus, yellow mosaic virus (YMV) in mungbean and urdbean aggravate with each day in delay in sowing time.Un-timely rainfall, cloudy weather, frost and high relative humidity to the Rabi pulses, especially at flowering stage, are the major climatic barriers attributing to production

related constraints.

v) Poor knowledge of farmers or poor resource base/socio-economic status (SES) resulting in non-practicing of seed treatment, Rhizobium inoculation, adaption of proper cropping sequence/crop management to meet any contingent situation.

vi) Excessive/poor vegetative growth is physiological constraint where excess lodging/self shading light interceptions limit production (lodging due to more canopy weight at pod formation/filling stage). Rapid leaf chlorosis result in poor translocation of photosynthetic and reduce grain size and quality by little nutrient uptake. Short statures genotype with least lodging and high harvest index should yet to be popularized/opted for cultivation.

vii) Late sowing results in low yields due to short stature, fewer node, smaller leaf area and short grain filling period. Solution lies in popularization of varieties with longer reproduction phase and better sink.

viii) Flower and Fruit drop causes poor sink realization upto 35-50% due to low nitrogen availability, reduced light intensity in plant canopy, hormonal imbalance, gas exchange in canopy, soil and water factor, low activity of RUBP carboxylase enzyme at grain filling, high temperature and moisture stress high abscision production and high pest infestation, etc, are the other production constraints.

1.2. Inputs related constraints

i) Non-availability of location specific/recommended high yielding varieties quality certified seeds at all levels as the production and distribution is usually for the very old and known varieties which are generally poor performers.

ii) Non-availability of quality inputs at village level (some times even at block levels); in-flow of spurious and sub-standard seeds, rhizobium culture/PSB, micro-nutrients, bio-intensive/bio-pesticides.

iii) Non-popularization/lack of demonstration and availability of implements like light seed drills, zero-till machine/rotavator/and ridge-maker (custom-hiring or community run-basis) in big areas of Bundelkhand region of U.P., and M.P.

iv) Pulses respond favorably to 1-2 critical irrigations for good yields, however, lack of power supply/low-voltage, non-opening of canal and less priority to the crop-group in addressing the water carrying/micro-irrigation related problems.

v) Lack of domestic milling support and Post Harvest Technology (PHT)/value addition support.

1.3. Marketing constraints

i) Price security, un-organized and distress sale, ruling of open market prices above the MSP, access/connectivity to mandies, farmers' exploitation in mandies in spite of APMC act, unawareness and difficult access to ware housing, heavy storage loss (20-30%) etc, are major market associated constraints.

ii) Wide price-gap between the whole and processed/milled product in the chain of farmer/producer-buyer-consumers, vulnerability to stored grains due to lack of scientific storage facilities at domestic level, lack of support to small scale processing, packaging, value addition and non-linking of pulses to procurement policy commensurate to staple food grains like wheat and paddy, are the other major market related constraints.

1.4. Technology Transfer/Extension constraints

i) Depleted public sector extension support, non-positioning of appropriate extension functionaries at the grass-root level (Block/villages) the technology dissemination/extension activities have adversely affected.
ii) Lack on guidance for proper certified seed production/variety identification, insect-pest/diseases identification and management phases, importance and procedure of seed treatment/rhizobium inoculation, lack of information/knowledge on current advances in production, management technology, and also poor or no knowledge about organizing seed production and its protection for succeeding crop.
iii) Poor knowledge base on nutrient use efficiency (NUE), IPM, method of preparation of spray solutions etc are the other technology transfer related constraints.
iv) The extension workers also lack advances in technological sector and there is a gap of HRD activities.
v) Interface between State Department of Agriculture (SDA) and State Agricultural Universities (SAUs), ICAR (KVK/ZRS/RGK) and Department of Agriculture & Cooperation DAC and other allied state level/district level field functionaries also seems to be bleak and visible with the absolute communication gap in conduction/organization of FLDs and block demonstration, FFS, IPM, etc.

2. SUGGESTIONS

2.1. Input related Interventions

Input related constraints are the major bottlenecks in increasing area and production of pulses in the country, following may, therefore, be suggested:

(i) Commensurate to the requirement of quality certified seed the existing (2005-06) seed replacement rate (SRR) in arhar (10.48%), mung (12.50%), urd (15.70%), gram (9.4%), peas (5%) and masoor (1%) has to be brought at the level of at least 25% upto the terminal year of XI plan (2011-12). Comprehensive five year seed rolling plan (variety-wise/Season-wise) for all three stages of seeds viz breeder – foundation – certified seed production may be prepared by SDA.
(ii) A tie-up arrangement amongst state + ICAR (breeder seed producers), Seeds and TMOP Divisions, Government of India, Department of Agriculture & Cooperation need to be more strengthened for advance indenting of breeder seeds. For production of foundation and certified seed, besides making cent-per cent utilization of centrally sponsored schemes on pulses (ISOPOM/NFSM). States need to enter in to MoA with the private seed producers, NGOs and SHGs/FOs/FIGs etc.
(iii) On going seed village scheme (SVS) component of ISOPOM, operational since VIII plan, need serious implementation by way of existing operational modifications.
(iv) To ensure the timeliness, availability of quality inputs at cost effective and approachable common panchait/village place, each potential district, its blocks should identify village-clusters, formulate Pulses Self-Help Groups (PSHG). Under the chairmanship of Rural Agriculture Extension Officer (RAEO) or ADO. A committee,

comprising of representatives from PSHG, Cooperative society, local rural bank, pesticide dealer, block Electricity Board and panchayt representative may be constituted. The committee should prepare season-wise Strategic Pulses Production Plan (SPPP), delineating input requirement, much in advance. The SPPP should be fine-tuned by the ADO-further refined by the Deputy Director Agriculture for final appraisal/review/approval by Chief Executive Officer/District Magistrate, Chairman of DFSMEC/ATMA.

(v) Supply of electricity for critical irrigation at the critical period of crop growth, credit support and all such vital input aspects may be properly addressed in an institutionalized manner by the DFSMEC.

2.2. Production related Interventions

Based on the analysis of production and productivity on all India basis (crop-wise analysis), ten potential districts each for pigeonpea, chickpea, blackgram, greengram and lentil, categorised as the major contributors (20-30 per cent of total all India production in the specific pulse crop), may be adopted by the respective SDAs/SAUs. These districts may be saturated with the entire pulse related development and research programme on cent per cent implementation basis. At least 20 number of each FLDs, FFS, SVS, IPM, infrastructural development and minikits demonstration need to be taken in each block/panchayat on cluster demonstration basis: Crop-wise ten potential districts are indicated below:(table 16.2)

Table – 16.2. Crop-wise potential districts with 20-30% production share – All India

S.No.	Crop	Districts
1.	Gram	Vidisha, Sagar, Narsinghpur, Prakashan, Raisen, Kurnool, Banda, Rajgarh, Dewas and Sehore
2.	Arhar	Gulberga, Yavatmal, Amravati, Wardha, Vadodra, Latur, Nanded, Buldhana, Chhindwada and Panchmahal
3.	Moong	Buldhana, jaipur, Nalgonda, Ajmer, Churu, Kutch, Parbhani, Pali, Jodhpur and Tonk
4.	Urd	Buldhana, Nanded, Krishna, Latur, Jalgaon, Washim, Srikakulam, East Godavari, Bundi and Adilabad
5.	Lentil	Jalaun, Patna, Bahraich, Barabanki, Hamirpur, Lalitpur, Basti, Murshidabad and Kheri.
6.	Total Pulses	Bikaner, Jalaun, Nagore, Gulberga, Vidisha, Jhansi, Narsinghpur Hamirpur, Buldhana and Amravati.

To address the production related constraints amongst the pulse growers, usually with low socio-economic status (SES), poor resource base and least exposure to human resource development (HRD), followings may be suggested:

i) Strong Development – Research interface need to be in place to intensify research efforts to evolve still high yielding varieties and management recommendations suited to dry farming/moisture-stress conditions/utera under rice-fallow areas and for different agro-ecological situations (AESs).

ii) There is need to evolve crop-management modules and low cost technology with best inter-cropping recommendations for various agro-climatic and agro eco-situations).

These modules may be helpful to meet-out any contingent situation associated with such production constraints.

iii) State Agriculture University/Agriculture Colleges/Zonal Research Station (ZRSs)/Krishi Vigyan Kendres (KVKs), etc. in consultation with the State Department of Agriculture now need to develop season-wise nutrient-use efficiency (NUE) plan for each districts on AES basis. Instead of simple recommendations of fertilizers based on the nutrient management practices, there is need to group and plan the practices as:

- Match between nutrient supply from soils and demand by crop on the basis of soil testing and optimization of split fertilizer application and soil and plant nutrition factors (soil moisture, pH, temperature, physical properties etc.).
- Improving nutrient application methods such as broad-casting, band placement, split application).
- Improving physical properties of fertilizers and use of inhibitors to reduce losses.
- Improving soil conditions, crop and water management practices, tillage, regulating soil moisture regimes, crop-rotations, weed control, residue management, break and catch crop etc.

iv) To be more serious on the sustainability of cropping system and judicious use of natural resources in the rainfed regions, depleting ground water level and frequent drought, State Department of Agriculture may draw the successful experience/results from within the best districts.

v) State may put a system and policy frame for pulses cultivation. This strategy would not only benefit the small and marginal pulse growers but would prove a boon to states' proposed crop-diversification programmes involving horticulture etc.

vi) Liberal credit policies and extending insurance cover with low premium offered by the Government of India also need to be aggresively addressed by the states.

vii) State Department of Agriculture, in view of the state's potential in a particular/group of pulse crop, may constitute a **'**Pulse Board**'** (similar to **'**Tur Board' in the state of Karnataka) and procurement policy adopted by A.P. involving private sector, NGO etc, to seriously watch the interest of pulse producer.

The 'Pulse Board' could be a multi-disciplinary approach agency taking full care of marketing, domestic level processing, pricing, value addition, Import-Export, and consumption behaviour of states socio-economic-group of farmers

2.3. Marketing related Interventions

To motivate the pulse growers of different socio-economic-status (SES) in various agro-eco-situations (AES) of the state, following interventions may be suggested.

i) To minimize the price-gap in the chain of producer to consumers, it is important to assign active role to some institutional buyer like cooperatives, civil supplies, MARKFED etc. State Government may fix a procurement target of at least 20% of the total production in order to build a purchase and price security environment.

ii) The SDAs should strongly put-forth its procurement share during the all India rabi and kharif procurement meetings organized at the behest of National Agricultural Marketing Federations Ltd. (NAFED), Govt. of India, New Delhi.

The targetted pulses within the purview of Price support Scheme (PSS) are pigeonpea, gram, lentil, pea, mungbean and urdbean. In view of its major production share in the country, states need to strongly pursue its position to central nodal agency (DAC) for recommendation of more cash credit limit (CCL) to NAFED to be sanctioned by RBI through SBI (up to 75% of hypothecation of stock keeping a margin of 25% in accordance to banking norms).

State Marketing Federations can also initiate a similar PSS system in the larger interest of pulse growers by way of provisioning a revolving fund commensurate to proposed procurement.

2.4. Extension related Interventions

Monitoring of pre-TMOP and post-TMOP, ongoing projects (NPDP/ISOPOM/NFSM) by the Directorate of Pulses Development conclude that pulse growers are usually resource poor, small and marginal group of farmers. The socio- economic status (SES) of this group inhibits them to have an immediate access to technology **in put**. It is, therefore, in the interest of this group in particular and the enhancement of pulses production and nutritional security of the country in general, under mentioned are suggested:

i) For strengthening technology dissemination and extension education, potential pulse producing districts/blocks should be identified. In each block, group of progressive farmers, FOs, SHGs, Cooperatives, NGOs, KVKs, FIGs, Women's Group; Zonal Research Stations (ZRSs), Agri-business Companies and Input dealers etc should be organized, strengthened to function as local information kiosks or extension education points.

ii) The district agriculture officer (DDA) should facilitate these private sectors in terms of local news papers, departmental scheme details, technical literature, credit and insurance consultancy, TV/internet facilities etc through on-going central sector or centrally sponsored, State Government run programmes, banks and input dealers in the field of fertilizers, seeds, pesticides, implements etc.

iii) DDA/SDO/ADA to facilitate the group in organizing the meetings at common panchait place, developing of Kharif, Rabi and Zaid **crop-cultivation seasonal action plan** clearly indicating the input requirements. The district administration should also provide all administrative/technical input and help in interactions with all other stake-holders or service providers.

iv) A certain percentage (10-15%) of total allocated developmental programmes (central sector/centrally sponsored/state-run) should be assigned to these identified groups (agents). Block demonstration, IPM demonstrations, production of certified seed etc components may also be given to these agencies for more accountability and ownership feelings.

v) Under the varietal diversification programme commonly known as seed minikit distribution under the ongoing ISOPOM programme, at least 10% of the minikits, alongwith the technology package, be given to these FOs/SHGs/FIGs/NGOs.

vi) Each potential block is identified as processing centre and at least one small/domestic dal mill like IIPR dal chakki, CIAE Dal mill may be provided. The responsibility of running the mill is rest with the NGOs/Farmers Organization.

vii) Methodologies and package of practices for improving fertilizer use efficiency (FUE) under various soil conditions and different crops, as brought out by Indian Council of Agriculture Research (ICAR) be documented in vernacular language by the state Directorate of Agriculture under the funds on publicity provided through ISOPOM/NFSM-pulses and made available to these groups by the district agriculture officer/farmers.

PRODUCTION TARGETS AND STRATEGY TO AUGMENT PRODUCTIION

1. PRODUCTION TARGET (XITH PLAN)

Commensurate to the tentative demand of pulses by 2011-12 arrived at 20 million tonnes, on the basis of behaviouristic approach (including seed, feed and wastage), proposed targets for area, production and productivity are 27.40 million ha, 20 million tonnes and 730 kg respectively, as summarized below in the table 17.1. In computing the demand, rate of growth of per capita disposable income is considered as 4.8 per cent.

Table -17.1. Crop-wise Production target

(Area = lakh ha., Production = lakh tonnes, Yield = kg/ha).

Crop	**Xth Plan (TE -2006-07)**			**Target XIth Plan (2011-12)**		
	A	**P**	**Y**	**A #**	**P @**	**Y**
Pigeonpea	35.50	24.97	703	41.00	36.00	878
Urd (kh)	25.46	9.37	368	27.00	16.00	593
Moong (kh)	27.10	7.47	276	28.00	14.00	500
Other (kh)	20.65	5.70	276	25.00	10.00	400
Total Kharif	**108.72**	**47.77**	**439**	**121.00**	**76.00**	**628**
Chickpea	70.41	58.03	824	78.00	72.00	923
Urd (rabi)	7.10	4.13	582	15.00	10.00	667
Moong (rabi)	6.65	2.70	406	15.00	10.00	667
Other (rabi)	34.67	23.20	669	45.00	32.00	711
Total rabi	**118.84**	**88.07**	**741**	**153.00**	**124.00**	**810**
Total Pulses	**227.55**	**135.83**	**597**	**274.00**	**200.00**	**730**

includes target of 40.47 lakh ha area expansion under 168 districts of NFSM + 5.98 lakh ha under other ISOPOM districts

@ includes target of 20.00 lakh tonnes under NFSM

2. PROPOSED STRATEGY - ELEVENTH PLAN (2007-08 – 2011-12)

The production of pulses may be proposed to be increased through the twin objectives of (i) area expansion and (ii) increase in the productivity level. This would inter-alia include popularization of pulses in non-traditional areas under irrigated system, inter/mixed cropping, multiple cropping, replacing upland and rain-fed paddy with pulses and also targetting a large Rice fallow land. The major strategies are:

2.1. **Area expansion**: Horizontal expansion of pulses is possible through *Inter-cropping* and *Rice fallow* coverage under different potential and prevalent situations/cropping systems in the country. An area of 46.45 lakh ha (40.47 lakh ha from NFSM districts + 5.98 lakh ha from ISOPOM districts), over and above the existing normal area of 227.55 lakh ha during tenth plan (TE 2006-07), may be additionally occupied by the terminal year of XIth plan.

2.1.1. Targetting Intercropping_– An area of 20.47 lakh hectares is possible under different cropping pattern/situations in the states. Rainfed areas may, particularly be, targetted under area expansion with the converegence approach providing critical irrigation through sprinkler system, if possible

Table- 17.2. Possible Intercropping area - crops/states

Crop	States	Normal Area (Lakh ha) (2000-01 to 2004-05)	Possible Area Expansion (Lakh ha)	Cropping pattern (Intercropping)
Pigeonpea	Madhya Pradesh	3.28	1.00	Early pigeon pea intercropping with coarse cereals, cotton, soybean and replacement of rain fed upland paddy
	Uttar Pradesh	3.87	0.56	
	Rajasthan	0.17	0.08	
	Orissa	1.30	0.50	
	Maharashtra	10.74	1.00	
	Andhra Pradesh	4.80	0.50	
	Karnataka	5.62	0.50	
	Gujarat	2.54	0.50	
	Chattisgarh	0.60	0.20	
			4.84	
Chick pea	Madhya Pradesh	25.08	2.00	Intercropping with safflower, mustard, wheat and barley
	Rajasthan	8.49	1.00	
	Uttar Pradesh	8.09	1.00	
	Maharashtra	7.71	2.00	
	Karnataka	4.51	0.50	
	Andhra Pradesh	3.28	1.00	
	Chhattisgarh	1.80	2.00	
			9.50	
Urd & Moong (Kharif)	Madhya Pradesh	6.00	0.50	Intercropping with pigeon pea and spring sugarcane, cultivation in waste lands, reclaimed lands, replacement of rain fed upland paddy
	Uttar Pradesh	4.76	0.58	
	Bihar	2.00	0.25	
	Orissa	2.40	0.50	
	Maharashtra	11.85	1.00	
	Karnataka	6.40	0.05	
	Chattisgarh	1.22	0.50	
			3.38	
Urd & Moong (Rabi)	Andhra Pradesh	5.98	1.00	Intercropping with rabi oilseeds
	Bihar	1.79	0.50	
	Orissa	0.85	0.50	
	Tamil Nadu	2.62	0.05	
			2.05	
Lentil	Bihar	1.79	0.20	Intercropping with mustard & autumn sugarcane
	Uttar Pradesh	6.13	0.50	
			0.70	
		Total	**20.47**	

2.1.2. Targetting rice fallow: Grain legumes such as chickpea, khesari and lentil in Northern India, mungbean and urdbean in southern Indian state are potential crops for Rice-fallows. These crops may not require supplemental irrigation and contribute substantially in enriching soil fertility status of these soils by fixing

atmospheric nitrogen and adding organic matter. In addition, they may help in sustaining rice-based systems by breaking pest and disease incidence associated with sole rice systems. Similarly, they could enhance microbiological activity and thereby, nutrient availability of soils following rice. It is assumed that the soils in these lands are fully saturated during most of the rice growing season and residual moisture, left in soil at the time of rice harvest, is enough to raise a short season legume.

Table - 17.3. Possible rice fallow area (State-wise)

State	Possible Area Expansion (Lakh ha)
Madhya Pradesh	1.50
Maharashtra	1.00
Uttar Pradesh	1.00
Andhra Pradesh	1.00
Orissa	2.50
Karnataka	0.50
Gujarat	0.10
Chattisgarh	7.50
West bengal	2.75
Bihar	2.00
Tamil Nadu	0.15
Total	**20.00**

2.1.2.1. Agronomic strategy for area expansion in rice fallow

(i) Usually legume face a problem of delayed sowing caused by late harvest of rice (in late November or December). This problem can be overcome by introducing short duration high yielding rice varieties with its earlier planting as dry seeding and earlier transplanting.

(ii) Relay sowing (uttera cropping) of lentil, khesari, small seeded chickpea and pea can also solve the problem of late sowing.

(iii) For maximum yield, DAP or SSP application is recommended for better and sturdy root development. So as to enable the crop to extract moisture from deeper zone for a longer time.

(iv) Recently released chickpea varieties viz. BG-372, KPG-59 and Pant G-186 that are better adapted to late sown conditions and are able to escape terminal drought and heat stresses, may be popularized. Similarly improved varieties of lentil for late sown conditions viz., PL-639, Narendra Masoor 1 and DPL-62 and Lathyrus with low neurotoxins content viz., Prateek and BIO-L-212 (less ODAP content), may be pursued.

(v) For good crop establishment, adopt seed priming (soaking the seeds over night in water surface, drying and sowing next day), seed treatment with effective Rhizobium strain, sowing of seed into deeper moist soil (in case of chickpea), lime pelleting for acidic soil and gypsum in saline areas must be encouraged.

(vi) To avoid major biotic stresses likely to threat pulses grown after rice (viz wilt root rot and seed rot), various integrated pest and disease management strategies should be followed, including seed treatment etc., with fungicides as basic strategy.

(vii) In the identified target sites, it will be necessary to conduct on farm demonstrations of the technologies with necessary minimum affordable inputs. This would be best done through farmers-managed trials, soliciting participation in the total exercise at the outset.

(viii) As per FAO recommendation for integrated plant nutrient management for pulse based cropping system in rice-rice-greengram/soybean system, N should be applied to both the rice crops, P to dry season rice and K, S and Zn to the second crop.

(ix) In rainfed rice-pulse system, fertilizers should be applied to rice only. If moisture conditions are favourable, 20 kg P_2O_5/ha may be applied to pulse.

(x) In maize+pulse intercropping system, N should be applied to maize, P to both the crops and K,S and Zn to maize, if needed.

(xi) Utilization of fallow lands which remain unutilized because of inadequate irrigation water with the convergence of different on going programmes (Central/State-run). An additional area of 4.47 million hectares may be brought under pulses through various cropping systems (Rice fallow + Intercropping etc.).

2.2 Productivity enhancement

In recent years, wide spread deficiency of sulphur and zinc has been noticed in pulse growing regions, which constrains productivity of pulses. In the major pulse growing areas, 44 districts have shown 40-60% sulphur deficiency and 82 districts with 50-60% zinc deficiency. Very encouraging response to application of S and Zn has been found with cost benefit ratio of 10-21%.

About 40% pulse growing regions have low to medium population of native rhizobium. Seed inoculation with biofertilizer (Rhizobium and PSB) - low cost inputs - can increase pulse productivity by 10-12%. Lack of quality culture in adequate quantity is one of the major constraints in popularization of biofertilizers.

The frontline demonstrations conducted in different agro-climatic regions on important pulse crops with a view to demonstrate and assess the befefits of new varieties and technologies under diverse cropping systems have revealed the existing potential of productivity to be exploited through technological interventions. A package technology like improved cultivar, Rhizobium inoculation, use of sulphur, INM, application of pendimethalin, foliar spray of urea, IPM etc may be vigorously pursued.

State-wise, crop-wise national and state average yield and the potential realised under the FLD along-with the states' own best yield is summarized below (Table 17.4):

Table - 17.4. Average productivity and FLD potential

State	Crop	Ave. Yield (Kg/ha)			States' best year
		National	State	FLD	
	Pigeonpea	657	420	509	2004-05 (456)

A.P. Pradesh	Urd (Rabi)	551	616	985	2000-01 (795)
	Moong (Kharif)	346	372	566	2003-04 (509)
	Moong (Rabi)	422	315	741	1996-97 (413)
	Chickpea	792	1084	1772	2000-01 (1139)
Bihar	Lentil	667	858	1880	2000-01 (981)
Chhattisgarh	Pigeonpea	657	477	1520	2003-04 (602)
	Urd (Kharif)	376	284	793	2001-02 (308)
	Chickpea	792	690	1330	2003-04 (964)
Gujarat	Pigeonpea	657	651	1256	1998-99 (952)
	Moong (Kharif)	346	406	717	1992-93 (513)
Haryana	Pigeonpea	657	947	1488	2003-04 (1202)
	Chickpea	792	785	1391	1994-95 (1099)
Karnataka	Pigeonpea	657	427	833	2004-05 (516)
	Urd (Kharif)	376	256	NA	1995-96 (758)
	Moong (Kharif)	346	210	898	1991-92 (438)
	Chickpea	792	518	1290	2000-01 (648)
M.P.	Pigeonpea	657	743	1287	1993-94 (967)
	Urd (Kharif)	376	328	NA	2003-04 (367)
	Chickpea	792	867	1224	1999-00 (986)
	Lentil	667	459	1517	1999-00 (522)
Maharashtra	Pigeonpea	657	671	978	1992-93 (876)
	Urd (Kharif)	376	407	598	1998-99 (636)
	Moong (Kharif)	346	432	648	1992-93 (607)
	Chickpea	792	555	1052	1993-94 (726)
Orissa	Urd (Kharif)	376	264	620	1991-92 (565)
Punjab	Moong (Kharif)	346	878	1141	1994-95 (875)
Rajasthan	Urd (Kharif)	376	344	500	2003-04 (523)
	Moong (Kharif)	346	318	760	2003-04 (620)
	Chickpea	792	696	1021	1997-98 (869)
Tamil Nadu	Urd (Rabi)	551	427	738	1998-99 (518)
	Moong (Rabi)	422	423	538	2000-01 (485)
Uttar Pradesh	Pigeonpea	657	1094	662	2000-01 (1254)
	Urd (Kharif)	376	359	877	1995-96 (457)
	Moong (Kharif)	346	290	712	1995-96 (333)
	Chickpea	792	929	1785	2003-04 (1035)
	Lentil	667	780	1525	2003-04 (907)
West Bengal	Urd (Kharif)	376	613	650	1991-92 (669)
	Chickpea	792	914	NA	1995-96 (1092)
	Lentil	667	690	953	2000-01 (901)

2.2.1. General Strategy for yield enhancement

- Increase in cropping intensity through multiple/inter/mixed cropping, *etc.*

- A campaign on pulses for sustainable rain-fed agriculture under on going schemes may be vigorously pursued harnessing the progress made on short duration pulse varieties for increasing the adaptability of pulses in different cropping systems.
- Increasing the existing productivity trend at about 600 kg/ha realised during the two five year plans (IX and Xth), need to be paralleled with the world's average yield of 871 kg/ha. Moisture/nutrient stress, vulnerability to biotic stress, lack of availability of quality seeds of descriptive varieties may be given strong programme back-stoppings.
- Higher productivity may be achieved through application of improved production technology, use of critical inputs. The results of FLD have displayed sizeable yield potentials which can be exploited in selected crops.
- Adoption of tailor-made improved rain fed farming management.
- Adequate and timely use of critical inputs with assured quality.
- Developing more effective and adaptive integrated management practices for major diseases.
- Dove-tailing of ISOPOM, NFSM-pulses with those of other similar schemes viz. NWDPRA, Technology Mission on Cotton, RKVY, NREG etc, for better synergy.
- Institutionalized and effective monitoring mechanism involving Panchayti Raj Institutions (PRI), ATMA (ITD-NATP), District Food Security Mission Executive Committee (DFSMEC)-NFSM, State Level Monitoring Team (SALMOT) and National Level Monitoring Team (NALMOT), constituted under ISOPOM.
- Adaption of cluster demonstration approach for cost effective, judicious, timely and efficient use of inputs management practices at farm level, especially concentrating on ten highest contributor districts in the country (table 1.13).
- Bacillus and Pseudo are efficient PGPR for early root colonization secrete a variety of secondary metabolites and contribute considerably in plant protection and production. it enhance level of flavonoid like compound in roots of legumes, which on seed bacterization, might be an additional factor in nodule promotion by these bacteria. PGPR and PSB improve BNF by enhancing nodulation through colonizing root system and suppressing growth of deleterious macro organisms. So, combined effects of PGPR + Rhizobium + PSB give a synergetic effect on BNF and grain yield over single and dual inoculation.
- Dual inoculation (double culturral treatment of seed) with 'Rhizobium' and 'PSB' takes care of 'N' as well as reduces 25-30% of phosphorus requirement by making available the initial fixed soil 'P' to the plants, need to be popularised.
- Rhizobium inoculation is must after paddy as it is an aerobic bacteria and most of its population die during flooding and compaction in absence of oxygen.
- *In-situ* management of rice straw/residues takes care of Zinc and other micronutrient and no need to apply them separately.
- Ensuring timely availability of quality rhizobium and PSB cultures in adequate quantity
- Supply of sulphur either through SSP (along with P application) or through Gypsum application, available at subsidized rate under ISOPOM, need to be ascertained.

- All India district-wise Nutrient map on Micronutrient deficiency prepared by IIPR, Kanpur, IISS, Bhopal,& NBSS &LUP, Nagpur may be taken by all the states to identify and ensure supply of specific Micronutrient to a particular district under ISOPOM/NFSM.

2.2.2. Ensuring fertilizer use efficiency

- Being energy rich crop, phosphorus requirement of pulses is quite high. hence assure supply of DAP and SSP on subsidized rate at the sowing time
- Drill 15-20 kg N and 40 kg P2O5 per hectare at the time of sowing.
- Apply P fertilizer for the first and second crop in a cropping system and grow the third (pulse) crop without P application to enrich and encash the residual effect.
- Application of K at 20 kg K_2O per hectare along with NP proved beneficial in K deficient areas.
- For higher S use efficiency, SO4 – S containing S sources Viz. SSP, gypsum, ammonium sulphate have to be applied as basal or before planting. Other source like Pyrites or elemental S should be broadcasted 2-4 weeks before sowing.

  Apply 20 Kg S per hectare in addition to recommended dose of NP at the time of sowing.
- Integrated use of FYM/compost/biogas slurry at 2.5 tonnes per hectare with 50% recommended dose of fertilizer plus Rhizobium inoculation helps in saving 50% of chemical fertilizers (especially recommended for low fertile and paddy soils).
- Seed inoculation should be done 10-12 hours before sowing. To inoculate 10 Kg seed of pulses, add 100 g gur (jaggery) + 20g gum arabica + heat-up for 30 minutes to prepare homogenous mixture, cool and add a packet (200-250 g) of culture and mix thoroughly. Pour this slurry over the heap of seed to be treated. Mix the seed homogenously with hands. Spread the treated seeds over clean surface for drying for about an hour before sowing.
- In acid soils Rhizobium inoculated seed should also be treated with 1.5 Kg of finely powdered lime (CaCO3, 300 mesh) and keep for 5 minutes after thorough mixing to make uniform pellets.
- Use of micro-nutrients like Zn, B, Mo and Fe helps in improving productivity.
- Foliar spraying of 0.5 kg ZnSo4 ha with 0.25 kg lime for Zn deficiency.
- One kg Sodium molybdate per hectare for Mo deficiency.
- Soil application of ZnSO4 @ 25 kg/ha to one crop on Zn deficient soils is helpful to both, the crops and pulse based cropping system.
- Foliar spray of B @ 0.5-1.0 kg per hectare or soil application of 5-10 kg borax per hectare enhances grain yield on boron deficient soils.
- Spray 1% FeSO4 to recoup from Fe deficiency.
- Liming is essential for pulse crops grown on acid soils.
- Give 2 post-sowing irrigation (at branching & flowering) for better fertilizer utilization.
- Weeds cause a reduction of 25-75% in seed yield of pulses. The field, therefore, must be free from weeds especially between 4 and 6 weeks after sowing of crop.

2.3. Market strategy/MSP

In all developing economics a positive agricultural price policy is incresingly being recognized as integral part of growth policy. A suitable price policy is likely to accelerate and sustain the growth of pulses output by protecting the interest of the farmers on a long-term basis particularly in respect of deficit commodities. It would also help in bringing about a balance in the relative quantitites procured of various commodities.

The price support scheme (PSS) in pulses to protect the interest of the farmers, is operational since three decades. NAFED is the nominated nodal agency for undertaking price support operation in identified oilseeds and pulses. However, congenial procurement policy at the field level has yet to initiate by identifying potential districts.

- Based on the experience gained during implementation of NPDP/ISOPOM, it has been realized that it requires some modifications in the line of approach, for marketing. Market Policy Government of Karnataka and Andhra Pradesh, enabling the marketing environment by way of specific bonus, over and above M.S.P., may be replicated.
- Aggresive awareness campaign on required FAQs for different pulses, rates of M.S.P. along-with the bonus prices, if any, proposed designated procurement points etc. need to be published to make the farmers aware of the policy.
- Grade specifications, general characteristics of grain and maximum permissible limits for support price need to be given wide publicity by the SDA; Grade specifications anounced and MSP for different pulses are as under:

Table - 17.5. Grade specifications and M.S.P. prescribed for PSS (FAQ Grade)

Crop	Maximum permissible limits of different refractions (per cent)							Allowed moisture %
	Foreign matter	Other food grains	Damaged grains	Slightly damaged touched grains	Immature shriveled & broken grains	Admixture of other varieties	Weevilled grains	
Gram	1.0	3.0	3.0	4.0	6.0	5.0	4.0	14.0
Lentil	2.0	-	3.0	4.0	3.0	3.0	4.0	12.0
Arhar	2.0		3.0	4.0	3.0	3.0	4.0	12.0
Urd & Moong	2.0		3.0	4.0	3.0	3.0	4.0	12.0

2.3.1. Required characteristics for grain to qualify under MSP procurement

- This should be the dried mature grains. (of *Cajanuas cajan*, syn. *Cajanus indicus*/*Phaseolus*, *syn*. *Phaseolus ratiatus*/*Phaseolus mungo*/*Lentilla jens*, syn. *lens culinaris*, *Lens esculenta*, *Ervum lens*/Pisum arvensu/*Phaseolus acontifolius*);
- The grains should have reasonably uniform size, shape and colour;
- It should be sweet, clean, wholesome and free from moulds, weevils, obnoxious smell, discolouration, admixture of deleterious substances and all other impurities except of the extent indicated in schedule;

- The grain/lot should be in sound merchantable condition; and
- It should have good cooking quality to confirm to PFA rules.

Table - 17.6. Minimum support price of pulses

Commodity	Year					%age increase over 2006-07
	2003-04	2004-05	2005-06	2006-07	2007-08	
Gram	1400	1425	1435	1445	1600	10.7
Lentil	1500	1525	1535	1545	1700	10.0
Arhar	1360	1390	1400	1410	1550	9.9
Urd	1370	1410	1520	1520	1700	11.8
Moong	1370	1410	1520	1520	1700	11.8

2.4. Value addition/ strategy processing

- There is a need for systematic listing of available various value additions/processing Technologies developed by various research institutes (ICAR/CSRI/CFTRI/SAUs etc) and publication of these for wider circulation in vernacular languages. Steps to avoid wasting the vast potential of the post harvest business in pulses sector need to be urgently addressed.
- Development of cheaper and acceptable Dal supplements/substitutes to ease out pressure on pulses through PHT.
- Export oriented crop cultivation and milling, need diversification and modernization of post harvest technology with special emphasis on export oriented processing. The varieties having export value e.g. bold-seeded lentil (sagar masra) and chickpea varieties like Gulab chana and kateela chana and special baigani arhar (grown in Mandla, Baigatribes), need popularization.
- Cost effective processing plants/units need to be set up at potential pulse pockets to avoid farmers' hardships for transportation and carriage.
- HRD programmes on scientific technologies/storage may be imparted for food preservation, value addition of by-products.
- There is need for cost effective/easy to access containers and chemicals for processing which should be within the reach of the poor farmers.
- Possibilities of import of tin containers, whose cost appears to be prohibitive in the indigenous market or its alternative, need to examine.
- Various incentives and social amenities need to be provided to the farmers to encourage them for maximum production of the raw-materials (pulses) to feed the processing industries for corresponding output. This may be achieved through formulations of Self Help Groups (SHGs) in the potential pulse areas.
- Modern techniques of pulse production is the foremost thing without which, processing and value addition of Pulses are not possible. Farmers, therefore, need up-to-date techniques along with proper transfer of technology.
- Appropriate food processing facilities cannot only avoid the wastage of food, but will also lead to value addition thereby, income generation in the centralized fashion in rural areas.

- Traditional food processing technologies as well as high-tech and environment friendly production technology should be encouraged.
- The food processing industry/machinery has to conform to high hygienic standard. Strict adherence to the standard prescribed by competent authorities has to be ensured.
- There is need to make better coordination mechanism between State Departments of Agriculture, marketing, mandi boards and Food Ministry at state level so that even marginal/small farmers could process their own produce without going to the far-flung bigger industries/plants. Small scale pulse mills could also be installed at community level through Farmers' Interest Groups (FIGs)/SHGs etc.
- Pulse growers must be provided with storage bins and other equipment required in post harvest operations to increase the durability of produce that will further go to the processing units for value added by-products.

2.5. Strategy related to research issues

- To break the yield barriers, development of physiologically efficient plant types,**Use of Biotechnology** for speedy transfer of genes, conferring resistance to important diseases and pests for e.g. transfer of Bt gene in chickpea and pigeonpea for control of pod borer, pre-harvest sprouting of mungbean and also the mutation breeding.
- **Exploitation of heterosis breeding by way of u**se of CMS in pigeonpea, need aggressive research to develop and refine the process cost effective seed production Technology.
- Integrated approach for the management of diseases, pests, drought, nutrient etc. need multi-disciplinatry research, development of multiple disease resistant varieties, transgencies for Helicoverpa pod borer and drought in chickpea and pigeonpea and MYMV in urdbean and mungbean and development of varieties having tolerance to temperature extremitie, etc are urgently needed to address 'low and unstable yield' constraints in pulses.
- Research on validation and refinement of technologies, development crop modules, forecasting and fore-warning the incidence of pests/diseases need to be initiated and developed.
- **Research emphasis on minor pulse** (mothbean, cowpea, horsegram, fababean, rajmash and lathyrus) need to be strengthened on regional basis alongwith development of technology dissemination modules for different situations.
- **Research back-up needed for** change from low point input to optimum input technology for various cropping systems as well as for cultivation as sole crop alongwith the need for development of nutrient and water use efficient genotypes.
- **Pulse Ideotype requirement** for Irrigated Medium stature semi-erect and compact, responsive to high input and high HI
- For **multiple cropping**, quick growing, short statures and synchronous in maturity.
- **Under rainfed conditions,** erect, tall, main stem with open canopy early flowering, larger size and number of leaflets with low osmotic adjustments are more desirable traits.

2.6. Crop Specific Strategy/Recommendations

Pigeonpea	- Early maturing pigeonpea can be grown in irrigated tracts of north-west Rajasthan, Haryana, Punjab and western U.P. and as **post-rainy season** crop in September in U.P., Bihar, Orissa, southern Gujarat, A.P. and West Bengal. - In case of M.P. inter crop or mixed crop with Soybean (late variety) in un-irrigated area may be taken especially in Vidisha, Raisen, Sehore, Bhopal and Narsinghpur districts. - The productivity is proposed to be increased by adoption of improved crop production technology i.e. use of improved seed, NPV for control of Heliothis, providing irrigation at critical stages, use of gypsum and bio-fertilizers etc. - For reducing the vagaries of diseases Integrated Pest Management comprising of deep summer ploughing, mixed cropping with sorghum, discouraging ratooning or perennial cropping, planting in well drained field, seed treatment with Benomyl or thiram or carbendazim+thiram @ of 2-3 g/kg for reducing incidence of wilt and root rot and selection of diseases resistant varieties for cultivation. For biological control of wilt and root-rot, seed dressing with standard formulations of *Tricoderma viridae* or *T. harzianum* @ 4 g/kg should be promoted.
Chickpea	- The frontline demonstrations conducted by ICAR have clearly shown the potential to exploit the gram yields with the available technology. Improved varieties, use of recommended does of fertilizers, providing irrigation at critical stages of crop growth, application of gypsum/bio-fertilizers, use of NPV for control of Heliothis. - For Integrated Diseases Management (IDM), deep summer ploughing, crop rotation with non legumes, deep or late sowing, wider spacing and inter-cropping with any one among wheat, barley or mustard for effective control of wilt, root rot, ascochyta blight and other soil borne diseases, seed treatment with Benlate, Benomyl, Carbendazim or Thiram @ 2-3 g/kg is recommended with the *T. viridae or Bacillus subtilis or Gliocladium virens* @ 4 g/kg of seed and select wilt resistant/tolerant varieties (Avrodhi KWR-108, JG-74, Pusa-372, ICCV-10, Vishwas, Vijay, Vishal) and Ascochyta blight resistant varieties (Gaurav GNG-146, Samarat PBG-1) supplemented with management practices for wilt and root rot are the best options.
Blackgram (Urd)	- Yellow mosaic virus **resistant varieties**, namely, PDU 1, Uttara, Pant-U-35, Pant U-19, Narendra Urd 1 and Mash 338; Improved **early maturing varieties** with a large number of clusters like Pant U-19 and Pant U-30; Variety for **spring season** in north India PDU-1, powdery

	mildew resistant variety LBG 17 (Krishnayya) and LBG-603 for Rabi season. - To enhance the kharif productivity selection of appropriate variety resistant to YMV, in-situ moisture conservation to escape terminal drought, IPM, application of gypsum, use of bio-fertilizer. - In case of **summer urd**, crop has to be grown under better management conditions, mostly inter-cropped with sugarcane and sunflower. It is necessary to use only recommended varieties for summer cultivation, seed treatment, use of gypsum, etc. In rice-fallow areas during Rabi, varieties resistant to powdery mildew are required to give more thrust in addition to other agronomic practices.
Greengram (Moong)	- In cropping system manipulation, sugarcane can be intercropped with mungbean in U.P. and northern Bihar cotton, pearl millet and groundnut can be inter-cropped in rainfed uplands of Maharashtra, Karnataka and Tamilnadu. - The increase in productivity during kharif season is to be achieved by use ot improved seed, seed treatment, use of weedicides, control of insects/pests through IPM, application of gypsum, providing irrigation in absence of rains, wherever possible. The average productivity obtained under the Frontline Demonstrations is about 7.8 qtl per ha suggested that the present productivity can be improved further with the use of available technology. - Early sowing during spring (around 15th March), soil application of insecticide like Phorate or Carbofuran G. @ 1.0 kg a.i./ha for effective control of YMV and fungal diseases or chemical (7 Carbendasim + Thiram) seed treatment for reducing incidence of wilt and root rot disease. - Select short duration YMV resistant varieties of Mungbean like Samrat (PDM-139), Pusa vishal, SML 667, Pant mung-2, IPM-99-125 (Meha) and TM 99-37 having a potential to increase area in spring/summer in U.P., Bihar, West Bengal, Punjab and Haryana. Powdery mildew resistant varieties like TARM-1, JM-721 under Rabi cultivation have a potential of additional area of 0.5 m.ha.
Lentil	- Bold seeded varieties with rust resistance namely, DPL 15 and DPL 62. Rust resistant varieties with different plant types – example, Lens-4076, Pant L-639, Sapna and Pusa Vaibhav. Wilt and rust resistant variety viz .Pant lentil-4 and KL-133. - Provide seeds of improved varieties resistant to wilt and rust, seed treatment with fungicide and Rhizobium culture, irrigation at critical stage (pod stage) of crop growth, use of gypsum, as a source of sulphur and use of IPM for the control of pest/diseases.
Peas	- Use of leafless dwarf types of Peas with high yield for closer planting (HFP 4, Uttara, Shikha). Powdery mildew resistant varieties (HUP 2, KFP 103, DMR 7 and JP 885, Rachna, Aparna, Pusa Prabhat, Ambika, Rust resistant variety Malviya Matar-15). - Under the Frontline Demonstrations, yield levels to the tune of 1790

	kg/ha have been reported which is almost double the normal yield levels. Field peas normally receive better management and thus farmers pay adequate attention to this crop. However, the targeted productivity would be achieved by providing seeds of better varieties resistant to powdery mildew, seed treatment, application of gypsum, managing rust disease and providing irrigation, etc. - Early sowing (during 1st week of October) to escape onset of powdery mildew and rust diseases in NEPZ. - Fungal seed treatment to reduce incidence of seed rot and root-rot, two-three foliar spray of wettable sulphur (0.3%) for control of powdery mildew and rust.
Lathyrus	- Lathyrus is most commonly grown as Utera in rice. Important states are Chhatisgarh, Orissa, Maharashtra, Madhya Pradesh, Bihar and West Bengal. - Increase in productivity in case of lathyrus would be obtained by better management of utera cultivation. - Variety Bio L 212 (Ratan), a.low toxin Lathyrus can be grown in rice fallows of Uttar Pradesh, Bihar, Orissa, West Bengal and Chattisgarh.
Moth	- Adoption of improved crop production technology i.e. use of improved seeds, NPV, irrigation IPM, INM disease resistant varieties, weed management and other package of practices at critical stage are.
Rajmash	- The cultivation of Rajmash may be promoted mainly in North East Plain Zone. - Rajmash and other beans can be grown profitably in irrigated areas of Uttar Pradesh, Maharashtra and Gujarat - Varieties suitable for the plains of northern India for rabi season available in different grain colours, namely, Variegated (PDR 14 or Uday), Red (HUR 137) and White (HUR 15).

2.7. Policy related strategy

- The credit in the 3rd phase of post liberalization period appears to be getting less inportance credit is one area where more serious and detailed exercises are needed at National, state and crop levels in view of the changing scenario of stagnation in foodgrains, especially pulses.
- It is felt that the states has to intervene to protect the interest of the pulse growers till the agriculture does not become self-sustaining, vigorous programme are needed to lend credits and crop insurance including the MSP. Provide an effective insurance cover to pulses to compensate the losses due to weather vagaries and also from pests and diseases.
- In order to make a break-through in expansion of area under pulses, short duration varieties of pigeonpea To need based replacement of soybean, and short duration early maturing chickpea varieties for late sown conditions after paddy harvest, need popularisation, through demonstration.

- Better package of practices especially the inter-cropping Package, developing effective and adaptive integrated management practices against major disease and Crop Management etc. need to be documented and popularized across the country.
- Development/promotion of perfect technology for *utera* cultivation with a view to divert an existing area of about 6 to 7 lakh ha under lathyrus towards chickpea lentil, cultivation.
- Dove-tailing and convergence concept should be materialized; provisions of assured irrigation in rabi and summer/spring season should be made on priority-basis. Besides convergence of ISOPOM/NFSM with similar schemes viz. NWDPRA and TMC etc.
- Developing strong seed production and distribution chain to achieve seed replacement rate of 25 per cent by 2011-12 from the present level of 5-10%.
- Creation of seed banks to meet seed shortage needs and for calamity situations by associating public as well as private sector seed companies.
- An area of approximately 2 million hectares of a large tracts of Rice-fallow land (because of unirrigated conditions and properties of soils to hold moisture for shorter duration), and 2.47 million hectares under inter cropping in different cropping situations may be brought under pulses through aggressive crop coverage campaign.
- Delineation of un-exploited potential belts in non-traditional areas like watershed, introduction of pulses during non-traditional seasons under irrigated conditions, inter/mixed-cropping, summer cropping etc.
- Creation of production units for Nuclear Polyhydrosis Virus (NPV) with all the KVKs and integration of development and research at district level.
- Emphasis on sprinklers and micro-irrigation systems to promote pulses in irrigated area with efficient water management.
- Provide an effective market mechanism to pulses by minimizing the price fluctuations. Self-help groups (SHGs), Farmers Interest Groups (FIGs) for effective market improvement can be organized.
- Dissemination of latest agronomic package of practices, HRD programme, *etc.*, by aggressive ToT programmes as the same has become un-sustainable after the termination of NAEP (T&V Programmes).

POLICY INTERVENTION

1. PROJECTS/PROGRAMME ON PULSES DEVELOPMENT

With the unabated population increase in the Country, pulses production, the main source of protein/balanced diet particularly for the rural mass also thought to be paralleled in proportionate to population growth. Accordingly the Department of Agriculture & Cooperation launched various development programmes on pulses during different Plan periods.

A Centrally Sponsored 'Pulses Development Scheme' was initiated from the IVth Plan (1969-70 to 1973-74) with the introduction of production technologies and improved varieties amongst the farmers.

Merging all the earlier centrally sponsored schemes on pulses, Seventh plan (1985-90) conceived the National Pulses Development Project (NPDP).

In order to supplement the efforts under NPDP, a Special Food grain Production Program (SFPP) on Pulses was also implemented during 1988-89 on a 100% Central assistance basis.

1.1. Technology Mission (TMO): The strategy adopted and the successes achieved in the Green Revolution in wheat, rice and cotton, prompted the Government of India to opt for a comprehensive Mission-mode approach for oilseeds. During 1985-86 six priority sectors viz. Water, Immunization, Literacy, Telecommunications, Dairy Development (Operation Flood-II) and Maximization of indegenous production of vegetable oilseeds/oils, etc, were identified and Technology Mission on Oilseeds (TMO) launched by the Ministry of Agriculture.

For accelerated development and successful implementation of the mini-mission approach, three strategic Committees were also set up for Structural Innovations as –

(i) Empowered Committee (EC), (ii) Technical Advisory Committee (TAC), and (iii) Standing Committee (SC)

The TMO set up in May 1986, under the supervision of ICAR, was subsequently transferred to Department of Agriculture & Cooperation (DAC) during 1988-89.

The Mission took four-pronged approach by way of four Mini-missions involving other stake holders. The MM-I with crop production Technology, MM-II PHT, MM-III input and support services to farmers and MM-IV for Price support, Storage, Processing and Marketing, were the strategic formations of the TMO.

1.1.1. TMOP: (NPDP)

Visualising the increasing demands for pulses and augmenting their production and productivity to ensure and enrich the protein intake of our vegetarian population, the pulses were brought under the ambit of TMOP during 1990-91, NPDP was also entrusted with the similar objectives as for oilseeds.

2. PLAN INTERVENTIONS – AT A GLANCE

Major projects and programme on pules research and development activities initiated from Third plan (1961-66) to Eleventh plan (2011-12), indicated that the pulses has been an integrated agenda of the Ministry of Agriculture (DAC/ICAR) almost in each five year plan as summarised below:

Table – 18.1. Plan-wise Intervention (IIIrd to XIth Plan)

Third Plan (1961-66)	**Fourth Plan (1969-74)**	**Fifth Plan (1974-79)**
i. All India Coordinated Pulses Research Project Established. ii All India Co-ordinated Varietal Trials have been made. iii Breeding of suitable varieties for accommodating into multiple cropping. iv Breeding of Synchronous varieties. v. Breeding of suitable varieties of Urad for mixed cropping in North India. vi. Breeding of multiple resistant varieties for different agricultural zones.	i. "Intensive Pulses District Programme" (IPDP) was initiated. ii Adoption of package of Practices involving use of improved seeds, phosphatic fertilizers, rhizobial culture and plant protection campaigns. iii Beyond the IPDP, Minikit Programme for major pulse crop was introduced. iv Extension of pulses area by catch cropping, inter-cropping and mixed cropping with cereals, millets, cotton, groundnut and sugarcane etc. were encouraged.	i. IPDP continued and further intensified. ii. Research programme on pulses stepped up by All India Co-ordinated Research Programme. iii Breeding of varieties suitable as catch crops to replace monsoon fallows. iv Standardization of techniques for fertilizer applications. v Development of pest control schedule and suitable bacterial culture. vi Development of more effective agronomic practices. vii Special emphasis on processing of pulses and modernization of dal milling industry.
Sixth Plan (1980-85)	**Seventh Plan (1985-90)**	**Eighth Plan (1992-97)** (*Two annual Plans (1990-92) after VI plan also conceived the NPDP*)
i Introduction of Pulse crops in irrigated farming system. ii Bringing additional area under short duration varieties of Urad, Moong etc., in rice fallows by utilizing the residual moisture in Rabi season and	i Introduction of Pulses in irrigated farming system. ii Bringing additional area under short-duration varieties of Moong and Urad in Rice fallows in the Rabi season and as a Summer crop where	i A number of programmes introduced in the Seventh plan were continued in the eighth plan. ii Pulses brought under Technology Mission in 1990-91. iii Pulses production was

in summer season with irrigation after oilseeds, sugarcane, potato and wheat. iii Multiplication and use of improved pulse seeds.	irrigation facilities are available. iii Intercropping of Arhar, Moong and Urad with other crops. iv Multiplication and use of improved seeds.	intensified by taking up NPDP and the Special Food Grain Production Programme (SFPP) on pulses.

(continued)

(table 18.1 continued)

Sixth Plan (1980-85)	**Seventh Plan (1985-90)**	**Eighth Plan (1992-97)**
iv Use of Phosphatic fertilizer and rhizobial culture. v. Improved post-harvest technology. vi. Selection of varieties as **"Pulse Crop Village"** in various blocks both in irrigated and rain-fed areas.	v Adoption of plant protection measures. vi Use of fertilizers and rhizobial culture. vii Remunerative prices relative to competing crops. viii Centrally sponsored National Pulses Development Programme (NPDP) was launched.	
Ninth Plan (1997-2002)	**Tenth Plan (2002-07)**	**Eleventh Plan (2007-2012)**
i Continuation of NPDP	i. NPDP continued from 2002-2004 ii NPDP merged with OPP, AMDP & OPDP and implemented in merger mode as Integrated Scheme of Oilsseds, Pulses, Oilpalm and maize (ISOPOM) from 2004-05 for 14 major pulse growing states.	i . ISOPOM programme continued ii National Food Security Mission (NFSM-Pulses) launched from 2007-08 in 168 districts of 14 states.

2.1. ON-GOING PROGRAMMES – (Eleventh Plan)

2.1.1. ISOPOM-Pulses

Merging the earlier Centrally Sponsored Schemes on pulses, the National Pulses Development Project (NPDP) with 17 components, had been in operation across the country in 28 states and 2 UTs in 352 districts from VIIIth Plan (1992 onwards) till 2003-04, begining two years of X plan. Merging the NPDP, OPP, OPDP and AMDP from the third year of Xth plan (2004-05), centrally sponsored Integrated Scheme on Oilseeds, Pulses, Oilpalm and Maize (ISOPOM), with 25 components under seven odd sub-head as seeds, demonstration, plant protection, soil improvement, farm mechanization/water saving devices, training/extension and others (contract research innovative, project

manning support and involvement of private sector), is continued during the eleventh plan (2007-08 -2011-12) in 14 potential pulse producing states across the country.

Specific features, components and norms of financial assistance are enumerated in table 18.2

2.1.2. NFSM-Pulses

Burgeoning imports, stagnation of production and productivity and disappointing compound annual growth rate (CAGR) in pulses to the tune of 0.25% between TE 1995-96 to 2006-07, further set the priority to the sector.

Based on the behaviouristic approach, the Eleventh Plan Working Group's projected demand for pulses (includes seed, feed & fodder) by the terminal year of Eleventh plan (2011-12), to the tune of 19.91 million tonnes, prompted the Government of India to launch the National food Security Mission on Pulses (NFSM-Pulses).

The Centrally sponsored NFSM-Pulses envisages to bring about 40.47 lakh ha additional area over and above the existing normal area of 227.55 lakh ha (TE 2006-07) and to harness additional production of 20 lakh tonnes by the end of Eleventh plan (rice fallow 20 lakh ha + Intercrop 20.47 lakh ha), targetting 730 kg/ha yield.

The NFSM-Pulses is operational in 168 potential districts of 14 states alongwith the ISOPOM programme. Major on-going developmental interventions, their distinct features, nature of funding, implementing agencies and pattern of assistance is summarised in **Table – 18.2**

2.1.4. Contractual Research (ISOPOM)

Contractural research projects on "Enhancing yield and stability of pigeonpea through heterosis breeding", Development of large seeded kabuli chickpea (in view of popularization of single dollar/double dollar/maxican gram of export origin) and "Development & popularization of model seed system for quality seed production of major legume" etc, have also been sanctioned during X plan and operational with IIPR, Kanpur/ICRISAT, Hyderabad and other coordinating centres. These programmes are continued during XI plan.

Details on implementing agencies, features and pattern of assistance etc are indicated in table 18.3.

Table – 18.2. On-going projects/programmes on pulses development – At a glance

Name of Project/ Programme	Nature of Scheme (CS/CSS)/ Area of operation	Stake holders	Features/components	Components/ assistance norms
i) ISOPOM (2004-05 onwards)	Centrally sponsored Scheme (75:25) No. of States-14 No. of districts- 425 (A.P., Bihar, Chhattisgarh, Gujarat, Haryana, Karnataka, M. P., Maharashtra, Orissa, Punjab, Rajasthan, T.N., U. P., and West Bengal)	i. States-SDA/ Commissionerate of Agriculture ii. NSC/SFCI/ NAFED/ IFFCO/ KRIBHCO iii. ICAR/IIPR/ SAUs/KVK/ZRS	i. Flexibility to the states to utilize the funds for the scheme/crop of their choice. ii. Annual action plan to be formulated by the State Governments for consideration and approval of the Government of India. iii. Introduction of innovative measures or any special component to the extent of 10% of financial allocation. iv. Involvement of private sector by the State Governments in the implementation of the programme with a financial cap of 15%. v. Flexibility for inter component diversion of funds up to 20% for non-seed components only. vi. Diversion of funds from seed components to non-seed components with the prior approval of the Department of Agriculture & Cooperation. vii. Monitoring through NALMOT, Director, DPD, Bhopal.	Pattern of Assistance is given at **annexure XI**

(continued)

(Table 18.2. continued)

Name of Project/ Programme	Nature of Scheme (CS/CSS)/ Area of operation	Stake holders	Features/components	Components/ Assistance/ Norms
ii) Contractual Research – (ISOPOM)(2004-05 onwards)				
a) Enhancing yield and stability of pigeonpea through Heterosis Breeding	R&D Promotion of hybrid research in pulses	i. IIPR, Kanpur ii. ICRISAT, Hyderabad iii. PAU, Ludhiana iv. PKU, Akola v. GAU, S.K. Nagar vi. TNAU, Coimbatore vii. GAU, Navsari	i To develop CMS based high yielding hybrids with early and medium duration maturity. ii To develop a cost-effective large-scale hybrid seed production technology. iii To develop male sterile lines and fertility restorer line having good agronomic traits viz. high productive and disease resistant. iv To study the stability of cytoplasmic genic male sterile lines (A.) and their fertility restorers (R) in major AGRO-ECOLOGICAL ZONES. v To develop molecular based marker techniques for gro out-test of hybrids and parents and to identify the restores. vi To build human resource capacity in hybrid pigeonpea breeding technology through training of scientific and technical staff of Indian National Research Systems and seed companies.	100% GOI
b) Development of Extra large seeded kabuli chickpea varieties for crop diversification	R&D To develop varieties with >40g - 50g Test wt. resistance to **fusarium** along-with early maturity	i. IIPR, Kanpur ii. ICRISAT, Hyderabad iii. PAU, Ludhiana iv. MPKV, Rahuri	i To develop variety having test weight >50 g ii Variety resistant to **fusarium wilt**. iii Early in maturity.	100% GOI

(continued)

(Table 18.2. continued)

Name of Project/ Programme	Nature of Scheme (CS/CSS)/ Area of operation	Stake holders	Features/components	Components/ Assistance/ norms
c) Development and popularization of model seed system(s) for quality seed production of major legumes	Development & Extn., Farmers participatory	i . ICRISAT, Hyderabad ii. NRCG, Junagarh iii. IIPR, Kanpur iv. NSC, New Delhi v. MSSDC, Akola vi. APSSDC, Hyderabad vii. JNKVV, Jabalpur viii . PKV, Akola ix. OUA&T, Bhubaneshwar x. ANGRAU, Anantapur & Tirupati	To ensure quality seed sufficiency of the improved varieties at village level.	100% GOI
d) Exploiting host plant resistance for Helicoverpa management to increase the production and productivity of Chickpea and pigeonpea under raifed conditions in India	Development & Extension	ICRISAT	i Identification of chickpea and pigeon pea genotypes with divers mechanisms of resistance of Helicoverpa. ii. Assessment of the effect of Helicoverpa-resistane cultivars on ETLs, reduction in pesticiede use, and their interaction with bio-control agents. iii. Effectiveness of Helicoverpa-resistane cultivars in IPM and sustainable crop production under rainfed conditions in drought prone areas in India. iv. Technolgy exchange and capacity building.	100% GOI

(continued)

(Table 18.2. ìcontinued)

Name of Project/ Programme	Nature of Scheme (CS/CSS)/ Area of operation	Stake holders	Features/components	Components/ Assistance/norms
iii) NFSM-Pulses (2007-08 to 2011-12)	Centrally Sponsored (100% central funded) 14 states (168 districts- A.P, Bihar, Chhattisgarh, Gujarat, Haryana, Karnataka, M.P., Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. **Annexure xiii**)	i. Mission Director/SDA/ Commissionerate of Agriculture ii. NSC/SFCI/ IFFCO/ KRIBHCO/ NAFED iii. PRIVATE	i. To increase production of pulses through area expansion and productivity enhancement. ii. To enahnce additional area coverage of 40.47 lakh hectares over and above the existing normal area of 227.55 (TE 2006-07) iii. To achieve additional production of 2 million tonnes. iv. Restoring soil fertility and productivity at individual farm level, v Creation of employment opportunities and enhancing farm level economy.	Pattern of Assistance is given at **Annexure XII**

2.2. CRITICAL INTERVENTIONS - ISOPOM/NFSM - Pulses

The Centrally sponsored scheme on ISOPOM/NFSM has major seed, non-seed and infrastructural nature of interventions as indicated in **Table – 18.3.**

Table – 18.3. Components/Intervention-ISOPOM/NFSM

I. Components-ISOPOM- Pulses

Major Head	**Components/Items**	**Norms of Assistance**
Seed	i Production and Purchase of Breeder seed ii. Production of Foundation Seed. iii. Production of Certified Seed (SVS). iv. Distribution of Certified Seed. v. Distribution of Minikits. vi. Infrastructure development for seed Production	**Annexure XI**
Demonstration	i. Front Line Demonstration ii. Block Demonstration. iii. IPM Demonstration. a) Farmers Field School (FFS) b) Bio-intensive	
Plant Protection	i. Supply of Plant Protection Chemicals ii. Weedicides iii. Supply of Plant Protection Equipments. iv. Nuclear Polyhedrosis Virus (NPV).	
Soil Improvement	i. Distribution of Rhizobium Culture/PSB. ii. Distributionof Gypsum/Pyrites/liming/ Dolomite iii. Distribution of Micronutrients	
Farm mechanization /Water saving Devices	i. Supply of Improved farm implemnts. ii. Distribution of Sprinkler sets. iii. Pipes	
Training/Extension	i. Farmers Training. ii. Officers Training iii. Publicity	
Others	i. Contract Research by ICAR ii. Innovative measures iii. Staff & Contingency iv. Involvement of private Sector in other activities.	

II. COMPONENTS-NFSM - PULSES

Major Head	Components/Items	Norms of Assistance
Seed components	i. Production of breeder seed ii. Procurement of breeder seed iii. Production of foundation seed iv. Production of certified seed (SVS) v. Distribution of certified seed vi. Infrastructure and Technical Support.	**Annexure XI**
Demonstration Components (Non-seed components)	i. Integrated Nutrient management (INM) ii. Integrated Pest management (IPM) iii. Promotion of sprinkler sets iv. Pilot component on Biotic menace (Blue Bull (Neel gai) v. Extension & HRD (including infrastructure) vi. Project of ICRISAT vii. Project Manning Support (Miscellaneous expenditure)	

3. PERFORMANCE OVER-VIEW – (first to Tenth plan)

AN ANALYSIS TO PRE AND POST TMOP INTERVENTION

For comparative analysis, the average area covered, the production, productivity and percentage of pulse area under irrigation have been taken into consideration on Five Year Plan basis. Annual plans (1966-69, 1979-80 and 1990-92), during which the five year plans could not be enforced/implemented, have, however, been excluded for the purpose of analysis. The analytical review of pulses status prior to and during the TMOP period is briefly analyzed as below:

Table- 18.4. Plan-wise trend of growth in pulses

Plan	Average Area (Million ha.)	Average Production (Million Tonnes)	Average yield (kg/ha.)	Average % of irrigation coverage
Pre-TMOP Periods				
Ist Plan (1951-56)	21.09	10.04	475.2	9.18
IInd Plan (1956-61)	23.71	11.75	494.8	8.26
IIrd Plan (1961-66)	23.85	11.14	466.8	8.90
IVth Plan (1969-74)	22.21	10.90	491.4	8.60
Vth Plan (1974-79)	23.32	11.71	501.4	7.70
VIth Plan (1980-85)	23.08	11.77	509.8	8.22
VIIth Plan (1985-90)	23.08	12.54	543.0	9.36
Post-TMOP Period (includes two annual plans (1990-92)				
VIIIth Plan (1992-97)	22.47	13.34	593.6	12.00
IXth Plan (1997-02)	21.97	13.15	597.4	13.06

Xth Plan (2002-07)	22.44	13.35	593.8	N.A.

3.1. Area stabilization

During the first five year plan (1951-56), the average pulse acreage of 21 million hectares maintained an increasing trend till Third plan (1961-66) where an area of about 24 million ha was occupied. However, there was a slight drop in area coverage i.e. 22.21 million hectares during the Fourth plan (1969-74) despite the introduction of first centrally sponsored Pulses Development Scheme. It is also a fact that the normal average area of pulses enhanced to about three million ha during IInd five year plans, the periods when average per cent coverage under pulses was about 8-9 percent.

It is observed that the role of plan funds had catalytic role especially in stabilization of area coverage under pulses as beyond the IIIrd five year plan, the normal five year plan area has been between 22-23million hectares, a visible two million hectares increase over the Ist plan period.

Another most important observation is stability in pulse area from eighth plan (1992-97) period onwards; the plan period had the critical intervention in pulses sector through the Technology Mission (TMOP) with the increase in irrigation coverage, 13% of total pulses stablized in irrigated area.

Critical analysis, on factors for stagnated area, coverage under pulses, point out to following important facts, besides, genetics associated with pulse varieties:

- Tendency of farmers to put input responsive and assured crops on resource rich farms
- Development of infrastructure/irrigation potential further pushes these crops on more marginal and poor lands.
- Non-reporting of more than eight lakh hectares Zaid/Summer pulse area by the SDA/SASA/Reveneuw.
- Anomoly in compilation/reporting of total pulse area, its ratification amongst weekly weather watch report of the Directorate of Pulses Development, State Commissionerate/Directorate of Agriculture, Land Records/SASA and DES need to be streamlined, as the same differs in almost all the seasons (Normal Rabi area for the state of Orissa as per State Department of Agriculture, Orissa for 2007-08 is 10.86 lakh ha whereas the DES in its record has considered a normal rabi area for the state as 2.26 lakh ha (Ave. 2000-01 to 2005-06)

3.2. Production enhancement

During the initial phase of the Ist Five year plan (1951-56), the production of pulses was 10 million tonnes. There was a slight fall during the IVth Plan (1969-74) from the IIIrd plan recording the average production of 10.90 Million tonnes. However, there was a homogeneous increase thereafter. With the inclusion of pulses development under TMOP during August 1990, the beneficial impacts were realized during the VIIIth Plan (1992-97) & X Plan (2002-07), the country witnessed an average plan period production of 13.34 Million tonnes & 13.35 million tonnes respectively, the maximum ever achieved during the pre TMOP Five year plans periods.

During Xth plan (2002-07), inspite of the consecutive droughts/flood in the major pulses growing states of Madhya Pradesh, Rajasthan, Uttar Pradesh, Bihar Andhra Pradesh and Maharashtra and stagnant area coverage, the country harnessed an average production of 13.35 lakh tonnes which may be attributed to TMOPs critical intervention and Central funding support under NPDP/ISOPOM making a dent on seeds/irrigation and other infrastructural support to farmers.

3.3. Productivity

Productivity of pulses has also increased during the TMOP period. Pre-TMOP plan period average yield during the first plan (1951-56) was only 475 Kg/ha and the Third Plan (1961-66) even exhibited minimum productivity of about 467 kg/ha whereas, maximum average yield was recorded (598 Kg/ha) during the Nineth Plan (1997-2002), Approximately 131 Kg/ha increase in productivity levels between the Pre-TMOP (1961-66) and during the TMOP period recorded. Although this productivity is still much below the world's average productivity of 871 kg/ha and as also what has been realised under the frontline demonstrations of ICAR.

3.4. Irrigation

The production and productivity increase during TMOP period against the stagnant area coverage under pulses may be attributed to adoption of modern technology based package of practices, more coverage of area under irrigation including various inputs. These could be possible because of the launching of TMOP in 350 districts of 30 states/Union Territories, nation-wide. It can be assumed that if the pace of pulses production in the country is constantly maintained, the pulse requirement could be easily met in the long run.

Inadequate irrigation facilities, especially the supply of critical irrigation, is the main cause of low production of Indian pulses. Taking the average of the five years of the first Five Year Plan (1951-56), the coverage of area under irrigation was hardly 9.18%. There was a decreasing trend till the Fifth plan. However, the increasing trend was restored from the Sixth plan with the maximum coverage of 12-13% from eighth plan onward i.e. the initial phase of the launching of TMOP, attributing the productivity enhancement i.e. about 600 kg/ha (VIII-X plan).

Annexure- I

State-wise area, production and yield - total pulses

(A=Area Lakh ha, P=Production Lakh tonnes, Y= Yield Kg/ha)

State/Season		2001-02	2002-03	2003-04	2004-05	2005-06	Average
1	2	3	4	5	6	7	8
Andhra Pradesh							
Kharif	A	8.940	9.270	11.260	8.868	8.497	9.367
	P	3.550	2.910	5.380	3.760	4.68	4.056
	Y	398	314	478	424	551	433
Rabi	A	10.260	11.729	10.590	9.170	9.32	10.214
	P	7.830	7.706	7.010	6.430	9.08	7.611
	Y	763	657	662	701	974	745
Total	A	19.200	20.999	21.850	18.038	17.817	19.581
	P	11.380	10.616	12.390	10.190	13.760	11.667
	Y	593	506	567	565	772	596
Arunachal Pradesh							
Kharif	A	0.047	0.036	0.034	0.038	0.037	0.038
	P	0.052	0.037	0.034	0.038	0.036	0.039
	Y	1106	1028	1000	1000	973	1026
Rabi	A	0.021	0.037	0.034	0.027	0.04	0.032
	P	0.019	0.040	0.040	0.03	0.047	0.035
	Y	905	1081	1176	1111	1175	1107
Total	A	0.068	0.073	0.068	0.065	0.077	0.070
	P	0.071	0.077	0.074	0.068	0.083	0.075
	Y	1044	1055	1088	1046	1078	1063
Assam							
Kharif	A	0.070	0.070	0.070	0.067	0.065	0.068
	P	0.050	0.050	0.050	0.048	0.045	0.049
	Y	714	714	714	716	692	711
Rabi	A	1.108	1.04	1.080	1.009	0.94	1.035
	P	0.607	0.55	0.590	0.566	0.495	0.562
	Y	548	529	546	561	527	542
Total	A	1.178	1.110	1.150	1.076	1.005	1.104
	P	0.657	0.600	0.640	0.614	0.540	0.610
	Y	558	541	557	571	537	553
Bihar							
Kharif	A	0.968	0.933	0.985	0.882	0.795	0.913
	P	0.853	0.814	0.880	0.812	0.78	0.828
	Y	881	872	893	921	981	907
Rabi	A	5.974	6.045	5.928	5.697	5.174	5.764
	P	4.617	4.795	4.746	3.857	3.688	4.341
	Y	779	793	801	677	713	753
Total	A	6.942	6.978	6.913	6.579	5.969	6.676
	P	5.470	5.609	5.626	4.669	4.468	5.168
	Y	788	804	814	710	749	774

(Annexure-i continued)

State/Season		2001-02	2002-03	2003-04	2004-05	2005-06	Average
Chhattisgarh							
Kharif	A	2.37	2.317	2.358	2.415	2.371	2.366
	P	0.796	0.693	0.870	0.819	0.788	0.793
	Y	336	299	369	339	332	335
Rabi	A	6.297	5.501	7.193	6.907	7.126	6.605
	P	3.688	2.964	4.937	2.859	3.744	3.638
	Y	586	539	686	414	525	551
Total	A	8.667	7.818	9.551	9.322	9.497	8.971
	P	4.484	3.657	5.807	3.678	4.532	4.432
	Y	517	468	608	395	477	494
Goa							
Kharif	A	0.005	0.002	0.005	0.005	0.005	0.004
	P	0.003	0.002	0.003	0.003	0.003	0.003
	Y	600	1000	600	600	600	636
Rabi	A	0.089	0.092	0.093	0.099	0.105	0.096
	P	0.081	0.073	0.089	0.091	0.112	0.089
	Y	910	793	957	919	1067	933
Total	A	0.094	0.094	0.098	0.104	0.110	0.1
	P	0.084	0.075	0.092	0.094	0.115	0.092
	Y	894	798	939	904	1045	920
Gujarat							
Kharif	A	6.789	6.36	6.779	5.838	5.83	6.319
	P	3.512	2.961	4.875	3.793	3.87	3.802
	Y	517	466	719	650	664	602
Rabi	A	0.515	0.617	1.547	1.264	1.94	1.177
	P	0.286	0.311	1.349	1.000	1.6	0.909
	Y	555	504	872	791	825	773
Total	A	7.304	6.977	8.326	7.102	7.770	7.496
	P	3.798	3.272	6.224	4.793	5.470	4.711
	Y	520	469	748	675	704	629
Haryana							
Kharif	A	0.334	0.646	0.687	0.672	0.53	0.574
	P	0.171	0.349	0.369	0.450	0.401	0.348
	Y	512	540	537	670	757	606
Rabi	A	1.531	0.62	1.303	1.170	1.368	1.198
	P	1.310	0.48	1.062	1.010	0.78	0.928
	Y	856	774	815	863	570	775
Total	A	1.865	1.266	1.990	1.842	1.898	1.772
	P	1.481	0.829	1.431	1.460	1.181	1.276
	Y	794	655	719	793	622	720

(Annexure -i continued)

State/Season		2001-02	2002-03	2003-04	2004-05	2005-06	Average

Himachal Pradesh							
Kharif	A	0.249	0.242	0.243	0.233	0.204	0.234
	P	0.083	0.057	0.060	0.081	0.083	0.073
	Y	333	236	247	348	407	311
Rabi	A	0.059	0.094	0.050	0.090	0.071	0.073
	P	0.028	0.110	0.030	0.100	0.113	0.076
	Y	475	1170	600	1111	1592	1047
Total	A	0.308	0.336	0.293	0.323	0.275	0.307
	P	0.111	0.167	0.090	0.181	0.196	0.149
	Y	360	497	307	560	713	485
J & K							
Kharif	A	0.249	0.268	0.251	0.280	0.244	0.258
	P	0.114	0.127	0.117	0.134	0.12	0.122
	Y	458	474	466	479	492	474
Rabi	A	0.020	0.020	0.025	0.027	0.024	0.023
	P	0.013	0.013	0.016	0.017	0.015	0.015
	Y	650	650	640	630	625	638
Total	A	0.269	0.288	0.276	0.307	0.268	0.282
	P	0.127	0.140	0.133	0.151	0.135	0.137
	Y	472	486	482	492	504	487
Jharkhand							
Kharif	A	0.427	1.495	2.100	2.160	2.179	1.672
	P	0.328	1.237	0.990	1.180	1.189	0.985
	Y	768	827	471	546	546	589
Rabi	A	0.164	0.162	0.560	0.570	0.732	0.438
	P	0.105	0.098	0.360	0.420	0.534	0.303
	Y	640	605	643	737	730	693
Total	A	0.591	1.657	2.660	2.730	2.911	2.110
	P	0.433	1.335	1.350	1.600	1.723	1.288
	Y	733	806	508	586	592	611
Karnataka							
Kharif	A	11.765	13.109	11.555	15.060	13.72	13.042
	P	3.928	3.759	3.478	5.120	6.66	4.589
	Y	325	287	301	340	485	352
Rabi	A	7.166	7.497	7.188	6.000	6.09	6.788
	P	3.587	3.177	2.214	2.800	2.98	2.952
	Y	501	424	308	467	489	435
Total	A	18.931	20.606	18.743	21.060	19.810	19.83
	P	7.515	6.936	5.692	7.920	9.640	7.541
	Y	397	337	304	376	487	380

(Annexure -i continued)

State/Season		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Kerala- Kharif	A	0.070	0.015	0.005	0.005	0.021	0.023

	P	0.054	0.012	0.004	0.004	0.015	0.018
	Y	771	800	800	800	718	767
Rabi	A	0.060	0.073	0.055	0.029	0.068	0.057
	P	0.049	0.056	0.046	0.025	0.054	0.046
	Y	817	767	836	862	794	807
Total	A	0.130	0.088	0.060	0.034	0.089	0.080
	P	0.103	0.068	0.050	0.029	0.069	0.064
	Y	792	773	833	853	775	796
Madhya Pradesh							
Kharif	A	8.723	9.471	10.531	10.063	8.765	9.511
	P	4.498	3.663	5.238	4.959	4.299	4.531
	Y	516	387	497	493	490	476
Rabi	A	32.979	31.904	35.323	35.134	34.084	33.885
	P	27.748	20.092	29.642	29.333	28.027	26.968
	Y	841	630	839	835	822	796
Total	A	41.702	41.375	45.854	45.197	42.849	43.395
	P	32.246	23.755	34.880	34.292	32.326	31.500
	Y	773	574	761	759	754	726
Maharashtra							
Kharif	A	25.070	26.592	25.211	24.640	22.7	24.843
	P	13.680	15.619	14.870	11.730	12.36	13.652
	Y	546	587	590	476	544	550
Rabi	A	8.810	9.106	9.250	9.200	11.62	9.597
	P	5.130	4.962	4.730	4.910	7.69	5.484
	Y	582	545	511	534	662	571
Total	A	33.880	35.698	34.461	33.840	34.320	34.440
	P	18.810	20.581	19.600	16.640	20.050	19.136
	Y	555	577	569	492	584	556
Manipur							
Kharif	A	0.060	0.054	0.063	0.058	0.086	0.064
	P	0.031	0.026	0.032	0.030	0.045	0.033
	Y	517	481	508	517	523	511
Total	A	0.060	0.054	0.063	0.079	0.086	0.068
	P	0.031	0.026	0.032	0.030	0.045	0.033
	Y	517	481	508	380	523	480
Meghalaya							
Kharif	A	0.021	0.02	0.021	0.021	0.021	0.021
	P	0.016	0.014	0.016	0.016	0.016	0.016
	Y	762	700	762	762	762	750
Rabi	A	0.026	0.026	0.026	0.005	0.027	0.022
	P	0.019	0.019	0.019	0.020	0.02	0.019
	Y	731	731	731	4000	741	882
Total	A	0.047	0.046	0.047	0.026	0.048	0.043
	P	0.035	0.033	0.035	0.036	0.036	0.035
	Y	745	717	745	1385	750	818

(Annexure -i continued)

State/Season		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Mizoram							
Kharif	A	0.018	0.025	0.026	0.024	0.046	0.028
	P	0.021	0.027	0.024	0.029	0.048	0.030

	Y	1167	1080	923	1208	1043	1072
Rabi	A	0.009	0.021	0.026	0.013	0.019	0.018
	P	0.018	0.023	0.021	0.019	0.031	0.022
	Y	2000	1095	808	1462	1632	1273
Total	A	0.027	0.046	0.052	0.037	0.065	0.045
	P	0.039	0.050	0.045	0.048	0.079	0.052
	Y	1444	1087	865	1297	1215	1150
Nagaland							
Kharif	A	0.170	0.140	0.185	0.159	0.146	0.16
	P	0.134	0.140	0.219	0.135	0.137	0.153
	Y	788	1000	1184	849	938	956
Rabi	A	0.180	0.160	0.150	0.157	0.164	0.162
	P	0.163	0.140	0.116	0.117	0.26	0.159
	Y	906	875	773	745	1585	982
Total	A	0.350	0.300	0.335	0.316	0.310	0.322
	P	0.297	0.280	0.335	0.252	0.397	0.312
	Y	849	933	1000	797	1281	969
Orissa							
Kharif	A	5.166	4.153	5.166	4.766	5.308	4.912
	P	1.917	1.39	1.996	1.779	2.13	1.842
	Y	371	335	387	373	401	375
Rabi	A	1.971	1.334	1.982	1.659	2.784	1.946
	P	0.925	0.554	0.730	0.717	1.233	0.832
	Y	469	415	368	432	443	427
Total	A	7.137	5.487	7.148	6.425	8.092	6.858
	P	2.842	1.944	2.726	2.496	3.363	2.674
	Y	398	354	381	388	416	390
Punjab							
Kharif	A	0.370	0.277	0.344	0.276	0.23	0.299
	P	0.21	0.193	0.274	0.217	0.182	0.215
	Y	568	697	797	786	791	719
Rabi	A	0.167	0.156	0.135	0.120	0.096	0.135
	P	0.150	0.146	0.120	0.100	0.08	0.119
	Y	898	936	889	833	833	884
Total	A	0.537	0.433	0.479	0.396	0.326	0.434
	P	0.360	0.339	0.394	0.317	0.262	0.334
	Y	670	783	823	801	804	770

(Annexure -i continued)

State/Season		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Rajasthan							
Kharif	A	23.525	13.352	26.975	24.858	23.173	22.377
	P	6.459	1.132	15.113	4.996	3.561	6.252
	Y	275	85	560	201	154	279

Rabi	A	10.047	4.677	11.634	10.853	11.273	9.697
	P	7.802	3.713	7.671	8.378	5.42	6.597
	Y	777	794	659	772	481	680
Total	A	33.572	18.029	38.609	35.711	34.446	32.073
	P	14.261	4.845	22.784	13.374	8.981	12.849
	Y	425	269	590	375	261	401
Sikkim							
Kharif	A	0.004	0.004	0.004	0.003	0.004	0.004
	P	0.004	0.004	0.004	0.004	0.004	0.004
	Y	1000	1000	1000	1333	1000	1053
Rabi	A	0.061	0.067	0.067	0.066	0.064	0.065
	P	0.052	0.063	0.064	0.062	0.057	0.060
	Y	852	940	955	939	891	917
Total	A	0.065	0.071	0.071	0.069	0.068	0.069
	P	0.056	0.067	0.068	0.066	0.061	0.064
	Y	862	944	958	957	897	924
Tamil Nadu							
Kharif	A	3.220	1.947	2.173	1.990	1.831	2.232
	P	1.306	0.627	0.826	0.830	0.621	0.842
	Y	406	322	380	417	339	377
Rabi	A	4.129	3.327	3.197	4.003	3.422	3.616
	P	1.833	1.195	1.182	1.623	1.149	1.396
	Y	444	359	370	406	336	386
Total	A	7.349	5.274	5.370	5.993	5.253	5.848
	P	3.139	1.822	2.008	2.456	3.456	2.576
	Y	427	345	374	410	658	441
Tripura							
Kharif	A	0.046	0.047	0.047	0.049	0.052	0.048
	P	0.031	0.03	0.029	0.031	0.033	0.031
	Y	674	638	617	633	635	639
Rabi	A	0.039	0.041	0.037	0.040	0.037	0.039
	P	0.024	0.025	0.023	0.024	0.023	0.024
	Y	615	610	622	600	622	613
Total	A	0.085	0.088	0.084	0.089	0.089	0.087
	P	0.055	0.055	0.052	0.055	0.056	0.055
	Y	647	625	619	618	629	628

(Annexure -i (continued)

State/Season		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Uttar Pradesh							
Kharif	A	7.855	7.824	8.929	8.959	9.04	8.521
	P	6.120	5.084	5.347	5.666	5.968	5.637
	Y	779	650	599	632	660	662
Rabi	A	18.970	18.953	18.055	19.078	18.467	18.705

	P	17.650	16.936	18.656	18.084	16.347	17.535
	Y	930	894	1033	948	885	937
Total	A	26.825	26.777	26.984	28.037	27.507	27.226
	P	23.770	22.020	24.003	23.750	22.315	23.172
	Y	886	822	890	847	811	851
Uttarakhand							
Kharif	A	0.098	0.27	0.230	0.240	0.34	0.236
	P	0.061	0.17	0.160	0.140	0.21	0.148
	Y	622	630	696	583	618	629
Rabi	A	0.201	0.196	0.190	0.210	0.27	0.213
	P	0.129	0.121	0.130	0.14	0.15	0.134
	Y	642	617	684	667	556	628
Total	A	0.299	0.466	0.420	0.450	0.610	0.449
	P	0.190	0.291	0.290	0.280	0.360	0.282
	Y	635	624	690	622	590	629
West Bengal							
Kharif	A	0.554	0.531	0.562	0.505	0.52	0.534
	P	0.368	0.354	0.354	0.339	0.332	0.349
	Y	664	667	630	671	638	654
Rabi	A	1.932	1.882	1.957	1.752	1.7	1.845
	P	1.381	1.322	1.763	1.332	1.411	1.442
	Y	715	702	901	760	830	782
Total	A	2.486	2.413	2.519	2.257	2.220	2.379
	P	1.749	1.676	2.117	1.671	1.743	1.791
	Y	704	695	840	740	785	753
Dadar & Nagar Haveli							
Kharif	A	0.035	0.030	0.032	0.032	0.031	0.032
	P	0.031	0.026	0.028	0.027	0.028	0.028
	Y	886	867	875	844	903	875
Rabi	A	0.045	0.035	0.028	0.033	0.034	0.035
	P	0.035	0.034	0.023	0.027	0.028	0.029
	Y	778	971	821	818	824	840
Total	A	0.080	0.065	0.060	0.065	0.065	0.067
	P	0.066	0.060	0.051	0.054	0.056	0.057
	Y	825	923	850	831	862	857

(Annexure – i continued)

State/Season		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Pondecherry							
Kharif	A		0.001		0.001	0.001	0.001
	P		0.001		0.001	0.001	0.001
	Y		1000		1000	1000	1000
Rabi	A	0.013	0.019	0.026	0.037	0.036	0.026
	P	0.007	0.006	0.009	0.011	0.011	0.009

	Y	538	316	346	297	306	336
Total	A	0.013	0.020	0.026	0.038	0.037	0.027
	P	0.007	0.007	0.009	0.012	0.012	0.009
	Y	538	350	346	316	324	351
Delhi							
Kharif	A	0.005	0.003		0.003	0.003	0.003
	P	0.004	0.003	0.006	0.002	0.003	0.004
	Y	800	1000		667	1000	1286
Rabi	A	0.013	0.001	0.001		0.013	0.006
	P	0.000		0.002	0.010	0.011	0.005
	Y					846	821
Total	A	0.018	0.004	0.001	0.003	0.016	0.008
	P	0.004	0.003	0.001	0.003	0.014	0.005
	Y	222	750	800	1000	875	590
A & N. Island							
Rabi	A	0.004	0.013	0.007	0.007	0.008	0.008
	P	0.002	0.006	0.004	0.004	0.004	0.004
	Y	500	462	571	571	500	513
Total	A	0.004	0.013	0.007	0.007	0.008	0.008
	P	0.002	0.006	0.004	0.004	0.004	0.004
	Y	500	462	571	571	500	513
All India							
Kharif	**A**	**107.223**	**99.504**	**116.831**	**113.17**	**106.795**	**108.705**
	P	**48.382**	**41.51**	**61.647**	**47.173**	**48.648**	**49.472**
	Y	**451**	**417**	**528**	**417**	**456**	**455**
Rabi	**A**	**112.861**	**105.458**	**117.750**	**114.46**	**117.118**	**113.529**
	P	**85.299**	**69.74**	**87.405**	**84.122**	**85.196**	**82.3524**
	Y	**756**	**661**	**742**	**735**	**727**	**725**
Total	**A**	**220.084**	**204.962**	**234.581**	**227.630**	**223.913**	**222.234**
	P	**133.681**	**111.250**	**149.052**	**131.295**	**133.844**	**131.824**
	Y	**607**	**543**	**635**	**577**	**598**	**593**

Source: E&S, GOI

Annexure- II

State-wise area, production and yield - Gram

(A=Area Lakh ha, P=Production Lakh tonnes, Y= Yield Kg/ha)

State		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Andhra Pradesh	A	2.850	3.900	4.220	3.410	3.940	3.664
	P	3.630	3.820	4.570	3.450	6.270	4.348
	Y	1274	979	1083	1012	1591	1187
Assam	A	0.020	0.038	0.020	0.021	0.020	0.024

	P	0.010	0.010	0.010	0.011	0.010	0.010
	Y	500	263	500	524	500	429
Bihar	A	0.682	0.714	0.803	0.721	0.622	0.708
	P	0.653	0.721	0.786	0.602	0.561	0.665
	Y	957	1010	979	835	902	938
Chhattisgarh	A	1.695	1.756	2.047	2.105	2.315	1.984
	P	1.246	1.131	1.973	1.141	1.634	1.425
	Y	735	644	964	542	706	718
Gujarat	A	0.491	0.575	1.496	1.227	1.670	1.092
	P	0.272	0.289	1.323	0.985	1.420	0.858
	Y	554	503	884	803	850	786
Haryana	A	1.430	0.550	1.230	1.070	1.300	1.116
	P	1.220	0.410	1.000	0.910	0.720	0.852
	Y	853	745	813	850	554	763
Himachal Pradesh	A	0.011	0.014	0.010	0.030	0.013	0.016
	P	0.011	0.010	0.010	0.040	0.007	0.016
	Y	1000	714	1000	1333	538	1000
J & K	A	0.003		0.003	0.002	0.002	0.002
	P	0.002		0.002	0.001	0.001	0.001
	Y	667		667	500	500	600
Karnataka	A	4.797	4.798	5.095	4.180	4.180	4.61
	P	2.816	2.519	1.711	2.240	2.290	2.315
	Y	587	525	336	536	548	502
Madhya Pradesh	A	25.539	24.706	27.913	27.465	25.607	26.246
	P	24.082	17.134	25.849	25.489	23.712	23.253
	Y	943	694	926	928	926	886
Maharashtra	A	7.560	7.960	7.950	8.300	10.200	8.394
	P	4.500	4.220	4.210	4.660	7.050	4.928
	Y	595	530	530	561	691	587
Meghalaya	A	0.005	0.005	0.005	0.005	0.005	0.005
	P	0.003	0.003	0.003	0.003	0.003	0.003
	Y	600	600	600	600	600	600
Nagaland	A	0.010	0.010	0.015	0.010	0.004	0.010
	P	0.010	0.010	0.020	0.010	0.004	0.011
	Y	1000	1000	1333	1000	1000	1102

(Annexure - ii continued)

State		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Orissa	A	0.295	0.210	0.286	0.328	0.353	0.294
	P	0.192	0.130	0.177	0.199	0.228	0.185
	Y	651	619	619	607	646	629
Punjab	A	0.071	0.070	0.060	0.051	0.040	0.058
	P	0.062	0.067	0.054	0.044	0.030	0.051
	Y	873	957	900	863	750	880
Rajasthan	A	9.696	4.497	11.175	10.352	10.819	9.308
	P	7.355	3.406	7.072	7.730	4.789	6.070
	Y	759	757	633	747	443	652
Tamil Nadu	A	0.070	0.062	0.066	0.067	0.059	0.065

	P	0.050	0.042	0.044	0.044	0.040	0.044
	Y	714	677	667	657	678	679
Tripura	A	0.004	0.004	0.004	0.004	0.004	0.004
	P	0.003	0.003	0.002	0.002	0.002	0.002
	Y	750	750	500	500	500	600
Uttar Pradesh	A	8.410	8.725	7.606	7.386	7.396	7.905
	P	8.170	7.791	7.871	6.722	6.606	7.432
	Y	971	893	1035	910	893	940
Uttarakhand	A	0.012	0.010	0.010	0.030	0.010	0.014
	P	0.010	0.010	0.010	0.020	0.010	0.012
	Y	833	1000	1000	667	1000	833
West Bengal	A	0.508	0.475	0.465	0.380	0.400	0.446
	P	0.502	0.371	0.477	0.389	0.365	0.421
	Y	850	781	1026	1024	913	944
Dadar & Nagar Haveli	A	0.002	0.002	0.002	0.002	0.002	0.002
	P	0.001	0.001	0.001	0.001	0.001	0.001
	Y	500	500	500	500	500	500
Delhi	A	0.001	0.001	0.001		0.001	0.001
	P		0.000	0.000		0.001	0.000
	Y					1000	250
All India	**A**	**64.162**	**59.064**	**70.481**	**67.146**	**69.264**	**66.023**
	P	**54.730**	**42.368**	**57.175**	**54.694**	**55.999**	**52.993**
	Y	**853**	**717**	**811**	**815**	**808**	**803**

Source: E&S, GOI

Annexure-III

State - wise area, production and yield - Tur

(A=Area in lakh ha.,P=Production lakh tonnes, Y=Yield Kg/ha)

State		2001-02	2002-03	2003-04	2004-05	2005-06	Average
1	2	3	4	5	6	7	8
Andhra Pradesh	**A**	4.200	4.320	5.210	4.800	4.94	4.694
	P	1.880	1.500	2.180	2.190	3.01	2.152
	Y	448	347	418	456	609	458
Assam	**A**	0.070	0.070	0.070	0.067	0.065	0.068
	P	0.050	0.050	0.050	0.048	0.045	0.049

	Y	714	714	714	716	692	711
Bihar	**A**	0.413	0.377	0.389	0.358	0.333	0.374
	P	0.477	0.430	0.481	0.442	0.43	0.452
	Y	1155	1141	1237	1235	1291	1209
Chhattisgarh	**A**	0.503	0.557	0.523	0.603	0.575	0.552
	P	0.202	0.241	0.315	0.308	0.256	0.264
	Y	402	433	602	511	445	479
Gujarat	**A**	3.323	3.130	2.967	2.544	2.54	2.901
	P	1.870	1.971	2.580	2.360	2.8	2.316
	Y	563	630	870	928	1102	798
Harayana	**A**	0.165	0.363	0.258	0.310	0.3	0.2792
	P	0.134	0.301	0.310	0.320	0.32	0.277
	Y	812	829	1202	1032	1067	992
Himachal Pradesh	**A**	0.003	0.003	0.003	0.003	0	0.002
	P	0.001	0.001	0.000	0.001	0	0.001
	Y	333	333	0	333		250
Jharkhand	**A**	0.163	0.450	0.740	0.900	0.852	0.621
	P	0.149	0.680	0.440	0.490	0.539	0.460
	Y	941	1511	595	544	633	740
Karnataka	**A**	4.821	5.137	5.323	5.620	6.01	5.382
	P	1.474	2.407	1.996	2.900	4.37	2.629
	Y	306	469	375	516	727	489
Madhya Pradesh	**A**	3.054	3.035	3.151	3.275	3.225	3.148
	P	2.506	1.879	2.557	2.570	2.384	2.379
	Y	821	619	811	785	739	756
Maharashtra	**A**	10.230	10.600	10.560	10.740	11	10.626
	P	7.730	7.770	6.950	6.580	7.92	7.39
	Y	756	733	658	613	720	695
Meghalaya	**A**	0.008	0.008	0.008	0.008	0.008	0.008
	P	0.006	0.006	0.006	0.006	0.006	0.006
	Y	750	750	750	750	750	750

(Annexure -iii continued)

State		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Mizoram	A	0.001	0.005	0.003	0.002	0.002	0.003
	P	0.001	0.003	0.002	0.002	0.002	0.002
	Y	1000	600	667	1000	1000	769
Nagaland	A	0.070	0.060	0.075	0.064	0.08	0.070
	P	0.050	0.060	0.080	0.060	0.076	0.065
	Y	714	1000	1067	938	950	934
Orissa	A	1.264	1.143	1.367	1.301	1.328	1.281
	P	0.816	0.735	0.957	0.889	0.985	0.876
	Y	646	643	700	683	742	684
Punjab	A	0.092	0.078	0.097	0.089	0.078	0.087
	P	0.079	0.067	0.091	0.077	0.069	0.077
	Y	859	859	928	865	885	882
Rajasthan	A	0.238	0.165	0.195	0.169	0.204	0.194

	P	0.137	0.039	0.159	0.126	0.132	0.119
	Y	576	236	815	746	647	611
Tamil Nadu	A	0.640	0.441	0.450	0.400	0.378	0.462
	P	0.410	0.241	0.275	0.250	0.204	0.276
	Y	641	546	611	625	540	598
Tripura	A	0.012	0.014	0.014	0.012	0.013	0.013
	P	0.009	0.010	0.009	0.008	0.090	0.025
	Y	750	714	643	667	692	1938
Uttar Pradesh	A	3.942	3.579	3.688	3.871	3.825	3.781
	P	4.562	3.418	4.059	3.802	3.776	3.923
	Y	1157	955	1101	982	987	1038
West Bengal	A	0.039	0.031	0.034	0.015	0.018	0.027
	P	0.033	0.028	0.034	0.011	0.016	0.024
	Y	846	903	1000	733	889	891
Dadar & Nagar Haveli	A	0.016	0.015	0.016	0.016	0.015	0.016
	P	0.013	0.014	0.014	0.013	0.013	0.013
	Y	813	1000	875	813	867	859
Delhi	A	0.005	0.003		0.003	0.003	0.003
	P	0.004	0.003		0.002	0.003	0.002
	Y	800	1000		667	1000	857
All India	**A**	**33.277**	**33.589**	**35.156**	**35.185**	**35.807**	**34.603**
	P	**22.598**	**21.858**	**23.564**	**23.469**	**27.38**	**23.774**
	Y	**679**	**651**	**670**	**667**	**765**	**687**

Source: E&S, GOI

Annexure- IV

State – wise area, production and yield - Mung

(A=Area in lakh ha.,P=Production lakh tonnes, Y=Yield Kg/ha)

STATE/SEASON		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Andhra Pradesh							
Kharif	A	3.383	3.550	4.790	3.040	2.52	3.457
	P	1.133	0.870	2.440	1.105	1.247	1.359
	Y	335	245	509	363	495	393
Rabi	A	1.38	1.182	2.020	1.500	1.33	1.482
	P	0.420	0.301	0.680	0.490	0.42	0.462
	Y	304	255	337	327	316	312
Total	A	4.763	4.732	6.810	4.540	3.850	4.939
	P	1.553	1.171	3.120	1.595	1.667	1.821

	Y	326	247	458	351	433	369
Assam							
Rabi	A	0.082	0.070	0.080	0.075	0.075	0.076
	P	0.037	0.030	0.040	0.038	0.034	0.036
	Y	451	429	500	507	453	469
Bihar							
Kharif	A	0.079	0.107	0.084	0.073	0.083	0.085
	P	0.039	0.057	0.042	0.036	0.052	0.045
	Y	494	533	500	493	627	531
Summer	A	1.727	1.851	1.814	1.754	1.741	1.777
	P	1.033	1.128	0.889	0.968	0.962	0.996
	Y	598	609	490	552	553	560
Total	A	1.806	1.958	1.898	1.827	1.824	1.863
	P	1.072	1.185	0.931	1.004	1.014	1.041
	Y	594	605	491	550	556	559
Chhattisgarh							
Kharif	A	0.097	0.096	0.098	0.104	0.099	0.099
	P	0.029	0.023	0.027	0.027	0.027	0.027
	Y	299	240	276	260	273	269
Rabi	A	0.056	0.068	0.083	0.067	0.073	0.069
	P	0.015	0.017	0.021	0.014	0.017	0.017
	Y	268	250	253	209	233	242
Total	A	0.153	0.164	0.181	0.171	0.172	0.168
	P	0.044	0.040	0.048	0.041	0.044	0.043
	Y	288	244	265	240	256	258
Gujarat							
Kharif	A	1.684	1.402	2.068	1.731	1.729	1.723
	P	0.767	0.323	1.212	0.717	0.535	0.711
	Y	455	230	586	414	309	413

(Annexure- iv continued)

STATE/SEASON		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Haryana							
Kharif	A	0.152	0.234	0.252	0.295	0.141	0.215
	P	0.035	0.041	0.040	0.113	0.061	0.058
	Y	230	175	159	383	433	270
Himachal Pradesh							
Kharif	A	0.004	0.004	0.004	0.003	0.004	0.004
	P	0.001	0.001	0.001	0.001	0.001	0.001
	Y	250	250	250	333	250	263
J & K							
Kharif	A	0.024	0.027	0.018	0.019	0.018	0.021
	P	0.011	0.012	0.009	0.009	0.009	0.01
	Y	458	444	500	474	500	472
Jharkhand							
Kharif	A	0.001	0.096	0.125	0.116	0.122	0.092

	P	0	0.05	0.049	0.061	0.057	0.043
	Y	0	521	392	526	467	472
Karnataka							
Kharif	A	2.513	4.024	2.644	5.180	3.93	3.658
	P	0.653	0.264	0.395	0.820	0.87	0.600
	Y	260	66	149	158	221	164
Rabi	A	0.071	0.105	0.084	0.050	0.07	0.076
	P	0.021	0.018	0.025	0.020	0.03	0.023
	Y	296	171	298	400	429	300
Total	A	2.584	4.129	2.728	5.230	4.000	3.734
	P	0.674	0.282	0.420	0.840	0.900	0.623
	Y	261	68	154	161	225	167
Kerala							
Kharif	A	0.017	0.004	0.001	0.001	0.008	0.006
	P	0.013	0.003	0.001	0.001	0.006	0.005
	Y	765	750	1000	1000	750	774
Madhya Pradesh							
Kharif	A	0.833	0.833	0.885	0.861	0.763	0.835
	P	0.285	0.229	0.314	0.281	0.248	0.271
	Y	342	275	355	326	325	325
Rabi	A	0.029	0.028	0.031	0.024	0.032	0.029
	P	0.007	0.007	0.008	0.006	0.009	0.007
	Y	241	250	258	250	281	257
Total	A	0.862	0.861	0.916	0.885	0.795	0.864
	P	0.292	0.236	0.322	0.287	0.257	0.279
	Y	339	274	352	324	323	323

(Annexure -iv continued)

State/Season		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Maharashtra							
Kharif	A	7.110	7.623	7.001	6.560	5.35	6.729
	P	2.910	3.761	3.910	2.280	1.89	2.950
	Y	409	493	558	348	354	438
Rabi	A	0.12	0.118	0.110	0.076	0.12	0.109
	P	0.06	0.056	0.040	0.019	0.049	0.045
	Y	500	475	364	250	408	412
Total	A	7.23	7.741	7.111	6.636	5.47	6.838
	P	2.97	3.817	3.95	2.299	1.939	2.995
	Y	411	493	555	346	354	438
Orissa							
Kharif	A	1.309	0.891	1.327	1.162	1.25	1.188
	P	0.275	0.141	0.287	0.223	0.237	0.233
	Y	210	158	216	192	190	196
Rabi	A	0.816	0.792	1.246	0.791	1.323	0.994
	P	0.236	0.242	0.314	0.213	0.425	0.286

	Y	289	306	252	269	321	288
Total	A	2.125	1.683	2.573	1.953	2.573	2.181
	P	0.511	0.383	0.601	0.436	0.662	0.519
	Y	240	228	234	223	257	238
Punjab							
Kharif	A	0.230	0.157	0.189	0.150	0.123	0.170
	P	0.110	0.105	0.158	0.120	0.099	0.118
	Y	478	669	836	800	805	697
Rajasthan							
Kharif	A	7.021	5.146	8.285	7.546	7.995	7.199
	P	2.072	0.325	5.136	2.049	1.3	2.176
	Y	295	63	620	272	163	302
Tamil Nadu							
Kharif	A	0.550	0.321	0.367	0.339	0.383	0.392
	P	0.252	0.108	0.156	0.164	0.141	0.164
	Y	458	336	425	484	368	419
Rabi	A	0.736	0.758	0.890	0.886	0.984	0.851
	P	0.328	0.261	0.377	0.369	0.318	0.331
	Y	446	344	424	416	323	389
Total	A	1.286	1.079	1.257	1.225	1.367	1.243
	P	0.58	0.369	0.533	0.533	0.459	0.495
	Y	451	342	424	435	336	398

(Annexure -iv continued)

State		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Tripura							
Kharif	A	0.007	0.005	0.005	0.008	0.008	0.007
	P	0.004	0.003	0.003	0.005	0.005	0.004
	Y	571	600	600	625	625	606
Rabi	A	0.003	0.003	0.004	0.004	0.003	0.003
	P	0.001	0.002	0.002	0.002	0.002	0.002
	Y	333	667	500	500	667	529
Total	A	0.01	0.008	0.009	0.012	0.011	0.01
	P	0.005	0.005	0.005	0.007	0.007	0.006
	Y	500	625	556	583	636	580
Uttar Pradesh							
Kharif	A	0.281	0.222	0.260	0.322	0.292	0.275
	P	0.077	0.063	0.082	0.089	0.078	0.078
	Y	274	284	315	276	267	282
Summer	A	0.440	0.320	0.589	0.539	0.396	0.457
	P	0.220	0.180	0.311	0.289	0.282	0.256
	Y	500	563	528	536	712	561

Total	A	0.721	0.542	0.849	0.861	0.688	0.732
	P	0.297	0.243	0.393	0.378	0.36	0.334
	Y	412	448	463	439	523	456
West Bengal							
Kharif	A	0.006	0.006	0.008	0.007	0.007	0.007
	P	0.003	0.003	0.004	0.003	0.004	0.003
	Y	500	500	500	429	571	500
Rabi	A	0.103	0.092	0.103	0.110	0.108	0.103
	P	0.057	0.048	0.044	0.041	0.042	0.046
	Y	553	522	427	373	389	450
Total	A	0.109	0.098	0.111	0.117	0.115	0.11
	P	0.06	0.051	0.048	0.044	0.046	0.050
	Y	550	520	432	376	400	453
Pondicherry							
Rabi	A	0.004	0.01	0.013	0.019	0.018	0.013
	P	0.002	0.002	0.004	0.005	0.006	0.004
	Y	500	200	308	263	333	297
All India							
Kharif	**A**	**25.301**	**24.748**	**28.411**	**27.517**	**24.815**	**26.158**
	P	**8.669**	**6.382**	**14.266**	**8.104**	**6.867**	**8.858**
	Y	**343**	**258**	**502**	**295**	**277**	**339**
Rabi	**A**	**5.567**	**5.397**	**7.067**	**5.895**	**6.273**	**6.040**
	P	**2.437**	**2.292**	**2.755**	**2.474**	**2.596**	**2.511**
	Y	**438**	**425**	**390**	**420**	**414**	**416**
Total	**A**	**30.868**	**30.145**	**35.478**	**33.412**	**31.088**	**32.198**
	P	**11.106**	**8.674**	**17.021**	**10.578**	**9.463**	**11.368**
	Y	**360**	**288**	**480**	**317**	**304**	**353**

Source: E&S, GOI

Annexure- V

State – wise area, production and yield - Urad

(A=Area in lakh ha.,P=Production lakh tonnes, Y=Yield Kg/ha)

State		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Andhra Pradesh							
Kharif	A	1.070	1.100	0.950	0.765	0.792	0.935
	P	0.445	0.450	0.670	0.351	0.348	0.453
	Y	416	409	705	459	439	484
Rabi	A	5.200	5.843	3.430	3.510	3.42	4.281
	P	3.380	3.308	1.330	2.240	2.16	2.484
	Y	650	566	388	638	632	580
Total	A	6.270	6.943	4.380	4.275	4.212	5.22
	P	3.825	3.758	2.000	2.591	2.508	2.94
	Y	610	541	457	606	595	563
Assam							
Rabi	A	0.418	0.400	0.400	0.373	0.354	0.389
	P	0.232	0.200	0.210	0.201	0.173	0.203
	Y	555	500	525	539	489	522

Bihar							
Kharif	A	0.320	0.251	0.242	0.240	0.252	0.261
	P	0.215	0.186	0.180	0.179	0.194	0.191
	Y	672	741	744	746	770	731
Chhattisgarh							
Kharif	A	1.135	1.063	1.157	1.136	1.134	1.125
	P	0.350	0.280	0.336	0.313	0.329	0.322
	Y	308	263	290	276	290	286
Rabi	A	0.055	0.062	0.056	0.068	0.062	0.061
	P	0.013	0.014	0.014	0.015	0.015	0.014
	Y	236	226	250	221	242	234
Total	A	1.190	1.125	1.213	1.204	1.196	1.186
	P	0.363	0.294	0.350	0.328	0.344	0.336
	Y	305	261	289	272	288	283
Gujarat							
Kharif	A	1.137	1.216	1.075	0.960	0.959	1.069
	P	0.641	0.453	0.713	0.486	0.363	0.531
	Y	564	373	663	506	379	497
Haryana							
Kharif	A	0.013	0.024	0.024	0.038	0.023	0.024
	P	0.002	0.003	0.004	0.013	0.008	0.006
	Y	154	125	167	342	348	246
Himachal Pradesh							
Kharif	A	0.100	0.105	0.105	0.101	0.113	0.105
	P	0.033	0.020	0.024	0.032	0.046	0.031
	Y	330	190	229	317	407	296

(Annexure –v continued)

State		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
J & K							
Kharif	A	0.129	0.142	0.146	0.143	0.155	0.143
	P	0.054	0.060	0.061	0.059	0.065	0.060
	Y	419	423	418	413	419	418
Jharkhand							
Kharif	A	0.039	0.569	0.741	0.686	0.722	0.551
	P	0.026	0.327	0.323	0.405	0.382	0.293
	Y	668	575	436	590	529	531
Karnataka							
Kharif	A	1.506	1.494	1.292	1.220	1.01	1.304
	P	0.556	0.213	0.325	0.140	0.19	0.285
	Y	369	143	252	115	188	218
Rabi	A	0.119	0.161	0.114	0.100	0.11	0.121
	P	0.044	0.019	0.060	0.040	0.05	0.043
	Y	370	118	526	400	455	353
Total	A	1.625	1.655	1.406	1.320	1.120	1.425
	P	0.600	0.232	0.385	0.180	0.240	0.327
	Y	369	140	274	136	214	230
Kerala							

Kharif	A	0.014	0.003	0.001	0.001	0.007	0.005
	P	0.011	0.002	0.001	0.001	0.005	0.004
	Y	786	667	1000	1000	714	769
Madhya Pradesh							
Kharif	A	4.431	5.029	6.130	5.566	4.434	5.118
	P	1.602	1.456	2.251	2.009	1.567	1.777
	Y	362	290	367	361	353	347
Rabi	A	0.068	0.058	0.060	0.068	0.063	0.063
	P	0.022	0.022	0.024	0.028	0.009	0.021
	Y	324	379	400	412	281	331
Total	A	4.499	5.087	6.190	5.634	4.497	5.181
	P	1.624	1.478	2.275	2.037	1.576	1.798
	Y	361	291	368	362	350	347
Maharashtra							
Kharif	A	5.880	6.336	6.010	5.300	4.68	5.641
	P	2.560	3.598	3.590	2.160	1.99	2.780
	Y	435	568	597	408	425	493
Rabi	A	0.12	0.118	0.110	0.076	0.12	0.109
	P	0.06	0.056	0.060	0.029	0.074	0.056
	Y	500	475	545	382	617	513
Total	A	6.000	6.454	6.120	5.376	4.8	5.75
	P	2.620	3.654	3.650	2.189	2.064	2.835
	Y	437	566	596	407	430	493

(Annexure –v continued)

State		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Orissa							
Kharif	A	1.470	1.152	1.324	1.225	1.272	1.289
	P	0.440	0.263	0.356	0.324	0.312	0.339
	Y	299	228	269	264	245	263
Rabi	A	0.019	0.020	0.036	0.021	0.061	0.031
	P	0.006	0.008	0.012	0.007	0.025	0.012
	Y	316	400	333	333	410	369
Total	A	1.489	1.172	1.360	1.246	1.333	1.32
	P	0.446	0.271	0.368	0.331	0.337	0.351
	Y	300	231	271	266	253	266
Punjab							
Kharif	A	0.045	0.039	0.052	0.034	0.028	0.040
	P	0.018	0.019	0.022	0.018	0.013	0.018
	Y	400	487	423	529	464	455
Rajasthan							
Kharif	A	1.815	2.587	2.396	1.462	1.385	1.929
	P	0.657	0.472	1.252	0.527	0.351	0.652
	Y	362	182	523	360	253	338
Sikkim							

Kharif	A	0.001	0.001	0.001	0.001	0.001	0.001
	P	0.001	0.001	0.001	0.001	0.001	0.001
	Y	1000	1000	1000	1000	1000	1000
Rabi	A	0.041	0.038	0.038	0.039	0.039	0.039
	P	0.03	0.028	0.028	0.029	0.028	0.029
	Y	732	737	737	744	718	733
Total	A	0.042	0.039	0.039	0.04	0.04	0.04
	P	0.031	0.029	0.029	0.03	0.029	0.030
	Y	738	744	744	750	725	740
Tamil Nadu							
Kharif	A	0.710	0.415	0.508	0.469	0.488	0.518
	P	0.302	0.130	0.208	0.219	0.152	0.202
	Y	425	313	409	467	311	390
Rabi	A	2.181	1.623	1.350	1.874	1.667	1.739
	P	0.956	0.665	0.552	0.802	0.556	0.706
	Y	438	410	409	428	334	406
Total	A	2.891	2.038	1.858	2.343	2.155	2.257
	P	1.258	0.795	0.760	1.021	0.708	0.908
	Y	435	390	409	436	329	402

(Annexure –v continued)

State		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Tripura							
Kharif	A	0.008	0.013	0.013	0.012	0.013	0.012
	P	0.005	0.007	0.007	0.007	0.007	0.007
	Y	625	538	538	583	538	559
Rabi	A	0.004	0.004	0.004	0.004	0.004	0.004
	P	0.002	0.002	0.002	0.002	0.002	0.002
	Y	500	500	500	500	500	500
Total	A	0.012	0.017	0.017	0.016	0.017	0.016
	P	0.007	0.009	0.009	0.009	0.009	0.009
	Y	583	529	529	563	529	544
Uttar Pradesh							
Kharif	A	3.629	4.020	4.976	4.763	4.92	4.462
	P	1.480	1.602	1.204	1.774	2.113	1.635
	Y	408	399	242	372	429	366
Summer	A	0.6	0.52	0.589	0.586	0.466	0.552
	P	0.3	0.28	0.300	0.302	0.277	0.292
	Y	500	538	509	515	594	528
Total	A	4.229	4.540	5.565	5.349	5.386	5.014
	P	1.78	1.882	1.504	2.076	2.39	1.926
	Y	421	415	270	388	444	384
Uttarakhand							

Kharif	A	0.098	0.270	0.220	0.23	0.33	0.230
	P	0.061	0.170	0.150	0.13	0.2	0.142
	Y	622	630	682	565	606	619
West Bengal							
Kharif	A	0.493	0.487	0.512	0.475	0.486	0.491
	P	0.323	0.318	0.312	0.32	0.307	0.316
	Y	655	653	609	674	632	644
Rabi	A	0.135	0.135	0.151	0.114	0.085	0.124
	P	0.142	0.086	0.111	0.084	0.102	0.105
	Y	1052	637	735	737	1200	847
Total	A	0.628	0.622	0.663	0.589	0.571	0.615
	P	0.465	0.404	0.423	0.404	0.409	0.421
	Y	740	650	638	686	716	685
All India							
Kharif	**A**	**24.062**	**26.511**	**27.891**	**24.843**	**23.22**	**25.305**
	P	**9.800**	**10.044**	**12.004**	**9.482**	**8.958**	**10.058**
	Y	**407**	**379**	**430**	**382**	**386**	**397**
Rabi	**A**	**8.968**	**8.990**	**6.350**	**6.85**	**6.468**	**7.525**
	P	**5.191**	**4.691**	**2.707**	**3.784**	**3.492**	**3.973**
	Y	**579**	**522**	**426**	**552**	**540**	**528**
Total	**A**	**33.03**	**35.501**	**34.241**	**31.693**	**29.688**	**32.831**
	P	**14.991**	**14.735**	**14.711**	**13.266**	**12.45**	**14.031**
	Y	**454**	**415**	**430**	**419**	**419**	**427**

Source: E&S, GOI

Annexure- VI

State – wise area, production and yield - Lentil

(A=Area in lakh ha.,P=Production lakh tonnes, Y=Yield Kg/ha)

State		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Assam	A	0.213	0.200	0.220	0.205	0.186	0.205
	P	0.112	0.110	0.120	0.115	0.099	0.1112
	Y	526	550	545	561	532	543
Bihar	A	1.726	1.796	1.710	1.787	1.625	1.729
	P	1.378	1.566	1.598	1.27	1.145	1.3914
	Y	798	872	935	711	705	805
Chhattisgarh	A	0.159	0.150	0.180	0.172	0.185	0.169
	P	0.052	0.046	0.062	0.044	0.06	0.0528
	Y	327	307	344	256	324	312
Haryana	A	0.089	0.054	0.063	0.086	0.054	0.069
	P	0.078	0.051	0.051	0.082	0.043	0.061
	Y	876	944	810	953	796	882
J & K.	A	0.001	0.002	0.002	0.002	0.002	0.002
	P	0	0.001	0.001	0.001	0.001	0.001
	Y	0	500	500	500	500	444
Madhya Pradesh	A	5.002	4.669	4.788	4.977	5.641	5.015
	P	2.404	1.81	2.404	2.477	2.875	2.394
	Y	481	388	502	498	510	477

Maharashtra	A	0.080	0.060	0.080	0.055	0.087	0.072
	P	0.040	0.020	0.030	0.014	0.036	0.028
	Y	500	333	375	255	414	387
Punjab	A	0.043	0.040	0.036	0.033	0.02	0.034
	P	0.030	0.027	0.023	0.016	0.01	0.0212
	Y	698	675	639	485	500	616
Rajasthan	A	0.170	0.059	0.261	0.288	0.185	0.193
	P	0.154	0.057	0.288	0.286	0.168	0.191
	Y	906	966	1103	993	908	990
Tripura	A	0.004	0.004	0.003	0.004	0.003	0.004
	P	0.002	0.002	0.002	0.002	0.002	0.002
	Y	500	500	667	500	667	556
Uttar Pradesh	A	6.250	5.839	5.567	6.13	6.079	5.973
	P	5.000	4.499	5.048	5.014	4.349	4.782
	Y	800	771	907	818	715	801
Uttrakhand	A	0.149	0.147	0.142	0.142	0.205	0.157
	P	0.078	0.073	0.079	0.079	0.092	0.0802
	Y	523	497	556	556	449	511
West Bengal	A	0.714	0.687	0.694	0.627	0.615	0.667
	P	0.375	0.432	0.532	0.379	0.47	0.4376
	Y	525	629	767	604	764	656
All India	**A**	**14.664**	**13.770**	**13.964**	**14.730**	**15.054**	**14.436**
	P	**9.744**	**8.732**	**10.378**	**9.942**	**9.462**	**9.652**
	Y	**664**	**634**	**743**	**675**	**629**	**669**

Annexure- VII

State – wise area, production and yield - Peas

(A=Area in lakh ha.,P=Production lakh tonnes, Y=Yield Kg/ha)

State		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Assam							
Rabi	A	0.244	0.230	0.250	0.233	0.179	0.227
	P	0.143	0.140	0.150	0.144	0.113	0.138
	Y	586	609	600	618	631	607
Bihar							
Rabi	A	0.238	0.233	0.237	0.228	0.241	0.235
	P	0.234	0.208	0.222	0.201	0.215	0.216
	Y	983	893	937	882	892	918
Chhattisgarh							
Rabi	A	0.119	0.122	0.173	0.166	0.182	0.152
	P	0.044	0.042	0.065	0.053	0.064	0.054
	Y	370	344	376	319	352	352
Haryana							
Rabi	A	0.012	0.016	0.010	0.014	0.014	0.013
	P	0.012	0.019	0.011	0.018	0.017	0.015
	Y	1000	1188	1100	1286	1214	1167
J & K							
Rabi	A	0.015	0.017	0.017	0.017	0.017	0.017

	P	0.011	0.012	0.012	0.012	0.011	0.012
	Y	733	706	706	706	688	699
Jharkhand							
Rabi	A	0.029	0.029	0.100	0.102	0.102	0.072
	P	0.022	0.02	0.08	0.09	0.062	0.054
	Y	759	724	770	882	805	751
Kerala							
Kharif	A	0.027	0.006	0.002	0.002	0	0.007
	P	0.021	0.005	0.001	0.001	0	0.006
	Y	778	833	500	500	0	757
Rabi	A	0.014	0.022	0.017	0.009	0.028	0.018
	P	0.011	0.016	0.013	0.007	0.021	0.014
	Y	786	727	765	778	750	756
Total	A	0.041	0.028	0.019	0.011	0.028	0.025
	P	0.032	0.021	0.014	0.008	0.021	0.019
	Y	780	750	737	727	750	756
Madhya Pradesh							
Rabi	A	1.791	1.934	2.005	2.187	2.292	2.042
	P	0.844	0.776	0.967	1.056	1.119	0.952
	Y	471	401	482	483	488	466

(Annexure -vii continued)

State		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Maharashtra							
Rabi	A	0.190	0.130	0.180	0.125	0.197	0.164
	P	0.100	0.050	0.070	0.034	0.087	0.068
	Y	526	385	389	272	442	415
Manipur							
Kharif	A	0.024	0.022	0.012	0.023	0.019	0.020
	P	0.012	0.010	0.006	0.011	0.01	0.010
	Y	500	455	500	478	526	490
Punjab							
Rabi	A	0.053	0.046	0.039	0.036	0.036	0.042
	P	0.058	0.052	0.043	0.04	0.04	0.047
	Y	1094	1130	1103	1111	1111	1110
Rajasthan							
Rabi	A	0.125	0.105	0.127	0.125	0.134	0.123
	P	0.244	0.237	0.254	0.28	0.317	0.266
	Y	1952	2257	2000	2240	2366	2162
Tripura							
Rabi	A	0.012	0.013	0.010	0.011	0.011	0.011
	P	0.008	0.008	0.008	0.008	0.008	0.008
	Y	667	615	800	727	727	702
Uttar Pradesh							
Rabi	A	3.270	3.549	3.704	4.437	4.13	3.818
	P	3.960	4.186	5.126	5.757	4.833	4.772
	Y	1211	1179	1384	1297	1170	1250

Uttarakhand							
Rabi	A	0.040	0.039	0.038	0.038	0.055	0.042
	P	0.041	0.038	0.041	0.041	0.048	0.042
	Y	1025	974	1079	1079	873	995
West Bengal							
Rabi	A	0.088	0.108	0.146	0.143	0.131	0.123
	P	0.056	0.087	0.172	0.094	0.115	0.105
	Y	636	806	1178	657	878	851
All India							
Kharif	**A**	**0.068**	**0.043**	**0.042**	**0.041**	**0.055**	**0.050**
	P	**0.042**	**0.023**	**0.021**	**0.021**	**0.029**	**0.027**
	Y	**618**	**535**	**500**	**512**	**527**	**546**
Rabi	**A**	**6.635**	**6.593**	**7.053**	**7.871**	**7.871**	**7.205**
	P	**6.034**	**5.892**	**7.231**	**7.835**	**7.07**	**6.812**
	Y	**909**	**894**	**1025**	**995**	**915**	**946**
Total	**A**	**6.703**	**6.636**	**7.095**	**7.912**	**7.926**	**7.254**
	P	**6.076**	**5.915**	**7.252**	**7.856**	**7.099**	**6.840**
	Y	**906**	**891**	**1022**	**993**	**896**	**943**

Source: E&S, GOI

Annexure- VIII

State – wise area, production and yield - Moth

(A=Area in lakh ha.,P=Production lakh tonnes, Y=Yield Kg/ha)

State		2001-02	2002-03	2003-04	2004-05	2005-06	Average
1	2	3	4	5	6	7	8
Gujarat	A	0.432	0.379	0.472	0.410	0.41	0.421
	P	0.145	0.088	0.271	0.147	0.11	0.152
	Y	336	232	574	359	268	362
Haryana	A	0.002	0.023	0.104	0.024	0.058	0.042
	P		0.004	0.008	0.003	0.01	0.005
	Y		174	77	125	172	118
Himachal Pradesh	A	0.001	0.001	0.001	0.001	0	0.001
	P	0.001	0.001	0.001	0.001	0	0.001
	Y	1000	1000	1000	1000	0	1000
J & K	A	0.037	0.035	0.025	0.027	0.028	0.030
	P	0.022	0.021	0.014	0.017	0.017	0.018
	Y	595	600	560	630	607	599
Maharashtra	A	0.410	0.456	0.410	0.51	0.42	0.441
	P	0.110	0.110	0.090	0.152	0.12	0.116
	Y	268	241	220	298	286	264
Punjab	A	0.003	0.003	0.006	0.003	0.001	0.003
	P	0.003	0.002	0.004	0.002	0.001	0.002
	Y	1000	667	667	667	1000	750
Rajasthan	A	13.041	4.307	14.919	14.363	12.278	11.782
	P	3.089	0.189	7.907	1.883	1.494	2.912

	Y	237	44	530	131	122	247
Uttar Pradesh	A	0.003	0.003	0.005	0.003	0.003	0.003
	P	0.001	0.001	0.002	0.001	0.001	0.001
	Y	333	333	400	333	333	353
All India	**A**	**13.929**	**5.207**	**15.942**	**15.341**	**13.198**	**12.723**
	P	**3.371**	**0.416**	**8.296**	**2.206**	**1.753**	**3.208**
	Y	**242**	**80**	**520**	**144**	**133**	**252**

Source: E&S, GOI

Annexure- IX

State – wise area, production and yield - Kulthi

(A=Area in lakh ha.,P=Production lakh tonnes, Y=Yield Kg/ha)

State/Season		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Andhra Pradesh							
Kharif	A	0.114	0.150	0.110	0.101	0.099	0.115
	P	0.044	0.060	0.040	0.051	0.041	0.047
	Y	386	400	364	505	414	411
Rabi	A	0.690	0.665	0.680	0.57	0.47	0.615
	P	0.350	0.226	0.350	0.21	0.16	0.259
	Y	507	340	515	368	340	421
Total	A	0.804	0.815	0.790	0.671	0.569	0.730
	P	0.394	0.286	0.390	0.261	0.201	0.306
	Y	490	351	494	389	353	420
Bihar							
Kharif	A	0.143	0.131	0.154	0.150	0.113	0.138
	P	0.115	0.104	0.114	0.121	0.097	0.110
	Y	804	794	740	807	858	797
Chhattisgarh							
Kharif	A	0.577	0.545	0.526	0.523	0.509	0.536
	P	0.196	0.131	0.175	0.156	0.159	0.163
	Y	340	240	333	298	312	305
Rabi	A	0.036	0.03	0.031	0.032	0.031	0.032
	P	0.010	0.007	0.009	0.008	0.009	0.009
	Y	278	233	290	250	290	269
Total	A	0.613	0.575	0.557	0.555	0.540	0.568

	P	0.206	0.138	0.184	0.164	0.168	0.172
	Y	336	240	330	295	311	303
Himachal Pradesh							
Kharif	A	0.023	0.026	0.026	0.024	0.024	0.025
	P	0.008	0.005	0.005	0.007	0.01	0.007
	Y	348	192	192	292	417	285
J & K							
Kharif	A	0.019	0.020	0.014	0.020		0.015
	P	0.006	0.006	0.005	0.006		0.005
	Y	316	300	357	300		315
Jharkhand							
Kharif	A	0.110	0.140	0.182	0.169	0.178	0.156
	P	0.063	0.062	0.061	0.077	0.073	0.067
	Y	573	443	335	456	410	431

(Annexure –ix continued)

State/Season		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Karnataka							
Kharif	A	1.552	1.330	1.090	1.400	1.25	1.324
	P	0.819	0.520	0.382	0.720	0.73	0.634
	Y	528	391	350	514	584	479
Rabi	A	1.881	2.021	1.647	1.430	1.45	1.686
	P	0.671	0.573	0.389	0.47	0.58	0.537
	Y	357	284	236	329	400	318
Total	A	3.433	3.351	2.737	2.830	2.700	3.010
	P	1.490	1.093	0.771	1.190	1.310	1.171
	Y	434	326	282	420	485	389
Kerala							
Rabi	A	0.046	0.051	0.038	0.02	0.04	0.039
	P	0.038	0.040	0.033	0.018	0.033	0.032
	Y	826	784	868	900	825	831
Madhra Pradesh							
Kharif	A	0.360	0.334	0.310	0.310	0.288	0.320
	P	0.090	0.079	0.097	0.082	0.082	0.086
	Y	250	237	312	265	285	268
Rabi	A	0.003	0.003	0.003	0.005	0.006	0.004
	P	0.001	0.001	0.001	0.002	0.002	0.001
	Y	333	333	333	400	333	350
Total	A	0.363	0.337	0.313	0.315	0.294	0.324
	P	0.091	0.080	0.098	0.084	0.084	0.087
	Y	251	237	313	267	286	269
Maharashtra							
Kharif	A	0.420	0.467	0.530	0.659	0.543	0.524
	P	0.110	0.110	0.130	0.22	0.174	0.149

	Y	262	236	245	334	320	284
Rabi	A	0.110	0.070	0.100	0.069	0.109	0.092
	P	0.050	0.030	0.030	0.014	0.049	0.035
	Y	455	429	375	255	450	378
Total	A	0.530	0.537	0.630	0.728	0.652	0.615
	P	0.160	0.140	0.160	0.234	0.223	0.183
	Y	302	261	254	321	342	298
Orissa							
Kharif	A	0.909	0.759	0.875	0.839	0.75	0.826
	P	0.280	0.143	0.247	0.208	0.209	0.217
	Y	308	188	282	248	279	263
Rabi	A	0.002	0.000	0.003	0.003	0.004	0.002
	P	0.001	0.000	0.001	0.001	0.001	0.001
	Y	500		333	333	250	333
Total	A	0.911	0.759	0.878	0.842	0.754	0.829
	P	0.281	0.143	0.248	0.209	0.210	0.218
	Y	308	188	282	248	279	263

(Annexure –ix continued)

State/Season		**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**Average**
Tamil Nadu							
Kharif	A	0.310	0.181	0.235	0.216	0.059	0.200
	P	0.139	0.061	0.063	0.066	0.036	0.073
	Y	447	337	268	306	610	365
Rabi	A	1.008	0.680	0.446	0.814	0.545	0.699
	P	0.471	0.178	0.120	0.335	0.184	0.258
	Y	467	262	269	412	338	369
Total	A	1.318	0.861	0.681	1.030	0.604	0.899
	P	0.610	0.239	0.183	0.401	0.220	0.331
	Y	463	278	269	389	364	368
West Bengal							
Rabi	A	0.037	0.057	0.041	0.028	0.028	0.038
	P	0.032	0.027	0.018	0.012	0.013	0.020
	Y	865	474	439	429	464	534
All India							
Kharif	**A**	**4.537**	**4.083**	**4.096**	**4.411**	**3.813**	**4.188**
	P	**1.870**	**1.281**	**1.319**	**1.714**	**1.611**	**1.559**
	Y	**412**	**314**	**322**	**389**	**423**	**372**
Rabi	**A**	**3.813**	**3.577**	**2.989**	**2.971**	**2.683**	**3.207**
	P	**1.624**	**1.082**	**0.961**	**1.075**	**1.031**	**1.1546**
	Y	**426**	**302**	**322**	**362**	**384**	**360**
Total	**A**	**8.350**	**7.660**	**7.085**	**7.382**	**6.496**	**7.395**
	P	**3.494**	**2.363**	**2.280**	**2.789**	**2.642**	**2.714**
	Y	**418**	**308**	**322**	**378**	**407**	**367**

Source: E&S, GOI

Annexure-X

State – wise area, production and yield - Lathyrus

(A=Area in lakh ha.,P=Production lakh tonnes, Y=Yield Kg/ha)

State		2001-02	2002-03	2003-04	2004-05	2005-06	Average
1	2	3	4	5	6	7	8
Bihar	A	1.570	1.416	1.331	1.182	0.921	1.284
	P	1.297	1.147	1.226	0.797	0.786	1.051
	Y	826	810	921	674	853	818
Madhya Pradesh	A	0.534	0.491	0.508	0.395	0.421	0.470
	P	0.382	0.337	0.384	0.271	0.278	0.330
	Y	715	686	756	686	660	703
Maharashtra	A	0.300	0.210	0.290	0.201	0.317	0.264
	P	0.160	0.09	0.120	0.058	0.148	0.115
	Y	533	429	414	289	467	437
West Bengal	A	0.347	0.328	0.357	0.350	0.333	0.343
	P	0.287	0.271	0.409	0.333	0.304	0.321
	Y	827	826	1146	951	913	935
Chhattisgarh	A	4.168	3.301	4.609	4.284	4.269	4.126
	P	2.305	1.703	2.788	1.581	1.942	2.064
	Y	553	516	605	369	455	500
All India	**A**	**6.919**	**5.746**	**7.095**	**6.412**	**6.261**	**6.487**
	P	**4.431**	**3.548**	**4.927**	**3.04**	**3.458**	**3.881**
	Y	**640**	**617**	**694**	**474**	**552**	**598**

Source: E&S, GOI

Pattern of financial assistance – ISOPOM – pulses (2007-08 to 2011-12) (14 states/48 districts) **Annexure –XI**

Components	Item of Expenditure	Implementing agency	Pattern of Assistance	Sharing Pattern %	
				Central	State
1. Seed					
i) Production of Breeder Seed	Production of Breeder seed through state Agriculture Universities/Research Institutes/SSc etc	ICAR as nodal agency	Rs. 175 lakh per year for 124 posts	100	-
ii) Purchase of Breeder seeds	For purchace of breeder seed produced by ICAR	State Deptt. of Agriculture (SDAs) NSC/SFCI	Full cost as per uniform rates fixed by Seed Division, GOI -do-	75 100	25 -
iii) Production of Foundation seed	For multiplication of breeder seed into foundation seed by SDAs through SSC's/OILFED's, NSC, SFCI, NAFED, IFFCO etc.	SDA's NSC/SFCI	Rs.1000/- per quintal -do-	75 100	25 -
iv) Production of Certified Seed (Seed Village Scheme)	For organizing production of certified seed in selected villages on farmers field through SSC's/OILFED's etc.	SDA's NSC/SFCI/KRIBHCO/ NAFED/IFFCO	Rs. 1000/- per quintal -do-	75 100	25 -
v) Crash Programme for quality seed production	To provide quality seed to the farmers at reasonable rate to increase seed replacement rate.	NSC/SFCI	1. Assistance for production of quality seed @ Rs. 1000/- per Qtls. as provided under Seed Village Scheme. 2. Assistance for distribution of quality seed @ 50% of the cost of seed per quintal or Rs. 1200/- whichever is less.	100	-

Components	Item of Expenditure	Implementing agency	Pattern of Assistance	Sharing Pattern %

				Central	State
v) Distribution of certified seed	For Supply of Certified seed to farmers at subsidised prices to increase seed replacement rate	SDA's NSC/SFCI/ NAFED/ KRIBHCO/ IFFCO	50% of the cost of certified seed of all pulses limited to 1200/- per quintal whichever is less	75 100	25 -
vii) Distribution of seed minikits (varietal Diversification)	Supply of seed kits of newly improved varieties/hybrids by NSC/SFCI/NAFED/KRIBHCO,IFFCO & Private through State Department of Agriculture(SDA's) to the farmers	NSC/SFCI/ KRIBHCO and IFFCO	Free of cost to the farmers	100	
viii) Infrastructure Development	For developing irrigation facilities and threshing floors at seed farms and seed storage godowns	SDA's/SAUs NSC/SFCI	Actual cost as per CPWD/PWD rates -do-	50 100	50
2. Demonstrations					
i) Block Demonstrations	For organising demonstrations of improved crop production technology on farmers field	SDAs	50% of the cost of the inputs and on actual cost basis limited to	75	25

Crop	**Rs./ha.**
Urd, Moong, Arhar, Cowpea, Moth, Guar Kulthi (Horse gram) & Lathyrus	2000/-
Lentil	2200/-
Gram & Peas	2500/-
Rajmash	3500/-

Components	**Item of Expenditure**		**Pattern of Assistance**	**Sharing Pattern %**

		Implementing agency		**Central**	**State**
ii) IPM Demonstration	For demonstrating IPM technologies on farmers fields	SDAs	a) IPM demonstration (farmers Field School (FFS) Rs. 22680/- per demonstration b) Bio-intensive at different stages of plant growth as mentioned below i) Gram:-TRICHODERMA, TRAP+LURE, NEEM 1500, LURE, NPV, LURE, BT with maximum ceiling of Rs. 747.50/- per ha. ii) Arhar:-TRICHODERMA, NEEM 1500, TRAP+LURE ,LURE, NPV, LURE, BT with maximum ceiling of Rs. 1140/- per ha.	75	25
iii) Front Line Demonstration by ICAR	For demonstrating new crop production technologies on farmers fields	ICAR	Actual cost of the demonstration limited to Rs.5000/- per ha.	100	- -
3. Plant Protection Chemicals	For need based of supply of PP chemicals at subsidized prices in the event of outbreak of pests and diseases	SDAs	50% cost of chemical or Rs. 500/- per ha. whichever is less.	75	25
4. Plant Protection Equipments	For supply of PP equipments to farmers at subsidized prices	SDAs	i) Manually operated – 50% of equipment or Rs. 800/- per PP Equipment whichever is less ii) Power Operated – 50% cost of equipment or Rs. 2000/- per PP Equipment whichever is less.	75	25

Components	Item of Expenditure	Implementing agency	Pattern of Assistance	Sharing Pattern %	
				Central	State
5. Weedicides	For supply of weedicides to farmers at subsidized prices in weed problematic areas	SDAs	50% cost of chemical or Rs. 500/- per ha. whichever is less	75	25
6. Nuclear Polyhedrosis Virus (NPV)	For supply of NPV for control of pod borer in gram and arhar	SDAs	50% cost of the culture or Rs. 250/- per ha. whichever is less	75	25
7. Supply of *Rhizobium Culture/ Phosphate Solublising Bacteria* (PSB)	For subsidized supply to the farmers of *Rhizobium Culture* / *PSB* for pulses	SDAs	50% of the cost of the chemicals or Rs.100/- per ha.	75	25
8. Distribution of gypsum/pyrite/ Liming/Dolomite	For supply of gypsum/pyrite (as source of sulphur) to the farmers at subsidized rate	SDAs	50% cost of the material plus transport cost limited to Rs.7500/- per ha. whichever is less	75	25
9. Farmers Training	for organizing training of farmers in improved crop production technologies and post harvest management	SDAs	Rs.15,000/- for training of farmers for a batch of 50 farmers.	75	25
10. Distribution of sprinkler sets.	For supply of sprinkler sets to the farmers at subsidized prices for better water use efficiency.	SDAs	1. 50% of the cost of sprinkler set or Rs.7500/- per set which ever is less .	75	25
11. Staff and contingencies	For special staff sanctioned for implementation and monitoring of the programme in the state.	SDAs	As per sanctioned strength under TMOP scheme under VIII plan continued during IX plan will also be applicable during XI plan.	75	25
12. Evaluation of ISOPOM	for concurrent evaluation of implementation of the scheme/components.	AFC or other agency appointed by GOI	Actual cost basis	100	

Components	Item of Expenditure	Implementing agency	Pattern of Assistance	Sharing Pattern %	
				Central	State
13.Pipes for carrying water source to the field.	for carrying water from the water source to the field to avoid percolation losses	SDAs	Assistance @ 50 % cost or Rs. 15000/- for water carrying pipes up to 800 meters and all types of pipes i.e. PVC, HDPE pipe etc. and all sizes as per requirement of farmers	75	25
14. Officers Training	To provide regular training to the officer/extension workers of the SDA's as also of the TMOP HQs. and its Directorates to update their knowledge about the new developments in the field of Agriculture	ICAR SDA's	Rs. 16000/- for 30 officers for 2 days training	100 75	 25
15. Supply of Improved farm implements		SDAs	Manual/bullock drawn - @50% of the cost or Rs.2500 per implement and power driven implement - @50% cost or Rs.15000 per implement whichever is less.	75	25
17. Supply of Micronutrients		SDAs	Assistance @50% of the cost or Rs.500 per ha., whichever is less.	75	25
18.Publicity	To establish linkage between farmers & agriculture experts for transfer of latest technology in shortest time	SDA's	A lumpsum of Rs. 2 lakh per states	100	-
17.Involvement of Private Sector in other activities	To involve private sector in activities like (a) Seed production (b) Supply of Inputs (c) Extension Support (d) Frontline demonstration & Block demonstration.		A cap of 15% for each component	75	25

Annexure- XII

Pattern of financial assistance/components – National Food Security Mission – Pulses (2007-08 to 2011-12)

Sl No.	**Components**	**Implementing agency**	**Pattern of assistance**
1	Seed		
	Production of Breeder seed of pulses	ICAR	Lump sum grant of Rs 2.0 crores/year on project basis.
	Purchase of Breeder seed of pulses from ICAR	State Departments of Agriculture/NSC/SFCI/KRIBHCO/NAFED/IFFCO/State Seed Corporations.	Full cost as per uniform rates fixed by Seeds Division, DAC, Ministry of Agriculture
	Production of Foundation and Certified seeds of pulses	State Departments of Agriculture/NSC/SFCI/ KRIBHCO/NAFED /IFFCO/State Seed Corporations.	Rs 1000/qtl
	Distribution assistance on certified seeds	State Departments of Agriculture/NSC/SFCI/KRIBHCO/NAFED/IFFCO/State Seed Corporations/Seed producing agencies in private and cooperative sectors.	50% of the cost or Rs 1200/qtl, whichever is less.
	Strengthening of state seed certification agency	State Departments of Agriculture.	Rs 25.00 lakhs /state/annum
2	Integrated Nutrient Management (INM)	State Departments of Agriculture or such agency as may be decided by Executive Committee of NFSM.	50% of the cost or Rs 1250/ha, whichever is less.
3	Integrated Pest Management (IPM)	State Departments of Agriculture or such agency as may be decided by Executive Committee of NFSM.	50% of the cost or Rs 750/ha, whichever is less.
4	Distribution of sprinkler sets	State Departments of Agriculture or such agency as may be decided by Executive Committee of NFSM.	50% of the cost or Rs 7500/ha, whichever is less.
5a	Extension, Training and Mass media campaign including best awards to	IIPR, Kanpur, State Departments of Agriculture or such agency as may be decided	Full cost (Lump sum grant of Rs

Sl No.	**Components**	**Implementing agency**	**Pattern of assistance**
	best performing districts	by Executive Committee of NFSM.	50 lakhs/state/year for Extension, Training and Mass media campaign; Rs 10 lakhs/district for award
5b	Strengthening of infrastructure of Indian Institute of Pulses Research, Kanpur for Breeder seed production	IIPR (ICAR), Kanpur.	Rs 5.00 crore for IIPR
6	Pilot project/projects on tackling the menace of blue bull (Neel Gai)	State Departments of Agriculture.	Funding on project basis
7	Demonstration of technologies and practices developed by ICRISAT to enhance productivity and production of pulses	ICRISAT	Funding on project basis
8	Miscellaneous expenses relating to Project Management Team including contractual services, POL, contingency and other expenses at district level	State Departments of Agriculture.	Full cost limited to Rs. 5.0 lakh per district per year

Area of operations (14 states/168 districts) – NFSM-Pulses **Annexure- XIII**

State	District	State	District
Andhra Pradesh	Adilabad	**Madhya Pradesh**	Chhatarpur
	Anantpur		Chindwara
	Cuddapah		Damoh
	East Godavari		Dewas
	Guntur		Guna
	Khammam		Rewa
	Krishna		Raisen
	Kurnool		Satna
	Mahaboobnagar		Tikamgarh
	Nalgonda		Sagar
	Nizamabad		Vidisha
	Prakasam		Ujjain
	Srikakulam		Jabalpur
	Warangal		Narasinghpur
Total	**14 districts**		Shivpuri
Uttar Pradesh	Jhansi		Panna
	Jalaun		Rajgarh
	Hamirpur		Seoni
	Sitapur		Shajapur
	Banda		Jhabua
	Chitrakut	**Total**	**20 districts**
	Mahoba	Haryana	Rohtak
	Bahraich		Sonepat
	Barabanki		Bhiwani
	Kheri		Hissar
	Lalitpur		Sirsa
	Kanpur (dehat)	**Total**	**5 districts**
	Kaushambi	**Maharashtra**	Ahmednagar
	Mirzapur		Akola
	Badaun		Amravati
	Ballia		Aurangabad
	Fatepur		Buldhana
	Balarampur		Chandrapur
	Chandauli		Hingoli
	19 districts		Jalgaon
Karnataka	Bagalkot		Jalana
	Belgaum		Latur
	Bellary		Nagpur
	Bidar		Nanded
	Bijapur		Nasik
	Chitradurga		Osmanabad

State	District	State	District
	Dharwad		Parbhani
	Gadag		Wardha
	Gulburga		Washim
	Koppal		Yavatmal
	Mysore	**Total**	**18 districts**
	Raichur	**Rajasthan**	Ajmer
	Tumkur		Bikaner
Total	**13 districts**		Barmer
Tamilnadu	Coimbatore		Chittorgarh
	Cuddalore		Churu
	Erode		Dausa
	Nagapattinam		Ganganagar
	Namakkal		Hanumangarh
	Thiruvallur		Jaipur
	Thiruvarur		Jhunjhunu
	Thoothukudi		Jodhpur
	Tiruvannmalai		Kota
	Vellore		Nagaur
	Villupuram		Sikar
	Virudunagar		Tonk
Total	**12 districts**	**Total**	**15 districts**
Gujarat		Punjab	Ludhiana
	Banaskantha		Sangrur
	Broach		Ferozpur
	Dohad		Gurdaspur
	Jamnagar		Amritsar
	Kutch	Total	**5 districts**
	Narmada	**Bihar**	Araria
	Panch Mahals		Aurangabad
	Patan		Bhojpur
	Sabarkantha		Bhabhua
	Surat		Madhubani
	Vadodara		Madhepura
Total	**11 districts**		Muzaffarpur
Orissa	Bolangir		Nalanda
	Baragarh		Patna
	Cuttack		Purnia
	Ganjam		Saharsa
	Kalahandi		Samastipur
	Keonjhar		Supaul
	Khurda	**Total**	**13 districts**
	Nayagarh	**Chhattisgarh**	Bilaspur

State	District	State	District
	Puri		Durg
	Rayagada		Jashpur
Total	**10 districts**		Kawardha
West Bengal	Birbhum		Raigarh
	Malda		Raipur
	Murshidabad		Rajnandgaon
	Nadia		Sarguja
	Purulia		**8 districts**
Total	**5 districts**		
Total 168 districts			

All India Zone-wise Package of Practices - major Pulses **Annexure- XIV**

CROP	NWPZ	NEPZ	CZ	SZ
Chickpea				
Sowing time Rain fed Irrigated Late sown	 2nd fortnight of Oct. 1st fortnight of Nov. 1st fortnight of December	 2nd fortnight of October 1st fortnight of November 1st fortnight of December	 1st fortnight of October Last week of October -	 Last Sept. - last of Oct. 2nd fortnight of Oct. -
Seed Rate & Spacing Rain fed Irrigated Late sown	 60-70 kg/ha , 30X10 cm 50-60Kg/ ha , 45X10 cm 80Kg/ ha , 30X10 cm	 70-80 kg/ha , 30X10 cm 60-70Kg/ ha , 30X10 cm 90Kg/ ha , 25X10 cm	 70-80 Kg/ha , 30 X 10 cm - -	 70-80 Kg , 30 X 10 cm - -
Fertilizer (Kg/ha)	18-20 : 40-60 : 20 : 20 N P K S	15-20 : 40-60 : 20 : 20 N P K S	15 : 20-40 : 20 N P S	15 : 30 : 20 N P S
Irrigation	One irrigation at pod development stage	Two irrigations 1st at 40 to 60 DAS & 2nd at pod formation stage	Three irrigations , First at branching,, 2nd at flowering & 3 rd at pod development	-
Weed Management	i. Two hand weedings at 30 & 60 DAS ii Application of Pendimethaline at pre-emergence stage @ 1 – 1.5 kg a. i./ha	i. Two hand weedings at 30 & 60 DAS ii Application of Pendimethaline at pre-emergence stage @ 1 – 1.5 kg a.i./ha	i.Two hand weedings at 30 & 60 DAS ii Application of Pendimethaline at pre-emergence stage @ 0.75 kg a.i./ha	-
Cropping System	Chickpea+Barley (4:2 row) Chickpea + Mustard (4-6:1 row)	Chickpea + Mustard (4 : 1)	Chickpea+Linseed, Chickpea + Safflower (4:1)	Chickpea+Safflower (2 : 1) & Chickpea+ Coriander (4 : 1)

CROP	NWPZ	NEPZ	CZ	SZ
Pigeonpea				
Sowing time	2 nd fortnight of May - 1st fortnight of June	Early – 1st fortnight of June Late - 1st fortnight of July Rabi – 1st fortnight of Sept.	Rainfed - 1st fortnight of July Irrigated – 2nd fortnight of June	Onset of Monsoon/ 2nd fortnight of June
Seed Rate & Spacing	18-20 kg/ha ; 45X15 cm	Early - 18-20 kg/ha , 45X15 cm Late - 12-15Kg/ ha , 30X10 cm Rabi- 25-30Kg/ ha , 30X10 cm	15-18 Kg; 45 x 15 cm	15-18 Kg ; 45x10cm
Fertilizer (Kg/ha)	15-20 : 40 : 20 : 25 N P S $ZnSO_4$	15-20 : 40 : 20 : 25 N P S $ZnSO_4$	15 : 40 : 20 N P S	15 : 30 : 20 N P S
Irrigation	One irrigation pod development stage if required	Early – Pre-monsoon irrigation as per requirement Rabi – After 40 to 60 DAS & 100- 110 days if required	One irrigation pod development stage if required	-
Weed Management	i. Two hand weedings at 25 & 45 DAS or ii. Application of Pendimethaline/Alachlor/ Metachlor @ 1 – 1.5 Kg/ha.	i. Two hand weeding at 25 & 45 DAS or ii. Application of Pendimethaline/Alachlor/ Metachlor @ 1 – 1.5 Kg/ha.	i. Two hand weedings at 25 & 45 DAS or ii. Application of Pendimethaline/ Alachlor/Metachlor @ 1 – 1.5 Kg/ha.	i.Two hand weedings at 25 & 45 DAS or ii Application of Pendimethaline/Alachlor/ Metachlor @ 1 – 1.5 Kg/ha.
Cropping System	Pigeonpea-wheat sequential cropping Intercropping with Urdbean Or Moongbean (1:1 row)	Early - Pigeonpea- wheat Late – Pigeonpea + Sorghum Moongbean/Urdbean/Sesame by pairing pigeonpea row at 40/80 cm & planting one row of intercrop	Pigeonpea+Groundnut (4 : 2) Pigeonpea + Soybean (4: 2) Pigeonpea + Sorghum (2:1) Pig onpea + Urdbean (1:1)	Pigeonpea+Sorghu-m(2 : 1) Pigeonpea+Groundnut (4: 2) Pigeonpea+Moong/Urdbean/ Cowpea (1:1)

Mung & Urd	**NWPZ**	**NEPZ**	**CZ**	**SZ**
Sowing time Spring/ Summer Kharif	2 nd fortnight of March - 1st week of April 1st week of July/ Onset of monsoon	2 nd fortnight of March - 1st week of April 1st week of July/ Onset of monsoon	Onset of monsoon or 2nd fortnight of June (only kharif)	Kharif – On set of monsoon Rabi – 2nd fortnight of November
Seed Rate & Spacing Spring/Summer Kharif	30-35 kg/ha , 25X5 cm 20-25Kg/ ha , 45X10 cm	30-35 kg/ha , 25X5 cm 20-25Kg/ ha , 45X10 cm	25-30 Kg , 30 X 10 cm	-
Fertilizer (Kg/ha) Spring/Summer Kharif	10 : 30 : 20 : 20 N P K S 10 : 40 : 20 : 20 N P K S	20 : 30 : 20 : 20 N P K S 10 : 40 : 20 : 20 N P K S	10 : 30-40 : 20 : 20 N P K S	15-20 : 30-40 : 20 :20 N P K S
Irrigation (Spring/ Summer)	1st at 25 DAS subsequent as per requirement	1st at 25 DAS subsequent as per requirement	As per requirement of crop in absence of rain	As per requirement of crop in absence of rain
Weed Management	i. One hand weeding at 30 DAS or ii Pre-emergence application of Pendimethaline at @ 1Kg/ha.	i. One hand weeding at 30 DAS or ii. Pre-emergence application of Pendimethaline at @ 1Kg/ha.	i. One hand weeding at 30 DAS or ii Pre-emergence application of Pendimethaline at @ 0.75-1 Kg/ha.	1) One hand weeding at 30 DAS or 2) Application of Pendimethaline at (Pre-emergence) @ 1 Kg/ha.
Cropping System	Intercropping of Moong bean /Urdbean with summer planted – sugarcane (2:1) and Sunflower (6:2 row ratio)	Intercropping of Moong bean /Urdbean with summer planted – sugarcane (2:1) and Sunflower (6:2 row ratio)	Intercropping of Moong bean /Urdbean with summer planted Sunflower (6:2 row ratio)	Rice – Rice-Greengram/ Blackgram

Lentil	NWPZ	NEPZ	CZ	SZ
Sowing time	2 nd fortnight of October to mid - November	2 nd fortnight of Oct. to mid - November	1st week of October	Not grown
Seed Rate & Spacing	40-45 kg/ha; 25x5 cm 50-60 kg (bold seeded)	40-45 kg/ha , 25x5 cm	45-50 Kg, 25 x 5 cm (normal sowing) 50-60 kg for utera sowing & bold seeded varieties.	-
Fertilizer (Kg/ha)	20 : 30-40 : 20 : 20 N P K S	20 : 30-40 : 20 : 20 N P K S	15-20: 30-40: 20 : 20 N P K S	-
Weed Management	i. Two hand weedings at 30 & 60 DAS or ii Pre-emergence application of Pendimethaline @ 0.75-1.0 Kg/ha.	i. Two hand weedings at 30 & 60 DAS or ii. Pre-emergence application of Pendimethaline @ 0.75-1.0 Kg/ha.	i. Two hand weedings at 25 & 50 DAS or ii. Pre-emergence application of Pendimethaline @ 0.75-1.0 Kg/ha.	-
Cropping system	Inter cropping with barely, rap & mustard (2:2) Inter cropping with autumn sugarcane (2:1).	Rice- lentil sequential cropping in Northern Bihar	Rice-lentil utera cropping in Chhattisgarh.	-
Fieldpea				
Sowing time	Third week of Oct. – Ist week of Nov.	Third week of Oct. – Ist week of Nov.	Third week of Oct. – Ist week of Nov.	
Seed rate & spacing	Tall 60-70 kg, 30x45cm Dwarf 80-100kg	Tall 60-70 kg, 30x45cm Dwarf 80-100kg	Tall 60-70 kg, 30x45cm Dwarf 80-100kg	
Fert. dose kg/ha)	20-40 : 60:20:20	20-40 : 60:20:20	20-40 : 60:20:20	
Weed management	One hand weeding at 30 DAS + 1 kg a.i. Pendimethalin as pre-emergence	One hand weeding at 30 DAS + 1 kg a.i. Pendimethalin as pre-emergence	One hand weeding at 30 DAS + 1 kg a.i. Pendimethalin as pre-emergence	
Cropping system	Sequential cropping after rice, maize or pearlmillet	Rice-Pea	Sorghum/soybean/pearlmillet - pea	

Input Use Table : Ready Reckoner **Annexure- XV**

Sl.No.	Inputs	Amount
i.	Rhizobium & PSB	One packet each (Urd, Moong, Cowpea, Moth and Pigeonpea) Two packet each (Lentil, Lathyrus & Horsegram) 3-4 packet each (Gram-Pea) 3-4 packet of PSB (Rajmash)
ii.	Fungicide for seed treatment. (Carbendazim or vitabex 50% WP) or Microbial (Trichoderma viridae)	12-16 g (Urd, Moong, Cowpea, Moth) 60-80 g (Gram, Pea, Lathyrus) 40-45 g (Lentil, Horsegram) 25-35 g (Urd, Moong, Cowpea, Moth & Pigeonpea) 70-100 g Lentil, Lathyrus, Horsegram 100-150 g Gram, Pea & Rajmash
iii.	Fertilizer (DAP) Gypsum	40 kg for Urd, Moong, Cowpea, Moth, Lentil 40-60 kg Pea, Gram, Pigeonpea (High amount for late sown crop) 50 kg (1 bag) DAP+50 kg Urea - Rajmash 40-50 kg
iv.	Herbicides (Pendimethalin 30 EC PE) Lasso/Alachlor 50 ECPE	 1.3 to 2 kg commercial product depending on soil type and weed intensity 750 g commercial product depending on soil type and weed intensity
v.	Insecticidal spray Endosulphone 35% EC M/L	 200-250 ml in 200 to 250 liters of water per spray for all pulse most critical spray at flowering.

Specific standards prescribed for certification at field stage for pulses **Annexure- XVI**

Sl No	Crop	Minimum number of inspection	Isolation distance in meter		Off type plants/ ear heads		Inseparable other crop plant		Objectionable weed plant		Plant affected by seed borne diseases		Remarks
			FS	CS	FS	CS	FS	CS	FS	CS	FS	CS	
1	Black gram Bengal gram Horse gram	2	10	5	0.1	0.2	-	-	-	-	-	-	-
2.	Green gram	2	10	5	0.1	0.2							Halo blight
3.	Cowpea fresh bean	2	10	5	0.1	0.2	-	-	-	-	0.1	0.2	Disease for cowpea Ashystem blight and Anthracnose Aschchyta blight & Cowpea mosaic for french bean bacterial blight Anthracnose, Aschochyta blight & bean mosaic
4.	Moth bean	2	10	5	0.1	0.2	-	-	-	-	-	-	-
5.	Lentil	2	10	5	0.1	0.2	-	-	-	-	-	-	-
6.	Peas	3	10	5	0.1	0.2	-	-	-	-	-	-	-
7. .	Pigeon pea	2	200	100	0.1	0.2	-	-	-	-	-	-	-
8	Rice bean	2	50	20	0.1	0.2	-	-	-	-	-	-	-

Annexure- XVII

Seed Standard for Foundation and Certified seed classes and minimum limits of germination and purity for labeling

Crop	Pure seed(Min) (%)		Inert matter(max) (%)		Other crop seed(max)		Total weed seed(max)		Objection-able weed seed (max)		Germination (min) (%)		Moisture ordinary container (%)		Maximum vapour proof container (%)		Other distinguishable varieties (ODV)	
	F	**C**	**F**	**C**	**F**	**C**	**F**	**C**	**F**	**C**	**F**	**C**	**F**	**C**	**F**	**C**	**F**	**C**
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Blackgram/ green gram	98.0	98.0	2.0	2.0	5/ Kg	10/Kg	5/ Kg	10/ kg	-	-	75	75	9.0	9.0	08	08	10/ kg	20/ kg
Cowpea	98.0	98.0	2.0	2.0	none	10/Kg	none	10/ kg	-	-	75	75	9.0	9.0	08	08	5/ kg	10/ kg
French bean	98.0	98.0	2.0	2.0	none	none	none	10/ kg	-	-	75	75	9.0	9.0	07	07	5/ kg	10/ kg
Gram	98.0	98.0	2.0	2.0	none	5 /Kg	none	none	-	-	85	85	9.0	9.0	08	08	5/kg	10/ kg
Horsegram	98.0	98.0	2.0	2.0	none	10/Kg	none	none	-	-	80	80	9.0	9.0	07	07	5/kg	10/ kg
Lentil/Khesari	98.0	98.0	2.0	2.0	5/ kg	10/Kg	10/kg	20/ kg	-	-	75	75	9.0	9.0	08	08	10/ kg	-
Redgram	98.0	98.0	2.0	2.0	5/ kg	10/Kg	5/kg	10/ kg	-	-	75	75	9.0	9.0	08	08	10/ kg	20/ kg

F-Foundation Seed, C-Certified seed.

List of organization involved in pulses Research – International/ National **Annexure- XVIII**

International	
ICRISAT, Hyderabad (India) – Pigeon pea, Chick pea and cropping system research.	ICARDA (International Centre for Agriculture Research in Dry land Areas) – Ibadan Nigeria – Lentil and cropping system research for African continent.
AVRC (Asian Vegetable Research Centre) – Taiwan/Vietnam – Urd bean and Moong bean	International Centre for Tropical Agriculture – Colombia Cow pea and cropping system research for Latin America.

National (ICAR)	
Indian Institute of Pulses Research Kalyanpur, Kanpur 208024 (U.P.)	Central Arid Zone Research Institute
Central Institute of Post Harvest Engineering & Technology, Ludhiana (Punjab)	Indian Agriculture Research Institute Pusa , New Delhi, 110012
National Bureau of Plant Genetic Resources, Pusa New Delhi, 110012	Directorate of Seed Research, Mau (U.P.)

National (State Agriculture universities)	
Acharya N.G. Ranga Agriculture University (ANGRAU), Rajendra nagar, **Hyderabad-500 030 (A.P.)**	Bidhan Chanra Krishi Vishwavidyalaya (BCKV) Haringhatta P.O., Mohanpur **Nadia-741 246 (W.B.)**
Gujarat Agriculture & Technology (GAU), Dantiwada **Sardar Krishi Nagar – 385 506** (Gujarat)	G.B. Pant University of Agriculture & Technology (GBPUA&T) **Pantnagar-263 145 Nainital** (Uttar Pradesh)
Choudhary Charan Singh Agricultural University (HAU), **Hissar- 124 001 (Haryana)**	Rajasthan Agricultural University (RAU) **Bikaner – 334 001(Rajasthan)**
Rajendra Agricultural University(RAU) **Pusa Samastipur- 848125 (Bihar)**	Tamil Nadu Agricultural University (TNAU) **Coimbatore-641 003 (T.N)**
University of Agricultural Sciences (UAS) P.B. 2477, Hebal, **Bangalore-560 024 (karnataka)**	University of Agricultural Sciences (UAS), Krishi Nagar, **Dharwad-580 005 (Karnataka)**
Tamil Nadu Veterinary & Agricultural Sciences University (TNV & ASU) **Chennai-600 007 (Tamil Nadu)**	Indira Gandhi Krishi Vishwavidhyalaya, Krishi Nagar **Raipur -492 006 (Chhattisgarh)**
Kokan krishi Vidyapeeth (KKV) **Dapoli-415 712 (Maharashtra)**	Jawaharlal Nehru Krishi Vishwavidhyalaya (JNKVV) **Jabalpur- 482 004 (M.P.)**

National (State Agriculture universities)	
Marathwada Agricultural University (MAU) **Parbhani- 431 402 (Maharashtra)**	(MPKV), **Rahuri 413712 (Maharashtra)**
	Ludhiana- 141 004 (Punjab)
Narendra Dev University of Agriculture &Technology (NDUA&T)	
Varanasi- 221 005 (U.P.)	
Sardar Vallabh Bhai Patel University of Agriculture & Technology	
Himachal Pradesh Krishi Vishwavidyalaya	**Jammu**

List of Bio-fertilizer making centers Annexure- XIX

State	Mailing address of the Biofertilizer Production Units
Andhra Pradesh	**Sri Aurbindo Institute of Rural Development (SAIRD)** SAIRD, Gaddipalli, Garidepalli Mandal, NALGONDA-508 201 (AP)
	Acharya N.G. Ranga Agriculture University, Agriculture Research Station Scientist (Soil Science) & Head, Agriculture Research Station, AMARAVATHI-522 020 (AP), Distt. Guntur e-mail: ramanareddy_9@yahoo.com
Bihar	**Hindustan Fertilizer Corporation Limited** AHPO Urbaraknagar, Distt. BEGUSARAI-851 115 (Bihar)
Gujarat	**National Agricultural Research Project Biofertilizer Project Gujarat Agriculture University,** Anand Campus, ANAND-388 110 (GUJ.)
	Gujarat State Co-operative Marketing Federation Ltd. Sahakar Bhavan, Relief Road, AHMEDABAD-380 001 (GUJ)
Haryana	**Prof. And Head of Microbiology**, Haryana Agricultural University, Hissar.
	Regional Biofertiliser Development Centre Assistant Microbilogist, 149-P, Sector 15-A, **HISSAR-125 001 (HAR).**
	Ganpati Bio Organic Limited Jind Road, SAFIDON Distt. Jind (Har)
Karnataka	**Regional Biofertiliser Development Centre** Regional Director 34-II main Road (Near Baptist Hospital), Hebbal **BANGALORE-560 024** (KA).
	Karnataka Agro Industries Corporation Limited Joint General Manager (A.I.D.), Hebbal Bellary Road, **BANGALORE-560 024** (KA)
	University of Agricultural Sciences Head, Biofertiliser Scheme, Department of Agricultural Microbiology, UAS, GKVK, **BANGALORE-560 065** (KA)
	University of Agricultural Sciences Professor & Head, Department of Agricultural Microbiology, College of Agriculture, **DHARWAD-580 005**
Madhya Pradesh	**Regional Biofertiliser Development Centre** Assistant Microbiologist, Hira Bhawan, Building No.21, New Chungi Nagar, Adhartal, **JABALPUR-482 004 (MP)**
	Hindustan Fertilizer Corporation Ltd. Neem Road, " Makka Building", Jinsi, **BHOPAL-462 008** (MP)
	M.P. State Agro Industries Development Corporation, Biofertiliser Plant, Agro Complex, Indrapuri C, Raisen Road, **BHOPAL (MP)**
	Nafed Biofertilizer, 51-A, Sector F, Sanwer Road, **INDORE- (MP)** e-mail:mailto:nafbio@mpindor.mp.nic.in/ nafbio@mpindor.mp.nic.in
	National Fertilizers Limited N.F.L. Plot No. 22, Secotr-B, Sanwer Road, Near Metalman Factory, **INDORE-452 015 (MP)**

State	Mailing address of the Biofertilizer Production Units
Maharashtra	**Regional Biofertiliser Development Centre** New Secretariate Building, East Wing, **NAGPUR-440 001 (MS)**
	Mahatma Phule Krishi Vidyapeeth Agricultural Microbiology Section, College of Agriculture, **PUNE-411 005 (MS)**
Orissa	**Regional Biofertiliser Development Centre** A-156, Shahid Nagar, **BHUBNESHWAR-751 007 (Orrisa)**
	Orrisa Agro Industries Corporation Ltd. 95,Satyanagar, **BHUBNESHWAR (Orrisa)**
	Deputy Director of Agriculture (PP) **BHUBNESHWAR (Orrisa)**
Punjab	**Microbiological Laboratory,** Punjab Agricultural University, **Ludhiana**, Punjab.
	Biofertiliser Production Unit Office of the Chief Agriculture Officer, **LUDHIANA (PB)**
Rajasthan	**Nafed Biofertilizer** SPL-80 RIICO Industrial Area, **BHARATPUR-321 001 (RAJ)**
	Rhizobia Scheme Agriculture Department Agriculture Research Station, Durgapura, **JAIPUR-302 018** e-mail-mailto:ggopalc@rediffmail.com/ ggopalc@rediffmail.com
Tamil Nadu	**Regional Research Station** **Tamil Nadu Agricultural University,** PIYUR-635 112, Via-Kaveripattinam, Dharmapuri District
	Tamil Nadu Agricultural University Prof. & Head, Deptt. of Agricultural Microbiology, **COIMBATORE-3 (TN),** e-mail : vctnau@vsnl.com
	Biofertilizer Production Unit, Department of Agriculture, Govt. of Tamil Nadu, Jamal Mohd. College Post, Khajamalai, **TRICHY-620 020 (TN)**
	Department of Agricultural Microbiology, Agriculture College and Research Institute, Tamil Nadu Agricultural University MADURAI-625 104
Uttar Pradesh	**National Biofertiliser Development Centre** Director, 204-B Wing, CGO Complex-II, Kamla Nehru Nagar, **GHAZIABAD-201 002 (UP)**
	Myodelphia Chemicals Company (Pvt.) Ltd. Regd. Off. R-Block-65-C, Dilshad Garden, DELHI-110 095, Works: 195, Prakash Industrial Estate, G.T. Road, Sahibadad, **GHAZIABAD (UP)** e-mail: myodelphia@usa.net
	Motilal Nehru Farmers Training Institute IFFCO Biofertiliser Unit, Motilal Nehru Farmers Training Institute, CORDET, Ghiyanagar, Phulpur, **ALLAHABAD-212 404 (UP)** e-mail: akshrmacordet@iffco.nic.in/ phulpur@iffco.nic.in
West Bengal	Process Development and Analytical Control Research Laboratory, **92/3, Acharya P.C. Road, KOLKATTA-700 009**
	Hindustan Fertilizer Cooperation Ltd. 52 A, Shakespeare Sarani, **KOLKATTA-700 017 (WB)**

Annexure- XX

List of Stake holders - State Agriculture Department/State Seed Corporation/ State Seed Certification Agencies/ GOI– Organization/ Undertakings

State Department of Agriculture	
Commissionerate of Agriculture, Government of Andhra Pradesh, **HYDERABAD-500001 (A.P.)**	Commissionerate of Agriculture, Government of Maharashtra, Central Buildings, **PUNE-411001 (MAHARASHTRA)**
Directorate of Agriculture Government of Bihar, New Secretariat, **PATNA-800015 (BIHAR)**	Directorate of Agriculture and Food Production, Government of Orissa, Head of Deptt. Buildings, **BHUBANESHWAR-751001(ORISSA)**
Directorate of Agriculture, Government of Chhattisgarh, **RAIPUR (Chhattisgarh,)**	Directorate of Agriculture, Government of Punjab, SCO No.85-88, Sector 34-A, **CHANDIGARH-160017(PUNJAB)**
Directorate of Agriculture, Government of Gujarat, Krishi Bhawan, Sector-10-A, **GANDHINAGAR-382010 (GUJARAT)**	Directorate of Agriculture, Government of Rajasthan, Pant Krishi Bhawan, **JAIPUR-302004 (RAJASTHAN)**
Directorate of Agriculture, Government of Haryana, **PANCHKULA-134112 (HARYANA)**	Directorate of Agriculture Government of Tamil Nadu, Chepauk, **CHENNAI-600005(TAMILNADU)**
Directorate of Agriculture Government of Karnataka, Seshadri Road, **BANGLORE-560001(KARNATAKA)**	Directorate of Agriculture, Government of Uttar Pradesh, Madan Mohan Malviya Marg, Krishi Bhawan, **LUCKNOW-226001 (U.P.)**
Farmers Welfare & Agriculture Development Government of Madhya Pradesh, Vindhyachal Bhawan, **BHOPAL-462004 (M.P.)**	Directorate of Agriculture, Government of West Bengal, Writer's Buildings, **KOLKATA-700001 (W.B.)**

State Seeds Certification Agencies	**State Seeds Corporation**
Gujarat state seed certification agency Beej pramanan Bhavan, Near Shyamal raw house, Opposite Gurukul raw house , **Ahmedabad-380015**	Maharashtra State Seeds Corporation Ltd., Mahabeej Bhavan, Amravati Road, **Akola– 444104 (MS)**
Maharashtra State Seed certification Agency, Shashtri Nagar, **Akola-444004**	Assam Seeds Corporation Ltd., Khanapara, **Guwahati – 22 (Assam)**
Karnataka State Seed Certification Agency, KAIC Premises, Opposite Baptist Hospital, Hebbel, **Bangalore-560024**	Bihar Rajya Beej Nigam Ltd., Indira Bhavan, 2nd Floor, Ram,charitra Singh Path, **Patna – 800001(Bihar)**
MP State Seed Certification Agency, Office Complex, Gautam Nagar, **Bhopal**	The Haryana Seeds Development Corporation Ltd., Bay No. 3-6, Sector-2, **Panchkula – 134112 (Haryana)**
Orissa State Seed Certification Agency, Govt. of Orissa , **Bhubaneshwar-751003**	Karnataka State Seeds Corporation Ltd., Beej Bhavan, Bellary Road Hebbal, **Bangalore -560024 (Karnataka)**
Punjab state seed certification agency, SCO No 837-38, Sector-22A, **Chandigarh**	Rajasthan State Seeds Corporation Ltd., Pant Krishi Bhavan, Bhagwan Dass Road, **Jaipur – 302005 (Rajasthan)**
Uttaranchal state seed certification agency, **Dehradun**	Orissa State Seeds Corporation Ltd., Santrapur, **Bhubaneshwar – 751002 (Orissa)**
Asssam state seed certification agency, Ram Krishna Misssion Road, Ulubari, **Guwahati-781006**	West Bengal Seeds Corporation Ltd., 4, Gangadhar Babu lane, 5th Floor, **Kolkata – 700012 (WB)**
AP state seed certification agency, HACA Bhavan, Opposite Public Garden, **Hyderabad-500004**	Punjab State Seeds Corporation Ltd., SCO Nos. 835 – 836, Sector – 22 A **Chhandigarh.**
Rajastan state seed certification agency, G.B. Pant Krishi Bhavan, Bhagwan Das Road, **Jaipur**	Gujarat State Seeds Corporation Ltd., Beej Bhavan, Sector – 10–A, **Gandhinagar – 382043**
West Bengalstate seed certification agency, Govt of West Bengal, Writers Building, **Kolkata-700001**	Andhra Pradesh State Seed Development Corporation Ltd., 510 – 193, IInd Floor, HACA Bhavan, **Hyderabad – 500004**
UP state seed certification agency, Horticulture Complex, Cariappa marg, Alam Bagh, **Lucknow**	U.P. Seeds & Tarai Development Corporation Ltd., Pantnagar, P.O. Haldi, **Distt. – Nainital (Uttaranchal)**
Haryana state seed certification agency, Bay No,11-12, Sector-14, **Panchkula, Haryana**	The National Agriculture Cooperative Marketing Federation Ltd., “NAFED HOUSE” Sidharth Enclave Ashram Chowk, Ring Road, **New Delhi - 110014**
Bihar state seed certification agency,	M.P. Rajya Beej Evam Farm Vikas Nigam

Mithapur Farm, Mithapur, **Patna**	Ltd., Beej Bhawan, Mother Taresh Road, Arera Hills, **Bhopal-462016**
Chhattisgarh state seed certification agency, Labhandi Farm, Krishak Nagar, **Raipur-12**	
HP state seed certification agency, Nalagarh House, **Shimla-171005**	
Divisional seed certification Officer, Talab Tillo**, Jammu**	

National Seed Corporation Beej Bhavan, Pusa, New Delhi 110012	State Farm Corporation of India 14-15, Nehru Place, New Delhi-110049
Krishak Bharati Co-operative Ltd., (KRIBHCO), Red rose House, 49-50, Nehru Place, New Delhi - 19	Indian Farmers Fertilizer Co-operative Ltd. (IFFCO), IFFCO Sadan, C-1, District Centre, Saket Place, New Delhi -17