Publication No.: DPD/Pub.1/Vol. 2/2016

PULSES IN INDIA: RETROSPECT AND PROSPECTS

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DIRECTORATE OF PULSES DEVELOPMENT
VINDHYACHAL BHAVAN
BHOPAL (M.P.)
462004

Published by Director, Govt. of India, Ministry of Agri. & Farmers Welfare (DAC&FW),
Directorate of Pulses Development, Vindhyachal Bhavan, Bhopal, M.P.- 462004,
(Website: http://dpd.dacnet.nic.in, email: dpd.mp@nic.in, Printed Year-Nov., 2016)

PREFACE

Food security and affordability top the Government's agenda as production stagnates and prices continue to be firm. The greatest challenge to the agriculture in the years to come is to provide adequate food to burgeoning population in order to combat with hunger and malnutrition. We will have to feed more people with scarce water resources, recurring droughts, degrading lands and difficult access to energy. The agricultural technologies need a shift from production oriented to profit oriented sustainable farming system.

A shift in crop preferences by the farmers has been seen since the 1990s. Indo-Gangetic belt farmers who grew pulses earlier, have increasingly taken to wheat production where yields range from 3,000 to 4,000 kg per hectare compared to only about 800 kg in case of pulses. Over the past two decades the production of pulses has largely shifted from northern India to central and southern part. Today, 80% of total pulses production is realized in six states namely, Madhya Pradesh, Maharashtra, Rajasthan, Andhra Pradesh, Karnataka and Uttar Pradesh. Both area and productivity of chickpea significantly increased over decades.

The Recommended Dietary Allowances (RDA) for adult male and female is 60 g and 55 g per day. The per capita availability of pulses is @ 42 g per day. Pulses are chief source of vegetable protein in the human diet. The deficiency of protein in human diet often leads to Protein-Energy-Malnutrition (PEM) causing various forms of anemia. Besides, nutritive value of pulses in human diet, food legumes tend to fix atmospheric nitrogen to N- compounds to the tune of 72 to 350 kg per hectare per year and provide soil cover that helps to sustain soil health.

India is the largest producer, 25% of world's production, and consumer 27% of total pulses of the world. The domestic production is often less than the estimated demand i.e. 23-24 million tons. Studies on consumption pattern has revealed that in India only 8-10 million tons of pulses are used directly as a food item (Dal), the remaining 12 million tons being indirect actual consumption as processed/value added products such as snacks, fast food for domestic consumption and export. Thus the average gap of 05 MT is met through imports. In India, the share of pulses to gross cropped area and in total foodgrains basket is about 12 per cent and 6-7 per cent respectively.

India's outstanding contribution towards total global acreage and production of pulses at 35 per cent and 25 per cent respectively is credited to our strength. The three five year plans viz., Xth, XIth & XIIth (T.E.2014-15) exhibited an increasing yield trends, the highest being 788 kg/ha during 2012-13 as against the world's average productivity of 904 kg/ha, is less than the demonstrated potential under the frontline demonstrations. The targeted production and productivity is possible by way of harnessing this yield gap by growing pulses in new niches, precision farming, quality inputs, soil test based INM and mechanized method of pulse cultivation complimented with generous *Governmental Policies* and appropriate funding support to implementing states/stake holders.

In India, pulses have always received due attentions both in terms of requirement by consumers and adequate programmatic support from the government at the production front. Besides the game changing efforts under the *'Prime Minister's Krishi Sinchai Yojna'* pulse production has received adequate importance. The IT initiatives in extension/apps to access market, Soil Health Cards, INM, crop advisories and E-NAM, involvement of KVKs in seed hub, additional breeder seed production, strengthening Bio-fertilizer/Bio-control production units and FPOs etc., are other specific efforts. Creation of buffer stock, imposition of stock limits and offering pulses at low cost through mobile vans including encouraging Foreign Direct Investment (FDI) in food processing etc., are the other policy interventions.

Since Seventh Plan onwards, the NPDP (1985-90 to 2003-04) and ISOPOM (2004-05 to 2010-11) were the major CSS on Pulse Development in addition to NFSM-Pulses since Eleventh Plan. NSFM was lunched to increase the additional production of rice, wheat and pulses by 10, 08 and 02 million tons, respectively at the terminal year of XIth plan. 12th Five Year Plan aims at additional production targets of 25 million tons of food grains comprising rice, wheat, pulses and coarse cereals at 10, 08, 04 and 03 million tons respectively.

Efforts through compilation, have been made to have an access to most of the FAQs on pulses development, plan effort's impacts, scenario, strategies, post harvest and processing aspects along-with the production technology. The Status Paper 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 future prospects* of this commodity in the country delineating the districts, as well. More emphasis has also been given on the proposed strategies beyond XIIth plan in the face of the National Nutritional Security. The strategies recommended would certainly cope with the limited and dwindling resources at hand. Various aspects of need-based pulse production and developmental programs associated, in line with the National Agricultural Policy, have been incorporated with their varying degrees of impacts during different areas.

I hope, the Status Paper ***"Pulses in India : Retrospect and Prospects"*** brought out by DPD, Bhopal would not only benefit the intelligentsia, the farmers, the developmental organizations, processors/traders and all the readers, 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 am personally grateful to Shri. S. K. Pattanayak, Secretary, Govt. of India, Ministry of Agriculture & Farmers Welfare, (DAC&FW), Dr. S. K. Malhotra, Agriculture Commissioner, Dr. B. Rajender, Joint Secretary (Crops), Shri. M.N. Sukumaran, Director (Crops) and Dr. U. S. Sadana, National Consultant-NFSM for their sustained support, guidance and encouragement in bringing out the volume.

I am thankful to my colleague and Team Dr. A. K. Shivhare and Shri. Vipin Kumar, Assistant Directors, Shri. Sarju Pallewar, SI, Dr. Sandip Silawat and Ms. Divya Sahare, STAs, Smt. Ashwini Bhoware and Shri. Sateesh Dwivedi, TAs PMT of DPD, Bhopal for their contribution in this endeavor.

Dr. Shivhare and Smt. Ashwini, deserve special mention for their sincere association, hard work for a pretty long period to accomplish the task.

Nov.23rd, 2016

(A.K. Tiwari)
Director

ABOUT THE DIRECTORATES

1.0 The Directorate of Pulses Development (DPD), one of the eight Commodity Development Directorates (CDDs) (Jute, Cotton, Wheat, Millets, Rice, Sugarcane and Oilseeds) of the Ministry of Agriculture & Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare (DAC&FW) was established at Lucknow (U.P.) in 1971 with the merger of Regional Extension Unit Ahmadabad (Gujarat). On the recommendations of "CDDs Re-organization Committee", the National Head Quarter of this commodity was subsequently shifted to Bhopal (M.P.) in 1996. The Directorate of Pulses Development is mandated to co-ordinate and monitor the implementation of all CSSs/CS schemes on pulses development from 2007-08, the National Food Security Mission (NFSM) – Pulses is operational in 29 States, 638 districts in the Country. With the bi-focal responsibilities for the assigned states MP & CG at present, this CDD functions as Regional office of DAC&FW for coordination and monitoring of all the crop related CS/CSS and Missions like NFSM (Wheat, Pulses, Rice, Sugarcane, Cotton, Jute and Coarse Cereals), NMSA, NMAET, NMOOP, MIDH, RKVY& BGREI etc.

1.1 With the unabated population increase, Pulses production also have to be paralleled for the vegetarian Indian Society, as these are the prime source of balanced diet and protein particularly for the rural mass. Keeping in view this necessity, a Centrally Sponsored Pulses Development Scheme was initiated as a plan intervention from the IVth Plan (1969-70 to 1973-74). Further, from VIIth Plan onward the National Pulses Development Project (NPDP) was implemented in 17 major states of the country. To supplement the efforts under NPDP, a Special Food Grain Production Program (SFPP) on Pulses was also operationalized during 1988-89 on a 100% Central assistance basis.

Under the GOI-UNDP Cooperation (1997-2003), Pulses Sector was identified as Priority Sector to be strengthened.

1.2 Keeping in view the spectacular achievement through TMO in Oilseeds Sector, Pulses were brought within the ambit of TMOP in 1990. From 2004-05, pulses development were Integrated Scheme of Oilseeds, Pulses, Oilpalm and Maize (ISOPOM). The new technologies, timely supply of inputs, extension supports, remunerative price, marketing infrastructure and post-harvest technologies were the focused area to increasing pulses production with the Mission Mode approach.

The CDD has been actively monitoring the programme implementation though out the county, through National Monitoring Team/ field visits allocation of Seed Minikit and its implementation and regularly interface with the Research and other stake holder organizations/ agencies in the country.

1.3 Beginning of XIth Plan (2007-08 (Rabi)), in pursuance of the resolution adopted in 53rd meeting of National Development Council (NDC), a Centrally Sponsored Scheme on National Food Security Mission was launched. It was resolved to enhance the production of rice, wheat and pulses by 10, 8 and 2 million tonnes, respectively by the end of XI Plan. To further supplement the efforts to accelerate the pulses production, during XI Plan a centrally sponsored Accelerated Pulses Production Programme (A3P) (2010-11 to 2013-14)-as cluster demonstration approach; Special initiatives for pulses and oilseeds in dry land area (2010-11); and Integrated development of 60000 Pulses villages in Rainfed Areas (2011-12) both under RKVY and Special plan to achieve 19+ million tonnes of Pulses production during Kharif (2012-13) were also implemented, in addition to NFSM-Pulses. The implementation of the NFSM scheme is continued during XIIth Plan.

1.4 The DPD drafted the policy paper/ guidelines during 2007-08, Seed Rolling Plan for the Ministry in consultation with the ICAR. The draft paper proposed increasing production of pulses through area expansion and productivity enhancement; restoring soil fertility and productivity; creating employment opportunities; and enhancing farm level economy to restore confidence of farmers of targeted districts. The basic strategies were implementation of interventions in a mission mode through active engagement of all the stake holders at various levels. These interventions include promotion and extension of improved technologies i.e., Seed, INM (micro-nutrient, soil amendments), IPM and resource conservation technologies (RCTs) and capacity building of farmers. Interventions proposed were integrated with the district plan and target for each identified district was fixed. Constant monitoring and concurrent evaluation were done for assessing the impact of the interventions for a result oriented approach by the implementing agencies.

1.5 During the XIIth five year Plan (2012-13 to 2016-17), NFSM-Pulses is operational in 29 states namely Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Goa, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerela, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Telangana, Tripura, Uttar Pradesh, Uttrakhand and West Bengal with additional production target of 4 Million tonnes by the end of XII Plan.

1.6 During 2015-16, the DPD, Bhopal organized Two National Seminar/Workshops "Pulses Development: Challenges & Opportunities in Central & Southern States" at CIAE, Bhopal (Feb 3rd-4th,2016) and Brainstorming Session on Promotion of "Pulses in Non-traditional Niches: Summer Cultivation" at IIPR, Kanpur (Feb 9th-10th, 2016); two Trainings on skill development organized at KVK, CRDE, Sehore (Oct. 7th-8th 2015) & KVK, Raisen (Oct.28th-29th, 2015) . In addition, conducted the NLMTs on BGREI, and NFSM, NMOOP in CG and MP states.

Other Objectives include:- Analysis of Area Production and Productivity trends/impact of Developmental Programmes on Pulses; research areas and Identification of Bottlenecks and suggest measures for their rectification and also feedback to ICAR-IIPR through institutionalized mechanism of National Conference/Group Meets on Chickpea, Pigeonpea, MULLaRP, Arid Legumes and DAC-ICAR Interface; Interface with National and International Research Organizations and Stake holders on area of crop Research; To assist Department of Agriculture and Cooperation in fixing targets of production and suggest measures to achieve them; to co-ordinate in programmatic review of all Centrally Sponsored/ Central Sector Schemes in agriculture (RKVY, NFSM, NMOOP etc.) special package (eg. Bundelkhand Package) and to organize and coordinate Seminar/Workshop/Conference /Review Meetings at state and national level.

1.7 Preparation of Weekly Weather Watch Report (WWWR), monitoring of weather/rainfall pattern/temp/coverage/market arrivals and prices of pulses at national level and for all agricultural crops in the nodal states for review of the **Crop Tracking Committee** meeting of the Ministry; crop tracking during growing season and production estimate forecast, formulation of Annual and Five year National plan, coordination in execution and monitoring of crop production programmes of pulses at national level, assisting states/UTs in initiation, planning, formulation and intensification of crop development programmes in consonance with the ongoing states programme/Contingency Planning/Crop diversification aspects & convergence and monitoring.

1.8 To assess the crop loss/damage to agricultural sector during Natural Calamities as Member Inter-Ministerial Central Team (IMCT) representing the Govt. of India, Department of Agriculture Cooperation & F W;. to act as nodal agency for Technology Transfer/Technology Dissemination/Extension for Pulses Development across the country and to work out Human Resource Development needs at all clientele level and to attend and reply of the Parliament Questions.

1.9 To monitor the NFSM funded project on Creation of Seed-Hub for Increasing Indigenous Pulse Production in India"; "Enhancing Breeder Seed Production for increasing Indigenous Pulse Production in India"; Cluster FLDs on Pulses/ Oilseed undertaken by KVKs of MP and Chhattisgarh states under ATARI Zone-VII; to formulate and monitor the Seed Minikit Programme on Pulses at national level, "Establishment/ Strengthening of Bio-fertilizer and Bio-control Production Units for Increasing Pulse Production In India", "National Demonstration Project and Value Chain Development of Pulses and Millets in India", CSS on MM-I on oilseeds and MM III on Tree Borne Oilseeds (TBOs) in Madhya Pradesh and Chhattisgarh states, Mini Mission-II on Oilpalm in Chhattisgarh state under National Mission on Oilseeds and Oilpalm (NMOOP), Dry Land development activities, extension reforms (ATMA), mechanization etc. under NMSA, NMAE&T and RKVY interventions in the state of Madhya Pradesh and Chhattisgarh.

1.10 To prepare the Quarterly Progress Report and Annual Progress Report NFSM-Pulses, BGREI (Chhattisgarh); NMOOP & RKVY schemes of assigned states.

1.11 To act as Convener/Team Leader, National Level Monitoring Team (NLMT) for Madhya Pradesh and Chhattisgarh under NFSM (Rice, Pulses, Wheat, Commercial Crops, Coarse Cereals) and Bringing Green Revolution in Eastern India (BGREI);To liaise with the other Central Ministries ICAR institutes, SAUs, International Research Organizations, NGOs and other stake holders in the field of Agri. and allied sectors for better Research-Development interface. Also represent Department of Agriculture and Cooperation on their Committee/ events with a view to have direct interface for onward benefits to formulate farmer friendly schemes at national level with a unified approach for the overall development of agriculture sector as a whole; Build data base and maintain the flow of information and ideas between research and development.

1.12 To provide crop specific advisories, technical inputs to extension agencies and to Extension Division of the Ministry of Agriculture for skill development, national policies and for the Plan year; To participate in the State Level Crop Training Programmes; Developing leaflets/ Literatures on training manuals;

1.13 To represent the Varietal Identification Committee (VIC) on pulses and evaluate the performance of the newly evolved/ released pulses varieties;

EXPLANATION TO ABBREVATIONS

ADO	Agriculture Development Officer
AES	Agro-ecological situations
AFC	Agriculture Finance Commission
AICRP	All India Coordinated Research Project
a.i.	Active ingredient
‘A’ lines	Male sterile lines
ALP	Aluminium Phosphate
AMDP	Accelerated Maize Development Programme
A,P,Y	Area, Production, Yield
A.P	Andhra Pradesh
ATARI	Agriculture Technology Application Research Institute
ATMA	Agriculture Technology Management Agency
B	Boron
‘B’ lines	Maintainer lines
BCMV	Bean Curl Mosaic Virus
BSP	Breeder Seed Production
BNF	Biological nitrogen fixation
BT	Bacillus thuringiensis
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 (RJ)
CZ	Central Zone
CPWD	Central Public Work Department
CIAE	Central Institute of Agriculture Engineering, Bhopal (M.P.)
CCL	Cash Credit Limit
CFTRI	Central Food Technology Research Institute, Mysore (Karnataka)
CWC	Central Warehousing Corporation
DAC	Department of Agriculture, Cooperation & Farmers Welfare
DAP	Di-ammonium Phosphate
DAS	Days after sowing
DFSMEC	District Food Security Mission Executive Committee
DGCI&S	Director General of Commerce Intelligence and Statistics
EC	Emulsifying Concentrate
ETL	Economic Threshold Level
EC	Empowered Committee
FAQ	Fair Average Quality
FFS	Farmer’s Field School
FOs	Farmers Organizations
FPOs	Farmers Producers Organizations
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 Pest Management
ISOPOM	Integrated Scheme of Oilseeds, Pulses, Oil palm and Maize
IIPR	Indian Institute of Pulse Research, Kanpur (UP)
ICAR	Indian Council of Agriculture Research, New Delhi
INM	Integrated Nutrient Management
ICMR	Indian Council of Medical Research
KCl	Potassium Chloride
K	Potassium
KVK	KrishiVigyan 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	Molybdenum
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 Co-operative Development Cooperation
NGOs	Non-Government organization
NABARD	National Bank for Agriculture and Rural Development
NPDP	National Pulses Development Project
NLMT	National Level Monitoring Team
NUE	Nutrient Use Efficiency
NFSM	National Food Security Mission
NAFED	National Agriculture Marketing Federation Ltd
NBSS&LUP	National Bureau of Soil Survey and Land Utilization Planning
NWDPRA	National Watershed Development project for Rural Agriculture
NSC	National Seed Corporation
NAEP	National Agriculture Extension Project
NE	North East
NWP	North Western Parts
OPDP	Oil palm Development Project
OILFED	Oil Federation
OPP	Oilseed Production Programme
PSHG	Pulses Self Help Group
PHT	Post Harvest Technology
PSB	Phosphate Solubilising Bacteria
PWD	Public Work Department
PGPR	Plant Growth Promoting Rhizobacteria
PC	Project Coordinator
PAU	Punjab Agriculture University, Ludhiana (PB)
PDKV	Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MS)

PFA	Prevention of Food Adulteration
PSS	Price Support Scheme
P	Phosphorous
Q	Quintal
RGK	Rural Gram Kendra
RBI	Reserve Bank of India
‘R’ lines	Restorer Lines
RAEO	Rural Agriculture Extension Officer
R&D	Research Development
SPPP	Strategic Pulses Production Programme
SVS	Seed Village Scheme
SES	Socio-economic Status
SBI	State Bank of India
SSP	Single Super Phosphate
SDA	State Department of Agriculture
SL	Solubilite
SRR	Seed Replacement Rate
SHGs	Self Help Group
SWCs	State Warehousing Corporation
SZ	South Zone
SFPP	Special Food Grain Production Programme
SSC	State Seed Corporation
SFCI	State Farm Corporation of India
SLMT	State Level Monitoring Team
ToT	Transfer of Technology
TMC	Technology Mission on Cotton
T&V	Training and Visit
TAC	Technical Advisory Committee
TE	Triennium Ending
TMO	Technology Mission on Oilseed
TN	Tamil Nadu
UK	United Kingdom
UNDP	United Nations Development Programme
USA	United States of America
UTs	Union Territories
UP	Uttar Pradesh
W.B.	West Bengal
WSC	Water Soluble Concentrate
YI	Yield Index
YMV	Yellow Mosaic Virus
ZRS	Zonal Research Station
@	At the rate
Ca	Calcium
Cm	Centimetre
^{0}C	Degree Centigrade
G	Gram
>	Greater than
Hr	Hour
Kg/ha	Kilogram/ hectare
Ml	Milli litre
mg	Milli gram
pH	Potential Hydrogen
m^2	Square Meter
Zn	Zinc
Mg	Magnesium

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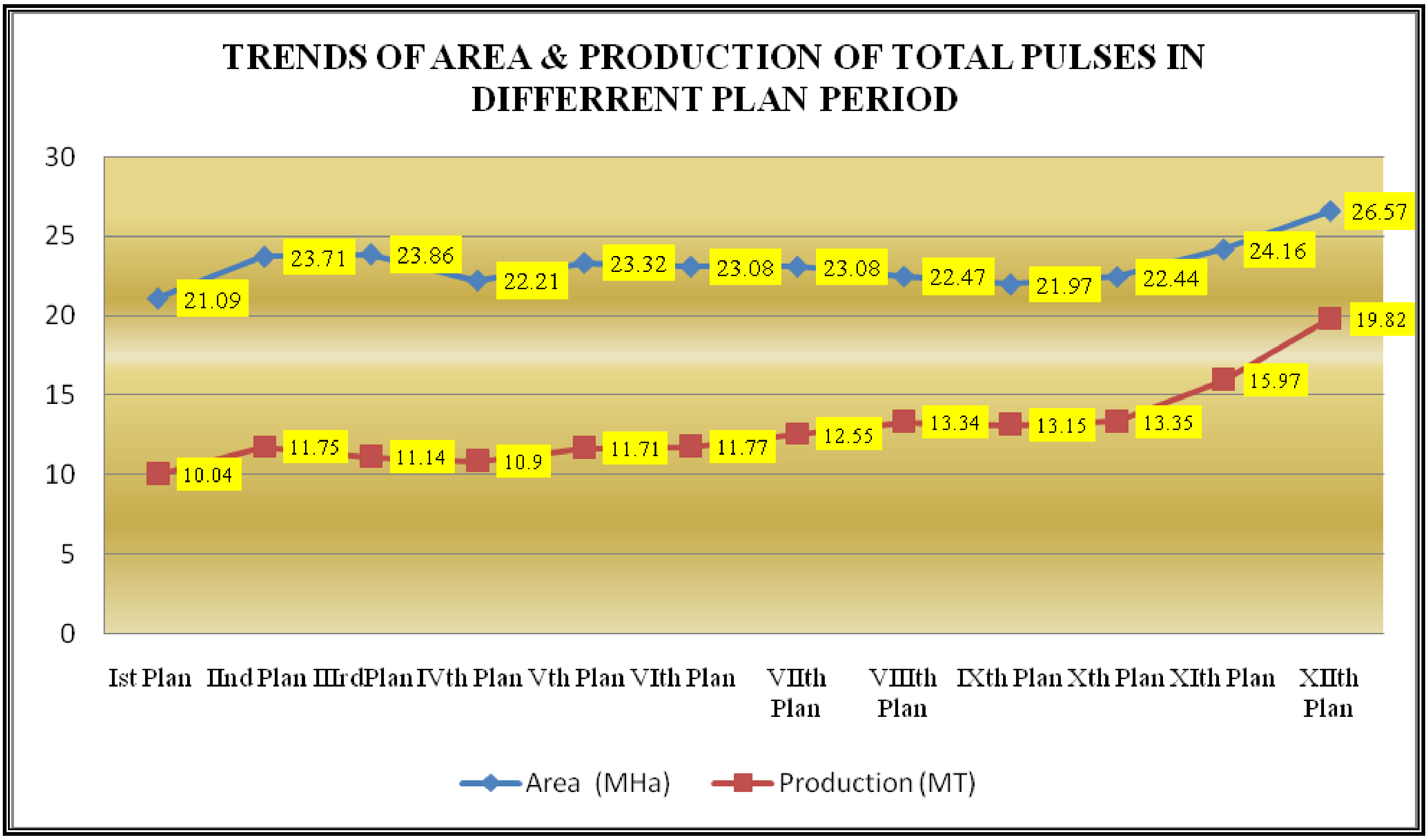
PULSES OVERVIEW



Pulses in India Retrospect & Prospects

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, pulses share to total foodgrain is production is only 6-7% in the country. 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 any significant increase in area and production during 1950-51 to 2009-10, however, significant growth in area and production has been recorded during the last five years (i.e. 2010-2011 to 2014-15). With the increase in infrastructural and irrigation facilities/resources, the pulses get the marginalized treatment pushing them to another poor and marginal land piece. The productivity of pulses has increased about 68% at 764 kg/ha during 2013-14 from the level of 441 kg/ha during 1950-51. 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 265.64 million tonnes during 2013-14 with the increase in area from 97.32 million hectares to 125 million hectares. The productivity of food grains has also sharply increased to 2120 kg/ha during 2013-14 from the level of only 522 kg/ha during 1950-51.

The potential of pulses to help address future global food security, nutrition and environmental sustainability needs has been acknowledged through the UN declaration of the 2016 International Year of Pulses. Pulses are a Smart Food as these are critical for food basket (dal-roti, dal-chawal), important source of plant protein and help address obesity, diabetes etc. In addition pulses are highly water efficient, can grow in drought prone areas and help improve soil fertility by fixing soil nitrogen.

1.1 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
iii. ***Summer*** – Greengram, Blackgram and Cowpea

1.2 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 2012-13 has gone down to 7.13 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 & Farmer's Welfare to vigorously pursue the NFSM-Pulses during the Eleventh plan (2007-08 to 2011-12) and is continued during Twelfth Plan (i.e. 2012-13 to 2016-17), **(Table .1.1)**.

Table 1.1 - Contribution of pulses to total foodgrains in India

{A- Million ha, P- Million Tonnes, Y- 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
2007-08	23.63	14.76	625	124.07	230.78	1860	19.05	6.40	33.58
2008-09	22.09	14.57	660	122.83	234.47	1909	17.98	6.21	34.55
2009-10	23.28	14.66	630	121.33	218.11	1798	19.19	6.72	35.03
2010-11	26.40	18.24	691	126.67	244.49	1930	20.84	7.46	35.80
2011-12	24.46	17.09	699	124.76	259.32	2079	19.61	6.59	33.61
2012-13	23.25	18.34	789	120.77	257.12	2129	19.25	7.13	37.06
2013-14	25.21	19.25	764	125.04	265.04	2120	20.16	7.26	36.03
2014-15	23.10	17.16	743	122.07	252.67	2069	18.92	6.791	35.91

13 Growth Rate of Total Pulses: From 1950-51 to 2013-14, the total acreage under pulses has almost been stagnated but for 2013-14 (25.21 million ha), however, the maximum growth rate in area was recorded between the period from 2002-03 to 2003-04 at 14.4% and 2009-10 to 2010-11 at 13.40%. Maximum production growth rate of 34.0% and 24.42% and maximum yield growth rate of 16.9% and 12.7 % were also observed during the same period. The highest production (19 million tonnes) & yield (764 kg/ha) was recorded during 2013-14 (**Table 1.2**).

Table 1.2-Growth Rate of Total Pulses

{A- Million ha, P- Million Tonnes, Y- kg/ha, Growth rate- Per cent (%)}

Year	Area		Production		Yield		% coverage under irrigation
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	12.7	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	12.1	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
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	-1.9	12.31	-2.7	552	-0.9	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	23.5	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	13.9
2005-06	22.39	-1.6	13.39	2.0	598	3.6	15.0
2006-07	23.76	6.1	14.11	5.4	594	-0.7	15.4
2007-08	23.63	-0.5	14.76	4.6	625	5.2	16.2
2008-09	22.09	-6.5	14.57	-1.3	660	5.6	16.0
2009-10	23.28	5.4	14.66	0.6	630	-4.5	16.2
2010-11	26.4	13.4	18.24	24.4	691	9.7	14.8
2011-12	24.46	-7.3	17.09	-6.3	699	1.2	16.1
2012-13	23.26	-4.9	18.34	7.3	788	12.7	18.6
2013-14	25.23	8.5	19.27	5.1	764	-3.0	N.A.
2014-15	23.10	-8.4		-10.9		-2.7	N.A.

Note: The yield rates given above have been worked out on the basis of production area figure taken in '000 units. *Green revolution period, N.A. not available.

Source: *Agricultural Statistics at a Glance, 2013.* Directorate of Economics and Statistics, Ministry of Agriculture, Govt. of India (Website http://www.dacnet.nic.in/eands).

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	Pantothenic-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 satisfactory Diets (ICMR)*

2.0 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 level of 35.4 g in the year 2010. The *per capita* per year availability shows the same decreasing trend from 22.1 kg in 1951 to 12.9 kg in the same period. However, since 2011 increasing trend of per capita per day availability is recorded. In the year 2014, provisional per capita/year availability is 17.2 kg which is 47.2 g per capita per day (**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	32.5	11.8
2007	35.5	12.9
2008	41.8	15.3
2009	37.0	13.5
2010	35.4	12.9
2011	43.0	15.7
2012	41.6	15.2
2013	43.3	15.8
2014 (P*)	47.2	17.2

*P= Provisional

Source: Agricultural Statistics at a glance-2014

3.0 PROJECTED DEMAND: (XIth & XIIth Plan)

Table 1.5 Tentative demand/production and projected target

(Qty: Million Tonnes)

Year	Demand *	Production @	Gap	Target
2007-08	16.77	14.76	-2.01	17.00
2008-09	17.51	14.57	-2.94	18.00
2009-10	18.29	14.66	-3.63	18.50
2010-11	19.08	18.24	-0.84	19.00
2011-12	19.91	17.09	-2.82	20.00
2012-13	18.30	18.34	0.04	-
2013-14	19.27	19.25	-0.02	-
2014-15	-	17.29	-	19.50
2015-16	-	16.47	-	20.05
2016-17	22.00	-	-	20.75

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.*

Source: *Projections of XII Plan working group (Planning Commission)*

3.1 IMPORT/EXPORTAND AVAILABILITY

The domestic production, and imports/exports and total availability from 1992-93 to 2015-16 is given below: **(Table 1.6)**

Table 1.6- Availability status of pulses production, import and export

(Quantity – Lakh Tonnes)

Year	Production	Import	Export	Total availability
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	142.30	22.56	2.47	162.40
2006-07	141.98	22.71	2.51	167.19
2007-08	147.62	28.35	1.64	177.61
2008-09	145.66	24.74	1.36	171.77
2009-10	146.62	35.10	1.00	182.71
2010-11	182.41	26.99	2.08	211.48

(*Quantity – Lakh Tonnes)*

Year	Production	Import	Export	Total availability
2011-12	170.89	33.65	1.74	206.28
2012-13	183.43	38.39	2.02	223.84
2013-14	192.53	36.44	3.46	232.42
2014-15	172.85	45.85	2.22	220.92
2015-16	164.70	57.98	2.56	225.24

Source: *DGCI &S, Ministry of Commerce, Kolkata*

3.1.1 **IMPORT:** The import of pulses in India during April, 2013 to March, 2014 was 36.44 lakh quintals worth Rs.12792.62 crores against the value of Rs.12927.15 crore for total foodgrains, Rs.87465.66 crore for total agricultural imports and against Rs.2715433.91 crore for total National Import. The import during April, 2014 to March, 2015 was 45.85 lakh tonnes worth Rs.17062.93 crore against the import value of Rs. 17196.91 crore for total foodgrains, Rs.115434.49 crore for total agricultural import and Rs.2733935.41 crore for total National import respectively during this period. The share of Agricultural import to National import was 3.22% and 4.22% respectively during April, 2013 to March, 2014 and April, 2014 to March, 2015.

{Dry Peas contributes the single largest share in India's import basket of pulses registering 42.57% & 38.72% in the total pulses importduring 2014-15 & 2015-16 respectively}.

3.1.2 **EXPORT:** The pulses export of the country during April, 2013 to March, 2014 was 3.46 lakh tonnes worth Rs.1749.30 crore against the value of Rs. 65292.12 crore for total foodgrains, Rs.262778.96 crore for total agricultural exports and against Rs.1905011.09 crore for total National export. The export during April, 2014 to March, 2015 was 2.22 lakh tonnes worth Rs.1218.10 crore against the export value of Rs. 59385.83 crore for total foodgrains, Rs.239453.23 crore for total agricultural export and Rs.1891644.67 crore for total National export respectively during this period. The share of agricultural export to National export was 13.79% and 12.66% respectively during April, 2013 to March, 2014 and April, 2014 to March, 2015.

{Chickpeas contributes the single largest share in India's export basket of pulses registering 85.64% and 84.87% share in the total pulses export during 2014-15 and 2015-16 respectively}.

Table 1.7 Pulse importing and exporting countries of major pulses (2015-16)

Pulses	Top 5 Export Destinations	Top 5 Import Sources
Peas (*Pisum sativum*)	Shri Lanka DSR (81.07%), Nepal (12.56%), Ukrain (4.28%), USA (1.63%), Bangladesh PR (0.42%)	Canada (60.97%), Russia (14.82%), USA (6.96%), France (5.36%), Luthuania (4.15%)
Chickpeas (Garbanzos)	Pakistan (35.60%), Algeria (15.17%), Turkey (8.58%), Sri Lanka (8.07%), U Arab EMTS (4.97%)	Australia (74.40%), Russia (16.49%), Tanzania (2.79%), Myanmar (0.92%), USA (0.74%)
Moong/Urd	USA (39.96%), Sri Lanka (13.05%), UK (9.86%), Australia (7.77%), Malaysia (7.63%)	Myanmar (70.37%), Kenya (7.43%), Australia (6.32%), Tanzania (3.15%), Uzbekistan (2.60%)
Lentils (Masur)	Sri Lanka DSR (43.39%), Bangladesh (18.11%), U Arab EMTS (8.35%), Egypt (3.98%), USA (3.67%)	Canada (89.58%), USA (7.47%), Australia (2.88%), Turkey (0.03%), Mozambique (0.03%)
Pigeon Peas (Tur)	USA (40.79%), U Arab EMTS (18.28%), Canada (11.28%), UK (10.75%), Singapore (5.11%),	Myanmar (46.35%), Tanzania (18.71%), Mozambique (15.36%), Malawi (12.56%), Sudan (3.36%)

(%) figures in parenthesis indicates percentage share of global import/export

4.0 VISION FOR 2030

In order to meet the projected demand of 32 million tonnes of pulses by 2030, as per the Vision 2030 paper prepared by the Indian Institute of Pulses Research, Kanpur, a growth rate of 4.2% has to be ensured. As in the case of cereals, there is scope for a lot of enhancement in pulses productivity. This will, however, require a paradigm shift in research, technology generation and dissemination, popularization of improved crop management practices and commercialization along with capacity building of the stakeholders in frontier areas of research. Genetic enhancement for yield and quality seed would be a critical factor in productivity.

4.1 TOTAL PULSES: CROP/SEASON-WISE CONTRIBUTION

Table –1.8 Normal Area, Production and Yield (crop-wise)

{A-lakh ha, P-lakh tonnes, Y-kg/ha}

Crop	Season	Area*	Production *	Productivity*
Arhar	Kharif	40.283 (17%)	29.795 (17%)	740
Urd	Kharif	25.275	12.923	511
	Rabi/Summer	8.059	5.937	737
	Total	**33.334 (14%)**	**18.86 (11%)**	566
Moong	Kharif	23.465	9.420	401
	Rabi/Summer	9.910	5.963	602
	Total	**33.375 (14%)**	**15.383 (9%)**	461
Horse gram	Kharif	2.319	1.051	453
	Rabi/Summer	2.277	1.104	485
	Total	**4.596 (2%)**	**2.155 (1%)**	**469**
Moth	Kharif	9.256 (4%)	2.77 (2%)	299
Chickpea	Rabi	88.432 (37%)	82.914 (47%)	938
Lentil	Rabi	13.901 (6%)	10.929 (6%)	786
Peas & Beans	Rabi	11.495 (5%)	10.357 (6%)	901
Lathyrus	Rabi	4.9311 (2%)	3.84 (2%)	779
Total	**Kharif**	**100.598**	**55.959**	**556**
	Rabi/Summer	**139.005**	**121.044**	**871**
	Total Pulses	**239.603**	**177.003**	**739**

*Average of 2012-13 to 2015-16 (figures in parenthesis indicates % share of crop)

4.2 PRODUCTION TRENDS

4.2.0 Global Scenario

The total world acreage under pulses, as recorded during 2013, is about 807.54 lakh ha with production at 730.07 lakh tones and productivity 904 kg/ha (**Table 1.9**). It reveals that the India ranked first in area and production with 35% and 25% respectively of world area and production. However, in case of productively Ireland stood first with 5333 kg/ha**.** Thus it is also evident that the country's productivity at 739 kg/ha is far below the world average productivity of 904 kg/ha and the existing potential may be harnessed (**Table 1.10**).

Table-1.9 GLOBAL RANKING: CROP-WISE

{A-lakh ha, P-lakh tonnes, Y-kg/ha}

Crop	Area	% to Total	Production	% to Total	Productivity
Chickpea	135.40	16.77	131.02	17.95	968
Lentil	43.45	5.38	49.52	6.78	1140
Pigeon pea	62.20	7.70	47.42	6.50	762
Other Pulses	566.49	70.15	502.12	68.78	886
Total Pulses	**807.54**		**730.07**		**904**

Source: FAO Statistics 2013.

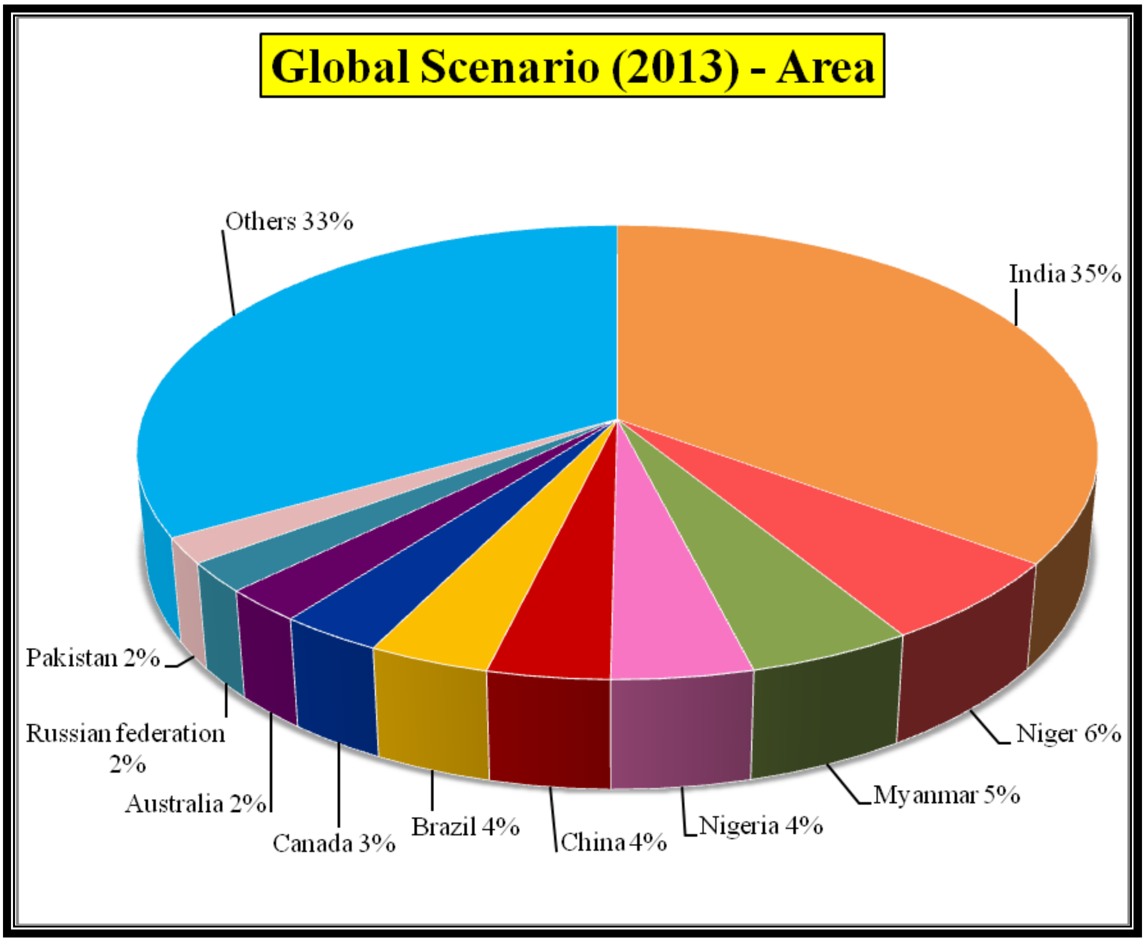
Table – 1.10 GLOBAL RANKING: TOTAL PULSES

{A-lakh ha, P-lakh tonnes, Y-kg/ha}

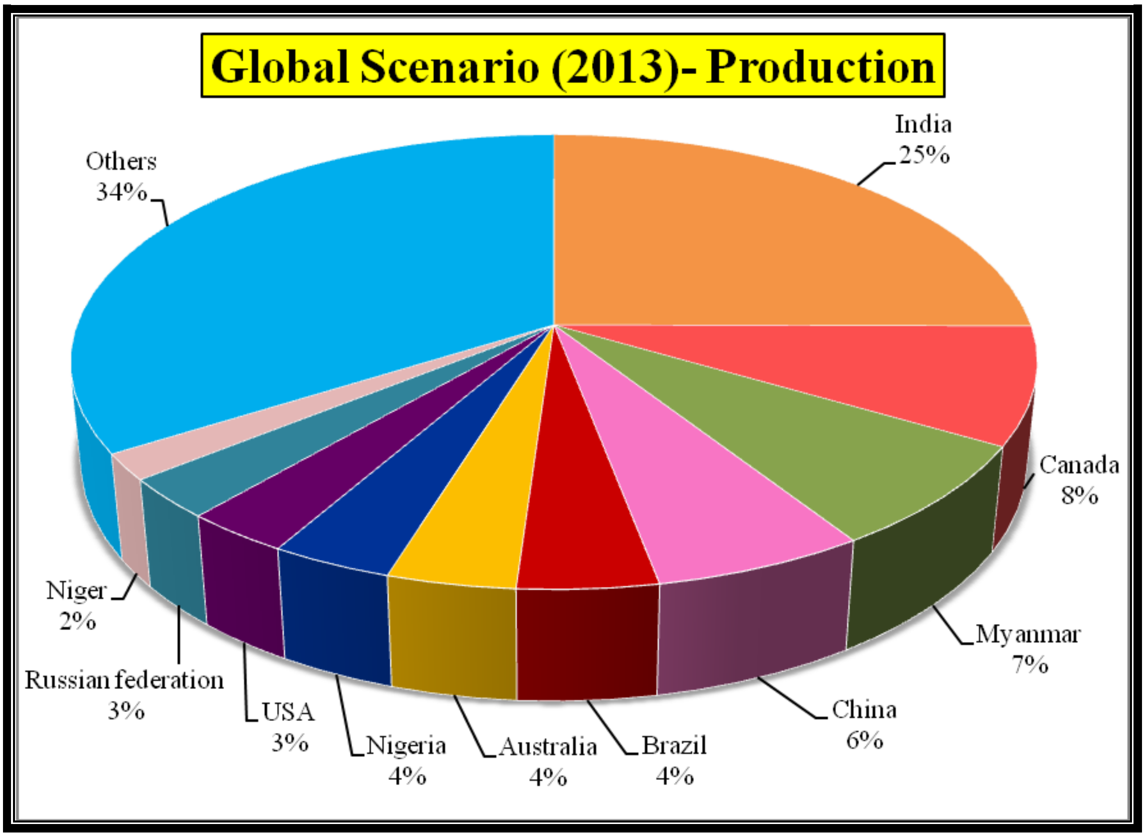
Country	Area		Country	Production		Country	Yield
	Area	% to World		Prod.	% to World		
India	281.70	34.88	India	183.11	25.08	Ireland	5333
Niger	48.41	6.00	Canada	61.05	8.36	Tajikistan	4753
Myanmar	38.88	4.81	Myanmar	54.37	7.45	Belgium	4224
Nigeria	33.3	4.12	China	44.73	6.13	France	3637
China	28.84	3.57	Brazil	29.46	4.04	UK	3526
Brazil	28.55	3.54	Australia	27.04	3.70	Netherland	3441
Canada	24.22	3.00	Nigeria	25.60	3.51	Denmark	3416
Australia	19.18	2.38	USA	22.33	3.06	Switzerland	3302
Russian federation	17.01	2.11	Russian federation	20.84	2.85	Luxembourg	3191
Pakistan	14.804	1.83	Niger	13.63	1.87	India	650
World	**807.54**		**World**	**730.07**		**World**	**904**

Source: FAO Statistics 2013

4.2.1. In the world, pulses are grown by 171 countries. Beansdry was cultivated by 120 countries, which contributed about 37.50% area to total world area, Chickpea by 52 contributed about 16.77%, Cowpeadry by 33 contributed 15.05%, Peasdry by 96 contributed 8.50%, Pigeonpea by 21 contributed 7.70%, Lentil by 51 contributed by 5.38% and others 11.1% The share to World production of Beansdry was 33.50% followed by Peasdry 15.91%, Chickpea 17.95%, Cowpeadry 8.45%, Pigeonpea 6.50%, Lentil 6.78% & others 17.69% .



Global Scenario (2013) - Area
Others 33%
India 35%
Pakistan 2%
Russian federation 2%
Australia 2%
Canada 3%
Brazil 4%
China 4%
Nigeria 4%
Myanmar 5%
Niger 6%



Global Scenario (2013)- Production
Others 34%
India 25%
Canada 8%
Myanmar 7%
China 6%
Brazil 4%
Australia 4%
Nigeria 4%
USA 3%
Russian federation 3%
Niger 2%

5.0. National Scenario

5.1. Total Pulses - Plan Periods

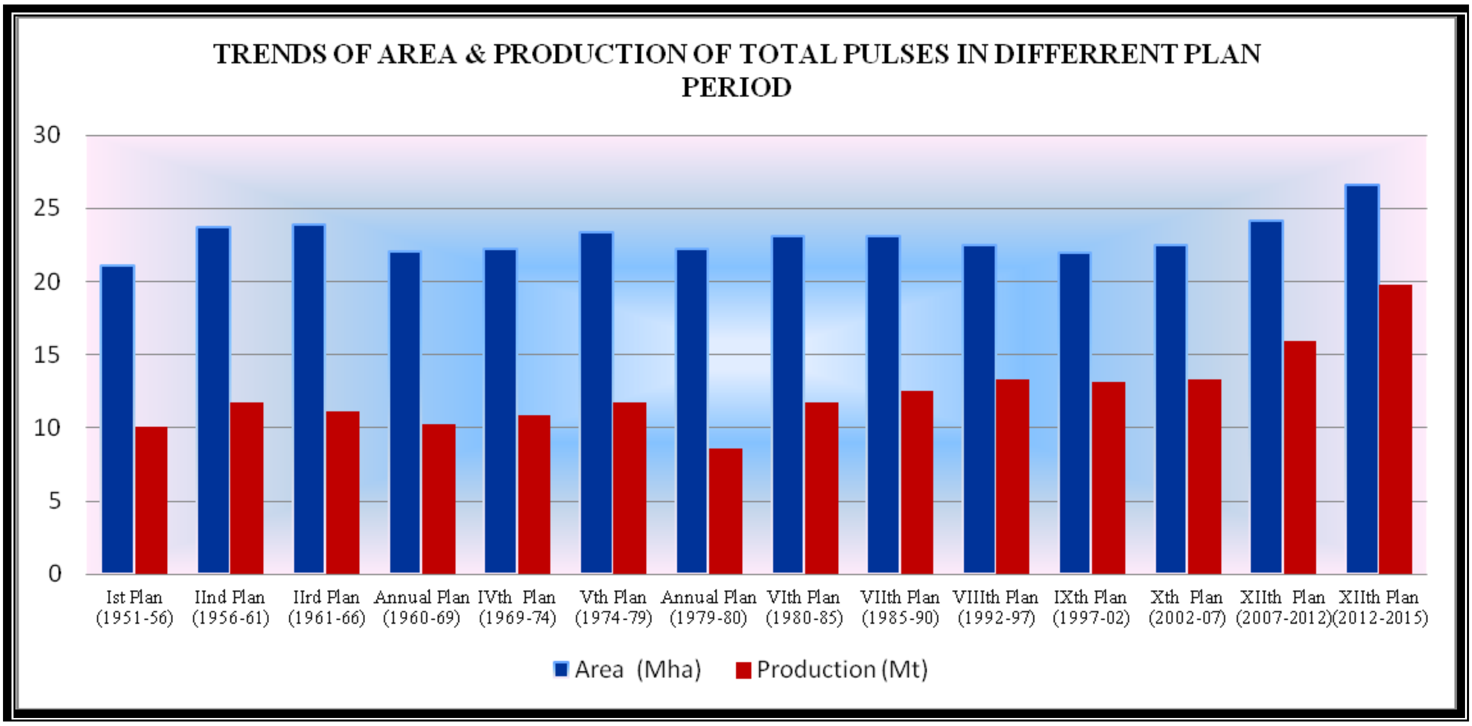
A visit to different plan periods records a slight growth in total production and productivity from Annual plans 1990-92. The pulses development was brought under the Technology Mission (TMO) during 1990. However, the area remained almost stagnant, stabilized uptill Xth plan. During XIth & XIIth plan, increasing trend recorded in area, production & productivity. Plan–wise area and production of total pulses & Percentage Change Over Previous Plan Periods (COPP) is given at **Table-1.11.**

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

{A- Million ha, P- Million Tonnes, Y- kg/ha, COPP- Per cent (%)}

Plan	Area	COPP*	Production	COPP*	Productivity	COPP
First Plan (1951-56)	21.09		10.04		476	
Second Plan (1956-61)	23.71	12.42	11.75	17.03	496	4.20
Third Plan (1961-66)	23.86	0.63	11.14	-5.19	467	-5.85
Annual Plan (1960-69)	22.01	-7.75	10.29	-7.63	467	0.0
Fourth Plan (1969-74)	22.21	-6.92	10.9	-2.15	491	5.14
Fifth Plan (1974-79)	23.32	5.00	11.71	7.43	502	2.24
Annual Plan (1979-80)	22.26	-4.55	8.57	-26.81	385	-23.15
Sixth Plan (1980-85)	23.08	-1.03	11.77	0.51	510	1.59
Seventh Plan (1985-90)	23.08	0.00	12.55	6.63	544	6.67
ighth Plan (1992-97)	22.47	-2.64	13.34	6.29	594	9.19
Nineth Plan (1997-02)	21.97	-2.23	13.15	-1.42	599	0.84
Tenth Plan (2002-07)	22.44	2.14	13.35	1.52	595	-0.67
Eleventh Plan (2007-2012)	24.16	7.66	15.97	19.63	661	11.09
#Twelfth Plan (2012-2015)	26.57	9.98	19.82	24.11	746	12.86

** % COPP is percentage change over previous plan. # Twelfth Plan upto 2015-16 (IIIrd Adv. Est.)*



5.2. States' Scenario

5.2.0 Total Pulses Xth –XIIth: A Plan Analysis

5.2.1 ***Tenth Plan (2002-2007)**:* The total pulse area in the country during the Tenth plan was 224.60 lakh hectares with a total production of 133.48 lakh tonnes.The same trend of pulses scenerio was observed during the tenth plan. Madhya Pradesh ranked first in area (43.27 lakh hectares or 19.26 %) with a total production of 31.45 lakh tonnes or 23.56 % of the total production). While, Maharashtra was placed second with respect to its area and production i.e., 35.32 lakh hectares (15.72 %) and 19.98 lakh tonnes (14.97 %) followed by Rajasthan, 31.77 lakh hectares (14.14%) &12.95 lakh tonnes (9.70 %) **(Table 1.12)**. The higest yield was recorded in Uttar Pradesh (819 kg/ha) followed by Punjab (811kg/ha) and West Bengal (754 kg/ha). The lowest yield was observed in the state of Karnataka (376 kg/ha) followed by Odisha (401 kg/ha) and Tamil Nadu (402 kg/ha).

5.2.2 ***Eleventh Plan (2007-2012)***:During Eleventh plan period the total pulses area and production were 239.74 lakh ha and 139.81 lakh tonnes respectively.The state-wise analysis exhibited first rank to Madhya Pradesh, both in area and production with 47.74 lakh hectares and 35.97 lakh tonnes which was 19.91% and 25.73% respectively. Rajasthan ranked second in coverage with 16.89% i.e (40.51 lakh hectares) while at production front, state of Maharashtra ranked at second with 17.76% (i.e. 24.83 lakh tonnes) followed by Uttar Pradesh with 14.18 % (i.e. 19.83 lakh tonnes).Maharshtra ranked third in area with 14.87% and Rajasthan ranked fourth in production with 13.99% (i.e. 19.56 lakh hectares) of country's production while in area, Karnataka stood at IVth rank with 10.04% of country coverage during that XI plan. The higest yield was recorded during the plan period in Bihar (859kg/ha) followed by Punjab (858 kg/ha) and Uttar Pradesh (841kg/ha). The lowest yield was observed in the state of Tamil Nadu (391 kg/ha) followed by Odisha (469 kg/ha) and Rajasthan (483 kg/ha).

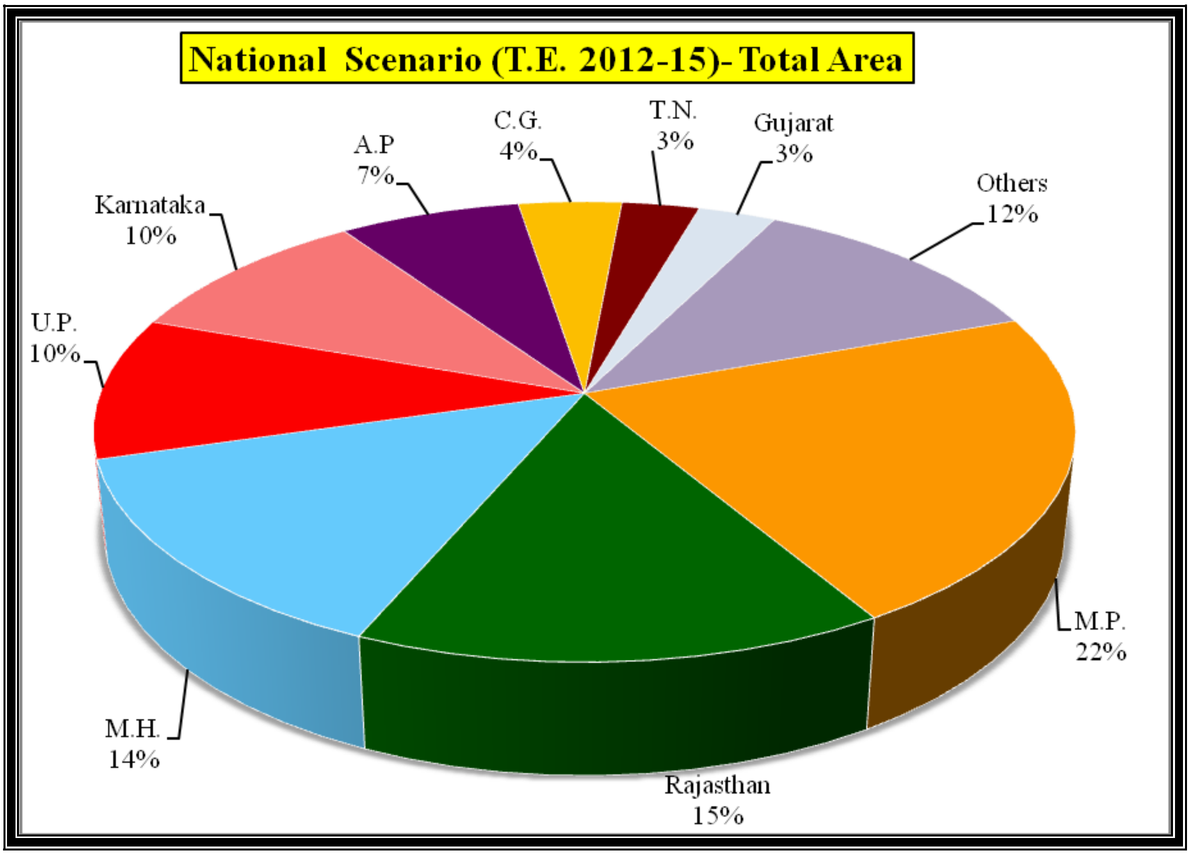
5.2.3 ***Twelfth plan (T.E 2012-2015):*** In India, total pulse area and production irrespective of Twelfth plan was 238.55 lakh hectares and 182.53 lakh tonnes respectively.Out of the total area, 53.58 lakh hectares is confined to Madhya Pradesh alone, earning a good pulse status and position contributing a remarkable 22.46% of the country's total area and a production of 48.38 lakh tonnes ,there by ranking first both in area and production followed by Rajasthan in area (36.01 lakh hectares, 15.09 % of the total area).While Rajasthan ranked third in production with 11.68% of the total pulse production and Maharashtra, which ranked second (24.04 lakh tonnes or 13.17 % of the total production); Uttar Pradesh was hardly placed at the forth rank in production (18.25 lakh tonnes or 10.0 % of the total production) and fifth rank in respect of area (23.37 lakh ha or 9.79 %). The higest yield was recorded in Jharkhand (1021 kg/ha) followed by Bihar (976 kg/ha) and Madhya Pradesh (903 kg/ha). The lowest yield was observed in the state of Odisha (515 kg/ha) followed by Rajasthan (592 kg/ha) and Karnataka (614 kg/ha).

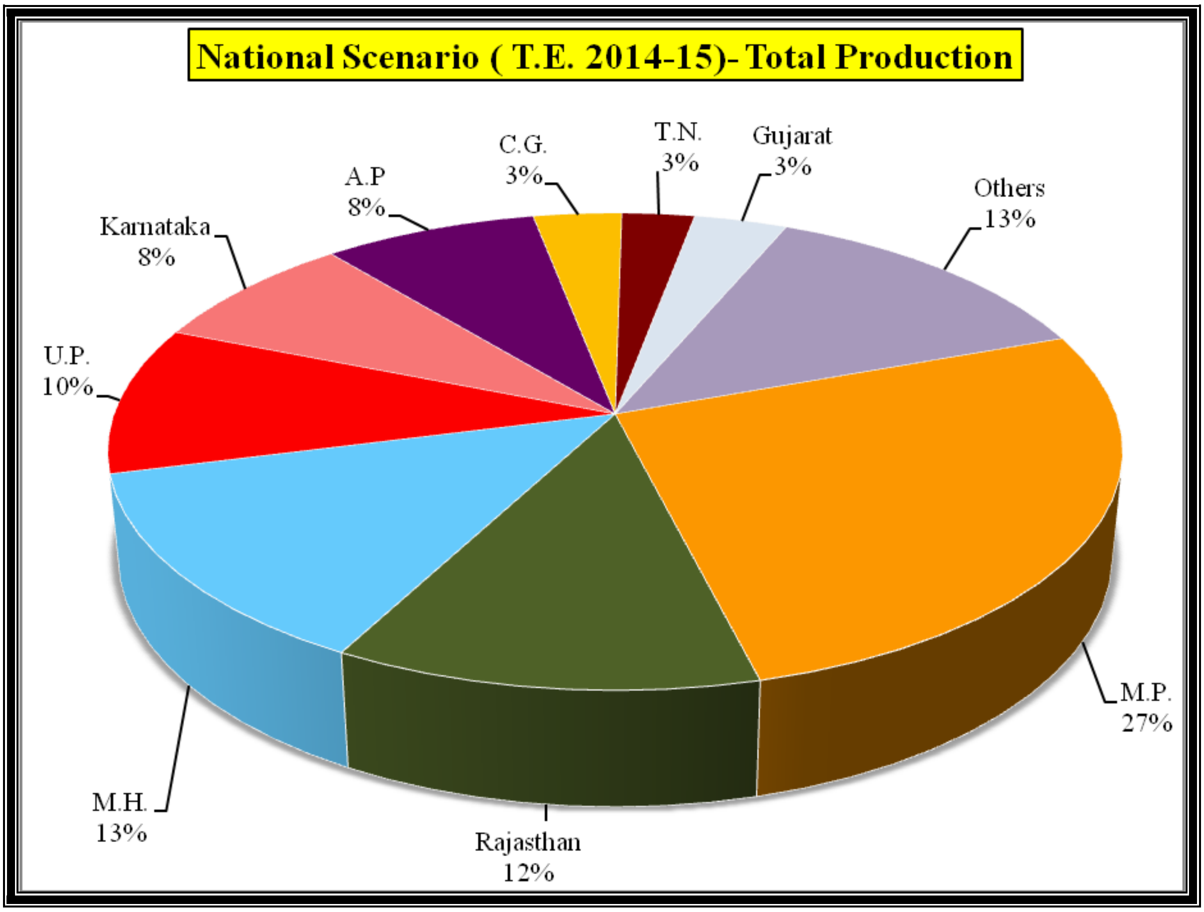
The overall area, production and productivity increasing trend during the last three plan period.

Table 1.12- Plan-wise states' scenario – Total Pulses

{A-lakh ha, P- Lakh Tonnes, Y- kg/ha}

States		X[th] Plan	% to AI	XI[th] Plan	% to AI	XII[th] Plan*	% to AI
A.P	A	19.71	8.78	19.76	8.24	16.90	7.09
	P	12.09	9.05	14.49	10.36	14.43	7.91
	Y	613		733		854	
Bihar	A	6.50	2.90	5.79	2.42	5.07	2.13
	P	4.95	3.71	4.98	3.56	4.95	2.71
	Y	761		859		976	
Chhattisgarh	A	9.06	4.03	8.52	3.55	8.50	3.57
	P	4.52	3.39	5.12	3.66	5.95	3.26
	Y	499		601		700	
Gujarat	A	8.04	3.58	8.49	3.54	7.03	2.95
	P	5.14	3.85	6.74	4.82	6.27	3.44
	Y	639		794		892	
Haryana	A	1.74	0.77	1.68	0.70	1.34	0.56
	P	1.26	0.94	1.33	0.95	1.05	0.58
	Y	725		792		784	
Jharkhand	A	2.74	1.22	4.01	1.67	5.83	2.44
	P	1.72	1.29	3.10	2.21	5.95	3.26
	Y	626		772		1021	
Karnataka	A	20.78	9.25	24.09	10.05	23.59	9.89
	P	7.82	5.86	12.11	8.66	14.49	7.94
	Y	376		503		614	
Madhya pradesh	A	43.27	19.27	47.75	19.92	53.58	22.46
	P	31.46	23.57	35.98	25.73	48.38	26.51
	Y	727		754		903	
Maharashtra	A	35.32	15.73	35.65	14.87	34.55	14.48
	P	19.98	14.97	24.84	17.76	24.04	13.17
	Y	566		697		696	
Odisha	A	7.01	3.12	8.28	3.45	8.14	3.41
	P	2.81	2.11	3.88	2.78	4.19	2.30
	Y	401		469		515	
Punjab	A	0.39	0.17	0.23	0.09	0.64	0.27
	P	0.32	0.24	0.19	0.14	0.55	0.30
	Y	811		858		865	
Rajasthan	A	31.77	14.15	40.51	16.90	36.02	15.10
	P	12.96	9.71	19.57	14.00	21.33	11.68
	Y	408		483		592	
Tamilnadu	A	5.45	2.43	5.97	2.49	7.54	3.16
	P	2.19	1.64	2.34	1.67	4.90	2.69
	Y	402		391		650	
U.P.	A	27.31	12.16	23.58	9.84	23.38	9.80
	P	22.37	16.76	19.83	14.19	18.26	10.00
	Y	819		841		781	
West bengal	A	2.32	1.03	1.86	0.78	2.45	1.03
	P	1.75	1.31	1.47	1.05	2.03	1.11
	Y	754		787		829	
All India	**A**	**224.60**		**239.75**		**238.56**	
	P	**133.48**		**139.82**		**182.53**	
	Y	**594**		**583**		**765**	


National Scenario (T.E. 2012-15)- Total Area
C.G.
4%
T.N.
3%
Gujarat
3%
A.P
7%
Karnataka
10%
Others
12%
U.P.
10%
M.P.
22%
M.H.
14%
Rajasthan
15%


National Scenario (T.E. 2014-15)- Total Production
C.G.
3%
T.N.
3%
Gujarat
3%
A.P
8%
Karnataka
8%
Others
13%
U.P.
10%
M.P.
27%
M.H.
13%
Rajasthan
12%

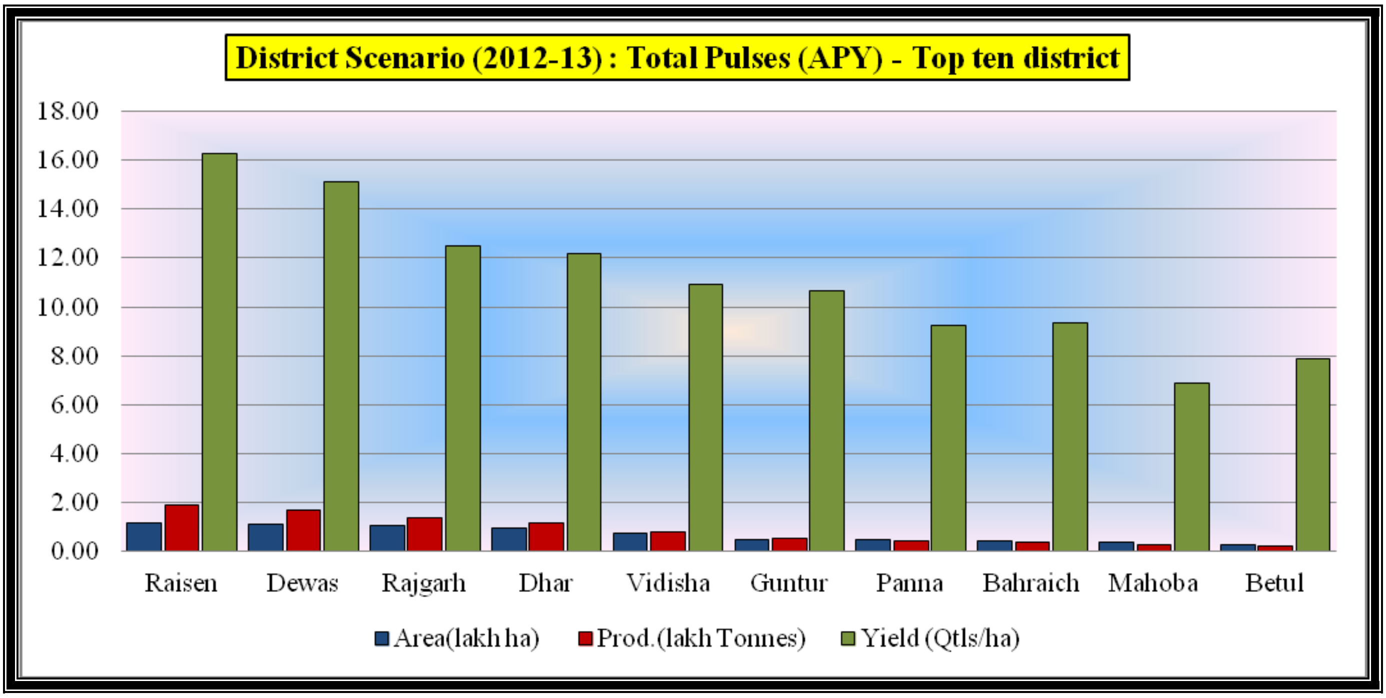
5.3 District scenario (2012-13) – Potential districts

The micro analysis at district level was also carried out and presented in **Table 1.13**. The intra-state analysis revealed that Raisen district of Madhya Pradesh had the highest production with 0.50 per cent share to India followed by Dewas of MP (0.49 %) and Rajgarh of MP (0.47 %). Inrespect of area coverage, District-wise area, production and yield of top ten districts of India in respect of production are presented below which contributed 3.07 % and 4.81 % of area and production of the country.

The yield levels of potential district are also above the national average yield level except Mahoba district of UP. Out of ten potential districts seven districts was belongs to Madhya Pradesh State during 2012-13 & rest of the other were two from Uttar Pradesh and one of Andhra Pradesh.

Table 1.13- Top potential districts (2012-13) (APY) – Total pulses

Name of District	State	Area (lakh ha)		Prod. (lakh Tonnes)		Yield (Kg/ha)	
		Area	% to India	Prod.	% to India	Yield	YI
Raisen	M.P.	1.172	0.50	1.909	1.04	1629	207
Dewas	M.P.	1.129	0.49	1.707	0.93	1511	192
Rajgarh	M.P.	1.083	0.47	1.355	0.74	1251	159
Dhar	M.P.	0.965	0.42	1.177	0.64	1220	155
Vidisha	M.P.	0.738	0.32	0.808	0.44	1094	139
Guntur	A.P.	0.505	0.22	0.540	0.29	1068	136
Panna	M.P.	0.497	0.21	0.461	0.25	926	118
Bahraich	U.P.	0.420	0.18	0.392	0.21	935	119
Mahoba	U.P.	0.366	0.16	0.253	0.14	690	88
Betul	M.P.	0.257	0.11	0.202	0.11	788	100
Total above		**7.133**	**3.07**	**8.804**	**4.81**	**1234**	**157**
All india		**232.32**		**183.15**		**788**	



6.0 SEASON-WISE PLAN ANALYSIS (Xth to XII th)

6.1 Kharif Pulses

6.1.1 ***Tenth Plan(2002-2007):*** With a total coverage of 108.61 lakh hectares and a total production of 49.38 lakh tonnes, In area and production, Maharashtra ranked first with 24.57 lakh hectares (22.62 %) and 13.54 lakh tonnes (27.42 %) of the total area and production under kharif pulses in the country. Rajasthan trailed to second in area (21.96 lakh hectares) with 20.22 % of the total kharif area. Rajasthan was the second largest producer with 6.05 lakh tonnes (12.26 %) while Karnataka third in acreage of 13.58lakh hectares (12.50%) during the plan period with a mere 4.81 lakh tonnes of production (9.73%), placed at third rank (Table 1.14). The highest yield was recorded by the state of Bihar (901 kg/ha) followed by Punjab (778 kg/ha) and Haryana (646 kg/ha). Lowest yield observed in Rajasthan only (276 kg/ha).

6.1.2 ***Eleventh Plan (2007-2012):*** The area and production under kharif pulses during twelfth plan were 110.78 lakh hectares and 56.94 lakh tonnes respectively. The state-wise contribution to total kharif pulses exhibited that the state stands first in acrerage were Rajasthan with 26.91 lakh ha (24.29 %) followed by Maharashtra (19.85%), Karnataka (12.82%) and Madhya Pradesh (9.27%). While at production front, Maharashtra ranked first with 14.08 lakh tonnes which are 24.73% of country's total kharif production. Karnataka stands third position with respect to production 6.43 lakh tones with (11.29%) followed by Madhya Pradesh (8.31%). The highest yield was recorded by the state of Bihar (1013 kg/ha) followed by Punjab (779 kg/ha) and Haryana (776 kg/ha) with the over all National yield average of (514 kg/ha). Lowest yield was observed in C.G. i.e., 344 kg/ha only.

6.1.3 ***Twelfth plan (T.E.2012-2015)*****:** The total area coverage and production of Kharif Pulses in India during the Twelft plan was 100.13 lakh hectares and 58.35 lakh tonnes respectively, out of which Rajasthan ranked first (20.71 lakh hectares) and contributed 20.68% of total area while in production Maharashtra ranked first with 21.56% (12.58 lakh tonnes) and ranked second in area accounting for 19.09% (19.11 lakh hectares) of the total area. Madhya Pradesh ranked second with 13.71 % of the country's production (8.00 lakh tonnes) and stands third in area with 13.29% (13.31 lakh hectares) and Rajasthan stood third in production which accounted for 13.66% (7.97 lakh tonnes) of the total Kharif pulses during the period. The twelfth plan recorded comparatively less kharif coverage with respect to area (10.65 lakh ha), however, production increased about 1.41 % than XIth plan period due to productivity increase about 13% higher than the previous plan period. In case of productivity, state of Bihar ranked first with (1205 kg/ha) followed by Jharkhand (936 kg/ha) and Gujarat (819 kg/ha). Lowest yield was observed in the state of Rajasthan (385 kg/ha).

Overall trend of area, production and yield of last three plan periods have shown increasing trend in production and productivity.

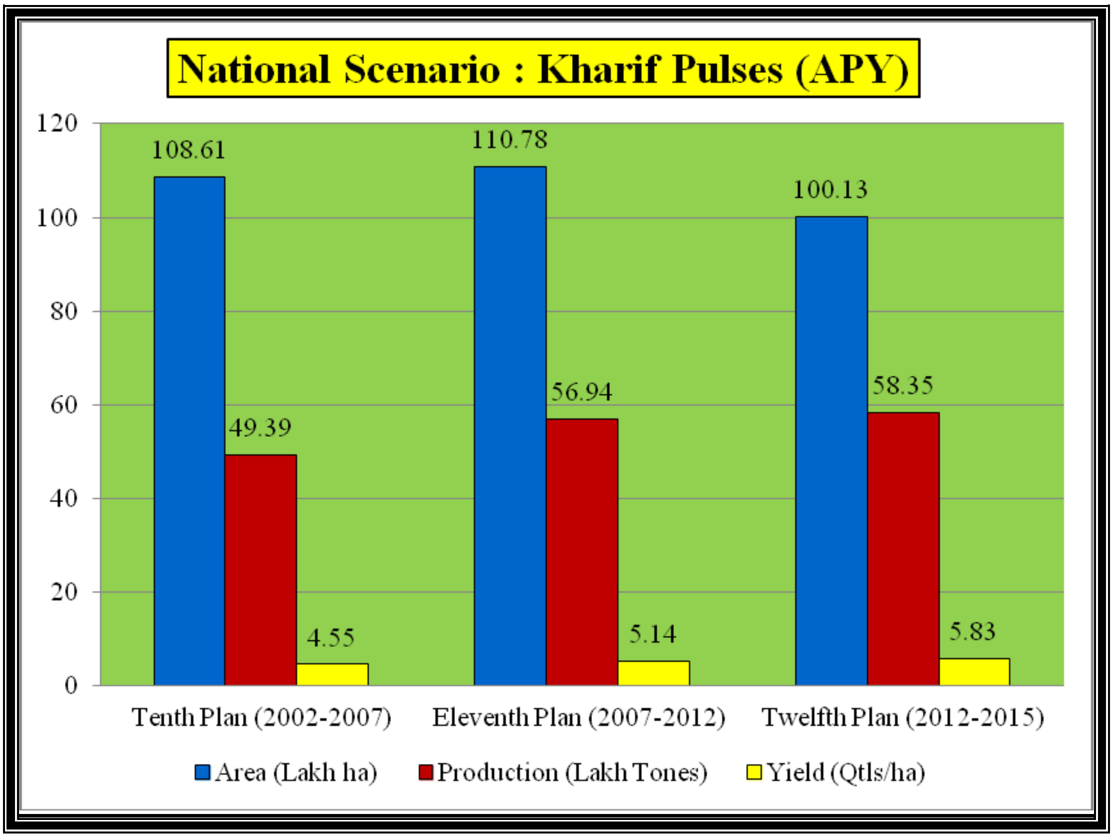
Table 1.14 Plan-wise states' scenario (APY) - Kharif Pulses

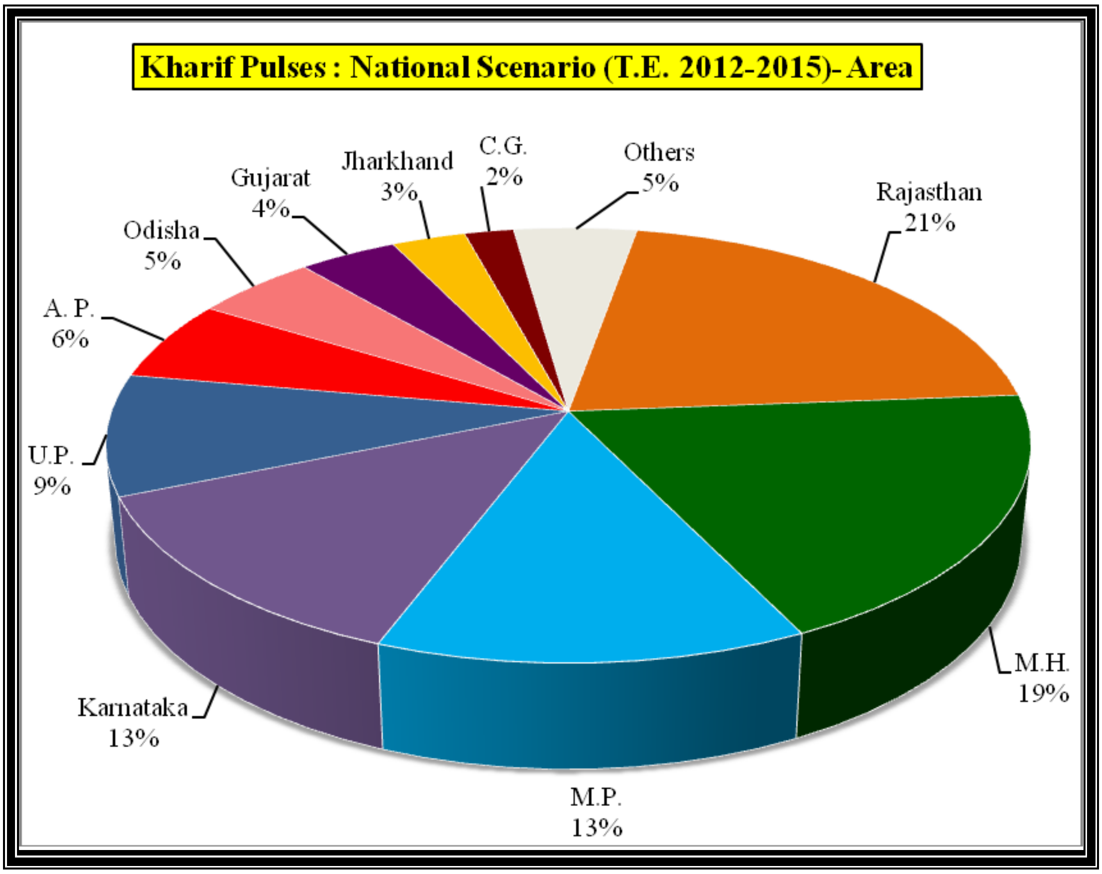
{A= lakh ha, P= Lakh Tonnes, Y= kg/ha}

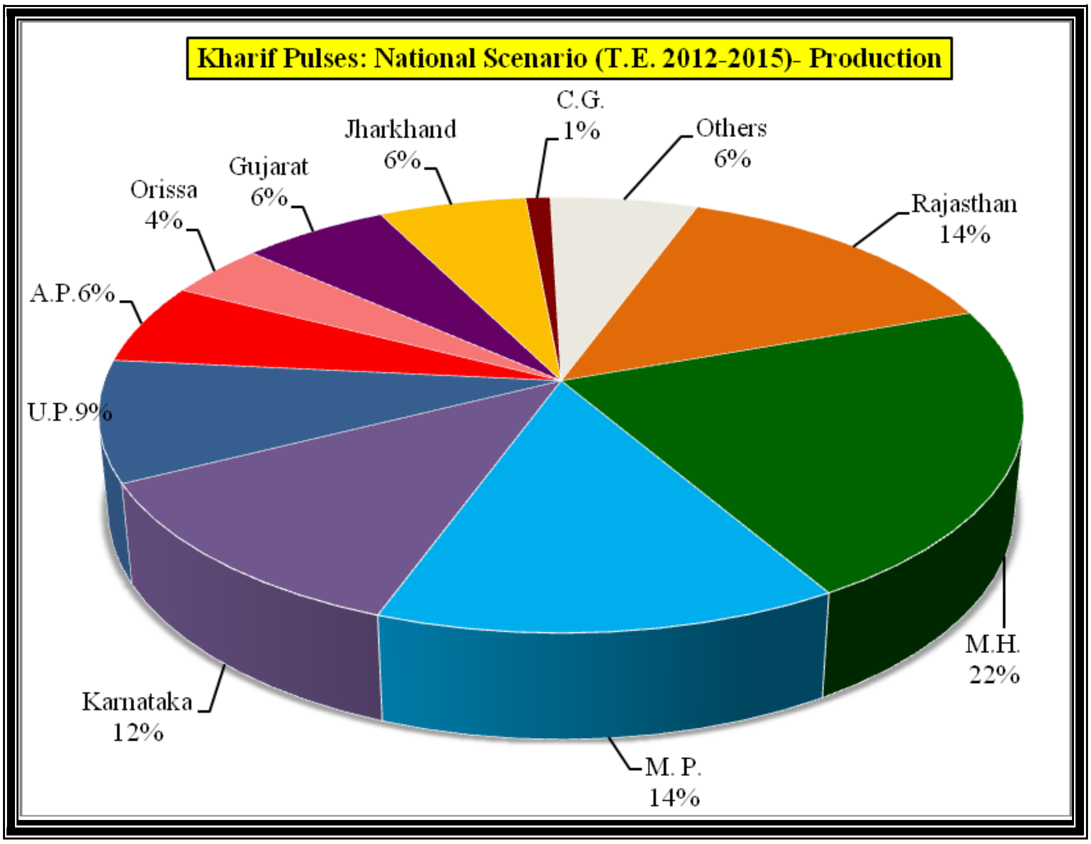
States		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
A.P	A	9.08	8.36	8.17	7.37	6.18	6.18
	P	3.89	7.87	3.61	6.34	3.54	6.07
	Y	428		442		573	
Bihar	A	0.89	0.82	0.69	0.62	0.58	0.58
	P	0.81	1.63	0.70	1.23	0.70	1.19
	Y	901		1013		1205	

{A= lakh ha, P= Lakh Tonnes, Y= kg/ha}

States		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
Chhattisgarh	A	2.35	2.17	2.22	2.00	2.00	2.00
	P	0.79	1.60	0.76	1.34	0.79	1.35
	Y	335		344		395	
Gujarat	A	6.31	5.81	6.13	5.53	4.40	4.40
	P	3.79	7.67	4.48	7.86	3.61	6.18
	Y	601		731		819	
Haryana	A	0.62	0.57	0.50	0.45	0.23	0.23
	P	0.40	0.81	0.39	0.68	0.18	0.30
	Y	646		776		758	
Jharkhand	A	2.08	1.92	2.48	2.24	3.46	3.45
	P	1.22	2.46	1.67	2.94	3.24	5.54
	Y	583		674		936	
Karnataka	A	13.59	12.51	14.21	12.83	12.55	12.53
	P	4.81	9.74	6.43	11.30	6.74	11.54
	Y	354		453		537	
Madhya Pradesh	A	9.50	8.75	10.28	9.28	13.31	13.30
	P	4.45	9.00	4.73	8.31	8.00	13.71
	Y	468		461		601	
Maharashtra	A	24.58	22.63	21.99	19.85	19.12	19.09
	P	13.54	27.42	14.08	24.73	12.58	21.56
	Y	551		640		658	
Odisha	A	4.90	4.51	5.06	4.57	4.72	4.72
	P	1.92	3.89	2.38	4.18	2.43	4.17
	Y	392		470		515	
Punjab	A	0.27	0.25	0.16	0.15	0.10	0.10
	P	0.21	0.43	0.13	0.22	0.08	0.13
	Y	778		779		783	
Rajasthan	A	21.97	20.23	26.91	24.30	20.72	20.69
	P	6.06	12.27	9.66	16.96	7.98	13.67
	Y	276		359		385	
Tamilnadu	A	1.88	1.73	1.61	1.45	2.11	2.10
	P	0.77	1.56	0.79	1.38	1.35	2.32
	Y	409		489		642	
U.P.	A	8.80	8.10	8.47	7.65	8.51	8.50
	P	5.59	11.31	5.74	10.07	5.54	9.49
	Y	635		677		650	
West Bengal	A	0.54	0.50	0.49	0.44	0.75	0.75
	P	0.35	0.71	0.33	0.59	0.47	0.80
	Y	650		685		625	
All India	**A**	**108.61**		**110.78**		**100.13**	
	P	**49.39**		**56.94**		**58.35**	
	Y	**455**		**514**		**583**	


National Scenario : Kharif Pulses (APY)
120
100
80
60
40
20
0
108.61
49.39
4.55
110.78
56.94
5.14
100.13
58.35
5.83
Tenth Plan (2002-2007)
Eleventh Plan (2007-2012)
Twelfth Plan (2012-2015)
Area (Lakh ha)
Production (Lakh Tones)
Yield (Qtls/ha)


Kharif Pulses : National Scenario (T.E. 2012-2015)- Area
Gujarat 4%
Jharkhand 3%
C.G. 2%
Others 5%
Rajasthan 21%
Odisha 5%
A. P. 6%
U.P. 9%
M.H. 19%
Karnataka 13%
M.P. 13%



6.2 Rabi /Summer Pulses

6.2.1 ***Tenth Plan (2002-2007):*** Total area of (115.99 lakh hectares) and production of 84.09 lakh tonnes of Rabi pulses were observed during the Tenth plan in India. Out of these, 29.11% of area (33.76 lakh hectares) and 32.12% of production (27.01 lakh tonnes) were contributed by Madhya Pradesh alone which ranked first. followed by Uttar Pradesh ranked second, could cover 15.96%)of the total area (18.51 lakh hectares) and produce 19.95% of production (16.78 lakh tonnes) while with respect to area Maharashtra at third place could hardly cover 9.26% (10.74 lakh hectares) and in production Andhra Pradesh is in third position with 9.74 % (8.19 lakh tones)of the country's total Rabi pulse during the plan period.The highest state average yield exhibited in Uttar Pradesh (906 kg/ha) followed by Punjab (884 kg/ha) and Madhya Pradesh (800 kg/ha) has been above the National average yield of 725 kg/ha. The lowest yield and the plan period was recorded in Tamilnadu (398 kg/ha) followed by Karnataka (419 kg/ha) and Odisha (420 kg/ha).

6.2.2 ***Eleventh plan (2007-2012)*****:** The total area and production under Rabi pulses during theEleventhplan were 128.97 lakh hectares and 82.87 lakh tonnes respectively. Madhya Pradesh ranked first both in area and production with 37.47 lakh hectares and 31.25 lakh tonnes which are 29.06 % and 37.7 % of the country's total rabi pulse acreage and production respectively followed by Uttar Pradesh with 11.72 % and 17.0% (15.11 lakh hectares and 14.09 lakh tonnes) and Maharashtra was placed third in area accounting for 10.59 % (13.66 lakh hectares) and Andhra Pradesh stood third in Production which accounted for 13.12 % (10.88 lakh tonnes) of the total Rabi pulses during the period.The highest state average yield exhibited in Punjab (1063 kg/ha) followed by Gujarat (960 kg/ha) and Andhra Pradesh (938 kg/ha) has been above the National average yield of

643kg/ha. The lowest yield was recorded on the state of Tamilnadu 356 kg/ha followed by Odisha (466 kg/ha) and Karnataka (574 kg/ha).

6.2.3 ***Twelfth plan (T.E. 2012-15)*****:** All India Rabi pulse acreage and production has been recorded at 138.47 lakh hectares and 124.18 lakh tonnes. Madhya Pradesh stood at first in area and production, covering 40.27 lakh hectares (29.09 %) with a production of 40.38 lakh tonnes (32.52%). Maharashtra ranked second with 15.44 lakh hectares of area (11.15 %), Rajasthan with third position which covered 15.30 lakh hectares of area (11.05 %) and UP shared the fourth rank having an area of 14.86 lakh hectare (10.74 %). However, Rajasthan stood second in terms of production contributing 13.35 lakh tonnes (10.75 %), UP in third position with a production of 12.72 lakh tonnes (10.24%) and Maharashtra in fourth position 11.46 lakh tonnes (9.23 %), **(Table 1.15).** The highest productivity was recorded in plan period in Jharkhand (1144 kg/ha) followed by A.P. (1016 kg/ha) and Gujarat (1014 kg/ha). The lowest yield was noticed in the state of Odisha (514 kg/ha).

Overall trend of area, production and yield of last three plan periods have shown increasing trend in area however, production and productivity declined during XI^th^ plan period from X^th^ plan period and significantly increased during XII^th^ plan period.

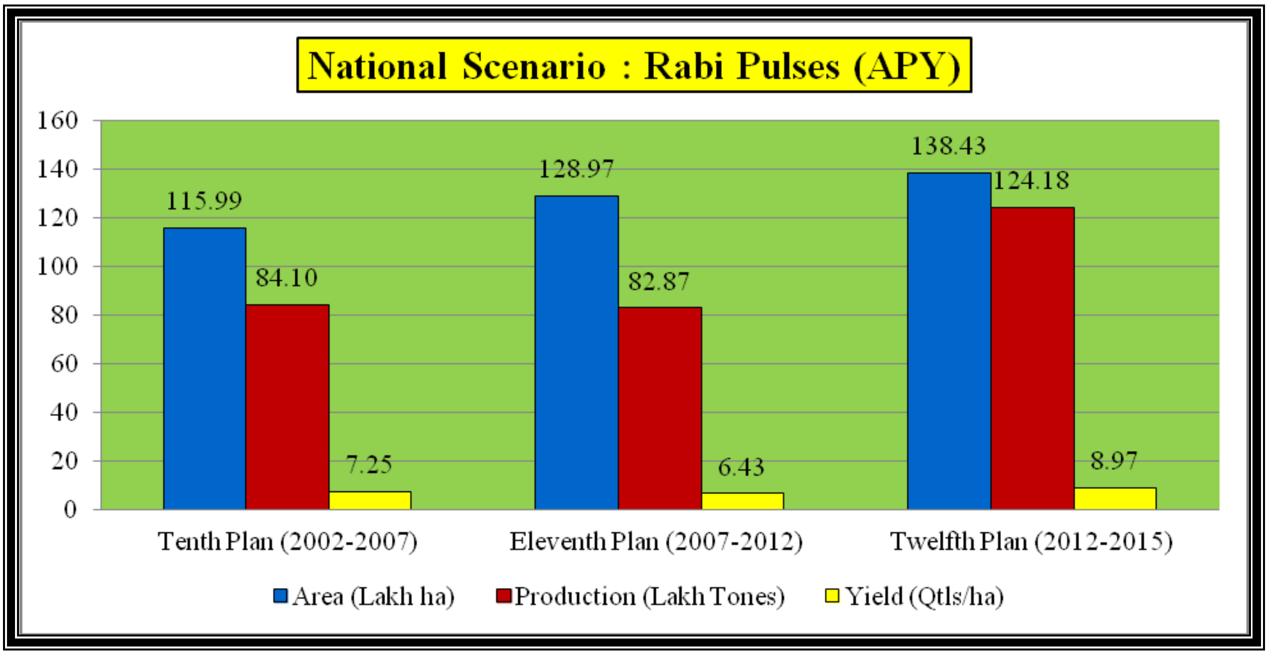
Table 1.15 - Plan-wise Scenario (APY) - States (Rabi Pulses)

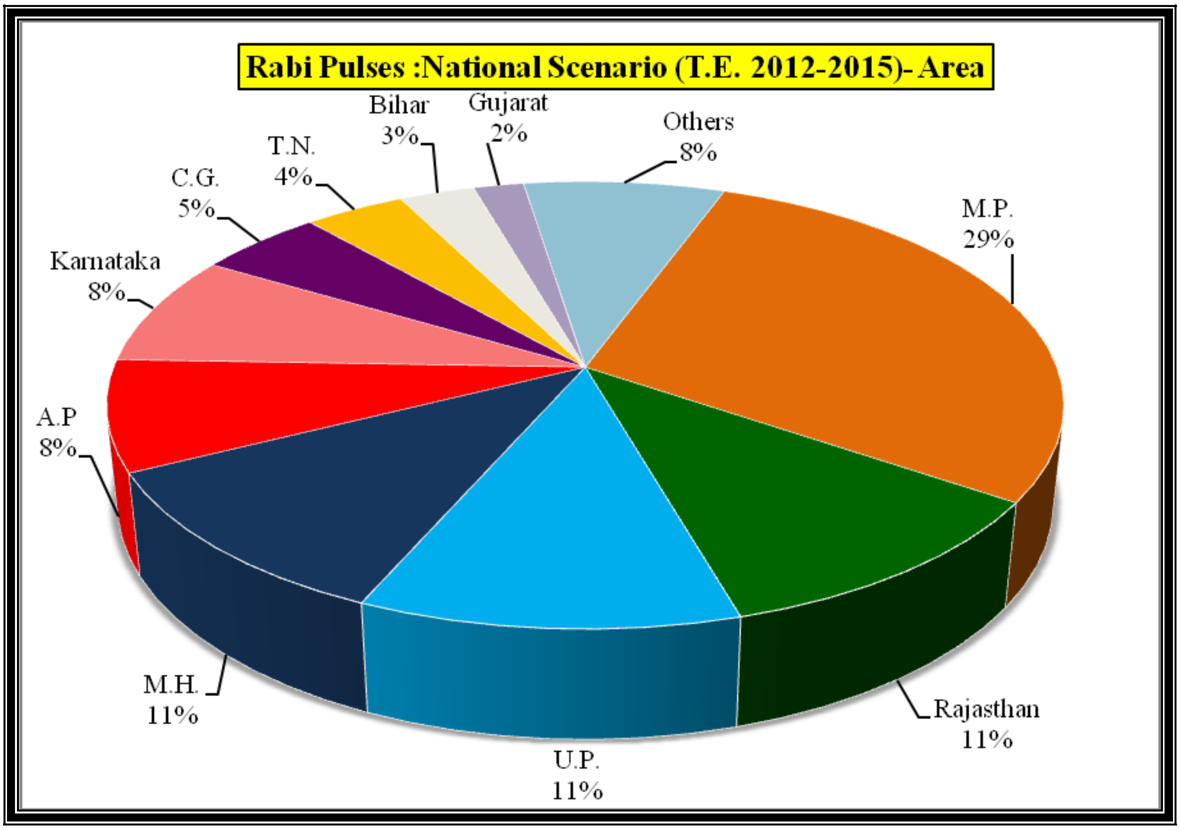
{Area-lakh ha, Prod.-Lakh Tonnes, Yield-kg/ha}

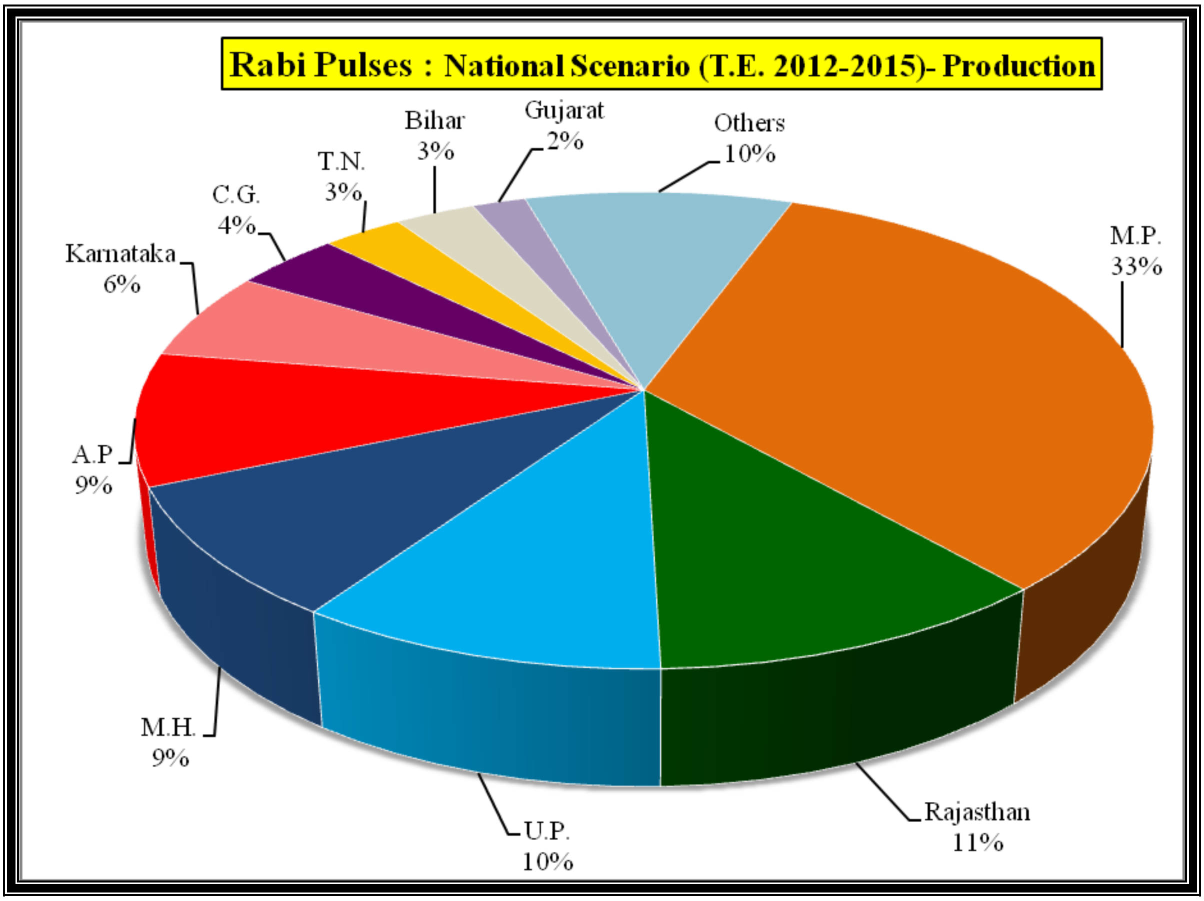
States		Xth Plan	% to A	XIth Plan	% to AI	XIIth Plan	% to AI
A.P	A	10.63	9.16	11.59	8.99	10.72	7.74
	P	8.20	9.75	10.88	13.12	10.89	8.77
	Y	771		938		1016	
Bihar	A	5.61	4.84	5.10	3.95	4.50	3.25
	P	4.15	4.93	4.28	5.16	4.26	3.43
	Y	739		839		946	
Chhattisgarh	A	6.70	5.78	6.30	4.88	6.51	4.70
	P	3.73	4.44	4.36	5.26	5.16	4.16
	Y	557		692		794	
Gujarat	A	1.73	1.49	2.36	1.83	2.63	1.90
	P	1.35	1.61	2.27	2.73	2.67	2.15
	Y	781		960		1014	
Haryana	A	1.12	0.97	1.18	0.91	1.11	0.80
	P	0.86	1.02	0.94	1.14	0.87	0.70
	Y	768		798		790	
Jharkhand	A	0.66	0.57	1.53	1.19	2.37	1.71
	P	0.50	0.60	1.42	1.72	2.72	2.19
	Y	760		932		1144	
Karnataka	A	7.20	6.21	9.88	7.66	11.04	7.98
	P	3.01	3.58	5.67	6.85	7.76	6.25
	Y	419		574		703	

{Area-lakh ha, Prod.-Lakh Tonnes, Yield-kg/ha}

States		Xth Plan	% to A	XIth Plan	% to AI	XIIth Plan	% to AI
Madhya Prd.	A	33.77	29.11	37.47	29.06	40.27	29.09
	P	27.01	32.12	31.25	37.70	40.38	32.52
	Y	800		834		1003	
Maharashtra	A	10.74	9.26	13.66	10.59	15.44	11.15
	P	6.44	7.66	10.75	12.97	11.46	9.23
	Y	599		787		742	
Odisha	A	2.12	1.83	3.22	2.49	3.42	2.47
	P	0.89	1.06	1.50	1.81	1.76	1.42
	Y	420		466		514	
Punjab	A	0.12	0.10	0.06	0.05	0.54	0.39
	P	0.11	0.13	0.07	0.08	0.48	0.38
	Y	884		1063		880	
Rajasthan	A	9.81	8.46	13.60	10.54	15.30	11.05
	P	6.90	8.21	9.91	11.96	13.35	10.75
	Y	704		729		873	
Tamilnadu	A	3.57	3.08	4.36	3.38	5.44	3.93
	P	1.42	1.69	1.55	1.87	3.55	2.86
	Y	398		356		653	
U.P.	A	18.52	15.96	15.11	11.72	14.86	10.74
	P	16.78	19.95	14.10	17.01	12.72	10.24
	Y	906		933		856	
West Bengal	A	1.78	1.54	1.38	1.07	1.70	1.23
	P	1.40	1.66	1.13	1.37	1.57	1.26
	Y	786		822		919	
All India	**A**	**115.99**		**128.97**		**138.43**	
	P	**84.10**		**82.87**		**124.18**	
	Y	**725**		**643**		**897**	




Rabi Pulses :National Scenario (T.E. 2012-2015)- Area
Bihar 3%
Gujarat 2%
Others 8%
T.N. 4%
C.G. 5%
M.P. 29%
Karnataka 8%
A.P 8%
M.H. 11%
Rajasthan 11%
U.P. 11%


Rabi Pulses : National Scenario (T.E. 2012-2015)- Production
Bihar 3%
Gujarat 2%
Others 10%
T.N. 3%
C.G. 4%
M.P. 33%
Karnataka 6%
A.P 9%
M.H. 9%
U.P. 10%
Rajasthan 11%

CHICKPEA (GRAM)

CHICKPEA

Botanical Name – *Cicer arietinum*
Synonym – Chickpea, Bengalgram, Chana and Gram
Origin – South West Asia – probably Afganisthan and/or Persia.
Chromosome nos. – 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.

1.1 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

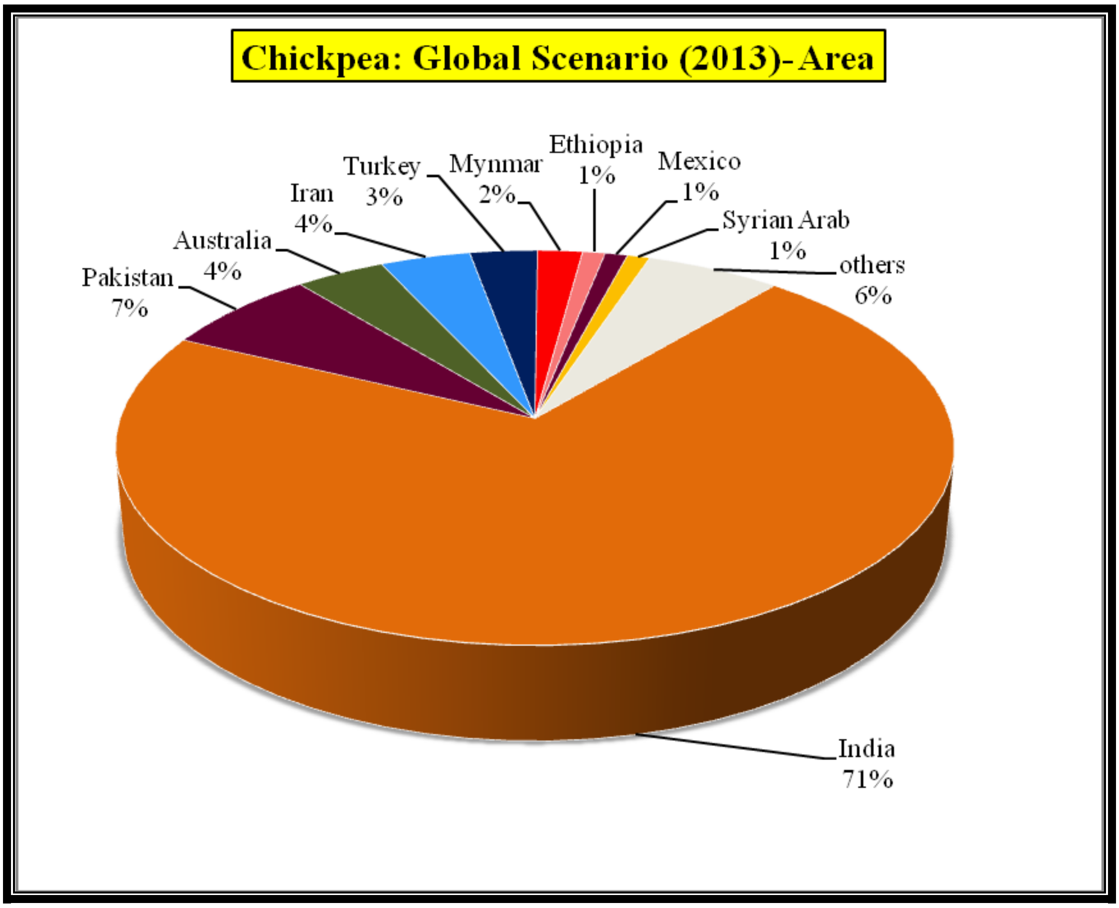
India ranked first in area and production in the world, followed by Pakistan, Australia and Iran. The highest productivity of 6120 kg/ha is observed in Isreal followed by Yemen, Canada and Egypt. India productivity was 920 kg/ha yields.

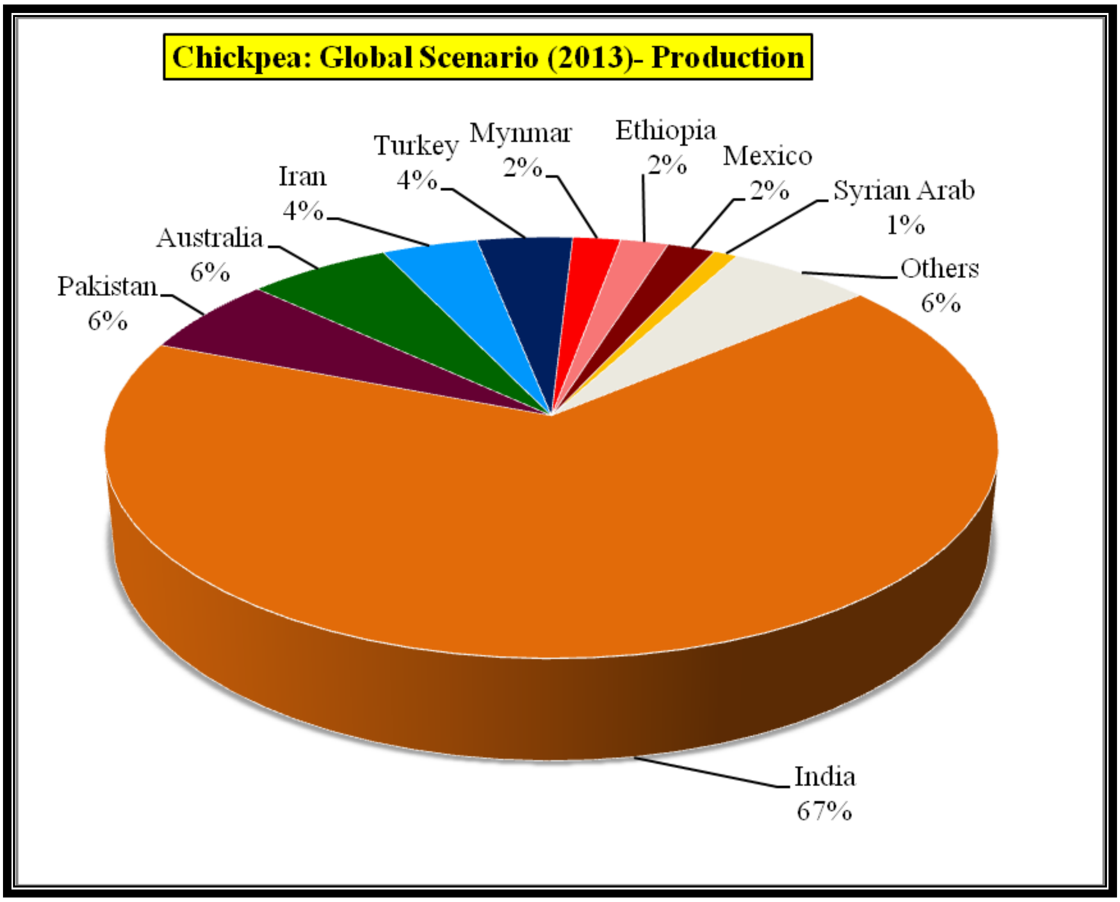
Table - 2.1 Global ranking in area, production and Yield: Major countries

{Area=lakh ha, Production=lakh tones, Yield-kg/ha}

Rank	Country	Area		Country	Production		Country	Yield
		Area	% to World		Prod.	% to World		
I	India	96.00	70.90	India	88.325	67.41	Isreal	6120
II	Pakistan	9.920	7.33	Australia	8.133	6.21	Yemen	2974
III	Australia	5.736	4.24	Pakistan	7.510	5.73	Canada	2353
IV	Iran	5.500	4.06	Turkey	5.060	3.86	Egypt	2136
V	Turkey	4.236	3.13	Mynmar	4.900	3.74	Ethiopia	2041
VI	Mynmar	3.350	2.47	Iran	2.950	2.25	Mexico	1817
VII	Ethiopia	1.222	0.90	Ethiopia	2.495	1.90	Cyprus	1533
VIII	Mexico	1.156	0.85	Mexico	2.099	1.60	Mynmar	1463
IX	Syrian Arab	0.845	0.62	Canada	1.694	1.29	Australia	1418
X	Canada	0.720	0.53	Yemen	0.580	0.44	Turkey	1195
	-	-	-	-	-	-	**India**	**920**
	World	**135.40**		**World**	**131.020**		**World**	**968**

Source: FAO Statistics- 2013


Chickpea: Global Scenario (2013)- Area
Turkey 3%
Mynmar 2%
Ethiopia 1%
Mexico 1%
Iran 4%
Syrian Arab 1%
Australia 4%
others 6%
Pakistan 7%
India 71%


Chickpea: Global Scenario (2013)- Production
Turkey 4%
Mynmar 2%
Ethiopia 2%
Mexico 2%
Iran 4%
Syrian Arab 1%
Australia 6%
Others 6%
Pakistan 6%
India 67%

2.2 National scenario: Area and Production trends - Plan Periods

2.2.1 ***Tenth Plan (2002-2007)*****:** A total of 68.18 lakh ha of area and 54.72 lakh tonnes of gram production were observed in the country during the plan. M.P. ranked first in terms of area and production (38.23% and 42.52%) followed by Maharashtra with 13.93% and 10.83% and Rajasthan with 13.77% and 11.60%, respectively. Andhra Pradesh has recorded and yield of 1147 kg/ha followed by Bihar with 915 kg/ha. The lowest yield observed in Karnataka (478 kg/ha) followed by Maharashtra (624 kg/ha) and Odisha (630 kg/ha).

2.*2.2 Eleventh plan (2007-12)*: The total area and production of gram in the country were 82.18 lakh hectares and 72.42 lakh tonnes respectively.Madhya Pradesh outstanding position in area coverage and production of gram (35.34% and 38.12% of the total area and production of the country), followed by Rajasthan (16.04% and 13.12%) and Maharashtra (15.27 % and 14.14%) respectively (Table-2.3). The highest productivity was recorded in plan period in Andhra Pradesh (1271 kg/ha) followed by Bihar (1072 kg/ha) and Gujarat (1050 kg/ha). The lowest yield was noticed in the state of Tamilnadu (648 kg/ha).

2.*2.3 Twelfth Plan (T.E. 2012-15)*: The total area and production of gram during twelfth Plan was 88.80 lakh hectares and 85.09 lakh tonnes respectively. Madhya Pradesh ranked first contributing an area of (34.32% and 39.47 % of total area and production of country), followed by Rajasthan (16.64 % and 14.99%) and Maharashtra (16.09 % and 12.95). The highest yield was recorded in the state of A.P. (1239 kg/ha) followed by West Bengal (1179 kg/ha) and Bihar (1171 kg/ha). The lowest yield was recorded in Tamilnadu (649 kg/ha).

Chickpea is a major pulse in India which, contributed about 37% of area & 47% of pulse production. Overall trend of area, production and yield of last three plan periods was shown significantly increased.

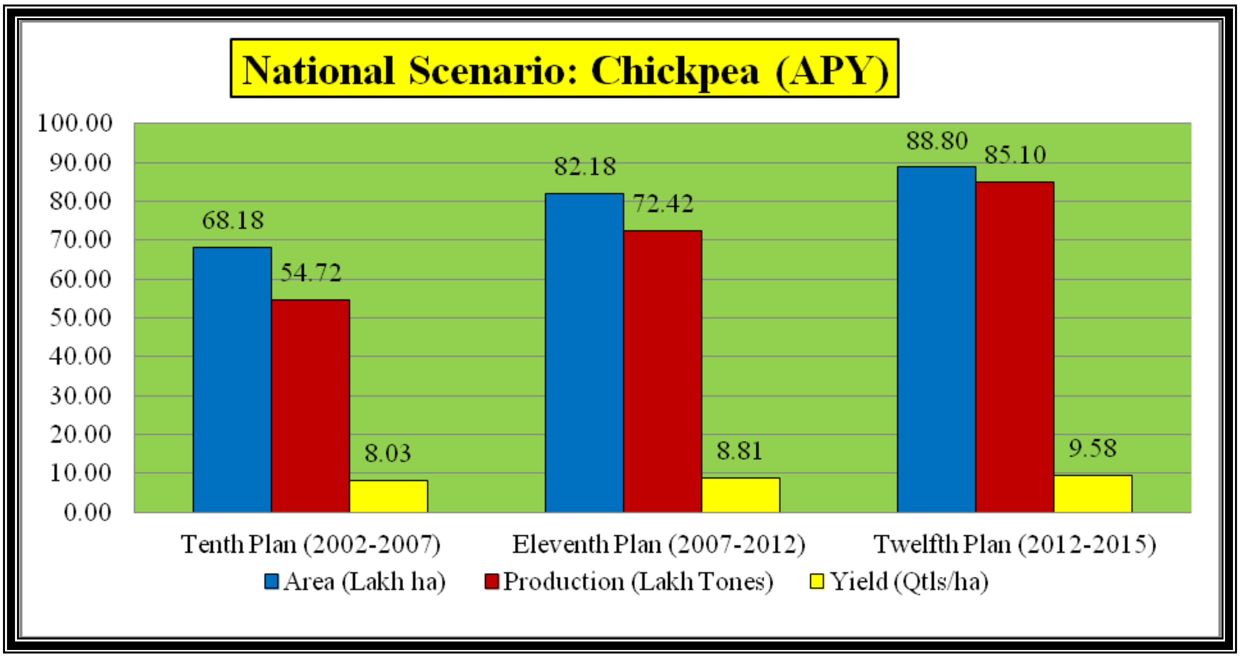
Table - 2.2 Plan-wise chickpea scenario - States

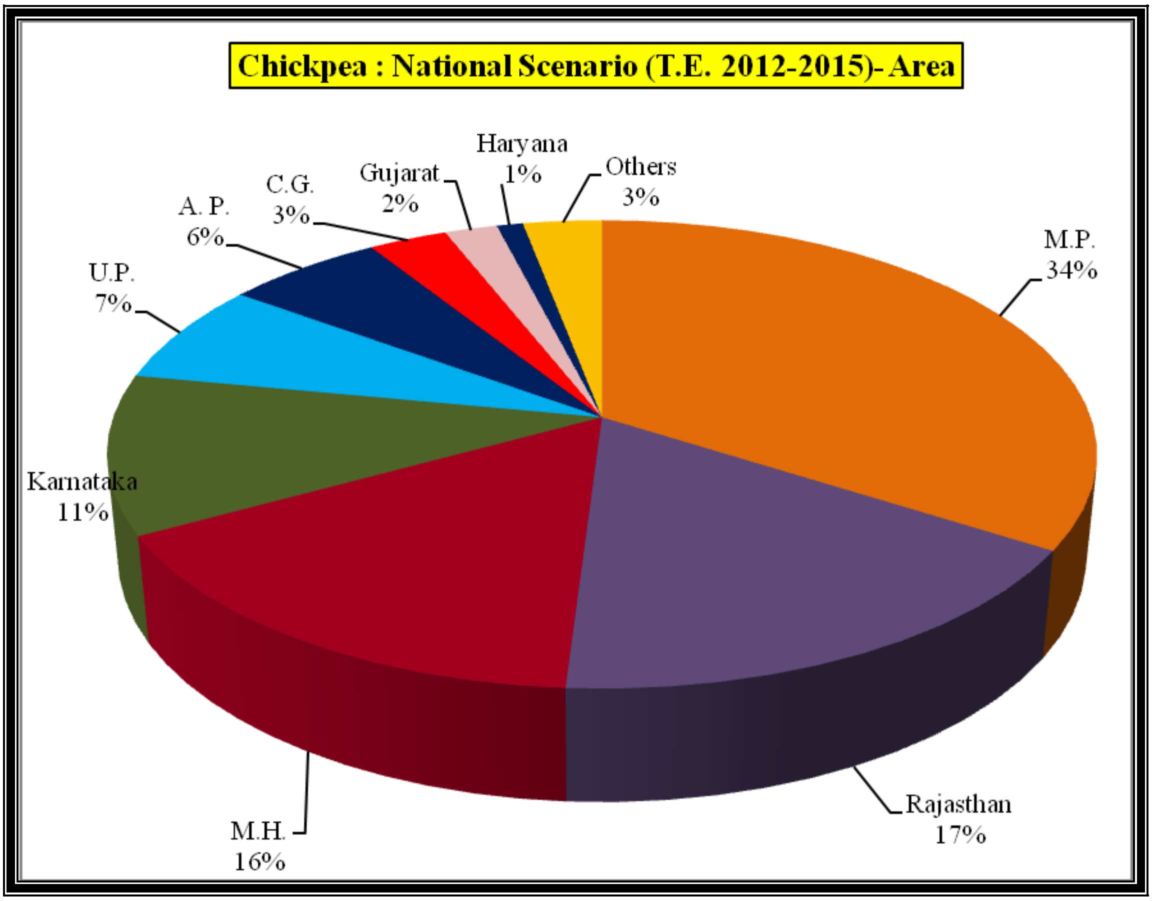
{Area=lakh ha, Production=lakh tones, Yield-kg/ha}

State		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
Andhra Pradesh	A	4.30	6.30	6.07	7.38	5.56	6.26
	P	4.93	9.01	7.71	10.65	6.89	8.09
	Y	1147		1271		1239	
Bihar	A	0.69	1.01	0.60	0.72	0.62	0.70
	P	0.63	1.15	0.64	0.88	0.72	0.85
	Y	913		1072		1161	
Chhattisgarh	A	2.07	3.04	2.44	2.97	2.75	3.09
	P	1.54	2.81	2.22	3.06	2.63	3.09
	Y	744		908		956	
Gujarat	A	1.49	2.18	1.88	2.28	1.96	2.21
	P	1.23	2.25	1.97	2.72	2.23	2.62
	Y	826		1050		1138	
Haryana	A	1.05	1.53	1.01	1.23	0.66	0.74
	P	0.79	1.44	0.85	1.18	0.57	0.67
	Y	752		844		864	

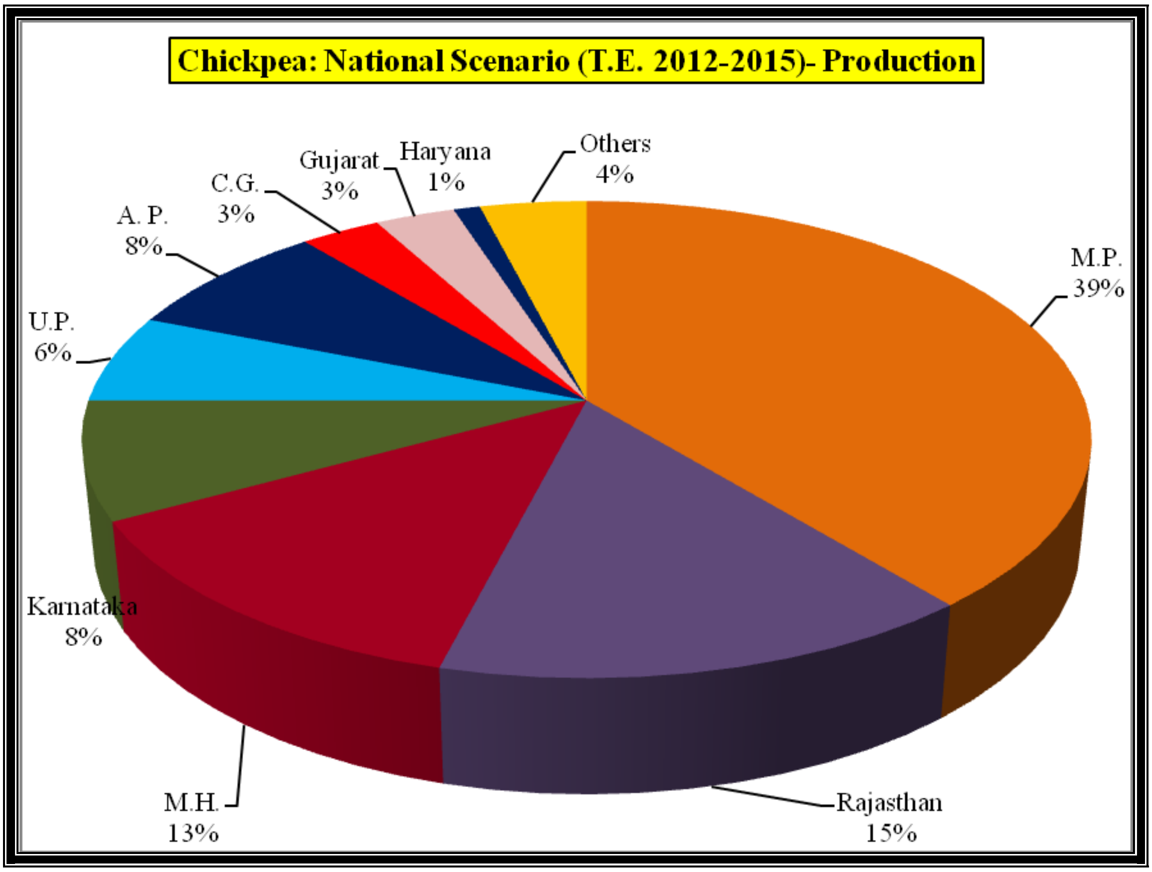
{Area=lakh ha, Production=lakh tones, Yield-kg/ha}

State		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
Karnataka	A	4.95	7.26	8.13	9.89	9.53	10.74
	P	2.37	4.33	4.88	6.74	7.03	8.26
	Y	479		601		738	
Madhya Prdesh	A	26.06	38.23	29.04	35.34	30.47	34.32
	P	23.26	42.52	27.60	38.12	33.59	39.47
	Y	893		951		1102	
Maharashtra	A	9.50	13.93	12.55	15.27	14.29	16.10
	P	5.93	10.84	10.24	14.14	11.02	12.95
	Y	624		816		771	
Odisha	A	0.31	0.45	0.40	0.49	0.45	0.51
	P	0.20	0.36	0.29	0.41	0.35	0.41
	Y	645		725		778	
Rajasthan	A	9.39	13.77	13.18	16.04	14.78	16.64
	P	6.35	11.60	9.50	13.12	12.76	15.00
	Y	676		721		863	
Tamilnadu	A	0.06	0.09	0.07	0.09	0.07	0.08
	P	0.04	0.08	0.05	0.07	0.05	0.06
	Y	667		648		714	
Uttar Pradesh	A	7.57	11.11	5.65	6.87	5.80	6.53
	P	6.80	12.43	5.32	7.35	5.11	6.00
	Y	898		942		881	
West Bengal	A	0.41	0.60	0.23	0.28	0.26	0.29
	P	0.37	0.67	0.24	0.33	0.30	0.36
	Y	902		1048		1154	
All India	**A**	**68.18**		**82.18**		**88.8**	
	P	**54.72**		**72.42**		**85.10**	
	Y	**803**		**881**		**958**	





Chickpea : National Scenario (T.E. 2012-2015)- Area
Haryana 1%
Others 3%
Gujarat 2%
C.G. 3%
A. P. 6%
U.P. 7%
M.P. 34%
Karnataka 11%
M.H. 16%
Rajasthan 17%



Chickpea: National Scenario (T.E. 2012-2015)- Production
Gujarat 3%
Haryana 1%
Others 4%
C.G. 3%
A. P. 8%
U.P. 6%
M.P. 39%
Karnataka 8%
M.H. 13%
Rajasthan 15%

2.3 Potential districts (2012-13)

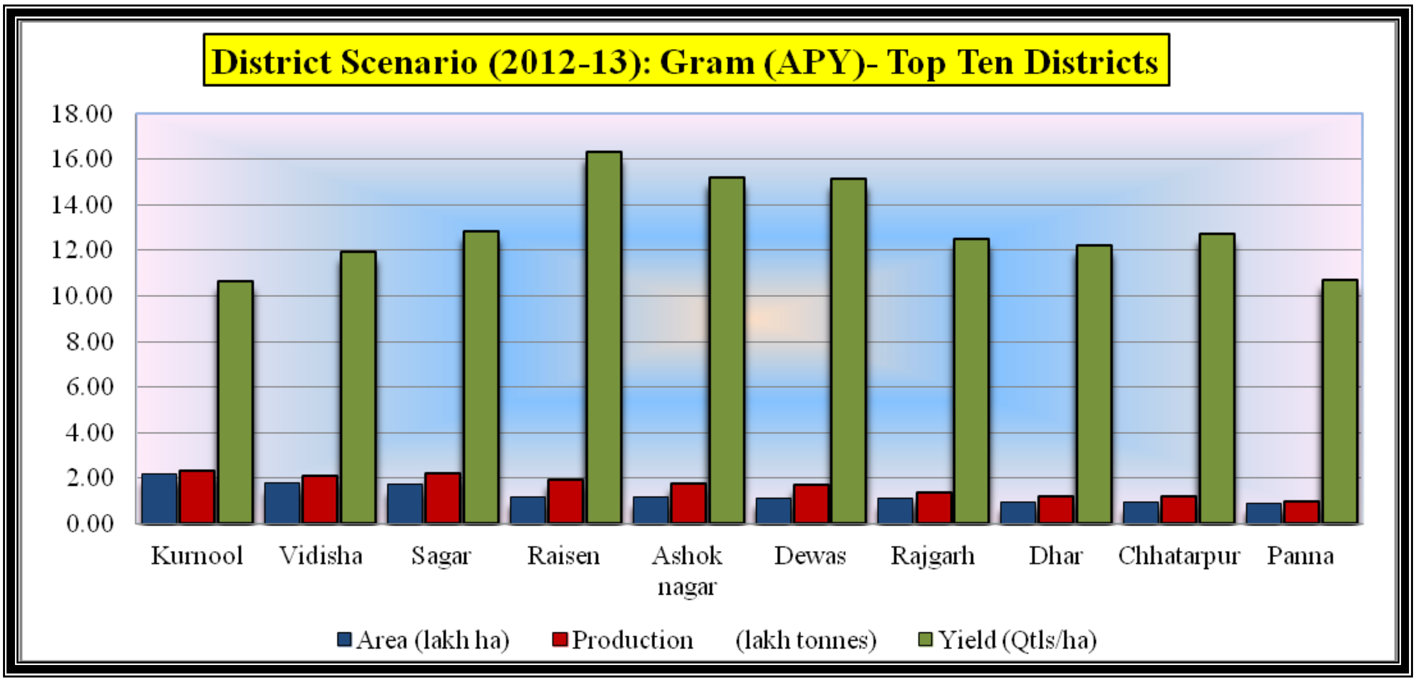
The intra-regional analysis at the district level as depicted in (**Table-2.3**) revealed the highest contribution in production of Kurnool, AP (2.56%) followed by Vidisha (2.07%) and Sagar (1.99%) of M.P.state. District-wise area, production and yield of top ten district of India in respect of production are presented below which contributed 15.24 per cent and 18.86 per cent of total area and production of chickpea in the country. The yield was revealed that the potential districts yield is higher than the National average yield (1036 kg/ha).

Out of Ten potential districts nine belongs to Madhya Pradesh whereas, only one district belongs to Andhra Pradesh.

Table - 2.3 Top potential districts (2012-13)

{A-Lakh ha, Production-Lakh Tonnes, Yield-kg/ha}

S. No.	Name of District	State	Area		Production		Yield	
			Area	% to India	Prod.	% to India	Yield	YI
I	Kurnool	A.P.	2.182	2.56	2.320	2.63	1063	103
II	Vidisha	M.P.	1.768	2.07	2.106	2.38	1191	115
III	Sagar	M.P.	1.700	1.99	2.181	2.47	1283	124
IV	Raisen	M.P.	1.172	1.38	1.909	2.16	1629	157
V	Ashok nagar	M.P.	1.165	1.37	1.769	2.00	1518	146
VI	Dewas	M.P.	1.129	1.33	1.707	1.93	1511	146
VII	Rajgarh	M.P.	1.083	1.27	1.355	1.53	1251	121
VIII	Dhar	M.P.	0.965	1.13	1.177	1.33	1220	118
IX	Chhatarpur	M.P.	0.924	1.08	1.174	1.33	1271	123
X	Panna	M.P.	0.901	1.06	0.964	1.09	1070	103
	Total above		12.99	15.24	16.66	18.86	1283	124
	All India		**85.22**		**88.32**		**1036**	



3. ECONOMIC CLASSIFICATION

3.1 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).

3.2 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

5.1 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 – 2.4). However, some varieties for specific situations are as follows: **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.

5.4 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 follows- **Rotation:-** Kharif fallow – Gram (in barani areas)**,** Paddy – Gram, Maize – Gram**,** Bajra – Gram and Jowar – Gram**; Inter cropping**: Chickpea + Mustard (2:1 to 4:1); Chickpea + Linseed (2:2); chickpea + wheat/ Barley (2:2), Chickpea + Safflower (2:2) and Chickpea + Corriander (2:2).

5.5 Seed and sowing

i. **Sowing time: Rainfed** – Ist fortnight of October in central and south India and IInd fortnight of October in North India. **Irrigated**– Ist fortnight of November in North India and IInd fortnight of October in central and southern India**; Late sowing**– Ist 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.

5.6 Plant nutrient management: About 5 tonnes 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. Application of fertilizer is based on soil testing. 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.

5.7 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.

5.8 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.

5.9 Weed management- Major weeds infestation in 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 arvensis* (Krishan neel), *Phalaris minor* and *Avena ludoviciana*.

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. Also application of Oxyflourfen 100-125 g a.i./ha or 400 to 500 g or ml /ha at 0-3 DAS controls wide spectrum of weeds in the crop.

5.10 Plant protection measures – Refer Table - 2.5.

5.11 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.

5.12 Yield- By adopting good management practices, as described above, an average yield of 15-20 q/ha can easily be obtained.

Table – 2.4 Recommended varieties of chickpea/characteristics

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
RSG-44	RAU, Durgapura	1991	Rajasthan	20-23	135-150	Tol. to drought and frost, double podded
KPG-59 (Uday)	CASUAT	1992	**NWPZ** (Punjab, Haryana, Delhi, North Rajasthan & West U.P., Bihar & West Bengal).	20.0	135-140	Tolerant to root rot & wilt stunt. Tolerant to pod borer. Bold seeded.**(late sown)**
Bharati (ICCV-10)	ICRISAT	1992	**SZ** (A.P., Karnataka, Odisha & Tamilnadu) **CZ** (MP, Maharashtra, Gujarat).	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** (East UP, Bihar, WB). **NWPZ** (Punjab, Haryana, Delhi, Rajasthan **CZ** (MS & Gujarat). (late sown)	21-23 14.0 14-15	135-150	Moderately resistant to wilt, blight & root rot., Small seed, light brown
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** (Punjab, Haryana, Delhi, North Rajasthan & West U.P).	21-23	145-155	Moderately resistant to Wilt, bold seeded
Vijay (Phule G-81-1-1)	MPKV	1994	**CZ** (MP, Maharashtra, Gujarat).	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** (Punjab, Haryana, Delhi, North Rajasthan & West U.P).	22-25	150-155	Resistant to wilt.
GPF-2 (GF-89-36)	PAU	1995	**NWPZ** (Punjab, Haryana, Delhi, North Rajasthan & West U.P).	21-23	152	Resistant to wilt & tolerant to Ascochyta blight. Seed yellowish brown

(Chick Pea Continued)

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
Pusa-362 (BG-362)	IARI	1995	**NWPZ** (Punjab, Haryana, Delhi, North Rajasthan & West U.P).	23-24	145-150	Tolerant to wilt, Bold seeded.
KWR-108	CSAUAT	1996	**NEPZ** (East Uttar Pradesh, Bihar, West Bengal).	20-23	130-135	Resistant to wilt, Seeds are dark brown and small.
JG-218	JNKVV	1996	Madhya Pradesh.	18-19	115-120	Early maturing, Tolerant to wilt.
Vishal (Phule G-87207)	MPKV	1996	**CZ** (MP,Maharashtra,Gujarat).	20.00	110-115	Resistant to wilt, Tolerant to pod borer, Early maturing.
Alok (KGD-1168)	CSAUAT	1996	**NWPZ** (Punjab, Haryana, Delhi, North Rajasthan & West U.P).	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** (Punjab, Haryana, Delhi, North Rajasthan & West U.P).	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** (MP, Maharashtra, Gujarat).	17-18	110-120	Moderately resistant to wilt & root rot. Bold seeded. Light brown
PDG-3 (GF 89-133)	PAU, Ludhiyana	1997	Punjab	15-17	160-165	Tolerant to pod borer.
Karnal Chana-1(CSG 8962)	CSSRI, Karnal	1997	**NWPZ** (Punjab, Haryana, Delhi, North Rajasthan & West U.P).	22-25	140-147	Recommended for salt affected areas; Wilt resistant.
DCP-92-3	IIPR	1997	**NWPZ** (Punjab, Haryana, Delhi, North Rajasthan & West U.P).	19-20	145-150	Lodging and wilt resistant. Yellowish brown and medium bold seeds. Suitable for high fertility and excessive moisture conditions.

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
JGG-1	JNKVV	1997	Madhya Pradesh	13-15	120-125	Seed pink
(BG-1003) (Pusa Kabuli)	IARI	1999	**NEPZ** (East Uttar Pradesh, Bihar, West Bengal).	17-19	140-150	White bold seeded, tolerant to wilt.
JG-11	ICRISAT/P KV/JNKVV	1999	**SZ** (Odisha, Karnataka, A.P. & Tamilnadu)	15-17	95-100	Resistant to wilt, moderately resistant to root rot. Bold seeded
Guj. Gram-1	GAU	1999	**CZ** (MP,Maharashtra,Gujarat)	17-22	115-120	Wilt resistant, Dark brown, medium bold.
Dharwad Pragati (BGD 72)	IARI	1999	**CZ (**MP,Maharashtra,Gujarat)	25-30	115-120	Resistant to wilt & root rot, bold seeded
CO-3	TNAU	1999	Tamilnadu	9-11	80-85	Bold seeded, Resistant to wilt & Collar rot
CO-4	TNAU	1999	Tamilnadu	9-11	80-85	Bold seeded
JG-322	JNKVV	1999	Madhya Pradesh	18-20	110-115	Suitable for wilt prone areas.
WCG-2 (Surya)	Meerut Uni.	1999	Uttar Pradesh	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** (Punjab, Haryana, Delhi, North Rajasthan & West U.P)	17-19	140-150	Tolerant to wilt
Gujarat Gram-4 (GCP-105)	GAU	2000	**NEPZ** (East U.P., Bihar, West Bengal).	18-20	135-130	Resistant to wilt. Seeds are dark brown.
PKV Kabuli-2 (KAK 2)	PKV	2000	**CZ (**MP, CG, MS, Gujarat)	17-18	125-130	Bold seeded
SAKI-9516 (Jawahar G 16)	JNKVV	2001	**CZ (**MP, Maharashtra, Gujarat)	18-20	110-120	Resistant to wilt.

Variety	**Source**	**Year of Release/ Notification**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Days to maturity**	**Remarks**
Vaibhav (RG 2918)	IGKV	2001	Chhattisgarh	14-15	110-115	Seeds wrinkled and bold
Kranti (ICCC-37)	ICRISAT	2001	Andhra Pradesh	16-20	90-100	Resistance to Wilt & Dry root rot
WCG-10 (Pant G-10)	GBPUAT	2001	Maharashtra, Haryana, U.P.	21-25	147	Resistant to root rot, Mod. Resis. To stunt virus, wilt and dry root rot
Haryana Kabuli 1 (HK- 89-131)	CSSHAU	2002	Haryana	20	142	Resistant to wilt
Virat (Kabuli)	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**- M.P., Maharashtra, Gujarat, Bundel khand region of U.P.	15-18	110-115	Mod. Resistant to wilt
Vihar(Phule G-95311)	MPKV	2002	Karnataka, A.P., TN, Odisha	16-18	90-100	Seed Bold, Resistant to wilt
Anubhav (RSG 888)	RAU	2003	Punjab, Haryana, Delhi, North Rajasthan & West U.P).	20-22	130-135	For rainfed, Moderately resistant to wilt & root rot
Pusa 1088	IARI	2003	Delhi	25-30	Med. early	Res. to wilt and root rots diseases.
Pusa 1103	IARI	2004	Delhi	19-23	Early	Resistant to root diseases.
Pusa 1105	IARI	2004	Delhi	25-30	Med.early	Mod. Resistant to root diseases.
Anuradha	Research station, Berhanpur	2004	West Bengal	22-25	120-130	Mod. Resistant to wilt.
Haryana Kabuli Chana 2 (HK 94 134)	CCS HAU	2004	U.P and Bihar	14	138	Resistant to wilt, Collor rot, dry root rot.

(Chick Pea Continue)

Variety	**Source**	**Year of Release/ Notification**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Days to maturity**	**Remarks**
Asha (RSG 945)	ARS, Duragapura	2005	Rajasthan	17	75-80	Mod. Res. to dry root rot and wilt.
PGC-1 (Pratap Channa-1)	ARS, Banswara	2005	Rajasthan	12-14	90-95	Mod. Resistant to wilt & pod borer.
Arpita (RSG-895)	RAU, Bikaner	2005	Rajasthan	14	125-130	Mod. Res. to dry root rot, wilt & B.G.M.
Haryana Chana-5 (H 96-99)	HAU, Hisar	2005	Haryana	20	Medium	Res. to *Fusarium* wilt and root rots
Aadhar (RSG-963)	ARS, Duragapura	2005	Raj, Hary, Punjab, Delhi parts of J & K, Uttrakhand and U.P	16-17	125-130	Mod. Resis. To Wilt, Dry root rot, B.G.M. & Collor rot, pod borer, & Nematodes
Himachal G-2	CSKHPKVV	2006	CZ	19	187	Resis. to Wilt, root rot & color rot, tolerant to Ascochyta Blight
JAKI -9218	PDKV, Akola	2006	CZ	18-20	93-125	Resistant to wilt, root rot, color rot
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	Medium	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
JG-63	JNKVV	2006	MP	20-25	110-120	Resistance to Wilt, Dry root rot & Mod. Resis. To Collor rot &*Helicoverpa* Species.
Akash (BDNG-797)	MPKV	2007	Maharashtra	15-16	102	Resistant to wilt, tolerant to pod borer

(Chick Pea Continue)

Variety	Source	Year of Release/ Notification	Area of adoptionZone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
Rajas (Phule-G-9425-9)	MPKV	2007	Punjab, Haryana, Uttarakhand, Delhi, Rajasthan 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 shanaya(LBeG 7)	ANGRAU	2007	M.P.	20-25	90	Tolerant to Wilt and rot condition
JGK-3 (JGK 19)	JNKVV	2007	M.P.	14-15	92-121	Resistant to wilt
Jawahar Gram 226 (JG 226)	JNKVV	2007	M.P.		112-115	Resistant to wilt and root rot complex
GNG 421 (Gauri)	ARS, Sri Ganga Nagar	2007	Rajasthan	18	127-160	Tolerant to dry root rot, stunt and wilt
GNG 1488 (Sangam)	ARS, Sri Ganga Nagar	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 (Aruna)	ARS, Duragapura	2007	Rajasthan	15-20	130-135	Mod. Res. to dry root rot, wilt, pod borer
JAKI 9218	PDKV	2008	Maharashtra	18-20	93-125	Resistant to *fusarium* wilt, root rot and collar rot
GNG 1581 (Ganguar)	ARS, Srigan-ganagar	2008	NWPZ	24.00	127-177	Resistant to water logging condition

(Chick Pea Continue)

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
WCG 3 (vallabh colour chana)	SVBPUAT, Meerut	2008	Uttar Pradesh	19-21	175	Bold seeded, protein content 22.8 %.
JG 6	JNKVV	2008	M.P.	20.00	103-132	Resistant to fusarium wilt and moderate resistant to dry root, Tolerantto pod borer
Pusa 2024	IARI	2008	Delhi	25-28	145	Moderately resistant against soil borne diseases and drought
BGD 103	UAS	2009	Karnataka	11-13	95-100	Resistant to fusarium wilt
JG 14	JNKVV	2009	M.P.	20-25	113	Moderate resistant to wilt, dry root and pod borer
Shubra (IPCK 2004-29)	IIPR	2009	CZ	21.00	104-108	Moderate resistant to wilt, escape terminal moisture stress and heat
Ujjawal (IPCK 2004-29)	IIPR	2010	CZ	20.00	103-111	Moderate resistant to wilt and tolerant to BGM, escape terminal moisture stress and heat
Phule G 0517	MPKV	2010	M.S., M.P., Karnataka	18.00	105-110	Tolerant to fusarium wilt, 59.4g/100 seed weight
Pant Kabuli chana 1	GPBUAT, Pantnagar	2010	Uttarakhand	30.00	120-122	Resistant to Botrytis grey mould
PKV Kabuli 4	PDKV	2010	Maharashtra, Madhya Pradesh	15-16	100-110	Moderately resistant to fusarium wilt dry rot and Botrytis grey mould
Gujarat Junagarh Gram 3 (GJG 0207)	JAU, Junagarh	2010	Gujarat	15.00	98-100	Moderately resistant to wilt and tolerant to pod borer
GPF 2	PAU	2010	NWPZ	22.00	134-163	Plants grow erect with thick stem resistant in lodging

(Chick Pea Continue)

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
MNK 1	UAS, Raichur	2011	Karnataka, A.P., Odisha, and Tamil Nadu	13.00	95-110	Moderately resistant to wilt
RSG 974 (Abhilasha)	ARS,Duragapura	2010	Rajasthan		130-135	Moderately resistant to wilt, dry root rot BGM and sterility mosaic
Raj Vijay Kabuli gram 101 (JSC 42)	RVSKVV	2012	Madhya Pradesh	15-20	90-110	Resistant to fusarium wilt and moderate tolerant to pod borer
Raj Vijay gram 201 (JSC 40)	RVSKVV	2012	Madhya Pradesh	20-25	95-113	Resistant to fusarium wilt
HK 4 (HK 05-169)	CCSHAU	2012	NEPZ	15.00	136	Resistant to wilt, bold seeded
Raj Vijay Kabuli gram 202	RVSKVV	2012	CZ	18-20	105	Suitable for late sown condition in paddy/cotton/soyabean-chickpea cropping system
Raj Vijay Kabuli gram 203 (RVG-203)	RVSKVV	2012	CZ	19-20	100	Moderately resistant to wilt, dry root rot
PBG -5	PAU, Ludhiana	2012	Punjab	17.00	160-165	Resistant to ascochyta blight disease
PKV harita (AKG 9303-12)	PDKV	2012	Vidarbha region of Maharashtra	12-18	106-110	Bold seeded, tolerant to wilt and drought, useful for culinary purpose
GJG 0809	Junagarh	2013	NHZ	16.0	157	Irrigated, medium brown colour attractive seed (21.5 g/100 seed), mod. Resistant to wilt & stunt, root rot & tolerant to ascochyta blight.

(Chick Pea Continue)

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
GNG 1958	Sriganga nagar	2013	**NWPZ (**Punjab, Haryana, Delhi, North Rajasthan, West U.P).	26.8	145	Irrigated, suitable for normal sown irrigated condition. It matures in 145 days. It has brown seed colour with 25.4 g average 100-seed weight.
GNG 1969	Sriganga nagar	2013	**NWPZ**	22.0	146	Irrigated, suitable for normal sown irrigated condition. It posses creamy beige seed colour with 26.2 g/100 seeds.
CSJ 515	Durgapura	2013	**NWPZ**	24.0	135	Irrigated, small brown colour seed (17.0 g/100 seed), mod. Resis. to dry root rot, and tolerant to ascochyta blight and BGM.
GLK 28127	Ludhiana	2013	**NWPZ**	21.0	149	Irrigated, large seeds (36.0 g/100 seeds), light yellow or creamy colour with irregular owl head.
Raj Vijay Kabuli gram 202 (RVG 202)	RVSKVV, Gwalior	2014	CZ	18-20	105	Late sown condition in paddy/cotton/soyabean-chickpea cropping system.

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, Odisha) 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 – 2.5 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	Monocrotophos 36 WSC @ 0.04%. Spray of Indoxacarb 14.5 SC @ 50 g a.i./ha
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.	Monocrotophos 36 EC or NPV @ 250 LE/ha. BT formulation @ 1.0-1.5 kg/ha. Spray of Indoxacarb 14.5 SC @ 50 g a.i./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 by Bavistin @ 2.5g kg^{-1} of seeds
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 (ARHAR)

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.

1.1 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 74% and 63% of world area and production respectively. In productivity, Philippines ranked first with 1669 kg/ha followed by Burundi and Grenada.

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

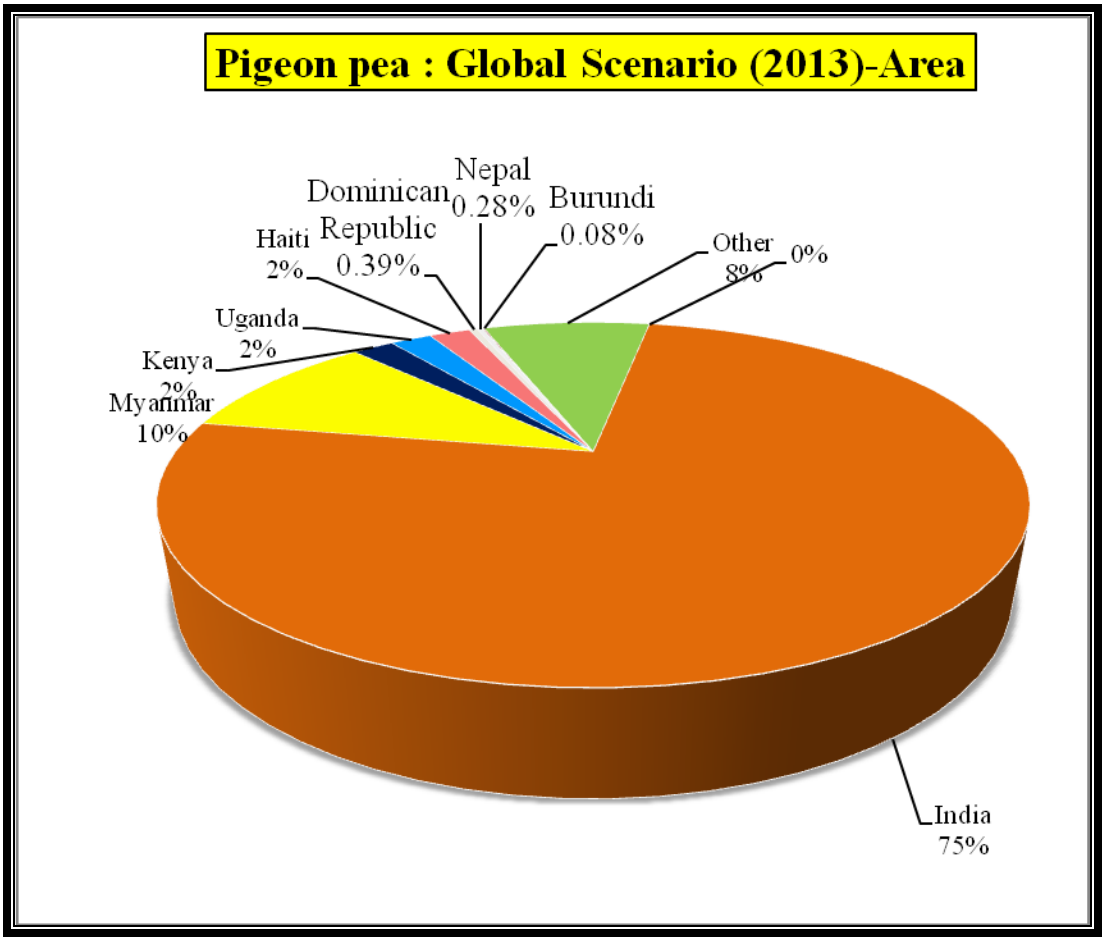
{Area-Lakh ha, Production-Lakh Tonnes, Yield-kg/ha}

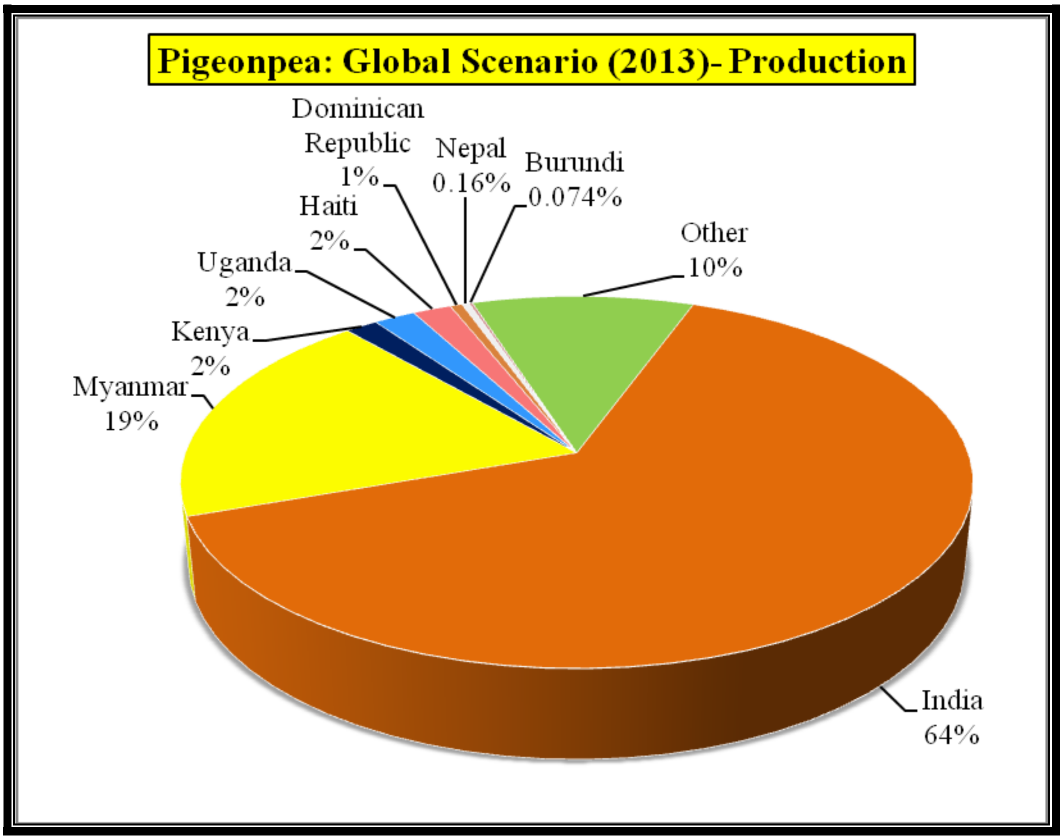
Rank	Country	Area		Country	Production		Country	Yield
		Area	% to World		Prod.	% to World		
I	India	46.5	74.76	India	30.227	63.74	Philippines	1669
II	Myanmar	6.5	10.45	Myanmar	9.000	18.98	Burundi	1543
III	Kenya	1.3	2.09	Uganda	0.939	1.98	Grenada	1455
IV	Haiti	1.09	1.75	Haiti	0.869	1.83	Myanmar	1385
V	Uganda	1.05	1.69	Kenya	0.732	1.54	Jamaica	1150

{Area-Lakh ha, Production-Lakh Tonnes, Yield-kg/ha}

Rank	Country	Area		Country	Production		Country	Yield
		Area	% to World		Prod.	% to World		
VI	Dominican Republic	0.241	0.39	Dominican Republic	0.269	0.57	Dominican Republic	1114
VII	Nepal	0.175	0.28	Nepal	0.165	0.347	Nepal	943
VIII	Burundi	0.048	0.08	Burundi	0.074	0.156	Uganda	895
IX	Panama	0.038	0.06	Panama	0.020	0.042	Puerto Rico	889
X	Trinidad & Tobago	0.009	0.01	Jamaica	0.010	0.020	Bangladesh	860
XI							**India**	**650**
	World	**62.199**		**World**	**47.421**		**World**	**762**

Source: *FAO Statistics*





2.2 National Scenario

2.2.1 ***Tenth Plan (2002-2007):*** The country's total area coverage and production of tur were 35.07 lakh hectares and 23.88 lakh tonnes respectively. The state-wise trend shows that Maharashtra ranked first both in respect of area and production (30.87% and 31.30%) followed by Karnataka (16.00% and 12.12%). The third place occupied by Andhra Pradesh in area (13.28%) and U.P. (15.15%) in production. The highest yield recorded by Bihar (1177 kg/ha) followed by Haryana (1033 kg/ha) and U.P. (951 kg/ha).The lowest yield recorded in the state of A.P. (451 kg/ha) followed by Chhattisgarh (483 kg/ha) and Karnataka (516 kg/ha).

2.2.2 ***Eleventh Plan (2007-2012)*****:** The country's total area coverage and production of tur were 37.89 lakh hectares and 26.64 lakh tonnes respectively. The state-wise trend shows that Maharashtra ranked first both in respect of area and production (30.68% and 33.44%) followed by Karnataka (18.69% and 14.75%). The third place occupied by Andhra Pradesh in area (13.14%) and U.P. 10.97%) in production. The highest yield recorded by Bihar (1301 kg/ha) followed by Haryana (1071 kg/ha) and Gujrat (1008 kg/ha). The lowest yield recorded in the state of A.P. (449 kg/ha) followed by C.G. (497 kg/ha) and Karnataka (555 kg/ha).

2.2.3 ***Twelft Plan (T.E.2012-2015)*****:** The country's total area coverage and production of tur were 38.35 lakh hectares and 29.92 lakh tonnes respectively. The state-wise trend shows that Maharashtra ranked first both in respect of area and production (29.19 % and 29.68 %) followed by Karnataka (19.23 % and 15.96 %). The third place occupied by Madhya Pradesh (13.17% and 13.30 %). The highest yield recorded by Bihar (1739 kg/ha) followed by Haryana (1111 kg/ha) and Gujrat (1105 kg/ha). The lowest yield observed in the state of A.P. (521 kg/ha) followed by C.G. (623 kg/ha) and Karnataka (648 kg/ha).

The overall trend of area, production and yield shown increasing trend during the last three Plan Period.

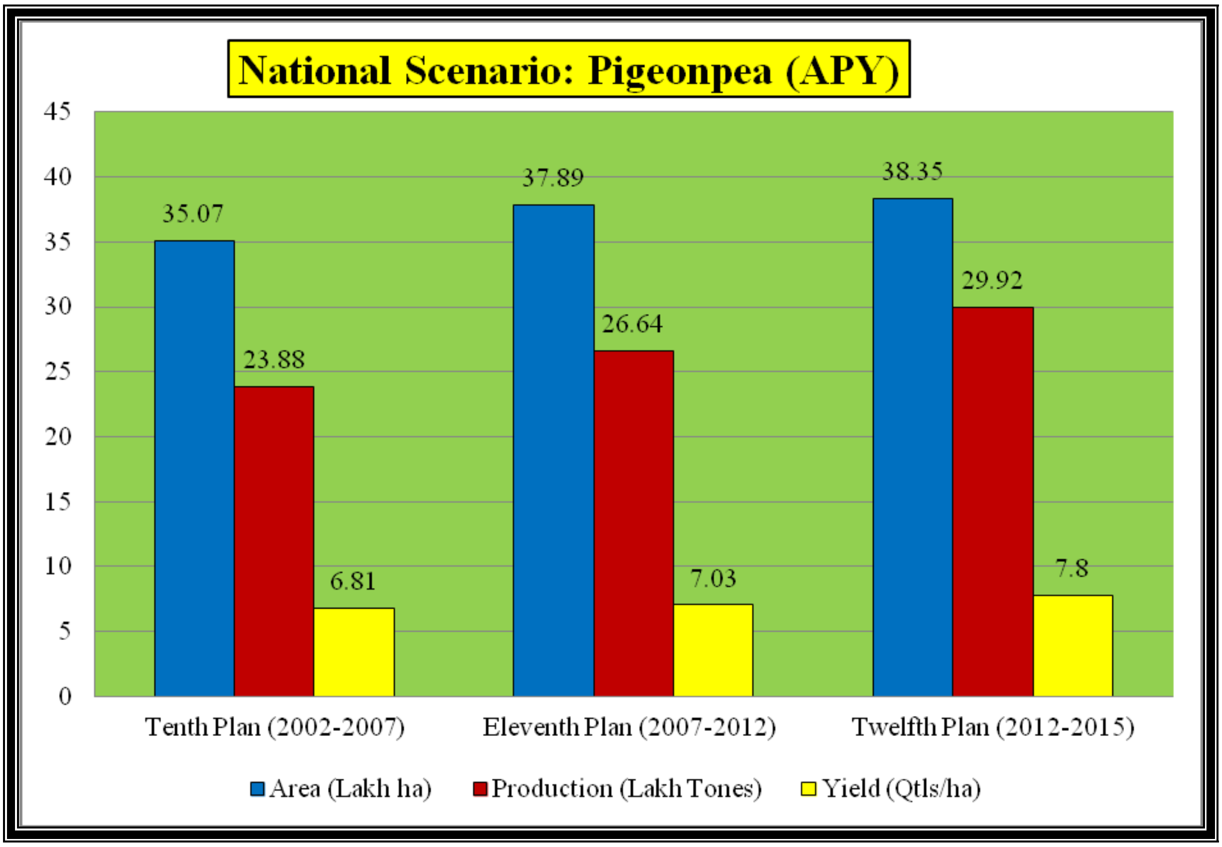
Table – 3.2 Plan-wise Pigeonpea Scenario - States

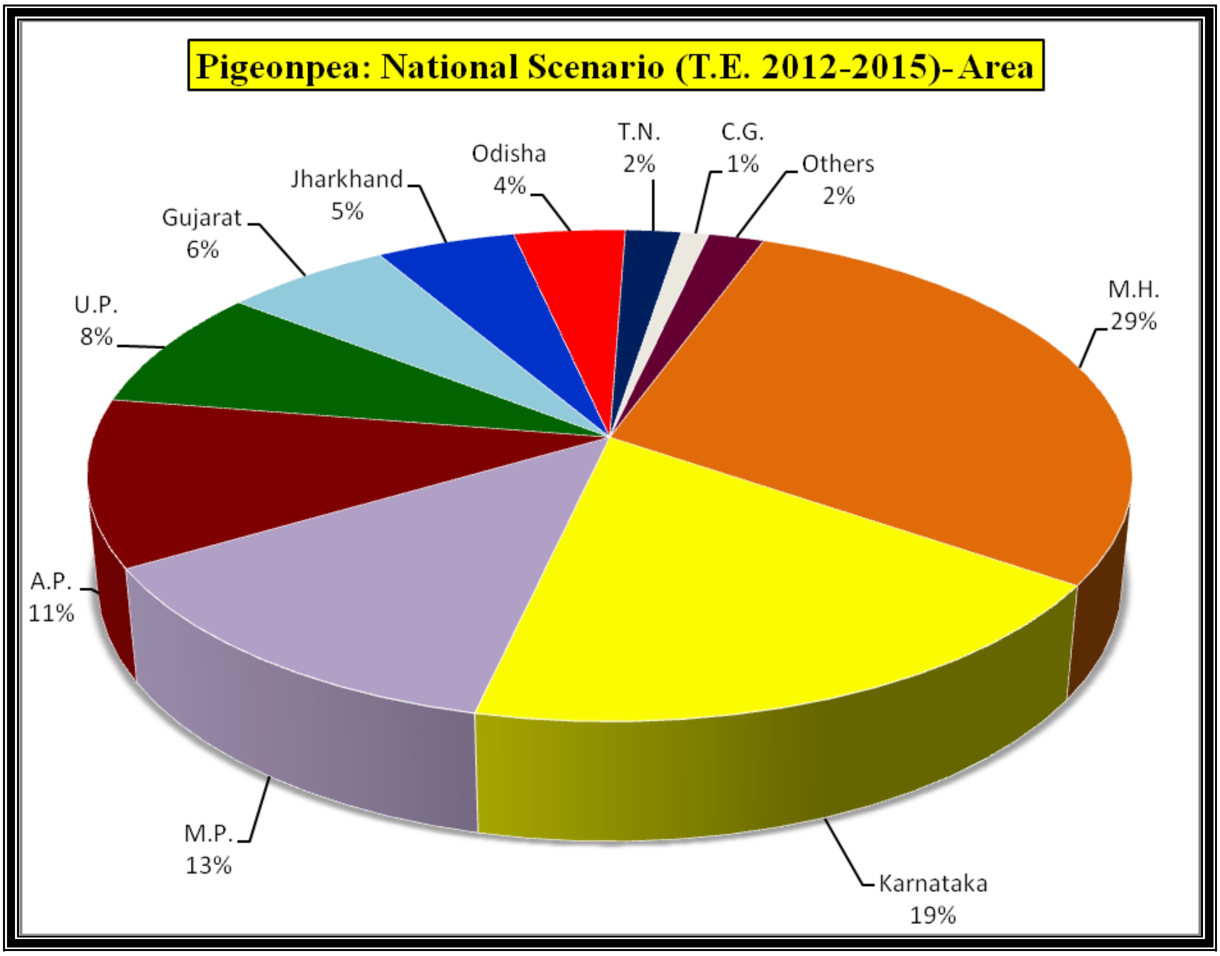
{A= lakh ha, P= Lakh Tonnes, Y= kg/ha}

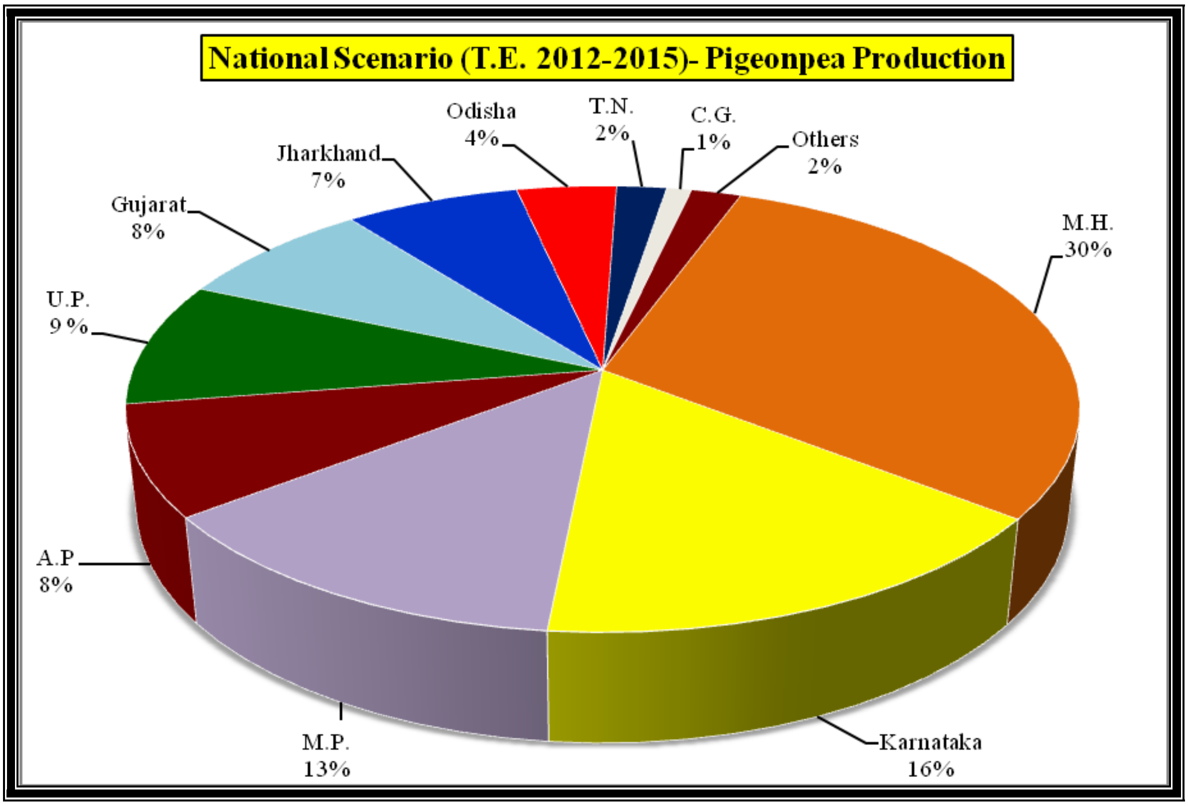
State		Xth Plan	% to AI	XIth Plan	% to AI	XIIthPlan	% to AI
A.P	A	4.66	13.28	4.98	13.14	4.33	11.29
	P	2.10	8.78	2.24	8.39	2.26	7.54
	Y	451		449		521	
Bihar	A	0.36	1.04	0.28	0.73	0.22	0.58
	P	0.43	1.79	0.36	1.35	0.39	1.29
	Y	1177		1301		1739	
Chattisgarh	A	0.56	1.59	0.55	1.46	0.52	1.36
	P	0.27	1.13	0.27	1.03	0.32	1.08
	Y	483		497		623	
Gujarat	A	2.81	8.02	2.64	6.96	2.22	5.80
	P	2.38	9.95	2.66	9.97	2.46	8.21
	Y	844		1008		1105	
Haryana	A	0.31	0.87	0.25	0.67	0.10	0.27
	P	0.32	1.32	0.27	1.02	0.11	0.38
	Y	1033		1071		1111	
Jharkhand	A	0.78	2.21	1.00	2.64	1.96	5.11
	P	0.55	2.30	0.77	2.89	2.02	6.76
	Y	710		771		1032	
Karnataka	A	5.61	16.00	7.08	18.69	7.37	19.23
	P	2.89	12.12	3.93	14.75	4.78	15.96
	Y	516		555		648	
Madhya Prd.	A	3.18	9.07	4.06	10.72	5.05	13.17
	P	2.32	9.71	2.57	9.63	3.98	13.30
	Y	729		632		788	
Maharashtra	A	10.83	30.87	11.62	30.68	11.19	29.19
	P	7.47	31.30	8.91	33.44	8.88	29.68
	Y	690		766		793	
Odisha	A	1.29	3.69	1.37	3.62	1.39	3.63
	P	0.93	3.88	1.16	4.37	1.26	4.20
	Y	716		847		902	
Punjab	A	0.08	0.24	0.05	0.13	0.03	0.07
	P	0.07	0.31	0.04	0.17	0.03	0.09
	Y	896		945		907	
Rajasthan	A	0.18	0.52	0.19	0.51	0.15	0.39
	P	0.11	0.46	0.13	0.50	0.11	0.38
	Y	598		693		762	

{A= lakh ha, P= Lakh Tonnes, Y= kg/ha}

State		X[th] Plan	% to AI	XI[th] Plan	% to AI	XII[th]Plan	% to AI
Tamilnadu	A	0.39	1.12	0.32	0.83	0.60	1.56
	P	0.24	0.99	0.23	0.86	0.57	1.91
	Y	604		724		953	
Uttar Pradesh	A	3.80	10.85	3.30	8.72	3.00	7.81
	P	3.62	15.15	2.92	10.97	2.57	8.58
	Y	951		884		857	
West Bengal	A	0.02	0.07	0.01	0.03	0.02	0.04
	P	0.02	0.09	0.01	0.04	0.02	0.08
	Y	873		870		1458	
All India	A	35.07		37.89		38.35	
	P	23.88		26.64		29.92	
	Y	681		703		780	




Pigeonpea: National Scenario (T.E. 2012-2015)- Area
Odisha 4%
T.N. 2%
C.G. 1%
Others 2%
Jharkhand 5%
Gujarat 6%
U.P. 8%
M.H. 29%
A.P. 11%
M.P. 13%
Karnataka 19%


National Scenario (T.E. 2012-2015)- Pigeonpea Production
Odisha 4%
T.N. 2%
C.G. 1%
Others 2%
Jharkhand 7%
Gujarat 8%
M.H. 30%
U.P. 9%
A.P 8%
M.P. 13%
Karnataka 16%

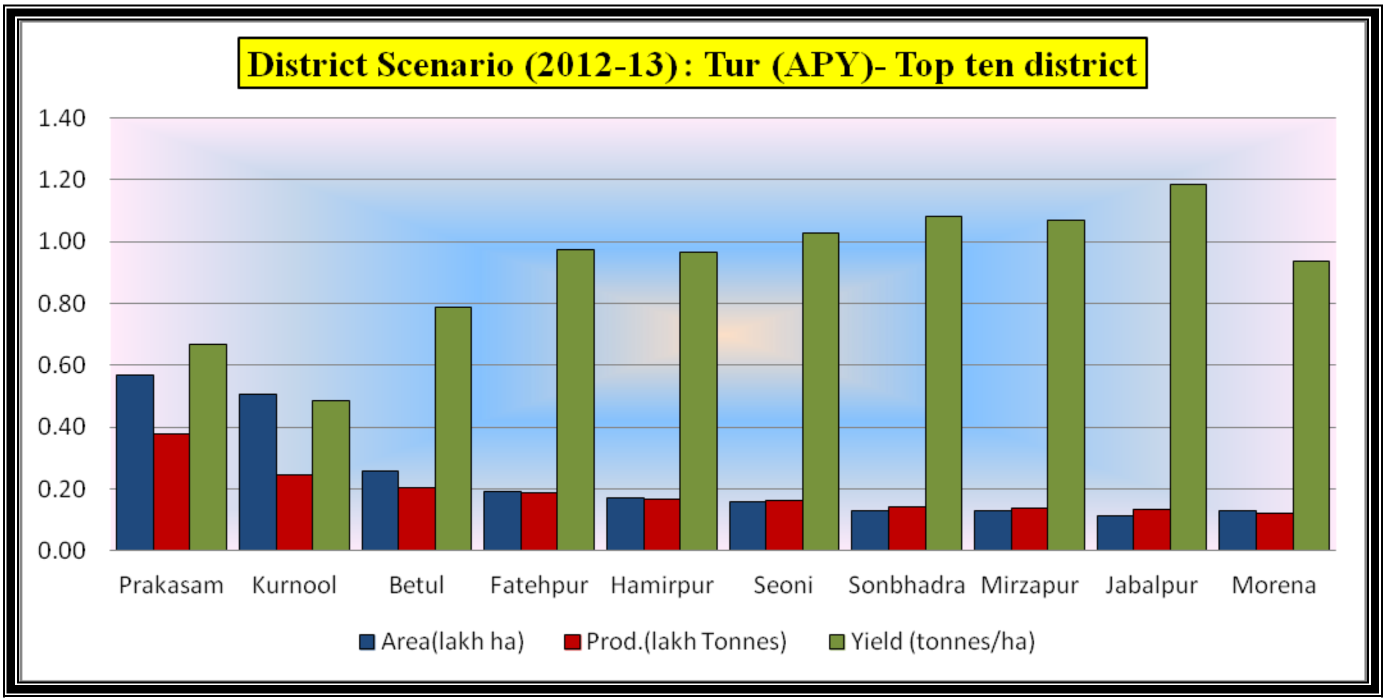
2.3. **Potential districts (2012-13)** -The intra-state analysis at the district level is presented in table – 3.3. Inter-district analysis across the country revealed that the highest area and production of pigeonpea is in Prakasam district of A.P. which are 1.45 per cent and 1.25 per cent respectively of country's total tur area and production followed by Kurnool, AP (1.30 % and 0.81 %), Betul, MP (0.66% and 0.67%), Fatehpur (0.49 % and 0.62%) and Hamirpur (0.44% and 0.55%) of UP. District-wise area, production and yield of top ten districts of India in respect of production are presented below which together contribute to 6.05 per cent and 6.21 per cent of area and production of the country (table 3.3).

The yield of Potential districts recorded higher than the National average yield except, Prakasham and Kurnool district of Andhra Pradesh.

Table – 3.3 Top potential districts (2012-13)

{A=Lakh ha, P=Lakh Tonnes, Y= kg/ha}

Sr. No.	Name of District	State	Area		Prod.		Yield	
			Area	% to India	Prod.	% to India	Yield	YI
I	Prakasam	A.P.	0.566	1.45	0.377	1.25	666	86
II	Kurnool	A.P.	0.504	1.30	0.245	0.81	485	62
III	Betul	M.P.	0.257	0.66	0.202	0.67	788	101
IV	Fatehpur	U.P.	0.192	0.49	0.187	0.62	973	125
V	Hamirpur	U.P.	0.173	0.44	0.167	0.55	965	124
VI	Seoni	M.P.	0.157	0.40	0.161	0.53	1028	132
VII	Sonbhadra	U.P.	0.131	0.34	0.141	0.47	1079	139
VIII	Mirzapur	U.P.	0.130	0.33	0.139	0.46	1069	138
IX	Jabalpur	M.P.	0.114	0.29	0.136	0.45	1187	153
X	Morena	M.P.	0.131	0.34	0.122	0.40	936	120
	Total above		**2.35**	**6.05**	**1.88**	**6.21**	797	**103**
	All India		**38.930**		**30.230**		**777**	



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 6^{th} to the 10^{th} 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)**

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.

5.5. 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	Pigeon pea + Rice (1:2 ratio)
iii. Jharkhand	Pigeon pea + Groundnut (1:3 ratio)
iv. Gujarat,A.P.,and MS	Pigeon pea + Cotton (1:1 ratio)
v. M.P., A.P., MS., and Gujarat	Pigeonpea + Soybean (2:2 ratio)
vi. Rajasthan and Eastern India	Pigeon pea + Maize/Bajra (1:1 ratio)

5.6 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.

5.7 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. Application of fertilizer is based on soil testing.

5.8 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.

5.9 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.

5.10 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.

5.10.1 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 % 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.

5.10.2 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. Application of Quizalofop ethyl 100 g a.i./ha 15 to 20 DAS controls annual grasses and Imazethapyr 50-100 a.i./ha at 20-25 DAS for wide spectrum of weeds.

5.11 Plant protection - Refer Table -3.8.

5.12 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. The hybrid pigeonpea research and development program is supported by Department of Agriculture, Cooperation & Farmer's Welfare, Govt. of India, under National Food Security Mission and ICRISAT's Hybrid Parents Research Consortium.

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 HybridGTH-1 developed by SKAU, SK Nagar (Gujarat), has recently been released for cultivation.

Table 3.6. CMS based pigeonpea hybrids

Hybrid	Source/Public sector Institution
ICPH-2671	ICRISAT, Hyderabad
ICPH- 2740	ICRISAT, Hyderabad

6.3 Scope:

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.

6.4 The Innovation

- In 1991, a milestone in the history of food legume breeding was achieved when the world's first pigeonpea hybrid, ICPH 8, was released.
- ICRISAT and ICAR jointly developed the hybrid using a genetic male-sterility (GMS) system, although high production costs prevented acceptance by seed producers.
- In 2005, another breakthrough was achieved when a cytoplasmic nuclear male-sterile (CMS) hybrid was developed by crossing a wild relative of pigeonpea (Cajanus cajanifolius) and a cultivar.
- The new hybrid technology is based on a three line system that includes A-line (male-sterile); B-line (maintainer), and R-line (restorer).
- Several experimental hybrids were evaluated at ICRISAT and various ICAR centers, which demonstrated 50-150% superiority in yield over popular varieties.
- In over 2000 on-farm trials conducted in five states of India the hybrids ICPH 2671 and ICPH 2740 respectively exhibited 47% and 42% yield advantage over the best local variety.
- Seed production of hybrids, mediated by honey bees, is easy. Under congenial growing conditions, 700-1200 kg/ha of hybrid seed was produced.

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, Odisha, 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. Fertilizer Application is based on soil testing.
- 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 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 20 cm 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 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)	Days to maturity	Remarks
BSMR-175	MAU	1991	Maharashtra	11-12	165-170	White seeded, res. to Sterility Mosaic & Wilt
JA-4	JNKVV	1991	Madhya Pradesh	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** (M.P., Maharashtra, Gujarat, Karnataka, Andhra pradesh, Odisha, Tamilnadu).	16-18	160-170	Resistant to wilt & SMD, Bold seeded., Indeterminate
Pusa-855	Central	1993	**NWPZ (**Punjab, Haryana, Delhi, North Rajasthan, West U.P).	24-25	145-150	Plant Indeterminate, Medium bold seeded.
Pusa-9	IARI	1993	**NEPZ (**East Uttar Pradesh, Bihar, West Bengal).	22-26	210-248	Tol. to Alternaria & SMD, Tall & bold- seeded, Suitable for pre-rabi.
CO-6	TNAU	1993	Tamil Nadu	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, Gulberga	1995	Karnataka	14-16	180-190	White, bold seeded, res. to Wilt
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** (MP,Maharashtra & Gujarat). **SZ** (Odisha, Karnataka, A.P. & Tamilnadu).	18-20	173-180	Tolerant to wilt & Phytophthora blight. Seeds dark brown

(*Pigeonpea Continue)*

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
BSMR-736	MAU	1996	Maharashtra	12-18	180-185	Resistant to wilt and SMD. Brown seeded. Indeterminate
Narendra Tur-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** (M.P., Maharashtra, Gujarat).	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 Tolerant, Sterility Mosaic Resistant
AKT-8811	Akola	2000	Maharashtra	13-14	145-150	Indeterminate
Laxmi (ICPL-85063)	ICRISAT	2000	Andhra Pradesh	18-20	160-200	Pre-rabi
Vaishali (BSMR-853)	MAU	2002	Maharashtra	16-17	165.170	Resistant to wilt and SMD.
Sel-31	ARS, Gulbarga	2002	Karnataka	12	100-110	Irrigated command areas wherever double & multiple cropping system is being in practices
Pusa-992	IARI	2002	Haryana, Punjab, U.P., Rajasthan	18-20	130-140	Indeterminate
MA-6	BHU	2002	Central & Eastern U.P.	20-23	248-267	Late, Spreading type
Pusa 991	IARI	2003	Delhi	16-20	140	Tolerant to wilt, Phytophthora blight and SMD
Pusa-992	IARI	2004	Haryana, Punjab, Delhi, Western UP and Rajasthan	17	119-162	Tolerant to SMD and wilt

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
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 SMD, Recommended for Kharif and pre-Rabi seasons.
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., Odisha	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	Moderate resistant to wilt & sterility mosaic, Tolerant to pod borer & pod fly
Vipula	MPKV	2007	Maharashtra	16	145-160	Resistant to *Fusarium wilt*, Moderate resistant to sterility mosaic disease
Lam-41	ANGRAU	2007	A.P.	12	Medium	Tolerant 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	No incidence of sterility mosaic disease
TT-401	BARC	2007	M.P., MS Gujarat & CG	16	138-156	Tolerant to pod borer & tolerant to wilt
Pusa 2002	IARI	2008	Delhi	17	110-150	Sowing to first week of June, suited for double cropping system, tolerant to moisture stress
Pant Arhar 291 (PA 291)	GBPAUT	2008	Uttrakhand	17	140-150	Early maturing, tolerant to phytophthora blight and pod borer

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
PAU 881 (AL 1507)	PAU	2008	Pun., Har., Western UP and plains of Uttrakhand	16-18		Early maturing
NDA 2	NDUA&T	2008	U.P., Bihar, WB, Assam & Jharkhand	25-28	240-260	Long duration, resistant to SMD and pod borers
TJT 501	BARC & ZARS, Khargone	2009	CZ	18	135-183	Tol.to SMD, wilt and phytophthro. Tol. to pod borer and pod fly
BRG 2	UAS, Bangalore	2009	SZ	12-16	175-185	Moderately tolerant to wilt, SMD and pod borer
Surya (MRG-1004)	ARS Madhira	2009	Andhra Pradesh	20-22	166-180	Tolerant to Macrophomina stem canker/wilt
TS-3R	ARS, Gulbarga	2011	Karnataka	11-17	150-160	Kharif and late sown cropping system res. to wilt
Anand grain Tur 2 (AGT 2)	AAU	2012	Gujarat	16	175-180	No severe disease was observed
BDN 711 (BDN2004-3)	ARS Badanapur	2012	Maharashtra	15-23	150-160	Mod. resistant to wilt and SMD

*** Hybrid**

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 Chloropyriphos (0.05%) or Fenvalerate (0.004%) or Cypermethrin 0.004%) or NPV @ 200-300 LE/ha. Imidachloprid 17.8 SL @ 70 g/ha. Use of neem seed kernels (5%) extract with 1 % soap solution.
ii. Tur pod fly	Larvae feed on soft grains within the pod making them unfit for consumption.	Monocrotophos (0.04%) or Dimethioate (0.03%). Flubendiamide 480 SC 48 g/ha.
iii. Tur plume moth	The larvae damage the seeds as well as cause flowers, buds and pods to drop.	Indoxacarb 14.5 SC 55 g/ ha.
iv. Hairy caterpiller	The hairy caterpillars damage the crop at seedling stage. It feeds on leaves eating away the green matter of the leaves.	Chloropyriphos (0.05%) or Fenvelerate (0.004%) or Quinolphos (0.05%).
v. Beetle	The adult beetle stipples the leaves with small and more or less circular holes. Severe attack adversely affects the vigour & growth of the plant.	Thimet 10% granules @ 10 Kg/ha.
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.
v. 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.

GREENGRAM (MUNGBEAN)

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, splitand 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.

1.1 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

2.1.1 ***Tenth Plan (2002-2007):*** The total area under Moong during ninth plan was 32.41 lakh hectares with production of 11.38 lakh hectares. Rajasthan stands first in respect of area (22.54%) followed by Maharashtra (17.06%) and A.P. (14.73%). The maximim contribution of production was in the state of Maharashtra (21.60%) followed by Rajasthan (20.22%) and A.P. (15.81%). The highest yield was recorded by the state of Punjab (794 kg/ha) followed by Jharkhand (551 kg/ha) and Bihar (546 kg/ha) with the over all National yield average of 351kg/ha. The lowest yield was recorded in Karnataka (145 kg/ha) followed by Odisha (238 kg/ha) and Chhattisgarh (254 kg/ha).

2.1.2 ***Eleventh Plan (2007-2012):*** The total area covered under moong in India was 33.32 lakh hectares with a total production of 13.37 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 Plan Period, the coverage of area and its production was maximum in Rajasthan (31.21% & 31.68%) followed by Maharashtra (15.26% & 18.57%) and Andhra Pradesh (10.36% & 10.62%). The highest yield was recorded by the state of Punjab (802 kg/ha) followed by Bihar (615 kg/ha) and Uttar Pradesh (573 kg/ha). The National yield average was of 404 kg/ha. The lowest yield was observed in Karnataka (202 kg/ha) followed by Odisha (272 kg/ha) and C.G. (252 kg/ha).

2.1.3 ***Twelfth Plan (T.E.2012-2015):*** The total area covered under moong in India was 30.41 lakh hectares with a total production of 14.24 lakh tonnes. The coverage of area and its production was maximum in Rajasthan (29.68 % & 25.51 % of the total area and production). Maharashtra ranked second in area coverage (12.98 %) and third in production (11.92 %). Andhra Pradesh ranked third in area (8.74 %) and second in production (12.43 %). The highest yield was recorded by the state of Punjab (838 kg/ha) followed by Jharkhand (680 kg/ha) and Tamil nadu (675 kg/ha). The National yield average was 468 kg/ha. The lowest yield observed in the state of Karnataka (247 kg/ha) followed by C.G. (269 kg/ha) and Odisha (337 kg/ha).

During the last three Plan Period area fluctuating, however, production and productivity showed increasing trend.

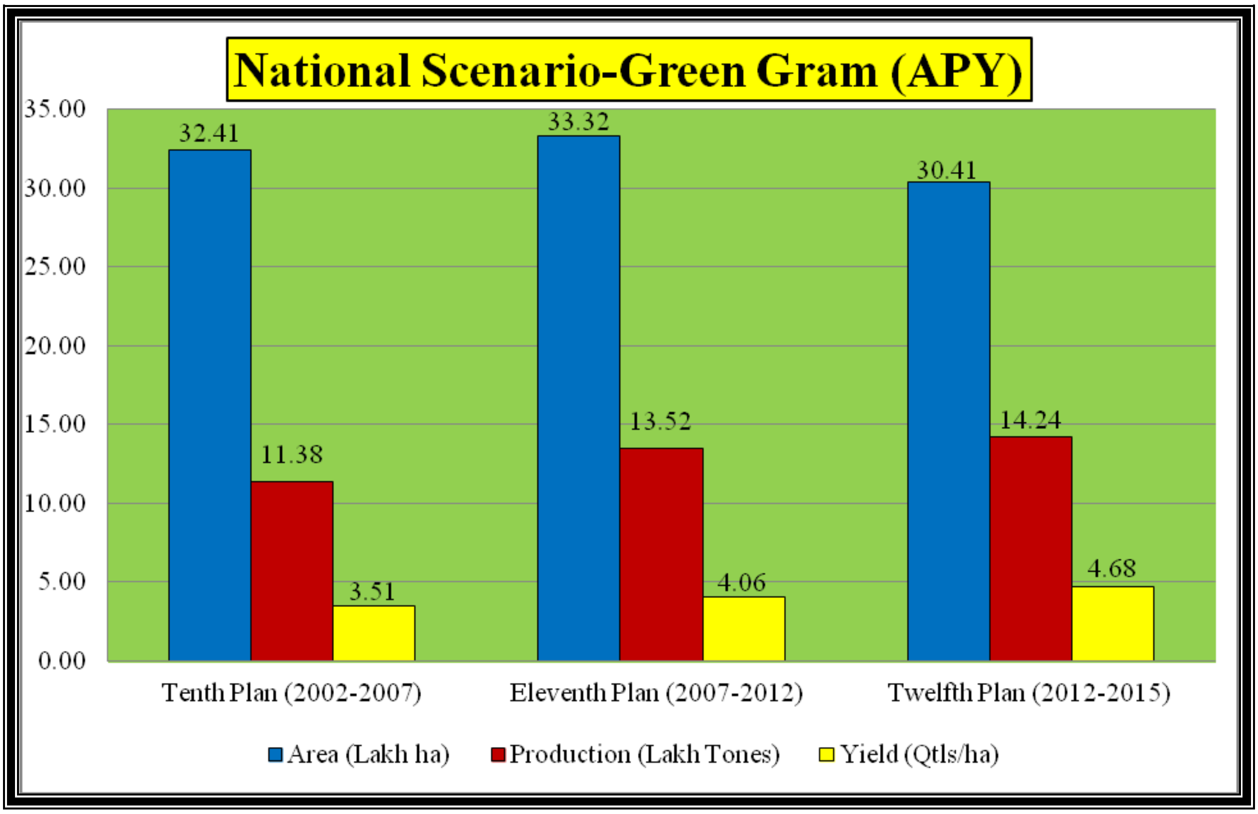
Table 4.1 Plan-wise green gram scenario- States

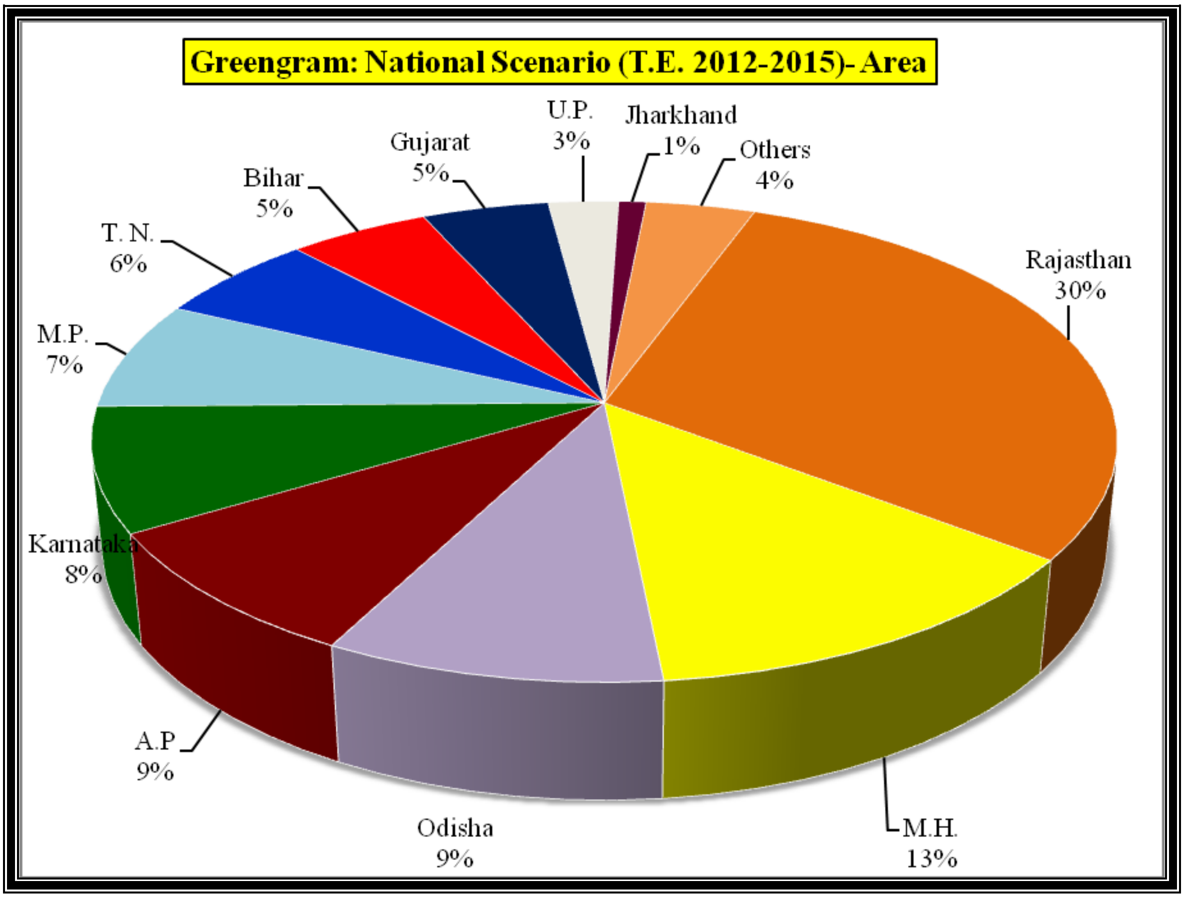
{*A= Lakh ha, P= Lakh tonnes, Y= kg/ha****}***

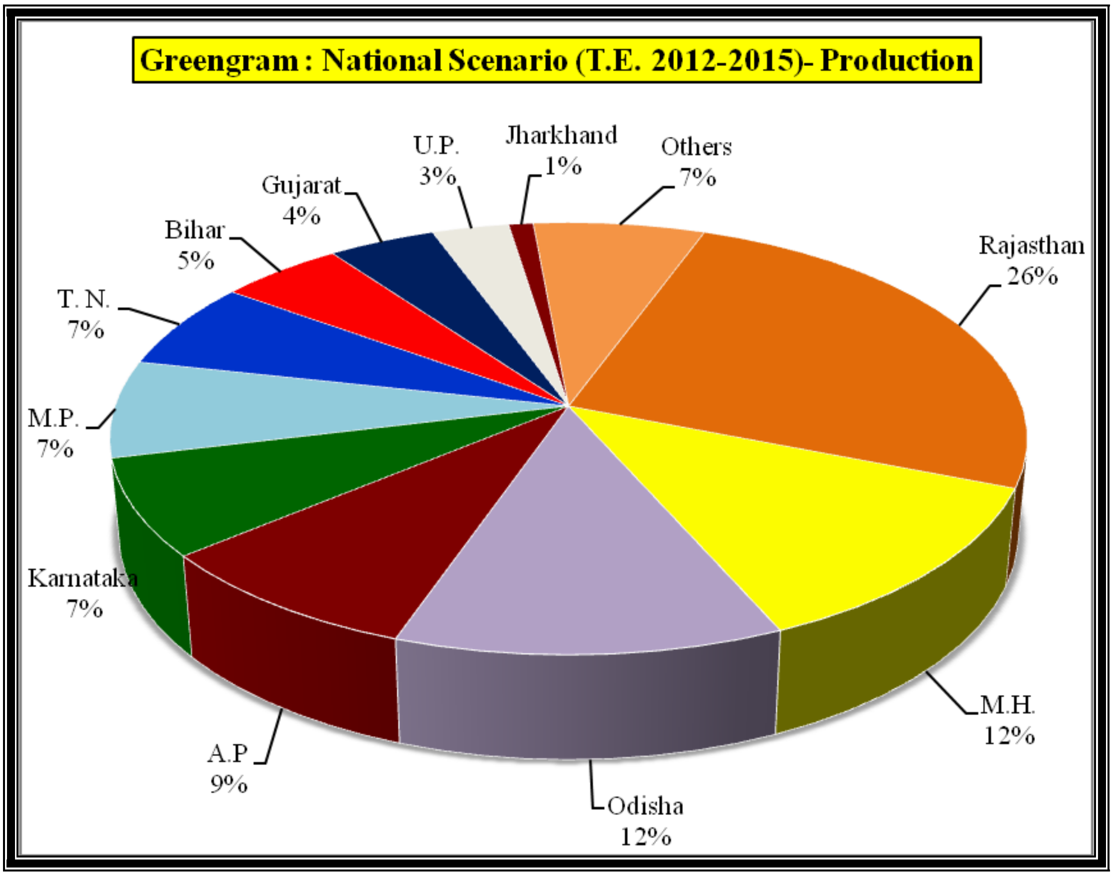
State		**Xth Plan**	**% to AI**	**XIth Plan**	**% to AI**	**XIIth Plan**	**% to AI**
A.P	A	4.77	14.73	3.45	10.36	2.66	8.74
	P	1.80	15.81	1.44	10.62	1.77	12.43
	Y	377		416		666	
Bihar	A	1.86	5.74	1.67	5.01	1.57	5.15
	P	1.02	8.92	1.03	7.59	1.04	7.29
	Y	546		615		664	
Chattisgarh	A	0.17	0.53	0.16	0.49	0.16	0.51
	P	0.04	0.38	0.04	0.30	0.04	0.29
	Y	254		252		269	
Gujarat	A	1.73	5.35	2.20	6.62	1.41	4.64
	P	0.70	6.12	1.06	7.84	0.72	5.06
	Y	402		481		511	
Haryana	A	0.22	0.67	0.27	0.80	0.49	1.62
	P	0.07	0.58	0.12	0.86	0.30	2.11
	Y	303		434		608	
Jharkhand	A	0.13	0.40	0.21	0.63	0.21	0.69
	P	0.07	0.63	0.12	0.86	0.14	1.00
	Y	551		550		680	
Karnataka	A	4.11	12.69	3.76	11.27	2.53	8.31
	P	0.60	5.26	0.76	5.61	0.62	4.38
	Y	145		202		247	
Madhya Prd.	A	0.85	2.62	0.86	2.58	2.22	7.29
	P	0.27	2.39	0.28	2.07	1.04	7.29
	Y	321		325		468	
Maharashtra	A	5.53	17.06	5.08	15.26	3.95	12.98
	P	2.46	21.61	2.51	18.57	1.70	11.92
	Y	444		494		430	
Odisha	A	2.23	6.87	2.59	7.76	2.78	9.15
	P	0.53	4.67	0.70	5.16	0.94	6.59
	Y	238		270		337	

{A= Lakh ha, P= Lakh tonnes, Y= kg/ha}

State		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
Punjab	A	0.15	0.46	0.09	0.26	0.53	1.75
	P	0.12	1.04	0.07	0.50	0.45	3.14
	Y	794		802		838	
Rajasthan	A	7.31	22.54	10.40	31.21	9.03	29.68
	P	2.30	20.23	4.28	31.68	3.63	25.51
	Y	315		412		403	
Tamilnadu	A	1.25	3.87	1.54	4.63	1.82	5.99
	P	0.54	4.73	0.54	3.99	1.23	8.62
	Y	429		350		675	
Uttar Pradesh	A	0.74	2.30	0.79	2.38	0.78	2.58
	P	0.35	3.05	0.45	3.36	0.43	3.02
	Y	466		573		549	
West Bengal	A	0.11	0.35	0.14	0.41	0.21	0.70
	P	0.05	0.42	0.08	0.62	0.18	1.25
	Y	421		607		839	
All India	**A**	**32.41**		**33.32**		**30.41**	
	P	**11.38**		**13.52**		**14.24**	
	Y	**351**		**406**		**468**	




Greengram: National Scenario (T.E. 2012-2015)- Area
U.P. 3%
Jharkhand 1%
Others 4%
Gujarat 5%
Bihar 5%
T. N. 6%
M.P. 7%
Rajasthan 30%
Karnataka 8%
A.P 9%
Odisha 9%
M.H. 13%


Greengram : National Scenario (T.E. 2012-2015)- Production
U.P. 3%
Jharkhand 1%
Others 7%
Gujarat 4%
Bihar 5%
T. N. 7%
M.P. 7%
Rajasthan 26%
Karnataka 7%
A.P 9%
Odisha 12%
M.H. 12%

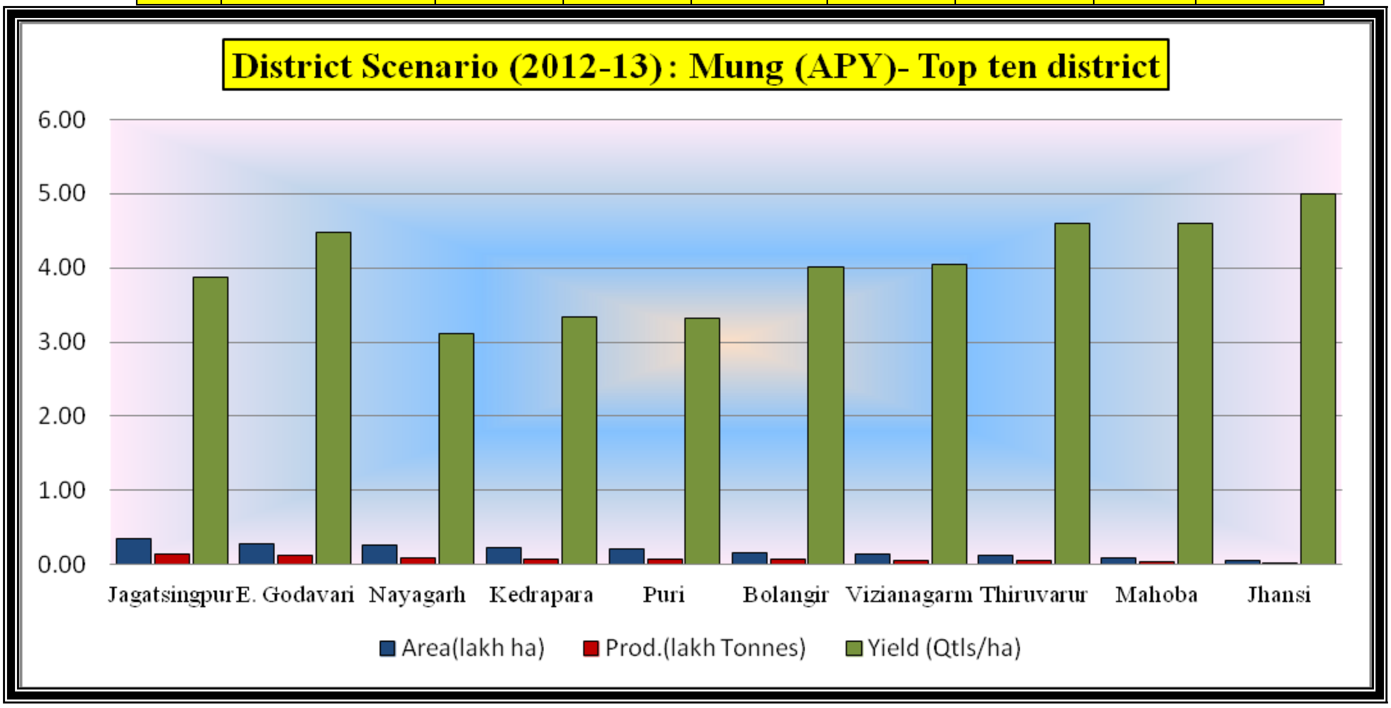
2.2. Potential districts (2013-14) - Analysing the Intra-state, status of the moong crop, district Jagatsingpurwith 1.27% area and 1.13% production tops in the country whereas, East Godavari, A.P. is on second position (1.02% & 1.05%) followed by Nayagarh (0.98% & 0.70%) & Kedrapara (0.85% & 0.65%) for area and production. District-wise area, production and yield of top ten district of India in respect of production, are presented below which contributed 7.04% and 6.25% percent of area and production of the country **(Table – 4.2).**

The yield of most of the potential districts were below the National average yield need to be adopt Improved Package of Practices of the greengram to increase the production in districts as well as country.

Table – 4.2. Top potential districts (2012-13)

{Area-Lakh ha, Production-Lakh Tonnes, Yield-kg/ha}

Sr. No.	Name of District	State	Area		Prod.		Yield	
			Area	% to India	Prod.	% to India	Yield	YI
I	Jagatsingpur	Odisha	0.347	1.27	0.134	1.13	388	89
II	East Godavari	A.P.	0.278	1.02	0.125	1.05	448	103
III	Nayagarh	Orrisa	0.266	0.98	0.083	0.70	312	72
IV	Kedrapara	Orrisa	0.232	0.85	0.078	0.65	334	77
V	Puri	Orrisa	0.215	0.79	0.071	0.60	332	76
VI	Bolangir	Orrisa	0.166	0.61	0.067	0.56	402	92
VII	Vizianagarm	A.P.	0.150	0.55	0.061	0.51	405	93
VIII	Thiruvarur	T.N.	0.116	0.43	0.053	0.45	460	105
IX	Mahoba	U.P.	0.087	0.32	0.040	0.34	460	105
X	Jhansi	U.P.	0.059	0.22	0.029	0.25	499	114
	Total above		**1.92**	**7.04**	**0.74**	**6.25**	**387**	**89**
	All India		**27.190**		**11.860**		**436**	



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.

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

Rice-Wheat-Moong (<u>*summer*</u>) Maize+Moong-Wheat-Moong Maize(early)-Potato(early)-wheat-Moong, Sugarcane+Moong (*summer 1:2*) Cotton + Greengram (1:3 in *Central India* <u>60/90 cm paired row</u>)	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.

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

ii. **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.

iii. **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.

iv. **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.

v. **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. Fertilizer application is based on soil testing.

vi. **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. Application of Pendimethalin (PI) + Imazethapyr (POE) 1250+100 g a.i./ha at 0-3 (PI) and 20-25 (POE) DAS control weeds.

vii. **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 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 Odisha* and *West Bengal*; *March in Bihar*, *Madhya Pradesh and Rajasthan*; and *first fortnight of April in Uttar Pradesh, Haryana and Punjab*.

i. **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.

ii. **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.

iii. **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.

iv. **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.

v. **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 spring 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 Odisha, West Bengal, Andhra Pradesh, Karnataka, Tamil Nadu and Kerala. There is a great scope of increasing the area under rabi greengram 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. Balanced Fertilizer application is based on soil testing.
- 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/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
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	Punjab, Haryana, Delhi & West UP	12.0	60-70	Res. to YMV, small seeded, early
BM-4	MAU	1992	M.P., Maharashtra, Gujarat.	10-12	65	Early, Tol.to YMV and PM, **Bold Seeded**
Phule M 2	MPKV	1992	Maharashtra	6.9	65	Tolerant to 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** (KN, A.P., Odisha, TN (Rabi).	8-10	65-75	Tolerant to Powdery Mildew. **Rabi**
Warangal-2 (WCG-2)		1995	Andhra Pradesh.	14.0	65-70	Suitable for all Season, Tolerant to YMV
Madhira-295	ANGRAU	1995	Andhra Pradesh.	14.0	65-70	Tolerant to YMV
LGG-407 (Lam 407)		1995	Andhra Pradesh.	14.0	70-75	Tolerant to YMV.
JM-721	JNKVV	1996	Madhya Pradesh.	12.4	70-75	Tolerant to PM.
ML-613	PAU	1996	Punjab.	13.0	84	Res. to YMV, Bacterial leaf spot and Pod-leaf spot. Seed med. bold
SML-134	PAU	1996	Punjab.	11.0	68	For **summer/spring**.
PDM-84-178		1996	Andhra Pradesh.	8.1	65-70	Tol. to YMV & PM, **suitable for summer** and early kharif.
TARM-1	BARC/PKV	1997	Maharashtra.	8-12	85	Res.to PM, **Suitable for Rabi**. Small seed

(*Mungbean Continued*)

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
Pant Mung-4	GBPUAT	1997	Eastern UP, Assam, Bihar, W.B	7.5	68	Resistant to YMV.
HUM-1	BHU	1999	Gujarat, MS, MP, TN, KN	8-9	60-65	Res. to YMV, **Summer season**
CO-6	TNAU	1999	Tamil Nadu	10.0	65	Suitable for all season, Resistant to YMV.
Pusa-9531	IARI	2000	M.P., Maharashtra, Gujarat, Punjab, Haryana, Delhi, West UP	10-12	60	Res. to YMV, Tolerant to Jassids and whitefly, **suitable for summer.**
Pusa Vishal	IARI	2000	**NWPZ**(Punjab,Haryana,Delhi, West UP, North Rajasthan)	11.0	62	Res. to YMV, Tol.to Jassids and whitefly, **suitable for summer,very bold seeded** (6 g/100 seed)
LAM-460	ANGRAU	2001	Andhra Pradesh	12.0	70-75	Tolerant to YMV
PDM 139	IIPR	2001	Uttar Pradesh.	12-15	50-60	**Summer season,** Mod.Res. to YMV
Ganga-8 (Gangotri)	RAU, Sri Ganga Nagar	2001	**NWPZ**(Punjab,Haryana, Delhi, West UP, North Rajasthan)	9.2	72	**Kharif,** tolerant to stem fly and pod borer.
OUM-11-5	OUAT	2002	**SZ** (Karnataka, AP, Odisha, TN).	7.0	62	**Kharif,** Moderately resistant to diseases
Malviya Jagriti (HUM-12)	BHU	2003	U.P., Bihar, Jharkhand, W.B.	11-12	66	Mod. Res. YMV, CLS, **Summer Season**
IPM 99-125	IIPR	2004	**NEPZ** (Eastern UP, Bihar,W.B.).	10.0	66	Res. To YMV, **Summer Season**
TM 99-37	BARC	2005	**NEPZ** (Eastern UP, Bihar, W.B.).	11.0	65	Mod. Res. To YMV, **Summer**
COGG 912	TNAU	2005	**SZ** (Karnataka, A.P, Odisha, TN).	8.0	62	Res. To YMV, CLS, **Kharif**
Kamdeva (OUM 11-5)	OUAT	2004	**SZ** (Karnataka, A.P, Odisha, TN)	8.0	46-69	Mod. Rest. To PM, MYMV & CLS
Muskan (MH-96-1)	CCS HAU	2004	Haryana	15.0	70-75	Resistant to YMV, Anthracnose and Leaf Crinkle
Ganga-1 (Jamnotri)	ARS, Sri Ganga Nagar	2004	Rajasthan	14	76	Mod. Res. to YMV, CLS, PM, anthracnose, Bacterial leaf blight, Macrophomina & web blight & Rhizopus, Moderate tolerant to white fly and jassids

(*Mungbean Continued*)

Variety	**Source**	**Year of Release/ Notification**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Days to maturity**	**Remarks**
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** (Eastern UP, Bihar, W.B.).	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 Cercospora leaf spot
Tromday Jawahar M-3 (TJM-3)	JNKVV	2006	MP	8-10	61-75	Kharif & summer, Resistant to YMV, PM and Rhyzoctonia root rot
SML 668	CSKHPKV, palampur	2007	North Hills sub-tropical zone	11-12	75-85	Under irrigated condition in summer as contigent crop or intercrop in sugarcane , resistant to anthracnose, cercospora leaf spot & YMV
Satya	CCSHAU	2008	NWPZ	16-17	70	suitable for kharif
KM 2241	CSAUAT	2008	North Hills zone of the country in timely sown condition	9.00	65-70	Resistant to MYMV, suitable for kharif
IPM 2-3	IIPR, Kanpur	2009	Rajasthan, Punjab, and Jammu region	10.00	70-72	Resistant to MYMV, large seed, suitable for kharif and spring
Pusa 0672	IARI	2009	Jammu & Kashmir, Manipur and Tripura	16.00	52-103	Resistant to MYMV, suitable for kharif

(*Mungbean Continued)*

Variety	**Source**	**Year of Release/ Notification**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Days to maturity**	**Remarks**
Madhira Pesara 347	ARS, Madhira	2009	Andhra Pradesh	12.00	60-70	Tolerant to crecospora, Leaf spot and Anthracnose
KKM 3	ARS, Kathalagere	2009	Karnataka	8-9	62	Moderately tolerant to Powdery Mildew and YMV and Pod borer
Pairy Mung		2010	MP,CG	9-10	60-65	Commonly used by farmer
Basanti	CCSHAU	2010	Haryana	15-17	65	Resistant to MYMV, suitable for kharif and spring
VBN (Gg) 3	NPR, VAMBAN	2010	Tamil Nadu	8-9	65-70	Moderately resistant to Powdery Mildew
MH 125	CCSHAU	2010	Haryana	12.00	64	Resistant to MYMV, Leaf crinkle, web blight, Anthracnose, moderately resistant to cercospora leaf spot
PKVAKM 4 (AKM 9904)	PDKV	2011	Karnataka, Tamil Nadu and Odisha	10-11	57-80	Tolerant to PM, suitable for kharif
PKV green gold	PDKV	2011	Maharashtra	10-11	57-80	Tolerant to PM, suitable for kharif
IPM 02-14	PDKV	2011	AP, Karnatana, Tamill Nadu and Odisha	10-12	62-70	Resistant to MYMV, large seed, suitable for summer
KM 2195 (swati)	CSAUAT	2012	Uttar Pradesh	10-12	65-70	Resistant to MYMV, cercospora leaf spot, web blight and Anthracnose, suitable for kharif
MH 421	CCSHAU	2012	Haryana	12.00	60	Non-shattering, resistant to YMV, suitable for kharif, spring & summer
BM 2003-2	ARS,BADN APUR	2012	Maharashtra	8-11	65-70	Green shiny special features : bold grain, long pod with prominent constriction

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

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.	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.	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 VirusVector – 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.	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.

BLACKGRAM (URDBEAN)

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.

1.1 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

2.1.1 *Tenth Plan* (*2002-2007*): The total area was 32.38 lakh ha with a total production of 13.96 lakh tonnes. States showed that Maharashtra state stands first in area and second in production (17.15% and 19.53 %), whereas A.P. ranked first in Production (20.56 %). U.P. ranked second in area and third in Production (16.14% and 15.46 %) and M.P. stands fourth in both area and production (15.95% and 12.77%) respectively. The highest yield was recorded by the state of Bihar (756 kg/ha) followed by West Bengal (669 kg/ha) and Andhra Pradesh (579 kg/ha) with the over all National yield average of (430 kg/ha). The lowest yield was observed in the state of Karnataka (184 kg/ha) followed by Odisha (263 kg/ha) and C.G. (282 kg/ha).

2.*1.2 Eleventh Plan (2007-2012)*: The total production was 14.81 lakh tonnes on an area of 30.56 lakh hectares. As regards the total contribution from states, Madhya Pradesh stand first in respect of area (17.08%) followed by U.P. (16.53%) and Andhra Pradesh (14.89%), whereas in production U.P. stands first (19.03%) followed by Aandhra Pradesh (18.37%)

and Maharashtra (15.35%). The highest yield was recorded by the state of Bihar (847 kg/ha) followed by Uttrakhand (846 kg/ha) and W.B. (698 kg/ha). The lowest yield was observed in the state of C.G. (290 kg/ha) followed by Odisha (295 kg/ha) and Karnataka (309 kg/ha).

2.*1.3 Twelfth Plan (2012-2015)*: The total production was 18.29 lakh tonnes on an area of 31.29 lakh hectares. As regards the total contribution from states, Madhya Pradesh stand first in respect of area (19.40%) followed by U.P. (17.88%) and Andhra Pradesh (11.69%), whereas in production U.P. stands first (16.98%) followed by Andhra Pradesh (16.75%) and Madhya Pradesh (15.07%). The highest yield was recorded by the state of Bihar (898 kg/ha) followed by Sikkim (895 kg/ha) and Jharkhand (890 kg/ha) the National yield average was (585 kg/ha). The lowest yield was recorded in the state of C.G. (309 kg/ha) followed by Odisha (326 kg/ha) and J&K (385 kg/ha).

The over all trend during last three plan period was shown increasing trend in Production and Productivity front but, area is fluctuating in the same period.

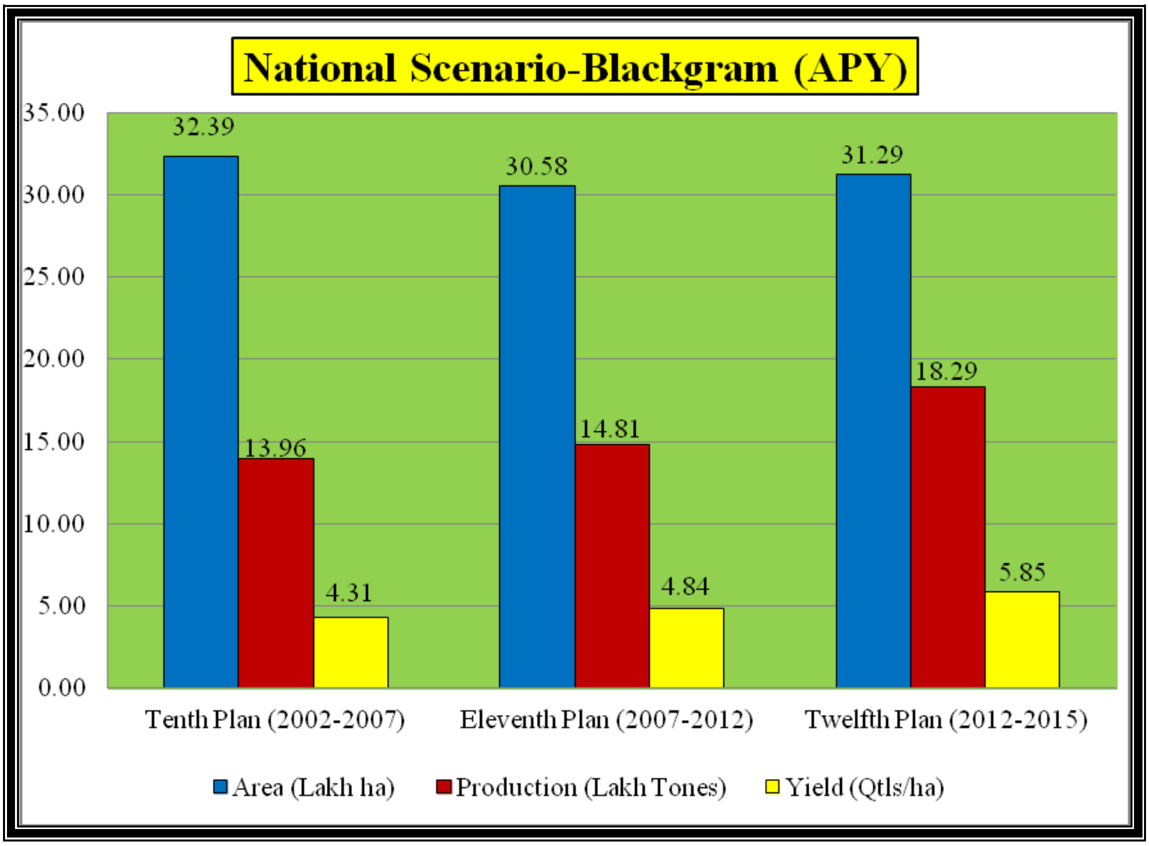
Table - 5.1. Plan-wise blackgram scenario - States

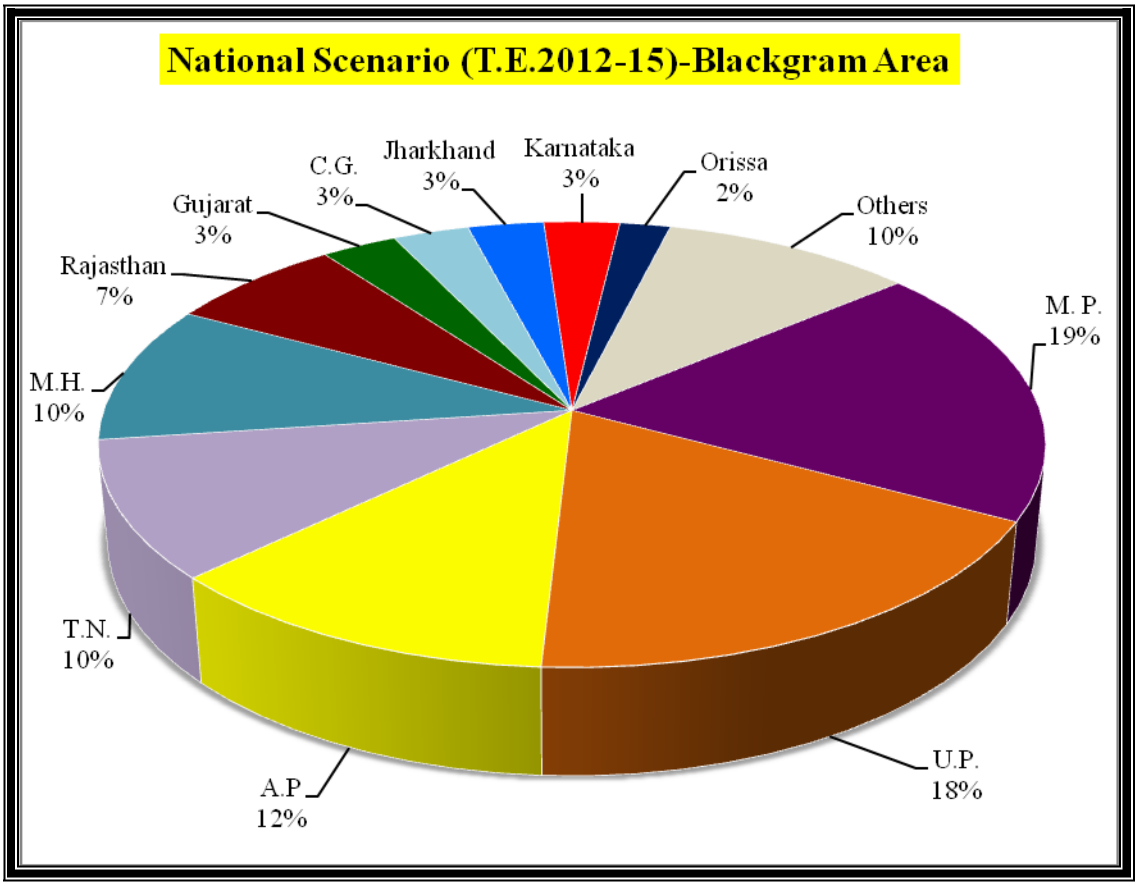
{A= Lakh ha, P= Lakh tonnes, Y= kg/ha}

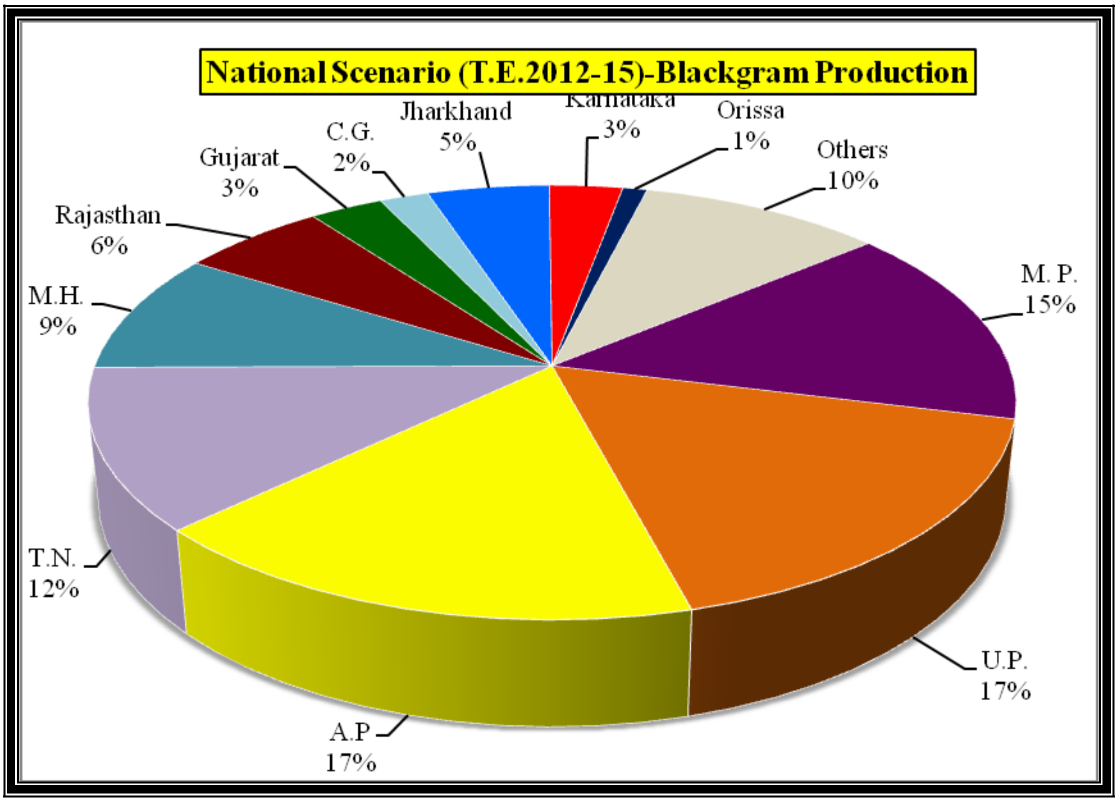
State		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
A.P	A	4.96	15.31	4.55	14.87	3.66	11.69
	P	2.87	20.56	2.72	18.37	3.06	16.75
	Y	579	134	598	124	838	143
Assam	A	0.38	1.17	0.43	1.39	0.59	1.87
	P	0.20	1.40	0.24	1.63	0.35	1.91
	Y	513	119	568	117	598	102
Bihar	A	0.25	0.77	0.19	0.62	0.15	0.48
	P	0.19	1.34	0.16	1.08	0.14	0.74
	Y	756	175	847	175	898	154
Chhattisgarh	A	1.19	3.66	1.09	3.57	1.00	3.20
	P	0.34	2.40	0.32	2.14	0.31	1.69
	Y	282	66	290	60	309	53
Gujarat	A	1.02	3.16	1.00	3.28	0.84	2.70
	P	0.47	3.34	0.65	4.40	0.52	2.86
	Y	456	106	649	134	620	106
Haryana	A	0.03	0.08	0.04	0.12	0.02	0.06
	P	0.01	0.05	0.02	0.12	0.01	0.04
	Y	295	68	489	101	436	75
H.Pradesh	A	0.11	0.33	0.11	0.35	0.09	0.30
	P	0.04	0.26	0.05	0.32	0.07	0.37
	Y	330	77	449	93	733	125
J & K	A	0.15	0.45	0.12	0.40	0.07	0.21
	P	0.06	0.43	0.05	0.30	0.03	0.14
	Y	417	97	366	76	385	66

{A= Lakh ha, P= Lakh tonnes, Y= kg/ha}

State		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
Jharkhand	A	0.73	2.25	0.83	2.71	0.99	3.17
	P	0.40	2.84	0.55	3.70	0.88	4.83
	Y	546	127	660	136	890	152
Karnataka	A	1.39	4.29	1.22	4.00	0.94	3.01
	P	0.26	1.83	0.38	2.55	0.41	2.26
	Y	184	43	309	64	440	75
Kerala	A	0.00	0.01	0.01	0.02	0.00	0.00
	P	0.00	0.03	0.00	0.03	0.00	0.00
	Y	864	200	741	153	0	0
Madhya Prd.	A	5.17	15.95	5.22	17.08	6.07	19.40
	P	1.78	12.77	1.85	12.50	2.76	15.07
	Y	345	80	354	73	454	78
Maharashtra	A	5.56	17.15	4.26	13.93	3.16	10.11
	P	2.73	19.53	2.27	15.35	1.70	9.31
	Y	491	114	534	110	538	92
Odisha	A	1.27	3.93	1.31	4.28	0.67	2.14
	P	0.34	2.40	0.39	2.60	0.22	1.19
	Y	263	61	295	61	326	56
Punjab	A	0.04	0.12	0.03	0.10	0.02	0.07
	P	0.02	0.12	0.01	0.09	0.01	0.06
	Y	462	107	460	95	485	83
Rajasthan	A	1.78	5.50	1.56	5.11	2.05	6.56
	P	0.58	4.18	0.75	5.05	1.03	5.62
	Y	327	76	478	99	500	86
Sikkim	A	0.04	0.12	0.07	0.22	0.03	0.11
	P	0.03	0.21	0.05	0.37	0.03	0.16
	Y	737	171	804	166	895	153
Tamilnadu	A	2.18	6.73	2.88	9.43	3.26	10.43
	P	0.90	6.47	1.11	7.48	2.21	12.09
	Y	414	96	384	79	678	116
Tripura	A	0.02	0.05	0.01	0.05	0.02	0.05
	P	0.01	0.07	0.01	0.07	0.01	0.06
	Y	541	126	681	141	649	111
U.P.	A	5.23	16.14	5.06	16.53	5.59	17.88
	P	2.16	15.46	2.81	19.00	3.11	16.98
	Y	413	96	557	115	555	95
Uttarakhand	A	0.27	0.85	0.13	0.43	0.15	0.46
	P	0.18	1.26	0.11	0.74	0.11	0.60
	Y	642	149	846	175	759	130
West Bengal	A	0.61	1.89	0.52	1.71	0.84	2.67
	P	0.41	2.93	0.36	2.46	0.54	2.94
	Y	669	155	698	144	645	110
All India	**A**	**32.386**		**30.58**		**31.285**	
	P	**13.964**		**14.808**		**18.294**	
	Y	**431**		**484**		**585**	


National Scenario-Blackgram (APY)
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
32.39
13.96
4.31
30.58
14.81
4.84
31.29
18.29
5.85
Tenth Plan (2002-2007)
Eleventh Plan (2007-2012)
Twelfth Plan (2012-2015)
Area (Lakh ha)
Production (Lakh Tones)
Yield (Qtls/ha)


National Scenario (T.E.2012-15)-Blackgram Area
C.G. 3%
Jharkhand 3%
Karnataka 3%
Orissa 2%
Gujarat 3%
Others 10%
Rajasthan 7%
M. P. 19%
M.H. 10%
T.N. 10%
A.P 12%
U.P. 18%



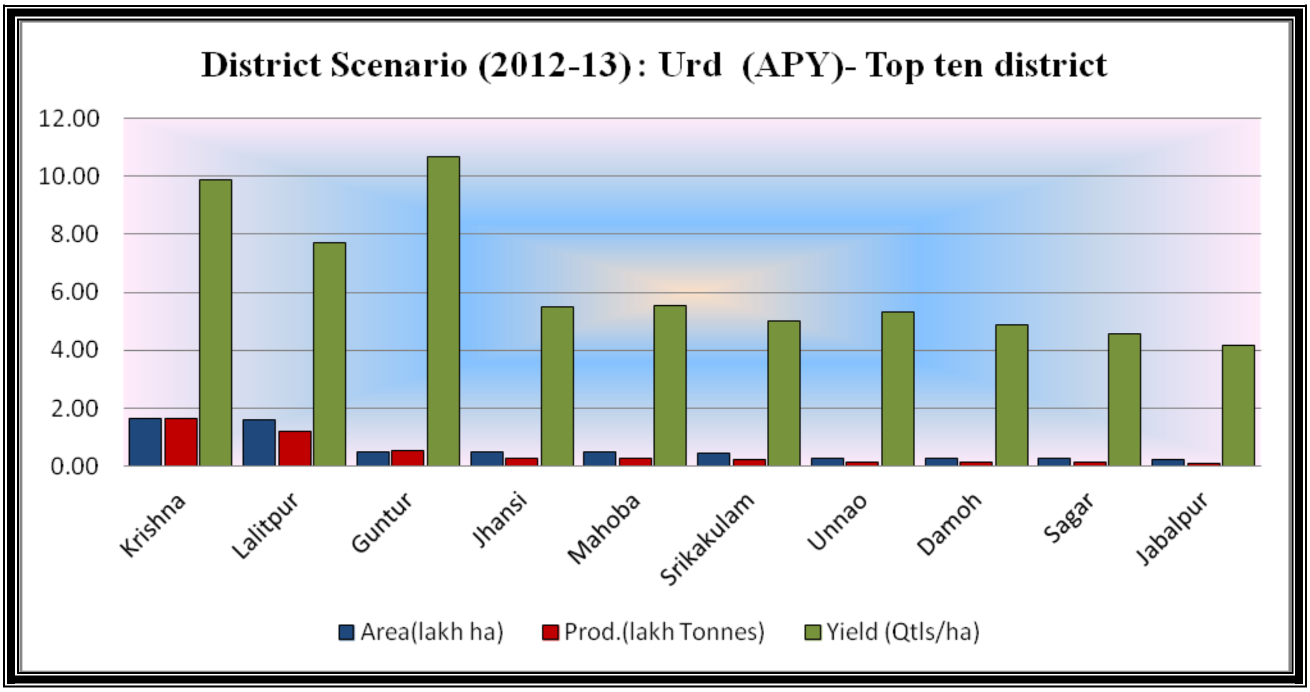
2.2. Potential districts (2012-13): Analysis of the districts within the country revealed that the Krishna district of A.P. contributed with 5.26 % of area and 8.35 % of production followed by Lalitpur of U.P. with 5.06 % area and 6.28 % of production. The district Guntur of A.P., however, ranked third in terms of production with 2.77%. Area, production and yield of top ten districts of India is contributing about 20% & 24% area and production of the country, presented below.

The yield of potential districts was observed in most of the district below the National average yield except first and second ranking districts.

Table – 5.2. Top potential districts (2012-13)

{A= Lakh ha, P= Lakh tonnes, Y= kg/ha}

Sr. No.	Name of District	State	Area		Prod.		Yield	
			Area	% to India	Prod.	% to India	Yield	YI
I	Krishna	A.P.	1.646	5.26	1.626	8.35	988	159
II	Lalitpur	U.P.	1.584	5.06	1.223	6.28	772	124
III	Guntur	A.P.	0.505	1.61	0.540	2.77	1068	172
IV	Jhansi	U.P.	0.498	1.59	0.275	1.41	551	89
V	Mahoba	U.P.	0.486	1.55	0.269	1.38	553	89
VI	Srikakulam	A.P.	0.450	1.44	0.225	1.16	501	81
VII	Unnao	U.P.	0.288	0.92	0.153	0.79	531	85
VIII	Damoh	M.P.	0.288	0.92	0.141	0.73	490	79
IX	Sagar	M.P.	0.272	0.87	0.124	0.64	455	73
X	Jabalpur	M.P.	0.248	0.79	0.104	0.53	418	67
	Total		**6.27**	**20.01**	**4.68**	**24.03**	**747**	**120**
	All India		**31.320**		**19.470**		**622**	



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.

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

- **Time of sowing: Kharif**- Sowing is done with the onset of monsoon i.e. IInd fortnignt of June or early part of July. **Rabi**- IInd fortnight of October (upland) IInd 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.
- **Seed Rate and Spacing: Kharif**- During kharif season 12-15 kg per hectare seed is sufficient. Wider spacing should be ensured. The crop should be sown at a distance of 30-45 centimeter with 10 cm plant spacing **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 seed rate in rice fallow if delayed sowing. **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. 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 thiram @ 2.5 g per kg of seed, 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. Application of 100-125g a.i./ha at 0-3 DAS controls wide spectrum of weeds.

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/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
Teja (LBG-20)	ANGRAU	1991	Andhra Pradesh	14.0	70-75	Tol. To YMV
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
Basant Bahar (PDU-1)		1991	All India except South & HillZone	12-13	70-80	**Spring,** Tolerant to YMV
Prabha (LBG 402)	ANGRAU	1991	Karnataka, Andhra Pradesh, Odisha, T.N.	10.8	78	**Rabi,** seed bold & dull black
TPU-4	BARC/MAU	1992	MP, Maharashtra & Central part of Rajasthan	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	Andhra Pradesh.	14.0	85-90	Resistant to wilt.
WBU-108	BCKV	1996	Punjab, West UP, Rajasthan, Karnataka, A.P. TN).	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	Tolerant 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	TN, Odisha, A.P. & Karnataka	12	70	Res. To YMV, **Rabi Season**
TU-94-2	BARC	1998	Karnataka, Andhra Pradesh, Odisha, Tamilnadu.	15.0	69	High yielding & YMV resistant early, **rabi season**

Variety	Source	Year of Release/Noti.	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
Azad Urd-1 (KU-92-1)	CSAUAT	1999	UP, Bihar, WB.	10.0	80	**Spring,** Res. To YMV
WBG-26	ANGRAU	1999	Karnataka, A.P. Odisha, TN	10	70	Res. to PM
Barkha (RBU-38)	RAU,Bansawar	1999	MP, Maharashtra & Central part of Rajasthan	12.0	75	**Bold seeded**,Res. to CLS
IPU-94-1 (Uttra)	IIPR	1999	Punjab,Haryana, West UP, North Rajasthan, Gujarat, Bihar, W.B.	11-12	85	Resistant to YMV, **kharif season**.
Shekhar 2 (KU-300)	CSAUAT	2001	Punjab, Haryana, Delhi, West UP & North Rajasthan)	11-12	70	Resistant to YMV, **spring season**.
NDU 99-3	NDAUT	2003	**NHZ**	9.5	85	Res. To YMV, **Kharif Season**
KU 96-3	CSAUAT	2003	**CZ** (MP, MS & Gujarat)	8.0	73	Res. To YMV, **Kharif Season**
Goutam (WBU-105)	Research station, 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	SDAU	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	Andhra Pradesh	14	Medium	Tolerant to YMV
Sulata (WBU109)	PORS Beahanpur	2008	UP, Bihar, WB, Assam & Jharkhand	15-16	80-83	Resistant to MYMV, spring season
Pant Urd 31	Central	2008	UP, Tripura, Rajasthan, Odisha,CG,Bihar,AP,Uttrakhand	15	75-80	Resistant to YMV,
Pant Urd 40	Central	2008	Rajasthan,Uttrakhand	14-15	70-75	Short duration variety
Prasad	Central	2008	UP, T N, Odisha	12-14	60-65	Short duration variety,
VBN (BG)5	Tamil Nadu	2009	TN,	14	60-65	Short duration variety,
Madhra Minumu 207	ARS, Madhira	2009	MS,MP & AP	13	75-80	Tolerant to YMV & stress. Suitable for Kharif, Rabi & Summer

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
IPU 02-43	IIPR, kanpur	2009	AP, Odisha, Karnataka, Tamil Nadu,Assam	9-11	75	Resistant to MYMV, and PM, kharif season.
KU 99-21	CSAUT, Kanpur	2009	Punjab, Haryana, Western UP and plains of Uttarakhand	10-11	70-75	Kharif season.
Mash 479 (KUG 479)	PAU, Ludhiana	2010	Punjab, Haryana, Western UP and plains of Uttrakhand	12.00	82	Resistant to MYMV and PM spring season
UPU 00-31 (Himachal Mash 1)	CSKHPKV, Palampur	2010	Low hill subtropical zone in kharif season (H.P.)	14-16	75	Resistant to Anthracnose, YMV and Leaf Crinkle and Tolerant to CLS and PM, lister Beetle and Hairy caterpillar.
Mash 114	Punjab	2010	Irrigated areas of Punjab state	9.0	70-75	Resistant to MYMV
LAM Minimum752	ANGRAU	2010	Andhra Pradesh	15	75-82	Resistant to wilt and YMV
CO 6 (COBG 653)	TNAU, Coimbatore	2011	AP, Odisha, Karnataka, Tamil Nadu	8-10	65-70	Resistant to MYMV and PM, sparing
Mash 391 (LU 391)	PAU, Ludhiana	2011	AP, Odisha, Karnataka, Tamil Nadu	8.00	71	Resistant to MYMV, Leaf Crinkle virus, CLS, Anthracnose and PM dery mildew, spring season
UH 1 (uh 04-06)	CSSHAU	2011	Haryana	11.0	73	Resistant to YMV, kharif season.
VBN (BG) 7 (VBG04-008)	TANU, Coimbatore	2012	AP, Odisha, Karnataka, Tamil Nadu	8.00	63-90	Resistant to MYMV and PM
VBN 6	NPRC, Vamban	2012	Tamil Nadu	9.00	69	Resistant to YMV
Vishwas (NUL-7)	Nirmal seeds, pachora (MS)	2012	Maharashtra, Gujarat, M.P., Chhattisgarh, UP,& Rajasthan	10.00	69-73	Tolerant to major disease

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, Odisha) 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/ 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.	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.	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.
vi. Yellow Mosaic VirusVector – 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 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.

LENTIL (MASUR)

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

1.1 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

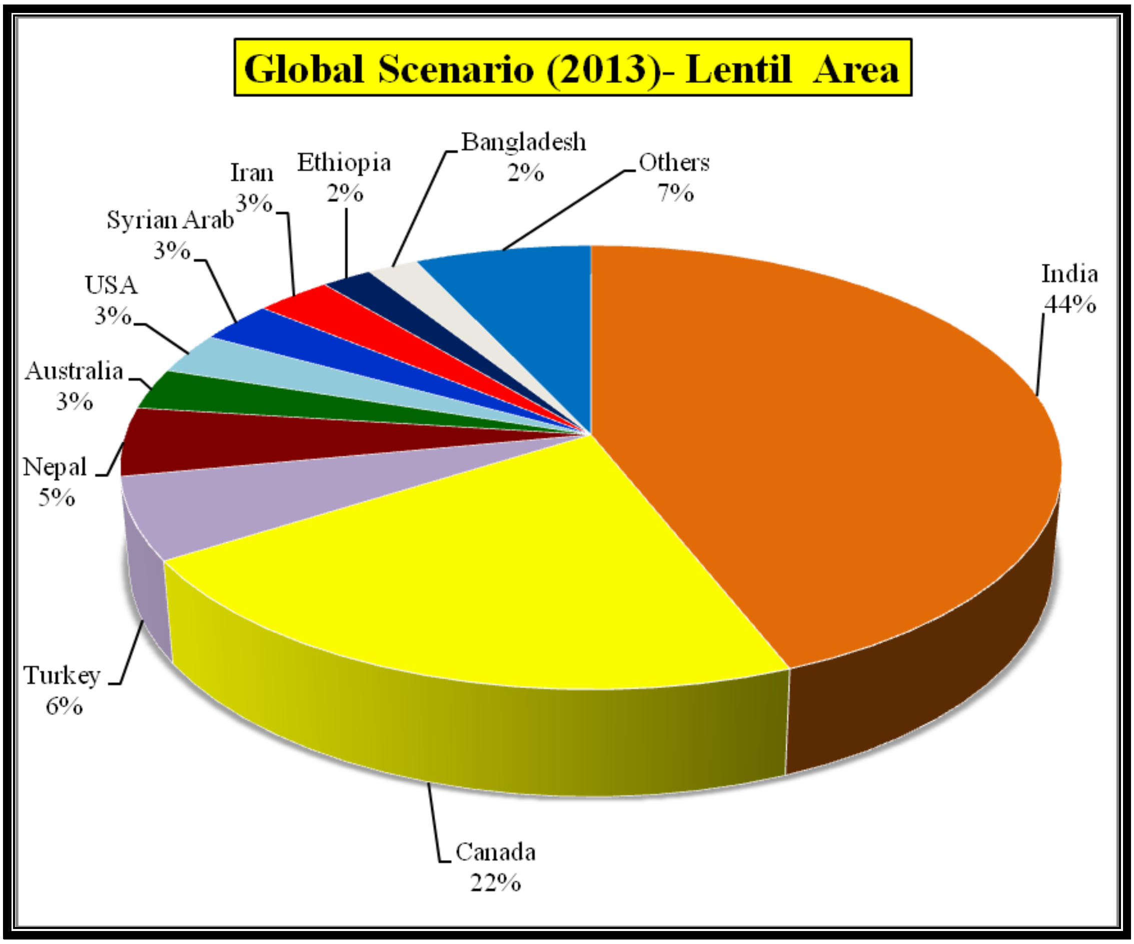
India ranked first in the area and second in the production with 43% and 37% of world area and production respectively.The highest productivity is recorded in New Zealand (2667 kg/ha) followed by China (2239kg/ha). Canada rank first in production (38%) due to very high level of productivity (1971 kg/ha) as compared to India (600 kg/ha) (table 6.1).

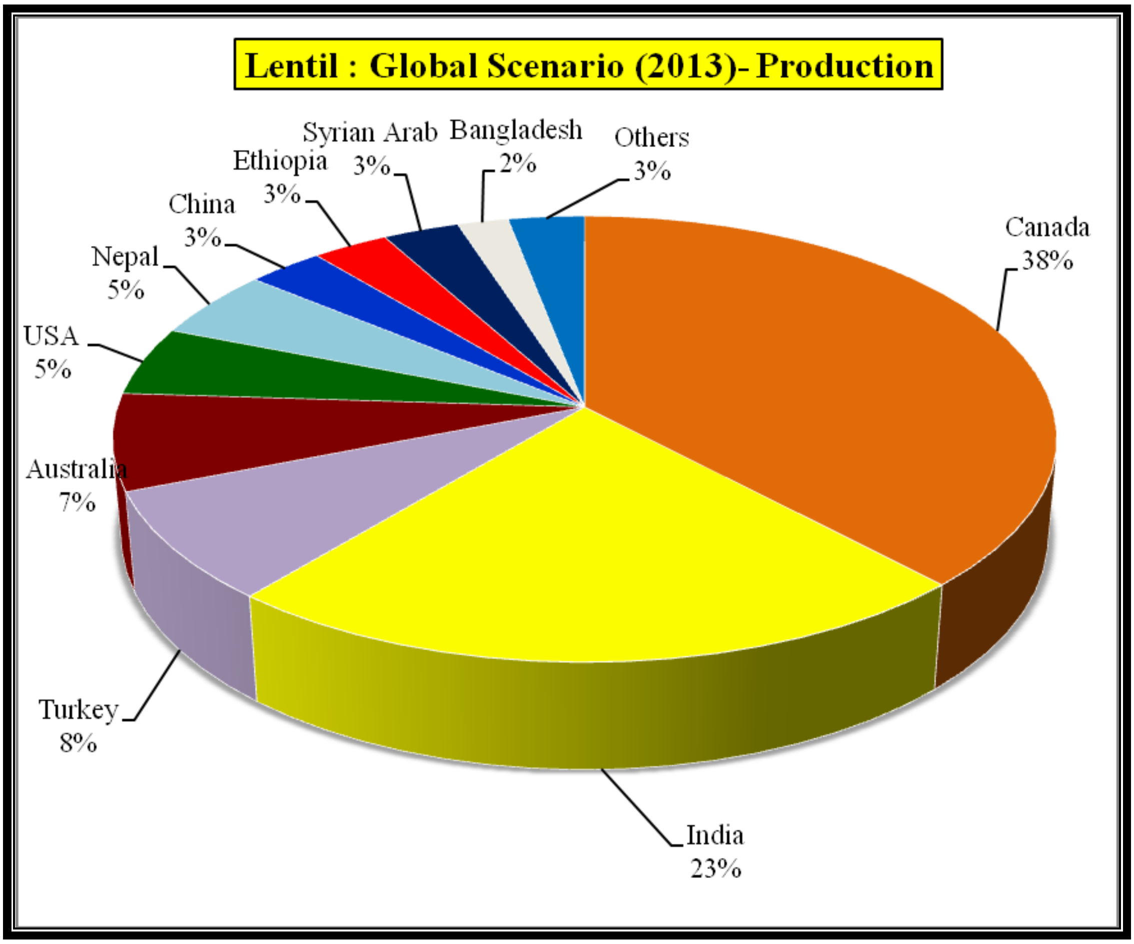
Table – 6.1. Global ranking in area, production and yield: Major countries

{Area-Lakh ha, Production-Lakh Tonnes, Yield-kg/ha}

Rank	Area			Production			Yield	
	Country	**Area**	**% to World**	**Country**	**Prod.**	**% to World**	**Country**	**Yield**
I	India	18.90	43.50	Canada	18.805	37.98	New zealand	2667
II	Canada	9.542	21.96	India	11.340	22.90	China	2239
III	Turkey	2.812	6.47	Turkey	4.170	8.42	Australia	2237
IV	Nepal	2.065	4.75	Australia	3.241	6.55	Egypt	2167
V	Australia	1.449	3.34	USA	2.277	4.60	Canada	1971
VI	USA	1.404	3.23	Nepal	2.269	4.58	USA	1621
VI	Syrian Arab	1.280	2.95	China	1.500	3.03	France	1613
VIII	Iran	1.200	2.76	Ethiopia	1.298	2.62	Turkey	1483
IX	Ethiopia	1.081	2.49	Syrian Arab	1.250	2.52	Armenia	1308
X	Bangladesh	0.898	2.07	Bangladesh	0.930	1.88	Argentina	1250
							India	**600**
	World	**43.447**		**World**	**49.517**		**World**	**1140**

Source : FAO statistics 2013





2.2 National Scenario

2.2.1 ***Tenth Plan (2002-2007)*****:** The area under lentil was 14.44 lakh hectares with the total production of 9.53 lakh tonnes. The highest area and production contribution was made by U.P. (41.27% and 48.79%) followed by M.P. (35.04% and 25.50%) and Bihar (11.91% and 14.17 %).The highest yield was recorded by the state of Rajasthan (995kg/ha) followed by Haryana (900 kg/ha) and Bihar (787 kg/ha). The National yield average was (660 kg/ha). The lowest yield was recorded in the state of C.G. (312 kg/ha) followed by Maharashtra (368 kg/ha) and M.P. (481 kg/ha).

2.2.2 ***Eleventh Plan (2007-2012)*****:** The country's area under Lentil was 14.64 lakh hectares with a production of 9.60 lakh tonnes. The highest area and production contribution was made by U.P. (37.98% and 46.25%) followed by M.P. (37.57% and 24.27%) and Bihar (12.36% and 16.56 %). The highest yield was recorded by the state of Rajasthan (917 kg/ha) followed by U.P. (799 kg/ha) and Bihar (878 kg/ha). The National yield average was (656 kg/ha). The lowest yield was observed in the state of C.G. (322 kg/ha) followed by M.P. (424 kg/ha) and Mahrashtra (431 kg/ha).

2.2.3 ***Twelfth Plan (T.E. 2012-15)*****:** The country's area under Lentil was 13.90 lakh hectares with a production of 10.93 lakh tonnes. Madhya Pradesh is on first ranked with respect to acerage 39.59% (5.50 lakh ha) followed by UP 33.95 % and Bihar 11.29% respectively. While in terms of production UP is on first ranked 34.36% (3.76 lakh tonnes) followed by Madhya Pradesh (30.73%) and Bihar (17.35%).The highest yield was recorded by the state of Bihar (1209 kg/ha) followed by Rajasthan (962 kg/ha) and W.B. (960 kg/ha). The

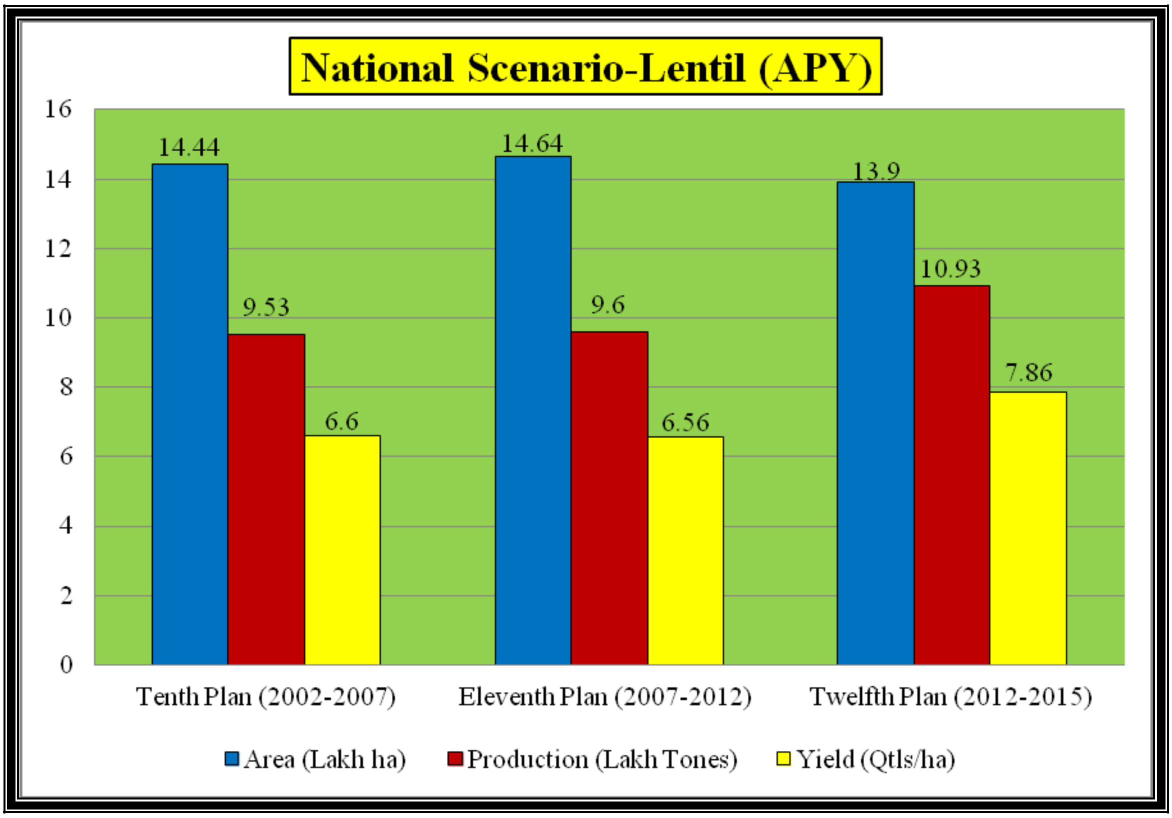
National yield average was (786 kg/ha). The lowest yield was observed in the state of C.G. (327 kg/ha) followed by Maharashtra (400 kg/ha) and M.P. (610 kg/ha).

The overall trend of area, production and yield during the last three plan period shows increasing trend in production and productivity however, area decline during XII plan period is a major concern

Table - 6.2. Plan-wise lentil scenario - States

{A= Lakh ha, P= Lakh tonnes, Y= kg/ha}

State		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
Assam	A	0.20	1.39	0.22	1.50	0.29	2.12
	P	0.11	1.15	0.11	1.15	0.20	1.80
	Y	548		511		668	
Bihar	A	1.72	11.91	1.81	12.36	1.57	11.29
	P	1.35	14.17	1.59	16.56	1.90	17.35
	Y	787		878		1209	
Chhattisgarh	A	0.17	1.18	0.16	1.09	0.14	1.00
	P	0.05	0.52	0.05	0.52	0.05	0.42
	Y	312		322		327	
Haryana	A	0.06	0.42	0.04	0.27	0.05	0.39
	P	0.05	0.52	0.03	0.31	0.05	0.46
	Y	900		783		935	
Madhya Pradesh	A	5.06	35.04	5.5	37.57	5.50	39.59
	P	2.43	25.50	2.33	24.27	3.36	30.73
	Y	481		424		610	
Maharashtra	A	0.07	0.48	0.07	0.48	0.04	0.26
	P	0.03	0.31	0.03	0.31	0.01	0.13
	Y	368		431		400	
Punjab	A	0.03	0.21	0.01	0.07	0.01	0.061
	P	0.02	0.21	0.01	0.10	0.01	0.050
	Y	560		673		647	
Rajasthan	A	0.19	1.32	0.28	1.91	0.31	2.23
	P	0.19	1.99	0.25	2.60	0.30	2.72
	Y	995		917		962	
Uttar Pradesh	A	5.96	41.27	5.56	37.98	4.72	33.95
	P	4.65	48.79	4.44	46.25	3.76	34.36
	Y	781		799		796	
Uttarakhand	A	0.16	1.11	0.15	1.02	0.11	0.82
	P	0.08	0.84	0.09	0.94	0.10	0.89
	Y	494		605		847	
West Bengal	A	0.65	4.50	0.55	3.76	0.65	4.66
	P	0.45	4.72	0.44	4.58	0.62	5.68
	Y	686		791		960	
All India	**A**	**14.44**		**14.64**		**13.90**	
	P	**9.53**		**9.6**		**10.93**	
	Y	**660**		**656**		**786**	


National Scenario-Lentil (APY)
16
14
12
10
8
6
4
2
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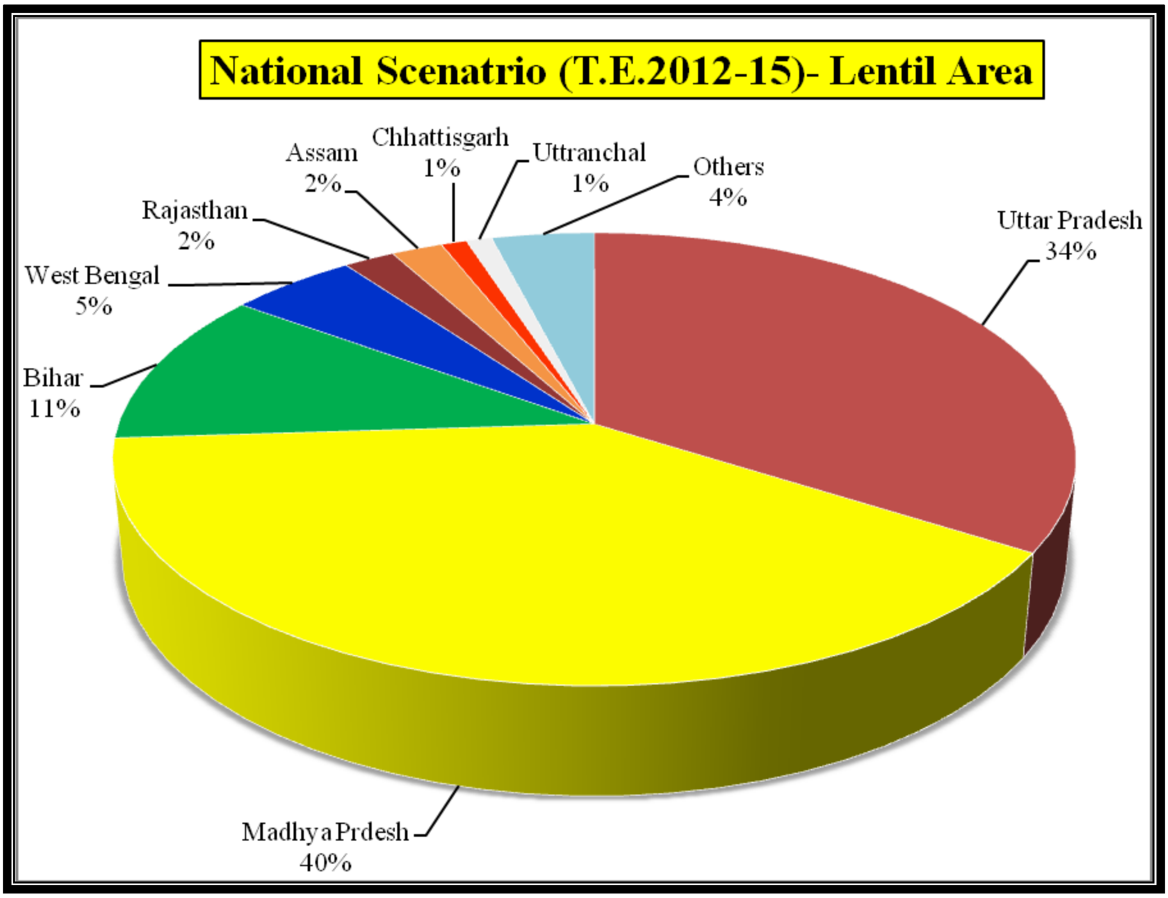
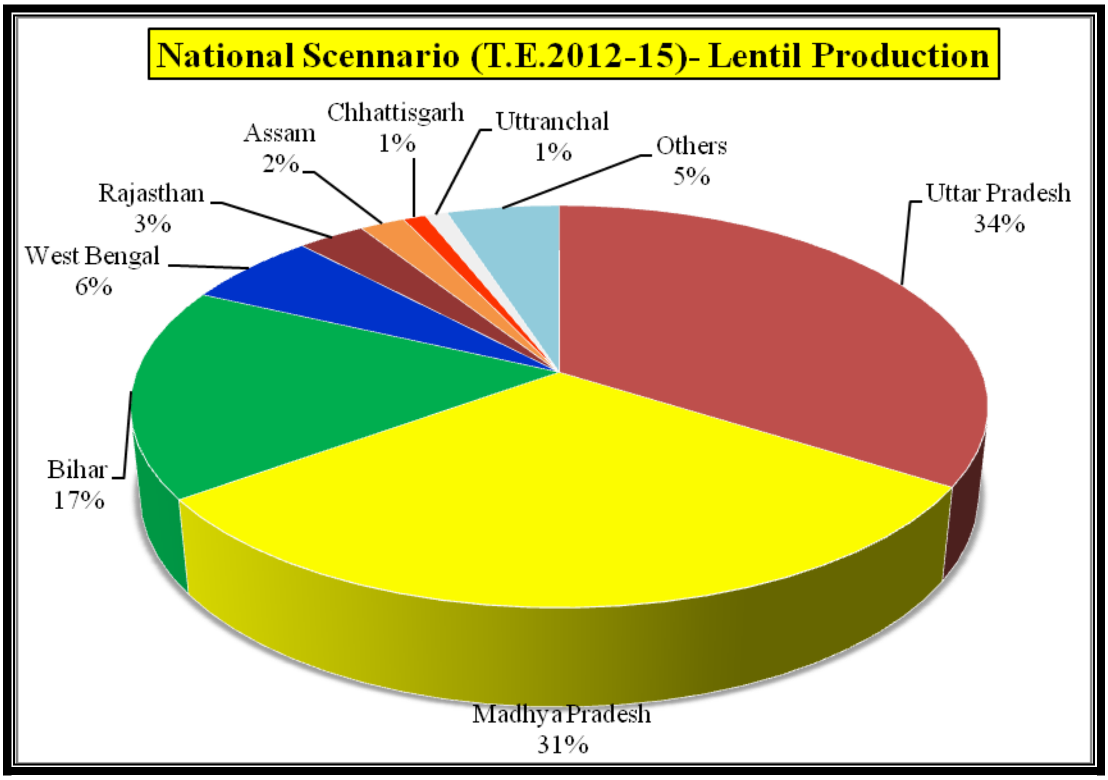
6.6
14.64
9.6
6.56
13.9
10.93
7.86
Tenth Plan (2002-2007)
Eleventh Plan (2007-2012)
Twelfth Plan (2012-2015)
Area (Lakh ha)
Production (Lakh Tones)
Yield (Qtls/ha)


National Scenatrio (T.E.2012-15)- Lentil Area
Assam 2%
Chhattisgarh 1%
Uttranchal 1%
Others 4%
Rajasthan 2%
Uttar Pradesh 34%
West Bengal 5%
Bihar 11%
Madhya Prdesh 40%



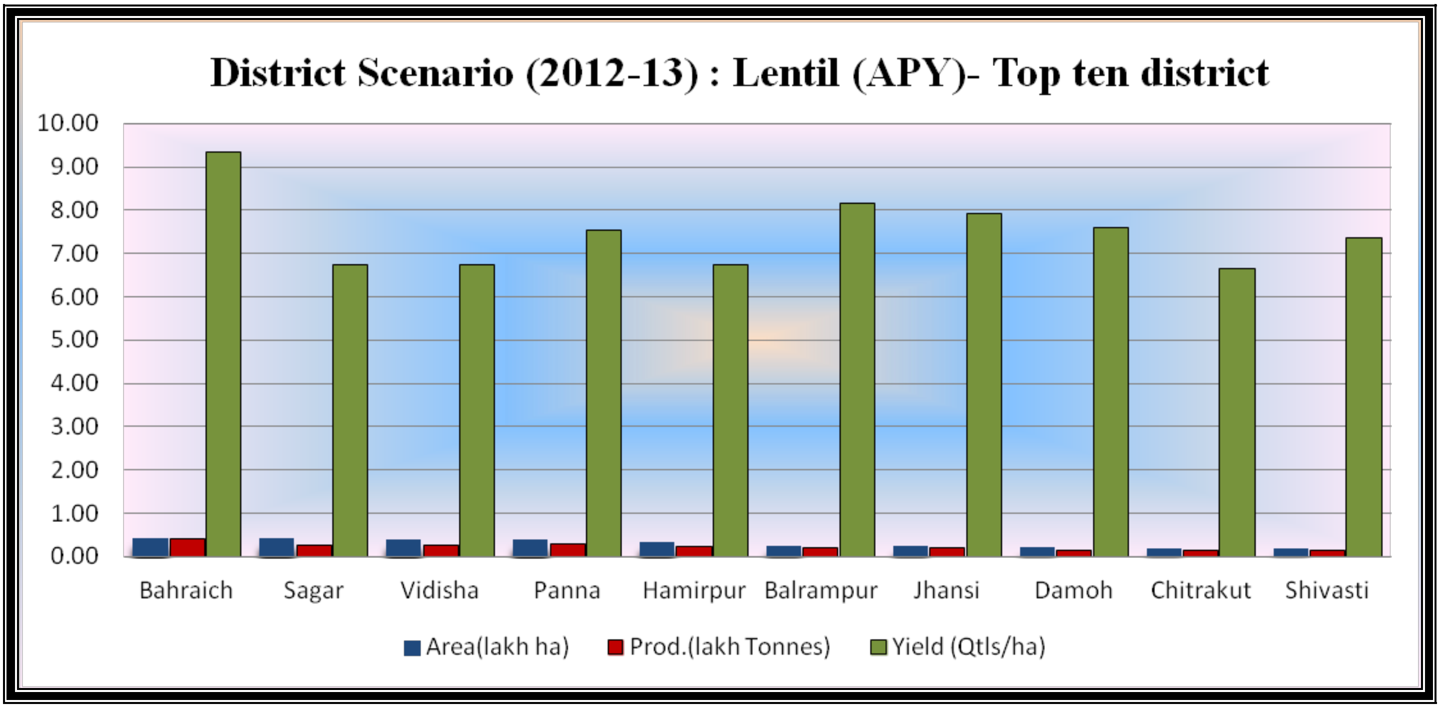
2.3. Potential districts (2013-14)

Analysis of the intra-state status of Lentil crop, is presented in table 6.3. Inter district analysis revealed that district Bahraich of U.P. with 3.46% of production has the highest share followed by Sagar. (2.38%), Vidisha (2.23%) and Panna (2.46%) of M.P. District-wise area, production and yield of top ten district of India in respect of production are presented below which contributed 20.63 per cent and 19.45 per cent of area and production of the country. The yield of potential districts may be exploited as the FLD yield gap analysis (2007-08 to 2011-12) has revealed a yield gapof 119 percent in MP and 60% at all India levels.

Table – 6.3. Top Potential districts (2013-14).

{Area-Lakh ha, Production-Lakh Tonnes, Yield-kg/ha}

Sr. No.	Name of District	State	Area		Prod.		Yield	
			Area	% to India	Prod.	% to India	Yield	YI
I	Bahraich	U.P.	0.420	2.950	0.392	3.461	935	117
II	Sagar	M.P	0.402	2.822	0.270	2.385	674	85
III	Vidisha	M.P	0.376	2.644	0.254	2.239	675	85
IV	Panna	M.P	0.371	2.606	0.279	2.461	753	94
V	Hamirpur	U.P.	0.324	2.274	0.218	1.923	674	85
VI	Balrampur	U.P.	0.247	1.736	0.201	1.775	815	102
VII	Jhansi	U.P.	0.239	1.678	0.189	1.665	791	99
VIII	Damoh	M.P.	0.195	1.373	0.148	1.309	760	95
IX	Chitrakut	U.P.	0.192	1.350	0.128	1.128	666	84
X	Shravasti	U.P.	0.171	1.202	0.126	1.110	736	92
	Total Above		**2.936**	**20.63**	**2.207**	**19.458**	**751**	**94**
	All India		**14.230**		**11.34**		**797**	



3. 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).

4. 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.

5. PRODUCTION TECHNOLOGY

5.1 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.

5.2 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 ar i) *Utera cultivation* - PL-406, PL-639, Arun and, ii) *Late sowings* – PL-406, PL-639, IPL-15, Narendra Masoor-1**.**

5.3 Soil/ land 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.

5.4 Cropping systems

5.4.1 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: Kharif fallow – lentil (rainfed areas); Paddy – lentil; Maize – lentil; Cotton – lentil; Bajra – lentil; Jowar – lentil; Groundnut – lentil.

5.4.2 Intercropping: Most common inter cropping systems are: Lentil + Sugarcane (Autumn) with two rows of lentil at 30cm row spacing in between twrows of sugarcane; Lentil + Linseed (2:2) and Lentil + Mustard (2:1)

5.5 Seed and sowing

5.5.1 Sowing Time: ***Rainfed*** - Ist fortnight of October in Central and South India and IInd 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.

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

5.5.3 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.)

5.5.4 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% $ZnSO_4$ + 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.

5.6 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.

5.7 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 arvensis*, *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. Application of Metolachlor 1000-1500 g a.i./ha at 0-3 DAS controls many annual grasses and broad leaf weeds.

5.8 Plant protection measure - Refer table -6.5.

5.9 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.

5.10 Yield- 10-15 q/ha.

Table – 6.4. Recommended lentil varieties/characteristics

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
JL 1	JNKVV	1991	MP	8.0	120-125	Early, Tolerant to wilt, **Seed bold**
Sapana (LH 84-8)	CCSHAU	1991	**NWPZ** (Punjab, Haryana, Delhi, West UP)	15.0	135-140	Tolerant to Rust & Bold Seeded
VL Masoor 4	VPKAS	1991	Uttrakhand	12.5	168	Tolerant to wilt & Rust, **Small seeded &black.**
Pant lentil-4 (PL-81-17)		1993	**NWPZ** (Punjab, Haryana, Delhi, West UP, North Rajasthan)	16.0	140-145	Resistant to Rust & tolerant to wilt.
Lens-4076	IARI	1993	**NWPZ** (Punjab, Haryana, Delhi, UP) **CZ** (MP, Maharashtra)	14.0	130-135	Tolerant to wilt & Rust. **Seed bold**
DPL-15 (Priya)	IARI	1995	**NWPZ** (Punjab, Haryana, Delhi, West UP)	15-18	130-135	Tolerant to wilt & Rust, **bold seeded.**
Pusa Vaibhav (L-4147)	IARI	1996	**NWPZ (**Punjab, Haryana, Delhi, West UP.)	20-24	130-135	Resistant to Rust & Tolerant to wilt, **small seeded**.
Garima (LH-84-6)	CCSHAU	1996	Haryana.	15-20	135-140	Tolerant 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 (**Punjab, Haryana, Delhi, West UP.)	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	JNKVV	1999	**CZ** (MP, Maharashtra)	15-19	115-120	Tolerant to wilt, **bold seeded**.
VL Masoor 103	VPKAS	2000	Uttrakhand	12-14	1645	Tolerant to Rust, **small seeded.**
Noori (IPL-81)	IIPR	2000	**CZ** (MP, Maharashtra)	17-18	110-120	Tolerant to Rust, wilt, **bold seeded**

(Lentil Continued)

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
Pant Lentil-5	GBPUAT	2001	Uttrakhand	15-18	135	Resistant to Rust, **bold seeded**.
Malaviya Vishwanath (HUL 57)	BHU	2005	Eastern and Central U.P., Bihar, Jharkhand, West Bengal and Assam	14.0	130	Resistant to rust & wilt, **small seeded.**
KLS 218	CSAUAT	2005	**NEPZ (**East Uttar Pradesh, Bihar, West Bengal).	14-15	125-130	Tolerant to Rust, wilt, **small seeded**
VL-Masoor-507	VPKAS, Almora	2006	J&K, H.P., Uttrakhand, North Eastern Hills	10-12	140-209	Resistant to wilt
Haryana Masoor-1 (LH-89-48)	CCSHAU	2006	Haryana	14	138	Moderate resistant to all disease
VL Masoor 125	VPKAS, Almora	2006	Uttrakhand	19-20	115-117	Resistant to wilt
VL Masoor 126 (VL-126)	VPKAS, Almora	2007	Uttrakhand, H.P., J&K and North Eastern Hills	12-13	126-212	Resistant to GM and Moderately resistantto wilt and rust
IPL-406 (Angoori)	IIPR	2007	Punjab, Haryana, North Rajasthan, Plains of Uttrakhand and Western UP	17	120-155	Resistant to rust and wilt
Pusa Masoor 5 (L-45994)	IARI	2008	Delhi	17-18	120-128	Resistant to rust moderately resistant to pod borer
Moitree WBL 77	PORS, Berhampore	2009	East UP, Bihar, Jharkhand, Assam & WB	15	117	Resistant to wilt and grey mould
Shekhar Masoor 2 (KLB-303)	Shekhar Masoor 2 (KLB-303)	2009	Uttar Pradesh	14	128	Moderately resistant to wilt and rust

(Lentil Continued)

Variety	**Source**	**Year of Release/ Notification**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Days to maturity**	**Remarks**
Shekhar Masoor 3 (KLB-320)	Shekhar Masoor 2 (KLB-303)	2009	Uttar Pradesh	14	128	Moderately resistant to wilt and rust
Pant Lentil 7 (PL 024)	GBPUAT	2010	Punjab, Haryana, UP	15	147	Resistant wilt to rust & pod borer
Pant Lentil 8 (PL 063)	GBPUAT	2010	Punjab, Haryana, Plains of Uttrakhand , Western UP, Delhi and Rajasthan	15	135	Mod. Resistant to rust and wilt. Resistant to pod borer
Pant Lentil-6 (PL-02)	GBPUAT	2010	Uttrakhand ,	11	125-145	Resistant to rust. Wilt, Ascochyta Blight and Tolerant to pod borer
VL Masoor -129	VPKAS, Almora	2010	Uttrakhand ,	9.0	151	Resistant to wilt and root rot and no infestation of pod borer
VL Masoor 133 (VL133)	VPKAS, Almora	2011	Uttrakhand ,	11	150	Resistant to wilt, root rot and rust
VL Masoor 514 (VL514)	VPKAS, Almora	2011	Uttrakhand ,	10	149-159	Moderately resistant to wilt and root rot disease. Tolerant to pod borer
LL 931	PAU	2012	Punjab	12-13	146-147	Resistant to lentil rust. Tolerant to pod borer

CZ- (MP., Maharashtra, Chhattisgarh, Gujarat) , SZ- (A.P., Karnataka, Tamil nadu, Odisha) NEPZ-North Eastplane 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 Monocrotophos (0.04%). Indoxacarb @ 50 g a.i./ha at 50% flowering stage.
ii. Aphids	Aphids suck the sap and in case of severe damage the growth is suppressed.	Metasystox or Monocrotophos (0.04%). Indoxacarb @ 50 g a.i./ha at 50% flowering stage.
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 look 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 (MATAR)

PEAS

Botanical Name - *Pisum sativum* (L.)
Synonym - Matar, Pea
Origin - Mediterranean Region of Southern Europe and Western Asia
Chromosome no. - 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 25-30 kg N/ha to the succeeding crops.

2. CROP STATUS

2.1. Global Scenario

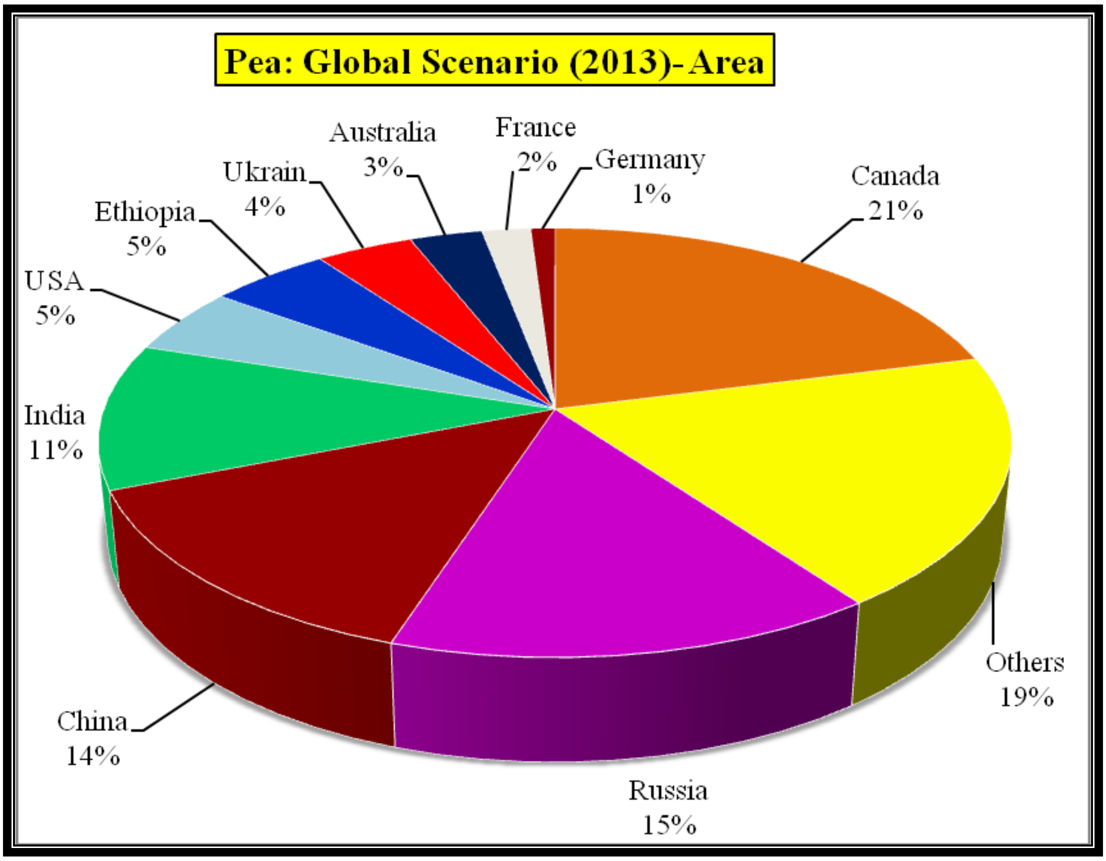
Canada rank first in area (21%) and production (35%) at Global level. Russia stands second position in area (15.14%) followed by China (14.19%) respectively. India occupy forth position in area (11.44%) and 5th position in production (6.00%). Highest productivity is recorded in Ireland (5000 kg/ha) followed by Netherland (5000 kg/ha), and France (3974 kg/ha). While, India's productivity is only 821 kg/ha.

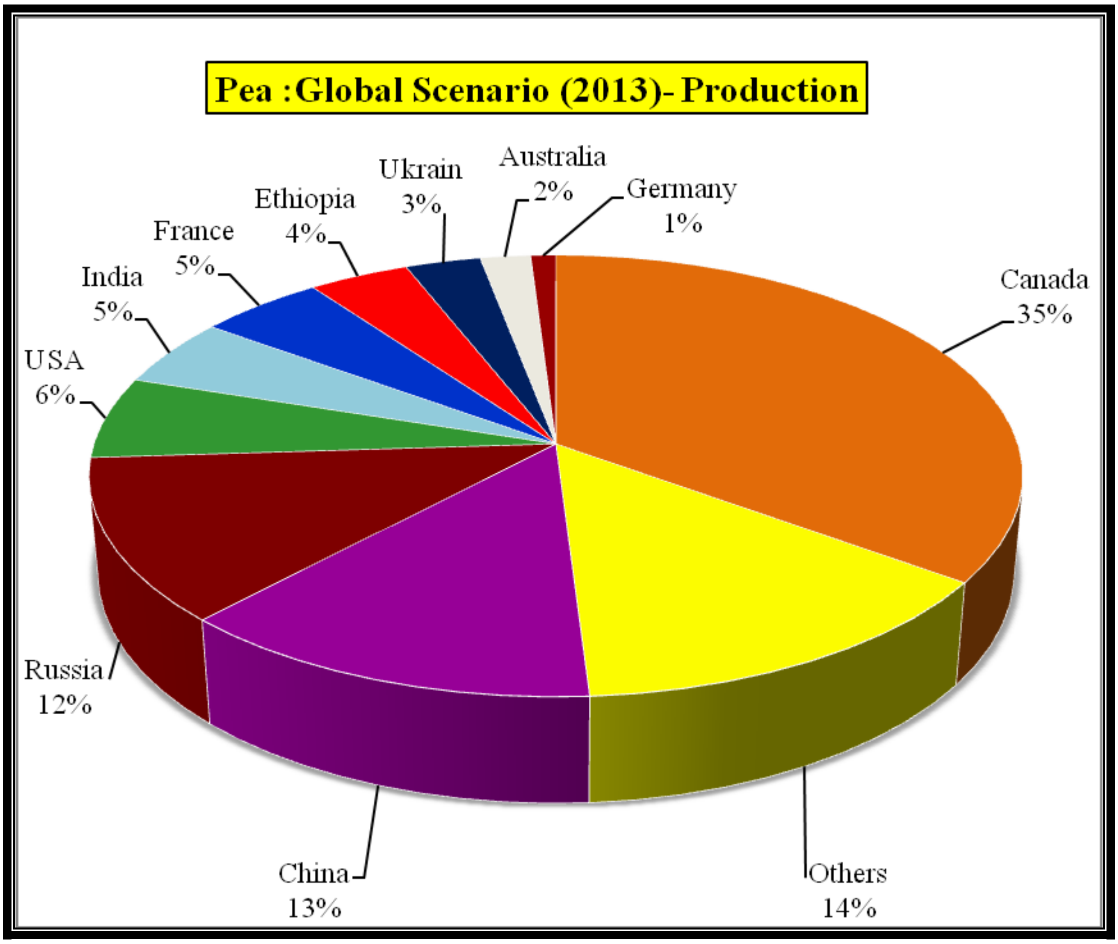
Table – 7.1. Global ranking in area, production and yield: Major countries

{Area-Lakh ha, Production-Lakh Tonnes, Yield-kg/ha}

Rank	Country	Area		Country	Production		Country	Yield
		Area	**% to World**		**Prod.**	**% to World**		
I	Canada	13.11	20.55	Canada	38.493	35.06	Ireland	5000
II	Russia	9.660	15.14	China	13.800	12.57	Netherland	5000
III	China	9.050	14.19	Russia	13.502	12.30	France	3974
IV	India	7.300	11.44	USA	7.085	6.45	Belgium	3750
V	USA	3.225	5.06	India	6.000	5.46	UK	3690
VI	Ethiopia	3.008	4.72	France	4.989	4.54	Luxembourge	3655
VII	Ukrain	2.408	3.77	Ethiopia	4.035	3.68	Germany	3417
VIII	Australia	1.742	2.73	Ukrain	2.750	2.50	Denmark	3395
IX	France	1.256	1.97	Australia	2.398	2.18	Switzerland	3395
X	Germany	0.379	0.59	Germany	1.295	1.18	Canada	2936
	World	**63.795**		**World**	**109.799**		**World**	**1721**

Source: FAO statistics, 2013


Pea: Global Scenario (2013)- Area
Australia 3%
France 2%
Germany 1%
Ukrain 4%
Ethiopia 5%
USA 5%
Canada 21%
India 11%
Others 19%
China 14%
Russia 15%


Pea :Global Scenario (2013)- Production
Australia 2%
Ukrain 3%
Germany 1%
Ethiopia 4%
France 5%
India 5%
Canada 35%
USA 6%
Russia 12%
China 13%
Others 14%

2.2 National Scenario

2.2.1 ***Tenth Plan (2002-2007):*** The area and production during the plan were 7.45lakh ha and 6.92 lakh tonnes respectively. The state of Uttar Pradesh ranked first in area and production (53.74% and 69.25%) followed by Madhya Pradesh (27.93% and 13.92%). Bihar stood in third position with area and production both 3.16% & 3.08% respectively. Ranjasthan has recorded yield (2193 kg/ha) followed by UP (1197 kg/ha) and Haryana (1153 kg/ha) which is greater than the National productivity (929 kg/ha). Lowest yield was observed in Chhattisgarh (350 kg/ha) followed by Maharashtra (396 kg/ha) and M.P. (463 kg/ha).

2.2.2 ***Eleventh Plan (2007-2012):*** During eleventh plan, the area and production were 7.20 lakh hectares and 6.24 lakh tonnes respectively. U.P. stands first in respect of area and production (44.72 % and 62.19 %) followed by M.P. (32.46 % and 15.41%) and Jharkhand (4.28 % & 5.03%). Rajasthan ranked first in yield (1313 kg/ha) followed by U.P. (1205 kg/ha) and Punjab (1174 kg/ha).The lowest yield was observed in C.G. (352 kg/ha) followed by Maharashtra (373 kg/ha) and Madhya Pradesh (412 kg/ha).

2.2.3 ***Twelfth Plan (T.E. 2012-2015):*** A total area of 11.50 lakh hectares and a total production of 10.36 lakh tonnes were recorded. Uttar Pradesh ranked first both in area and production (45.80% and 48.72%) followed by Madhya Pradesh (25.57% and 23.64%) and Jharkhand (2.70 % and 4.46%). In case of productivity Rajasthan ranked first with (1762 kg/ha) followed by Jharkhand (1491 kg/ha) and West Bengal (1157 kg/ha). The lowest yield was observed in C.G. (370 kg/ha) followed by Maharashtra (412 kg/ha) and Assam (745 kg/ha).

The area, production and yield significanlt increased during XII plan from previous plans.

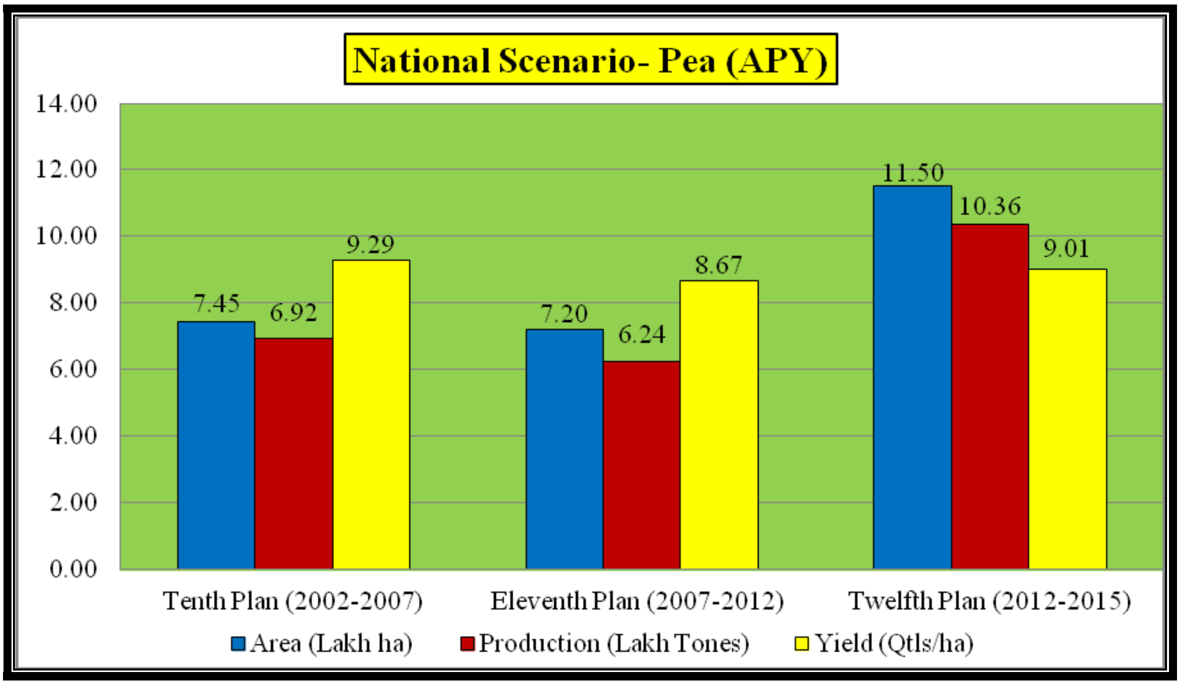
Table - 7.2 Plan-wise pea Scenario -States

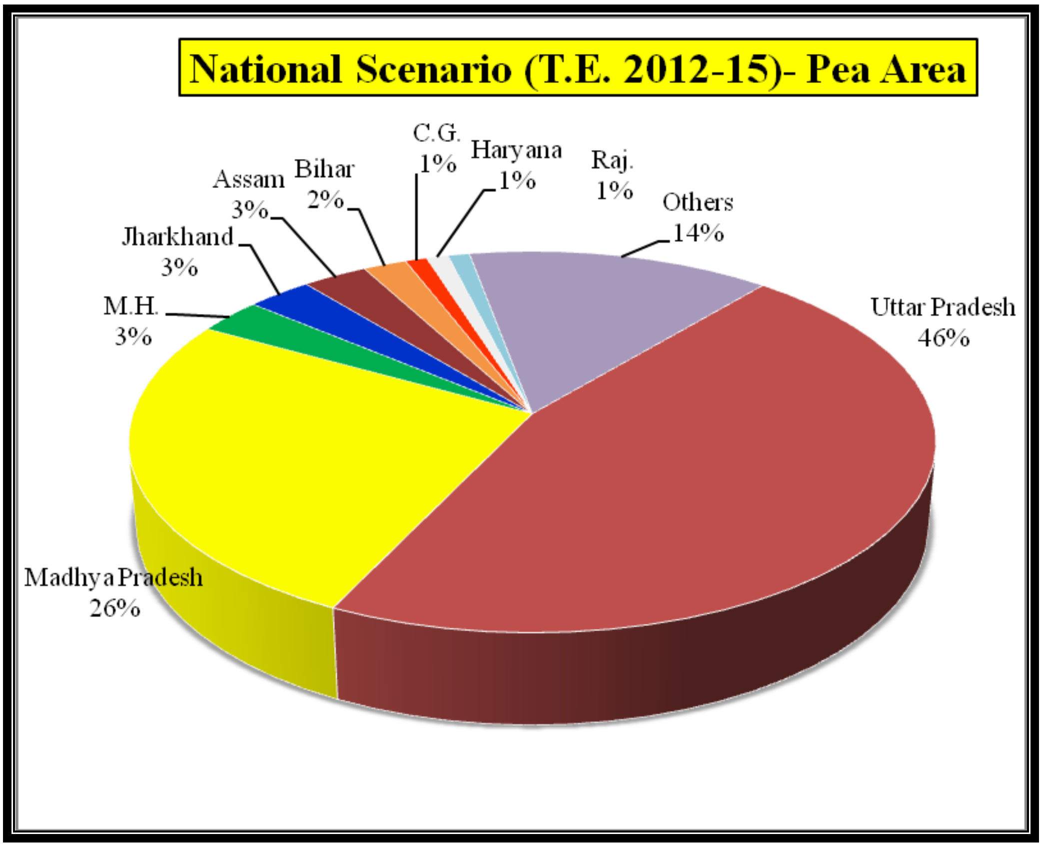
{A= Lakh ha, P= Lakh tonnes, Y= kg/ha}

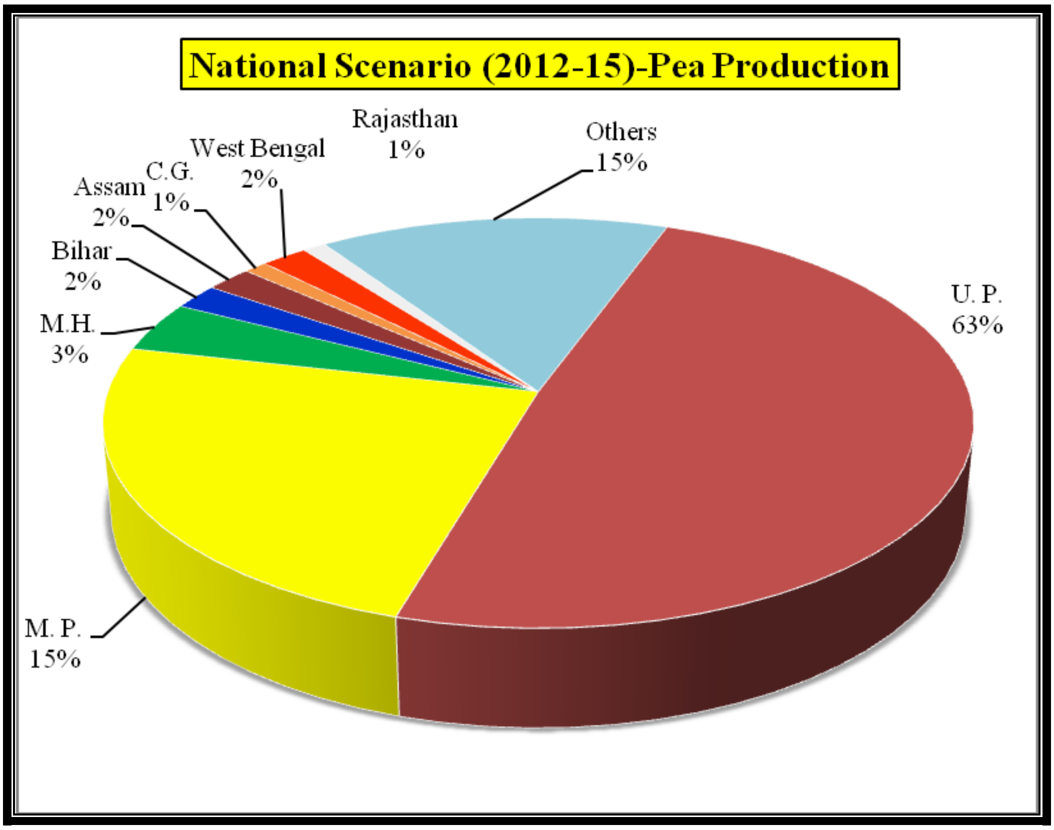
State		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
Assam	A	0.216	2.905	0.218	3.028	0.311	2.70
	P	0.133	1.928	0.134	2.144	0.232	2.24
	Y	616		614		745	
Bihar	A	0.235	3.157	0.216	3.003	0.179	1.56
	P	0.213	3.081	0.217	3.471	0.188	1.81
	Y	906		1002		1050	
Chhattisgarh	A	0.162	2.172	0.159	2.203	0.146	1.27
	P	0.057	0.818	0.056	0.894	0.054	0.52
	Y	350		352		370	
Haryana	A	0.014	0.193	0.013	0.183	0.075	0.65
	P	0.017	0.240	0.015	0.234	0.072	0.69
	Y	1153		1106		960	
Jharkhand	A	0.080	1.074	0.308	4.283	0.310	2.697
	P	0.067	0.962	0.314	5.038	0.462	4.464
	Y	833		1019		1491	

{A= Lakh ha, P= Lakh tonnes, Y= kg/ha}

State		X^{th} Plan	% to AI	XI^{th} Plan	% to AI	XII^{th} Plan	% to AI
Kerala	A	0.023	0.306	0.021	0.286	0.009	0.08
	P	0.017	0.246	0.011	0.176	0.008	0.07
	Y	746		534		815	
Madhya Pradesh	A	2.081	27.933	2.337	32.458	2.940	25.57
	P	0.963	13.916	0.962	15.413	2.450	23.64
	Y	463		412		833	
Maharashtra	A	0.167	2.242	0.221	3.064	0.293	2.55
	P	0.066	0.957	0.082	1.317	0.121	1.16
	Y	396		373		412	
Punjab	A	0.038	0.505	0.026	0.367	0.038	0.33
	P	0.042	0.610	0.031	0.497	0.045	0.43
	Y	1122		1174		1176	
Rajasthan	A	0.121	1.624	0.049	0.683	0.081	0.71
	P	0.265	3.835	0.065	1.035	0.144	1.39
	Y	2193		1313		1762	
Uttar Pradesh	A	4.004	53.745	3.220	44.722	5.268	45.80
	P	4.792	69.254	3.881	62.192	5.048	48.72
	Y	1197		1205		958	
Uttrakhand	A	0.042	0.564	0.060	0.839	0.052	0.45
	P	0.040	0.572	0.030	0.474	0.049	0.47
	Y	943		490		941	
West Bengal	A	0.131	1.753	0.104	1.439	0.125	1.09
	P	0.110	1.595	0.099	1.580	0.145	1.40
	Y	845		952		1157	
All India	**A**	**7.449**		**7.199**		**11.495**	
	P	**6.917**		**6.239**		**10.357**	
	Y	**929**		**867**		**901**	




National Scenario (T.E. 2012-15)- Pea Area
C.G. 1%
Haryana 1%
Raj. 1%
Others 14%
Bihar 2%
Assam 3%
Jharkhand 3%
M.H. 3%
Uttar Pradesh 46%
Madhya Pradesh 26%


National Scenario (2012-15)-Pea Production
Rajasthan 1%
Others 15%
West Bengal 2%
C.G. 1%
Assam 2%
Bihar 2%
M.H. 3%
U. P. 63%
M. P. 15%

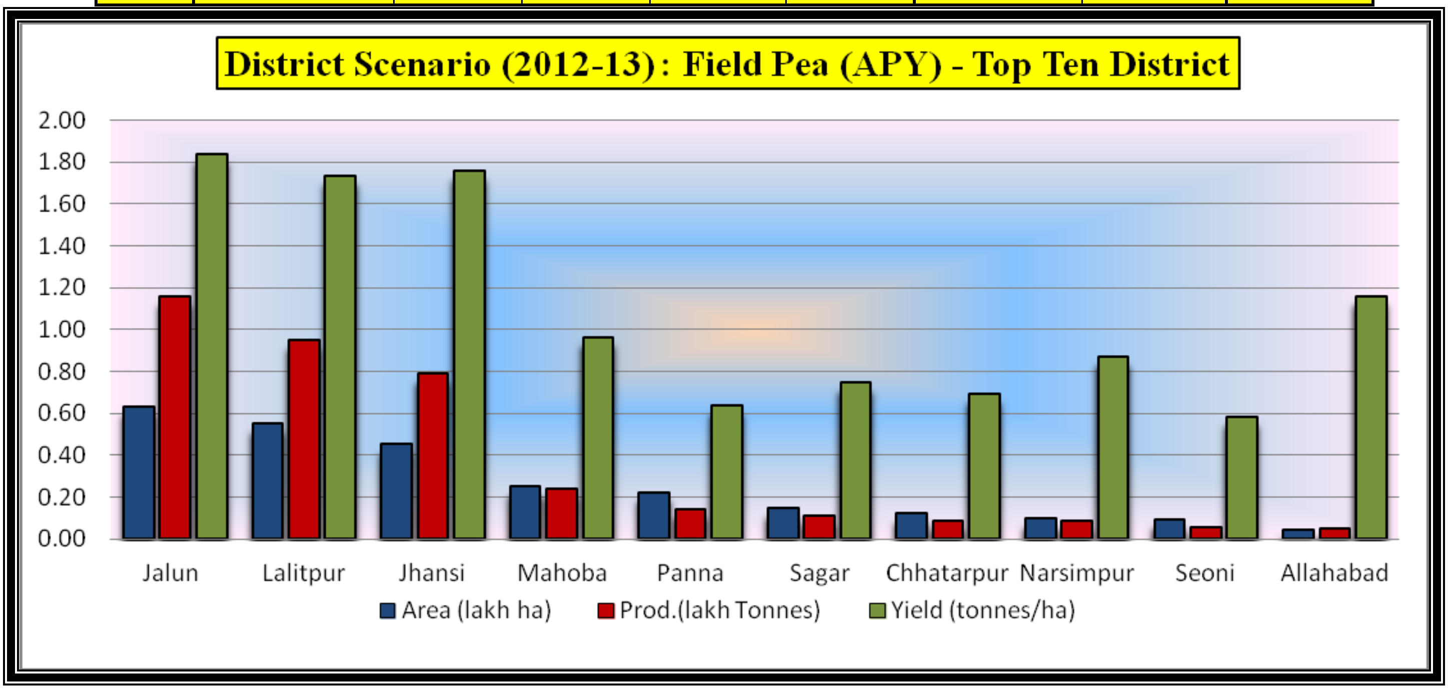
2.3 Potential Districts (2012-13)

Analysis of the intra-state status of Pea crop, is presented in table 7.3. Inter district analysis revealed that district Jalaun with 13.72% of production has the highest share followed by Lalitpur (11.26%), Jhansi (9.33%) and Mahoba (2.81%) of U.P. District-wise area, production and yield of top ten district of India in respect of production are presented below which contributed 33.72% and 43.19% of area and production of the country. The yield index of potential districts revealed that the yield of these districts has been above the National average yield (1099 kg/ha) in four districts. Rest of the other six districts having the below National average yield, need to adopt the improved package of practices to increase the production of peas in these distrits and in the country, as well.

Table- 7.3. Top Potential Districts (2012-13)

{Area-Lakh ha, Production-Lakh Tonnes, Yield-kg/ha}

Sr. No.	Name of District	State	Area		Prod.		Yield	
			Area	% to India	Prod.	% to India	Yield	YI
I	Jalaun	U.P.	0.629	8.22	1.154	13.72	1834	167
II	Lalitpur	U.P.	0.547	7.15	0.947	11.26	1730	157
III	Jhansi	U.P.	0.448	5.85	0.785	9.33	1753	159
IV	Mahoba	U.P.	0.246	3.22	0.237	2.81	961	87
V	Panna	M.P.	0.221	2.88	0.140	1.66	633	58
VI	Sagar	M.P.	0.143	1.86	0.106	1.26	743	68
VII	Chhatarpur	M.P.	0.119	1.55	0.082	0.97	689	63
VIII	Narsimpur	M.P.	0.094	1.22	0.081	0.97	867	79
IX	Seoni	M.P.	0.092	1.20	0.053	0.63	580	53
X	Allahabad	U.P.	0.042	0.55	0.048	0.57	1158	105
	Total above		**2.58**	**33.72**	**3.63**	**43.19**	**1408**	**128**
	All India		**7.650**		**8.410**		**1099**	



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

3.1 **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.

3.2 **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 7.4.

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; andbajra – pea,

5.5 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.

5.6 Seed and Sowingtime:

i. **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.

ii. **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.
iii. **Spacing**: i. 25-30 cm (row to row) and 8-10 cm (plant to plant) for dwarf genotypes like Aparna 30-40 cm (row to row) and 10-12 cm (plant to plant) for tall varieties like Rachna.

5.7 Plant nutrient management: Apply 2.5-5 t biogas slurry/compost per ha, apply 60 kg P_2O_5 per ha as basal dosein 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. along with 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.

5.8 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.

5.9 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. Application of Metribuzin 250 g a.i./ha at 0-3 DAS or 15-20 DAS.

5.10 Plant Protection: Refer table 7.5.

5.11 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.

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

Table – 7.4. Recommended varieties of peas/characteristics

Variety	**Source**	**Year of Release/Notification**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Days to maturity**	**Remarks**
JP-885	JNKVV	1992	**CZ** (MP, Maharashtra & Gujarat)	21.0	120-140	Resistant to PM.
KFP-103 (Shikha)	CSAUAT	1993	**NWPZ** (Punjab, Haryana, Delhi, West UP & North Rajasthan)	15-20	130-140	Resistant to PM.
DMR-7 (Alankar)	IARI	1996	**NWPZ** (Punjab, Haryana, Delhi, West UP & North Rajasthan)	20-25	115-135	Resistant to PM.
Uttra (HFP-8909)	CCSHAU	1996	**NWPZ** (Punjab, Haryana, Delhi, West UP & North Rajasthan)	20-25	120-140	Resistant to PM., dwarf
Sapna (KPMR-1441)		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	Resistant to PM. & tolerant to rustDwarf, escapes leaf minor
Malviya Matar-15 (HUDP-15)	BHU	1999	**NEPZ** (East UP, Bihar, West Bengal). **NHZ**	25-30	110-130	Resistant to PM., rust and leaf miner
DDR-23 (Pusa Prabhat)	IARI	2000	**NEPZ** (East UP, Bihar, W.B).	15.0	95-115	Extra early, Resistant to PM
Ambika	IGKV	2000	**CZ** (MP, Maharashtra & Gujarat)	15-20	100-125	Resistant to PM, Tall Plants
DDR-27 (Pusa Panna)	IARI	2001	**NWPZ** (Punjab, Haryana, Delhi, West UP & North Rajasthan)	18.0	100-115	Very early, Resistant to PM
Indra (KPMR-400)	CSAUAT	2001	**CZ** (MP, Maharashtra & Gujarat)	20.0	105-115	Dwarf type, Resistant to PM
Shubhra (IM-9101)	IGKV	2001	Chhattisgarh	15-20	90-95	Resistant to PM

(Peas Continued)

Variety	**Source**	**Year of Release/ Notification**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Days to maturity**	**Remarks**
Jay(KPMR-522)	CSAUAT	2001	**NWPZ** (Punjab, Haryana, Delhi, West UP & North Raj.	23.0	120-140	Dwarf type, Resistant to PM
Adarsh (IPF 99-25)	IIPR	2004	**CZ** (MP, Maharashtra & Gujarat)	23	110-115	Resistant to Powdery Mildew
Vikas (IPFD 99-13)	IIPR	2005	H.P., Maharashtra, C.G., Gujarat & Bundel khand region of U.P.	23	102	Resistant to PM and tolerant to rust
Prakash (IPFD-1-10)	IIPR	2006	M.P., C.G., Maharashtra, Gujarat, Bundel khand region of UP, J&K, H.P. and Uttrakhand	21	94-121	Resistant to PM and tolerant to rust
Paras	IGAU, Raipur	2006	Chhattisgarh	18-24	92-119	Resistant to powdery mildew
Pant P-14	GBPUAT	2006	Uttrakhand	15-22		Resistant to rust and PM
VL-Matar-42	VPKAS, Almora	2007	Eastern U.P., Bihar, Jharkhand, East Bengal, Assam	20	108-155	Resistant to PM, Moderate resistant to rust
Hariyal (HFP-9907B)	CCSHAU	2007	Punjab, Haryana, Rajasthan, Delhi, Western U.P.	17-20	128	Resistant to PM & tolerant to rust
Pant Pea -25	GBPUAT	2007	Uttrakhand	18-22	125-128	Resistant to PM &Mod. Resistant to rust
HFP -9426	CCSHAU Hisar	2008	Irrigated areas of Haryana	20	135	Res. To PM and tolerant to root rot. Mod. Resistant to nematodes.
Pant Pea -42	GBPUAT	2008	Western UP, Northern Rajasthan, Punjab, Haryana and plains of Uttrakhand	22	113-149	Resistant to powdery mildew and mod. Resistant to pod borer and stem fly
Swarna Tripti	ICAR,RS, Plandu, Ranchi	2008	Jharkhand, Bihar, & WB.	25	65-70	Resistant to rust and powdery mildew. tolerant to pod borer

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
Vivek Matar - 10 (VP101)	VPKAS, almora	2008	Uttar Pradesh & Uttrakhand	72-98 (pods)	120-130	Mod. Resistant to PM, white rot, wilt & leaf blight. Less incidence of pod borer
Variety	**Source**	**Year of Release/ Notification**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Days to maturity**	**Remarks**
Pant Pea 13	Central	2008	Western UP,Rajasthan	24-26	110-115	Resistant to powdery mildew
GOMATI (TRCP-8)	ICAR NHE Regional centre, Lembuherra	2010	Uttrakhand Hills, Jammu & Kashmir and North Eastern states	22-24	87-97	Suitable for late sown condition resistant to PM. tolerant to pod borer and stem fly
Aman (IPF 5-19)	IIPR	2010	Punjab, Haryana. Plains of Uttrakhand west UP, Delhi and Parts of Rajasthan	22	124-137	Res. To PM and tolerant to rust. Mod. resistant to pod borer and stem fly
IPF 4-9	IIPR, Kanpur	2011	Suitable to irrigated areas	17	129	Resistant to powdery mildew and mod. Resistant to pod borer and stem fly
VL Matar 47 (VL47)	VPKAS, Almora	2011	Uttrakhand	14.0	142-162	Resistant to wilt , Rust and powdery mildew
Dantiwada Field pea 1 (SKNP 04-09)	S.D.Agri. university ,	2011	Uttar Pradesh, Bihar, Jharkhand, and West Bengal.	17.0	98-123	Resistant to powdery mildew

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

Table – 7.5. 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.	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. Spray of NSKE 5 % at 40 DAS.
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.	Monocrotophos 36 EC or NPV @ 250 LE/ha.
v. Powdry Mildew (Erysiphepolygoni)	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 covered by a powdery mass.	i. Adopt early duration var. ii. Spraying with wettable sulphur @ 3 gm/litre or Dinocap @ 1 ml/litre of water.
vi. Wilt (Fusariumoxysporum)	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 (Uromycesfabae)	During advance stages affected plants dries out	i. Adopt early duration varieties. ii. Spray with Maneb @ 2 gm/litre of water.

MOTHBEAN (MOTH)

MOTHBEAN

Botanical Name	**-**	*Vigna acontifolia*
Origin	-	India
Synonym	-	Moth
Chromosome no.	-	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 40º C. 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

2.1.1 ***Tenth Plan (2002-2007):*** The area coverage and production were 12.42 lakh hectares and 2.97 lakh tonnes respectively, during the tenth plans. Rajasthan ranked first both in area (92.43 %) and production (90.24%). Maharashtra stand second in area (3.62%) followed by Gujarat (3.54%), while in production Gujarat stands second with 5.39 % followed by Maharashtra 4.04 % respectively. The yield was recorded above the National average in the state of Gujarat i.e. (364 kg/ha) followed by Maharashtra (267 kg/ha) remaining state below the National average yield.

2.1.2 ***Eleventh Plan (2007-2012)***: During eleventh plan, the area and production of moth were14.06 lakh hectares and 4.27 lakh tonnes respectively. Rajasthan occupied first position accounting 94.66% area and 92.82 % production share followed by Gujarat (2.65 % and 3.79%) and Maharashtra with 1.97% area and 2.25% production share in the country. The yield was observed below the National average in Rajasthan (297 kg/ha) which is major producing state.

2.1.3 ***Twelfth Plan (T.E.2012-2015)***: A total of 9.26 lakh hectares and 2.77 lakh tonnes of Moth production was recorded in the country during the twelfth plan period. Area and production of mothbean highest in Rajasthan contributing (96.75% and 94.49%) followed by Gujrat (2.38% and 3.6%) respectively. However, yield of Rajsthan (292 kg/ha) was below the National average yield of (299 kg/ha). Need to adopt improved package of practices and varietal breakthrough.

The overall area and production declined during XIIth plan period from previous plan. Emphasis needed to adopt the improved technology recommendations and varieties to increase the moth production in the country.

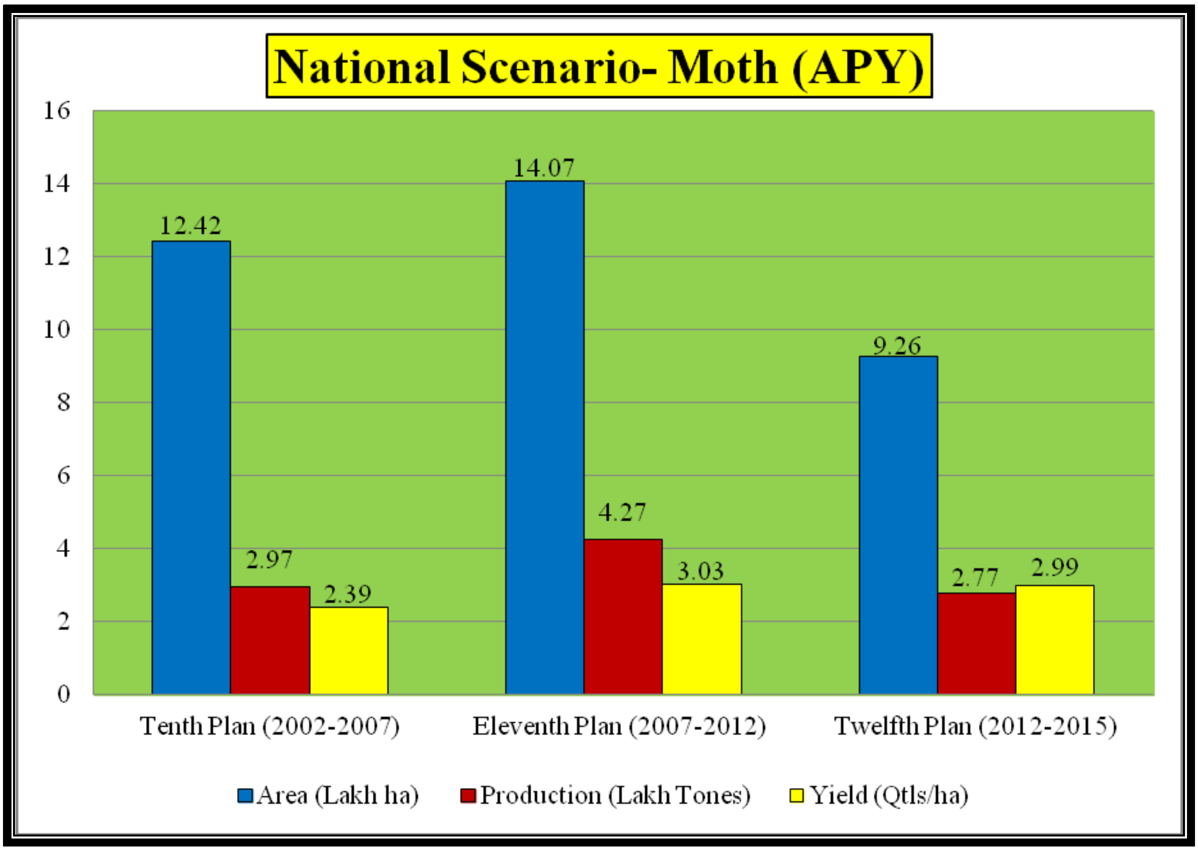
Table - 8.1. Plan-wise mothbean scenario - States

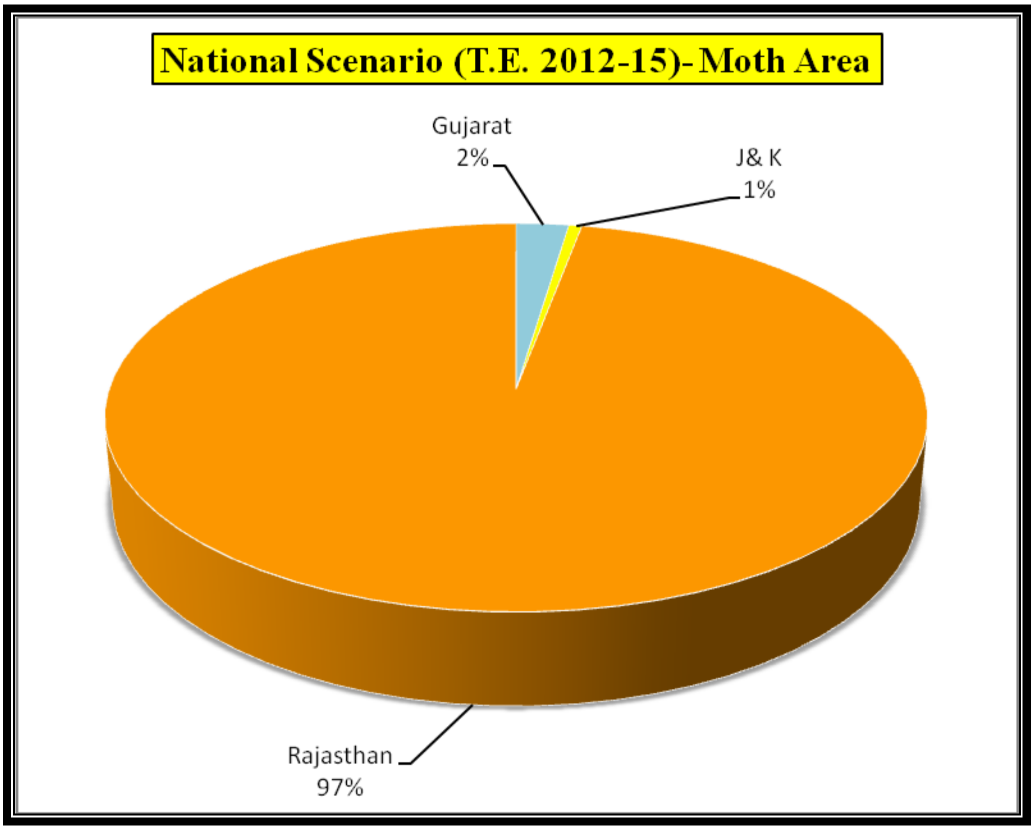
{A= Lakh ha, P= Lakh tonnes, Y= kg/ha}

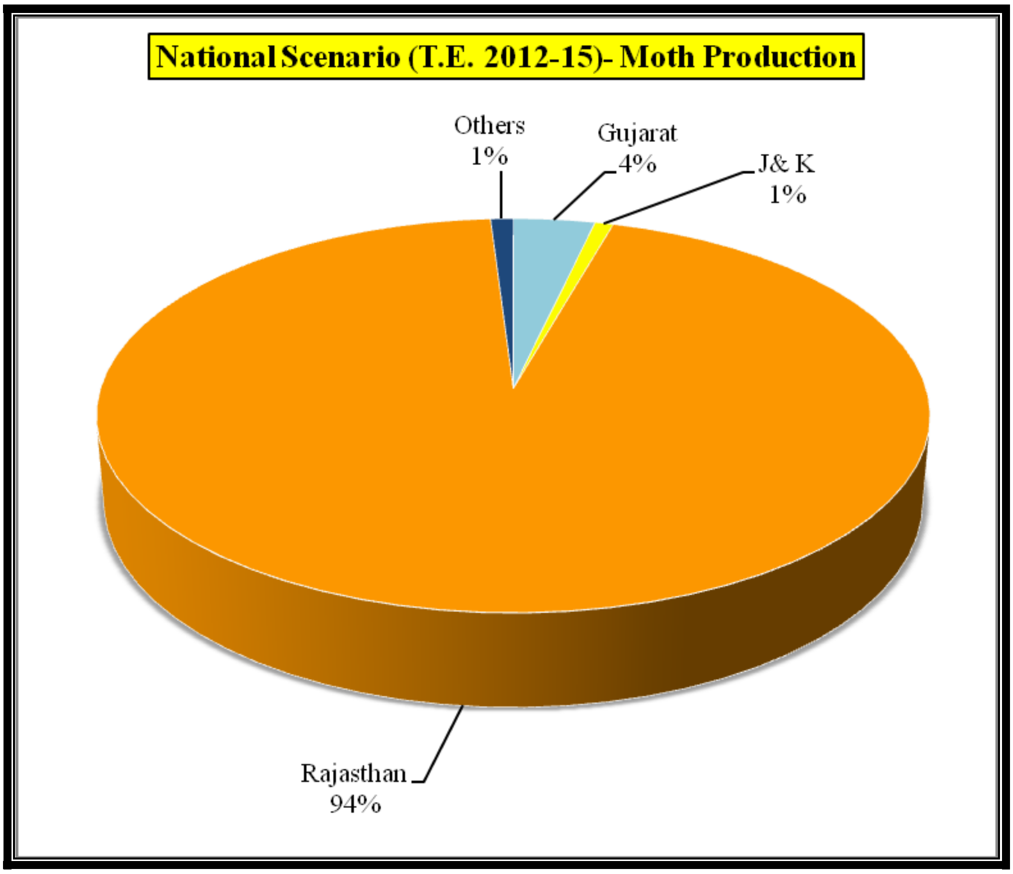
State		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
Gujarat	A	0.44	3.54	0.374	2.659	0.22	2.38
	P	0.16	5.39	0.162	3.798	0.1	3.61
	Y	364		433		455	
Haryana	A	0.05	0.4	0.045	0.319	0.014	0.15
	P	0.01	0.34	0.014	0.323	0.004	0.14
	Y	200		308		293	
Himachal Pradesh	A			0.009	0.062	0.013	0.14
	P			0.012	0.274	0.027	0.96
	Y			1351		2046	
Jammu & Kashmir	A			0.042	0.296	0.054	0.59
	P			0.02	0.465	0.022	0.81
	Y			477		411	
Maharashtra	A	0.45	3.62	0.278	1.973		
	P	0.12	4.04	0.096	2.25		
	Y	267		346			

{A= Lakh ha, P= Lakh tonnes, Y= kg/ha}

State		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
Rajasthan	A	11.48	92.43	13.314	94.661	8.956	96.75
	P	2.68	90.24	3.96	92.819	2.618	94.49
	Y	233		297		292	
All India	A	12.42		14.065		9.257	
	P	2.97		4.266		2.771	
	Y	239		303		299	




National Scenario (T.E. 2012-15)- Moth Area
Gujarat
2%
J& K
1%
Rajasthan
97%


National Scenario (T.E. 2012-15)- Moth Production
Others
1%
Gujarat
4%
J& K
1%
Rajasthan
94%

2.2 Potential Districts (2012-13)

Inter district analysis revealed that the all the potential districts having area and production of the country about 5 % and 9% respectively and yield above the National average yield (281 kg/ha) in all the potential districts.

Table- 8.2 Top Potential Districts (2012-13)

{Area-Lakh ha, Production-Lakh Tonnes, Yield-kg/ha}

Sr. No.	Name of District	State	Area		Prod.		Yield	
			Area	% to India	Prod.	% to India	Yield	YI
I	Kutch	Gujarat	0.260	2.918	0.108	4.320	415	148
II	Banas Kantha	Gujarat	0.060	0.673	0.037	1.480	617	220
III	Ahmedabad	Gujarat	0.046	0.516	0.029	1.160	630	225
IV	Patan	Gujarat	0.033	0.370	0.016	0.640	485	173
V	Surendranagar	Gujarat	0.022	0.247	0.013	0.520	591	211
VI	Mehsana	Gujarat	0.012	0.135	0.008	0.320	667	238
VII	Bhavnagar	Gujarat	0.010	0.112	0.006	0.240	600	214
VIII	Rajkot	Gujarat	0.004	0.045	0.003	0.120	750	267
IX	Gandhinagar	Gujarat	0.003	0.034	0.002	0.080	667	238
X	Kheda	Gujarat	0.002	0.022	0.002	0.080	1000	356
	Total above		**0.452**	**5.073**	**0.224**	**8.960**	**496**	**177**
	All India		**8.910**		**2.500**		**281**	

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.

A. Abiotic Stresses of Mothbean

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

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

B. Remedy to over come constraint

Alteration in plant type (Research efforts) 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 8.3.**

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-IInd to IIIrd 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.

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 8.4.**

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 – 8.3. Recommended varieties of moth/characteristics

Variety	**Source**	**Year of Release/ Notif.**	**Area of adoption Zone/State**	**Ave. yield (Q/ha)**	**Days to maturity**	**Remarks**
Maru Bahar (RMO-435)	RAU	2002	Rajasthan, Gujarat, Maharashtra	6-6.5	65-67	Early maturing
CAZRI Moth 2	CAZRI	2003	Rainfed areas	5-7	70-72	
CAZRI Moth 3	CAZRI (Jodhpur)	2004	Rainfed areas	6-5	60-88	Erect, upright growth lush green foliage Resistant to YMV and dry root rot
RMO-423	ARS, Bikaner	2004	Rajasthan	5-6	67-70	Tolerant to disease insect & pests
RMO-257	RAO	2005	Rajasthan	6-7	63-65	Semi erect
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 – 8.4. Pest and diseases in mothbean and their management

S. 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). - Application of Phorate or aldicarb
ii.	White fly	II week of August to harvest	Regular	
iii.	Thrips	II week of August to harvest	Regular	

iv.	Aphid & mite	II week of Aug. to I week of Sept.	Sporodic minor pest	@1.25 kg a.i. effective upto 4 week. - Spray with monocrotophos @ 25 kga.i./ha or dimethoate @ 0.15 kg a.i./ha.
	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.

HORSEGRAM (KULTHI)

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, Odisha, Tamil Nadu, M.P., Chhattisgarh and in foot hills of Uttrakhand and H.P., in India. It is also cultivated in other countries mainly Sri Lanka, Malaysia, West Indies etc.

2. CROP STATUS

2.1 National Scenario

2.1.1 ***Tenth Plan (2002-2007):*** During the tenth Plan, the total area coverage of Kulthi in the country was 7.16 lakh hectares with a total production of 2.56 lakh tonnes. Karnataka ranked the first both in area and production with 41.65% and 42.48% respectively. Odisha is second in area (11.09%), while, Tamilnadu in production (11.14%). Andhra Pradesh held third position both in area and production (9.74% and 11.25%). The highest yield was recorded in the state of Bihar (804 kg/ha) followed by W.B. (444 kg/ha) and A.P. (413 kg/ha).

2.1.2 ***Eleventh Plan (2007-2012)***: The total area and production during Ninth plan was 3.29 lakh hectares and 1.43 lakh tonnes respectively, Karnataka stands first in respect of area and production with 28.15% and 33.15% respectively. The second position in respect of area and production is occupied by Odisha (18.74% & 12.55%) followed by Chhatisgarh (14.48% & 9.94%). The highest yield was, however, recorded in the state of Bihar followed by W.B. (825 kg/ha) and A.P. (581 kg/ha).

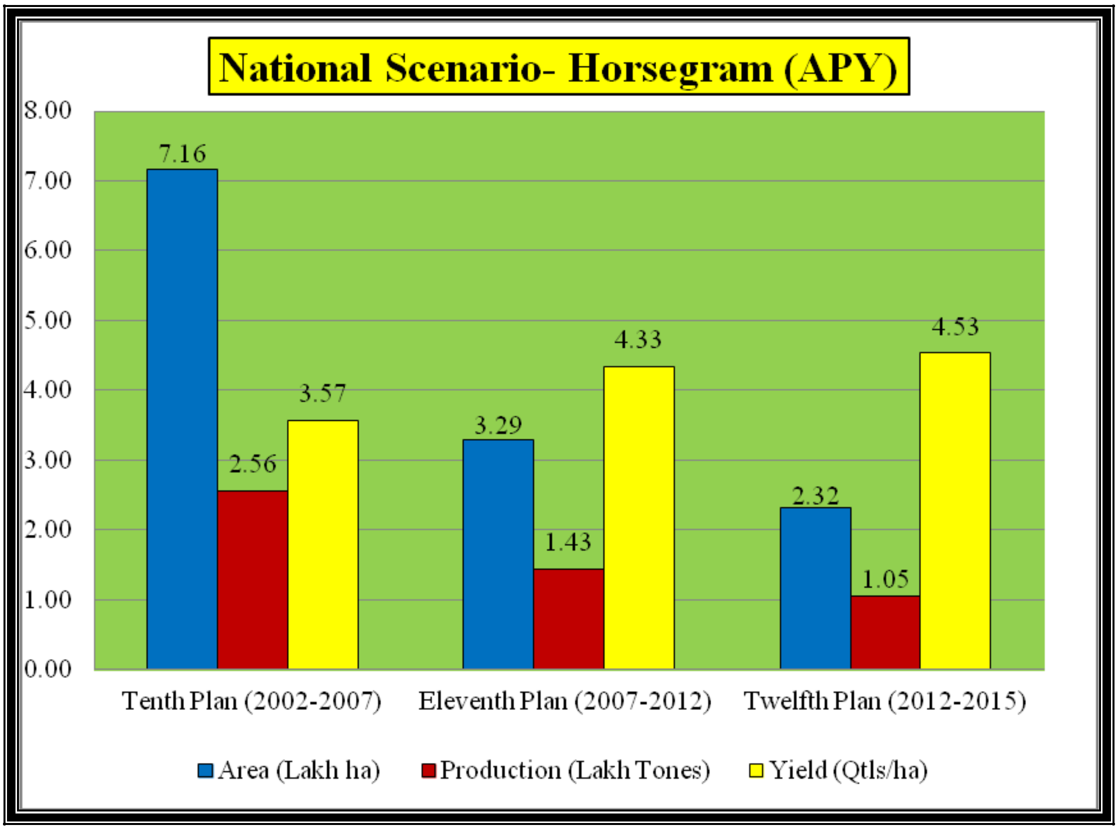
2.1.3 ***Twelfth Plan (T.E. 2012-2015):*** In India, the total area under Horsegram and its production during this plan was 2.32 lakh hectares and 1.05 lakh tonnes respectively. In terms of area and production, Karnataka is on the first position on all India basis contributing 26.72% and 25.71% followed by Odisha (19.46% & 15.48%) and Chhatisgarh (19.29% & 13.29%).The highest yield was recorded in the state of Bihar (959 kg/ha) followed by W.B. (796 kg/ha) and Jharkhand (603 kg/ha).

The trend of area and production during the last three plan period showed significant decreased.

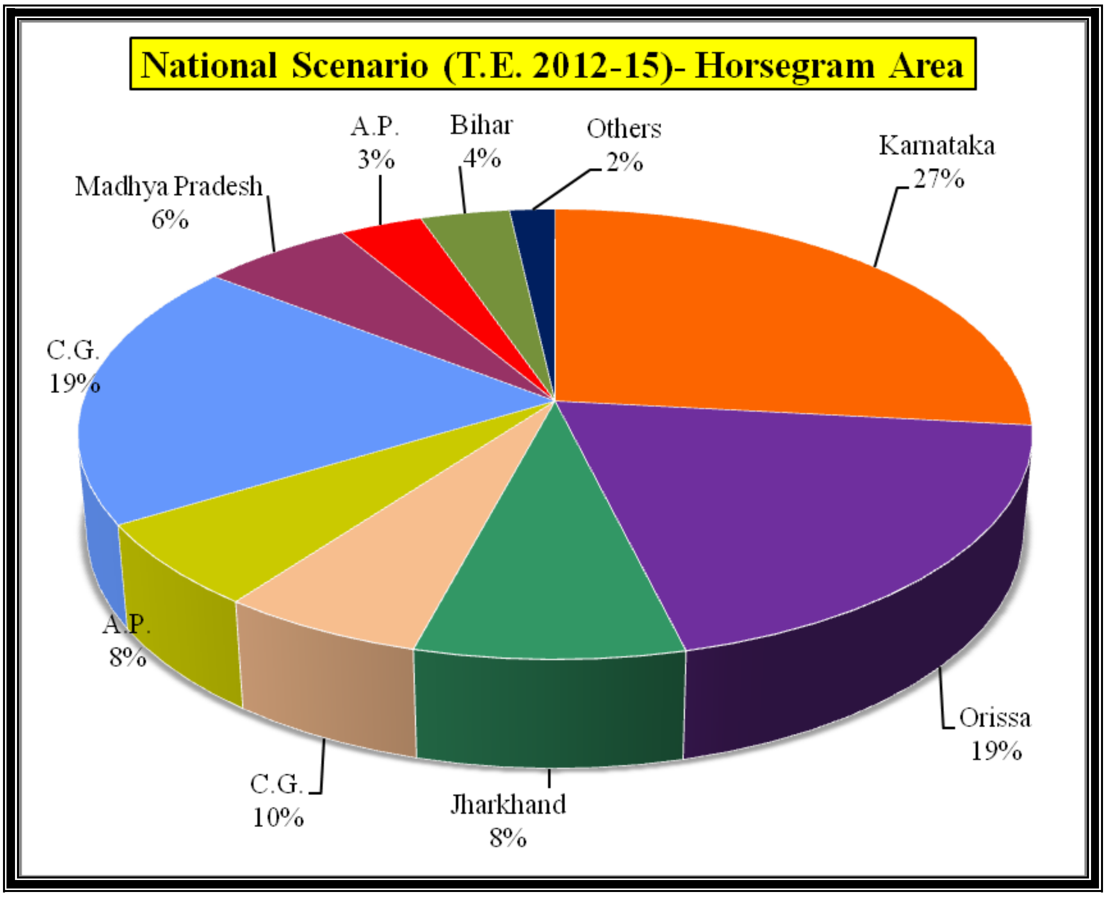
Table -9.1. Plan-wise horsegram scenario – States

{Area = Lakh ha, P= Lakh tonnes, Y= kg/ha}

State		X^{th} Plan	% to AI	XI^{th} Plan	% to AI	XII^{th} Plan	% to AI
Andhra Pradesh	A	0.70	9.74	0.09	2.61	0.08	3.23
	P	0.29	11.25	0.05	3.50	0.04	3.81
	Y	413		581		533	
Bihar	A	0.14	1.93	0.11	3.32	0.08	3.49
	P	0.11	4.34	0.10	7.15	0.08	7.40
	Y	804		938		959	
Chhattisgarh	A	0.55	7.68	0.48	14.48	0.45	19.29
	P	0.16	6.41	0.14	9.94	0.14	13.29
	Y	298		298		312	
Jharkhand	A	0.17	2.32	0.16	4.95	0.19	7.96
	P	0.07	2.66	0.09	6.41	0.11	10.60
	Y	410		563		603	
Karnataka	A	2.98	41.65	0.93	28.15	0.62	26.72
	P	1.09	42.48	0.47	33.15	0.27	25.71
	Y	365		512		435	
Madhya Pradesh	A	0.31	4.33	0.23	7.04	0.14	5.93
	P	0.09	3.40	0.07	4.88	0.05	5.05
	Y	281		301		385	
Maharashtra	A	0.65	9.12	0.32	9.65		
	P	0.20	7.97	0.12	8.48		
	Y	312		382			
Odisha	A	0.79	11.09	0.62	18.74	0.45	19.46
	P	0.20	7.97	0.18	12.55	0.16	15.48
	Y	257		291		360	
Tamil Nadu	A	0.75	10.43	0.20	5.97	0.14	6.02
	P	0.29	11.14	0.08	5.39	0.07	6.80
	Y	382		392		511	
West Bengal	A	0.04	0.50	0.12	3.77	0.14	6.13
	P	0.02	0.63	0.10	7.15	0.11	10.78
	Y	444		825		796	
All India	**A**	**7.16**		**3.29**		**2.32**	
	P	**2.56**		**1.43**		**1.05**	
	Y	**357**		**433**		**453**	



National Scenario- Horsegram (APY)
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
7.16
2.56
3.57
3.29
1.43
4.33
2.32
1.05
4.53
Tenth Plan (2002-2007)
Eleventh Plan (2007-2012)
Twelfth Plan (2012-2015)
Area (Lakh ha)
Production (Lakh Tones)
Yield (Qtls/ha)



National Scenario (T.E. 2012-15)- Horsegram Area
A.P. 3%
Bihar 4%
Others 2%
Karnataka 27%
Madhya Pradesh 6%
C.G. 19%
A.P. 8%
C.G. 10%
Jharkhand 8%
Orissa 19%

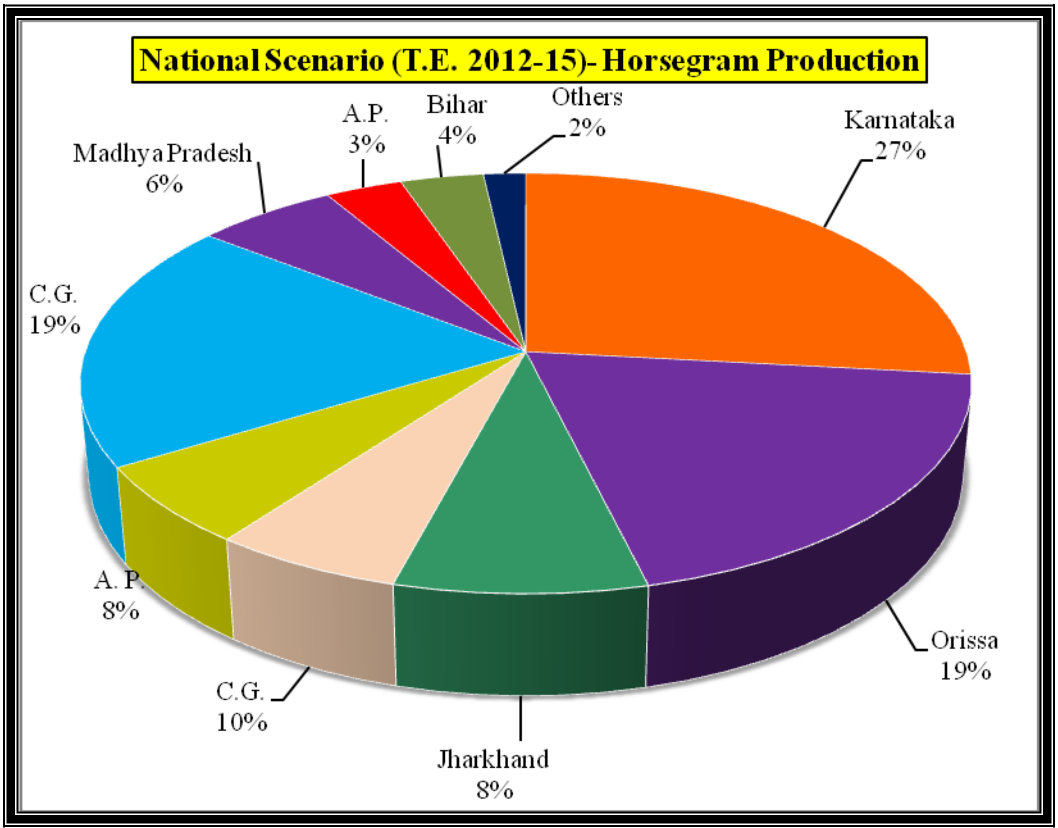


Table- 9.2 Top Potential Districts (2012-13)

Inter district analysis revealed that the major potential district contribute area and production about (9.5% & 13%) respectively. Most of the potential districts having yield above the National average yield (416 kg/ha) except Coimbatore district.

S. No.	Name of District	State	Area (lakh ha)		Production (lakh tonnes)		Yield (kg/ha)	
			Area	% to India	Prod.	% to India	Yield	YI
I	Dharmapuri	T.N.	0.157	3.38	0.089	4.59	565	136
II	Srikakulam	A.P.	0.063	1.36	0.047	2.42	741	178
III	Vellore	T.N.	0.061	1.31	0.031	1.59	503	121
IV	Cuddapah	A.P.	0.030	0.65	0.021	1.09	701	169
V	Anantpur	A.P.	0.028	0.61	0.019	0.99	672	161
VI	Sundargarh	Odisha	0.025	0.53	0.012	0.60	468	113
VII	Koraput	Odisha	0.024	0.52	0.010	0.53	423	102
VIII	Naworangpur	Odisha	0.017	0.36	0.007	0.38	439	106
IX	Cuttack	Odisha	0.017	0.36	0.007	0.36	414	100
X	Coimbatore	T.N.	0.016	0.35	0.006	0.33	395	95
	Total above		0.44	9.43	0.25	12.87	568	137
	All India		4.64		1.93		416	

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 – 9.3.**

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 9.4

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 6-10 qtls of grain/ha depending upon the monsoon behavior.

Table – 9.3. Recommended varieties of horsegram/characteristics

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
KS 2	RAU	1991	Rajasthan	6-7	80-85	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** (Karnataka, AP, Odisha, TN).	8-9	100-106	For Sept- Oct sowing
PHG 9	UAS	2001	**SZ** (Karnataka, AP, Odisha, TN).	7-9	100-105	Semi spreading thick foliage
Pratap Kulthi - 1 (AK 42)	MPUAT	2005	Rajasthan, Gujarat, M.P. Haryana	10-12	83-87	Protein 30% lush green foliage with wax deposition
VL Gahat-8	VPKAS, Almora	2007	Uttrakhand	12	92-106	Resistant to anthracnose and stem root
VL Gahat-10	VPKAS, Almora	2007	Uttrakhand	10	110-115	Resistant to YMV & root rot and leaf spot.
GPM 6	AICRP, Bijapur	2008	Karnataka	8-9	120-130	Resistant to YMV, moderately resistant to Rhizoctonia root rot
VL Gahat 15	VPKAS, Almora	2009	Northern India	5-6	95-105	Resistant to Anthrocnose and leaf spot
VL Gahat 19	VPKAS, Almora	2010	North Zone	5	88-94	Multiple disease resistance to important disease
CRIDA 1-18 R	CRIDA, Hyderabad	2009	Karnataka, AP and TN	8	72-102	Tolerant to YMV, powdery mildew, leaf blight, and root rot
CRIDALATHA (RHG 4)	CRIDA	2010	South Zone	8.0	72-110	Tolerant to YMV, powdery mildew, leaf blight, and root rot & mites
Indira kulthi 1 (IKGH 01-01)	IGKV	2010	Chhattisgarh	7.0	92	Up lands under rainfed condition with sowing time of august 15 onwards
Gujarat Dantiwada Horsegarm-1(GHG-5)	SDAU, SK Nagar	2012	Gujarat, Rajasthan, Uttrakhand, Jharkhand, UP & Maharashtra	5-6	89-100	Resistant to root rot, moderately resistant to PM, Collar rot, Cercopsora leaf spot and leaf blight.

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

Table – 9.4. 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.	Monocrotophos 36 EC or NPV @ 250 LE/ha. Indoxacarb 14.5 SC @ 50 g a.i./ha at 50 % flowering.
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 solani)*	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 (KHESARI)

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%

The major Lathyrus cultivating states in India are Chhattisgarh, Bihar, Jharkhand, Maharashtra, Odisha, Assam, West Bengal and Eastern Uttar Pradesh. In the Rice-Based Cropping system, utilizing the available moisture, it is grown as a relay crop and it's a better option to earn income from rice fields. It is also taken as mixed crop and intercrop during *rabi* and sole crop under "Utera" conditions.

Grasspea contains 34% protein and other essential micro-nutrients and may provide nutritional security to the low income people in the society. However the seeds contain Beta-*ODAP (*β-N-oxalyl-L-α, β-diaminopropionic acid), a toxin known to cause neuro-lathyrism, if consumed as staple food for as long period of 4 to 5 months continuation. In view of this, a ban on the sale of its produce was imposed in some states but its cultivation was not under ban.

Chhatisgarh (Raipur, Durg, Ranjandgaon, Kabirdham, Bilaspur, Dhamtari, Raigarh, Mahasamund, Janjgir-Champa and Jashpur) and its adjoining areas of Vidarbha region of Maharashtra and MP are the major areas of its cultivation and consumption. In Chhattisgarh, its major cultivation is mainly under "Utera" system, where the seeds of grass pea are broadcasted on the standing water in the paddy field about 10-15 days before harvest.

2. **BACKGROUND: POLICY ON CONSUMPTION/SALE OF LATHYRUS**

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.

2.1 High Power Committee on lathyrus:

The States of Chhattisgarh, Jharkhand, West Bengal, M.P. and Odisha, did not have any ban on cultivation, sale and consumption of lathyrus during 2007-08. However, this was banned in Maharashtra state.

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, Odisha 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, Odisha; 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).

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) <u>Rule 44-A-Sale of khesari grain prohibited</u>:- 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) **"Project on Enhancing Grass pea production for safe human food, animal feed and sustainable rice-based production systems in India funded under NFSM Monitoring Report regarding".**

iv) The promotion of this crop and its cultivation has not been covered under the NFSM-Pulses, A3P and 60000 Pulse Village Programme up till 2015-16. However, the DAC-ICARDA collaborative project was funded during the 11th Plan (last two years 2010-11 to 2011-12) with an out lay of Rs. 362.03 lakh. The pilot states in the first Phase were U.P (Jhansi, Lalitpur, hamirpur, Mirzapur, Chandauli); Chhattisgarh (Raipur, Durg, Bilaspur), Bihar (Patna, Nalanda) and West Bengal (Coochbehar /Nadia). Initially for two years (2010-11 to 2011-12), the project continued during 2012-13.

v) The other cooperating centres were Indian Grassland and Fodder Research Institute, Jhansi, IIPR, Kanpur, IGKV, Raipur, Society for Promotion of Agricultural Research & Knowledge (SPARK), Patna (Bihar), Uttar Banga Krishi Viswavidyalaya, Cooch Behar (West Bengal) Bidhan Chandra Krishi Vishwavidyalaya, Kalyani (West Bengal) and Pulses & Oilseeds Research Station Berhampore, Murshidabad (West Bengal).

The Objectives of the project were:

- Enhancing fodder and straw yields through introduction of high-biomass and low toxin grass pea varieties to support nutritional feed & fodder where only paddy straw is available as cattle feed.
- Replacement of indigenous high toxin grass pea varieties available with farmers with low toxin & high biomass varieties through farmers participatory approach.
- Identification of new grass pea varieties through adaptive research, multi-locational testing by farmers participatory selection.
- Developing strong seed production and distribution system of quality dual purpose seeds of farmers- preferred varieties along with matching production technologies.
- Capacity building of farmers, extension personnel etc. for farmer-participatory adaptive research and technology transfer for adoption and expansion of improved production technologies, quality seed production through training, visits, workshops and seminars etc.
- Back-up research (farmers participatory) for further identification of grass pea varieties and refinement of production technologies.

Lathyrus under Development Programmes

- Assam, West Bengal has taken this cultivation of Lathyrus under NFSM during 2016-17 (Rabi). The state of C.G. has also taken the development programme on lathyrus under RKVY.
- Varieties like Nirmal, Prateek and Mahateora having less ODAP content may be proposed.

3. CROP STATUS

3.1 National Scenario

3.1.1 ***TenthPlan*** (2002-2007)*:* The total area and production of Khesari was 6.35 lakh hectares and 3.76 lakh tonnes respectively. Out of these, Chhatisagarh ranked first both inarea and production (64.89% and 54.32%) followed by Bihar (18.47% and 25.69%). Madhya Pradesh is in third position for acreage with 7.09%, while W.B. ranked third in production (8.62%). Due to highest yield (960 kg/ha) among the lathyrus producing states. The major contributing state of Chhattisgarh recorded yield below (496 kg/ha) the National average yield (592 kg/ha).

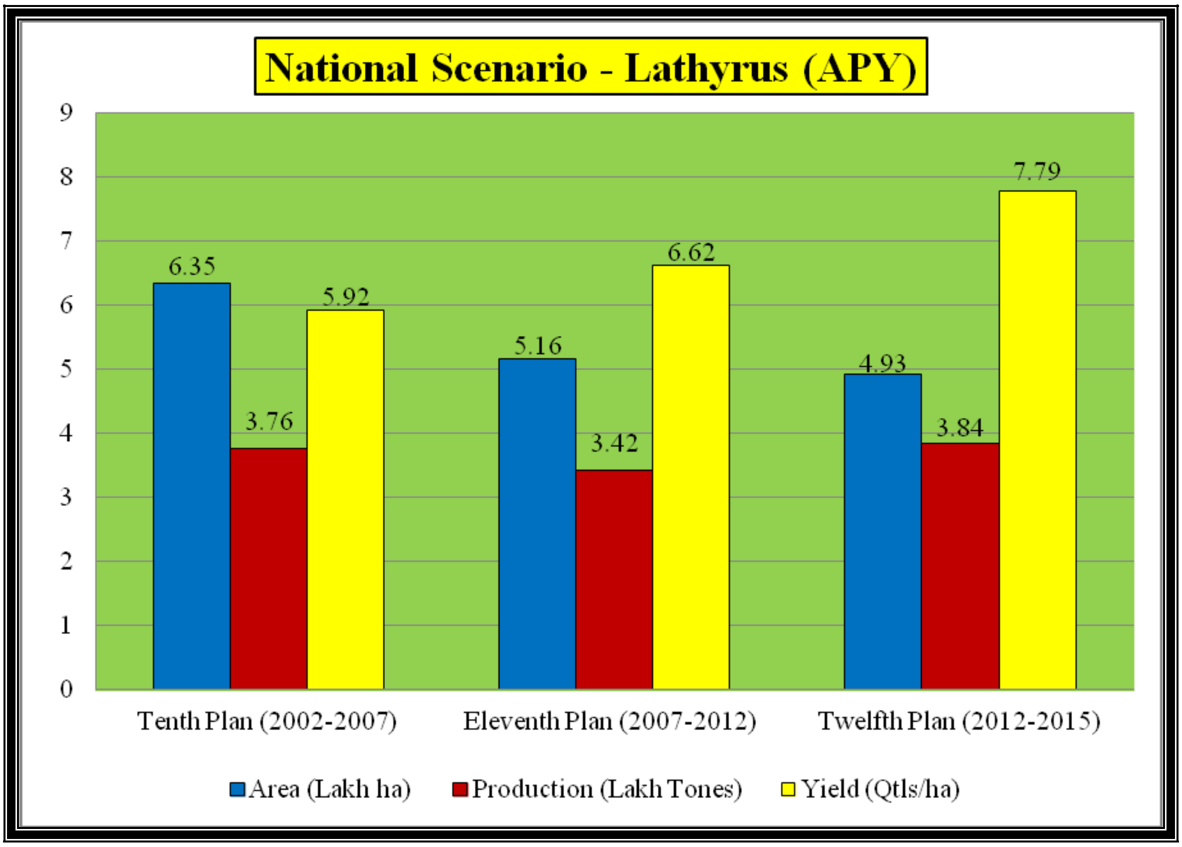
3.1.2 ***Eleventh Plan*** (2007-2012)***:*** The total area and production of lathyrus were 5.16 lakh hectares and 3.42 lakh tonnes. C.G. stands first in respect of area and production (65.64 % and 58.38%) followed by Bihar (16.83% and 24.53%). And M.P. (9.10% & 9 %). The highest yield was recorded in the state of Bihar (965 kg/ha) followed by West Bengal (778 kg/ha) and M.P. (654 kg/ha). However, major contributing state i.e. C.G. (589 kg/ha) was observed below the National average yield (662 kg/ha).

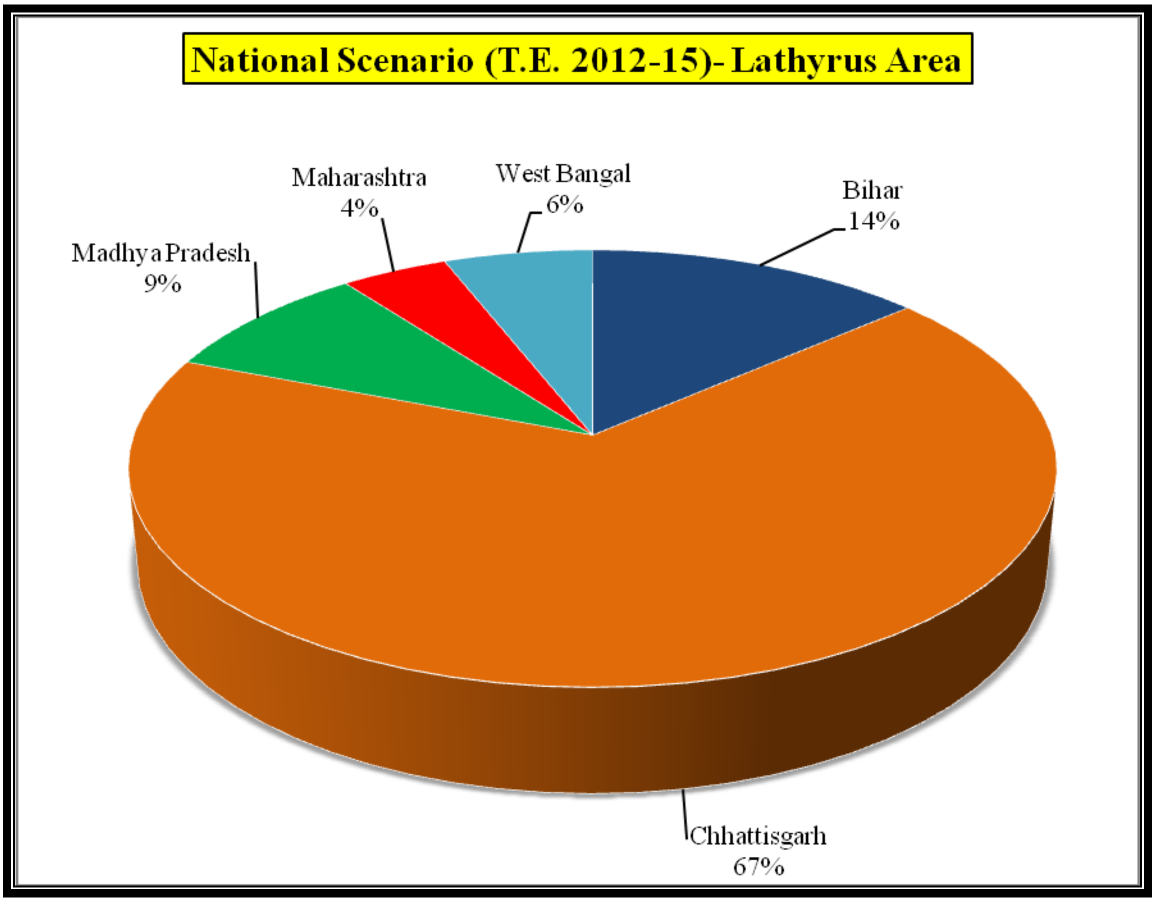
3.1.3 ***Twelfth Plan*** *(T.E. 2012-2015):* The total area and production of Khesari were recorded at 4.93lakh hectares and 3.84 lakh tonnes respectively. Chattisgarh ranked the first position both in area and production (67.26 % and 59.52%), followed by Bihar (13.62 % and 20.09%). Madhya Pradesh ranked third in area (8.80%), wheres in production W.B. (9.56%), respectively. Due to highest yield among the all lathyrus producing state.

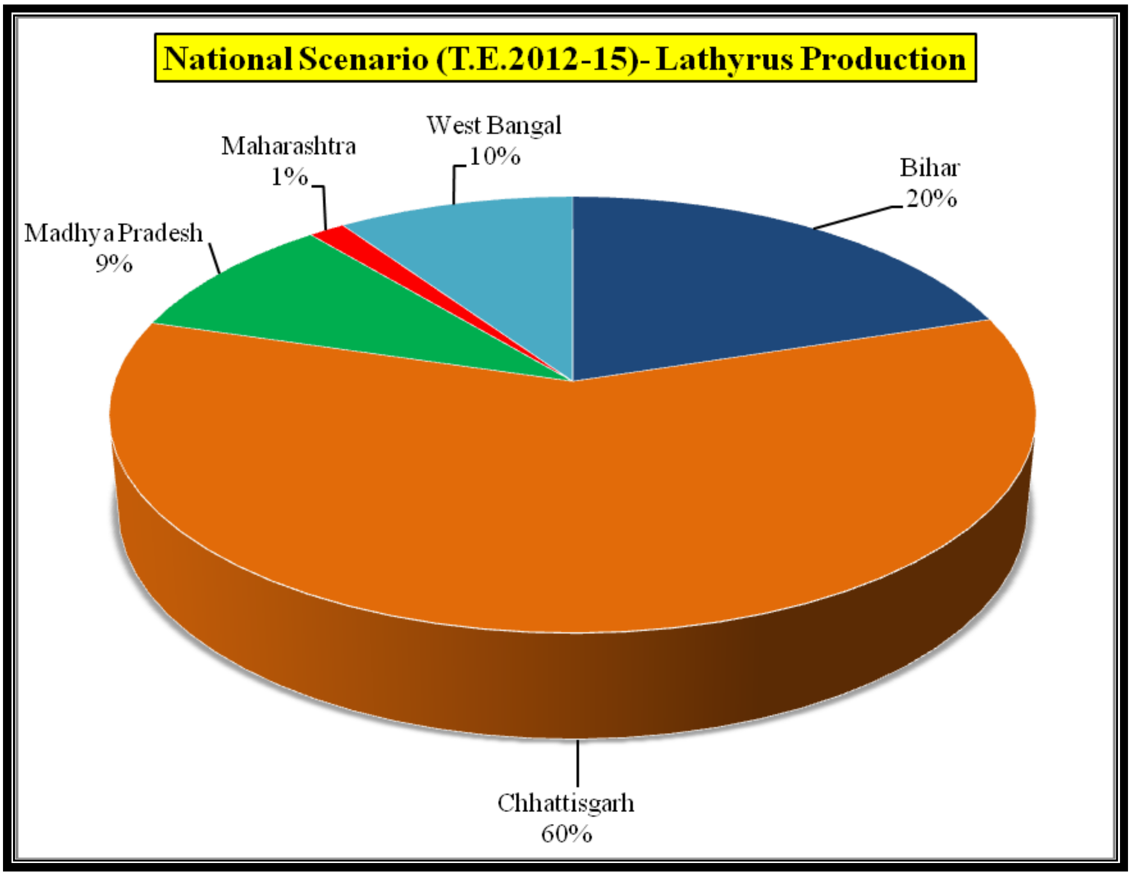
Table - 10.1. Plan-wise lathyrus scenario - States

{A= Lakh ha, P= Lakh tonnes, Y= kg/ha}

State		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
Bihar	A	1.17	18.47	0.87	16.83	0.67	13.62
	P	0.97	25.69	0.84	24.53	0.77	20.09
	Y	824		965		1149	
Chhattisgarh	A	4.12	64.89	3.39	65.64	3.32	67.26
	P	2.04	54.32	1.99	58.38	2.29	59.52
	Y	496		589		689	
Madhya Pradesh	A	0.45	7.09	0.47	9.10	0.43	8.80
	P	0.31	8.35	0.31	9.00	0.36	9.35
	Y	697		654		827	
Maharashtra	A	0.27	4.24	0.15	2.97	0.21	4.32
	P	0.11	3.03	0.06	1.69	0.06	1.48
	Y	423		376		267	
West Bangal	A	0.34	5.32	0.28	5.46	0.30	6.00
	P	0.32	8.62	0.22	6.41	0.37	9.56
	Y	960		778		1240	
All India	**A**	**6.35**		**5.16**		**4.93**	
	P	**3.76**		**3.42**		**3.84**	
	Y	**592**		**662**		**779**	


National Scenario - Lathyrus (APY)
9
8
7
6
5
4
3
2
1
0
6.35
3.76
5.92
5.16
3.42
6.62
4.93
3.84
7.79
Tenth Plan (2002-2007)
Eleventh Plan (2007-2012)
Twelfth Plan (2012-2015)
Area (Lakh ha)
Production (Lakh Tones)
Yield (Qtls/ha)


National Scenario (T.E. 2012-15)- Lathyrus Area
Maharashtra
4%
West Bangal
6%
Bihar
14%
Madhya Pradesh
9%
Chhattisgarh
67%



3.2 Top Potential Districts (2012-13)

Inter District analysis revealed that major top ten potential district contributing the area and production about 6.5% and 7% respectively. All the Potential districts comes under M.P. and having most of the districts average yield above the National average yield (742 kg/ha) except Rewa (544 kg/ha), Mandla (565 kg/ha) and Anuppur (495 kg/ha) districts of M.P.

Table- 10.2 Top Potential Districts

{Area-lakh ha, Production-Lakh tones, Yield-kg/ha}

Sr. No.	Name of District	State	Area		Prod.		Yield	
			Area	% to India	Prod.	% to India	Yield	YI
I	Balaghat	M.P.	0.107	1.84	0.085	1.97	791	107
II	Seoni	M.P.	0.083	1.42	0.070	1.61	842	113
III	Vidisha	M.P.	0.070	1.20	0.064	1.48	909	123
IV	Sagar	M.P.	0.054	0.94	0.041	0.96	762	103
V	Rewa	M.P.	0.027	0.46	0.015	0.34	544	73
VI	Mandla	M.P.	0.023	0.40	0.013	0.30	565	76
VII	Ashok nagar	M.P.	0.005	0.08	0.007	0.16	1428	192
VIII	Narsimpur	M.P.	0.004	0.07	0.007	0.16	1601	216
IX	Bhopal	M.P.	0.003	0.06	0.004	0.09	1205	162
X	Anuppur	M.P.	0.003	0.05	0.001	0.03	495	67
	Total above		**0.379**	**6.528**	**0.306**	**7.103**	**807**	**109**
	All India		**5.81**		**4.310**		**742**	

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 10.3.

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

i. **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.
ii. **Seed Rate**: 70-80 kg/ha for broadcasted sowing in utera system and 40-60 kg/ha in line sowing is required.
iii. **Spacing:** Under utera cropping sown as broadcasted in-between the rice rows. Whereas normal spacing 30 cm x 10 cm is recommended.
iv. **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.10.4.

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 – 10.3. Recommended varieties of lathyrus/characteristics

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
Bio L-212 (Ratan)	IARI	1997	**NEPZ** (East UP, Bihar, West Bengal)	15.0	108-116	Tolerant to stress, Low ODAP, Bold seed, Blue flower.
Prateek	IGKV, Raipur	2001	M.P.	6-9 (Utera) 11-15 (sole)	110-115	Tol. to downy mildew & mod. Resistant to powdery mildew.
Maha Teora	IGKV	2007	Chhattisgarh	15	94	Tol. to nematode & thirps, mod. Resistant to PM

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 – 10.4. 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, Zine 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 (FRENCHBEAN)

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 nos.	-	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.

1.1 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) II^{nd} fortnight of October and for spring (Lower hills) II^{nd} fortnight of March and for bold seeded 100-125 kg/ha.Kharif (Hills) - 45-50 cm x 8-10 cm;Rabi & Spring - 40 cm x 10 cm (irrigated) 30 cm x 10 cm (Rainfed).

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.

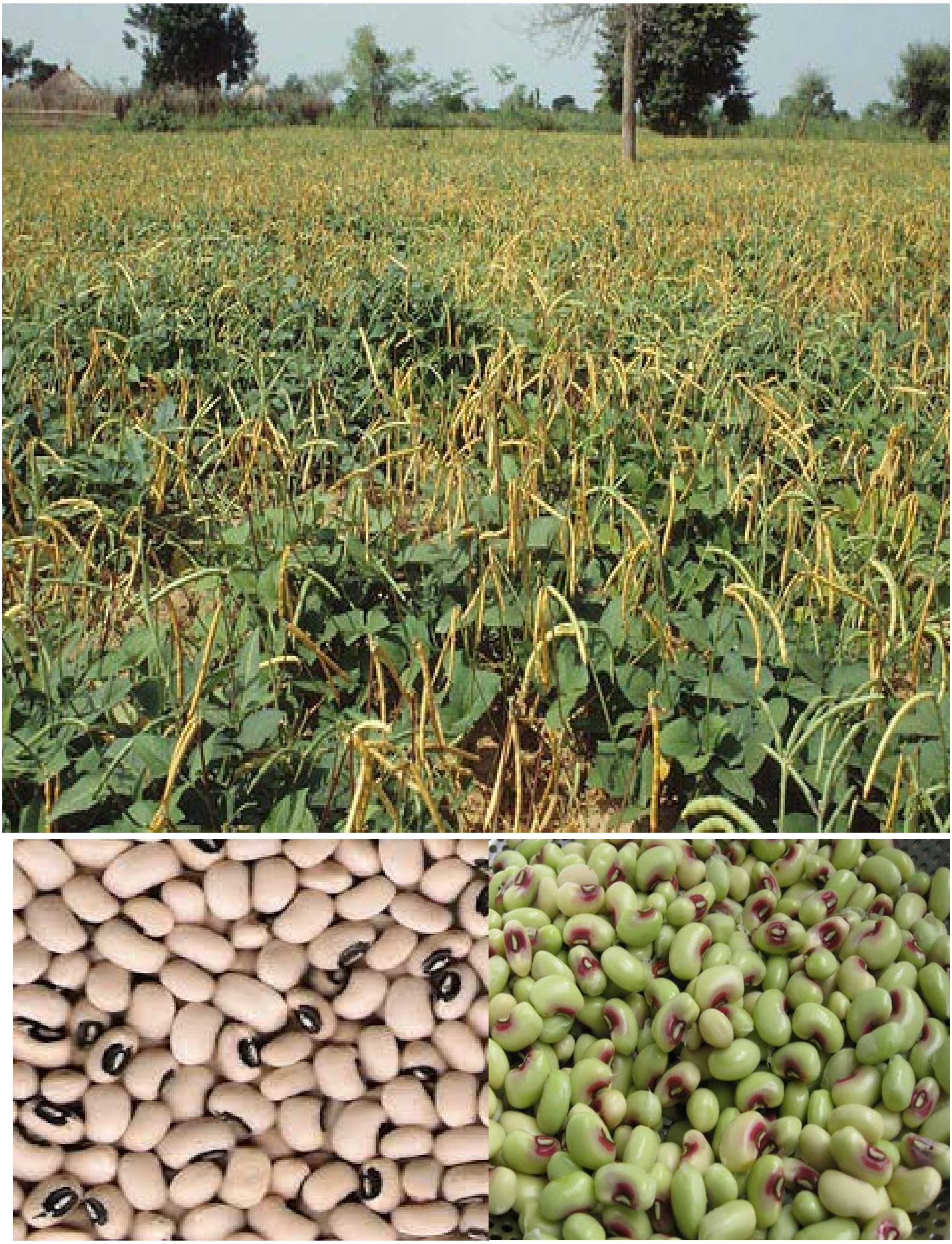
3.11. Yield: A well managed crop can easily give 20-25qtls/ha yields under irrigated conditions of plain and 5-10qtls/ha under rain fed conditions of hill with 40-50qtls/ha of straw for cattle's.

Table – 11.1. Recommended varieties of rajmash/characteristics

Variety	Source	Year of Release/ Notification	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
HUR-137 (Malviya Rajmash-137)	BHU	1991	**NEPZ** (East Uttar Pradesh, Bihar, West Bengal)	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	Tolerant to Anthracnose
IPR 96-4 (Amber)	IIPR	2002	**NEPZ** (East UP, Bihar, W.B.).	15-16	139	Res. to BCMV & Leaf Curl. Red
Ankur (RSJ-178)	Central	2005	Rajasthan	12	110-120	Moderately resistant to root rot, leaf crinkle and leaf spot dry root rot.
Gujarat Rajma-1	SDAU	2006	Gujarat	20	30-35	Moderate resistant to bean common mosaic virus
VL Rajma 125	VPKAS	2007	Uttrakhand	14-15	82-85	Resistant to root rot, Mod. Resistant to Anthracnose, angular leaf spot & rust
VL Bean 2	VPKAS, Almora	2008	Uttrakhand	14-15	82	Resistance to root rot, mod. Resistant to anthracnose, angular leaf spot and rust
Arka Anup		2012	Karnataka	18-20	43-45	Suitable for eastern dry zone of karnataka in bot h kharif and rabi season

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

COWPEA (LOBIA)



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.

1.1 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).

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 inPunjab), 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 Cowpea-Potato-urd/bean Maize/Rice-Wheat-Cowpea Maize-Toria-Wheat-Cowpea Rice-Rice-Cowpea Rice-Cowpea Rice-Mustard-Cowpea	Sorghum + cowpea-berseem-maize+cowpea Maize-berseem/oat- maize+cowpea Sudan grass- berseem/oat- maize+cowpea Cowpea-berseem-maize+cowpea

3.5 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.

3.6 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.

3.7 Sowing:

i. **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.

ii. **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.

iii. **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.

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

3.8 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.

3.9 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.

3.10 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.

3.11 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.

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

3.13 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/ Notifi.	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
Gujarat Cowpea-3	GAU	1990	**CZ** (MP, Maharashtra & Gujarat)	12-14	65-85	Seed bold, amber colour
V-240	IARI	1993	All Zones	14.0	80	Tall, Indeterminate, seed red
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	TNAU	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 sampada)	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
UPC 622	GBPUAT	2007	Uttrakhand Assam, U.P., M.P., J & k, H.P., Punjab, Raj., Har., WB., Odisha, Bihar, and Jharkhand	4-5	145-150	Tolerant to drought resistant to YMV, Anthracnose, root/collar rot and bacterial leaf blight, Aphids, leaf Miner, flea beetle, pod borer/bugs and root knot nematode & bruchids.
Khalleshwari	IGKV, Raipur	2007	Chhattisgarh	6-7		RRF in rabi with restricted irrigations and rainfed upland in kharif season
Swarna Harita (IC285143)	ICAR Res. Station,	2008	Assam, U.P., M.P., Kerla, A.P., Punjab, Raj., WB., Odisha, Jharkhand, CG., and TN.	60-150(Pods)	75-90	Resistant to rust and mosaic viral disease & tolerant to pod borer.
Kashi Kanchan (VRCP 4)	IIVR, Varanasi	2008	Punjab, UP, Bihar, Jharkhand, Orisha, CG, MP, AP	150-175(Pods)	50-55	Reistant to golden mosaic virus, *Pseudo-cercospora cruenta* diseases,
UPC 628	GBPUAT	2010	Punjab, UP, Bihar, Jharkhand, Orisha, CG, MP, WB,MS	3.5-4.0	145-150	Iriigated Summer, and rainfed condition,Medium late variety

Variety	Source	Year of Release/ Notifi.	Area of adoption Zone/State	Ave. yield (Q/ha)	Days to maturity	Remarks
IT – 38956-1	UAS,GKVK, Bangalore	2009	Karnataka	10-12	80-85	Rainfed areas of eastern dry region
Hisar Cowpea 46 (HC 98-46)	CCSHAU	2009	Haryana	10	65-70	Resistant to YMV
Pant Lobia -1	GBPUAT	2010	Uttrakhand, UP	20	130-135	Moderately resi. to Aphids, Thrips, Bruchids & other field pests. Suitable for spring ,summer and Kharif season
KM 5		2010				
UPC 628	GBPUAT	2010	Uttrakhand, HP, J&K, Punjab, Harya., Raj.,UP, MP, CG, Bihar, Jharkhand, WB, Odisha, Assam, Gujrat & MS	350-400 (Pods)	145-150	Tolerant ot drought and other edephic /abiotic stresses, reis. To YMV, Anthacnose/leaf blight, Aphids, Semilooper, Flea Beetle/Defoliators, Pod borer/bugs & Root knot nematode , tolerant to storage Beevil
HIDRUDAYA	ORARS, Kerela	2010	Kerela	10-11	50-55	Tolerant to leaf rust, Aphids, Pod borer & American Serpentine leaf minor, summer season
C 519 (Himachal Lobia 11)	CSKHPKV, Palampur	2010	Himachal Pradesh	15-16	80-85	Resistant to Cercospora leaf spot, YMV, Low hills, Sub-tropical zone under rainfed condition in kharif
PKB 4	UASGKVK, Banglore	2012	Karnataka	11-13	80-85	Resistant to Bacterial leaf blight, Rust & Pod borer, suitable for early kharif season
PKB 6	UASGKVK, Banglore	2012	Karnataka	10-12	80-85	Resistant to Bacterial leaf blight, Rust & Pod borer, suitable for late kharif and summer season

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

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.	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.	Grow resistant variety i. Use Disease-free seeds. ii. Use Bactericide for control of pathogen.
iv. Mosaic Virus	A viral disease transmitted by aphid affects the leaves first. Pale yellow leaves show 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 @ 3g/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.

MINOR PULSES

A.BROAD BEAN

B. RICEBEAN

BROAD-BEAN

Botanical Name - Vicia ***faba*** L.
Synonym - 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

3.5 Seed rate: 70-100kg/ha.

3.6 Cropping system: Maize-Broadbean, Pearlmillet/Maize-Potato-Broadbean**.**

3.7 Plantnutrient management: 20 kg N + 40-50 kg P_2O_5/ha .

3.8 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.

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

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

3.11 Harvesting, threshing: Similer to lentil**.**

3.12 Yield: 10-40 Q/ha.

B. RICE-BEAN

Botanical Name -*Vigna umbellate* (Thunb.) Ohwi & Ohashi}
Origin - Himalayin region of North east
Synonym - 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.

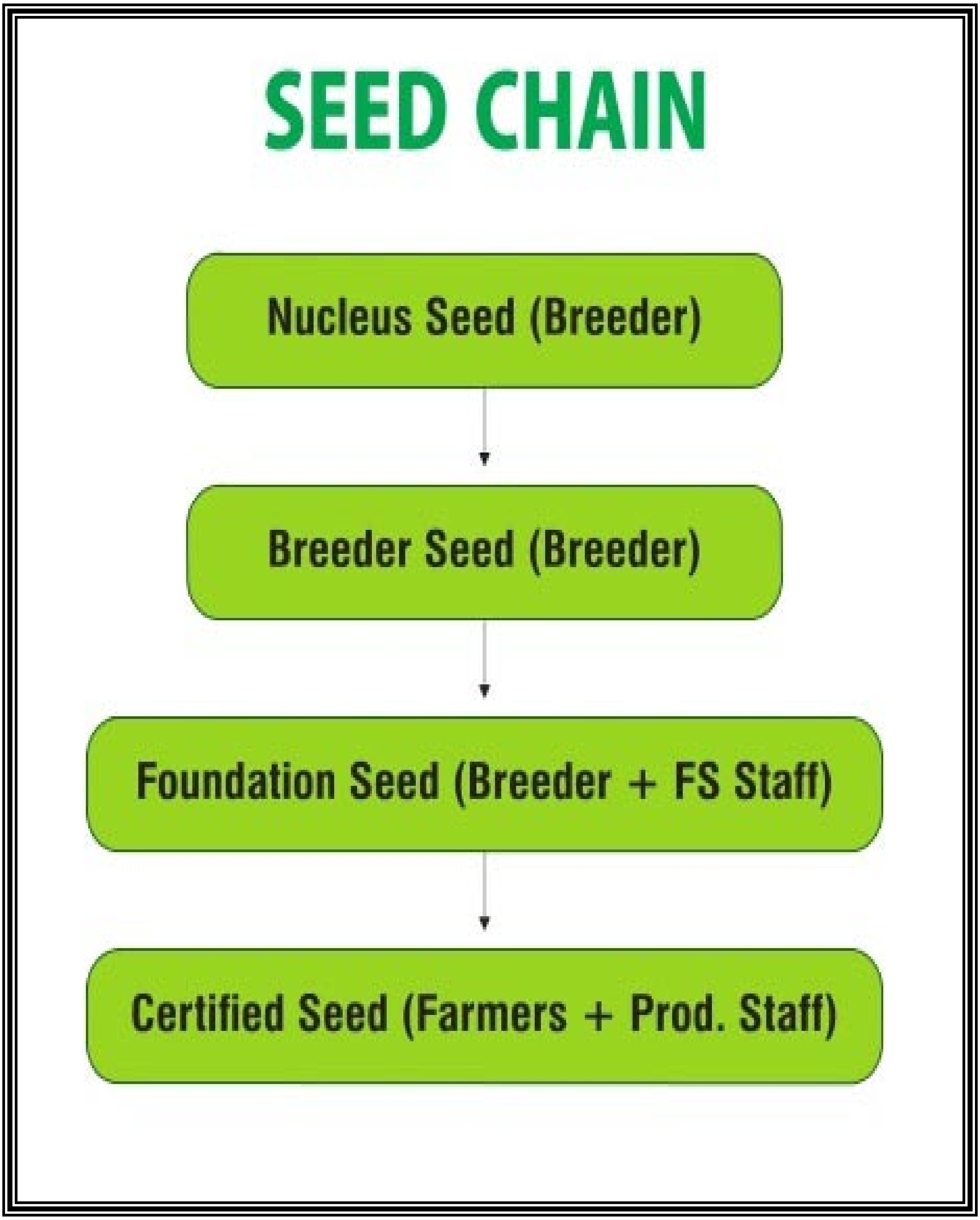
3.10. Plant Protection: No need to do any spray as very rare infestation of pest & diseases is observed.

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 PRODUCTION

Seed is the key input in pulse crop cultivation and vital 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 between states' average yield and FLDs. Concerted efforts and proper planning along with realistic execution are required to produce the quality seed of improved varieties to phase out the old seed of obsolete varieties.

To enhance production of pulses in the country, availability of quality seeds (SRR) of latest/ promising varieties (VRR) and adoption of recommended technologies (TOT) has been viewed a major bottleneck. "*The Committee for Monitoring Actions/ Strategy for Increasing Pulses Production*" under the Chairmanship of Dr. Ashok Dalwai, Additional Secretary, Govt. of India, DAC&FW, in it's Meeting dated 28th March, 2016 has proposed certain strategic interventions during 2016-17.

As a new initiative, both at the *seeds* and *technology transfer* front, 04 under mentioned projects/ programmes have been funded to ICAR- IIPR and ICAR-Extension (ATARI) to further supplement the massive developmental interventions under NFSM-Pulses in all the districts of the country:

i) ***Enhancing Breeder Seed Production*** (*Rs. 2039.00 lakh* for *2016-17,*) is operational at 12 centres in 08 states including Madhya Pradesh (IIPR-RS Phanda, Bhopal, JNKVV, Jabalpur and RVSKVV, Gwalior).

ii) ***Creation of Seed-Hubs*** (*Rs.15031.08 lakh* for *2016-17 to 2017-18)* out of which *Rs.8674.54 lakh for 2016-17*) is operational at 100 locations in the country (ICAR Institute/ SAUs-08, AICRPs-34, KVKs-58). In MP 11 hubs (IIPR-RS Phanda-01 + AICRP-Jabalpur and ARS, Sagar-02 + KVK-Betul, Narsinghpur, Damoh and Harda-04 under JNKVV and AICRP-Gwalior and RAK, Sehore-02+ KVK-Ujjain and Dewas-02 under RVSKV, Gwalior) and in Chhattisgarh 05 hubs (AICRP-Raipur/ Bhatapara-01+ KVK- Kawarda, Bhatapara, Ambikapur and Rajnandgaon-04) are under implementation. Each Seed-Hub has a financial assistance of Rs. 1.50 crore (*infrastructure*- Rs. 50 lakh for Storage of seeds/ processing during 2016-17 and Rs. 100 lakh for *revolving fund* towards production, procurement, processing, *of seeds during 2016-17 and 2017-18)*.

iii) ***Cluster FLD on Pulses (minimum 10 ha each)*** by ATARI (*Rs. 2529.10 lakh* for *2016-17*) is operational in 31000 ha area @ Rs. 7500/ha (Rs. 750 for monitoring + literature + field day) across the country being conducted by 08 ATARIs through 534 KVKs. In MP, the Cluster FLD area is 1180 ha/ 2950 No. (Chickpea-910 ha, Lentil-180 ha, Field Pea-40 ha, Lathyrus-50 ha) and in Chhattisgarh, the area is 1090 ha/ 2725 No. (Chickpea-590 ha, Lentil-260 ha, Field Pea-130 ha, Lathyrus-110 ha).

iv) ***FLD on Pulses by IIPR*** *(Rs. 97.50 lakh for 2016-17)* are being organized in 1300 ha area (@ Rs.7500/ha of which Rs.6700 being assistance to beneficiary towards input cost). The area under Rabi/ summer accounts for 714 ha (Chikpea-389 ha, Mungbean-30 ha (Rabi) + 15 ha (*summer*), Urdbean-75 ha, Lentil-130 ha, Field Pea-75 ha) while during the Kharif, the area was 586 ha (Pigeonpea-335 ha, Mungbean-95 ha, Urdbean-90 ha, Mothbean-19 ha, Horsegram-27 ha, Cowpea-20 ha).

1. **SEED REQUIREMENT:** To achieve the targeted 33% Seed Replacement Rate, the requirement of breeder, foundation and certified seed by the end of 2016-17 is as under:

Table – 14.1 Seed requirement at 33% SRR – end of twelth plan

Crop	Targeted Area (Ha)	Seed Requirement (33% SRR) (qtls.)		
		Breeder Seed	Foundation Seed	Certified Seed
Pigeonpea	4000000	1320	66000	2640000
Urd (kh)	2500000	2750	55000	1650000
Moong (kh)	2500000	2750	55000	1650000
Other (kh)	1800000	1980	39600	1188000
Total kharif	**10800000**	**8800**	**215600**	**7128000**
Chickpea	10000000	176000	1760000	26400000
Lentil	1500000	2063	41250	1237500
Urd (rabi)	1000000	1100	22000	660000
Moong (rabi)	1100000	1210	24200	726000
Other (rabi)	1600000	5280	105600	2112000
Total rabi	**15200000**	**185653**	**1953050**	**31135500**
Total Pulses	**26000000**	**194453**	**2168650**	**38263500**

SEED REPLACEMENT: The pace of SRR has, however, not been fast as sufficient quantities of certified seed are not available from all the seed sources put together. Various efforts have been made to ensure availability of good quality seeds of high yielding varieties/hybrids, yet nearly 70-75% of the total seed requirements are met by the farm-saved seed. Further, the seeds of released varieties are also not reaching farmers in the absence of both information and availability of seed. It is, therefore, imperative to widen the focus on increasing the seed replacement rate of low potential/pest susceptible old varieties by new high yielding varieties with promising yield potential, strengthening of infrastructure facilities for production and distribution of quality seeds and taking up more and more villages under the Seed Villages Programme.

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, SDAs, SAUs, SSC, Seed Grower Societies and private sectors, place their breeder seed indent to Seed Division, Govt. of India, DAC & FW. The indent, in compiled form, is given to ICAR who organizes. Breeder Seed Production (BSP) of various varieties of different crops through ICAR Institutes, SAUs, and AICRPs other organizations like NSC, 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 Annual Group Meet group meet. The BSP-I proforma issued by PI/PC accounts for crop, variety, name of breeder to whom BSP is allocated, DAC & FW indent allocation and indentors.

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, seed division of DAC&FW arranges lifting of the breeder seeds by indentors.

BSP-V: After lifting 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 II.***

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

	
SMALL SCALE MILLING OF PULSES	**MINI DHAL MILL (CFTRI)**
	
VERSATILE DHAL MILL	**MINI VERSATILE DHAL MILL**

POST-HARVEST TECHNOLOGY AND MANAGEMENT

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.

1. HARVESTING PRECAUTIONS

To minimize quantitative and qualitative losses, besides harvesting the crop at 08 per cent of total pods maturity stage, under mentioned. ***Advisory should be followed**:*

- *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. The quality parameters of pulses are wholesome, clean, odorless and less moisture content.

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

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*, Methyl Bromide and Aluminium phosphide are common fumigants. Aluminium phosphide @ 3g pallet per 5-10 qtls whole grain for 7 days is recommended. 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 **Improved/scientific structures** i Pusa Kothi ii Nanda bins iii. Hapur Kothi iv PAU bins v PKV bins vi Chittore stone bins	i. Warehouse CAP Storage (cover and plinth storage) Soils. ii. Steel Silos

5.1. Storage Infrastructure/programmes/facilities

5.1.1 Rural godowns

Considering the importance of rural storage in marketing of agricultural produce, DAC& FW, 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 co-operatives 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

Co-operative storage facilities are provided to the producer at cheaper rates, which reduces the storage cost. These Co-operatives 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 Co-operative storage. To meet the increasing need for storage capacity, the National Co-operative Development Corporation (NCDC) encourages construction of storage facilities by Co-operatives, 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	**7.1** Producer □ Procuring Agency □ Dal Miller □ Consumer
ii) Producer □ VillageTrader □ Dal Miller □ Wholesaler □ Retailer □ Consumer	ii) Producer □ Procuring Agency □ Dal Miller □ Wholesaler □ Retailer □ Consumer
iii) Producer □ Dal Miller □ Retailer □ Consumer	iii) Producer □ Procuring Agency □ 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	

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/small scale 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 owing to 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,ICAR (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 may 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 Benefits of mini/small scale mills: Simple technology/mini 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.

COMMON PULSE PROCESSING AVENUES

The Pulses can be processed and used in the following ways:

- Cooking
- Dehulling -Dal
- Germination- Cooking
- Puffing
- Cooking- Sambar
- Wet grinding- Idli,Vada, Dosa
- Dry Grinding- Sev, Bajji, Bonda
- Some eaten raw

PROBLEMS OF TRADITIONAL DAL MILLING INDUSTRY

There are about 7000 registered dhal mills in India and about 5000 small or cottage scale dhal mills

The problems are –

- Long processing time for pulses (5-6 days)
- Lower yield of dal (72-74%) and more broken (12-15%)
- Lack of skilled labour / trained personnel
- Dust pollution

Factors influencing the milling are –

(a) RAW MATERIAL CHARACTERISTICS

- Size and shape of pulses
- Husk content and its thickness
- Adherence of husk to the cotyledons
- Moisture content of the grains
- Extent of infestation

(b) PRE-MILLING TREATMENT

- Wet pre-milling treatment (Soaking in water & Sun drying)
- Dry pre-milling treatment (Pitting, oil mixing, Sun drying, water addition, Sun drying).

9. DOMESTIC MACHINERIES DEVELOPED

Under the R & D in PHT on Oilseeds, Pulses and maize Mini Mission II of TMOP, domestic processing machines were developed. CFTRI, CSIR, SAUs and ICAR institutes, under this programme, developed processing technologies.

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

Name of the domestic Machinary (Institutes)	Brief Features	Advantages
Mini Dal Mill (CFTRI, Mysore)	• 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 ➢ Supplied under subsidy programme
Versatile Dal Mill (CFTRI, Mysore)	• 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 (CFTRI, Mysore)	• 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

Name of the domestic Machinary (Institutes)	Brief Features	Advantages
Table Gota Separator (CFTRI, Mysore)	• 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%
Hand-Operated Pulse Dehusker (CFTRI, Mysore)	• Capacity – 40 kg per hour • Power – Nil • Utility – can process bold pulses, suitable for Home/cottage scale	➢ Suitable for small scale processing ➢ Good quality dal at competitive price ➢ By-products – valuable animal feed

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)

↓

Dehusking & Splitting ← Conditioning ← Pre-treatment with oil

(Mixture of husk & broken 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.

Processing of Arhar is mainly done in the states of Madhya Pradesh, Chhattisgarh, Uttar Pradesh, Maharashtra, Gujarat, Karnataka, Tamilnadu, Bihar and Uttrakhand.

10.2.2 Dehulling of tur – large scale (Wet Method)

Raw Pulse → Cleaning &grading → First pitting in → Oil addition & mixing Size grading
Roller machine mixing (0.3-0.6 %)
↓
Dust, Chaff etc. ↓ ↓
↑→ Water addition ← Sun drying ← Second pitting in ← Tempering or
(4-6%) (2-3 days) roller Equilibration
↑ ↓ (12-24 hrs.)
↓ Dal II
↓
↑ Sun drying **or** Mechanical drier → Splitting in chakki
(2-3 days) (2-4 hrs) ↓ ↓
↑ Dehusking in roller
↓
←←←←←←Gota← Aspiration & Dal separation →Dal I
↓
Husk & brokens

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***

Dry method

Raw pulse → cleaning & grading → Pitting in roller → Oil addition & mixing
(0.3-0.5%)
↓
Dehusking ← Sun drying ← Water addition ← Tempering
in roller (2-3 days) & mixing (12-24 hrs.
↓ (2-4%)
↑
Aspiration & sieving → Gota →
↓↓
Dhal Husk, brokens

Fig. 2

Fig 2 Dehulling of tur- dry method

Wet method

Raw pulse → Soaking in Water (2-8 hrs.) → Tempering of soaked tur (2-4 hrs.) → Sun drying (2-3 days)

↓

Husk, brokens   Husk aspiration & Sieving (Mannual or by machine) ← Dehusking & splitting (chakki or sheller)

↑

Dhal ←←←

Fig. 3

Fig 3 Dehulling of tur- wet method

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 Chickpea is confined mainly to Rajasthan, Delhi, Uttar Pradesh, Madhya Pradesh, Chhattisgarh and Maharashtra (**Fig.4**).

Raw pulse → Cleaning & → Pitting in roller → Water mixing

Size grading (2-6%)

↓

(Dust, chaff, small grains) ↓

Dehusking in roller ←←← Sun drying (1-2 days) ←Tempering(8-12 hrs.)

↓

↓ →→→→→→ ↓

↓

Aspiration & sieving ← Splitting in disc sheller

↓↓↓ ↑

Husk &Dal ↓→ GOTA →→→→→→→

Broken

Fig. 4.

Fig. 4 Process for dehulling of Bengal gram

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 Ist grade dal. 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.

Processing of Urdbean in the states of Andhra Pradesh, Odisha, Tamilnadu, Karnataka, Maharashtra, Chhattisgarh, Madhya Pradesh, Uttar Pradesh and Delhi.

10.5. Dehulling of green gram

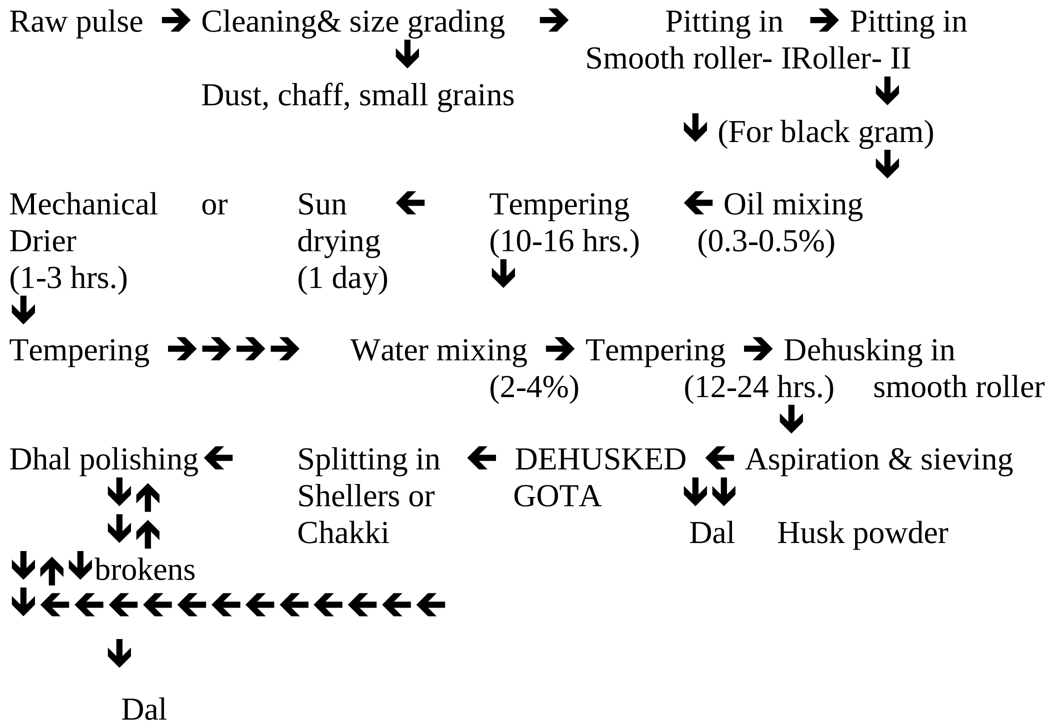


Fig. 5.

Fig. 5 Process for milling green gram and blackgram

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 Rajasthan, Madhya Pradesh, West Bengal, Uttar Pradesh, Andhra Pradesh, Odisha and Maharashtra.

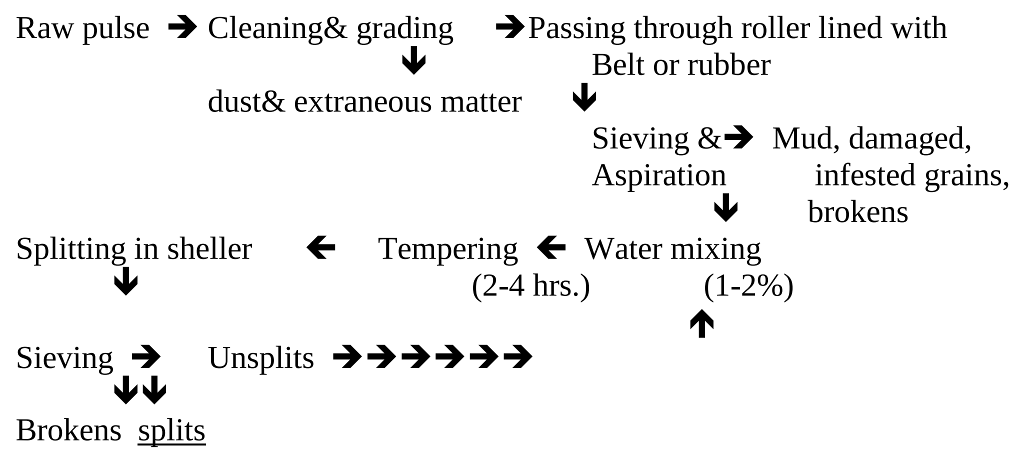


Fig. 6

Fig 6 Green gram/black gram splits-flow chart

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, Jharkhand, West Bengal, Madhya Pradesh and Delhi while milling of peas (yellow peas) is restricted to the state of Uttar Pradesh, West Bengal, Maharashtra, Delhi, Chhattisgarh, Madhya Pradesh. Khesari pulse is processed mainly in Madhya Pradesh, Chhattisgarh and Bihar States.

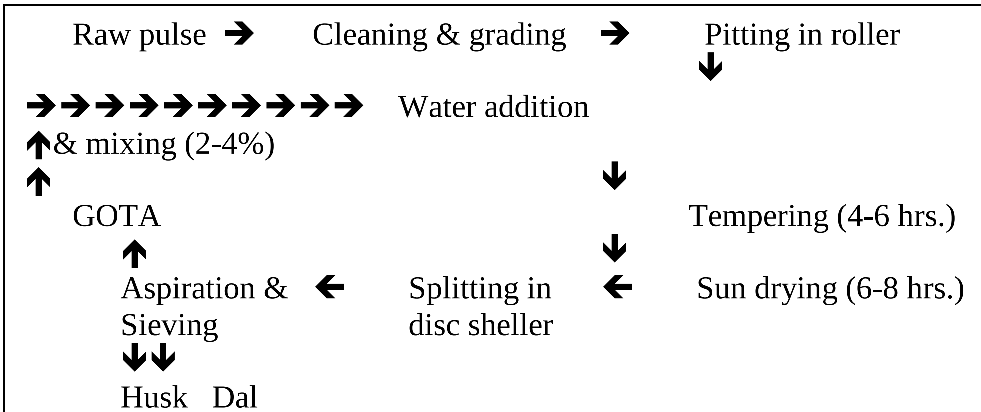


Fig. 7

Fig 7 Process for dehulling peas

Raw pulse → Cleaning & Size grading → Pitting -I → Pitting –II
↓ ↓
Salt solution or Oil mixing (0.2%)
Water addition ↓
& mixing (2-4%)
↓ ↓
Dehusking in ← Sun drying ← Tempering (6-12 hrs.)
Smooth roller (1-2 days)
↓
Aspiration → Dehusked → Water mixing
& sieving whole masoor (1-2%)
↓↓ ↓
Husk Dal Tempering (4-6 hrs.)
↑↓
←←←←←← Passing through roller

Fig. 8

Fig 8. Process for milling of masoor (lentil)

Raw Pulse → Washing in tanks → Tempering → Passing through
or raizor (2-3 hrs.) Roller
↓ ↓
Mud Dal-II ← Sieving
↓
Splitting ← Tempering ← Water addition ← GOTA
URDS (4-6 hrs) and mixing (2-5%)
↓
Aspiration → Husk, brokens
& Sieving → Dhal- II
↓
GOTA → Splitting → Aspiration & → Dhal-I
V.Chakki Sieving
↓
Husk & brokens

Fig . 9.

Fig 9 Process for dehulling khesari pulse (lakh)

CONSTRAINTS AND SUGGESTIONS

CONSTRAINTS AND SUGGESTIONS

Based on the review of the planned agricultural development programmes on pulses (NPDP, ISOPOM & NFSM) 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, Mid-term evaluation and Imact evaluation of NFSM programme by AFCL and also studies conducted by CDDs 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 2009-10 to 2013-14 could be tapped, given to adaptation of complete package technology (integration of all components viz. timely sowing, high yielding varieties, fertilizer management based on soil testing (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	Yield recorded in FLDs	Gap	
				kg/ha	%
1	Gram	947	1427	480	51
2	Lentil	700	996	296	42
3	Pea	941	1364	423	45
4	Urd	541	873	332	61
5	Mung	432	789	357	83
6	Lathyrus	700	1019	319	46
7	Rajmash	-	1259		
8	Moth	304	1289	985	324
9	Pigeonpea	722	1304	582	81

Source: FLD report IIPR (2009-10 to 2013-14); 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.

Table 16.2 Biotic & Abiotic Challenges of pulses production

Climate variability	State	Damage %	Crop	Remarks	Climate variability
Mid-season cold waves and terminal heat during Rabi	UP, MP, PB, Haryana	10-40%	Gram, Lentil Pigeonpea	Calamity year – Drought in MP 2014 & 2015 & in CG 2015	Mid-season cold waves and terminal heat during Rabi
Inundation of water in black cotton soils during heavy rains sub-optimal nutrient uptake	MP, MS, Guj, AP, TN	10-50%	Pigeonpea, Urd,Mung		Inundation of water in black cotton soils during heavy rains sub-optimal nutrient uptake
Micronutrient deficiency (Zn, Fe, B, and Mo) - unbalanced use/seldom soil test; Quality issues	All states	-	All Crops	Ineffective Cluster Demo.	Micronutrient deficiency (Zn, Fe, B, and Mo) - unbalanced use/seldom soil test; Quality issues
Sulphur deficiency ; inadequate availability of Gypsum or pyrites	MP,MS,Guj,AP ,Karnataka, UP	-	All Crops	Adhoc approach in arrengment	Sulphur deficiency ; inadequate availability of Gypsum or pyrites
Pod borer complex	UP,MP,Bihar, Jha.,Pb,Haryana	40-60% 10-90%	Pigeonpea Chickpea		Pod borer complex
Podfly and maruca	UP, MP, Bihar, Jha.,Punjab, Haryana.	10-50%	Pigeonpea		Podfly and maruca
Fusarium wilt	MP, UP, Bihar, Jharkhand	20-25% 10-15%	Chickpea Tur & Lentil		Fusarium wilt
YMV & Powdery mildew	All States including MP	10-50%	Urdbean & Moongben	Kharif 2015	YMV & Powdery mildew
Stray cattle/ Blue bull meanace	UP, Bihar, MP, Jharkhand, RJ, CG, Haryana		All crops	Pigeonpea, Summer Pulses	Stray cattle/ Blue bull meanace
Region specific technologys- Pigeonpea on bunds transplanting/intercropping etc.	All states		All crops		Region specific technologys- Pigeonpea on bunds transplanting/intercro-pping etc.

iii) Grown mainly under rain fed conditions (only 19% 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. Poor availability of quality/certified seed/poor varietal development/limited varietal choice during last 10 years & poor varietal diversification of pulses in India. Crop-wise gap of availability of quality certified seeds, varietal development & varietal choice last one decade & poor varietal diversification are given table 16.3, 16.4 & 16.5.

Table 16.3 Requirement and availability of certified seeds during 2015-16.

Quantity : Thousand Tonnes

Crop	Requirement	Availability	Deficit/Surplus
GRAM	181.43	148.55	**-32.87**
MOONG	5.94	7.70	1.75
URD	7.82	8.09	0.27
ARHAR	0.13	0.62	0.49
LENTIL	13.05	10.56	**-2.49**
PEAS	21.17	18.28	**-2.88**
COWPEA	**0.44**	**0.70**	0.26
HORSEGRAM	1.56	1.56	0.00
INDIAN BEAN	0.13	0.13	0.00
KHESARI	**0.62**	**0.64**	0.02
RAJMA	0.62	0.56	-0.06
TOTAL PULSES	**232.91**	**197.39**	**-35.51**

Table 16.4 POOR VARIETAL DEVELOPMENT (XIth and XIIth Plan)

(a) Varietal Release Profile-Notification During Last 10 Years (2006 to 2015)

Crop	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Arhar	2	6	4	3	-	1	2	3	2	1	24
Urd	2	-	4	4	4	3	3	1	3	1	25
Moong	3	2	2	4	4	3	3	1	2	-	24
Gram	7	11	5	3	7	1	6	5	2	2	49
Lentil	3	2	1	3	4	2	1	1	1	-	18
Peas	3	3	5	1	2	3	1	-	2	-	20

Table 16.5 Limited States' Varietal Choice during last 10 years (2006-2015)

State/Crop	Arhar	Urd	Moong	Chickpea	Lentil	Peas
Maharashtra	7	3	2	10	1	2
Rajasthan	-	5	4	16	2	4
A.P.	6	8	3	1	-	-
Karnataka	5	5	4	3	-	-
Gujarat	4	1	-	7	-	-
Odisha	2	6	2	1	-	-
M.P.	4	2	-	18	1	2
U.P.	2	7	4	7	6	10
Bihar	2	2	1	1	1	3
Tamil Nadu	2	8	3	1	-	-

Table 16.6 Poor Varietal Diversification (VRR)

State	Crop	Prevalent Varieties	Recommended Varieties (ICAR/SAUs)
Madhya Pradesh	Pigeonpea	TJT 501, ICPL 87119, Non-descript	TJT-501, ICPL 87119, ICPL 88039, JA 4
	Urdbean	T-9, HFP8909, IPU-94-1, Non-descript	KU-96-3, PU 30, MASH 338
	Moongbean	HUM-1, HUM-12 .Non-descript	HUM 1 JM 721, TARM 1, HUM 6
Madhya Pradesh	Chickpea	JG 11, JG 16, JG 130, JAKI 9218	JG-130, JG-322, JG 63
	Lentil	JL 1, Mallika, DPL 62, IPL 81	JL1, K-75, IPL 406
	Peas	Arkel, Azad-1	KPMR-400, IM 9101 (Subhra), Rachna
Maharashtra	Pigeonpea	ICPL-87119, ICPL-8863, BSMR-736, Vipula	ICPL-87119, ICPL-8863, BDN-708, BDN-711
	Urdbean	TAU-1	BDU-1, TPU-4, TAU-1
	Moongbean	Kopargaon-1, Utkarsha	BPMR-145, BM-4, 2002-01, Vaibav
	Chickpea	Chaffa, Agnirekha	BDN-9-3, PKV-2, 5, 4-1, JAKI-9218
Maharashtra	Other Kharif Pulses	-	Seena, Maan (Kulthi)
	Other Rabi Pulses	Ratna local(Khesari), Parvati (Cowpea)	Ratna (Khesari), Pusa Komal (Cowpea)
Rajasthan	Pigeonpea	ICPL-151, ICPL-87, Gwalior-3	ICPL-151, ICPL-87, Gwalior-3, UPAS 120
	Urdbean	T-9, Pant U 19	T-9, RBU 38, Pant U 19
	Moongbean	K-851, RMG-62, RMG-268	K-851, RMG-62, RMG-268
	Chickpea	Dahod Yellow, RSG 888	RSG 902, GNG 1581, Pratap Raj Chana, RSG 991,

Uttar Pradesh	Pigeonpea	Rajeev Lochan, PAU-881, VL Arhar-1, Pusa-992, Malviya Chamatkar (MAL-13)	NDA-2, Pusa-992, MAL-13, PAU-881, NDA-88-2, KA-32-1, K91-25
	Urdbean	Pant Urd-31 & 40, LAM-709, Azad Urd-3	NUL-7, Vallabh Urd-1, Azad urd-1, Uttra, Shekhar-2, 3
	Moongbean	IPM-02-3, Pant Mung-6, TM-96-2, Meha	KM-2195, MH-421, HUM-16, Pant Mung-4, Pusa-9531, Pusa Vishal
	Chickpea	RVG-101, 210, PKV Kabuli-4,RSG-991, Pusa-1103, HK-94-124	GNG-1969, GNG-1958, WGG-3, HK-2, RSG-963, WCG-10, JGK-1, RSG-88
	Lentil	Pant Lentil-7, PL-02, HUL-57, VL-507	KLB-303, KLB-320, PL-8, HUL-57, IPL-406, Pant Lentil-4 ,DPL-15
	Peas	Sapna, VL Matar-47, VP-101	VP101, Pant P 13, IPF-5-19, SKNP 04-09
Andhra Pradesh	Pigeonpea	LRG-41, PRG-158 & ICPH-2740	LRG-41, PRG-158
	Urdbean	PU-31, LAM, TM-76-2	PU-31, LBG-752 & TM-76-2
	Moongbean	LGG-460, TM-96-2	LGG-460, TM-96-2
	Chickpea	JG-11, JAKI-9218 & PBH-4	JG-11, JAKI-9218 & PBH-4
Karnataka	Pigeonpea	BRG-1, BRG-2	ICP 8863 (Maruthi), ICPL 87119 (Asha), ICPL 87 (Pragathi)
	Urdbean	TAU-1, T-9	Kargane-3, T-9, LBG-625
	Moongbean		PS-16, Pusa baisaki
	Chickpea	Annigeri-1, JG-11	Annigeri-1, JG-11, KAK-2, Vishal
	Kulthi	Hebbal Local	KBH-1, PHG-9
Gujarat	Pigeonpea	Gujarat Tur-100, Gujarat Vegetable Tur-1	BDN-2
	Urdbean	TPU-4, Gujarat Urd-1	T-9
	Moongbean	Gujarat Mung-3, CO-4	GM-4, K-851
	Chickpea	GG-1, Chaffa, Dahod Yellow, ICCC-4, Gujarat Junagarh Gram-3	Gujarat Gram-4
Telangana	Pigeonpea	Asha, ICPL 87119, ICPL 85063, PRG 158, WRG 65, MRG 1004, LRG 41 & LRG 158	Asha, ICPL 85063, LRG 41 & PRG 158
	Urdbean	PU 31, LBG 752, LBG 787	PU 31, LBG 752, LBG 787
	Moongbean	LGG 460, MGG 295	LGG 460, MGG 295, MGG 347 & 348, MGG 42
	Chickpea	JG 11, JAKI 9218	JG 11, JAKI 9218

iii. 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.

iv. 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.

v. 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.

vi. 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) Depleting public sector extension support, non-positioning of skilled/sound 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 and multiplicity of extension system on IPM, esp., pesticide dealers 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. Quality cluster demonstrations have been an observation across the board.

v) Interface between State Department of Agriculture (SDA) and State Agricultural Universities (SAUs), ICAR (ATARI) 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 cluster demonstrations, 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 (2011-12) seed replacement rate (SRR) in arhar (22%), mung (30%), urd (34%), gram (20%) and masoor

(22%) has to be brought at the level of at least 33% upto the terminal year of XII plan (2016-17). 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 NFSM Divisions, Government of India, Department of Agriculture, Cooperation & Farmers Welfare 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 (NFSM). States need to enter in to MoU with the private seed producers, NGOs and FPOs/SHGs/FOs/FIGs etc.

(iii) On going ***seed hub programme*** project under NFSM, operational during Kharif 2016-17, need serious implementation by KVKs and other associated agencies for their sustainability.

(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 (5-40 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, 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 16.7).

Table – 16.7. Crop-wise potential districts with 20-30% production share – All India

S.No.	Crop	Districts
1.	Gram	Kurnool, Vidisha, Sagar, Raisen, Ashok nagar, Dewas, Rajgarh, Dhar, Chhatarpur, Panna
2.	Arhar	Prakasam, Kurnool, Betul, Fatehpur, Hamirpur, Seoni, Sonbhadra, Mirzapur, Jabalpur, Morena
3.	Moong	Jagatsingpur, East Godavari,Nayagarh, Kedrapara, Puri, Bolangir, Vizianagarm, Thiruvarur, Mahoba, Jhansi
4.	Urd	Krishna, Lalitpur, Guntur, Jhansi, Mahoba, Srikakulam, Unnao, Damoh, Sagar, Jabalpur
5.	Lentil	Bahraich, Sagar, Vidisha, Panna, Hamirpur, Balrampur, Jhansi, Damoh, Chitrakut, Shivasti
6.	Field Pea	Jalaun, Lalitpur, Jhansi, Mahoba, Panna, Sagar, Chhatarpur, Narsingpur, Seoni, Allahabad
6.	Total Pulses	Raisen, Dewas, Rajgarh, Dhar,Vidisha,Guntur, Panna, Bahraich, Mahoba, Betul

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 under PMFBY 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 and accountability 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 an effective 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 projects (NPDP/ISOPOM) including ongoing NFSM-Pulses by the Directorate of Pulses Development, Bhopal 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, FPOs constituted during XIth and XIIth plan group of progressive farmers, FOs, SHGs, Cooperatives, NGOs, KVKs, FIGs, Women's Group; 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 NFSM programme, at least 10% of the minikits, alongwith the technology package, be given to these FOs/SHGs/FIGs/NGOs. The SDA may also start their own seed minikit programme.

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 NFSM-pulses and made available to these groups by the district agriculture officer/farmers.

PRODUCTION TARGET AND STRATEGY TO AUGMENT PRODUCTION

PRODUCTION TARGETS AND STRATEGY TO AUGMENT PRODUCTIION

As per 4th advance estimates for the year 2015-16, total pulses are cultivated on 25.3 million hectares with total production of 16.47 million tonnes. Major states producing total pulses are Madhya Pradesh (5.1 million tonnes), Rajasthan (2.0 million tonnes), Karnatka and Maharashtra (1.4 million tonnes each), Andhra Pradesh and Uttar Pradesh (1.2 million tonnes each) followed by Tamil Nadu, Jharkhand, Orissa, Gujarat and Chhattisgarh producing less than 0.6 million tonnes each.

Total production of gram is 7.17 million tonnes. Major states producing gram are: Madhya Pradesh (3.27 million tonnes), Karnataka (0.90 million tonnes), Rajasthan (0.80 million tonnes), Maharashtra (0.73 million tonnes) and Andhra Pradesh (0.50 million tonnes). Total production of Tur (Arhar) is 2.46 million tonnes. Major states producing Tur (Arhar) are Madhya Pradesh (0.62 million tonnes), Maharashtra (0.47 million tonnes), Karnataka (0.26 million tonnes), Gujarat (0.24 million tonnes), Uttar Pradesh (0.18 million tonnes) and Jharkhand (0.17 million tonnes). Moong is cultivated in kharif and rabi on 3.83 million hectares with total production of 1.60 million tonnes. Similarly Urd is cultivated in kharif and rabi on 4.12 million hectares with total production of 2.20 million tonnes.

1. PRODUCTION TARGET AT THE END OF TWELFTH PLAN *(Target 2016-17)*

Commensurate to the tentative demand of pulses by 2016-17 arrived at 20.75 million tonnes, on the basis of behaviouristic approach (including seed, feed and wastage), proposed targets for area, production and productivity are 26.00 million ha, 20.75 million tonnes and 798 kg respectively, as summarized below in the table 17.1.

Table -17.1 Crop-wise Production target

{Area = Million ha, Production = Million tonnes, Yield = kg/ha}

Crops	Season	XIIth Plan (Tet.E. 2012-16)			Target 2016-17			% (+/-)		
		A	P	Y	A	P	Y	A	P	Y
Tur	Kharif	4.02	2.98	740	4	3.62	905	-0.02	0.64	165
Urd	Kharif	2.53	1.29	511	2.5	1.45	580	-0.03	0.16	69
	Rabi	0.8	0.59	737	1	0.7	700	0.2	0.11	-37
	Total	3.33	1.88	566	3.5	2	571	0.17	0.12	5
Mung	Kharif	2.34	0.94	401	2.5	1.22	488	0.16	0.28	87
	Rabi	0.99	0.59	602	1.1	0.65	591	0.11	0.06	-11
	Total	3.33	1.53	461	3.6	1.84	511	0.27	0.31	50
Gram	Rabi	8.84	8.29	938	10	9.6	960	1.16	1.31	22
Other Pulses	Kharif	1.17	0.38	325						
	Rabi	3.27	2.63	804						
	Total	4.44	3.01	678	4.9	3.51	716	0.46	0.5	38
Total Pulses	Kharif	10.06	5.59	556	9	6.29	699	-1.06	0.7	143
	Rabi	13.9	12.1	871	12.1	10.95	905	-1.8	-1.15	34
	Total	23.96	17.69	738	26	20.75	798	2.04	3.06	60

XIIth Plan (Average of 2012-13 to 2015-16)

2. Proposed Strategy – Long Term Measures To Increase Production Of Pulses:

Considering the import burden of pulses, thin global market, and volatile prices in domestic markets, India ought to become self-sufficient in pulses. Therefore, the production of pulses needs to be increased on sustainable basis to meet the ever increasing domestic requirement and projected production of pulses of 23.50 million tonnes by 2020 and 27.5 million tonnes by 2025. 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:

17.2 Strategy for achieving desired production level

Sl. No.	Approach	Target	Target by 2020	Target by 2025
1	Productivity Enhancement	Improving productivity from 786 kg/ha to 1000 kg/ha	Production: 23.50 million tonnes Productivity: 900 kg/ha	Production: 27.50 million tonnes Productivity: 1000 kg/ha
2	Increasing the area under cultivation	Bringing 3.0-4.0 million ha additional area under cultivation from existing 24.0 million ha	26.0 million ha	27.5 million ha
3	Reducing duration of crop	Diversification of cropping system into new system and niches	Reduction in maturity duration of existing varieties (in days) *Mungbean*: (for spring/summer season and *rabi* rice fallow): (10-12 days) to duration of 50-55 days *Cowpea*: (10-12 days) to crop duration of 55-65 days	Reduction in maturity duration of existing varieties (in days) *Urdbean*: (for spring/ summer season and *rabi* rice fallow) : (10-12 days) to duration of 60-65 days *Chickpea/lentil*: (for rice fallow): (15-20 days) to crop duration of 100-110 days Early duration *Pigeonpea*: (20-30 days) to crop duration.. of <120 days

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.

For attaining production of pulses 23.50 million tonnes in 2020 and 27.50 million tonnes in 2025, there is need of increase in productivity of pulses up to 900 kg/ha and 1000 kg/ha, respectively. The following initiatives are being under taken to attain required production of pulses.

- Focus is on key areas like seeds of improved varieties, irrigation tailored to pulses (especially micro irrigation), bringing new niche areas under pulse cultivation, attractive minimum support price (MSP) and markets that allow farmers to increase their profitability aligned to improved farmer welfare.
- About 38 lakh quintals of quality seed are estimated to be required to achieve 33% Seed Replacement Rate (SRR). In order to increase availability of quality seeds of improved varieties, the following new initiatives have been taken:
- Total of 7.85 lakhs minikits of newer varieties are allocated for the year 2016-17 free of cost to farmers through State Governments for faster spread of seed of newer varieties.
- Demonstrations of pulses on 31,000 hectares on improved production technology including seed are being conducted by 534 KVKs to spread seed of newer varieties and create awareness among the farmers.
- For ensuring the availability of quality seeds of pulses, 100 seed hubs are being established in 22 states during 2016-17 through ICAR institutes, State Agriculture Universities and KVKs. An amount of Rs. 1.50 crore is approved for each seed hub and 1000 quintals of quality seed is to be produced at each seed hub.
- An amount of Rs 20.39 crores is being provided to twelve ICAR Institute and State Agriculture Universities for strengthening infrastructure for production of breeder seed of pulses with an additional target of 3717 quintals in 2016-17.
- Government of India is committed to accord high priority to water conservation and its management. To this effect Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) has been formulated with the vision of extending the coverage of irrigation **'Har Khet ko pani'** and improving water use efficiency **'More crop per drop'** in a focused manner with end to end solution on source creation, distribution, management, field application and extension activities. PMKSY is being extended to pulse growing districts so that protective irrigations are made to pulses through micro irrigation system.

2.3 Increasing the area under cultivation: The additional production of rabi pulses comes from additional area coverage in rice fallows mainly gram in Chhattisgarh, West Bengal, Bihar, Jharkhand, Odisha, Assam, Andhra Pradesh, Tamil Nadu.

- Lentil in Chhattisgarh, West Bengal, Bihar, Jharkhand, Assam and moong and urd in rice fallow costal region.

- In addition intercropping gram with barley, mustard and linseed in Rajasthan, UP, Bihar, Vidarbha (Maharashtra) and intercropping of gram/ lentil with autum planted ratoon sugarcane in UP, Maharashtra, Bihar.
- The additional production of kharif pulses comes from additional area coverage (diversion to other crops like cotton, oilseeds, coarse cereals, cultivation of kharif pulses as intercrop, planting of red gram on rice bunds, cultivation of minor pulses in niche areas.
- The additional production of summer pulses comes from Punjab, Haryana, Madhya Pradesh, Uttar Pradesh, Bihar, West Bengal and Gujarat
- Detailed action plan for increasing area under pulses is given below:

Table 17.3 Area Expansion through Intercropping/Catch Crop/Rice Fallows.

Sl. No.	Potential crop / cropping systems / niche	Specific area	Potential area (m ha)	Total Target area (m ha		Target of additional production(M ton)		Agencies involved
				2020	2025	2020	2025	
1.	Intercropping							
	Mungbean with Sugarcane (irrigated) Mungbean with Cotton and millets (rainfed uplands)	Western, Central & Eastern U.P., Bihar Maharashtra, A.P. and T.N.	0.70	0.30	0.40	0.10	0.15	Developmental Agencies-State Department of Agriculture, DAC&FW, KVKs, SAUs, ICAR
	Pigeonpea with soybean, sorghum,cotton, millets and groundnut (rainfed upland)	A.P., Malwa Plateau of M.P., Vidarbha of Maharashtra, T.N. North Karnataka,	0.50	0.30	0.30	0.20	0.20	
	Chickpea with barley, mustard, linseed and safflower (rainfed)	South East, Punjab, Rajasthan, Haryana, U.P., Bihar, Vidarbha of Maharashtra	0.50	0.10	0.20	0.05	0.10	
	Chickpea/lentil with autumn planted /ratoon	Maharashtra, Uttar Pradesh, Bihar	1.00	0.30	0.50	0.20	0.30	
2.	**Catch crop :** Mungbean spring / summer	Western U.P., Central U.P. Haryana, Punjab, Bihar, West Bengal	1.00	0.50	0.70	0.20	0.30	
3.	**Rice fallows**							
	Chickpea	Eastern U.P., Bihar, Jharkhand, Orissa, Chhattisgarh, W.B.	0.40	0.20	0.30	0.15	0.30	
	Urdbean / mungbean	A.P., Tamil Nadu, Orissa, Karnataka	0.50	0.20	0.30	0.10	0.20	
	Lentil	Eastern U.P., Bihar, West Bengal, Assam, Jharkhand	0.30	0.10	0.30	0.05	0.20	
	Lentil/fieldpea	North-East	0.10	0.10	0.10	0.05	0.05	
4.	**Kharif fallow**	Urdbean /mungbean in Bundelkhand U.P., M.P.	1.20	0.30	0.40	0.10	0.15	
	Total		**6.2**	**2.4**	**3.5**	**1.2**	**1.95**	

2.4 Comparative Net return analysis of pulses vis-à-vis wheat and paddy: The cost of cultivation of pulses and wheat and paddy is taken into consideration to analyze net returns of pulses with fine cereals (rice and wheat). The comparative analysis is worked out on basis of yield enhancement and higher MSP to equalize the net return of pulses with fine cereals. The outcome of analysis is given below:

- Normal yield of Arhar is 7.25 q/ha and at current MSP, net return is Rs. 13115/- which is slightly less than net return (Rs. 15575/-) of paddy. With the 10% increase in Arhar productivity and 10% enhancement in MSP (Rs.5555/-) equalize the same return as of paddy.
- Normal yield of moong is 4.56 q/ha and at current MSP, the net return is Rs. 7990/- which significantly less than net return of paddy (Rs. 15575/-). With 10% increase in the yield of moong and 20% increase in MSP (Rs. 6010/-) would not equalize the net return of paddy and it yields half of the net return of the paddy.
- Similarly normal yield of urd bean is 5.41 q/ha and at current MSP the net return is Rs. 7660/- which is half of the net return of paddy (Rs. 15575/-). With the 10% increase in the yield level and 20% increase in MSP (Rs. 6000/-) will result into net return of Rs. 13320/- which is marginally less than the paddy.
- Normal yield of Gram is 9.42 q/ha and at current MSP the net return is Rs. 12910/-which is about 60% of the net return of wheat (Rs. 21840/-). With the 10% increase in the yield level and 20% increase in MSP (Rs. 4200/-) will result into net return of Rs. 17970/- which is around 83% of net return of wheat.
- In case of Lentil with the 10% increase in yield level and 20% in MSP (Rs. 4080/-) will result net return of Rs. 7960/- which is approximately one-third of net return (Rs. 21840/-) of wheat.
- With the increase in MSP and increase in productivity level of Arhar only can equalize the net return of paddy crop in Kharif season and same as increase of rabi season, enhancement of yield and increase of MSP of chickpea result into near to the net return of wheat.
- In irrigated area and prevalent paddy-wheat cropping system there is only potential to replace some extent low profitable paddy with Arhar and chickpea with wheat growing in limited irrigated areas with focused approach for increase in yield of pulses along with substantial increase in MSP.

17.4 Comparative analysis of pulses vis-a-vis other cereals like wheat and paddy at enhanced yields and higher MSP

S.No	Crop	Yield (q/ha)		Average cost of cultivation (Rs/ha)^	MSP for Kharif 2016 (Rs/q)		Gross Returns (Rs/ha)	Net Returns (Rs/ha)
		Normal*	Enhanced		2016	Enhanced		
1	Paddy	35		36575	1490		52150	15575
2	Arhar	7.25		23498	5050		36613	13115
			7.61*	27130^		5555#	42273	15143
			7.98**	28450^		5555#	44330	15880
3	Moong (Green Gram)	4.56		18536	5225		23826	7990
			4.79*	21410^		5750#	27540	6130
			5.02**	22440^		5750#	28865	6425
			5.02**	22440^		6010$	30170	7730
4	Urd (Black Gram)	5.41		19390	5000		27050	7660
			5.68*	22380^		5500#	31240	8860
			5.95**	22380^		5500#	32725	10345
			5.95**	22380^		6000$	35700	13320

Rabi cereal crops								
5	Wheat	30		23910	1525		45750	21840
Rabi-pulses								
6	Chickpea (Bengal Gram)	9.42		21110	3500		34020	12910
			9.89*	24380^		3850#	38080	13700
			10.36**	25540^		3850#	39890	14350
			10.36**	25540^		4200$	43510	17970
7	Lentil	4.28		9305	3400		14552	5247
			4.5*	10755^		3740#	16820	6065
			4.71**	11260^		3740#	17615	6355
			4.71**	11260^		4080$	19220	7960

Normal Yield (2010-11 to 2014-15) was taken into consideration to workout intercrop parity 5%* and 10%** enhancement level in yield of kharif and rabi pulses over normal yield ^10% increase in cost of production as per CACP Reports on price policy for kharif crops and rabi crops 2016-17 10%# and 20%$ increase in MSP of all kharif & rabi pulses and incase of Arhar only 10% increase in MSP

2.6 Reducing duration of crop: ICAR, State Agricultural Universities and CGIAR institutes like ICRISAT have already initiated research work to develop short duration varieties of various pulses to be best fitted in prevalent cropping systems particularly in irrigated and rice fallow areas. The detailed plan for various pulses is as under:

Table 17.5 Plan for reducing crop duration

Crop	Present duration	Research strategy	Target	Time frame
Mungbean	65-70 days	Hybridizationusing Cultivated germplasm and wild accessions for combining different components of maturity duration for reducing the crop duration and increasing per day productivity	50-55 days	2020
Cowpea	65-75 days		55-60 days	2020
Urdbean	75-85 days		65-70 days	2025
Lentil	110-130 days		100-110 days	2025
Chickpea	110-130 days		100-110 days	2025
Pigeonepa (short duration)	120-150		<120 days	2025

2.7 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/ DSR and early 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. wilt resistant (JAKI 9218, JG 6, WCG 3, RVG 201, RVG 101, PKV Harita (AKG 9303-12), Wilt tolerant varieties (RSG 902, BGD 103, Phule G 0517, GJG 3, PKV Kabuli 4, RVG 203) and Ascochyta blight resistant varieties (GJG 0809, Samrat (GNG-469), PBG-5, CSG 515) supplemented with management practice for wilt and root rot are the best option. Varieties suitable for saline areas GG-2 & PKV-2. The heat tolerant desi chickpea variety JG 14 was evaluated under late sown condition in U.P., Bihar, Jharkhand, MP, Chhatisgarh and Odisha. JG 14 gave 10 to 25% higher yield than the check cultivars and late sown conditions. Use short duration varieties DEsi: JG-11, JG-14, JG-16, JAKI 9218 & Kabuli: IPCK 2002-29, IPCK-2004-29, KAK 2, JGK-1 and for Rice fallow condition Pant G 186, BG-372, Rajas, RSG 963, Pusa 547, Vaibhav.

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.).

2.8 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^{th} and X^{th}), 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 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, District Food Security Mission Executive Committee (DFSMEC)-NFSM,

State Level Monitoring Team (SALMOT) and National Level Monitoring Team (NALMOT), constituted under NFSM.

- 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.
- 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 ISOPOM may be taken by all the states to identify and ensure supply of specific Micronutrient to a particular district under ISOPOM/NFSM.

2.9 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.

2.10. 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 and NFSM-pulses it has been realized that it requires some modifications in the line of approach for marketing. Market Policy of 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 - 17.6. 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	Weeville d 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

2.10.1. 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 - 17.7 Minimum support price of pulses

Commodity	Year				
	2012-13	2013-14	2014-15	2015-16	2016-17
Gram	3000	3100	3175	3500	4000
Lentil	2900	2950	3075	3400	3950
Arhar	3850	4300	4350	4425	4625
Urd	4300	4300	4350	4425	4575
Moong	4400	4500	4600	4650	4800

2.11. Value addition/ strategy processing

- There is a need for systematic listing of available various value additions/processing Technologies developed by various research institutes (ICAR/CSIR/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 Gulabi chana and "kateela chana" and special Baigani arhar (grown in Mandla, Baiga tribes), 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.

2.12. 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.

Table 17.8 Crop Specific Strategy/Recommendations *(var./ plant protection)*

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, Odisha, 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. - Popularization of Dharwad system (transplanting Pigeonpea), Seedlings are raised in polythene bags, transplanted in main field at 45 days with the apacing of 5 feet X 3 feet under rainfed condition and 6 feet X 3 feet in irrigated condition. - Nipping (2 times) of pigeonpea after 45 and 55 days. - 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 *Tricodermaviridae*or *T. harzianum* @ 4 g/kg should be promoted. - Use micro irrigation (precision) through drip irrigation. - Cultivation of pigeonpea on raised beds by using Broad Bed Furrow (BBF) Planter. - Use Sterlity Mosaic Resistant Var. (BDN 708, GTH-1, BRG 2, BDN 711, Bahar, BSMR 736, Sharad, Pusa 9, BSMR 853), Phytophthora resistant (TJT 501, CORG 9701, JKM 189, Pant Arhar 291 etc.) Wilt resistant (VL Arhar 1, Vipula, GT 101, Maruti, BDN 2, BSMR 736, MA 6). - Use Pre-emergence herbicides like Pendimethalin @ 750-100 g/ha,Metribuzin 250-100 g/ha for weed control. - GTH-1 is the hybrid variety for tasgenic (Cry gene) against pod borer.
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 Gliocladiumvirens*@ 4 g/kg of seed and select wilt resistant (JAKI 9218, JG 6, WCG 3, RVG 201, RVG 101, PKV Harita (AKG 9303-12), Wilt tolerant varieties (RSG 902, BGD 103, Phule G 0517, GJG 3, PKV Kabuli 4, RVG 203) and Ascochyta blight resistant varieties (GJG 0809, Samarat (GNG-469) PBG-5, CSG 515) supplemented with management practices for wilt and root rot are the best options. Varieties suitable for saline areas GG-2 & PKV-2. - Heat tolerant chickpea cultivars would be required for all late sown conditions (in rice-fallows; after a short season catch crop, such as potato and vegetables, in rabi season. - The heat tolerant desi chickpea variety JG 14 was evaluated under late sown

	condition in UP, Bihar, Jharkhand, MP, Chhatisgarh and Odisha. JG 14 gave 10 to 25% higher yield than the check cultivars n late sown conditions. - Use Pre-emergence herbicides like Oxyfluoren @ 150-250 g/ha , Pendimethalin 750-1000 g/ha for weed control. - Use short duration varieties Desi: JG-11, JG 14, JG 16, JAKI 9218 & Kabuli : IPCK 2002-29, IPCK 2004-29, KAK 2, JGK-1 and for Rice fallow condition Pant G 186, BG 372, Rajas, RSG 963, Pusa 547, Vaibhav.
Blackgram (Urd)	- Yellow mosaic virus **resistant varieties**, namely VBN 6, IPU 94-1, Mash 391, LAM 752, Mash 479, IPU 2-43, LBG 625, LBG 685, Improved **early maturing varieties** with a large number of clusters like Mash 1008 and Pant U-30; Azad Urd 1,; PDU 1 Variety for **spring season** in north India PDU-1, Azad Urd 1, Shekhar 2 (KU 300), WBU 109, Mash 414 **powdery mildew** resistant variety CO 6, VBN 4 & 7, Gujarat Urd 1, IPU 2-43, WBG 26 and LBG 402, LBG 625, 685 & 623 (Prabha), KU 301, TU 94-2 for Rabi season. CO 6, ADT 5, Vamban 6 for rice fallows condition. - 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. - **IPM Management** : Seed treatment with Thomethoxam 35 FS @ 2g/kg seed; installation of yellow sticky trap @ 20 /acre; sowing of 1 row of maize or tur after every 30 rows of mungbean as a barrier crop; removal of weeds and disease plant from the crop; spray of NSKE 5 % after 25 DAS or on appearance of pest; foliar spray of thiomethoxam @ 0.3 g or Trizophos @ 4.0 ml/lit water. - Control for **Tobacoco caterpillar :** Novaluron 10 EC @ 150 ml or Acepate 75 SP @ 800 g or Chloropyriphos 20 EC @ 1.5 lit. using 100 lit. of water/acre at the appearance of pest and repeat after 10 days if necessary.
Blackgram (Urd)	- Use Pre-emergence herbicides like Oxyfluoren @ 150-250 g/ha , Imazethapyr 75-100 g/ha for weed control. - Apply Pendimethalin + Imazethapr (Pre mix) 0.9 kg/ha as pre emergence or Imazerhaapyr 100 gm /ha as eraly post or Imazethapyr + Imazamox 50g/ha as early post for effective control of weeds in mostvof the pulsecrops. - Hoeing of 20 & 40 DAS recorded higher weed control efficiency and it was comparable with EPOE Imaethapyr + Imazamox (RM) 70-80g/ha. - Proper water management-border irrigation under flood and sprinkler/micro-irrigation under limited water availability particularly at pod filling stage. - Timely availability of quality seeds of recommended varieties. - Good tillage and crop stablshment practices-laser land levelling, use of new type seed-drills, Zero-tillage sowing in proper moisture, residue retension of previous crop. - Use of pre-emergence herbicides (Pendamethalin @ 0.75-1.50 kg ai/ha) and one need based hand weeding. - Use of phosphorus and Sulphur particularly after wheat and intercropping with sugarcane. - Control of Thrips in Mungbean at pre-flowering (use of Dimethoate or emidacholoprid).

	- Promising varieties against White fly OBG 33, KUG 503, AKU 10-2.
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. - **IPM Management** : Seed treatment with Thomethoxam 35 FS @ 2g/kg seed; installation of yellow sticky trap @ 20 /acre; sowing of 1 row of maize or tur after every 30 rows of mungbean as a barrier crop; removal of weeds and disease plant from the crop; spray of NSKE 5 % after 25 DAS or on appearance of pest; foliar spray of thiomethoxam @ 0.3 g or Trizophos @ 4.0 ml/lit water. - Control for **Tobacoco caterpillar :** Novaluron 10 EC @ 150 ml or Acepate 75 SP @ 800 g or Chloropyriphos 20 EC @ 1.5 lit. using 100 lit. of water/acre at the appearance of pest and repeat after 10 days if necessary. - Select short duration YMV resistant varieties of Mungbean like HUM 16, IPM 2-3, IPM 02-14, Pusa 0672, SML 668, Samrat (PDM-139), Pant mung-2, 4 & 6, IPM-99-125 (Meha) and having a potential to increase area in spring/summer in U.P., Bihar, West Bengal, MP, Rajasthan, Punjab and Haryana. Powdery mildew resistant varieties like TJM 3, VBN 3, AKM 9904, PKV Green Gold TM 96-2, TARM-1 & 2, TARM-18, JM-721. Large seeded Pant M-5, Pusa Vishal, SML 668, HUM 16, TMB 37. - Promising varieties against Thrips SML 1807, 1814, 1810, 1836, 1837, LGG 486 and for White fly ML 1774, ML 1779. - Use Imazethapyr 30 g/ha as a Pre & Post-emergence & Imazapic 10 g/ha as a post-emergence for weed control whereas, Co-7, Vamban 3, ADT 5 for Rice fallow condition. - Proper water management-border irrigation under flood and sprinkler/micro-irrigation under limited water availability particularly at pod filling stage. - Timely availability of quality seeds of recommended varieties. - Good tillage and crop stablshment practices-laser land levelling, use of new type seed-drills, Zero-tillage sowing in proper moisture, residue retension of previous crop. - Use of pre-emergence herbicides (Pendamethalin @ 0.75-1.50 kg ai/ha) and one need based hand weeding. - Use of phosphorus and Sulphur particularly after wheat and intercropping with sugarcane. - Control of Thrips in Mungbean at pre-flowering (use of Dimethoate or emidacholoprid).
Lentil	- **Bold seeded** varieties namely, DPL 15 and DPL 62, DPL 4046, Sapna, Priya, Pant L 5, Mallika, JL 3, IPL 81. **Rust resistant** varieties with different plant types – VL-126, IPL 406, Pusa Masur 5, Shekhar Masur 2 & 3, Pant L-024, PL-8. **Wilt resistant** variety viz .VL 125, Moitree WBL 77, Pant L-6, VL Masur 129 & VL-133. **Small seeded** varieties Pant L 4, IPL 406, Pusa vaibhav, Pant L 406 & 639,

	KLS 218, HUL 57. Pusa vaibhav, KLS 218, Pant L 639, DPL 62, Pant L 5. - 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. - Use Pre-emergence herbicides like Oxyfluoren @ 150-250 g/ha , Imazethapyr 75-100 g/ha for weed control.
Peas	- Use of leafless dwarf types of Peas with high yield for closer planting (JAY (KPMR 522), HFPD 24, KPMR 400). Powdery mildew resistant varieties (IPF 99-25, IPFD 1-10, Paras, Pant Pea 14, VL Matar 42, Pant Pea 25 & 42 and Rust resistant variety Swarna Trapti, VL Matar 47, Aman (IPF 5-19). - 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 wettablesulphur (0.3%) for control of powdery mildew and rust. - Use Pre-emergence herbicides like Oxyfluoren @ 150-250 g/ha , Pendimethalin 750-1000 g/ha and Metribuzin 250-100 g/ha for weed control.
Lathyrus	- Lathyrus is most commonly grown as Utera in rice. Important states are Chhattisgarh, Odisha, 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), Prateek (ODAP-0.109%) & Mahateora (ODAP-0.074%) a low toxin Lathyrus can be grown in rice fallows of Uttar Pradesh, Bihar, Odisha, West Bengal and Chattisgarh. - Strees tolerant varieties Prateek, GNG 1581, Mahateora.
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. - Yellow Mosaic resistant varieties TMV-1, Rajasthan Moth 257, RMO 2004, CZM-45 & 99, JMM-259 and for Drought tolerant is RMO 423.
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). - Anthracnose resistant varieties are Phule Surekha (KOF B-4), Varun (ACPR 94040), VL Rajma 125, VL Bean 2 and rresistant to Bacterial Blight Mosaic Virus (BCMV)- Amber (IPR 96-4), IPR 98-5 (Utkarsh), IPR 98-3-1 (Arun) etc.,

2.14. Policy related strategy

- 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 IPM 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.
- Developing strong seed production and distribution chain to achieve seed replacement rate of 33 % by 2016-17 for all pulses.
- Creation of seed banks to meet seed shortage needs and for calamity situations by associating public as well as private sector seed companies. Monitoring of seed hub by SDA.
- An area of approximately 1.3 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. FPOs, Self-help groups (SHGs), Farmers Interest Groups (FIGs) for effective market improvement can be organized.
- Development and Dissemination of location specific agronomic package of practices by SAUs, Skill development packages *etc.*, by aggressive ToT programmes.

POLICY INTERVENTION

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 & Farmers Welfare launched various development programmes on pulses during different Plan periods.

Plan interventions in the pulses sector were brought by the Govt. Of India, Department of Agriculture, Cooperation & Farmers Welfare since Fourth Five year Plan with more focused approach since VIth Plan onwards as under:

"Pulses Development Scheme" a Centrally Sponsored Scheme, was initiated from the IVth Plan (1969-70 to 1973-74). The focused area was the introduction of production technologies and improved varieties amongst the farmers.

Seventh plan (1985-90): conceived the National Pulses Development Project (NPDP), merging all the earlier centrally sponsored schemes on pulses.

To further supplement the efforts under NPDP, a "Special Food Grain Production Programme (SFPP) on Pulses" was also implemented during 1988-89 on a 100% Central assistant basis.

Technology Mission on Oilseeds (TMO 1985-86): To ensure the accelerated development of certain priority areas of economic and social concern, the Government of India adopted a compressive approach and launched *Six Technology Missions* viz. i) Rajiv Gandhi National Drinking Water Mission ii) Immunization Mission iii) National Literacy Mission iv) Tele-communication Mission v) Dairy Development (Operation Flood-II): and vi) Maximization of indigenous production of vegetable oilseeds/oils etc.

For accelerated development and successful implementation of the mini-missions approach, three strategic Committees were also set up for Structural innovation viz. (i) Empowered Committee (EC) (ii) Technical and Advisory Committee (TAC) (iii) Standing Committee (SC).

The TMO remained operational under the supervision of ICAR till 1987-88. From 1988-89 onwards, the implementation and responsibilities were transferred to Department of Agriculture and Co-operation to harness the best of production, processing management technologies harmonizing the interest of farmers, consumers and accelerate self-reliance in oilseeds and edible oils. The TMO pursued a Mission-Mode-Approach by forming a consortium of concerned department and stake holders.

TMOP (1990-91): Pulse development programmes were brought to the ambit of the Mission in August 1990. Thereafter Oilpalm (1992-93) and Maize (May,1995) also became the part of it, renaming the TMO as Technology Mission on Oilseeds, Pulses and Maize (TMOP&M). The Seventh Plan ongoing interventions under National Pulses Development Project (NPDP) became the part of TMOP&M.

TMOP&M had four-pronged strategy approach under its four Mini Missions involving the concerned department and agencies to facilitate the task of handling specialized focused areas of development viz. MM-I - ***Crop Protection Technology**:* DARE with ICAR as nodal deptt., Department of Bio-Technology and SAUs as implementing agencies; MM-II - ***Post Harvest Technology**:* Department of Scientific & Industrial Research with CSIR as nodal deptt. and Department of civil supplies as participating agencies; MM-III- **Input and service support to farmers**: DAC as nodal agency with SDAs, NDDB, NABARD and NOVOD Board, as implementing agencies and MM-IV- **Price support, storage, processing and marketing**: DAC as nodal deptt. with participating agencies as NCDC, NDDB, NAFED, Department of civil supplies KVIC and NOVOD Board.

ISOPOM (2004-05 to 2009-10): From April 2004 to March 2010, on the advice of the Planning Commission, "Integrated Schemes of Oilseeds, Pulses, Oilpalm and Maize (ISOPOM)" has been under implementation by merging 4 ongoing schemes of NPDP, OPP, OPDP and AMDP. The ISOPOM had a more focussed and integrated approach. To strengthen the market invention and effective pricing policies were some of the added features of this programme.

NFSM-Pulses (2007-08): From 2007-08 (Rabi), in pursuance of the resolution adopted in 53rd meeting of National Development Council, a Centrally Sponsored Scheme on" National Food Security Mission was launched. It was resolved to enhance the production of rice, wheat and pulses by 10, 8 and 2 million tonnes, respectively by the end of XI Plan. The implementation of the NFSM scheme is continued during XII Plan.

The NFSM aimed at increasing production of rice, wheat and pulses through area expansion and productivity enhancement; restoring soil fertility and productivity; creating employment opportunities; and enhancing farm level economy to restore confidence of farmers of targeted districts. The basic strategies were implementation of interventions in a mission mode through active engagement of all the stake holders at various levels. These interventions includes promotion and extension of improved technologies i.e., Seed, Integrated Nutrient Management (micro-nutrient, soil amendments), IPM and resource conservation technologies along with capacity building of farmers. Flow of fund closely monitored to ensure that intervention reach the target beneficiaries on time, Interventions proposed were integrated with the district plan and target for each identified district was fixed. Constant monitoring and concurrent evaluation were done for assessing the impact of the interventions for a result oriented approach by the implementing agencies.

NFSM + Special initiatives (2010-11 to 2013-14): To accelerate the pulses production, a centrally sponsored Accelerated Pulses Production Programme (A3P) (2010-11 to 2013-14)- cluster demonstration approach from; Special initiatives for "pulses and oilseeds in dry land area" under RKVY during 2010-11; Integrated development of 60000 Pulses villages in Rainfed Areas under RKVY during 2011-12 and "Special plan to achieve 19+ million tonnes of Pulses production during Kharif 2012-13" were also been implemented.

Strong Research and Development efforts during XI Plan had spectacular achievement realising more than 20% increase in the production of Pulses at the terminal year of XI Plan (2011-12).

NFSM-Pulses XII Plan: During 2014-15, the Pulses development scheme under NFSM was under implementation in 24 states viz. Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Telangana, Tripura, Uttar Pradesh and West Bengal with additional production target of 4 Million tonnes by the end of XII Plan (2016-17).

During 12th Plan, the NFSM with the other four Missions, viz. NMAET, NMSA, NMOOP & MIDH is continued. The pattern of Central assistance under NFSM has been 100 per cent up-till 2014-15.

The Twelfth Plan NFSM (2012-13 to 2016-17), revamped from 2014-15 and is under implementation with five components viz.i) NFSM- Rice, ii) NFSM-Wheat, iii) NFSM-Pulses, iv) NFSM-Coarse Cereals (millets) and v) NFSM-Commercial Crops (Jute, Cotton, Sugarcane).

A target of an additional production of 25 million tonnes of food grains i.e. from 259.29 MT to 284.29 over the base year of XI Plan (i.e. 2011-12) comprising Rice-10 million tonnes, Wheat - 08 million tonnes, Pulses - 04 million tonnes & Coarse Cereals-03 million tonnes, is targeted to be achieved at the end of 12th Plan (2016-17).

The existing Centrally Sponsored Scheme have also been rationalized and 03 schemes viz. (i) Krishi Unnati Yojana (ii) National Crop Insurance Programme (NCIP) and (iii) Pradhan Mantri Krishi Sinchai Yojana (PMKSY) are operational since 2015-16. NFSM-2015-16 is a part of KrishiUnnatiYojana (State Plan). From 2016-17, the revamped NFSM under State Plan Scheme – Krishi Unnati Yojana (State Plan) with interim sharing pattern of 60:40 for plains and 90: 10 for hilly states between Centre and State is under implementation in 29 states. A Central Share of Rs. 1700 Crores has been approved during 2016-17.

The basic strategy of the Mission is to focus on low productivity high potential districts, promote and extend improved technology package, implementation of cropping system centric interventions on technological package, agro-climatic zone wise planning and cluster approach demonstrations, Further 30% of total demonstrations would be Cropping System Based Demonstration (CSBD) with technical backstopping of ICAR/State Agricultural Universities (SAUs)/ on Rice, Wheat, Pulses; distribution of certified HYV seeds/Hybrid seeds, Resource Conservation Technology (RCT) tools, irrigation machineries/MIS, trainings and undertaking local initiatives to the tune of 5% of total budgetary allocation to improve productivity.

Special emphasis has also to be given by targeting reclamation of problematic soils, water logging areas and mitigation of adverse effects of climate change for high productivity areas, value chain integration (FPOs) and assistance to Custom Hiring Centre (CHCs). 30% of budgetary allocation has to be earmarked for women beneficiaries.

To ensure equity, of the total budgetary allocation to a district proportionate expenditure under Special Component Plan (SCP) for SCs, Tribal Sub Plan (TSP) – SMF and Women farmers at 16%, 8%, 33% and 30% respectively is mandatory.

Assistance for various interventions like cluster demonstrations on improved package of practices, demonstrations on cropping system, cropping system based training of farmers, seed distribution of HYVs , manual sprayer, power sprayer, tractor mounted sprayer, chiseller (deep ploughing), water carrying pipes, mobile raingun, sprinkler set, pump set (up to 10 HP), seed drill, zero till seed drill, multi crop planter, zero till multi crop planter, ridge furrow planter, rotavator, multi crop thresher, laser land leveller, plant protection chemical and bio pesticides, weedicides, gypsum / phospho-gypsum, bio-fertilizers, micro nutrients, local initiatives are provided under NFSM-Pulses programme.

Concerted efforts are being made for promotion of cultivation of pulses as inter-crop with cereals, oilseeds, commercial crops.At least 30% of the cluster demonstrations under NFSM and BGREI are being conducted by adopting cropping system approach to promote pulses as second crop in rice fallow areas.

Formation of Farmer-Producer Organizations (FPOs) is also being promoted particularly to support the small and marginal farmers to offer collective strength for seed production, procurement and access to improved technologies. Besides, for primary processing of pulses, assistance is provided for establishment of mini *dal* mills under NFSM. State Agriculture Universities/ Indian Council of Agricultural Research Institutes/ International Research Organizations are also involved to address various researchable issues of pulses and demonstrations of latest technologies for better yield realization at farmers' field.

Government of India has allocated Rs. 1700 crores for NFSM for 2016-17, out of which an amount of Rs. 1100 crores is earmarked for pulses.

Additional Programme for increasing Pulses Production 2016-17
Breeder seed production infrastructure: Breeder seed production reduced to 14000 qtls from 10000 qtls; Strengthening of infrastructure at ICAR/SAUs;
Allocation: Rs. 20.39 Crore

Seed production subsidy: @ Rs. 25 /- per kg for new varieties; Allocation of Rs. 200 crore
Seed hubs: Total seed hubs - 100 (ICAR/SAUs and KVKs); Each seed hubs to produc - 1000 qtls of pulses seed; Total seed to be Produced -1.50 lakh qtls (1000x150); Allocation**:** Rs. 150.3108 crore
Cluster FLDs: 25.291 crore
FLD on Pulses through ICAR-IIPR: Rs. 0.97 crore
Establishment/Strenghtening of Biofertilizer and Bio-control Production Units (24 centres/Institutes) : Rs. 29.61 crores
FPOs: (111) Rs. 52.1084 crores
Seed Minikit: Total allocation Rs. 150 Crore

Table 18.1 Plan-wise intervention (VIIIth to XIIth Plan)

Sr.No	Plan Period (VIIIth To XIIth Plan)	States Covered
	VIIIth -IXth and Xth Plan	
1.	National Pulses Development Project (NPDP) (1990-91 to 2003-04)	28 + 02 UT
2.	Integrated Scheme of Oilseeds, Pulses, Oilpalm and Maize (ISOPOM)-Pulses (2004-05 - 2006-07)	14
	XIth Plan	
1.	Integrated Scheme of Oilseeds, Pulses, Oilpalm and Maize (ISOPOM)-Pulses (2007-08 - 2009-10)	14
2.	National Food Security Mission-Pulses (Rabi, 2007-08 to 2011-12)-*Pulses component of ISOPOM merged with NFSM w.e.f.1.4.2010*	16
3.	Accelerated Pulses Production Programme (A3P) (2010-11 to 2011-12)	16
4.	Special initiatives for pulses and oilseed in dry land areas under RKVY (2010-11)	07
5.	Integrated Development of 60000 Pulses villages in Rainfed Areas under RKVY (2011-12)	11
6.	Macro Management of Agriculture (MMA) (2004-05 onwards)	Other than NFSM
	XIIth Plan (2012-13 to 2016-17)	
	2012-13 to 2013-14	
1.	National Food Security Mission (NFSM)–Pulses	16

2.	Accelerated Pulses Production Programme (A3P)	16
3.	Special Plan to achieve 19+ million tonnes of Pulses production during *Kharif* 2012-13	08
	2014-15 to 2016-17	
1.	National Food Security Mission (NFSM)–Pulses 2014-15	27
2.	National Food Security Mission (NFSM)–Pulses 2015-16	27
3.	National Food Security Mission (NFSM)–Pulses 2016-17	29
4.	Seed Hub-ICAR	100
5.	Breeder Seed Production Programme -ICAR	
6.	Seed Minikit	NFSM States
7.	Cluster FLDs through KVKs	31000 ha
8.	Establishment/strengthening of Bio-fertilizer and Bio-control Production Units	24 Nos.
9.	Farmer Producer Organization (FPOs)	111 Nos.

Table 18.2 INTERVENTIONS UNDER NFSM-PULSES:

Sr. No.	Head	Interventions
1.	Technology Demonstrations	• Cluster demonstrations • Cropping system based demonstrations • Front Line Demonstrations by ICAR/SAUs
2.	Seed	• Distribution of HYVs seed
3.	Integrated Nutrient Management (INM)	• Micro-nutrients • Lime/Gypsum/80% WG Sulphur • Lime • Bio-fertilizers
4.	Integrated Pest Management (IPM)	• Distribution of Plant Protection chemicals • Weedicides
5.	Resource Conservation Technologies/Tools	• Power Knap Sack Sprayers • Manual Sprayer • Zero Till Seed Drills • Multi Crop Planter • Seed Drills • Zero Till Multi Crop Planters • Ridge Furrow Planters • Rotavators • Chiseller • Laser Land Levelers • Tractor mounted sprayer • Multicrop Thresher
6.	Efficient Water Application Tools	• Sprinkler Sets • Pump Sets • Pipe for carrying water from source to the field. • Mobile Rain guns
7.	Cropping System based trainings	• Four Sessions in a crop season (One before Kharif and Rabi Season & one each during Kharif and Rabi Crops).
8.	Miscellaneous Expenses (Project Management Support & Monitoring)	• Project Management Team & other miscellaneous expenses at District and state level
9.	Local Initiatives	• On project basis, up to 9% of the total allocation to the state
10.	Other	• Specialized projects for high productivity areas • Support to institute/organizations including NGOs in remote areas. • Value chain integration of small producers • Assistance to Custom Hiring Centres • Marketing support for pulses

2. 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[th] plan.

Detailes of contractual research programme given in table 18.3 & 18.4.

Table 18.3 Contractural Research ISOPOM/NFSM

Rs. In Lakh

S.No	Name	Duration	Implementing Agency	Financial Outlay
1	Developing of extra-large seeded Kabuli chickpea varieties for crop diversification	2004-05	IIPR/ICARDA	129.60
2	Development and popularization of model seed system (S) for quality seed production of major legumes	-do-	IIPR/ICARDA	
3	Exploiting host plant resistance for Helicoverpa Mangment to increase the production and productivity of chickpea and pigeonpea under rainfed condition in India.	-do-	ICRISAT	253.65
4	Enhancing yield and stability of pigenpea through Heterosis breeding	-do-	IIPR/ICARDA	
5	"Enhancing Lentil Production for Food, Nutritional Security & Improved Rural Livelihoods	2010-11 to 2012-13	ICARDA	270.00
6	Enhancing grasspea production for safe human food, animal feed, and sustainable rice based production system in India	2011-12 to 2012-13	ICARDA	362.00
7	Pre-breeding and genetic enhancement in breaking yield barriers in lentil and Kabuli chickpea and lentil through DAC–ICARDA-ICAR collaboration	2010-11 to 2014-15	ICARDA /IIPR	314.00 (2010-11 & 2011-12)
8	Enhancing lentil production in Eastern & Northern states for safe human food, animal feed, and sustainable rice based production system in India.	2013-14 to 2015-16	ICARDA	390.00
9	Enhancing grasspea production in Eastern and North Eastern states for safe human food, animal feed, and sustainable rice based production system in India.	2013-14 to 2015-16	ICARDA	300.00

Table 18.4 Ongoing Contractual Researches (NFSM)

(Amount in Lakhs)

S.No.	Project Title	Implementing Agency	Project Duration	Total Allocation	Alloc. for 2016-17	1st Release
1	Enhancing breeder seed production for increasing indigenous production of pulses in India	ICAR, New Delhi	2016-17 to 2018-19		2039.00	815.60 (40% of allocation)
2	Scaling up and popularization of	ICRISAT,	2016-17	77.965	77.965	58.47

	high yielding pigeonpea hybrids for enchancing productivity of small and marginal farmers of Maharashtra,Karnataka & Odisha States of India	Hyderabad, Telangana				
3	Creation of seed –hubs for increasing indigenous production of pulses in India	IIPR, Kanpur	2016-17 to 2017-18	15031.08 (incl. 7 addl hub)	8044.54	4022.27
4	Creation of seed –hubs for increasing indigenous production of pulses in India	IIPR, Kanpur	2016-17 to 2017-18	-	630.00	315.00 (50 % of add.alloc.)
5	Addressing phytophthora blight disease : An emerging threat of pigeonpea expansion & production	ICRISAT, Hyderabad	2013-14 to 2016-17	400.923 (Revised)	121.976	
6	Quality seed production for higher productivity of pulses through farmers participatory programme in Shiwalik foothills of Jammu region	SKUAST, Jammu	2014-15 to 2016-17	51.60 (Revised)	14.61	10.70
7	Enhancing mothbean and mungbean productivity through high yielding varieties, nutrient management and IPM practices in Western Rajasthan	SKRAU, Bikaner	2014-15 to 2016-17		11.51040	5.788
8	Generation advancement and development of new genotypes through pre-breeding in Lentil and Kabuli Chickpea"	ICARDA	2013-14 to 2016-17	320.196 (Revised)	81.536	
9	Identification of salt tolerant chickpea varieties for coastal regions of Gujarat.	NAU, Navsari (Dr. P.B.Patel)	2014-15 to 2016-17	32.123 (Revised)	11.216	
10	Investigation on the present pigeon pea pest complex and their management with emphasis on radiation technology as an integral component in IPM.	UAS, Raichur, Karnataka	2013-2014 to 2016-17	690.74 (Revised)	114.396	21.634
11	Enhancing productivity through introduction of new high yielding varieties, production technologies in chickpea, green gram, black gram & cowpea.	UAS, Dharwad , Karnataka			35.18	
12	Utilizing chickpea genome sequence for crop improvement.	ICRISAT, Hyderabad	2013-14 to 2016-17	1293.9984 (Revised)	220.50	165.375
13	Developing chickpea cultivars suited to mechanical harvesting and tolerant to herbicides.	ICRISAT, Hyderabad	2013-14 to 2016-17	795.47 (Revised)	218.776	210.35

3. PERFORMANCE OVER-VIEW–(FIRST TO TWELFTH PLAN)

AN ANALYSIS TO PRE, POST TMOP AND DURING NFSM INTERVENTIONS

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 TMOP, during the TMOP and during NFSM period is briefly analyzed as below:

Table- 18.5. Plan-wise trend of growth in pulses

{Area-Mha., Production- MTons, Yield- kg/ha}

Plan	Average Area	Average Production	Average yield	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
IIIrd 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	14.46
NFSM Plan Period				
XIth Plan (2007-2012)	24.16	15.97	661	15.86
XIIth Plan (2012-2017) Up to 2014-15	26.57	19.82	746	18.60

3.1. Area expansion

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 to tenth plan period (2002-07)and eleventh to twelfth plan period (2007-12 to 2012-2015). The plan period had the critical intervention in pulses sector through the Technology Mission (TMOP) and National Food Security Mission (NFSM) with the increase in irrigation coverage, 13% and 18.6 % of total pulses stablized in irrigated area.

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) andXth Plan (2002-07) the country witnessed an average plan period production of 13.34 Million tones and 13.35 million tonesrespectively, 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.

During the course of implementation of NFSM throughout the XIth & XIIth plan (2012-13 to 2014-15), the country witnessed a significant increase in production of pulses i.e. 15.97 Million tons and19.82 Million tons respectively, the maximum ever achieved.

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. Similarly, during the NFSM plan period, eleventh and twelfth plan, productivity was achieved 661 kg/ha and 746 kg/ha respectively. Although this productivity is still below the world's average productivity of 904 kg/ha and as also what has been realized under the frontline demonstrations of ICAR. A group productivity gap in chickpea-54%; lentil-59%; pigeonpea (early-37%, medium-100%, long duration >71%); Mungbean (*Kharif*-73, *Rabi*- >100%); urdbean (*Kharif*-68% and *Rabi*- rice fallow-51% and normal-104%), under total pulses between the FLDs and states' average is the existing potential and a challenge for both the research and development agencies to harness.

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, are 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).

During the NFSM plan period, irrigation increased upto 19%, attributing the productivity enhancement i.e. about 746 kg/ha (Twelfth plan).

3.5 Conclusion

The demand for Pulses is projected to grow at about 2% per year on account of the increase in population and growth in direct demand. This growth rate is almost four times the growth rate experienced in the domestic production of the food grains including pulses during the last decade.

This has created serious imbalnces between domestic production and demand which for some time was met by liquidating stocks and cutting down on exports. If the growth rate of dometic production of pulses fails to rise to the required level, it would result in lead to increase dependence on imports to met the domestic demand.

If we want to meet the domestic demand of pulse requirement, we must increase production or depend on imports. As Agriculture growth is limited, imports will help improve the supply situation in the short term whereas, the long term, we will need to focus on productivity increase, through public capital formation in irrigation, Quality seeds of promising varieties and their availability at least 33% SRR, research and efficient use of water, plant nutrition and other necessary inputs.

Policy initiatives must lead for efficiency and help in maintaining balance between domestic production and demand. It we strive to achieve these potential yield levels, then the increasing demand requirement of the country can be met in future.

In order to give the much needed fillip to pulse production, the government has given emphasis on pulses through various developmental programmes and has been significantly increasing the MSP for most pulses. This has resulted in an above normal growth in pulses production in recent years.

In the past four years, there has been significant increase in pulse consumption averaging 50 grams due to somewhat higher production and larger imports.

ANNEXURES

ANNEX.-I

STATE-WISE YEAR WISE AREA, PRODUCTION AND YIELD TOTAL PULSES

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE/SEASON		2010-11	2011-12	2012-13	2013-14	2014-15	Average
ANDHRA PRADESH							
Kharif	**A**	9.968	7.110	7.010	6.420	5.120	7.126
	P	4.390	2.740	4.160	3.740	2.720	3.550
	Y	440	385	593	583	531	498
Rabi	**A**	11.350	12.200	12.480	10.300	9.380	11.142
	P	10.010	9.560	12.070	11.770	8.839	10.450
	Y	882	784	967	1143	942	938
Total	**A**	21.318	19.310	19.490	16.720	14.500	18.268
	P	14.400	12.300	16.230	15.510	11.559	14.000
	Y	675	637	833	928	797	766
ARUNACHAL PRADESH							
Kharif	**A**	0.042	0.046	0.047	0.045		0.045
	P	0.037	0.042	0.050	0.048		0.044
	Y	881	913	1076	1062		985
Rabi	**A**	0.044	0.049	0.048	0.041		0.046
	P	0.054	0.063	0.056	0.054		0.057
	Y	1227	1286	1167	1305		1245
Total	**A**	0.086	0.095	0.095	0.086		0.090
	P	0.091	0.105	0.106	0.102		0.101
	Y	1058	1105	1122	1177		1116
ASSAM							
Kharif	**A**	0.071	0.057	0.060	0.061	0.060	0.062
	P	0.051	0.041	0.049	0.056	0.050	0.050
	Y	718	719	829	920	833	802
Rabi	**A**	1.193	1.140	1.353	1.439	1.679	1.361
	P	0.650	0.645	0.795	0.987	1.067	0.829
	Y	545	566	588	686	635	609
Total	**A**	1.264	1.197	1.413	1.500	1.739	1.423
	P	0.701	0.686	0.844	1.043	1.117	0.878
	Y	555	573	598	695	642	617
BIHAR							
Kharif	**A**	0.631	0.561	0.560	0.568	0.602	0.584
	P	0.678	0.613	0.766	0.674	0.644	0.675
	Y	1074	1093	1368	1187	1070	1155
Rabi	**A**	5.492	4.682	4.598	4.432	4.462	4.733
	P	4.700	4.500	4.661	4.546	3.558	4.393

	Y	856	961	1014	1026	797	928
Total	**A**	6.123	5.243	5.158	5.000	5.064	5.318
	P	5.378	5.113	5.427	5.220	4.202	5.068
	Y	878	975	1052	1044	830	953

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE/SEASON		2010-11	2011-12	2012-13	2013-14	2014-15	Average
CHHATTISGARH							
Kharif	**A**	2.190	2.193	2.000	2.003	1.991	2.075
	P	0.712	0.722	0.792	0.775	0.798	0.760
	Y	325	329	396	387	401	366
Rabi	**A**	6.424	5.944	7.265	6.390	5.862	6.377
	P	4.663	4.269	5.695	4.046	5.749	4.884
	Y	726	718	784	633	981	766
Total	**A**	8.614	8.137	9.265	8.393	7.853	8.452
	P	5.375	4.991	6.487	4.821	6.547	5.644
	Y	624	613	700	574	834	668
GOA							
Kharif	**A**	0.002	0.002	0.002	0.002		0.002
	P	0.001	0.001	0.002	0.001		0.001
	Y	500	500	826	824		663
Rabi	**A**	0.074	0.097	0.097	0.079		0.087
	P	0.078	0.081	0.088	0.088		0.084
	Y	1054	835	907	1108		964
Total	**A**	0.076	0.099	0.099	0.081		0.089
	P	0.079	0.082	0.090	0.089		0.085
	Y	1039	828	905	1102		958
GUJARAT							
Kharif	**A**	6.120	6.200	4.460	4.760	3.990	5.106
	P	4.610	4.520	3.780	3.550	3.490	3.990
	Y	753	729	848	746	875	781
Rabi	**A**	2.780	3.370	2.140	3.370	2.380	2.808
	P	2.620	3.280	1.942	3.740	2.320	2.780
	Y	942	973	907	1110	975	990
Total	**A**	8.900	9.570	6.600	8.130	6.370	7.914
	P	7.230	7.800	5.722	7.290	5.810	6.770
	Y	812	815	867	897	912	855
HARYANA							
Kharif	**A**	0.590	0.390	0.365	0.182	0.150	0.335
	P	0.440	0.290	0.262	0.152	0.115	0.252
	Y	746	744	718	832	767	750
Rabi	**A**	1.174	1.410	1.264	1.344	0.710	1.180
	P	1.145	0.980	1.042	1.099	0.480	0.949
	Y	975	695	824	818	676	804
Total	**A**	1.764	1.800	1.629	1.526	0.860	1.516
	P	1.585	1.270	1.304	1.251	0.595	1.201

	Y	**899**	**706**	**800**	**819**	**692**	**792**

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE/SEASON		2010-11	2011-12	2012-13	2013-14	2014-15	Average
HIMACHAL PRADESH							
Kharif	**A**	0.202	0.211	0.207	0.160	0.200	0.196
	P	0.129	0.123	0.153	0.092	0.169	0.133
	Y	639	583	738	575	844	679
Rabi	**A**	0.141	0.112	0.119	0.129	0.135	0.127
	P	0.287	0.185	0.308	0.418	0.251	0.290
	Y	2035	1652	2584	3235	1856	2276
Total	**A**	0.343	0.323	0.326	0.289	0.335	0.323
	P	0.416	0.308	0.461	0.510	0.420	0.423
	Y	1213	954	1413	1764	1252	1308
JAMMU & KASHMIR							
Kharif	**A**	0.258	0.237	0.246	0.232	0.238	0.242
	P	0.146	0.113	0.124	0.115	0.058	0.111
	Y	566	477	503	495	244	459
Rabi	**A**	0.028	0.023	0.021	0.027	0.028	0.025
	P	0.022	0.019	0.018	0.024	0.020	0.020
	Y	786	826	855	887	709	809
Total	**A**	0.286	0.260	0.267	0.259	0.266	0.268
	P	0.168	0.132	0.142	0.139	0.078	0.132
	Y	587	508	530	535	292	492
JHARKHAND							
Kharif	**A**	2.992	2.399	3.592	3.319	3.457	3.152
	P	2.047	1.857	3.316	3.187	3.201	2.722
	Y	684	774	923	960	926	863
Rabi	**A**	1.270	2.255	2.278	2.350	2.490	2.129
	P	1.249	2.263	2.777	2.599	2.770	2.332
	Y	983	1004	1219	1106	1112	1095
Total	**A**	4.262	4.654	5.870	5.669	5.947	5.280
	P	3.296	4.120	6.093	5.786	5.971	5.053
	Y	773	885	1038	1021	1004	957
KARNATAKA							
Kharif	**A**	16.390	13.370	11.260	14.180	12.200	13.480
	P	8.330	5.860	5.713	8.085	6.410	6.880
	Y	508	438	507	570	525	510
Rabi	**A**	11.530	9.660	11.430	10.800	10.890	10.862
	P	7.320	5.481	6.880	7.920	8.470	7.214
	Y	635	567	602	733	778	664
Total	**A**	27.920	23.030	22.690	24.980	23.090	24.342
	P	15.650	11.341	12.593	16.005	14.880	14.094

	Y	561	492	555	641	644	579

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE/SEASON		2010-11	2011-12	2012-13	2013-14	2014-15	Average
KERALA							
Kharif	**A**	0.026	0.018	0.014	0.010	0.004	0.014
	P	0.030	0.025	0.019	0.009	0.006	0.018
	Y	1154	1389	1400	882	1686	1247
Rabi	**A**			0.018	0.016	0.008	0.014
	P			0.014	0.019	0.008	0.014
	Y			750	1228	964	972
Total	**A**	0.026	0.018	0.032	0.026	0.012	0.023
	P	0.030	0.025	0.032	0.028	0.014	0.026
	Y	1154	1389	1029	1092	1176	1145
MADHYA PRADESH							
Kharif	**A**	11.720	11.958	12.774	11.533	15.630	12.723
	P	4.278	5.105	7.829	5.986	10.190	6.678
	Y	365	427	613	519	652	525
Rabi	**A**	39.898	39.901	40.370	42.425	38.010	40.121
	P	29.584	36.514	43.829	40.457	36.859	37.449
	Y	741	915	1086	954	970	933
Total	**A**	51.618	51.859	53.144	53.958	53.640	52.844
	P	33.862	41.619	51.658	46.443	47.049	44.126
	Y	656	803	972	861	877	835
MAHARASHTRA							
Kharif	**A**	24.670	21.180	20.360	20.110	16.880	20.640
	P	17.378	14.100	14.080	14.920	8.745	13.845
	Y	704	666	692	742	518	671
Rabi	**A**	15.710	11.550	12.380	19.420	14.510	14.714
	P	13.620	8.580	8.980	16.770	8.630	11.316
	Y	867	743	725	864	595	769
Total	**A**	40.380	32.730	32.740	39.530	31.390	35.354
	P	30.998	22.680	23.060	31.690	17.375	25.161
	Y	768	693	704	802	554	712
MANIPUR							
Kharif	**A**	0.047	0.049	0.045	0.044		0.046
	P	0.052	0.052	0.046	0.045		0.049
	Y	1106	1061	1024	1007		1051
MEGHALAYA							
Kharif	**A**	0.016	0.014	0.008	0.011		0.012
	P	0.011	0.010	0.009	0.014		0.011
	Y	688	714	1152	1254		901
Rabi	**A**	0.028	0.028	0.028	0.018		0.026
	P	0.026	0.027	0.028	0.018		0.025

	Y	929	964	982	989		964
Total	**A**	0.044	0.042	0.036	0.029		0.038
	P	0.037	0.037	0.037	0.032		0.036
	Y	841	881	1019	1092		943

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE/SEASON		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
MIZORAM							
Kharif	**A**	0.024	0.021	0.020	0.024		0.022
	P	0.031	0.022	0.019	0.034		0.027
	Y	1292	1048	956	1412		1191
Rabi	**A**	0.015	0.017	0.011	0.014		0.014
	P	0.030	0.031	0.013	0.022		0.024
	Y	2000	1824	1264	1563		1701
Total	**A**	0.039	0.038	0.031	0.039		0.037
	P	0.061	0.053	0.033	0.057		0.051
	Y	1564	1395	1061	1468		1389
NAGALAND							
Kharif	**A**	0.154	0.150	0.194	0.172		0.167
	P	0.170	0.167	0.215	0.199		0.188
	Y	1104	1113	1109	1155		1121
Rabi	**A**	0.190	0.168	0.008	0.206		0.143
	P	0.194	0.180	0.006	0.227		0.152
	Y	1021	1071	842	1098		1061
Total	**A**	0.344	0.318	0.201	0.378		0.310
	P	0.364	0.347	0.221	0.425		0.339
	Y	1058	1091	1099	1124		1093
ODISHA							
Kharif	**A**	5.127	4.184	4.983	4.580	4.604	4.696
	P	2.517	1.960	2.629	2.448	2.486	2.408
	Y	491	468	528	534	540	513
Rabi	**A**	3.664	3.109	3.289	3.228	3.745	3.407
	P	1.752	1.475	1.615	1.745	1.917	1.701
	Y	478	474	491	541	512	499
Total	**A**	8.791	7.293	8.272	7.808	8.349	8.103
	P	4.269	3.435	4.244	4.193	4.403	4.109
	Y	486	471	513	537	527	507
PUNJAB							
Kharif	**A**	0.148	0.130	0.104	0.097	0.085	0.113
	P	0.118	0.090	0.083	0.074	0.067	0.086
	Y	797	692	798	763	788	766
Rabi	**A**	0.064	0.060	0.540	0.357	0.730	0.350
	P	0.075	0.060	0.447	0.322	0.662	0.313
	Y	1172	1000	828	902	907	894
Total	**A**	0.212	0.190	0.644	0.454	0.815	0.463

	P	0.193	0.150	0.530	0.396	0.729	0.400
	Y	910	789	823	872	894	863

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE/SEASON		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
RAJASTHAN							
Kharif	**A**	29.161	29.715	19.556	22.206	20.388	24.205
	P	16.036	13.133	6.367	7.930	9.630	10.619
	Y	550	442	326	357	472	439
Rabi	**A**	18.387	14.866	12.900	19.772	13.230	15.831
	P	16.561	11.188	13.201	16.979	9.874	13.561
	Y	901	753	1023	859	746	857
Total	**A**	47.548	44.581	32.456	41.978	33.618	40.036
	P	32.597	24.321	19.568	24.909	19.504	24.180
	Y	686	546	603	593	580	604
SIKKIM							
Kharif	**A**	0.067	0.065	0.064	0.063		0.065
	P	0.060	0.059	0.058	0.058		0.059
	Y	896	908	915	925		911
Rabi	**A**	0.065					0.065
	P	0.059					0.059
	Y	908					908
Total	**A**	0.132	0.065	0.064	0.063		0.081
	P	0.119	0.059	0.058	0.058		0.074
	Y	902	908	915	925		910
TAMILNADU							
Kharif	**A**	1.749	2.058	1.795	2.511	2.009	2.024
	P	0.823	1.355	0.903	1.655	1.494	1.246
	Y	471	658	503	659	744	615
Rabi	**A**	4.619	4.628	3.281	5.647	7.390	5.113
	P	1.637	2.338	1.196	4.483	4.978	2.926
	Y	354	505	365	794	674	572
Total	**A**	6.368	6.686	5.076	8.158	9.399	7.137
	P	2.460	3.693	2.099	6.138	6.472	4.172
	Y	386	552	414	752	689	585
TRIPURA							
Kharif	**A**	0.041	0.052	0.047	0.076		0.054
	P	0.028	0.034	0.031	0.052		0.036
	Y	683	654	670	682		673
Rabi	**A**	0.033	0.034	0.038	0.046		0.038
	P	0.024	0.026	0.028	0.036		0.029
	Y	727	765	748	779		757
Total	**A**	0.074	0.086	0.085	0.122		0.092

	P	0.052	0.060	0.060	0.087		0.065
	Y	703	698	705	719		707

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE/SEASON		2010-11	2011-12	2012-13	2013-14	2014-15	Average
UTTAR PRADESH							
Kharif	A	9.890	8.650	8.750	8.360	8.430	8.816
	P	7.430	6.890	6.920	5.050	4.640	6.186
	Y	751	797	791	604	550	702
Rabi	A	14.600	15.560	14.920	14.690	14.980	14.950
	P	12.940	17.140	16.400	11.924	9.832	13.647
	Y	886	1102	1099	812	656	913
Total	A	24.490	24.210	23.670	23.050	23.410	23.766
	P	20.370	24.030	23.320	16.974	14.472	19.833
	Y	832	993	985	736	618	835
UTTRAKHAND							
Kharif	A	0.378	0.390	0.437	0.476	0.450	0.426
	P	0.315	0.350	0.369	0.406	0.370	0.362
	Y	833	897	844	854	822	850
Rabi	A	0.235	0.160	0.173	0.175	0.210	0.190
	P	0.206	0.140	0.144	0.159	0.157	0.161
	Y	877	875	834	910	749	847
Total	A	0.613	0.550	0.610	0.650	0.660	0.617
	P	0.521	0.490	0.513	0.565	0.527	0.523
	Y	850	891	842	869	799	849
WEST BENGAL							
Kharif	A	0.483	0.472	0.549	1.040	0.654	0.640
	P	0.318	0.286	0.384	0.553	0.465	0.401
	Y	658	606	699	532	712	627
Rabi	A	1.480	1.378	1.470	1.827	1.810	1.593
	P	1.443	1.021	1.539	1.864	1.291	1.432
	Y	975	741	1047	1020	713	899
Total	A	1.963	1.850	2.019	2.867	2.464	2.233
	P	1.761	1.307	1.923	2.417	1.756	1.833
	Y	897	706	952	843	713	821
D & N. HAVELI							
Kharif	A	0.035	0.015	0.027	0.030		0.027
	P	0.028	0.012	0.022	0.024		0.021
	Y	800	800	799	803		801
Rabi	A	0.033	0.027	0.028	0.028		0.029
	P	0.033	0.028	0.028	0.028		0.029
	Y	1000	1037	1000	1000		1009
Total	A	0.068	0.042	0.055	0.058		0.056
	P	0.061	0.040	0.050	0.052		0.051
	Y	897	952	901	898		909

PONDICHERRY							
Rabi	A	0.026	0.024	0.016	0.012		0.019
	P	0.013	0.010	0.008	0.005		0.009
	Y	500	417	494	425		461

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE/SEASON		2010-11	2011-12	2012-13	2013-14	2014-15	Average
DELHI							
Kharif	A	0.004	0.004	0.003			0.004
	P	0.007	0.006	0.006			0.006
	Y	1750	1500	1774			1667
Rabi	A	0.001			0.000		0.001
	P	0.001			0.001		0.001
	Y	1000			1500		1143
Total	A	0.005	0.004	0.003	0.000		0.003
	P	0.008	0.006	0.006	0.001		0.005
	Y	1600	1500	1774	1500		1608
A & N. ISLANDS							
Kharif	A		0.002	0.001	0.000		0.001
	P		0.001	0.000	0.000		0.000
	Y		500	283	1500		531
Rabi	A	0.026	0.016	0.013	0.006		0.015
	P	0.012	0.009	0.006	0.003		0.008
	Y	462	563	508	483		500
Total	A	0.026	0.018	0.013	0.006		0.016
	P	0.012	0.010	0.007	0.003		0.008
	Y	462	556	499	517		501
ALL INDIA							
Kharif	**A**	**123.196**	**111.903**	**99.539**	**103.277**	**97.581**	**107.099**
	P	**71.201**	**60.578**	**59.157**	**59.934**	**56.224**	**61.419**
	Y	**578**	**541**	**594**	**580**	**576**	**573**
Rabi	**A**	**140.821**	**132.719**	**133.029**	**148.853**	**133.399**	**137.764**
	P	**111.208**	**110.311**	**124.268**	**132.595**	**116.630**	**119.002**
	Y	**790**	**831**	**934**	**891**	**874**	**864**
Total	**A**	**264.017**	**244.622**	**232.568**	**252.130**	**230.980**	**244.863**
	P	**182.409**	**170.889**	**183.425**	**192.529**	**172.854**	**180.421**
	Y	**691**	**699**	**789**	**764**	**748**	**737**

ANNEXURE-II

STATE-WISE YEAR WISE AREA, PRODUCTION AND YIELD TUR

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		2010-11	2011-12	2012-13	2013-14	2014-15	Average
A.P	A	6.388	4.820	4.790	4.480	3.720	4.840
	P	2.650	1.460	2.510	2.430	1.830	2.176
	Y	415	303	524	542	492	450
ARUNACHAL PRADESH	A	0.006	0.007	0.049	0.050		0.028
	P	0.005	0.006	0.048	0.050		0.027
	Y	833	857	968	1000		968
ASSAM	A	0.071	0.057	0.060	0.061	0.060	0.062
	P	0.051	0.041	0.049	0.056	0.050	0.050
	Y	718	719	829	920	833	802
BIHAR	A	0.260	0.221	0.221	0.219	0.228	0.230
	P	0.365	0.335	0.471	0.365	0.326	0.372
	Y	1404	1516	2131	1667	1428	1620
CHATTISGARH	A	0.550	0.541	0.521	0.509	0.531	0.530
	P	0.242	0.234	0.323	0.312	0.338	0.290
	Y	440	433	620	613	637	546
GUJARAT	A	2.770	2.440	2.280	2.100	2.290	2.376
	P	2.730	2.570	2.700	2.090	2.580	2.534
	Y	986	1053	1184	995	1127	1066
HARYANA	A	0.250	0.180	15.100	9.400	0.060	4.998
	P	0.270	0.200	16.400	11.000	0.065	5.587
	Y	1080	1111	1086	1170	1083	1118
JHARKHAND	A	1.038	1.139	1.957	1.968	1.959	1.612
	P	0.712	1.030	2.024	2.052	1.995	1.563
	Y	686	904	1034	1042	1018	969
KARNATAKA	A	8.910	7.670	6.600	8.240	7.280	7.740
	P	5.290	3.540	3.663	5.875	4.790	4.632
	Y	594	462	555	713	658	598
KERALA	A	0.020	0.015	0.012	0.089	0.003	0.028
	P	0.030	0.025	0.019	0.080	0.005	0.032
	Y	1500	1667	1588	899	1885	1147
MADHYA PRD.	A	4.875	5.349	5.305	4.640	5.210	5.076
	P	1.645	3.342	3.510	3.320	5.110	3.385
	Y	337	625	662	716	981	667
MAHARASHTRA	A	13.020	12.330	11.800	11.410	10.370	11.786
	P	9.760	8.710	9.660	10.340	6.645	9.023

	Y	750	706	819	906	641	766
MEGHALAYA	**A**	0.008	0.008	0.008	0.011		0.009
	P	0.006	0.006	0.009	0.014		0.009
	Y	750	750	1152	1254		1003

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
NAGALAND	**A**	0.025	0.025	2.880	2.970		1.475
	P	0.021	0.022	2.590	2.660		1.323
	Y	840	880	899	896		897
ODISHA	**A**	1.354	1.421	1.409	1.389	1.379	1.390
	P	1.240	1.154	1.285	1.244	1.238	1.232
	Y	916	812	912	896	898	886
PUNJAB	**A**	0.042	0.030	3.100	2.900	0.026	1.220
	P	0.039	0.030	2.800	2.600	0.024	1.099
	Y	929	1000	903	897	923	901
RAJASTHAN	**A**	0.213	0.191	16.820	14.490	0.132	6.369
	P	0.162	0.127	14.790	9.410	0.097	4.917
	Y	761	665	879	649	735	772
TAMILNADU	**A**	0.358	0.360	39.630	59.640	0.807	20.159
	P	0.237	0.313	31.120	57.670	0.828	18.034
	Y	662	869	785	967	1026	895
TRIPURA	**A**	0.012	0.016	1.500	3.850		1.345
	P	0.009	0.012	1.124	2.760		0.976
	Y	750	750	749	717		726
UTTAR PRADESH	**A**	3.440	3.200	3.110	3.010	2.870	3.126
	P	3.090	3.340	3.250	2.710	1.740	2.826
	Y	898	1044	1045	900	606	904
UTTARAKHAND	**A**	0.017	0.020	0.030	0.034	0.040	0.028
	P	0.012	0.020	0.024	0.027	0.030	0.023
	Y	706	1000	799	810	750	805
WEST BENGAL	**A**	0.016	0.013	0.014	0.015	0.018	0.015
	P	0.022	0.005	0.021	0.021	0.027	0.019
	Y	1375	385	1434	1429	1500	1257
A & N ISLAND	**A**		0.002	0.005	0.000		0.003
	P		0.001	0.002	0.000		0.001
	Y		286	283	1500		316
DADAR & NAGAR HAVELI	**A**	0.020	0.015	0.013	0.016		0.016
	P	0.016	0.012	0.011	0.013		0.013
	Y	800	800	800	804		801
DELHI	**A**	0.004	0.003	0.003			0.003
	P	0.007	0.006	0.005			0.006
	Y	1750	2000	1724			1818

ALL INDIA	**A**	**43.667**	**40.074**	**38.929**	**39.049**	**37.078**	**39.759**
	P	**28.611**	**26.541**	**30.227**	**31.744**	**27.793**	**28.983**
	Y	**655**	**662**	**776**	**813**	**750**	**729**

ANNEXURE-III

STATE-WISE YEAR WISE AREA, PRODUCTION AND YIELD GRAM

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
ANDHRA PRADESH	**A**	5.840	5.650	6.810	5.860	4.010	5.634
	P	7.200	5.200	7.620	8.430	4.610	6.612
	Y	1233	920	1119	1439	1150	1174
ASSAM	**A**	0.018	0.018	0.017	0.021		0.018
	P	0.009	0.009	0.010	0.014		0.011
	Y	500	500	557	698		568
BIHAR	**A**	0.508	0.593	0.615	0.613	0.627	0.591
	P	0.603	0.768	0.862	0.703	0.608	0.709
	Y	1187	1295	1402	1147	969	1199
CHHATTISGARH	**A**	2.519	2.416	2.668	2.765	2.806	2.635
	P	2.415	2.404	2.852	2.132	2.904	2.541
	Y	959	995	1069	771	1035	965
GUJARAT	**A**	1.760	2.400	1.720	2.470	1.700	2.010
	P	2.000	2.730	1.682	3.090	1.920	2.284
	Y	1136	1138	978	1251	1129	1137
HARYANA	**A**	1.120	0.790	0.470	0.830	0.670	0.776
	P	1.100	0.720	0.530	0.750	0.440	0.708
	Y	982	911	1128	904	657	912
H. PRADESH	**A**	0.006	0.007	0.005	0.005	0.005	0.006
	P	0.006	0.007	0.005	0.005	0.005	0.006
	Y	1000	1000	1021	1000	1060	1014
JAMMU & KASHMIR	**A**	0.002	0.001	0.017			0.007
	P	0.001	0.001	0.009			0.004
	Y	500	1000	542			561
JHARKHAND	**A**	0.699	1.275	1.383	1.558	1.607	1.304
	P	0.735	1.360	1.623	1.817	1.864	1.480
	Y	1052	1067	1174	1166	1160	1134
KARNATAKA	**A**	9.590	8.030	9.690	9.460	9.450	9.244
	P	6.310	4.681	6.230	7.160	7.690	6.414
	Y	658	583	643	757	814	694
KERELA	**A**					0.006	0.006
	P					0.005	0.005
	Y					897	897
MADHYA PRD.	**A**	31.121	30.437	31.287	31.601	28.530	30.595
	P	26.866	32.903	38.124	32.991	29.640	32.105
	Y	863	1081	1219	1044	1039	1049

MAHARASHTRA	**A**	14.380	10.510	11.200	18.200	13.480	13.554
	P	13.000	8.150	8.540	16.220	8.290	10.840
	Y	904	775	763	891	615	800
MANIPUR	**A**			0.007	0.020		0.013
	P			0.006	0.018		0.012
	Y			985	875		902

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
MEGHALAYA	**A**	0.006	0.006	0.054	0.018		0.021
	P	0.003	0.004	0.033	0.018		0.014
	Y	500	667	611	989		688
NAGALAND	**A**	0.007	0.008	0.076	0.074		0.041
	P	0.005	0.005	0.064	0.062		0.034
	Y	714	625	842	838		824
ODISHA	**A**	0.419	0.390	0.412	0.472	0.476	0.434
	P	0.327	0.298	0.319	0.362	0.366	0.335
	Y	780	764	774	768	770	771
PUNJAB	**A**	0.021	0.020	0.020	0.019	0.020	0.020
	P	0.027	0.020	0.028	0.023	0.030	0.026
	Y	1286	1000	1400	1211	1500	1280
RAJASTHAN	**A**	17.833	14.339	12.529	19.235	12.563	15.300
	P	16.007	10.611	12.774	16.404	9.104	12.980
	Y	898	740	1019	853	725	848
TAMILNADU	**A**	0.073	0.086	0.070	0.089	0.063	0.076
	P	0.049	0.055	0.045	0.058	0.041	0.050
	Y	671	640	645	653	647	651
TRIPURA	**A**	0.003	0.002	0.016	0.013		0.009
	P	0.002	0.001	0.013	0.010		0.006
	Y	667	500	774	787		754
UTTAR PRADESH	**A**	5.700	5.770	6.040	5.770	5.580	5.772
	P	5.300	6.840	6.760	4.755	3.812	5.493
	Y	930	1185	1119	824	683	952
UTTRAKHAND	**A**	0.005	0.010	0.053	0.084	0.010	0.032
	P	0.004	0.010	0.044	0.066	0.007	0.026
	Y	800	1000	830	786	720	810
WEST BENGAL	**A**	0.221	0.233	0.251	0.249	0.270	0.245
	P	0.237	0.244	0.296	0.293	0.320	0.278
	Y	1072	1047	1175	1176	1185	1135
DADAR & NAGAR HAVELI	**A**	0.004	0.001	0.173	0.170		0.087
	P	0.004	0.001	0.173	0.170		0.087
	Y	1000	1000	1000	1000		1000
DELHI	**A**	0.008	0.001		0.040	0.041	0.022
	P	0.007	0.007		0.060	0.042	0.029

	Y	882	7000		1500	1029	1293
ALL INDIA	**A**	**91.865**	**82.990**	**85.218**	**99.274**	**81.914**	**88.252**
	P	**82.211**	**77.023**	**88.325**	**95.263**	**71.699**	**82.904**
	Y	**895**	**928**	**1036**	**960**	**875**	**939**

ANNEXURE-IV

STATE-WISE YEAR WISE AREA, PRODUCTION AND YIELD LENTIL

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		2010-11	2011-12	2012-13	2013-14	2014-15	Average
ASSAM	**A**	0.239	0.230	0.289	0.300	0.300	0.272
	P	0.118	0.115	0.170	0.224	0.224	0.170
	Y	494	500	588	747	747	627
BIHAR	**A**	2.386	1.685	1.597	1.541	1.541	1.750
	P	2.147	1.716	1.832	1.961	1.961	1.923
	Y	900	1018	1147	1273	1272	1099
CHHATTISGARH	**A**	0.139	0.149	0.129	0.149	0.149	0.143
	P	0.042	0.050	0.042	0.049	0.049	0.046
	Y	302	336	326	329	329	324
HARYANA	**A**	0.033	0.050	0.064	0.044	0.044	0.047
	P	0.026	0.040	0.052	0.049	0.049	0.043
	Y	788	800	813	1114	1114	919
HIMACHAL PRADESH	**A**	0.061	0.063	0.067	0.058	0.006	0.051
	P	0.035	0.052	0.044	0.040	0.004	0.035
	Y	583	825	657	690	690	689
JAMMU & KASHMIR	**A**	0.056	0.046	0.041	0.044	0.004	0.038
	P	0.032	0.028	0.026	0.034	0.003	0.025
	Y	563	613	642	773	773	645
JHARKHAND	**A**	0.209	0.487	0.408	0.440	0.440	0.397
	P	0.172	0.409	0.457	0.365	0.365	0.354
	Y	823	840	1120	830	831	891
MADHYA PRD.	**A**	5.905	6.205	5.705	5.301	5.301	5.683
	P	1.774	2.300	3.334	3.383	3.383	2.835
	Y	300	371	584	638	638	499
MAHARASHTRA	**A**	0.040	0.031	0.035			0.035
	P	0.020	0.014	0.014			0.016
	Y	500	452	400			453
PUNJAB	**A**	0.011	0.010	0.070	0.100	0.010	0.040
	P	0.007	0.010	0.050	0.060	0.006	0.027
	Y	636	1000	714	600	600	662
RAJASTHAN	**A**	0.441	0.319	0.276	0.343	0.343	0.344
	P	0.384	0.359	0.304	0.292	0.292	0.326
	Y	871	1125	1101	851	851	947
TRIPURA	**A**	0.004	0.004	0.048	0.186	0.019	0.052
	P	0.002	0.003	0.032	0.128	0.013	0.036
	Y	500	750	667	688	688	682
UTTAR PRADESH	**A**	5.860	5.730	4.950	4.490	4.490	5.104
	P	4.110	5.050	4.410	3.100	3.100	3.954
	Y	701	881	891	690	690	775
UTTARANCHAL	**A**	0.122	0.120	0.118	0.111	0.111	0.116
	P	0.090	0.100	0.096	0.099	0.099	0.097

	Y	738	833	814	892	887	831
WEST BENGAL	**A**	0.574	0.593	0.640	0.655	0.655	0.623
	P	0.534	0.412	0.615	0.628	0.628	0.563
	Y	930	695	961	959	959	904
ALL INDIA	**A**	**15.974**	**15.624**	**14.234**	**13.412**	**13.412**	**14.531**
	P	**9.438**	**10.587**	**11.34**	**10.175**	**10.175**	**10.343**
	Y	**591**	**678**	**797**	**759**	**759**	**712**

ANNEXURE-V

STATE-WISE YEAR WISE AREA, PRODUCTION AND YIELD MOTH

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
GUJARAT	**A**	0.220	0.460	0.140	0.300	0.300	0.284
	P	0.130	0.230	0.050	0.150	0.150	0.142
	Y	591	500	357	500	500	500
HARYANA	**A**	0.080	0.010	0.240	0.030	0.003	0.073
	P	0.030	0.004	0.070	0.009	0.001	0.023
	Y	375	400	292	300	300	314
HIMACHAL PRD.	**A**	0.013	0.011	0.026	0.002	0.000	0.010
	P	0.018	0.019	0.052	0.007	0.001	0.019
	Y	1385	1727	2037	2958	2958	1856
JAMMU & KASHMIR	**A**	0.037	0.078	0.081	0.028	0.028	0.050
	P	0.021	0.023	0.026	0.019	0.019	0.022
	Y	564	300	319	684	684	429
MAHARASHTRA	**A**	0.220					0.220
	P	0.074					0.074
	Y	336					336
RAJASTHAN	**A**	15.934	13.182	8.639	9.273	9.273	11.260
	P	7.747	4.472	2.362	2.874	2.874	4.066
	Y	486	339	273	310	310	361
ALL INDIA TOTAL	**A**	16.504	13.741	8.910	9.604	9.604	11.673
	P	8.020	4.748	2.497	3.044	3.044	4.271
	Y	**486**	**346**	**280**	**317**	**317**	**366**

ANNEXURE-VI

STATE-WISE YEAR WISE AREA, PRODUCTION AND YIELD LATHYRUS

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		2010-11	2011-12	2012-13	2013-14	2014-15	Average
BIHAR	**A**	0.738	0.728	0.711	0.632	0.632	0.688
	P	0.737	0.921	0.838	0.706	0.706	0.781
	Y	999	1265	1179	1116	1116	1135
CHHATISGARH	**A**	3.493	3.076	4.170	3.087	3.087	3.383
	P	2.124	1.723	2.707	1.760	1.760	2.015
	Y	608	560	649	570	570	596
MADHYA PRADESH	**A**	0.482	0.504	0.434			0.473
	P	0.274	0.338	0.359			0.324
	Y	568	671	827			684
MAHARASHTRA	**A**	0.240	0.188	0.213			0.214
	P	0.080	0.055	0.057			0.064
	Y	333	293	267			299
WEST BENGAL	**A**	0.258	0.258	0.285	0.307	0.307	0.283
	P	0.302	0.154	0.353	0.381	0.381	0.314
	Y	1171	597	1239	1241	1241	1110
ALL INDIA	**A**	5.211	4.754	5.813	4.027	4.027	4.766
	P	3.517	3.191	4.314	2.847	2.847	3.343
	Y	**675**	**671**	**742**	**707**	**707**	**701**

ANNEXURE-VII

STATE-WISE YEAR WISE AREA, PRODUCTION AND YIELD FIELD PEAS

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		2010-11	2011-12	2012-13	2013-14	2014-15	Average
ASSAM							
Rabi	**A**	0.224	0.218	0.310	0.313	0.300	0.273
	P	0.138	0.133	0.198	0.265	0.277	0.202
	Y	616	610	640	848	924	742
BIHAR							
Rabi	**A**	0.200	0.187	0.185	0.173	0.221	0.193
	P	0.210	0.192	0.193	0.184	0.182	0.192
	Y	1050	1027	1041	1060	824	994
CHHATTISGARH							
Rabi	**A**	0.148	0.155	0.147	0.145	0.170	0.153
	P	0.050	0.054	0.055	0.053	0.103	0.063
	Y	338	348	374	366	602	411
HARYANA							
Rabi	**A**	0.021	0.010				0.016
	P	0.019	0.020				0.020
	Y	905	2000				1258
HIMACHAL PRADESH							
Rabi	**A**	0.129	0.099	0.108	0.119	0.115	0.114
	P	0.278	0.173	0.299	0.410	0.274	0.287
	Y	2155	1747	2773	3450	2376	2516
JAMMU & KASHMIR							
Rabi	**A**	0.003	0.002	0.020	0.021	0.022	0.013
	P	0.001	0.001	0.012	0.017	0.019	0.010
	Y	333	500	612	849	859	750
JHARKHAND							
Rabi	**A**	0.362	0.390	0.303	0.317	0.333	0.341
	P	0.342	0.443	0.549	0.376	0.404	0.423
	Y	945	1136	1812	1186	1212	1240
KERALA							
Kharif	**A**					0.003	0.003
	P					0.003	0.003
	Y					1115	1115
Rabi	**A**			0.018	0.015		0.017
	P			0.014	0.013		0.014
	Y			778	867		818

Total	A			0.018	0.015		0.017
	P			0.014	0.013		0.014
	Y			778	867		818
MADHYA PRADESH							
Rabi	A	2.265	2.639	2.809	3.071	3.555	2.868
	P	0.625	0.942	1.948	2.951	3.629	2.019
	Y	276	357	693	961	1021	704

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
MAHARASHTRA							
Rabi	A	0.330	0.258	0.293		0.263	0.286
	P	0.117	0.118	0.121		0.096	0.113
	Y	355	457	413		366	395
MANIPUR							
Kharif	A	0.008	0.009		0.016	0.181	0.053
	P	0.011	0.011		0.016	0.172	0.052
	Y	1375	1222		1013	948	980
ODISHA							
Rabi	A				1.353		1.353
	P				0.804		0.804
	Y				594		594
PUNJAB							
Rabi	A	0.032	0.030	0.017	0.008	0.022	0.022
	P	0.041	0.030	0.022	0.013	0.026	0.026
	Y	1281	1000	1294	1625	1182	1211
RAJASTHAN							
Rabi	A	0.113	0.027	0.027	0.136	0.170	0.095
	P	0.116	0.047	0.059	0.228	0.309	0.152
	Y	1027	1741	2162	1682	1817	1605
TRIPURA							
Rabi	A	0.006		0.010	0.010	0.020	0.012
	P	0.005		0.008	0.009	0.018	0.010
	Y	833		800	900	882	862
UTTAR PRADESH							
Rabi	A	3.040	3.230	3.070	3.570	4.160	3.414
	P	3.530	4.630	4.590	3.540	3.140	3.886
	Y	1161	1433	1495	992	755	1138
UTTRANCHAL							
RABI	A	0.105	0.030	0.049	0.055	0.078	0.063
	P	0.011	0.030	0.044	0.054	0.076	0.043
	Y	105	1000	896	982	968	676
WEST BENGAL							
Rabi	A	0.116	0.121	0.124	0.127	0.141	0.126
	P	0.136	0.100	0.140	0.150	0.168	0.139
	Y	1172	826	1128	1186	1189	1104
ALL INDIA							
Kharif	**A**	**0.022**	**0.023**				**0.023**
	P	**0.032**	**0.032**				**0.032**

	Y	**1455**	**1391**				**1422**
Rabi	**A**	**7.250**	**7.565**	**7.651**	**9.612**	**9.754**	**8.366**
	P	**5.900**	**7.059**	**8.408**	**9.229**	**8.893**	**7.898**
	Y	**814**	**933**	**1099**	**960**	**912**	**944**
Total	**A**	**7.272**	**7.588**	**7.651**	**9.612**	**9.754**	**8.375**
	P	**5.932**	**7.091**	**8.408**	**9.229**	**8.893**	**7.911**
	Y	**816**	**935**	**1099**	**960**	**912**	**945**

ANNEXURE-VIII

STATE-WISE YEAR WISE AREA, PRODUCTION AND YIELD KULTHI

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		2010-11	2011-12	2012-13	2013-14	2014-15	Average
ANDHRA PRADESH							
Kharif	**A**	0.060	0.060	0.050	0.100	0.110	0.076
	P	0.030	0.030	0.030	0.050	0.050	0.038
	Y	500	500	600	500	455	500
Rabi	**A**	0.310	0.250	0.270	0.210	0.250	0.258
	P	0.130	0.110	0.160	0.110	0.110	0.124
	Y	419	440	593	524	440	481
Total	**A**	0.370	0.310	0.320	0.310	0.360	0.334
	P	0.160	0.140	0.190	0.160	0.160	0.162
	Y	432	452	594	516	444	485
BIHAR							
Kharif	**A**	0.099	0.086	0.080	0.082	0.083	0.086
	P	0.097	0.082	0.078	0.078	0.080	0.083
	Y	980	953	968	951	957	962
CHHATTISGARH							
Kharif	**A**	0.473	0.480	0.431	0.464	0.490	0.468
	P	0.135	0.142	0.135	0.144	0.155	0.142
	Y	285	296	313	310	316	304
Rabi	**A**	0.019	0.022	0.017	0.048	0.056	0.032
	P	0.005	0.007	0.005	0.011	0.021	0.010
	Y	263	318	294	229	378	304
Total	**A**	0.492	0.502	0.448	0.512	0.546	0.500
	P	0.140	0.149	0.140	0.155	0.176	0.152
	Y	285	297	313	303	323	304
HARYANA							
Kharif	**A**			0.007		0.004	0.006
	P			0.002		0.002	0.002
	Y			286		500	364
HIMACHAL PRADESH							
Kharif	**A**	0.022	0.021	0.020	0.018	0.015	0.019
	P	0.011	0.012	0.009	0.008	0.007	0.009
	Y	500	571	430	417	429	474

J AMMU & KASHMIR							
Kharif	**A**	0.010	0.021	0.022	0.006	0.008	0.013
	P	0.003	0.003	0.004	0.002	0.001	0.003
	Y	300	143	182	333	167	199
JHARKHAND							
Kharif	**A**	0.209	0.162	0.122	0.247	0.323	0.213
	P	0.172	0.098	0.072	0.150	0.223	0.143
	Y	823	605	590	609	691	673

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
KARNATAKA							
Kharif	**A**	0.880	0.660	0.640	0.600	0.580	0.672
	P	0.510	0.350	0.260	0.280	0.270	0.334
	Y	580	530	406	467	466	497
Rabi	**A**	1.330	1.140	1.420	1.030	1.230	1.230
	P	0.830	0.570	0.540	0.590	0.600	0.626
	Y	624	500	380	573	488	509
Total	**A**	2.210	1.800	2.060	1.630	1.810	1.902
	P	1.340	0.920	0.800	0.870	0.870	0.960
	Y	606	511	388	534	481	505
MADHYA PRADESH							
Kharif	**A**		0.201	0.158	0.117	0.250	0.182
	P		0.049	0.048	0.058	0.100	0.064
	Y		244	304	496	400	351
Rabi	**A**	0.004	0.002	0.0015			0.003
	P	0.001	0.001	0.0005			0.001
	Y	250	500	333			333
Total	**A**	0.004	0.203	0.160	0.117		0.121
	P	0.001	0.050	0.049	0.058		0.039
	Y	250	246	304	496		326
MAHARASHTRA							
Kharif	**A**	0.190					0.190
	P	0.085					0.085
	Y	447					447
Rabi	**A**	0.150	0.117	0.133		0.120	0.130
	P	0.060	0.042	0.043		0.034	0.045
	Y	400	359	320		284	344
Total	**A**	0.340	0.117	0.133		0.120	0.177
	P	0.145	0.042	0.043		0.034	0.066
	Y	426	359	320		284	371
ODISHA							
Kharif	**A**	0.690	0.442	0.483	0.421	0.382	0.483
	P	0.221	0.107	0.175	0.150	0.132	0.157

	Y	320	242	362	357	344	325
Rabi	**A**	0.004		0.003	0.003	0.001	0.003
	P	0.004		0.001	0.001	0.000	0.002
	Y	1000		333	333	333	571
Total	**A**	0.694	0.442	0.486	0.424	0.384	0.486
	P	0.225	0.107	0.176	0.151	0.132	0.158
	Y	324	242	362	357	344	326

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
TAMILNADU							
Kharif	**A**	0.147	0.217	0.1421	0.1373	0.139	0.157
	P	0.084	0.117	0.0572	0.0856	0.106	0.090
	Y	571	539	403	623	760	575
Rabi	**A**	0.326	0.473	0.483	0.75	0.781	0.563
	P	0.133	0.255	0.192	0.483	0.577	0.328
	Y	408	539	398	644	739	583
Total	**A**	0.473	0.690	0.625	0.887	0.921	0.719
	P	0.217	0.372	0.249	0.569	0.683	0.418
	Y	459	539	399	641	742	581
UTTARAKHAND	**A**	0.128	0.120	0.133	0.151	0.143	0.135
	P	0.104	0.100	0.107	0.119	0.116	0.109
	Y	813	833	806	788	810	809
WEST BENGAL							
Rabi	**A**	0.024		0.025	0.030	0.030	0.027
	P	0.012		0.013	0.015	0.015	0.014
	Y	500		520	500	500	505
ALL INDIA							
Kharif	**A**	**2.908**	**2.470**	**2.288**	**2.343**	**2.529**	**2.508**
	P	**1.453**	**1.090**	**0.976**	**1.125**	**1.241**	**1.177**
	Y	**500**	**441**	**427**	**480**	**491**	**469**
Rabi	**A**	**2.167**	**2.005**	**2.350**	**2.069**	**2.489**	**2.216**
	P	**1.175**	**0.985**	**0.953**	**1.212**	**1.368**	**1.139**
	Y	**542**	**491**	**406**	**586**	**550**	**514**
Total	**A**	**5.075**	**4.475**	**4.638**	**4.412**	**5.017**	**4.723**
	P	**2.628**	**2.075**	**1.929**	**2.337**	**2.609**	**2.316**
	Y	**518**	**464**	**416**	**530**	**520**	**490**

ANNEXURE-IX

STATE-WISE YEAR WISE AREA, PRODUCTION AND YIELD MUNGBEAN

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		2010-11	2011-12	2012-13	2013-14	2014-15	Average
A.P							
Kharif	**A**	2.610	1.520	1.510	1.280	0.810	1.546
	P	1.220	0.820	1.070	0.830	0.450	0.878
	Y	467	539	709	648	556	568
Rabi	**A**	1.170	1.310	1.270	1.320	1.780	1.370
	P	0.440	0.800	0.870	0.870	1.219	0.840
	Y	376	611	685	659	685	613
Total	**A**	3.780	2.830	2.780	2.600	2.590	2.916
	P	1.660	1.620	1.940	1.700	1.669	1.718
	Y	439	572	698	654	645	589
ASSAM							
RABI	**A**	0.090	0.074	0.101	0.122	0.180	0.113
	P	0.041	0.034	0.059	0.078	0.120	0.066
	Y	456	459	587	641	667	586
BIHAR							
Kharif	**A**	0.091	0.078	0.088	0.091	0.106	0.091
	P	0.059	0.047	0.072	0.074	0.074	0.065
	Y	648	603	812	805	693	714
Summer	**A**	1.634	1.473	1.476	1.459	1.474	1.503
	P	0.982	0.884	0.921	0.980	0.996	0.953
	Y	601	600	624	672	676	634
Total	**A**	1.725	1.551	1.564	1.550	1.580	1.594
	P	1.041	0.931	0.993	1.054	1.070	1.018
	Y	603	600	635	680	677	638
CHHATTISGARH							
Kharif	**A**	0.093	0.092	0.108	0.085	0.085	0.093
	P	0.026	0.024	0.033	0.025	0.025	0.027
	Y	280	261	306	294	294	287
Rabi	**A**	0.065	0.073	0.068	0.058	0.064	0.066
	P	0.015	0.017	0.016	0.013	0.014	0.015
	Y	231	233	235	224	219	229
Total	**A**	0.158	0.165	0.176	0.143	0.149	0.158
	P	0.041	0.041	0.049	0.038	0.039	0.042
	Y	259	248	278	266	262	263
GUJARAT							

Kharif	**A**	1.770	2.000	0.920	1.280	0.810	1.356
	P	0.890	0.880	0.400	0.670	0.370	0.642
	Y	503	440	435	523	457	473
Rabi	**A**	1.020	0.660	0.230	0.550	0.440	0.580
	P	0.620	0.330	0.110	0.390	0.220	0.334
	Y	608	500	478	709	500	576
Total	**A**	2.790	2.660	1.150	1.830	1.250	1.936
	P	1.510	1.210	0.510	1.060	0.590	0.976
	Y	541	455	443	579	472	504

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
HARYANA							
Kharif	**A**	0.220	0.100	0.153	0.068	0.060	0.120
	P	0.120	0.040	0.077	0.034	0.030	0.060
	Y	545	400	503	500	500	501
Rabi	**A**		0.560	0.730	0.470		0.587
	P		0.200	0.460	0.300		0.320
	Y		357	630	638		545
Total	**A**	0.220	0.660	0.883	0.538	0.060	0.472
	P	0.120	0.240	0.537	0.334	0.030	0.252
	Y	545	364	608	621	500	534
HIMACHAL PRDADESH							
Kharif	**A**	0.004	0.003	0.003	0.003	0.003	0.003
	P	0.002	0.001	0.001	0.001	0.001	0.001
	Y	500	333	478	323	300	393
JAMMU & KASHMIR							
Kharif	**A**	0.010	0.015	0.016	0.012	0.014	0.013
	P	0.004	0.009	0.008	0.008	0.004	0.007
	Y	400	600	532	650	252	490
JHARKHAND							
Kharif	**A**	0.469	0.147	0.275	0.161	0.193	0.249
	P	0.235	0.096	0.173	0.103	0.152	0.152
	Y	501	653	631	637	786	609
KARNATAKA							
Kharif	**A**	3.910	2.840	1.690	3.140	2.570	2.830
	P	1.080	0.700	0.510	0.790	0.520	0.720
	Y	276	246	302	252	202	254
Rabi	**A**	0.110	0.090	0.060	0.060	0.060	0.076
	P	0.030	0.030	0.010	0.020	0.020	0.022
	Y	273	333	167	333	333	289
Total	**A**	4.020	2.930	1.750	3.200	2.630	2.906
	P	1.110	0.730	0.520	0.810	0.540	0.742
	Y	276	249	297	253	205	255
MADHYA PRD.							
Kharif	**A**	0.958	0.846	0.839	0.895	1.550	1.018

	P	0.343	0.213	0.396	0.403	0.700	0.411
	Y	358	252	472	450	452	404
Rabi	**A**	0.033	0.037	0.038	2.269	1.060	0.687
	P	0.007	0.008	0.013	1.058	0.543	0.326
	Y	212	216	342	466	513	474
Total	**A**	0.991	0.883	0.877	3.164	2.610	1.705
	P	0.350	0.221	0.409	1.461	1.243	0.737
	Y	353	250	466	462	476	432

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
MAHARASHTRA							
Kharif	**A**	5.540	4.330	4.310	4.310	3.190	4.336
	P	3.720	2.540	2.110	2.080	0.890	2.268
	Y	671	587	490	483	279	523
Rabi	**A**	0.040	0.031	0.035			0.035
	P	0.020	0.014	0.014			0.016
	Y	500	452	400			453
Total	**A**	5.580	4.361	4.345	4.310	3.190	4.357
	P	3.740	2.554	2.124	2.080	0.890	2.278
	Y	670	586	489	483	279	523
ORISSA							
Kharif	**A**	1.039	0.667	1.213	1.148	1.198	1.053
	P	0.239	0.138	0.334	0.322	0.348	0.276
	Y	230	207	276	280	290	262
Rabi	**A**	1.842	1.471	1.593	1.372	1.825	1.621
	P	0.613	0.476	0.543	0.565	0.703	0.580
	Y	333	324	341	412	386	358
Total	**A**	2.881	2.138	2.806	2.520	3.023	2.674
	P	0.852	0.614	0.877	0.887	1.051	0.856
	Y	296	287	313	352	348	320
PUNJAB							
Kharif	**A**	0.078	0.070	0.051	0.046	0.037	0.056
	P	0.063	0.050	0.045	0.038	0.031	0.045
	Y	808	714	882	826	838	805
Rabi	**A**					0.650	0.650
	P					0.555	0.555
	Y					854	854
Total	**A**					0.687	0.687
	P					0.586	0.586
	Y					853	853
RAJASTHAN							
Kharif	**A**	10.500	12.722	7.902	10.200	8.940	10.053

	P	6.525	6.472	2.343	3.912	4.606	4.772
	Y	621	509	297	384	515	475
Rabi	**A**					0.036	0.036
	P					0.040	0.040
	Y					1106	1106
Total	**A**					8.975	8.975
	P					4.645	4.645
	Y					518	518

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
TAMILNADU							
Kharif	**A**	0.279	0.272	0.253	0.250	0.228	0.256
	P	0.178	0.194	0.066	0.141	0.130	0.142
	Y	638	713	261	563	571	553
Rabi	**A**	1.437	1.369	0.929	1.703	2.098	1.507
	P	0.399	0.657	0.270	1.373	1.704	0.881
	Y	278	480	290	807	812	584
Total	**A**	1.716	1.641	1.182	1.953	2.326	1.764
	P	0.577	0.851	0.336	1.514	1.834	1.022
	Y	336	519	284	775	788	580
TRIPURA							
Kharif	**A**	0.005	0.005	0.004	0.006		0.005
	P	0.002	0.003	0.002	0.003		0.003
	Y	400	600	538	540		520
Rabi	**A**	0.002	0.003	0.003	0.003		0.003
	P	0.001	0.002	0.002	0.002		0.002
	Y	500	667	571	593		590
Total	**A**	0.007	0.008	0.007	0.009		0.008
	P	0.003	0.005	0.004	0.005		0.004
	Y	429	625	552	556		544
UTTAR PRADESH							
Kharif	**A**	0.890	0.380	0.400	0.380	0.370	0.484
	P	0.620	0.160	0.200	0.120	0.120	0.244
	Y	697	421	500	316	324	504
Summer	**A**		0.350	0.380	0.410	0.410	0.388
	P		0.300	0.310	0.270	0.270	0.288
	Y		857	816	659	659	742
Total	**A**	0.890	0.730	0.780	0.790	0.780	0.794
	P	0.620	0.460	0.510	0.390	0.390	0.474
	Y	697	630	654	494	500	597
WEST BENGAL							
Kharif	**A**	0.009	0.008	0.015	0.010	0.010	0.010

	P	0.006	0.006	0.014	0.008	0.009	0.009
	Y	667	750	933	837	900	834
Rabi	**A**	0.168	0.173	0.0198	0.3245	0.255	0.188
	P	0.116	0.111	0.014	0.28	0.207	0.146
	Y	690	642	707	863	812	774
Total	**A**	0.177	0.181	0.035	0.334	0.265	0.198
	P	0.122	0.117	0.028	0.288	0.216	0.154
	Y	689	646	805	862	815	777

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
PONDICHERRY							
RABI	**A**	0.015	0.013	0.009	0.0059		0.011
	P	0.007	0.005	0.0027	0.0024		0.004
	Y	467	385	300	407		399
ALL INDIA							
Kharif	**A**	**28.476**	**26.094**	**19.749**	**23.38**	**20.192**	**23.578**
	P	**15.332**	**12.392**	**7.855**	**9.576**	**8.474**	**10.726**
	Y	**538**	**475**	**398**	**410**	**420**	**455**
Rabi	**A**	**6.606**	**7.777**	**7.438**	**10.449**	**10.338**	**8.522**
	P	**2.670**	**3.952**	**4.007**	**6.482**	**6.614**	**4.745**
	Y	**404**	**508**	**539**	**620**	**640**	**557**
Total	**A**	**35.082**	**33.871**	**27.187**	**33.829**	**30.530**	**32.100**
	P	**18.002**	**16.344**	**11.862**	**16.058**	**15.087**	**15.471**
	Y	**513**	**483**	**436**	**475**	**494**	**482**

ANNEXURE-X

STATE-WISE YEAR WISE AREA, PRODUCTION AND YIELD URDBEAN

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		2010-11	2011-12	2012-13	2013-14	2014-15	Average
ANDHRA PRADESH							
Kharif	**A**	0.820	0.630	0.57	0.47	0.390	0.576
	P	0.460	0.410	0.51	0.37	0.340	0.418
	Y	561	651	895	787	872	726
Rabi	**A**	3.820	4.770	3.87	2.63	3.040	3.626
	P	2.070	3.270	3.21	2.1	2.660	2.662
	Y	542	686	829	798	875	734
Total	**A**	4.640	5.400	4.440	3.100	3.430	4.202
	P	2.530	3.680	3.720	2.470	3.000	3.080
	Y	545	681	838	797	875	733
ARUNACHAL PRADESH							
Kharif	**A**	0.036	0.039	0.0416	0.0071		0.031
	P	0.032	0.037	0.045	0.006		0.030
	Y	889	949	1089	845		973
ASSAM							
Rabi	**A**	0.488	0.444	0.485	0.540	0.730	0.537
	P	0.272	0.268	0.267	0.313	0.470	0.318
	Y	557	604	551	580	644	592
BIHAR							
Kharif	**A**	0.148	0.137	0.141	0.155	0.158	0.148
	P	0.126	0.119	0.122	0.141	0.145	0.131
	Y	851	869	864	913	914	883
CHHATTISGARH							
Kharif	**A**	1.024	1.026	0.899	0.945	0.937	0.966
	P	0.293	0.307	0.288	0.294	0.297	0.296
	Y	286	299	320	311	317	306
Rabi	**A**	0.032	0.040	0.054	0.138	0.029	0.059
	P	0.009	0.010	0.014	0.028	0.008	0.014
	Y	281	250	259	203	276	235
Total	**A**	1.056	1.066	0.953	1.083	0.966	1.025
	P	0.302	0.317	0.302	0.322	0.305	0.310
	Y	286	297	317	297	316	302
GUJARAT							
Kharif	**A**	1.020	0.960	0.940	0.890	0.670	0.896
	P	0.690	0.680	0.570	0.540	0.440	0.584
	Y	676	708	606	607	657	652
Rabi	**A**		0.070		0.002	0.030	0.034
	P		0.040		0.001	0.020	0.020

	Y		571		500	667	598
Total	**A**		1.030	0.940	0.892	0.700	0.891
	P		0.720	0.570	0.541	0.460	0.573
	Y		1280	606	1107	1323	1250
HARYANA							
Kharif	**A**	0.040	0.080	0.020	0.015	0.020	0.035
	P	0.020	0.040	0.008	0.006	0.010	0.017
	Y	500	500	400	400	500	480

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		2010-11	2011-12	2012-13	2013-14	2014-15	Average
HIMACHAL PRADESH							
Kharif	**A**	0.099	0.103	0.103	0.079	0.098	0.096
	P	0.047	0.063	0.043	0.036	0.127	0.063
	Y	475	612	423	449	1287	654
JAMMU & KASHMIR							
Kharif	**A**	0.144			0.133		0.138
	P	0.048			0.051		0.050
	Y	333			385		358
JHARKHAND							
Kharif	**A**	0.896	0.781	1.052	0.942	0.982	0.931
	P	0.719	0.554	0.936	0.883	0.831	0.785
	Y	802	709	889	937	846	843
KARNATAKA							
Kharif	**A**	1.180	0.840	1.030	0.950	0.630	0.926
	P	0.410	0.310	0.490	0.460	0.180	0.370
	Y	347	369	476	484	286	400
Rabi	**A**	0.090	0.090	0.070	0.070	0.070	0.078
	P	0.040	0.040	0.040	0.040	0.030	0.038
	Y	444	444	571	571	429	487
Total	**A**	1.270	0.930	1.100	1.020	0.700	1.004
	P	0.450	0.350	0.530	0.500	0.210	0.408
	Y	354	376	482	490	300	406
MADHYA PRADESH							
Kharif	**A**	5.846	5.514	6.426	5.851	8.620	6.451
	P	2.281	1.488	3.857	2.186	4.280	2.818
	Y	390	270	600	374	497	437
Rabi	**A**	0.071	0.060	0.079	0.166	0.200	0.115
	P	0.028	0.018	0.044	0.074	0.085	0.050
	Y	394	300	557	446	427	433
Total	**A**	5.917	5.574	6.505	5.851	5.851	5.940
	P	2.309	1.506	3.901	2.186	2.186	2.418
	Y	390	270	600	374	374	407
MAHARASHTRA							
Kharif	**A**	4.820	3.640	3.600	3.340	2.550	3.590
	P	3.290	2.490	2.130	2.060	0.920	2.178
	Y	683	684	592	617	361	607
ODISHA							
Kharif	**A**	1.257	1.061	1.070	0.818	0.790	0.999
	P	0.367	0.280	0.355	0.250	0.264	0.303
	Y	292	264	332	306	335	304
Rabi	**A**	0.080	0.060	0.050	0.030	0.040	0.052
	P	0.030	0.021	0.019	0.013	0.016	0.020

	Y	375	350	378	445	413	384
Total	**A**	1.337	1.121	1.120	0.848	0.829	1.051
	P	0.397	0.301	0.374	0.263	0.281	0.323
	Y	297	269	334	311	338	307
PUNJAB							
Kharif	**A**	0.028	0.030	0.022	0.022	0.022	0.025
	P	0.016	0.010	0.010	0.010	0.012	0.012
	Y	571	333	455	455	545	468

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
RAJASTHAN							
Kharif	**A**	1.278	2.552	2.180	1.960	2.017	1.997
	P	0.941	1.317	1.253	0.706	1.122	1.068
	Y	736	516	575	360	556	535
SIKKIM							
Kharif	**A**	0.037	0.034	0.033	0.033		0.034
	P	0.032	0.030	0.029	0.030		0.030
	Y	865	882	890	899		884
Rabi	**A**	0.039					0.039
	P	0.028					0.028
	Y	718					718
Total	**A**	0.076	0.034	0.033	0.033		0.044
	P	0.060	0.030	0.029	0.030		0.037
	Y	789	882	890	899		847
TAMILNADU							
Kharif	**A**	0.394	0.542	0.411	0.699	0.350	0.479
	P	0.209	0.462	0.243	0.587	0.303	0.361
	Y	530	852	593	840	866	753
Rabi	**A**	2.650	2.540	1.670	2.953	3.705	2.704
	P	1.029	1.326	0.640	2.520	2.343	1.572
	Y	388	522	383	853	632	581
Total	**A**	3.044	3.082	2.081	3.652	4.055	3.183
	P	1.238	1.788	0.883	3.107	2.646	1.933
	Y	407	580	425	851	653	607
TRIPURA							
Kharif	**A**	0.012	0.012	0.0083	0.0132		0.011
	P	0.008	0.007	0.0051	0.0082		0.007
	Y	667	583	614	621		622
Rabi	**A**	0.004	0.005	0.0055	0.0038		0.005
	P	0.003	0.004	0.0037	0.003		0.003
	Y	750	800	673	789		749
Total	**A**	0.016	0.017	0.014	0.017		0.016
	P	0.011	0.011	0.009	0.011		0.011
	Y	688	647	638	659		658
UTTAR PRADESH							
Kharif	**A**	5.560	5.070	5.240	4.970	5.190	5.206
	P	3.720	3.390	3.470	2.220	2.780	3.116
	Y	669	669	662	447	536	599
Summer	**A**		0.480	0.480	0.450	0.450	0.465

	P		0.320	0.330	0.260	0.260	0.293
	Y		667	688	578	578	629
Total	**A**	5.560	5.550	5.720	5.420	5.640	5.578
	P	3.720	3.710	3.800	2.480	3.040	3.350
	Y	669	668	664	458	539	601
UTTRAKHAND							
Kharif	**A**		0.130	0.150	0.146	0.140	0.141
	P		0.110	0.115	0.115	0.100	0.110
	Y		846	771	791	714	779

A= Lakh ha, P= Lakh tonnes, Y= kg/ha

STATE		**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
WEST BENGAL							
Kharif	**A**	0.450	0.446	0.51	1.007	0.617	0.606
	P	0.285	0.272	0.343	0.518	0.423	0.368
	Y	633	610	673	514	686	608
Rabi	**A**	0.119		0.12	0.13	0.120	0.122
	P	0.107		0.106	0.115	0.110	0.110
	Y	899		883	885	917	896
Total	**A**	0.569	0.446	0.630	1.137	0.737	0.704
	P	0.392	0.272	0.449	0.633	0.533	0.456
	Y	689	610	713	557	724	648
D & N. HAVELI							
Kharif	**A**	0.014		0.014	0.014		0.014
	P	0.011		0.01	0.01		0.010
	Y	786		714	714		738
PONDICHERRY							
Rabi	**A**	0.011	0.011	0.006	0.006		0.009
	P	0.006	0.006	0.005	0.003		0.005
	Y	545	545	833	500		588
ALL INDIA							
Kharif	**A**	**25.071**	**23.588**	**24.418**	**23.477**	**24.269**	**24.165**
	P	**13.974**	**12.338**	**14.788**	**11.506**	**12.655**	**13.052**
	Y	**557**	**523**	**606**	**490**	**521**	**540**
Rabi	**A**	**7.400**	**8.571**	**6.903**	**7.158**	**8.448**	**7.696**
	P	**3.623**	**5.322**	**4.685**	**5.496**	**6.021**	**5.029**
	Y	**490**	**621**	**679**	**768**	**713**	**654**
Total	**A**	**32.471**	**32.159**	**31.321**	**30.635**	**32.717**	**31.861**
	P	**17.597**	**17.660**	**19.473**	**17.002**	**18.677**	**18.082**
	Y	**542**	**549**	**622**	**555**	**571**	**568**

ANNEX- XI

PATTERN OF ASSISTANCE: NFSM – PULSES

S. No.	Intervention	Approved rates /Unit
1	***Demonstrations on Improved Technologies:**	
	(a) Cluster Demonstrations (of 100 ha each)	Rs.7500/-ha
	(b) Cropping System based Demonostration(Pulse(Urad,moong, Moth,Cowpea, Pigeonpea) -Wheat)	Rs.12500/-ha
2	**Distribution of Seed minikits on Pulses & Oilseeds**	Free of cost
3	**Distribution of Certified Seeds:**	
	(a) HYVs seeds	Rs.2500/-Qtls
	Integrate Nutrient Management:	
	(a) Micro-nutrients	Rs.500/-ha
	(b) Gypsum/80% WG Sulphur	Rs.750/-ha
	(d) Bio-fertilizers	Rs.300/-ha
4	**Integrated Pest Management (IPM)**	
	(a) Distribution of PP Chemicals	Rs.500/-ha
	(b) Weedicides	Rs.500/-ha
5	**Resource Conservation Technologies/Tools:**	
	(a) Manual Sprayer	Rs. 600/Unit
	(b) Power Knap Sack Sprayer	Rs.3000/Unit
	(c) Zero Till Seed Drill	Rs.15000/Unit
	(d) Multi Crop Planter	Rs.15000/Unit
	(e) Seed Drill	Rs.15000/Unit
	(f) Zero Till Multi Crop Planter	Rs.15000/Unit
	(g) Ridge Furrow Planter	Rs.15000/Unit
	(h) Chiseller	Rs.8000/Unit
	(i) Rotavator	Rs.35000/Unit
	(j) Laser Land Leveler	Rs.150000/Unit
	(k) Tractor mounted sprayer	Rs. 10000/Unit
	(i) Multi crop thresher	Rs. 40000/Unit
6	**Efficient Water Application Tools:**	
	(a) Sprinkler Sets	Rs.10000/-
	(b) Pump Sets	Rs.10000/Unit
	(c) Pipe for carrying water from source to the field	Rs. 15000 or Rs.25/m
	(d) Mobile Rain gun	Rs. 15000/Unit
7	**Cropping System based trainings**	Rs.3500/ Sess. Rs.14000/ Trai.
8	**Miscellaneous Expenses** Project Management Team & Other Miscellaneous Expenses at District level	Rs. 14.00 lakh unit of state PMT
9	**Local Initiative**	
(a)	Seed Treatment Drum	Rs. 1000/Unit
(b)	Spiral Grader	Rs. 2000/Unit

10	Demonstrations by (KVK)	Rs.7500/ha
11	**Miscellaneous Expenses (**Other Miscellaneous Expenses at Distt. level	

ANNEX-XII

AREA OF OPERATION (29 STATES/638 DISTRICTS) – NFSM-PULSES

District Covered (Identified) Under NFSM - Pulses			
SI.No.	**States**	**Total Number of Districts in states**	**Total Number of Districts covered under - NFSM**
1	Andhra Pradesh	13	13
2	Arunachal Pradesh	17	17
3	Assam	27	27
4	Bihar	38	38
5	Chhattisgarh	27	27
6	Goa*	2	2
7	Gujarat	26	26
8	Haryana	21	21
9	Himachal Pradesh	12	12
10	Jammu & Kashmir	22	22
11	Jharkhand	24	24
12	Karnataka	30	30
13	Kerala*	14	14
14	Madhya Pradesh	51	51
15	Maharashtra	35	33
16	Manipur	9	9
17	Meghalaya	11	11
18	Mizoram	8	8
19	Nagaland	11	11
20	Odisha	30	30
21	Punjab	22	22
22	Rajasthan	33	33
23	Sikkim	4	4
24	Tamil Nadu	32	30
25	Telangana	10	9
26	Tripura	8	8
27	Uttar Pradesh	75	75
28	Uttarakhand	13	13
29	West Bengal	19	18

	Total	644	638

ANNEXURE- XIII

INPUT USE TABLE: READY RECKONER

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 Vitavax 50% WP) or Microbial (Trichoderma viride)	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 Indoxacarb 15.8%	300-400 ml in 500-1000 liters of water per spray for all

	EC	pulse most critical spray at flowering.

ANNEX – XIV

LIST OF ORGANIZATION INVOLVED IN PULSES RESEARCH – INTERNATIONAL/ NATIONAL

INTERNATIONAL	
FAO - Food and Agricultural Organization	FAO Representative: KHADKA, MR SHYAM BAHADUR e-mail: fao-in@fao.orgweb site: www.fao.org/india
CGIAR - Consultative Group on International Agricultural Research	CGIAR System Organization **Mailing address** CGIAR System Management Office 1000, Avenue Agropolis F-34394 Montpellier cedex 5 **Phone**Tel. + 33 4 67 04 7575 **E-mail**contact (at) cgiar (dot) org **Fax**+33 4 67 04 75 83
ICRISAT - International Crops Research Institute for the Semi-Arid Tropics	Patancheru Hyderabad 502324 Telangana Email ICRISAT@CGIAR.ORG Phone +91 40 30713071 Fax +91 40 30713071
IRRI - International Rice Research Institute	International Rice Research Institute India Office, First Floor, CG-Block, NASC Complex, Dev Prakash Shastri Marg, Pusa Campus New Delhi - 110 012 INDIA

	Tel:+91-011-66763000
IWMI - International Water Management Institute	2nd Floor, CG Block C, NASC Complex, DPS Marg, Pusa, Opp Todapur, New Delhi 110 012, India Tel: +91 11 25843536, 25840812 & 65976151 Fax: +91 11 25840811 *Email: iwmi-delhi@cgiar.org*

ANNEX – XIV continued…….

National Research Centres	
ICAR-NCIPM	ICAR-National Research Centre for Integrated Pest Management Pusa Campus, New Delhi-110012, Ph.: 011-25843936, E-mail: director.ncipm@icar.gov.in,ipmnet@ncipm.org.in
ICAR- CRIDA	Central Research Institute of Dryland Agriculture, Hyderabad , Santoshnagar, Hyderabad - 500 059 Phone : +91 -040 24532243, 24530161 E-mail : admin@crida.in Web : http://www.crida.in orhttp://crida.in
ICAR- Indian Institute of Soil and Water Conservation, Dehradun	ICAR-Indian Institute of Soil and Water Conservation, 218, Kaulagarh Road, Dehradun-248 195 (Uttarakhand) Tel. : 91-135-2758564; Fax: 91-135-2754213, 2755386 E-mail: directorsoilcons@gmail.com;director.iiswc@icar.gov.in Website: www.cswcrtiweb.org
ICAR-IGFRI	Indian Grassland & Fodder Research Institute, Jhansi - 284003, India Email: igfri.director@gmail.com, ghosh_pk2006@yahoo.com Phone: 0510-2730666 Fax: 0510-2730833
ICAR-IISS	Indian Institute of Soil Sciences, BhopalNabibagh, Berasia Road, Bhopal - 462038 Madhya Pradesh, India. Email: director@iiss.res.in , patraak@gmail.com Phone: (Off.) 0755-2730946 Fax: 0755-2733310
ICAR-NIBSM	National Institute of Biotic Stresses Management Baronda, Raipur 493 225, Chhattishgarh, India, Directors office, Fax No. (0771) 2225351; Telephone No. (0771) 2225352Office Telephone No. (0771) 2225333
ICAR-NIASM	National Institute of A biotic Stress Management, Malegaon, Maharashtra Malegaon-Karhavagaj Road, Khurd, Baramati, Maharashtra 413115 Phone: 02112 254 057
ICAR - IIFSR	ICAR- Indian Institute of Farming Systems Research, ModipuramModipuram Meerut, Email directoriifsr@yahoo.com Phone : 0121-2888711
ICAR-IIOR	Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad – 500 030, Ph: 040-24598444, 24016141 Fax : 040-24017969, Email : director.iior@icar.gov.in
ICAR- IIWM	ICAR-INDIAN INSTITUTE OF WATER MANAGEMENT Opp. Rail Vihar, Chandrasekharpur, Bhubaneswar - 751023, 0674-2300010/2300016, FAX 0674-2301651 EMAIL director.iiwm@icar.gov.in
ICAR- CIWA	Central Institute for Women in Agriculture, Plot No. 50-51, Mouza - Jokalandi, P.O. - Baramunda,, Bhubaneswar - 751003, Odisha, India E-mail : director.ciwa@icar.gov.in Phone No : (0674)-2386940, 2386241, Fax : (0674) 2386242
ICAR-IISR	Indian Institute of Seed Science, Mau-275103, Uttar Pradesh, India

	Phone: (+91) (0547) 2530326, Fax: (+91) (0547) 2530325 Email: pddsrmau@gmail.com, director.seed@icar.gov.in
ICAR-CAZRI, Jodhpur	Central Arid Zone Research Institute, Near Industrial Training Institute (ITI), Light Industrial Area, Jodhpur - 342 003 (Rajasthan) Telephone : +91 291 2786584, Fax : +91 291 2788706
ICAR-C I A E, Bhopal	Central Institute of Agricultural Engineering, Nabi Bagh, Berasia Road, Bhopal - 462038 (Madhya Pradesh) INDIA Director: 91-755-2737191 E-mail: director.ciae@icar.gov.in
ICAR-CIPHET	Central Institute on Post harvest Engineering and Technology, Ludhiana, P.O. PAU Ludhiana (Punjab) , -141004 Off. Phone: 0161-2313101 Fax: 0161-2308670 Email: ciphetludhiana1989@gmail.comciphet.director@gmail.com

ANNEX – XIV continued…….

CENTRAL AND STATE AGRICULTURE UNIVERSITIES CONTACT LIST

S. No.	Name, email & website	Address
1	**Acharya NG Ranga Agricultural University** **Website:** http://www.angrau.net **Email:** angrau_vc@yahoo.com, raghuvardhanreddy_s@rediffmail.com	Administrative Office, Rajendra Nagar, Hyderabad-500030, Andhra Pradesh
2	**Agriculture University Jodhpur** **Website:** http://www.au-ju.org **Email:** vcunivag@gmail.com	Mandor, Jodhpur-342304
3	**Agriculture University Kota** **Website:** http://aukota.org **Email:** vcaukota@gmail.com	Borkhera, Kota-324001
4	**Anand Agricultural University** **Website:** http://www.aau.in **Email:** vc@aau.in, vc_aau@yahoo.com	Anand 388110, Gujarat
5	**Assam Agricultural University** **Website:** http://www.aau.ac.in **Email:** vc@aau.ac.in, kmbujarbaruah@rediffmail.com	Jorhat 785013, Assam
6	**Bidhan Chandra Krishi Viswavidyalaya** **Website:** http://www.bckv.edu.in **Email:** bckvvc@gmail.com, sarojsanyal@yahoo.co.in	Mohanpur, Nadia-741252, West Bengal
7	**Bihar Agricultural University** **Website:** http://www.bausabour.ac.in **Email:** vcbausabour@gmail.com	Sabour, Bhagalpur 813210, Bihar
8	**Birsa Agricultural University** **Website:** http://www.baujharkhand.org **Email:** vc_bau@rediffmail.com	Kanke, Ranchi-834006, Jharkhand
9	**Central Agricultural University** **Website:** http://www.cau.org.in **Email:** snpuri04@yahoo.co.in , snpuri@rediffmail.com	P.O. Box 23, Imphal-795004, Manipur
10	**Chandra Shekar Azad University of Agriculture & Technology** **Website:** http://www.csauk.ac.in **Email:** vc@csauk.ac.in	Kanpur-208002, Uttar Pradesh
11	**Chaudhary Charan Singh Haryana Agricultural University** **Website:** http://www.hau.ernet.in **Email:** vc@hau.ernet.in	Hisar-125004, Haryana
12	**CSK Himachal Pradesh Krishi Vishvavidyalaya** **Website:** http://www.hillagric.ac.in **Email:** vc@hillagric.ac.in	Palampur-176062, Himachal Pradesh

13	**Dr Balasaheb Sawant Konkan Krishi Vidyapeeth** **Website:** www.dbskkv.org **Email:** vcbskkv@yahoo.co.in	Dapoli Distt, Ratnagiri 415 712, Maharashtra
12	**Dr Panjabrao Deshmukh Krishi Vidyapeeth** **Website:** http://www.pdkv.ac.in **Email:** vc@pdkv.ac.in	Krishinagar,Akola-444104, Maharashtra
13	**Govind Ballabh Pant University of Agriculture & Technology** **Website:** http://www.gbpuat.ac.in **Email:** vcgbpuat@gmail.com	Pantnagar-263145,Distt Udham Singh , Nagar , Uttaranchal
14	**Indira Gandhi Krishi Vishwavidyalaya** **Website:** www.igau.edu.in **Email:** vcigkv@gmail.com	Krishak Nagar, Raipur-492006, Chhattisgarh

S. No.	Name, email & website	Address
15	**Jawaharlal Nehru Krishi Viswavidyalaya** **Website:** http://www.jnkvv.nic.in **Email:** vst.vcjnkvv@gmail.com	Krishi Nagar, Adhartal Jabalpur-482004, Madhya Pradesh
16	**Junagadh Agricultural University** **Website:** http://www.jau.in **Email:** vc@jau.in	Univ. Bhavan, Motibagh Junagadh-362001, Gujarat
17	**Dr Panjabrao Deshmukh Krishi Vidyapeeth** **Website:** http://www.pdkv.ac.in **Email:** vc@pdkv.ac.in	Krishinagar,Akola-444104, Maharashtra
18	**Govind Ballabh Pant University of Agriculture & Technology** **Website:** http://www.gbpuat.ac.in **Email:** vcgbpuat@gmail.com	Pantnagar-263145,Distt Udham Singh , Nagar , Uttaranchal
19	**Indira Gandhi Krishi Vishwavidyalaya** **Website:** www.igau.edu.in **Email:** vcigkv@gmail.com	Krishak Nagar, Raipur-492006, Chhattisgarh
20	**Jawaharlal Nehru Krishi Viswavidyalaya** **Website:** http://www.jnkvv.nic.in **Email:** vst.vcjnkvv@gmail.com	Krishi Nagar, Adhartal Jabalpur-482004, Madhya Pradesh
21	**Junagadh Agricultural University** **Website:** http://www.jau.in **Email:** vc@jau.in	Univ. Bhavan, Motibagh Junagadh-362001, Gujarat
22	**Kerala Agricultural University** **Website:** http://www.kau.edu **Email:** vc@kau.in , vicechancellorkau@gmail.com	Vellanikara, Trichur 680656, Kerala
23	**Maharana Pratap Univ. of Agriculture & Technology** **Website:** http://www.mpuat.ac.in **Email:** vc@mpuat.ac.in	Udaipur, Rajasthan 313001
24	**Mahatma Phule Krishi Vidyapeeth** **Website:** http://mpkv.mah.nic.in **Email:** vcmpkv@rediffmail.com	Rahuri-413722, Maharashtra
25	**Manyavar Shri Kanshiram Ji University of Agriculture and Technology** **Website:** http://www.mskjuat.edu.in/ **Email:** vc.mskjuat@gmail.com	Banda - 210001, Uttar Pradesh
26	**Narendra Deva University of Agriculture & Technology** **Website:** http://www.nduat.ernet.in **Email:** vc_nduat2010@yaho.co.in	Kumarganj, Faizabad -224229, Uttar Pradesh
27	**Navsari Agricultural University** **Website:** http://www.nau.in **Email:** vc_2004@yahoo.co.in	Navsari-396450 Gujarat
28	**Orissa Univ. of Agriculture & Technology**	Bhubaneshwar-751003, Orissa

	Website: http://www.ouat.ac.in **Email:** ouat_dproy@yahoo.co.in ,	
29	**Prof. Jayashankar Telangana State Agricultural University** **Website:** www.pjtsau.ac.in **Email:** vcpjtsau@gmail.com	Admn. Office: Rajendranagar, Hyderabad - 500 030
30	**Punjab Agricultural University** **Website:** http://www.pau.edu **Email:** vcpau@pau.edu	Ludhiana-141004, Punjab
31	**Rajendra Agricultural University** **Website:** http://www.pusavarsity.org.in **Email:** : vcrau@sify.com	Pusa, Samastipur 848125, Bihar

S. No.	Name, email & website	Address
32	**Rajmata Vijayraje Sciendia Krishi Vishwa Vidyalaya** **Website:** http://www.rvskvv.nic.in **Email:** vcrvskvv@gmail.com	Race Cource Road, Gwalior 474002 Madhya Pradesh
33	**Rani Laxmi Bai Central Agricultural University** **Website:** http://www.rlbcau.ac.in **Email:** : ddgedn@icar.org.in	Jhansi, Uttar Pradesh
34	**Sardar Vallabhbhai Patel University of Agriculture and Technology** **Website:** http://www.svbpmeerut.ac.in **Email:** vc_agunivmeerut@yahoo.com	Modipuram, Meerut - 250110 Uttar Pradesh
35	**Sardarkrushinagar-Dantiwada Agricultural University** **Website:** http://www.sdau.edu.in **Email:** vc@sdau.edu.in	Sardar Krushinagar, Distt Banaskantha, Gujarat-385506
36	**Sher-E-Kashmir Univ of Agricultural Sciences & Technology** **Website:** http://www.skuast.org **Email: vc@skuast.org**	Railway Road, Jammu 18009, J&K
37	**Sher-E-Kashmir Univ of Agricultural Sciences & Technology of Kashmir** **Website:** http://www.skuastkashmir.ac.in **Email:** vc@skuastkashmir.ac.in , skuastkvc@gmail.com	Shalimar Campus, Shrinagar-191121, Jammu & Kashmir
38	**Sri Karan Narendra Agriculture University** **Website:** http://sknau.ac.in **Email:** nsrdsr@gmail.com , vc@sknau.ac.in	Jobner-303329, Jaipur(RAJ.)
39	**Swami Keshwanand Rajasthan Agricultural University** **Website:** http://www.raubikaner.org **Email:** vcrau@raubikaner.org	Bikaner-334006,Rajasthan
40	**Agricultural University** **Website:** http://www.tnau.ac.in **Email:** vc@tnau.ac.in	Coimbatore-641003, Tamil Nadu
41	**Punjab Agricultural University** **Website:** http://www.pau.edu **Email:** vcpau@pau.edu	Ludhiana-141004, Punjab
42	**Rajendra Agricultural University** **Website:** http://www.pusavarsity.org.in **Email:** : vcrau@sify.com	Pusa, Samastipur 848125, Bihar
43	**Rajmata Vijayraje Sciendia Krishi Vishwa Vidyalaya** **Website:** http://www.rvskvv.nic.in **Email:** vcrvskvv@gmail.com	Race Cource Road, Gwalior 474002 Madhya Pradesh
44	**Rani Laxmi Bai Central Agricultural University** **Website:** http://www.rlbcau.ac.in **Email:** ddgedn@icar.org.in	Jhansi, Uttar Pradesh
45	**Sardar Vallabhbhai Patel University of Agriculture and Technology** **Website:** http://www.svbpmeerut.ac.in **Email:** vc_agunivmeerut@yahoo.com	Modipuram, Meerut - 250110 Uttar Pradesh
46	**Sardarkrushinagar-Dantiwada Agricultural University** **Website:** http://www.sdau.edu.in **Email:** vc@sdau.edu.in	Sardar Krushinagar, Distt Banaskantha, Gujarat-385506
47	**Tamil Nadu Agricultural University** **Website:** http://www.tnau.ac.in **Email:** vc@tnau.ac.in	Coimbatore-641003, Tamil Nadu

S. No.	Name, email & website	Address
48	**University of Agricultural Sciences, Bangalore** **Website:** http://www.uasbangalore.edu.in **Email:** vcuasb1964@gmail.com , vc@uasbangalore.edu.in	GKVK,Bengaluru-560065, Karnataka
49	**University of Agricultural Sciences, Dharwad** **Website:** http://www.uasd.edu **Email:** vc_uasd@rediffmail.com	Dharwad-580005, Karnataka
50	**University of Agricultural Sciences, Shimoga** **Website:** http://www.uasbangalore.edu.in/asp/agriShimoga.asp	Shimoga**,** Karnataka
51	**University of Agricultural Sciences** **Website:** http://www.uasraichur.edu.in **Email:** vcuasraichur10@rediffmail.com	PB 329, Raichur – 584101 Karnataka
52	**Uttar Banga Krishi Viswavidyalaya** **Website:** http://www.ubkv.ac.in **Email:** vcubkv@gmail.com , vcubkv@rediffmail.com	P.O. Pundibari, Dist. Coach Bihar-736165,West Bengal
53	**Vasantrao Naik Marathwada Agricultural University** **Website:** http://www.mkv2.mah.nic.in **Email:** vcmau@rediffmail.com	Parbhani-431402, Maharashtra

ANNEX-XV

LIST OF BIO-FERTILIZER MAKING CENTERS

State	Mailing address of the Bio fertilizer 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
	Krishna Agro Bioproducts Vikshmitra, 9/1A-1 Road No. 16, IDA Nacharam Hyderabad (Andhra Pradesh)
	Madras Fertilizers Ltd, Bio Unit Vijayawada (AP)
	Prathista Industries Ltd. S. Lingotam Village Chotuppal Nalgonda Andhra Pradesh
	Radar Biotech Vijayawada Andhra Pradesh
	Regional Soil Testing Laboratory (RSTL) Hyderabad, Andhra Pradesh
	Rovar Biotech, Vijaywada, Andhra Pradesh
	Sri Sai Agro Bio Lab Cheerumpally, Vijaynagaram, Andhra Pradesh
	Varsha Biosciences and Technology 17-1-382/SN/1/2, MNR Colony, Balaji Nagar, Hyderabad (Andhra Pradesh)
	Godavari Fertilisers and Chemicals Ltd., Beach Road Kakinada - 533 003, Dist. East Godavari, Andhra Pradesh, Tel: (0884) 2302420-27, Fax: (0884)2341069
Assam	Directorate of Research, Assam Agricultural University Jorhat-785 013
	Brahmaputra Valley Fert. Corpn. Ltd., Namrup P.O. Parbatpur Dist. Dibrugarh - 786 623 Email: bvfclnam@sancharnet.in
	North East Green Tech Pvt. Ltd., Anuradha Complex Barum Maidan, Guwahati
	Orgaman R&D Division Nehru Park, T.R. Phukan Road, Dist. Jorhat
Bihar	Hindustan Fertilizer Corporation Limited AHPO Urbaraknagar, Distt. BEGUSARAI-851 115 (Bihar)
	Association for Social Economic Transformation, Barauni, Bihar
Gujarat	National Agricultural Research Project Biofertilizer Project Gujarat Agriculture University, Anand Campus, ANAND-388 110 (GUJ.)
	Gujarat State Fertilizers & Chemicals Ltd. P.O. Fertilizernagar - 391 750, Dist. Vadodara Tel: (0265) 2242651, 2242451, Fax: 0265 2240966, Email: ho@gsfcltd.com
	Gujarat State Co-operative Marketing Federation Ltd. Sahakar Bhavan, Relief Road, Ahmedabad-380 001 (GUJ)
	CORDET-Kalol, Cooperative Rural Development Trust, Biofertilier Production Unit, P.O. Kasturinagar, Dist. Gandhinagar Tel: (02764) 224066, Email: cordet_kalol@iffco.nic.in
	Krishak Bharati Cooperative Ltd., KRIBHCO Nagar Hazira Surat-394 515 Tel: (0261)2862766-70 Fax: (0261)2860283

State	Mailing address of the Bio fertilizer Production Units
Haryana	Prof. and Head of Microbiology,, Haryana Agricultural University, Hissar.
	Choudhury Charan Singh Haryana Agricultural University Dept. of Microbiology, Hisar
	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)
Jharkhand	Dept of Soil Science & Agricultural Chemistry Birsa Agricultural University, Ranchi - 834 066 Tel: (0651)2450621 Fax: (0651)2451106
	Swarnarekha Enterprises, Ranchi
Karnataka	Regional Bio-fertilizer Development Centre Regional Director 34-II main Road (Near Baptist Hospital), Hebbal, Bangalore-560 024
	Karnataka Agro Industries Corporation Limited Joint General Manager (A.I.D.), Hebbal Bellary Road, Bangalore-560 024
	Chaitra Fertilizers & Chemicals (P) Ltd. No. E-1, Sri Krishna Complex, D. Banumaiah Circle, Mysore
	Madras Fertilizers Ltd., Bio Unit, Jigani, Bangalore
	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)
	Agri Business & Development Cooperative, Bhopal, Madhya Pradesh
	Indore Biotech Input & Research (P) Ltd., Indore, Madhya Pradesh
	Jawahar Lai Nehru Krish Vishwa Vidyalaya (JNZKW), Jabalpur, MP
	The M.P. State Cooperative Oil seed Growers' Federation Ltd.1, Arera Hills, Behind Govt. Press, Bhopal - 462 011
	M.P. State Agro Industries Development Corporation Ltd. Biofertiliser Plant, Agro Complex, C-Sector, Indrapuri, Bhopal - 462 022 Madhya Pradesh, Tel: 2756142, 2757400
	NAFED Biofertilizer, 51-A, Sector F, Sanwer Road, Indore, MP, Email: nafbioind@nafed.nic.in
	National Fertilizers Ltd., Vijaipur-473 111, Dist. Guna, Madhya Pradesh Fax: (07544) 273109, 273089
	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- 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 Bio fertilizer Production Units
Maharashtra	Regional Bio-fertilizer Development Centre New Secretariat Building, East Wing, Nagpur-440 001 (MS)
	Arun Bio-fertilizers, Near MSEB Power House Kurundwad, Tal. Shirol, Dist. Kolhapur
	Institute of Natural Organic Agriculture (INORA) 11 B, Kularani Bungalow, Shikshak Nagar Poud Road, Pune, Maharashtra
	BAIF Development Research Foundation Bharatiya Agro Industries Foundation Central Research Station, Urulikanchan Pune, Maharashtra
	Deenee Chemicals Pvt. Ltd. 37/9, MIDC Road, Padoli, Chandrapur, Maharashtra
	Department of Agriculture, Govt of Maharashtra Lanja, Maharashtra
	Ellora Biotech, 20, Udyogmitra Industrial Estate Chitegaon, Paithan, Aurangabad, Maharashtra
	Bioira Technologies, B-15, Corporation Building First Floor, Link Road, Nagpur, Maharashtra
	Choudhury Agrotech, Sri Devi Complex Agyaram Devi Chowk, Subash Road, Nagapur, Maharashtra
	Mahatma Phule Krishi Vidyapeeth Agricultural Microbiology Section, College of Agriculture, Pune-411 005 (MS)
Odisha	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)
	Department of Agriculture, Bhubaneswar, Orissa
	Maa Kanak Biofertilizer, Bhubaneswar, Orissa
	The Orissa Agro Industries Corporation Ltd. (A Govt, of Orissa Undertaking), 95, Satyanagar, Bhubaneswar -751 007,Orissa Tel: (0674) 2503746, Fax: (0674) 2503396, Email: oaic7@hotmail.com
Punjab	Microbiological Laboratory, Punjab Agricultural University, Ludhiana, Punjab.
	Bio-fertilizer Production Unit Office of the Chief Agriculture Officer, Ludhiana (Punjab)
Rajasthan	Nafed Biofertilizer SPL-80 RIICO Industrial Area, Bharatpur-321 001 (RAJ)
	Mahaveer Bio Lab, 49, Sunderwas (North), Udaipur, Rajasthan
	NAFED Biofertiliser, SPL-80, RIICO Industrial Area, Bharatpur, Rajasthan
	State Biofertilizer Quality Control Laboratory, Department of Agriculture Durgapura, Jaipur, Rajasthan
	Department of Agricultural Chemistry & Soil Science Rajasthan College of Agriculture, Maharana Pratap University of Agriculture & Technology Udaipur-313 001, Rajasthan Tel: (0294) 2417492, Fax: (0294) 2420447, Email: pckant@yahoo.co.in
	Rhizobia Scheme Agriculture Department Agriculture Research Station, Durgapura, JAIPUR-302 018 e-mail-mailto:ggopalc@rediffmail.com/ ggopalc@rediffmail.com

State	Mailing address of the Bio fertilizer Production Units
Tamil Nadu	Regional Research Station Tamil Nadu Agricultural University, PIYUR-635 112, Via-Kaveripattinam, Dharmapuri District
	Elbitech Innovations Ltd. 46 & 48, 2nd Floor, Masilamani Road, Balajinagar, Chennai-606 014, T.N
	Esvin Advanced Technologies Ltd. ESVIN House, Perungudi, Chennai - 600 096, Tamil Nadu Tel: (044) 66849358; Fax: (044) 24960156; Email: tsv@vsnl.com
	Foliage Chemicals Private Ltd., No.45, Ambattur Road Puzhal, Chennai - 600 066, Tamil Nadu
	Innova Agrotech (P) Ltd. 2/527-1, East Street, Kulloorchanadai Virudhanagar-626 001, Chennai, Tamil Nadu
	Jaypee Biotechs, 25, Chinniah School Street Virudhnagar- 626 001, Tamil Nadu
	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)
	Bio Fertilizer Production Unit, Department of Agriculture, Govt, of Tamil Nadu, Sakkottai, Thanjavur-612 401, Tamil Nadu
	Bio Fertilizer Production Unit, Department of Agriculture Gundusalai Road, Sommandalam, Cuddalore - 607 001 Tamil Nadu
	Bio Fertilizer Production Unit, Department of Agriculture, Kajamalai, Jamal Mohamed College (PO) Trichirappalli - 620 020, Tamil Nadu
	Bio Fertilizer Production Unit Department of Agriculture, Seelanaickenpatty, Salem - 636 201, Tamil Nadu
	Bio Fertilizer Production Unit Department of Agriculture, Kudumianmalai –622 104, Pudukottai, TN
	Bio Fertilizer Production Unit Department of Agriculture, Collectorate Post RTO Office Road, Ramanathapuram - 623 503, Tamil Nadu
	Department of Agricultural Microbiology, Agriculture College and Research Institute, Tamil Nadu Agricultural University MADURAI-625 104

State	Mailing address of the Bio fertilizer Production Units
Uttar Pradesh	National Bio-fertilizer 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
	Department of Agriculture, Govt of Uttar Pradesh, Varanasi Uttar Pradesh
	Department of Agriculture, Govt, of Uttar Pradesh Etah Compound, Near Mannoo Malchauraha, Etah, Uttar Pradesh
	IFFCO Biofertiliser Production Unit, Motilal Nehru Farmers Training Institute Cooperative Rural Development Trust (CORDET) IFFCO, Ghiyanagar, Phulpur, Allahbad-212 404, Uttar Pradesh, Tel: (0532) 2285071, 2253379; Fax: (05332) 253379 Email: phulpur@iffco.nic.in
	Krishna Bharati Cooperative Ltd., Varanasi, Uttar Pradesh
	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)
	Department of Agriculture, Govt, of West Bengal, West Bengal
	Excel Biotech Pvt Ltd, 24 Parganas Kolkata, West Bengal
	Nitrofix Laboratories, (A Colloboration Unit of West Bengal Forest Development Corporation Ltd.), 25, Bansdroni Avenue, Kolkata - 700 070, West Bengal Tel: (033)4718486
	Bidhan Chandra Krishi Viswavidyala Survey, Selection & Mass Production of Nodule Bacteria Mohanpur, NADIA, P.O. Krishi Viswavidyalaya - 741 252, West Bengal Tel: (03473) 222269 Extn. 38
	Vivekananda Institute of Biotechnology, 24 Parganas, Kolkata, West Bengal

ANNEX – XVI

PRODUCTION TARGET OF BIO-FERTILIZERS/ BIO- CONTROL AGENTS UNDER PROJECT

(InQuintal/year)

S. No.	Centre's	Present status of production		Additional Quantity to be produced during				Total additional quantity to be produced		Total quantity to be produced	
				2016-17		2017-18					
		R*	T**	R*	T**	R*	T**	R*	T**	R*	T**
1	ANGRAU, Guntur Andhra Pradesh	221	1	200	80	250	100	450	180	671	181
2	Assam Agricultural University, Jorhat	10	5	150	50	220	70	370	120	380	125
3	Dr. RPCAU, Pusa, Samastipur, Bihar	11.6	0	190	70	350	90	540	160	551.6	160
4	Bihar Agriculturr University, Sabour	0	0	100	50	120	90	220	140	220	140
5	IGKV, Raipur, Chhattisgarh	8	40	400	70	400	100	800	170	808	210
6	AAU, Anand, Gujarat	30	20	400	90	450	100	850	190	880	210
7	Birsa Agriculture University, Ranch, Jharkhand	5	10	150	40	120	100	270	140	275	150
8	UAS, Dharwad, Karnataka	2600	22	350	70	400	100	750	170	3350	192
9	UAS, Raichur, Karnataka	0	0	290	70	530	100	820	170	820	170
10	JNKVV, Jabalpur, Madhya Pradesh	5	10	390	70	450	140	840	210	845	220
11	RVSKVV, Gwalior, Madhya Pradesh	1	1.5	70	30	120	50	190	80	191	81.5
12	MPKV, Rahuri, Maharashtra	33	63	340	70	450	90	790	160	823	223
13	MAU, Parbhani, Maharashtra	150	20	270	70	450	90	720	160	870	180
14	OUAT,Bhubneswar (Odisha)	0	0	240	40	400	90	640	130	640	130
15	PAU, Ludhiana, Punjab	7.93	0	330	40	570	100	900	140	907.93	140
16	MPUA&T, Udaipur, Rajasthan	0.7	1.8	290	40	400	100	690	140	690.7	141.8
17	RAU, Bikaner, Rajasthan	10	5	110	40	167	50	277	90	287	95
18	TNAU, Coimbatore, Tamil Nadu	10	5	390	70	450	100	840	170	850	175
19	PJTSAU,Hyderabad, Telangana	0	0	290	40	430	70	720	110	720	110
20	ICAR-IIPR, Kanpur, Uttar Pradesh	1	1	70	40	150	50	220	90	221	91
21	BHU, Varansi, Uttar Pradesh	5	20	140	60	120	80	260	140	265	160
22	ICAR, NBAIR, Bangalore, Karnantaka	0	10	80	50	300	50	380	100	380	110
23	ICAR-NBAIM, Mau, Uttar Pradesh	10	10	80	50	367	50	447	100	457	110
24	ICAR-NCIPM, Pusa, New Delhi	0	10	80	50	337	50	417	100	417	110
Tot	**3119.23**	**255.30**	**5400.00**	**1350.0**	**8001.0**	**2010**	**13401**	**3360**	**16520.2**	**3615.30**	

***R- RHIZOBIUM, **T-TRICHODERMA**

ANNEX – XVII

LIST OF STAKE HOLDERS- STATES AGRICULTURE DEPARTMENT/ STATE SEED CORPORATION/ STATE SEED CERTIFICATION AGENCIES/ GOVT. OF INDIA ORGANIZATIONS/ UNDERTAKEN

States Agriculture Department	
Director (Agriculture) Farmer Welfare an Agriculture Development, Vindhyachal Bhavan, Bhopal 462004 **(M.P.)**	Director (Agriculture) Director of Agriculture, Raipur 492001 **(C.G.)**
Commissioner (Agriculture) Commissionerate of Agriculture Hyderabad 500001 **(A.P.)**	Director (Agriculture) Directorate of Agriculture, Gowahati **(Assam)**
Director (Agriculture) Directorate of Agriculture Nahalagan- 791110 , **(Arunachal Pradesh)**	Director (Agriculture) Direcorate of Agriculture, Patna **(Bihar)**
Director Agriculture Direcorate of Agriculture, Gandhinagar **(Gujarat)**	Director Agriculture Direcorate of Agriculture, Panchkula, **(Punjab)**
Director Agriculture Direcorate of Agriculture, Panji **Goa**	Director Agriculture Direcorate of Agriculture, Shimla **(Himachal Pradesh)**
Director Agriculture Direcorate of Agriculture, Ranchi **(Jharkhand)**	Commissioner Agriculture, Directorate of Agriculture, Shrinagar **(Jammu & Kashmir)**
Director Agriculture Direcorate of Agriculture, Thiruananthapuram , **(Kerela)**	IAS, Agriculture Commissioner Commissionerate of Agriculture, Bangalore **(Karnataka)**
Director Agriculture Direcorate of Agriculture, Imphal **(Manipur)**	Director Agriculture Commissionerateof Agriculture, Pune **(Maharashtra)**
Director Agriculture Direcorate of Agriculture, Aizawl **(Mizoram)**	Director Agriculture Direcorate of Agriculture, Shilong **(Meghalaya)**
Commissioner-cum Director Direcorate of Agriculture, Bhubaneshwar **(Odisha)**	Director Agriculture Direcorate of Agriculture, Kohima **(Nagaland)**
Agriculture Commissioner Direcorate of Agriculture, Jaipur **(Rajasthan)**	Director Agriculture Direcorate of Agriculture, Chandigarh **(Punjab)**
Director Agriculture Direcorate of Agriculture, **(Telangana)**	Director Agriculture Direcorate of Agriculture, Chennai **(Tamil Nadu)**
Director Agriculture Direcorate of Agriculture, Todong **(Sikkim)**	Director Agriculture Direcorate of Agriculture, Agartala **(Tripura)**
Director Agriculture Direcorate of Agriculture, Dehradun **(Uttarakhand)**	Director Agriculture Direcorate of Agriculture, Lakhnow **(Uttar Pradesh)**
Director Agriculture Direcorate of Agriculture, Kolkata **(West Bengal)**	

State Seeds Certification Agencies	
Gujarat State Seed Certification Agency, Outside Shahpur Gate, Opposite Chisti Chambers Narayan Kunj, **Ahmedabad-**380001	Karnataka State Seed Certification Agency, KAIC Premises, Opposite Baptist Hospital, Hebbel, **Bangalore-560024**
Maharashtra State Seed Certification Agency, In front of NilKanth Cotton Mill, NH-6 Muzhzapur Road, Shivani **Akola** – 444 005	Madhya Pradesh State Seed Certification Agency, HIG/A-7, BDA Colony, Near 1250 Hospital, Tulsinagar, **Blopal-**462003
Orissa State Seed Certification Agency, Cold Storage Campus, Samantrapur **Bhubaneshwar-**751002	Uttaranchal state seed certification agency, **Dehradun**
Haryana State Seed Certification Agency, SCO 1038-39, Sector 22-B **Chandigarh-**160020	Assam State Seed Certification Agency, Dr. B.K. Kskoti Road Ulubari, **Guwahati-**781007
AP state seed certification agency, HACA Bhavan, Opposite Public Garden, **Hyderabad-500004**	West Bengal State Seed Certification Agency, 238, Netaji Subhash Chandra Bose Road, **Calcutta-** 700040
Rajasthan State Seed & Organic Production Certification Agency, 3rd Floor, Pant Krishi Bhawan, Jan Path, **Jaipur-**302004 **- Rajasthan**	Uttar Pradesh State Seed Certification Agency, A-284, Sector 5, Indira Nagar, **Lucknow**
Punjab State Seed Certification Authority, SCO-837-838, Sector 22-A, **Chandigarh-**160022	Chhattisgarh State Seed Certification Agency, Indira Gandhi, Agri. University Campus, Krishak Nagar, **Raipur-**492006 (C.G.)
Bihar State Seed Certification Agency, Tranquality Riding Road, Sheikhpura, **Patna-**800014	HP state seed certification agency, Nalagarh House, **Shimla-171005**
Seed Certification Wing Department of Agriculture Jammu Division, Talab Tilloo **Jammu**	Seed Certification Wing Department of Agriculture Kashmir Division,Lalmandi Post Office Jawahar Nagar, **Srinaga**r-190008
Seed Certification Unit Delhi Administration, Room No. 5 & 6, Old Civil Supply Building, New Courts, Tis Hazari, **Delhi-**110004	Department of Seed Certification Directorate of Agriculture, Vikas Bhavan **Trivandrum-**647041
Punducherry State Seed Certification Agency, New Light House Road, Vamba Keerapalayam, **Punducherry** -605001	Seed Certification Wing Department of Agriculture Government of Sikkim **Gangtok-**737101

State Seeds Corporation	
Maharashtra State Seeds Corporation Ltd., Mahabeej Bhavan, Amravati Road, **Akola– 444104 (MS)**	Rajasthan State Seeds Corporation Ltd., Pant Krishi Bhavan, Bhagwan Dass Road, **Jaipur – 302005 (Rajasthan)**
Assam Seeds Corporation Ltd., Khanapara, **Guwahati – 22 , (Assam)**	Orissa State Seeds Corporation Ltd., Santrapur, **Bhubaneshwar – 751002 (Odisha)**
Bihar Rajya Beej Nigam Ltd., Indira Bhavan, 2nd Floor,Ram,charitra Singh Path, **Patna – 800001(Bihar)**	West Bengal Seeds Corporation Ltd., 4, Gangadhar Babu lane, 5th Floor, **Kolkata – 700012 (WB)**
The Haryana Seeds Development Corporation Ltd., Bay No. 3-6, Sector-2, **Panchkula – 134112 (Haryana)**	Punjab State Seeds Corporation Ltd., SCO Nos. 835 – 836, Sector – 22 A **Chhandigarh.**
Karnataka State Seeds Corporation Ltd., Beej Bhavan, Bellary Road Hebbal, **Bangalore -560024 (Karnataka)**	Gujarat State Seeds Corporation Ltd., Beej Bhavan, Sector – 10–A, **Gandhinagar – 382043**
Andhra Pradesh State Seed Development Corporation Ltd.,510 – 193, IInd Floor, HACA Bhavan,**Hyderabad – 500004**	U.P. Seeds & Tarai Development Corporation Ltd., Pantnagar, P.O. Haldi, **Distt. – Nainital (Uttarakhand)**
The National Agriculture Cooperative Marketing Federation Ltd., “NAFED HOUSE” Sidharth Enclave **New Delhi - 110014**	M.P. Rajya Beej Evam Farm Vikas Nigam Ltd., Beej Bhawan, Mother Taresh Road, Arera Hills, **Bhopal-462016**

ANNEXURE-XVIII

PULSES: ALL INDIA- ZONE-WISE CROP CALENDER: PACKAGE OF PRACTICE

Zone/States / Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Chickpea					
States	Punjab, Haryana, Delhi, Rajasthan, West Uttar Pradesh, Plains of Uttrakhand	East Uttar Pradesh, Bihar, West Bengal, Jharkhand, Assam, J&K	M.P., Chhattisgarh, Maharashtra, Gujarat and (Bundelkhand Region of UP)	A. P., Kerala, Karnataka, Tamil Nadu, Odisha	J&K, H.P., Uttrakhand NEH States (Sikkim, Nagaland, Meghalaya, Manipur, Mizoram, Tripura, Arunachal Pradesh)
Sowing time					
Rainfed Areas	1st fortnight of Oct.	1st fortnight of Oct.	1st fortnight of Oct.	1st fortnight of Oct.	1st fortnight of Oct. -2nd fortnight of Oct.
Irrigated Areas	Last week of Oct. - 1st week of Nov.	Last week of Oct. - 1st week of Nov.	Last week of Oct. - 1st week of Nov.	2nd fortnight of Nov. - 1st fortnight of Dec.	1st fortnight of Nov. - 1st fortnight of Dec.
Late sown Areas	1st fortnight of Dec. -2nd fortnight of Dec.	1st fortnight of Dec. - 2nd fortnight of Dec.	1st fortnight of Dec.	2nd fortnight of Dec.	2nd fortnight of Dec.
Seed Rate					
Small size	60-70 kg/ha	70-80 kg/ha	70-80 kg/ha	70-80 kg/ha	70-80 kg/ha
Medium size	80-90 kg/ha	80-90 kg/ha	80-90 kg/ha	80-90 kg/ha	80-90kg/ha
Bold size	100- 120 kg/ha	90-100 kg/ha	100- 120 kg/ha	90- 100 kg/ha	100- 120 kg/ha
Spacing					
Timely Sown	30 X 10 cm	30 X 10 cm	30 X 10 cm	30 X 10 cm	30 X 10 cm
Late Sown	25 X10 cm	25 X10 cm	25 X10 cm	25 X10 cm	25 X10 cm
Irrigated	45 X 10 cm	45 X 10 cm	45X 10 cm	45 X 10 cm	45 X 10 cm
Seed Treatment					
Fungicide	2 gm Thiram + 1 gm Carbendazim or Carboxin (Vitavax) 2 gm/kg of Seeds	2 gm Thiram + 1 gm Carbendazim or Carboxin (Vitavax) 2 gm/kg of Seeds	2 gm Thiram + 1 gm Carbendazim or Carboxin (Vitavax) 2 gm/kg of Seeds	2 gm Thiram + 1 gm Carbendazim or Carboxin (Vitavax) 2 gm/kg of Seeds	2 gm Thiram + 1 gm Carbendazim or Carboxin (Vitavax) 2 gm/kg of Seeds
Insecticide	Thiamethoxam 70 W.P. @ 3 gm/kg Seed	Thiamethoxam 70 W.P. @ 3 gm/kg Seed	Thiamethoxam 70 W.P. @ 3 gm/kg Seed	Thiamethoxam 70 W.P. @ 3 gm/kg Seed	Thiamethoxam 70 W.P. @ 3 gm/kg Seed
Rhizobium	Rhizobium 5 gm + PSB 5 gm/kg	Rhizobium 5 gm + PSB 5 gm/kg	Rhizobium 5 gm + PSB 5 gm/kg	Rhizobium 5 gm + PSB 5 gm/ kg	Rhizobium 5 gm + PSB 5 gm/kg

Zone/States Crop	**NWPZ**	**NEPZ**	**CZ**	**SZ**	**NHZ**
Fertilizer (kg/ha) (*Soil test based applied as Basal*)					
Macronutrients	N:P:K:S 18-20:40-60:20:20	N:P:K:S 15-20:40-60: 20 : 20	N:P:K:S 20:40:20:20	N:P:S 15:30-40:20	N:P:K:S 20-25 :40:20:20
Micronutrients	$ZnSo_4$ @ 25 kg /ha, Mo (Na-Molybdate) @ 3.5g for seed treatment	$ZnSo_4$ @ 25 kg /ha, Mo (Na-Molybdate) @ 3.5g for seed treatment	$ZnSo_4$ @ 25 kg /ha, Mo (Na-Molybdate) @ 3.5g for seed treatment	$ZnSo_4$ @ 25 kg /ha, Mo (Na-Molybdate) @ 3.5g for seed treatment	$ZnSo_4$ @ 25 kg /ha, Mo (Na-Molybdate) @ 3.5g for seed treatment
Foliar Spray *(Need based)*	Urea @ 2% at 45-55 DAS, DAP @ 2% Boron @ 0.2% at flowering (50-60 DAS)	Urea @ 2% at 45-55 DAS, DAP @ 2% Boron @ 0.2% at flowering (50-60 DAS)	Urea @ 2% at 45-55 DAS, DAP @ 2% Boron @ 0.2% at flowering (50-60 DAS)	Urea @ 2% at 45-55 DAS, DAP @ 2% Boron @ 0.2% at flowering (50-60 DAS)	Urea @ 2% at 45-55 DAS, DAP @ 2% Boron @ 0.2% at flowering (50-60 DAS)
Irrigation	Two irrigations 1st at Branching (40 -50 DAS) & 2nd at pod initiation (70-80 DAS)	Two irrigations 1st at Branching (40 -50 DAS) & 2nd at pod initiation (70-80 DAS)	Two irrigations 1st at Branching (40 -50 DAS) & 2nd at pod development (70-80 DAS)	Two irrigations 1st at pre flowering (45-55 DAS), and 2nd at pod development stage (70-80 DAS)	One irrigation at pod development stage (70-80 DAS)
Weed Management					
Manual	One hand weeding at 25-30 DAS	One hand weeding at 25-30 DAS	One hand weeding at 25-30 DAS	One hand weeding at 25- 30 DAS	One hand weeding at 25-30 DAS
Chemical	Pendimethalin at PE stage @ 1-1.25 Kg a.i. /ha or Fluchloralin @ 0.75 kg a.i. /ha.	Pendimethalin at PE stage @ 1 – 1.25 kg a.i. /ha	Pendimethalin at PE stage @ 1 – 1.25 Kg a.i./ha	Pendimethalin at PE stage @ 1 – 1.25 Kg a.i./ha	Pendimethalin at PE stage @ 1 – 1.25 Kg a.i./ha
Maturity/ Harvesting					
Rainfed	130-140 DAS Early March- Early April	120-140 DAS Mid -March- April	120-140 DAS Mid -Feb- Mid March	120-140 DAS Mid- Jan-Last March	120-140 DAS Mid - March- Early April
Irrigated	120-140 DAS Mid- March- Mid April	120-140 DAS Mid -March- Mid April	120-140 DAS Mid- March- Mid April	120-140 DAS Early March-Last April	120-140 DAS Mid -March- Mid April
Late Sown	120-130 Last March-Last April	120-130 Last March-Last April	125-135 Last March-Last April	120-130 Last March-Last April	120-130 DAS Last March-Last April
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)	Chickpea + Mustard (4:2 and 6:2) Chickpea + Wheat (2:2)

Zone/States Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Pigeonpea					
States	Punjab, Haryana, Delhi, Rajasthan, West Uttar Pradesh, Plains of Uttrakhand	East Uttar Pradesh, Bihar, West Bengal, Jharkhand, Assam, J&K	M.P., Chhattisgarh, Maharashtra, Gujarat and (Bundelkhand Region of UP)	A. P., Kerala, Karnataka, Tamil Nadu, Odisha	J& K, H.P., Uttrakhand NEH States (Sikkim, Nagaland, Meghalaya, Manipur, Mizoram, Tripura, Aru.Pradesh)
Sowing time					
Normal	2nd fortnight of May - 1st fortnight of June Summer: Mid-April-1st week of May	Early: 1st fortnight of June Late: 1st fortnight of July Rabi: Mid Sep.- Mid Oct.	Rainfed: 1st fortnight of July Irrigated: 2nd fortnight of June Rabi: Mid Sep.- Mid Oct.	Kharif: Onset of Monsoon/ 2nd fortnight of June Rabi: Mid Sep.- Mid Oct.	Early: Mid May-Mid July
Transplant (Bidar/Dharwad)	-	-	1stfortnight of May- 1stfortnight of June	1stfortnight of May- 1stfortnight of June	-
Seed Rate & Spacing					
Normal	18-20 kg/ha; 45X15 cm	Early: 18-20 kg/ha,45X15cm Late - 12-15kg/ha ,60X10cm Rabi: 25-30 kg/ha;30X10 cm	Early:18-20kg/ha,45x15cm Late:15-18kg/ha;60X20cm Rabi: 25-30 kg/ha;30X10 cm	Early:15-18kg/ha;45x10cm Rabi:25-30kg/ha;30X10cm	Early:18-20 kg/ha,45X15cm
Transplant (Bidar/Dharwad)			Seed Rate- 2-5 kg/ha Spacing: Irrigated: 5ftX 3ft Rainfed 6ftX 3 ft (MP- Shahdol, Rewa, Maharashtra- Vidarbha and some parts of MH)	Seed Rate- 2-5 kg/ha Spacing: Irrigated: 5ftX 3ft Rainfed -6ftX 3 ft Karnataka- Gulbarga, Bijapur, Bidar, Dharwad etc. and some parts of AP, TN and Telangana)	

Zone/States / Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Seed Treatment					
Fungicide	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg
Insecticide	Thiamethoxam 70 W.P. @ 3 gm/Kg Seed	Thiamethoxam 70 W.P. @ 3 gm/Kg Seed	Thiamethoxam 70 W.P. @ 3 gm/Kg Seed	Thiamethoxam 70 W.P. @ 3 gm/Kg Seed	Thiamethoxam 70 W.P. @ 3 gm/Kg Seed
Rhizobium	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg
Fertilizer (kg/ha) *(Soil test based as Basal dose)*	N:P:S: ZnSo4 15-20:40:20:25	N:P :S: ZnSo4 15-20:40:20:25	N : P : S 15:40:20	N: P: S 15:30:20	N:P:S: ZnSo4 15-20:40 : 20:25
Irrigation	One irrigation pod development stage if required (100-110 DAS)	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 (100-110 DAS)	One irrigation pod development stage if required (100-110 DAS)	One irrigation pod development stage if required (100-115 DAS)
IC Operation (Nipping)	-	-	1st at 40-45 DAS & 2nd at 55-60 DAS	1st at 40-45 DAS & 2nd at 55-60 DAS	-
Weed Management					
Manual	Two hand weedings at 25 & 45 DAS	Two hand weeding at 25 & 45 DAS	Two hand weedings at 25 & 45 DAS	Two hand weedings at 25 & 45 DAS	Two hand weeding at 25 & 45 DAS
Chemical	Application of Pre-emergence Pendimethalin /Alachlor/Metachlor @ 1 – 1.5 a.i. kg/ha.	Application of Pre-emergence Pendimethalin /Alachlor/Metachlor @ 1 – 1.5 a.i. kg/ha.	Application of Pre-emergence Pendimethalin /Alachlor/Metachlor @ 1 – 1.5 a.i. kg/ha.	Application of Pre-emergence Pendimethalin /Alachlor/Metachlor @ 1 – 1.5 a.i. kg/ha.	Application of Pre-emergence Pendimethalin /Alachlor/Metachlor @ 1 – 1.5 a.i. kg/ha.
Maturity/Harvesting					
Kharif	190-200 DAS Oct.-Dec.	190-200 DAS Nov.-Jan.	140-190 DAS Oct.-Jan.	145-170 DAS Sep.-Oct.	200-230 DAS Oct.-Dec.
Rabi	-	240-260 DAS Jan.- Feb.	200-230 DAS Jan.- Feb.	200-230 DAS Jan.- Feb.	-
Summer	190-200 DAS Oct.-Nov.	-	-	-	-
Dharwad	-	-	180-200 DAS May-June	180-200 DAS May-June	-
Cropping System	Pigeonpea-wheat sequential cropping Intercropping with Urdbean or Moongbean	Early - Pigeonpea- wheat Late –Pigeonpea +Sorghum Moong/Urd/Sesame by pairing pigeonpea row at	Pigeonpea+ Groundnut (4 :2)Pigeonpea + Soybean (4: 2) Pigeonpea + Sorghum (2:1)	Pigeonpea+ Sorghum (2:1) Pigeonpea + Groundnut (4: 2) Pigeonpea+Mung/Urdbean/	Pigeonpea:Sorghum (1:1) Pigeonpea:Pearl millet (1:1) Pigeonpea+ Cauliflower/Capsicum

	(1:1 row)	40/80 cm & planting one row of intercrop	Pigeonpea +Urdbean(1:1)	Cowpea (1:1)	

Zone/States / Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Mung/Urd					
States	Punjab, Haryana, Delhi, Rajasthan, West Uttar Pradesh, Plains of Uttrakhand	East Uttar Pradesh, Bihar, West Bengal, Jharkhand, Assam, J&K	M.P., Chhattisgarh, Maharashtra, Gujarat and (Bundelkhand Region of UP)	A. P., Kerala, Karnataka, Tamil Nadu, Odisha, Telangana	J& K, H.P., Uttrakhand NEH States (Sikkim, Nagaland, Meghalaya, Manipur, Mizoram, Tripura, Aru.Pradesh)
Sowing Time					
Kharif	1st fortnight of July/ Onset of monsoon	1st fortnight of July/ Onset of monsoon	2nd fortnight of June / Onset of monsoon	2nd fortnight of June / Onset of monsoon	1st week of July to 1st week of Aug.
Rabi	-	-	2nd fortnight of Oct.- 2nd fortnight of Nov.	October begging to January ending	-
Spring/ Summer	Feb. (end) to March(mid)/ March(mid) to April (mid)	Feb. (mid) to March(beginning) / March(end) to April (mid)	Feb. (end) to March(mid)/ March(mid) to April (beginning)	Feb. (mid) to March(mid) / March(mid) – April (mid)	Feb.(end) to March (end) / March (end) to Mid April
Seed rate & Spacing					
Kharif	15-20 kg/ha; 45X10 cm	15-20 kg/ha;45X10 cm	15-20 kg/ha;45X10 cm	15-20 kg/ha;45X10 cm	15-20 kg/ha;45X10 cm
Rabi	-	-	25-30 kg/ha;30X10 cm,	25-30 kg/ha30X10 cm,	-
Spring/ Summer	30-35 kg/ha , 25X5 cm 20-25kg/ ha ,45X10 cm	30-35 kg/ha , 25X5 cm 20-25kg/ ha , 45X10 cm	30-35 kg/ha , 25X5 cm 20-25kg/ ha , 45X10 cm	30-35 kg/ha , 25X5 cm 20-25kg/ ha , 45X10 cm	30-35 kg/ha , 25X5 cm 20-25kg/ ha , 45X10 cm
Seed Treatment					
Fungicide	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @ 3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @ 3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @ 3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @ 3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @ 3 gm or Trichoderma 5 gm / kg
Insecticide	Thiamethoxam 70 W.P. @ 3 gm/kg Seed	Thiamethoxam 70 W.P. @ 3 gm/kg Seed	Thiamethoxam 70 W.P. @ 3 gm/kg Seed	Thiamethoxam 70 W.P. @ 3 gm/kg Seed	Thiamethoxam 70 W.P. @ 3 gm/kg Seed
Rhizobium	Rhizobium@5gm/kg seed	Rhizobium @5gm/kg seed	Rhizobium @5gm/kg seed	Rhizobium@5gm/kg seed	Rhizobium@5gm/kg seed

Zone/States Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Fertilizer (kg/ha) (Soil test based applied as basal dose)					
Kharif	N:P:K:S 10:40:20:20 as (Basal) Mo (Na-Molybdate) @ 3.5g for seed treatment	N:P:K:S 10:40:20:20 as (Basal) Mo (Na- Molybdate) @ 3.5g for seed treatment	N:P:K:S 10:30-40: 20 :20 as (Basal) Mo (Na-Molybdate) @ 3.5g for seed treatment	N:P:K:S 15-20:30-40 : 20 :20 as (Basal) Mo (Na-Molybdate) @ 3.5g for seed treatment	N:P:K:S 10 : 40 : 20 : 20 as (Basal) Mo (Na-Molybdate) @ 3.5g for seed treatment
Rabi	-	-	N:P:K:S 20-25:30-40:20:20	N:P:K:S 20-25:30-40:20:20	-
Spring/Summer	N:P:K:S- 10:30:20:20	N:P:K:S- 20:30:20:20	N:P:K:S- 20:30:20:20	N:P:K:S 20-25:30-40:20:20	N:P:K:S 20-25:30-40:20:20
Irrigation					
Rabi	-	-	As per requirement of crop in absence of rain	As per requirement of crop in absence of rain	-
(Spring/Summer)	1st at 25 DAS subsequent as per requirement	1st at 25 DAS subsequent as per requirement	1st at 25 DAS subsequent as per requirement	1st at 25 DAS subsequent as per requirement	1st at 25 DAS subsequent as per requirement
Weed Managment					
Manual	One hand weeding at 30 DAS	One hand weeding at 30 DAS	One hand weeding at 30 DAS	One hand weeding at 30 DAS	One hand weeding at 30 DAS
Chemical	Pre-emergence application of Pendimethalin @ 0.75-1kg/ha.	Pre-emergence application of Pendimethalin @ 0.75-1kg/ha.	Pre-emergence application of Pendimethalin @ 0.75-1kg/ha.	Pre-emergence application of Pendimethalin @ 0.75-1kg/ha.	Pre-emergence application of Pendimethalin @ 0.75-1kg/ha.
Maturity/Harvesting					
Kharif	70-90 DAS; Sep.-Oct.	70-90 DAS; Sep.-Oct.	75-85; Sep.-Oct.	70-90 DAS; Sep.-Oct.	65-85 DAS; Sep.-Oct.
Rabi	-	-	75-85 DAS; Jan.-Feb.	75-85 DAS; Jan.-Feb.	-
(Spring/Summer)	70-90 DAS; May-June	70-90 DAS; May-June	70-90 DAS; May-June	70-90 DAS; Mar.-April 70-90 DAS; May-June	70-90 DAS; Mar.-April 70-90 DAS; May-June

Zone/States Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Cropping System	Intercropping of Moong bean /Urdbean with summer planted – sugarcane (2:1) and Sunflower (6:2 row ratio), Maize-Potato/ Mustard-Mungbean, Rice- Wheat-Mungbean	Intercropping of Moong bean /Urdbean with summer planted – sugarcane (2:1) and Sunflower (6:2 row ratio), Spring sugarcane + Mungbean, Maize- Rajmash-Mungbean	Intercropping of Moong bean /Urdbean with summer planted Sunflower (6:2 row ratio)	Rice – Rice-Greengram/ Blackgram Mungbean/Urdbean+ Sugarcane(2:1); Relay cropping in rice fallow	Intercropping of Mung bean /Urdbean with summer planted – sugarcane (2:1) and Sunflower (6:2 row ratio) Mung/Urd: Capsicum;
Major Potential Area/ Districts for Spring/ Summer	**Punjab-** Moga, Muktsar,Ludhiana, Sangrur, Ferozpur, Tarantaran, Mansa,Bathinda,Patiala, Nava Shahar, Barnala, Amritsar, Hoshiarpur **Haryana-** Palwal, Kaithal, Fatehabad, Sonipat, Panipat, Jind, Mahindergarh, Karnal, Ambala, Yamuna Nagar	**Bihar-** Saharsa, Supol, Madhubani, Muzaffarpur **Jharkhand-** Garhwa, Chatra, Ramgarh, Godda, Jamtara, Deoghar **West Bengal-** South 24-Parganas, Nadia, Uttar Dinajpur, Howrah, Birbhum, Paschim Medinipur	**Madhya Pradesh-** Hoshangabad, Bhopal, Rewa, Morena, Gwalior, Sagar, Jabalpur, Ujjain, Indore, Shahdol **Gujarat-** Sabarkantha, Surat, Junagarh, Jamnagar, Panchmahal, Tapi, Banaskantha,Porbandar, Vadodara, Dahod, Baharuch	**Tamil Nadu-** New Delta Region & Kaveri Delta **Telangana-** Khammam, Karimnagar, Warangal, Adilabad, Nizamabad, Mahabubnagar	

Zone/States / Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Lentil					
States	Punjab, Haryana, Delhi, Rajasthan, West Uttar Pradesh, Plains of Uttrakhand	East Uttar Pradesh, Bihar, West Bengal, Jharkhand, Assam, J&K	M.P., Chhattisgarh, Maharashtra, Gujarat and (Bundelkhand Region of UP)	A. P., Kerala, Karnataka, Tamil Nadu, Odisha	J& K, H.P., Uttrakhand NEH States (Sikkim, Nagaland, Meghalaya, Manipur, Mizoram, Tripura, Aru. Pradesh)
Sowing time	2nd fortnight of Oct. to 1st fortnight Nov.	2nd fortnight of Oct. to 1st fortnight Nov.	1st fortnight of Oct.	-	1st week of Nov.- 1st week of Dec.
Seed Rate & Spacing					
Small	40-45 kg/ha;30x5 cm	40-45 kg/ha;30x5 cm	45-50 kg;30 x 5 cm	-	40-45 kg/ha; 30x5 cm
Bold	50-60 kg/ha; 20X5cm	50-60 kg/ha; 20X5cm	50-60 kg/ha; 20X5cm	-	50-60 kg/ha; 20X5cm
Utera	-	-	Utera sowing 50-60 kg	-	-
Seed Treatment					
Fungicide	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg	-	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg
Insecticide	Chlorpyriphos 20 EC @8 ml/kg of seed	Chlorpyriphos 20 EC @8 ml/kg of seed	Chlorpyriphos 20E.C. @8 ml/kg of seed	-	Chlorpyriphos 20EC @8 ml/kg of seed
Rhizobium	Rhizobium + PSB, one packet each for 10kg seed	Rhizobium + PSB, one packet each for 10 kg seed	Rhizobium + PSB, one packet each for 10kg seed	-	Rhizobium + PSB, one packet each for 10 kg seed
Fertilizer (kg/ha) (*Soil test based applied as Basal dose*)					
	N:P:K:S 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 20:30-40:20: 20
Weed Management					
Manual	One hand weeding at 30 DAS	One hand weeding at 30 DAS	One hand weeding at 30 DAS	-	One hand weeding at 30 DAS
Chemical	Pre- emergence Pendimethalin @ 0.75-1.0 kg/ha.	Pre-emergence Pendimethalin @ 0.75-1.0 kg/ha.	Pre-emergence Pendimethalin @ 0.75-1.0 kg/ha.	-	Pre-emergence application of Pendimethalin @ 0.75-1.0 kg/ha.

Lentil continued……

Zone/States / Crop	NWPZ	NEPZ	CZ	SZ	NHZ
					Lentil Continued
Maturity/ Harvesting	120-140 DAS March-April	135-140 DAS March-April	130-140 DAS March-April	-	120-140 DAS March-April
Cropping System	Inter cropping with barely, rape / mustard (2:2) Inter cropping with autumn sugarcane (2:1).	Rice- lentil sequential cropping in Northern Bihar	Rice-lentil Utera cropping in Chhattisgarh. Intercrop with Linseed, Barley and Mustard	-	Inter cropping with barely, rape & mustard (2:1) Lentil + Vegetable crops intercropping

Field pea					
States	Punjab, Haryana, Delhi, Rajasthan, West Uttar Pradesh, Plains of Uttrakhand	East Uttar Pradesh, Bihar, West Bengal, Jharkhand, Assam, J&K	M.P., Chhattisgarh, Maharashtra, Gujarat and (Bundelkhand Region of UP)	A. P., Kerala, Karnataka, Tamil Nadu, Odisha	J& K, H.P., Uttrakhand NEH States (Sikkim, Nagaland, Meghalaya, Manipur, Mizoram, Tripura, Aru.Pradesh)
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.	2nd week of Oct- 2nd week of Dec	Third week of Oct. – Ist week of Nov
Seed rate & spacing					
Tall	60-70 kg; 30x10 cm	60-70 kg; 30x10 cm	60-70 kg; 30x10 cm	60-70 kg; 30x10 cm	60-70 kg; 30x10 cm
Dwarf	80-100kg; 22X10 cm	80-100kg:22X10 cm	80-100kg; 22X10 cm	80 -90 kg/ha; 22X10 cm	80-100kg; 22X10 cm
Seed Treatment					
Fungicide	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg
Insecticide	Chlorpyriphos 20 EC @8 ml/Kg of seed	Chlorpyriphos 20 EC @8 ml/Kg of seed	Chlorpyriphos 20 EC @8 ml/Kg of seed	Chlorpyriphos 20 EC @8 ml/Kg of seed	Chlorpyriphos 20 EC @8 ml/Kg of seed
Rhizobium	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg
Fert. Dose (kg/ha) (Soil test based applied as Basal)	N:P:K:S 20-40:60:20:20	N:P:K:S 20-40:60:20:20	N:P:K:S 20-40 : 60:20:20	N:P:K:S 20-40 : 60:20:20	N:P:K:S 20-40:60:20:20
Weed management					
Manual	One hand weeding at 30 DAS	One hand weeding at 30 DAS	One hand weeding at 30 DAS	One hand weeding at 30 DAS	One hand weeding at 30 DAS
Chemical	Pendimethalin @1 kg a.i. as pre-emergence	Pendimethalin @1 kg a.i. as pre-emergence	Pendimethalin @1 kg a.i. as pre-emergence	Pendimethalin @1 kg a.i. as pre-emergence	Pendimethalin @1 kg a.i. as pre-emergence
Maturity/ Harvesting	120-140 DAS March-April	125-135 DAS March-April	130-150 DAS Mid Feb- Mid- March	120-140 DAS Feb- March	120-140 DAS Feb- March
Cropping System	Sequential cropping after rice, maize or pearl millet	Wheat-Pea	Sorghum/soybean/Pearl millet – pea	-	Sequential cropping after rice, maize or pearl millet Field pea- Vegetable crops

Zone/States Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Lathyrus					
States	Punjab, Haryana, Delhi, Rajasthan, West Uttar Pradesh, Plains of Uttrakhand	East Uttar Pradesh, Bihar, West Bengal, Jharkhand, Assam, J&K	M.P., Chhattisgarh, Maharashtra, Gujarat and (Bundelkhand Region of UP)	A. P., Kerala, Karnataka, Tamil Nadu, Odisha	J& K, H.P., Uttrakhand NEH States (Sikkim, Nagaland, Meghalaya, Manipur, Mizoram, Tripura, Aru. Pradesh)
Sowing time					
Rabi	-	Last week Oct. to early Nov.	Last week Oct. to early Nov.	-	Last week Oct. to early Nov.
Utera	-	-	Last week of Sep to First week to Oct	-	-
Seed Rate /Spacing					
Line Sowing	-	40-60 kg/ha (30X10 cm)	40-60 kg/ha (30X10 cm)	-	40-60 kg/ha,(30X10 cm)
Utera(Broadcast)	-	70-80 kg/ha	70-80 kg/ha	-	70-80 kg/ha
Seed Treatment					
Fungicide	-	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg	-	Thiram @ 2gm + Carbendazim @ 1gm or Thiram @3 gm or Trichoderma 5 gm / kg
Insecticide	-	Chlorpyriphos 20 EC @8 ml/kg of seed	Chlorpyriphos 20 EC @8 ml/kg of seed	-	Chlorpyriphos 20 EC @8 ml/kg of seed
Rhizobium	-	Rhizob.culture10gm/ kg	Rhizob.culture 10gm/kg	-	Rhizobium culture 10gm/kg
Fertilizer (kg/ha) (Soil test based applied as basal)	-	N:P:K:S 0:40-60:0:0	N:P:K:S 0:40-60:0:0	-	N:P:K:S 0:40-60:0:0
Irrigation		One irrigation(60-70 DAS)	One irrigation(60-70 DAS)	-	One irrigation(60-70 DAS)
Manual *(if soil condition permits)*	-	one hand weedings at 30 – 35 DAS	one hand weedings at 30 - 35 DAS	-	one hand weedings at 30 -35 DAS
Chemical	-.	Application of Pendimethalin as pre-emergence stage @ 1 kg a.i./ha	Application of Pendimethalin as pre-emergence stage @ 1 kg a.i./ha	-	Application of Pendimethalin as pre-emergence stage @ 1 kg a.i./ha.
Maturity/ Harv.	-	110-120 DAS	95-100 DAS	-	110-120 DAS
Cropping System	-	-	Can be grown with Rice as relay/ Utera	-	-

Zone/States / Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Horsegram					
States	Punjab, Haryana, Delhi, Rajasthan, West Uttar Pradesh, Plains of Uttrakhand	East Uttar Pradesh, Bihar, West Bengal, Jharkhand, Assam, J&K	M.P., Chhattisgarh, Maharashtra, Gujarat and (Bundelkhand Region of UP)	A. P., Kerala, Karnataka, Tamil Nadu, Odisha	J& K, H.P., Uttrakhand NEH States (Sikkim, Nagaland, Meg., Man.r, Mizo., Tripura, Aru.P)
Sowing Time					
Kharif	Last June - last July	-	-	-	Last June – last July
Rabi	-	Last Oct.- early Nov.	Ist fortnight of Sep. -early Oct.	Ist fortnight of Sep.-early Oct.	-
Seed Rate /Spacing					
Line Sowing	22-30 kg/ha 40-45X25-30 cm	22-30 kg/ha 40-45X25-30 cm	22-30 kg/ha 40-45X25-30 cm	22-30 kg/ha 40-45X25-30 cm	22-30 kg/ha 40-45X25-30 cm
Broadcast	40-50 kg/ha	40-50 kg/ha	40-50 kg/ha	40-50 kg/ha	40-50 kg/ha
Seed Treatment					
Fungicide	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed
Insecticide	Chlorpyriphos 20 EC @ 8 ml/kg of seed	Chlorpyriphos 20 EC @8 ml/kg of seed	Chlorpyriphos 20 EC @ 8 ml/kg of seed	Chlorpyriphos 20 EC@ 8 ml/kg seed	Chlorpyriphos 20EC @ 8 ml/kg of seed
Rhizobium	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg
Fertilizer (kg/ha) *(STB)*	N:P:K:S 10:20:0:0	N:P:K:S 10:20:0:0	N:P:K:S 10:20:0:0	N:P:K:S 10:20:0:0	N:P:K:S 10:20:0:0
Irrigation	Grown as rainfed	Grown as rainfed	Grown as rainfed	Grown as rainfed	Grown as rainfed
Weed Management					
Manual	one hand weedings at 20-25 DAS	one hand weedings at 20-25 DAS	one hand weedings at 20-25 DAS	one hand weedings at 20-25 DAS	one hand weedings at 20-25 DAS
Chemical	Application of Pendimethalin as pre-emergence stage @ 0.75 - 1.00 kg a.i./ha	Application of Pendimethalin as pre-emergence stage @ 0.75 - 1.00 kg a.i./ha	Application of Pendimethalin as pre-emergence stage @ 0.75 - 1.00 kg a.i./ha	Application of Pendimethalin as pre-emergence stage @ 0.75 - 1.00 kg a.i./ha	Application of Pendimethalin as pre-emergence stage @ 0.75 - 1.00 kg a.i./ha
Maturity/ Harvesting	80-100 DAS Sep.-Oct.	80-100 DAS Jan.-Feb.	80-130 DAS Dec.-Feb.	80-110 DAS Dec.-Jan.	80-115 DAS Sep.-Nov.

Zone/States / Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Ricebean					
States	Punjab, Haryana, Delhi, Rajasthan, West Uttar Pradesh, Plains of Uttrakhand	East Uttar Pradesh, Bihar, West Bengal, Jharkhand, Assam, J&K	M.P., Chhattisgarh, Maharashtra, Gujarat and (Bundelkhand Region of UP)	A. P., Kerala, Karnataka, Tamil Nadu, Odisha	J& K, H.P., Uttrakhand NEH States (Sikkim, Nagaland, Meghalaya, Manipur, Mizoram, Tripura, Aru.Pradesh)
Sowing time					
Kharif (Grain Purpose)	2nd fortnight of August	-	-	-	2nd fortnight of August
Rabi (Fodder Purpose)	Upto September	-	-	-	Upto September
Seed Rate					
Grain Purpose	40-50 kg/ha; 45-60X5-10cm	-	-	-	40-50 kg/ha 45-60X510cm
Fodder	60-75 kg/ha; 45-60X5-10cm	-	-	-	60-75 kg/ha; 45-60X5-10cm
Seed Treatment					
Fungicide	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	-	-	-	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed
Insecticide	Chlorpyriphos 20 EC @8 ml/kg of seed	-		-	Chlorpyriphos 20 EC @8 ml/kg of seed
Rhizobium	Rhizobium culture 10gm/kg	-	-	-	Rhizobium culture 10gm/kg
Fertilizer(kg/ha) *(Soil test based applied as basal)*	Grown on residual soil fertility.	-	-	-	Grown on residual soil fertility.
Irrigation	Grown as rainfed	-	-	-	Grown as rainfed
Weed Manag. Manual	One hoeing @ 30 DAS is enough	-	-	-	One hoeing @ 30 DAS is enough
Maturity/ Harvesting	Kharif: 120-130 DAS Dec.-Jan. Rabi: Jan.-Feb.	-	-	-	Kharif: 120-130 DAS Dec.-Jan. Rabi: Jan.-Feb.
Cropping System	-	-	-	-	Mixed with Jute, Maize, Finger millets

Zone/States Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Mothbean					
States	Punjab, Haryana, Delhi, Rajasthan, West Uttar Pradesh, Plains of Uttrakhand	East Uttar Pradesh, Bihar, West Bengal, Jharkhand, Assam, J&K	M.P., Chhattisgarh, Maharashtra, Gujarat and (Bundelkhand Region of UP)	A. P., Kerala, Karnataka, Tamil Nadu, Odisha	J& K, H.P., Uttrakhand NEH States (Sikkim, Nagaland, Meghalaya, Manipur, Mizoram, Tripura, Aru.Pradesh)
Sowing time	2nd fortnight of July	-	2nd fortnight of July	-	-
Seed Rate	10-15 kg/ha 30-60-40X15cm	-	10-15 kg/ha 30-60-40X15cm	-	-
Seed Treatment					
Fungicide	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	-	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	-	-
Insecticide	Chlorpyriphos 20 EC @8 ml/kg of seed	-	Chlorpyriphos 20 EC @8 ml./kg of seed	-	-
Rhizobium	Rhizobium culture 10gm/kg	-	Rhizobium culture 10gm/kg	-	-
Fertilizer (kg/ha)	N:P:K 10:40:0	-	N:P:K 10:40:0	-	-
Irrigation	As per requirement	-	As per requirement	-	-
Weed Management					
Manual	One hoeing at 30 DAS	-	One hoeing at 30 DAS	-	-
Chemical	Pre Plant incorporation of fluchloralin (Basalin) @ 0.5 to 1 kg a.i./ha	-	Pre Plant incorporation of fluchloralin (Basalin) @ 0.5 to 1 kg a.i./ha	-	-
Maturity/ Harvesting	120-130 DAS Nov.-Dec.	-	120-130 DAS Nov.-Dec.	-	-
Cropping System	Mothbean+Pearlmillet (2:1)	-	Mothbean+Pearlmillet (2:1)	-	-

Zone/States Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Rajmash					
States	Punjab, Haryana, Delhi, Rajasthan, West Uttar Pradesh, Plains of Uttrakhand	East Uttar Pradesh, Bihar, West Bengal, Jharkhand, Assam, J&K	M.P., Chhattisgarh, Maharashtra, Gujarat and (Bundelkhand Region of UP)	A. P., Kerala, Karnataka, Tamil Nadu, Odisha	J& K, H.P., Uttrakhand NEH States (Sikkim, Nagaland, Meghalaya, Manipur, Mizoram, Tripura, Aru.Pradesh)
Sowing time					
Kharif	-	-	-	-	last week June to first week of July
Rabi	2^{nd} fortnight of October	2^{nd} fortnight of October	2^{nd} fortnight of October	2^{nd} fortnight of October	-
Spring	-	-	-	-	Spring (Lower hills) 2^{nd} fortnight of March
Seed Rate					
Kharif	-	-	-	-	100-125 kg/ha 45-50X8-10 cm
Rabi/Spring	100-125 kg/ha Rainfed:40cmx10 cm Irrigated: 30cmx10cm	100-125 kg/ha Rainfed: 40cmx10cm Irrigated:30cm x10cm	100-125 kg/ha Rainfed: 40 cmx10 cm Irrigated: 30cmx 10cm	100-125 kg/ha Rainfed: 40 cmx10cm Irrigated:30cmx10cm	100-125 kg/ha Rainfed: 40 cmx 10cm Irrigated: 30 cm x 10cm
Seed Treatment					
Fungicide	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed
Insecticide	Chlorpyriphos 20 EC @ 8 ml/kg of seed	Chlorpyriphos 20 EC @ 8 ml/kg of seed	Chlorpyriphos 20 EC @ 8 ml/kg of seed	Chlorpyriphos 20 EC @ 8 ml/kg of seed	Chlorpyriphos 20 EC @ 8 ml/kg of seed
Rhizobium	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg	Rhizobium culture 10gm/kg
Fertilizer(kg/ha) *(Soil test based applied as basal)*	N:P:K 90-120:60-80:0	N:P:K 90-120:60-80:0	N:P:K 90-120:60-80:0	N:P:K 90-120:60-80:0	N:P:K 90-120:60-80:0
Irrigation	25 DAS followed by irrigation at 75 DAS. 2 to 3 irrigation as per requirement	25 DAS followed by irrigation at 75 DAS. 2 to 3 irrigation as per requirement	25 DAS followed by irrigation at 75 DAS. 3 to 4 irrigation as per requirement	25 DAS followed by irrigation at 75 DAS. 3 to 4 irrigation as per requirement	25 DAS followed by irrigation at 75 DAS. 2 to 3 irrigation as per requirement

Zone/States Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Weed Management					
Manual	One hand weeding at 30-35 DAS	One hand weeding at 30-35 DAS	One hand weeding at 30-35 DAS	One hand weeding at 30-35 DAS	One hand weeding at 30-35 DAS
Chemical	Pendimethalin @ 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence
Maturity/ Harvesting					
Kharif	-	-	-	-	80-120 DAS Nov.-Dec.
Rabi	80-120 DAS Feb.-March	80-120 DAS Feb.-March	80-120 DAS Feb.-March	80-120 DAS Feb.-March	-
Spring	-	-	-	-	80-120 DAS Aug.-Sep.
Cropping System	-	-	-	-	Early Potato-Rajmash (2:2 or 2:3)

Zone/States / Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Cowpea					
States	Punjab, Haryana, Delhi, Rajasthan, West Uttar Pradesh, Plains of Uttrakhand	East Uttar Pradesh, Bihar, West Bengal, Jharkhand, Assam, J&K	M.P., Chhattisgarh, Maharashtra, Gujarat and (Bundelkhand Region of UP)	A. P., Kerala, Karnataka, Tamil Nadu, Odisha	J& K, H.P., Uttrakhand NEH States (Sikkim, Nagaland, Meghalaya, Manipur, Mizoram, Tripura, Aru.Pradesh)
Sowing time					
Kharif	Early June - End of July	Early June - End of July	Early June - End of July	-	-
Rabi	-	-	-	1st fortnight of Oct.-1st fortnight of Nov.	-
Summer	-	-	-	-	Grain Purpose: 2nd to 4th week of March Fodder purpose: February Green Manuring: April- May
Seed Rate					
Pure crop	20-25 kg/ha	20-25 kg/ha	20-25 kg/ha	20-25 kg/ha	20-25 kg/ha
Fodder/Green Manure	30-35 kg/ha	30-35 kg/ha	30-35 kg/ha	30-35 kg/ha	30-35 kg/ha
Spacing					
Bushy	35X10 cm	35X10 cm	35X10 cm	35X10 cm	35X10 cm
Spreading	45X15 cm	45X15 cm	45X15 cm	45X15 cm	45X15 cm
Seed Treatment					
Fungicide	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed	Bavistin@ 2g/kg or Trichoderma @ 4g/kg of Seed
Insecticide	Chlorpyriphos 20 EC @ 8 ml/kg of seed	Chlorpyriphos 20 EC @ 8 ml/kg of seed	Chlorpyriphos 20 EC @ 8 ml/kg of seed	Chlorpyriphos 20 EC @ 8 ml/kg of seed	Chlorpyriphos 20 EC @ 8 ml/kg of seed
Rhizobium	Rhizobium culture 10 gm/kg	Rhizobium culture 10 gm/kg	Rhizobium culture 10 gm/kg	Rhizobium culture 10 gm/kg	Rhizobium culture 10 gm/kg

Cowpea Continued……

Zone/States Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Fertilizer (kg/ha) *(Soil test based applied as basal)*	N:P:K 15-20:50-60:10-20	N:P:K 15-20:50-60:10-20	N:P:K 15-20:50-60:10-20	N:P:K 15-20:50-60:10-20	N:P:K 15-20:50-60:10-20
Irrigation	As per requirement	As per requirement	As per requirement	As per requirement	As per requirement
Weed Management					
Manual	One hand weeding at 20-30 DAS	One hand weeding at 20-30 DAS	One hand weeding at 20-30 DAS	One hand weeding at 20-30 DAS	One hand weeding at 20-30 DAS
Chemical	Pendimethalin @ 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence
Maturity/ Harvesting					
Kharif	90-100 DAS Oct.-Nov.	145-150 DAS Nov.-Dec.	65-85 DAS Sep.-Oct.	-	-
Rabi	-	-	-	80-120 DAS Dec.-Jan.	-
Summer	-	-	-	-	Grain Purpose: 85-105 DAS (May-June) Fodder Purpose: 90-110 DAS (April-May) Green Manure: 90-120 (Sep.-Oct.)
Cropping System	Sorghum+ Cowpea (1:1)	-	Pigeonpea+ Cowpea (1:1)	Maize+ Cowpea (1:1)	Sorghum+Cowpea (1:1)

ANNEXURE- XIX

SPECIFIC STANDARDS PRESCRIBED FOR CERTIFICATION AT FIELD STAGE FOR PULSES

Sl No	Crop	Minimum number of inspection	Isolation distance in meter		Off type plants/ earheads		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 Aschochyta stem blight and Anthracnose Aschochyta 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	250	100	0.1	0.2	-	-	-	-	-	-	-
8	Rice bean	2	50	20	0.1	0.2	-	-	-	-	-	-	-

ANNEXURE- XX

SEED STANDARD

Crop	Pure seed(Min)		Innert Matter (max)		Other crop seed(max)		Total weed seed(max)		Objectiona-ble 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	08	08	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	20/ 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.

ANNEX-XXI

LIST OF CONTACT DETAILS ATARI ZONES (I-VIII)

Zone	Correspondence Address	Contact Address	States/KVKs under Zone
Zone-I	**Dr. Rajbir Singh, Director**, Agricultural Technology Application Research Institute (Formerly Zonal Project Directorate) Zone-I, ICAR, PAU Campus, Ludhiana-141004 (Punjab)	0161- 2401018 **(O)** 2412719 0161-2412719 **(Fax)** zcu1ldh@gmail.com, narula512002@yahoo.co.in	PUNJAB HARYANA DELHI HIMACHAL PRADESH JAMMU & KASHMIR
Zone-II	**Dr. A. K. Singh, Director,** Agricultural Technology Application Research Institute (Formerly Zonal Project Directorate) Zone-II, Bhumi Vihar Complex, Salt Lake City, Sector III, Block GB, Kolkata-700097 (West Bengal)	033-23352355 **(O)** 23353830 033-23352355 **(Fax)** zpdkolkata@gmail.com	WEST BENGAL A&N ISLANDS BIHAR JHARKHAND
Zone-III	**Dr. A. K. Tripathi (Acting), Director**, Agricultural Technology Application Research Institute (Formerly Zonal Project Directorate) Zone-III Umiam (Barapani), Distt Ri-Bhoi, Meghalaya-793103	0364- 2570081 **(O)** 0364-2570396 2570081 **(Fax)** icarzcu3@gmail.com	ARUNACHAL PRADESH MEGHALAYA ASSAM MANIPUR MIZORAM NAGALAND SIKKIM TRIPURA
Zone-IV	**Dr.U. S. Gautam, Director**, Agricultural Technology Application Research Institute (Formerly Zonal Project Directorate) Zone-IV, ICAR, G.T. Road, Rawatpur, Kanpur-208002 (Uttar Pradesh)	0512-2550927 **(O)** 0512-2533560 **(Fax)** **zpdicarkanpur@gmail.com** **aksinghcsa@yahoo.co.in**	UTTAR PRADESH UTTRAKHAND

ANNEX-XXI continued…….

Zone	Correspondence Address	Contact Address	States/KVKs under Zone
Zone-V	**Dr. Y. G. Prasad, Director**, Agricultural Technology Application Research Institute (Formerly Zonal Project Directorate) Zone-V, CRIDA Campus, Santhosh Nagar, Hyderabad-500059 (Andhra Pradesh)	040- 24530300 **(O)** 040- 24533543 **(Fax)** zcu5hyd@gmail.com, zcu5hyd@yahoo.com	ANDHRA PRADESH TELANGANA MAHARASHTRA
Zone-VI	**Dr. S. K. Singh, Director,** Agricultural Technology Application Research Institute (Formerly Zonal Project Directorate) Zone-VI, CAZRI Campus, Diesel Shed Road, PO Krishi Upaj Mandi, Basni, Jodhpur-342005 Rajasthan	0291-2748412 **(O)** 2740516 2744367 **(Fax)** **zpd6jodhpur@gmail.com** **zpdzone6@yahoo.in**	RAJASTHAN GUJARAT
Zone-VII	**Dr. Anupam Mishra, Director,** Agricultural Technology Application Research Institute (Formerly Zonal Project Directorate) VII, JNKVV Campus, PO Adhartal, Jabalpur-482004 Madhya Pradesh	0761- 2680158 **(O)** 0761- 2680485 **(Fax)** zpd7jabalpur@gmail.com, amishra1958@yahoo.co.in	MADHYA PRADESH CHHATTISGARH ODISHA
Zone-VIII	**Dr. Sreenath Dixit, Director,** Agricultural Technology Application Research Institute (Formerly Zonal Project Directorate) Zone-VIII, MRS, H.A. Farm Post, Hebbal, Bengaluru-560024 Karnataka	080-23510616 **(O)** 23410614 23410615 **(Fax)** **icartot8@yahoo.com** **zpd8banglore@gmail.com**	KARNATAKA KERALA TAMIL NADU PONDICHERRY GOA LAKSHADWEEP

ANNEX-XXII

COMPARATIVE STATEMENT OF MSP FOR KHARIF CROPS (2012-13 TO 2016-17)

(Rs. Per quintal)

Commodity	Variety	2012-13	2013-14	% incr. Over 2012-13	2014-15	% incr. Over 2013-14	2015-16	% incr. Over 2014-15	2016-17 (Without bonus)	% incr. Over 2015-16	2016-17 (With bonus)	% increase over2015-16 (With bonus)
Kharif crops												
Paddy	Common	1250	1310	4.8	1360	3.8	1410	3.7	1470	4.3	1470	4.3
	Grade A	1280	1345	5.1	1400	4.1	1450	3.6	1510	4.1	1510	4.1
Jowar	Hybrid	1500	1500	0.0	1530	2.0	1570	2.6	1625	3.5	1625	3.5
	Maldandi	1520	1520	0.0	1550	2.0	1590	2.6	1650	3.8	1650	3.8
Bajra		1175	1250	6.4	1250	0.0	1275	2.0	1330	4.3	1330	4.3
Maize		1175	1310	11.5	1310	0.0	1325	1.1	1365	3.0	1365	3.0
Ragi		1500	1500	0.0	1550	3.3	1650	6.5	1725	4.5	1725	4.5
Arhar(tur)		**3850**	**4300**	**11.7**	**4350**	**1.2**	**4425^**	**1.7**	**4625^^**	**4.5**	5050	14.1
Moong		**4400**	**4500**	**2.3**	**4600**	**2.2**	**4650^**	**1.1**	**4800^^**	**3.2**	5225	12.4
Urad		**4300**	**4300**	**0.0**	**4350**	**1.2**	**4425^**	**1.7**	**4575^^**	**3.4**	5000	13.0
Cotton	Medium Staple	3600	3700	2.8	3750	1.4	3800	1.3	3860	1.6	3860	1.6
	Long Staple	3900	4000	2.6	4050	1.3	4100	1.2	4160	1.5	4160	1.5
GN. in shell		3700	4000	8.1	4000	0.0	4030	0.8	4120*	2.2	4220	4.7
Sunflower	Seed	3700	3700	0.0	3750	1.4	3800	1.3	3850*	1.3	3950	3.9
Soybean	Black	2200	2500	13.6	2500		-		-		2775	
	Yellow	2240	2560	14.3	2560	0.0	2600	1.6	2675*	2.9	2775	6.7
Sesame		4200	4500	7.1	4600	2.2	4700	2.2	4800^	2.1	5000	6.4
Niger seed		3500	3500	0.0	3600	2.9	3650	1.4	3725*	2.1	3825	4.8

$** Fair and remunerative price ** Bonus of Rs. 75 per quintal is payable over and above the MSP. ^ Bonus of Rs. 200 per quintal is payable over and above the MSP ^^ Bonus of Rs. 425 per quintal is payable over and above the MSP * Bonus of Rs. 100 per quintal is payable over and above the MSP **$$ Minimum support price of soybean yellow is also applicable to black variety during 2015-16 and 2016-17.

COMPARATIVE STATEMENT OF MSP FOR RABI CROPS (2012-13 to 2016-17)

(Rs. Per Quintal)

Commodity	2012-13	2013-14	% incr. Over 2012-13	2014-15	% incr. Over 2013-14	2015-16	% incr. Over 2014-15	2016-17	% incr. Over 2015-16	2017-18	% increase over 2016-17
Wheat	1350	1400	3.7	1450	3.6	1525	5.2	1625	6.62	-	-
Barley	980	1100	12.2	1150	4.5	1225	6.5	1325	8.20	-	-
Gram	**3000**	**3100**	**3.3**	**3175**	**2.4**	**3425****	**7.9**	**4000**	**14.30**	**-**	**-**
Lentil	**2900**	**2950**	**1.7**	**3075**	**4.2**	**3325****	**8.1**	**3950**	**16.20**	**-**	**-**
Mustard	3000	3050	1.7	3100	1.6	3350	8.1	3700	10.50	-	-
Safflower	2800	3000	7.1	3050	1.7	3300	8.2	3700	12.20	-	-
Toria	2970	3020	1.7	3020	0.0	3290	8.9	-	-	-	-
Jute	2200	2300	4.5	2400	4.3	2700	12.5	3200	18.5	-	-
Sugarcane	170	210	23.5	220	4.8	230	4.5	230	0.0	-	-

ANNEX-XXIII

STATE-WISE/SEASON-WISE/CROP-WISE ALLOCATED SEED MINIKITS DURING 2016-17

Unit-No. of minikits

State	Kharif				Rabi					Summer			Grand Total	% to total Minikit
	Arhar	Urd	Moong	Total	Gram	Lentil	Urd	Moong	Total	Moong	Urd	Total		
Andhra Pradesh	8000	5000	2000	**15000**	5000	0	10000	10000	**25000**	0		0	**40000**	**5.55**
Aruncahal Pradesh	0	500	500	**1000**	0	0	0	0	**0**	0		0	**1000**	**0.14**
Assam	750	500	1000	**2250**	1000	500	3000	0	**4500**	0		0	**6750**	**0.94**
Bihar	2500	5000	3000	**10500**	0	15000	500	0	**15500**	10000		10000	**36000**	**4.99**
Chhattisgarh	0	6000	1000	**7000**	20000	0	1000	0	**21000**	1000	5000	6000	**34000**	**4.72**
Gujarat	875	3000	5000	**8875**	18250	0	0	0	**18250**	0		0	**27125**	**3.76**
Haryana	0	0	2200	**2200**	7000	5000	0	0	**12000**	15000		15000	**29200**	**4.05**
Himachal Pradesh	0	675	500	**1175**	0	300	0	0	**300**	0		0	**1475**	**0.20**
J&K	0	500	500	**1000**	0	325	0	0	**325**	0		0	**1325**	**0.18**
Jharkhand	7500	6500	3875	**17875**	10000	1000	500	0	**11500**	0		0	**29375**	**4.08**
Karnataka	2500	50	10000	**12550**	5000	0	1000	2500	**8500**	0		0	**21050**	**2.92**
Kerala	0	0	500	**500**	0	0	0	0	**0**	0		0	**500**	**0.07**
Madhya Pradesh	0	15000	10000	**25000**	24813	0	1000	0	**25813**	25000	5000	30000	**80813**	**11.21**
Maharashtra	7500	2925	25000	**35425**	15000	0	0	0	**15000**	0		0	**50425**	**7.00**
Manipur	0	500	500	**1000**	0	0	0	0	**0**	0		0	**1000**	**0.14**
Meghalaya	0	500	500	**1000**	0	0	0	0	**0**	0		0	**1000**	**0.14**
Mizoram	0	500	500	**1000**	0	0	0	0	**0**	0		0	**1000**	**0.14**
Nagaland	0	500	500	**1000**	0	0	0	0	**0**	0		0	**1000**	**0.14**
Odisha	0	1000	8000	**9000**	10000	0	1000	10000	**21000**	0		0	**30000**	**4.16**
Punjab	0	100	1000	**1100**	5281	1063	0	0	**6344**	15000		15000	**22444**	**3.11**
Rajasthan	2000	29000	39000	**70000**	21057	15000	0	0	**36057**	0		0	**106057**	**14.71**
Sikkim	0	500	500	**1000**	0	0	0	0	**0**	0		0	**1000**	**0.14**
Tamil Nadu	0	0	2500	**2500**	2000	0	5000	10000	**17000**	0		0	**19500**	**2.71**
Telangana	12000	0	6750	**18750**	5000	0	0	5000	**10000**	0		0	**28750**	**3.99**
Tripura	750	1000	500	**2250**	0	0	0	500	**500**	0		0	**2750**	**0.38**
UP	11025	11000	6125	**28150**	18750	30750	15000	0	**64500**	24000	25000	49000	**141650**	**19.65**
Uttrakhand	1000	1000	500	**2500**	0	0	0	0	**0**	0		0	**2500**	**0.35**
WB	500	2500	600	**3600**	0	1000	7000	1000	**9000**	15000		15000	**27600**	**3.83**
Total	**56900**	**93750**	**132550**	**283200**	**168151**	**69938**	**45000**	**39000**	**322089**	**105000**	**35000**	**140000**	**745289**	

AGENCY WISE CROP WISE ALLOCATED QUNATITY AND COST OF DIFFERENT PULSES SEED MINIKITS DURING 2016-17

Unit-No. of minikits

Agency	Qunatity (qtl)						Cost Rs. In Lakhs						Agency-wise % cost incurred
	Arhar	Gram	Urd	Moong	Lentil	Total	Arhar	Gram	Urd	Moong	Lentil	Total	
NSC	2196	15765	3550	5502	5595	**32608**	425.28	1261.20	639.00	825.30	671.40	**3822.18**	61.91
KRIBHCO	0	2000	0	0	0	**2000**	0.00	160.00	0.00	0.00	0.00	**160.00**	2.59
NAFED	80	3200	0	1400	0	**4680**	14.40	256.00	0.00	210.00	0.00	**480.40**	7.78
IFFDC	0	2539	0	0	0	**2539**	0.00	203.12	0.00	0.00	0.00	**203.12**	3.29
HIL	0	3400	3400	4160	0	**10960**	0.00	272.00	612.00	624.00	0.00	**1508.00**	24.43
Total	**2276**	**26904**	**6950**	**11062**	**5595**	**52787**	**439.68**	**2152.32**	**1251**	**1659.3**	**671.4**	**6173.7**	
Crop-wise % to quantity & cost incurred	**4.31**	**50.97**	**13.17**	**20.96**	**10.60**		**7.12**	**34.86**	**20.26**	**26.88**	**10.88**		

Crop wise Allocated qunatity and cost of different pulses seed minikits during 2016-17

Unit-No. of minikits

Crop	No. of Minikits				Qunatity in qtls				Rate/qtl		Total Cost (Rs. inLakhs)
	Rabi	Kharif	Summer	Total	Rabi	Kharif	Summer	Total	Hybrid	Other	
Arhar	0	56900	0	56900	0	2276	0	2276	28000	18000	**439.68**
Gram	168151	0	0	168151	26904	0	0	26904	8000		**2152.32**
Lentil	69938	0	0	69938	5595	0	0	5595	12000		**671.40**
Urd bean	45000	93750	35000	173750	1800	3750	1400	6950	18000		**1251.00**
Moong bean	39000	132550	105000	276550	1560	5302	4200	11062	15000		**1659.30**
Total	**322089**	**283200**	**140000**	**745289**	**35859**	**11328**	**5600**	**52787**			**6173.70**
		Rate	**Cost**								
Hybrid Arhar	300	28000	84.00								
Variety Arhar	1976	18000	355.68								
			439.68								

IPM MODULES FOR PIGEONPEA AND CHICKPEA

Component	Operations
Field	Deep Summer Ploughing
Cultural Practices	Ridge Sowing+Cover crops (Cowpea, Soybean, Mungbean,Urdbean)
Resistant/Tolerant Varieties	Varieties resistant to wilt and Sterility mosaic should be used like TJT 501, TT-401, CORG-9701, GT-101 etc.
Seed treatment	Carbendazim+Thiram (1:3 g/kg)
Intercropping and Crop rotation	With Sorghum and harvesting only panicles. This results in lower incidence of wilt and stalk serve as perches for birds
Sowing Time	Timely sowing
Monitoring	Pheromone trap @ 5 traps/ha. A catch of 4-5 male moths/trap/night during post winter months indicates that *H. armigera* will attain its ETL a fortnight later (NWPZ,NEPZ)
Foliar Sprays	As per enclosed Scheduled
Bird Perches	30-40 perches/ha

SCHEDULE FOR FOLIAR SPRAYS OF INSECTICIDES FOR PEST MANAGEMENT

NEPZ

1st spray of Dimethoate (0.03%) or Monocrotophos (0.04%) for Pod fly at ETL
2nd sprays of NSKE (5%) at pod borer ETL
3rd sprays of NPV (500 LE)
4th Spray of Indoxacarb 15.8% EC, if needed

NWPZ

1st sprays of NSKE (5%) at pod borer ETL
2nd sprays of NPV (500 LE)
3rd Spray of Indoxacarb 15.8% EC, if needed

CZ

1st sprays of NSKE (5%) at pod borer ETL
2nd sprays of NPV (500 LE)
3rd Spray of Indoxacarb 15.8% EC
4th Use of Trichocard @ 5 card/ha at weekly interval.
5th Spray of Dimethoatev (0.03%) or Monocrotophos (0.04%) for pod fly at ETL

SZ

1st sprays of NSKE (5%) at pod borer ETL
2nd sprays of NPV (500 LE)
3rd Spray of Indoxacarb 15.8% EC or Chlorpyriphos (0.07%)

CHICKPEA

Component	Operations
Field	Deep Summer Ploughing
Resistant/Tolerant Varieties	Varieties resistant to wilt/root rot and tolerant to Ascochyta blight. Growing mixture of tolerant and susceptible genotypes is recommended. (*Var:* PBG -5, Raj Vijay gram 201, MNK 1, BGD 103, JAKI -9218 etc.)
Seed treatment	Antagonistic fungi at 2-4 g/kg seed and vitavax 1 g/kg seed (Trichoderma @ 4 g/kg, Gliocladium @ 2 g/kg)
Intercropping and Crop rotation	Mustard 6:2 (NEPZ, NWPZ), Coriander (SZ)
Sowing Time	Timely sowing. Avoid selayed sowing
Monitoring	Pheromone trap @ 5 traps/ha. A catch of 4-5 male moths/trap/night during post winter months indicates that *H. armigera* will attain its ETL a fortnight later (NWPZ,NEPZ)
Foliar Sprays	First spray with HaNPV or NSKE or Bt, second spray (if needed with Bt, NSKE or HaNPV)
Bird Perches	30-40 perches/ha