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PULSES IN INDIA : RETROSPECT AND PROSPECTS

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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, global warming 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 is visible since the 1990s. The farmers of Indo-Gangetic belt who grew pulses earlier, have shifted to wheat where yields ranges 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, >90% of total pulses production is realized in 10 states namely, MP, MS, Rajasthan, UP, Karnataka, AP, Gujarat, Jharkhand, CG and Telangana. 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 @ 52 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, 26% of world's production, and consumer, 30% of total pulses of the world. The domestic production of about 23 million tones during 2016-17 shall be still less than the future estimated demand of 29-30 million tones. 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 06 MT is met through imports. In India, the share of pulses to gross cropped area and in total foodgrains basket is about 15 per cent and 8 per cent respectively.

India's outstanding contribution towards total global acreage and production of pulses at 36 per cent and 26 per cent respectively is credited to our strength. The three five year plans between Xth to XIIth exhibited an increasing yield trends, the highest being 779 kg/ha during 2016-17 as against the world's average productivity of 909 kg/ha, is less than the demonstrated potential under the FLDs. 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 Sinchayi 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 XI^{th} plan. XII^{th} 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 effortös 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 XII^{th} 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 readersô 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 and Dr. B. Rajender, Joint Secretary (Crops) for their sustained support, guidance and encouragement in bringing out the volume.
Dr. A. K. Shivhare, Assistant Director and Ms. Ashwini, Technical Assistant deserve special mention for their sincere association, dedication and hard work for a pretty long period to accomplish the task.

(A.K. Tiwari)
Director

ABOUT THE DIRECTORATE

1.0 The Directorate of Pulses Development (DPD), one of the eight Commodity Development Directorates (CDDs) viz Jute, Cotton, Wheat, Millets, Rice, Sugarcane and Oilseeds, under the *crops division* of the Ministry of Agriculture & Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare (DAC&FW) ,was established in 1971 at Lucknow (U.P.) by merging the Regional Extension Unit , Ahmedabad (Gujarat). On the recommendations of "CDDs Re-organization Committee", in 1996, the National Head Quarter of pulses commodity was subsequently shifted to Madhya Pradesh , Bhopal.

2.0 The Directorate of Pulses Development is mandated to co-ordinate and monitor the implementation of all pulse related centrally sponsored/central sector schemes on crops development & research across the country .

3.0 With the bi-focal responsibilities for the assigned states of MP & CG at present, it coordinates and monitors all crop related schemes / programmes/ Missions in these states. At present National Food Security Mission (NFSM) ï Pulses is operational in 29 States,638 districts in the Country and NFSM (Wheat, Pulses, Rice, Sugarcane, Cotton, Jute and Coarse Cereals),National Mission on Sustainable Agriculture (NMSA),National Mission on Agricultural Extension & Technology (NMAET), National Mission on Oilseeds, Oilpalm (NMOOP),Mission on Integrated Development of Horticulture (MIDH), Rashtriya Krishi Vikas Yojana (RKVY) & Bringing Green Revolution In Eastern India(BGREI) etc.

4.0 The Directorate functions as Nodal/Regional office of DAC&FW,Govt of India, New Delhi for MP & CG states to represent in State Level Sanction Committees, Inter-Ministerial Central Teams & Task-force etc.

5.0 The Directorate has been instrumental in conceiving and coordinating the Plan interventions initiated since IVth Plan (1969-70 to 1973-74) onward followed by major CSS, the the National Pulses Development Project (NPDP) from VIIth Plan , 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 operationalised during 1988-89 on a 100% Central assistance basis. Under the GOI-UNDP Co-operation (1997-2003), pulses were identified as priority sector, the ICAR-IIPR was given the project assistance.

6.0 In view of the spectacular achievement in Oilseeds Sector through TMO, pulses were brought within the ambit of TMOP in 1990. From 2004-05, the Integrated Scheme of Oilseeds, Pulses, Oilpalm and Maize (ISOPOM) was launched. 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.

7.0 The DPD, Bhopal has been actively monitoring the programme implementation at the national level, through National Monitoring Team/ field visits, allocation of Seed Minikits, interface with the Research and other stake holder organizations/ agencies in the country.

8.0 During XIth Plan (2007-08 Rabi)), in pursuance of the resolution adopted in 53rd meeting of National Development Council, a CSS 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.

9.0 The DPD *drafted the policy paper/ guidelines for NFSM -Pulses,* Seed- Rolling Plan ,the draft paper proposed the strategy of area expansion and productivity enhancement in consultation with states and ICAR; 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 proposed for assessing the impact of the interventions for a result oriented approach by the implementing agencies.

10.0 NFSM-Pulses is operational beyond XIIth Plan (2012-13 to 2016-17 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, Uttarakhand and West Bengal.

11.0 The DPD, Bhopal recently organized two National Seminar/Workshops on:

i) ñPulses Development: Challenges & Opportunities in Central & Southern Statesò (CIAE, Bhopal :Feb 3~~rd~~- 4th,2016); ñPromotion of Pulses in Non-traditional Niches: Summer Cultivationò (IIPR, Kanpur :Feb 9th-10th, 2016);

ii) Two skill development trainings (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.

12.0 The Directorate accomplishes the task relating to analysis of Area ,Production and Productivity trends/impact of developmental programmes ; 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; fixing targets of production and suggest measures to achieve them; to co-ordinate in programmatic review of all CSSs, special packages (eg. Bundelkhand Package) and to organize and coordinate Seminar/Workshop/Conference /Review Meetings at state and national level.

13.0 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 **<u>Crop Tracking Committee</u>** 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.

14.0 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.

15.0 **The Other Existing Activities/ Functions include**

i) To monitor the NFSM funded project on Creation of Seed-Hub for Increasing Indigenous Pulse Production in Indiaò; ñEnhancing Breeder Seed Production for increasing Indigenous Pulse Production in Indiaò; Cluster FLDs on Pulses/ Oilseed undertaken by KVKs of MP and Chhattisgarh states under ATARI Zone-IX; to formulate and monitor the Seed Minikit Programme on Pulses at national level, ñEstablishment/ Strengthening of Bio-fertilizer and Bio-control Production Units for Increasing Pulse Production In Indiaò, ñNational Demonstration Project and Value Chain Development of Pulses and

Millets in Indiaò, 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.

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

iii) 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.

iv) 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;

v) 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
óAô 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
óBô lines	Maintainer lines
BCMV	Bean Curl Mosaic Virus
BSP	Breeder Seed Production
BNF	Biological nitrogen fixation
BT	Bacillus thuringenesis
COPP	Change over previous plan periods
CAGR	Compound Annual Growth Rate
CZ	Central Zone
C.G.	Chhattisgarh
CGMS	Cytoplasmic Genetic Male Sterility
CEC	Cation Exchange Capacity
CAZRI	Central Arid Zone Research Institute, Jodhpur (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	Farmerôs 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
K	Kharif
KVK	Krishi Vigyan Kendra
KVIC	Khadi Village Industries Commission
KW	Kilo Watt
KRIBHCO	Krishak Bharti Co-operative Ltd.
LE	Larval Extract
MM-1	Mini-Mission 1
MSP	Minimum Support Price
Min.	Minimum
Max.	Maximum
Mo	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 Utilisation Planning, Nagpur
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	Rabi
ôRô 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
&	And
@	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
%	Percent
m^2	Square Meter
Zn	Zinc
Mg	Magnesium

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DIAGRAM

PULSES OVERVIEW

1.0 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 2016-17). 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 77% at 779 kg/ha during 2016-17 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 275.68 million tonnes during 2016-17 with the increase in area from 97.32 million hectares to 128 million hectares. The productivity of food grains has also sharply increased to 2153 kg/ha during 2016-17 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.

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.

1.1 PULSES SHARE TO TOTAL FOODGRAIN BASKET

Per cent share of pulses to total food-grain basket in the country in terms of area and production was 19.62 and 16.55 per cent respectively during 1950-51. This trend continued till 1960-61 and started declaration from 1970-71 (after green revolution) due to no break-through in production technology of pulses in comparison to other commodities of foodgrains. At present, except the area stabilization, the production upto 2015-16 has gone down to 6.50 per cent due to stagnation in productivity of pulses as compared to other commodities of foodgrains. Deceleration of Per cent contribution of pulses to total foodgrains has prompted the Ministry of Agriculture to vigorously pursue the NFSM-Pulses during the Twelfth Plan (2012-13 to 2016-17), a centrally sponsored scheme, in addition to ongoing ISOPOM scheme for all 14 pulse potential states. Food grains cover almost 62% of total gross cropped area comprising cereals 51% and pulses in about 11% in India. Further, among total pulses, the area under gram is 4%, arhar 2% and the other pulses in about 5% of gross cropped area.

The net irrigated area in the country is 47% while the remaining falls under rainfed ecology. The pulses under irrigation are cultivated in about 20% of the area while 80% of pulses are grown under *rainfed* conditions. Under pulses highest area under irrigation in gram *i.e.* 35%, remaining pulses irrigation below 10%.

(TABLE–1.0): CONTRIBUTION OF PULSES TO TOTAL FOODGRAINS IN INDIA

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

Year	Pulses			Foodgrains			Pulses % to Foodgrains		
	A	P	Y	A	P	Y	A	P	YI
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
2015-16	24.91	16.35	656	123.22	251.57	2042	20.22	6.50	32.13
2016-17*	29.46	22.95	779	128.03	275.68	2153	23.01	8.32	36.18

Source: *DES, 2016-17*- IVth Advance Estimate*

(TABLE - 1.1): SEASON-WISE PULSE CONTRIBUTION TO TOTAL PULSES

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

Year	Kharif Pulses			% Cont. to Total Pulses			Rabi Pulses			% Cont. to Total Pulses			Total Pulses		
	A	P	Y	A	P	YI	A	P	Y	A	P	YI	A	P	Y
2000-01	106.58	44.48	417	52.4	40.2	77	96.90	66.27	684	47.6	59.8	126	203.48	110.75	544
2001-02	107.22	48.38	451	48.7	36.2	74	112.86	85.30	756	51.3	63.8	124	220.08	133.68	607
2002-03	99.50	41.51	417	48.5	37.3	77	105.46	69.74	661	51.5	62.7	122	204.96	111.25	543
2003-04	116.83	61.65	528	49.8	41.4	83	117.75	87.41	742	50.2	58.6	117	234.58	149.05	635
2004-05	113.17	47.17	417	49.7	35.9	72	114.46	84.12	735	50.3	64.1	127	227.63	131.30	577
2005-06	106.80	48.65	456	47.7	36.3	76	117.12	85.20	727	52.3	63.7	122	223.91	133.84	598
2006-07	106.76	47.95	449	46.0	33.8	73	125.16	94.02	751	54.0	66.2	123	231.92	141.98	612
2007-08	114.90	64.03	557	48.6	43.4	89	121.44	83.58	688	51.4	56.6	110	236.33	147.62	625
2008-09	98.09	46.86	478	44.4	32.2	72	122.85	98.80	804	55.6	67.8	122	220.94	145.66	659
2009-10	105.82	42.04	397	45.5	28.7	63	127.00	104.58	823	54.5	71.3	131	232.82	146.62	630
2010-11	123.20	71.20	578	46.7	39.0	84	140.82	111.21	790	53.3	61.0	114	264.02	182.41	691
2011-12	111.90	60.58	541	45.7	35.4	77	132.72	110.31	831	54.3	64.6	119	244.62	170.89	699
2012-13	99.54	59.16	594	42.8	32.3	75	133.03	124.27	934	57.2	67.7	118	232.57	183.42	789
2013-14	103.33	59.95	580	41.0	31.1	76	148.85	132.60	891	59.0	68.9	117	252.18	192.55	764
2014-15	99.98	57.31	573	42.4	33.4	79	135.55	114.22	843	57.6	66.6	116	235.53	171.52	728
2015-16	113.14	55.30	489	45.4	33.8	74	135.98	108.18	796	54.6	66.2	121	249.11	163.48	656
2016-17*	143.44	94.22	657	48.68	41.05	84	151.20	135.32	895	51.32	58.95	115	294.64	229.54	779

Source: *DES, 2016-17*- IVth Advance Estimate*

1.2 PER CAPITA AVAILABILITY OF PULSES IN INDIA

As a result of stagnant pulse production and continuous increase in population, the per capita availability of pulses has decreased considerably. The *per capita* per day availability of pulses in 1951 was 60 g that dwindled down to a provisional level of 47.2 g in the year 2014. The *per capita* per year availability shows the same decreasing trend from 22.1 kg in 1951 to 17.2 kg in 2014. However the increase trend shows during 2017 (P) both in per capita per day (52.9 g) and per capita per year (19.3 kg) respectively. This amply proves that increase in population growth affects the pulses availability on *per capita* basis (Table 1.2).

(TABLE- 1.2): 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	46.4	16.9
2015	43.8	16.0
2016	43.0	15.7
2017 (P*)	52.9	19.3

P - Provisional figures is based on IVth Advance Estimates of production for 2016-17, Net Import for Jan. 2017and stock position as on 01.02.2017. ***Source:*** *Agricultural statistics at a glance-2016.*

1.3 PROJECTED DEMAND: (XIth& XIIthPLAN)
(TABLE- 1.3): TENTATIVE DEMAND/PRODUCTION AND PROJECTED TARGET

(Qty: Million Tonnes)

Year	Demand *	Production @	Gap	Target
2007-08	16.77	13.61	-3.16	17.00
2008-09	17.51	13.65	-3.86	18.00
2009-10	18.29	13.68	-4.61	18.50
2010-11	19.08	13.72	-5.36	19.00
2011-12	19.91	13.75	-6.16	20.00
2012-13	19.00	18.34	-0.66	18.24
2013-14	20.00	19.25	-0.75	19.00
2014-15	21.00	17.15	-3.85	19.50
2015-16	21.00	16.35	-4.65	20.05
2016-17	23.00	22.95	2.20	20.75
2017-18				22.90

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).

1.4 IMPORT/EXPORTAND AVAILABILITY

The domestic production, and imports/exports and total availability from 2000-2001 to 2016-17 is given below (Table-1.4).

(TABLE- 1.4): AVAILABILITY STATUS OF PULSES PRODUCTION, IMPORT AND EXPORT

(Quantity – Lakh Tonnes)

Year	Production	Import	Export	Total availability
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	162.39
2006-07	141.98	22.71	2.51	162.18
2007-08	147.62	28.35	1.64	174.33
2008-09	145.66	24.74	1.36	169.04
2009-10	146.62	35.10	1.00	180.72
2010-11	182.41	26.99	2.08	207.32
2011-12	170.89	33.65	1.74	202.80
2012-13	183.43	38.39	2.02	219.80
2013-14	192.53	36.44	3.46	225.51
2014-15	171.52	45.85	2.22	215.15
2015-16	163.48	57.98	2.56	218.90
2016-17*	229.54	66.09	1.37	294.26

Source: *DGCI&S, Ministry of Commerce, Kolkata; Production- DES, 2016-17*- IVth Advance Estimate*

IMPORT AND EXPORT

IMPORT: The import of pulses in India during April, 2014 to March, 2015 was 45.85 lakh tonnes worth Rs.17062.94 crores against the value of Rs.17196.87 crore for total foodgrains, Rs.121319.02 crore for total agricultural imports and against Rs.2737086.58 crore for total National Import. The import during April, 2015 to March, 2016 was 57.98 lakh tonnes worth Rs.25619.06 crore against the import value of Rs. 26841.87 crore for total foodgrains, Rs.140288.69 crore for total agricultural import and Rs.2490298.08 crore for total National import respectively during this period. The share of Agricultural import to National import was 4.43% and 5.63% respectively during April, 2014 to March, 2015 and April, 2015 to March, 2016

{Dry Peas contributes the single largest share in India's import basket of pulses registering in the total pulses import}.

EXPORT: The pulses export of the country during April, 2014 to March, 2015 was 2.22 lakh tonnes worth Rs.1218.31 crore against the value of Rs. 59500.54 crore for total foodgrains, Rs.239681.04 crore for total agricultural exports and against Rs.1896445.47 crore for total National export.The export during April, 2015 to March, 2016 was 2.56 lakh tonnes worth Rs.1656.03 crore against the export value of Rs. 42622.29 crore for total foodgrains, Rs.215395.68 crore for total agricultural export and Rs.1716378.05 crore for total National export respectively during this period. The share of agricultural export to National export was 12.64% and 12.55% respectively during April, 2014 to March, 2015 and April, 2015 to March, 2016.

{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-1.5): PULSE IMPORTING AND EXPORTING COUNTRIES OF MAJOR PULSES (2016-17)

Pulses	Top 5 Export Destinations	Top 5 Import Sources
Peas (PisumSativum)	Shri Lanka DSR (96.3%), Myanmar (1.6%), Bhutan (1.4%), Nepal (0.5%), U Arab EMTS (0.09%).	Canada (54.5%), Russia (10.3%), Luthuania (9.0%), France (6.8%), USA (6.4%)
Chickpeas (Garbanzos)	Pakistan (21.6%), U Arab EMTS (10.6%), Algeria (11.6%), Saudi Arab (9.5%), Sri Lanka (7.3%)	Australia (85.1%), Russia (4.7%), Tanzania (3.8%), USA (1.4%), Canada (0.91%),
Moong/Urad	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 ARP (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

1.5 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.

(TABLE -1.6): TOTAL PULSES: CROP/SEASON-WISE CONTRIBUTION

{Area-lakh ha, Production-lakh tonnes, Yield-kg/ha}

Crop	Season	Area	Production	Productivity
Arhar	Kharif	39.24 (37.17%)	28.44 (26.94%)	725
Urd	Kharif	24.78 (23.48%)	12.87 (12.19%)	519
	Rabi/Summer	7.85 (5.72%)	5.85 (4.26%)	745
	Total	32.64	18.72	574
Moong	Kharif	23.41 (22.17%)	9.70 (9.18%)	414
	Rabi/Summer	9.26 (6.75%)	5.35 (3.90%)	577
	Total	32.67	15.04	460
Horse gram	Kharif	2.40 (2.28%)	1.10 (1.04%)	457
	Rabi/Summer	2.20 (1.60%)	1.12 (0.82%)	509
	Total	4.60	2.22	482
Moth	Kharif	10.43 (9.88%)	3.37 (3.19%)	323
Chickpea	Rabi	86.80 (63.25%)	80.90 (58.96%)	932
Lentil	Rabi	14.14 (10.31%)	10.44 (7.61%)	738
Peas & Beans	Rabi	8.72 (6.36%)	8.20 (5.98%)	940
Lathyrus	Rabi	4.70 (3.43%)	3.65 (2.66%)	776
Other Pulses	Kharif	5.30 (5.02%)	2.98 (2.82%)	562
	Rabi/Summer	3.55 (2.58%)	2.40 (1.75%)	677
	Total	8.84	5.38	608
Total	Kharif	105.57	58.44	554
	Rabi/Summer	137.22	117.91	859
	Total Pulses	242.79	176.36	726

Source: *DES, DAC&FW,ND (Normal- Avg. 2011-12 to 2015-16).(figures in parenthesis indicates % share of crop).*

1.6 GROWTH RATE

From 1950-51 to 2006-07, the total acreage under pulses has almost been stagnated but for 1990-91 (24.66 million ha), however, the maximum growth rate in area was recorded between the period from 2002-03 to 2003-04 at 14%. Maximum production growth rate of 34% and maximum yield growth rate of 17% were also observed during the same period. The highest production (23 million tonnes) & yield (767 kg/ha) was recorded during 2016-17 followed by 19 & 18 million tones during 2013-14 & 2012-13 (Table-1.7).

(TABLE-1.7): GROWTH RATE OF TOTAL PULSES

(A- Million ha, P- Million tones, Y-kg/ha, Growth Rate (GR)-%)

Year	Area	GR	Prod.	GR	Yield	GR	% 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
1965-66	22.72	-0.7	9.94	-4.3	438	-3.7	9.4
1967-68*	22.65	-0.1	12.1	4.3	534	4.4	8.7
1970-71	22.54	-0.1	11.82	-0.5	524	-0.4	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	0.2	14.24	3.1	635	3.0	12.7
1997-98	22.87	0.4	12.98	-1.8	567	-2.1	11.3
1998-99	23.5	0.6	14.91	3.0	634	2.4	12.1
1999-00	21.12	-2.0	13.42	-2.0	635	0.0	16.1
2000-01	20.35	-0.7	11.08	-3.5	544	-2.9	12.5
2001-02	22.01	1.6	13.37	4.1	607	2.3	13.3
2002-03	20.50	-1.4	11.13	-3.4	543	-2.1	14.4
2003-04	23.46	2.9	14.91	6.8	635	3.4	13.6
2004-05	22.76	-0.6	13.13	-2.4	577	-1.8	13.9
2005-06	22.39	-0.3	13.39	0.4	598	0.7	15
2006-07**	23.76	1.2	14.11	1.1	594	-0.1	15.4
2007-08	23.63	-0.1	14.76	0.9	625	1.0	16.2
2008-09	22.09	-1.3	14.57	-0.3	660	1.1	16
2009-10	23.28	1.1	14.66	0.1	630	-0.9	16.2
2010-11	26.4	2.7	18.24	4.9	691	1.9	14.8
2011-12	24.46	-1.5	17.09	-1.3	699	0.2	16.1
2012-13	23.26	-1	18.34	1.5	788	2.5	18.6
2013-14	25.23	8.5	19.27	5.1	764	-3.1	19.70
2014-15	23.55	-6.7	17.15	-11.0	728	-4.7	NA
2015-16	24.91	5.8	16.35	-4.7	656	-9.9	NA
2016-17*	29.46	18.20	22.95	40.36	779	18.7	NA

Note: The yield rates given above have been worked out on the basis of production & area figure taken in ó000 units. ** Green Revolution period, N.A.- Not available. *2016-17*- IVth Advance Estimate.*

Source: *Agricultural Statistics at a Glance, 2016.*Directorate of Economics and Statistics, Ministry ofAgriculture& FW, Govt. of India (Website http://www.dacnet.nic.in/ean.

1.7 PRODUCTION TRENDS

1.7.1 GLOBAL SCENARIO: CROP-WISE

The total world acreage under pulses as recorded during 2014 is about 851.91 lakh ha with production at 774.73 lakh tones and productivity 909 kg/ha (Table -1.8).

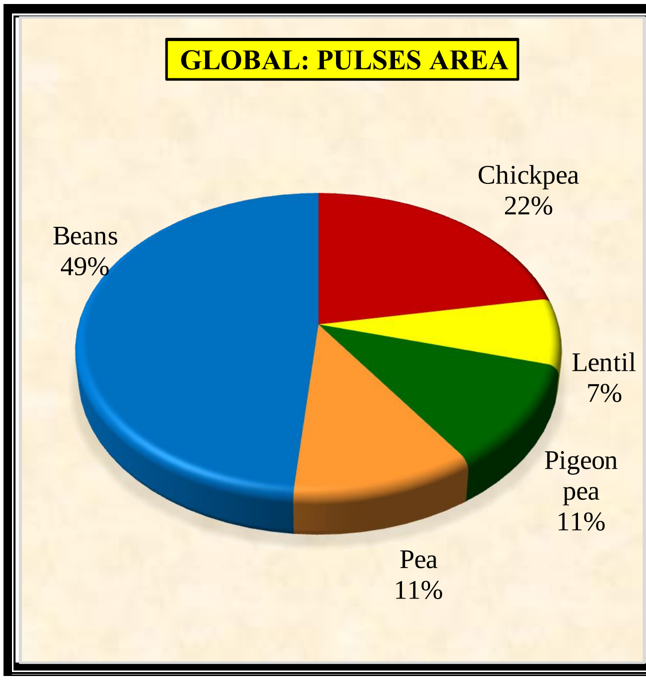
In the world, pulses are grown by 198 countries. Beansdry was cultivated by 152 countries, which contributed about 35.93 % area to total world area, Chickpea by 58 contributed about 16.41%, Peasdry by 98 contributed 8.14%, Pigeonpea by 23 contributed 8.26 %, Lentil by 56 contributed by 5.31% and others 25.95%. The share to World production of Beans dry was 31.64% followed by Chickpea 17.72%, Peasdry 14.44%, Pigeonpea 6.31%, Lentil 6.23% & others 23.66%.

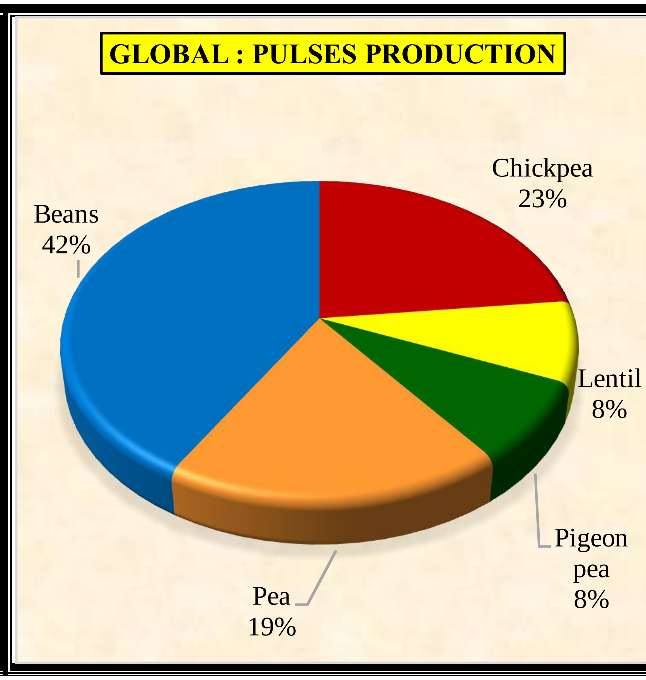
(TABLE-1.8): GLOBAL RANKING: CROP-WISE

{Area-lakh ha, Production-lakh tonnes, Yield-kg/ha}

Crop	Area	% to Total	Production	% to Total	Productivity
Chickpea	139.81	16.41	137.31	17.72	982
Lentil	45.24	5.31	48.27	6.23	1067
Pigeon pea	70.33	8.26	48.90	6.31	695
Pea	69.32	8.14	111.86	14.44	1614
Beans	306.13	35.93	245.16	31.64	801
Total Pulses	**851.91**		**774.73**		**909**

Source: *FAO Statistics 2014.*





1.7.2 GLOBAL SCENARIO: TOTAL PULSES

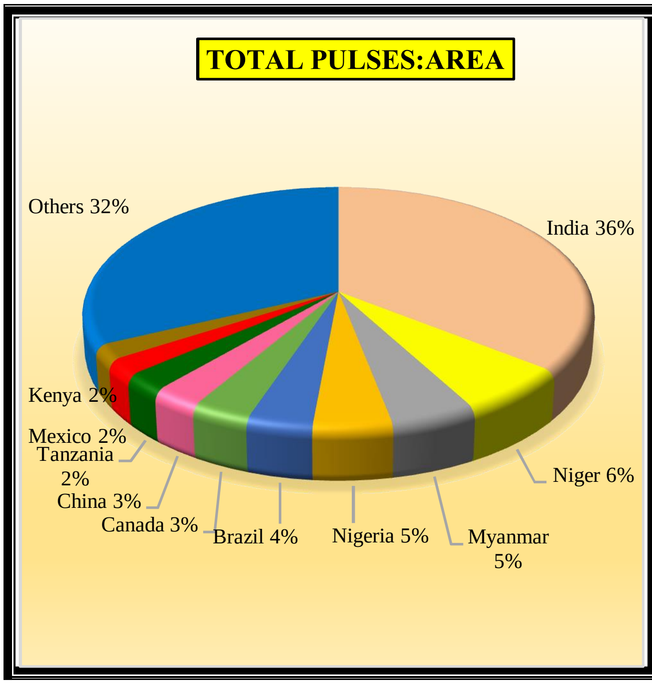
The total world acreage under pulses as recorded during 2014 is about 851.91 lakh ha with production at 774.73 lakh tones and productivity 909 kg/ha. It reveals that the India ranked first in area and production with 35% and 25% respectively of world area and production. However, in case of productively Bahrain stood first with 18485 kg/ha.Thus it is also evident that the countryôs productivity at 660 kg/ha is far below the world average productivity of 909 kg/ha (Table 1.9).

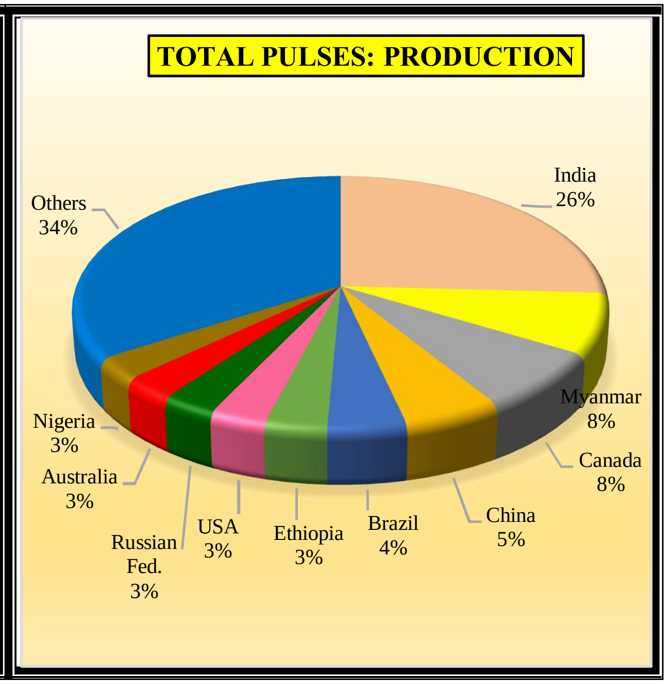
(TABLE–1.9): GLOBAL RANKING: TOTAL PULSES

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

Country	Area	% cont.	Country	Prod.	% cont.	Country	Yield
India	303.09	35.58	India	199.8	25.79	Bahrain	18485
Niger	54.7	6.42	Myanmar	59.77	7.72	Ireland	5886
Myanmar	42.03	4.93	Canada	58.28	7.52	Israel	5576
Nigeria	38.49	4.52	China	41.13	5.31	Belgium	4445
Brazil	32.09	3.77	Brazil	33.06	4.27	Tajikistan	3985
Canada	28.7	3.37	Ethiopia	26.13	3.37	Denmark	3952
China	23.85	2.80	USA	23.95	3.09	Trinidad &Tobago	3919
Tanzania	20.68	2.43	Russian Fed.	22.94	2.96	United Kingdom	3755
Mexico	18.35	2.15	Australia	22.47	2.9	Netherlands	3639
Kenya	17.19	2.02	Nigeria	22.05	2.85	Switzerland	3638
Others	272.74	32.02	Others	265.15	34.22	Others	1068
World	**851.91**		**World**	**774.73**	**World**		**909**
					India		**660**

Source: *FAO Statistics 2014.*





1.7.3 NATIONAL SCENARIO: PLAN PERIODS (TOTAL PULSES)

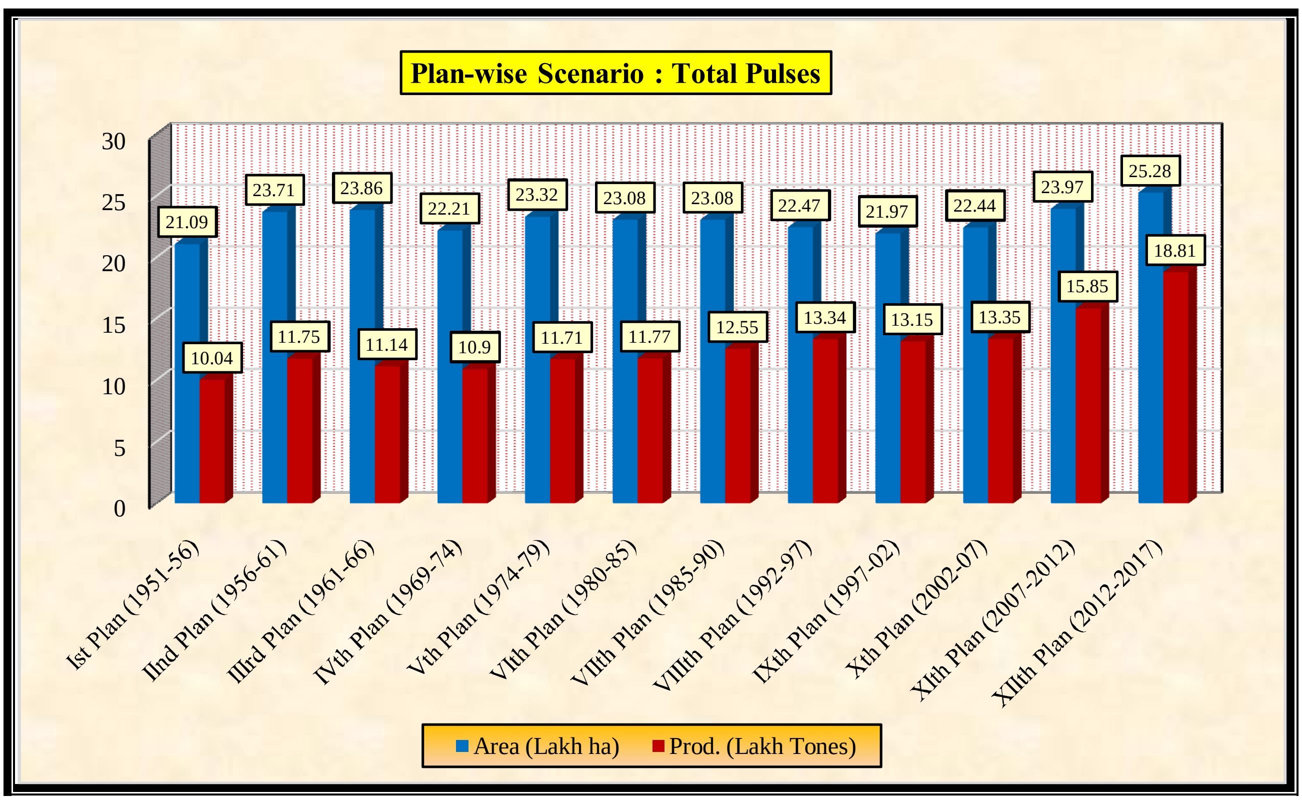
A visit to different plan periods records a slight growth in total production and productivity from VIII[th] Plan 1992-97 with 7% & 9% respectively. The area remained almost stagnant, stabilized up-till X[th] plan. However, the XII[th] plan analysis shows that the increasing per cent change trend under area (+ 5%) and production (+18%) of total pulses over previous plan periods (COPP) is given at (Table-1.10).

(TABLE-1.10): PLAN-WISE NATIONAL SCENARIO- TOTAL PULSES

(Area-Mha, Production-MTonnes, Yield-kg/ha)

Plan	Area	% COPP	Prod.	% 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	4.10
Third Plan (1961-66)	23.86	0.63	11.14	-5.19	467	-5.79
Fourth Plan (1969-74)	22.21	-6.92	10.90	-2.15	491	5.11
Fifth Plan (1974-79)	23.32	5.00	11.71	7.43	502	2.32
Sixth Plan (1980-85)	23.08	-1.03	11.77	0.51	510	1.56
Seventh Plan (1985-90)	23.08	0.00	12.55	6.63	544	6.63
Eighth Plan (1992-97)	22.47	-2.64	13.34	6.29	594	9.18
Ninth Plan (1997-02)	21.97	-2.23	13.15	-1.42	599	0.82
Tenth Plan (2002-07)	22.44	2.14	13.35	1.52	595	-0.61
Eleventh Plan (2007-2012)	23.97	6.80	15.85	18.73	662	11.19
Twelfth Plan (2012-2017)*	25.28	5.47	18.81	18.68	744	12.40

Source: *DES, Twelfth Plan (2012-2017)*& 2016-17 APY is the IVth Advance Estimate; % COPP is percentage change Over previous plan.*



1.7.4 STATES' SCENARIO : PLAN ANALYSIS(Xth –XIIth)

***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 scenario was observed during the Tenth plan Madhya Pradesh ranked first in area (43.27 lakh hectares or 19.27 %) with a total production of 31.46 lakh tonnes or (23.57 % of the total production). While, Maharashtra was placed second with respect of area and its production 35.32 lakh hectares (15.73 %) and 19.98 lakh tonnes (14.97 %) followed by Rajasthan 31.77 lakh hectares (14.15 %) & 12.96 lakh tonnes (9.71 %).

Eleventh Plan (2007-2012): During Eleventh plan period the total pulses area and production were 239.75 lakh ha and 139.82 lakh tonnes respectively. Out of 239.75 lakh hectares about 53 % area under rabi and 46 % area under kharif were covered. However, approx. 59 % share of rabi production and 41 % share of kharif production exhibited in total pulse production in the country which explained the productivity of Rabi pulses is much higher than the kharif pulses. The state-wise analysis exhibited first rank to Madhya Pradesh, both in area and production with 47.75 lakh hectares and 35.98 lakh tonnes which was 19.92 % and 25.73 % respectively. Rajasthan ranked second in coverage with 16.90 % (40.51 lakh hectares) while at production front, state of Maharashtra ranked at second with 17.76 % (24.84 lakh tonnes) followed by Uttar Pradesh with 14.19 % (19.83 lakh tonnes). Maharashtra ranked third in area with 14.87% and Rajasthan ranked fourth in production with 14.00% (19.57 lakh hectares) of countryὂs production while in area, Karnataka stood at IVth rank with 10.05 % of country coverage during that XIth plan.

Twelfth plan (2012-2017): In India, total pulse area and production irrespective of Twelfth Plan was 252.43 lakh hectares and 187.00 lakh tonnes respectively. Out of the total area, 57.03 lakh hectares is confined to Madhya Pradesh alone, earning a good pulse status and position contributing a remarkable 22.59 % of the countryὂs total area and a production of 52.02 lakh tonnes, thereby ranking first both in area and production followed by Rajasthan in area (39.37 lakh hectares, 15.60% of the total area). While Rajasthan ranked third in production with 12.15% of the total pulse production and Maharashtra which ranked second (25.48 lakh tonnes or 13.63 % of the total production); Uttar Pradesh was hardly placed at the forth rank in production (17.60 lakh tonnes or 9.41 % of the total production).While Karnataka is on the forth rank in respect of area (25.71 lakh ha or 10.19 %).

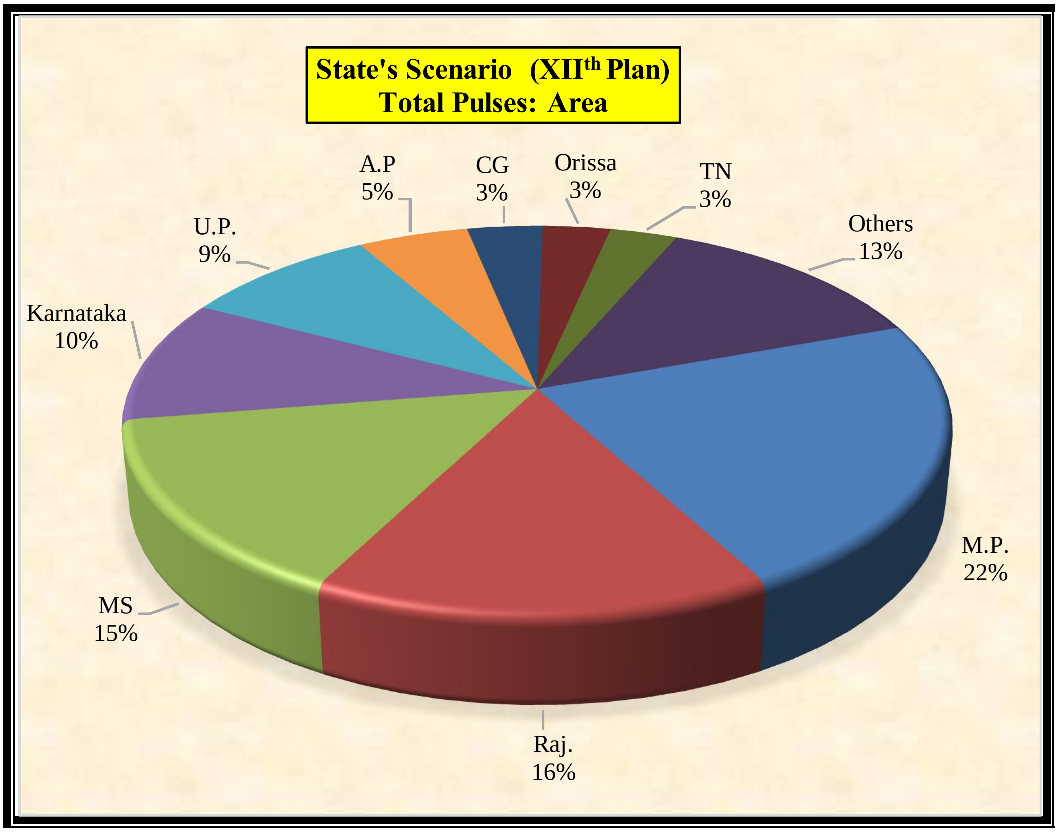
The overall area, production and productivity increasing trend during the last three plan period.

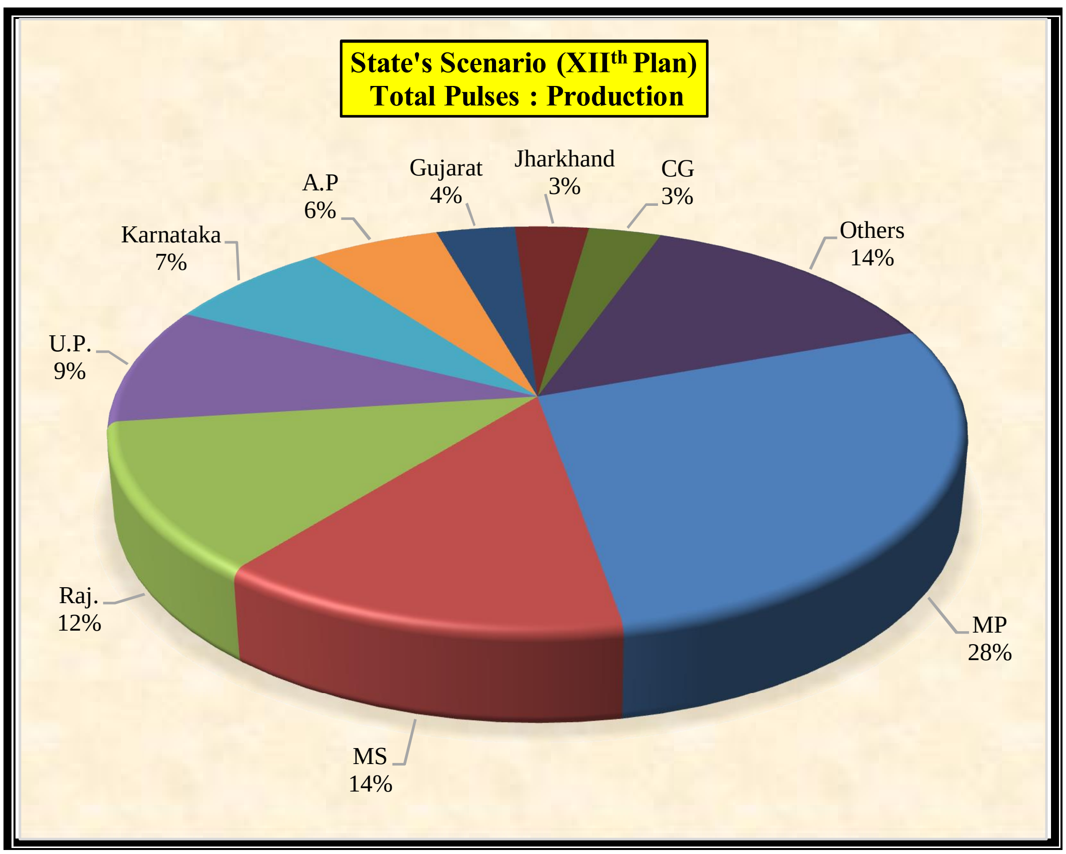
(TABLE-1.11):PLAN-WISE STATES' SCENARIO–MAJOR STATES

{Area-lakh ha, Production-lakh tonnes, Yield-kg/ha}

States		Tenth Plan	% to Country	Eleventh Plan	% to Country	*Twelfth Plan	% to Country
A.P	A	19.71	8.78	19.76	8.24	12.79	5.07
	P	12.09	9.05	14.49	10.36	10.86	5.80
	Y	613		733		849	
Bihar	A	6.50	2.90	5.79	2.42	5.17	2.05
	P	4.95	3.71	4.98	3.56	4.82	2.58
	Y	761		859		931	
Chhattisgarh	A	9.06	4.03	8.52	3.55	8.72	3.46
	P	4.52	3.39	5.12	3.66	5.98	3.20
	Y	499		601		685	
Gujarat	A	8.04	3.58	8.49	3.54	7.19	2.85
	P	5.14	3.85	6.74	4.82	6.49	3.47
	Y	639		794		902	
Haryana	A	1.74	0.77	1.68	0.70	1.33	0.53
	P	1.26	0.94	1.33	0.95	0.99	0.53
	Y	725		792		742	
Jharkhand	A	2.74	1.22	4.01	1.67	6.12	2.42
	P	1.72	1.29	3.10	2.21	6.08	3.25
	Y	626		772		994	
Karnataka	A	20.78	9.25	24.09	10.05	25.71	10.19
	P	7.82	5.86	12.11	8.66	13.75	7.36
	Y	376		503		535	
Madhya Pradesh	A	43.27	19.27	47.75	19.92	57.03	22.59
	P	31.46	23.57	35.98	25.73	52.02	27.82
	Y	727		754		912	
Maharashtra	A	35.32	15.73	35.65	14.87	37.56	14.88
	P	19.98	14.97	24.84	17.76	25.48	13.63
	Y	566		697		679	
Orissa	A	7.01	3.12	8.28	3.45	7.88	3.12
	P	2.81	2.11	3.88	2.78	4.09	2.19
	Y	401		469		519	
Punjab	A	0.39	0.17	0.23	0.09	0.53	0.21
	P	0.32	0.24	0.19	0.14	0.46	0.25
	Y	811		858		871	
Rajasthan	A	31.77	14.15	40.51	16.90	39.37	15.60
	P	12.96	9.71	19.57	14.00	22.72	12.15
	Y	408		483		577	
Tamil Nadu	A	5.45	2.43	5.97	2.49	7.79	3.09
	P	2.19	1.64	2.34	1.67	5.47	2.93
	Y	402		391		702	
U.P.	A	27.31	12.16	23.58	9.84	22.86	9.05
	P	22.37	16.76	19.83	14.19	17.60	9.41
	Y	819		841		770	
West Bengal	A	2.32	1.03	1.86	0.78	2.96	1.17
	P	1.75	1.31	1.47	1.05	2.73	1.46
	Y	754		787		922	
All India	A	224.60		239.75		252.43	
	P	133.48		139.82		187.00	
	Y	594		583		741	

**Twelfth plan is the Ave. of 2012-13 to 2016-17 & 2016-17 APY is the III[rd] Adv. Estimates.*


State's Scenario (XIIth Plan)
Total Pulses: Area
A.P 5%
CG 3%
Orissa 3%
TN 3%
U.P. 9%
Others 13%
Karnataka 10%
M.P. 22%
MS 15%
Raj. 16%


State's Scenario (XIIth Plan)
Total Pulses : Production
Gujarat 4%
Jharkhand 3%
CG 3%
A.P 6%
Karnataka 7%
Others 14%
U.P. 9%
Raj. 12%
MP 28%
MS 14%

1.7.5 DISTRICT SCENARIO (2012-13) – POTENTIAL DISTRICTS

The micro analysis at district level was also carried out and presented in (Table 1.12). 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.

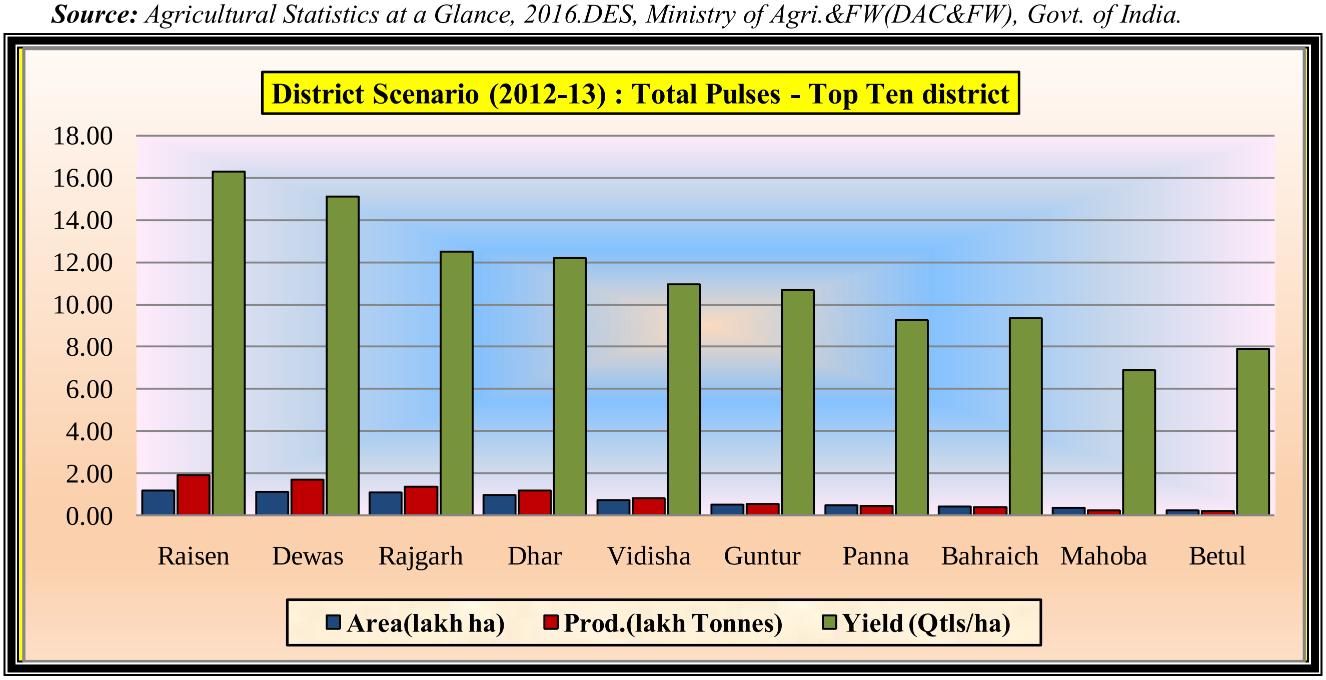
The yield levels of potential district are also above the national average yield level except Mahoba district of UP.Out of ten potential districts seven districts was belongs to Madhya Pradesh State during 2012-13 & rest of the other were two from Uttar Pradesh and one of Andhra Pradesh.

(TABLE-1.12): TOP POTENTIAL DISTRICTS (2012-13) –TOTAL PULSES

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

Name of District	State	Area		Production		Yield	
		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**	

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*



1.8 NATIONAL SCENARIO: PLAN PERIODS (KHARIF PULSES)

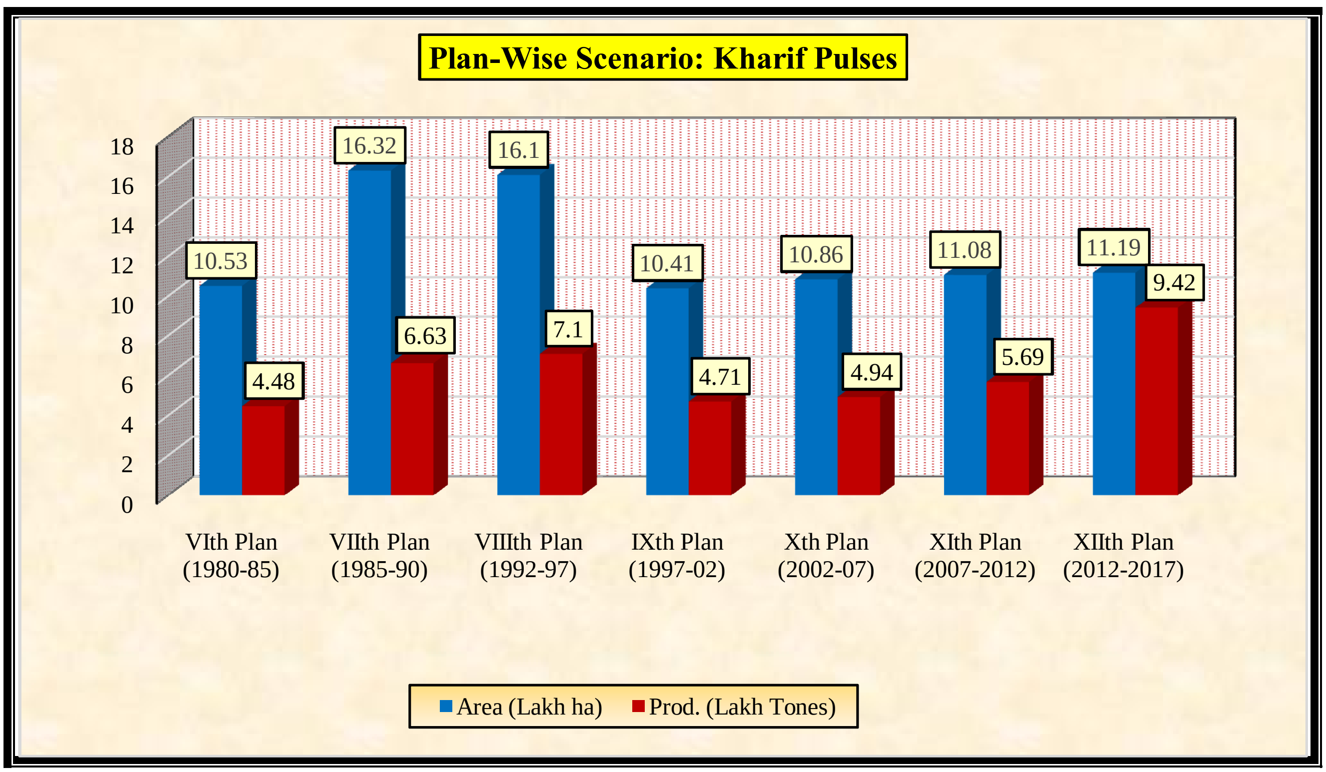
A visit to different plan periods records a slight growth in total Area and production from Xth Plan 2002-07 with 4.3% and 4.8% respectively. Highly variability seen like sudden growth with area (+54%) and production (+47%) during VIIth plan and decreasing trend for area (-35%) and production (-33%) during IXth plan is given at (Table-1.13).

(TABLE-1.13): PLAN-WISE NATIONAL SCENARIO - KHARIF PULSES

(Area-Million ha, Production-Million Tonnes, Yield-kg/ha)

Plan	Area	% COPP	Prod.	% COPP	Productivity	% COPP
Sixth Plan (1980-85)	10.53		4.48		425	
Seventh Plan (1985-90)	16.32	54.99	6.63	47.99	406	-4.51
Eighth Plan (1992-97)	16.10	-1.35	7.10	7.09	441	8.55
Ninth Plan (1997-02)	10.41	-35.34	4.71	-33.66	452	2.60
Tenth Plan (2002-07)	10.86	4.32	4.94	4.88	455	0.54
Eleventh Plan (2007-2012)	11.08	2.03	5.69	15.18	514	12.90
Twelfth Plan (2012-2017)*	11.19	0.99	9.42	65.56	585	13.81

Source: *DES, Twelfth Plan (2012-2017)*& 2016-17 APY is the IVth Advance Estimate; % COPP is percentage change over previous plan.*



1.8.1 STATES' SCENARIO: PLAN ANALYSIS (Xth –XIIth)

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 24.58 lakh hectares (22.63%) 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 (21.97 lakh hectares) with 20.23% of the total kharif area. Rajasthan was the second largest producer with 6.06 lakh tonnes (12.27%) while Karnataka third in acreage of 13.59 lakh hectares (12.51 %) during the plan period with a mere 4.81 lakh tonnes of production (9.74%), placed at third rank. The highest yield was recorded by the state of Bihar (910 kg/ha) followed by Punjab (778 kg/ha) and Haryana (645 kg/ha). Lowest yield observed in Rajasthan only (276 kg/ha).

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 (12.83%) and Madhya Pradesh (9.28%). While at production front, Maharashtra ranked first with 14.08 lakh tonnes which are 24.73% of countryȏs 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 (1014 kg/ha) followed by Punjab (813 kg/ha) and Haryana (780 kg/ha) with the over all National yield average of (514 kg/ha). Lowest yield was observed in C.G. *i.e.,* 342 kg/ha only.

Twelfth plan (2012-2017)**:**The total area coverage and production of Kharif Pulses in India during the Twelft plan was 111.88 lakh hectares and 64.57 lakh tonnes respectively, out of which Rajasthan ranked first (25.04 lakh hectares) and contributed 22.38% of total area while in production Maharashtra ranked first with 20.13% (13.00 lakh tonnes) and ranked second in area accounting for 18.79% (21.02 lakh hectares) of the total area. Madhya Pradesh ranked second with 16.41 % of the countryȏs production (10.60 lakh tonnes) and stands third in area with 14.00% (15.66 lakh hectares) and Rajasthan stood third in production which accounted for 15.36% (9.92 lakh tonnes) of the total Kharif pulses during the period. In case of productivity, state of Bihar ranked first with (1174 kg/ha) followed by Jharkhand (921 kg/ha) and Gujarat (826 kg/ha). Lowest yield was observed in the state of Rajasthan (396 kg/ha).

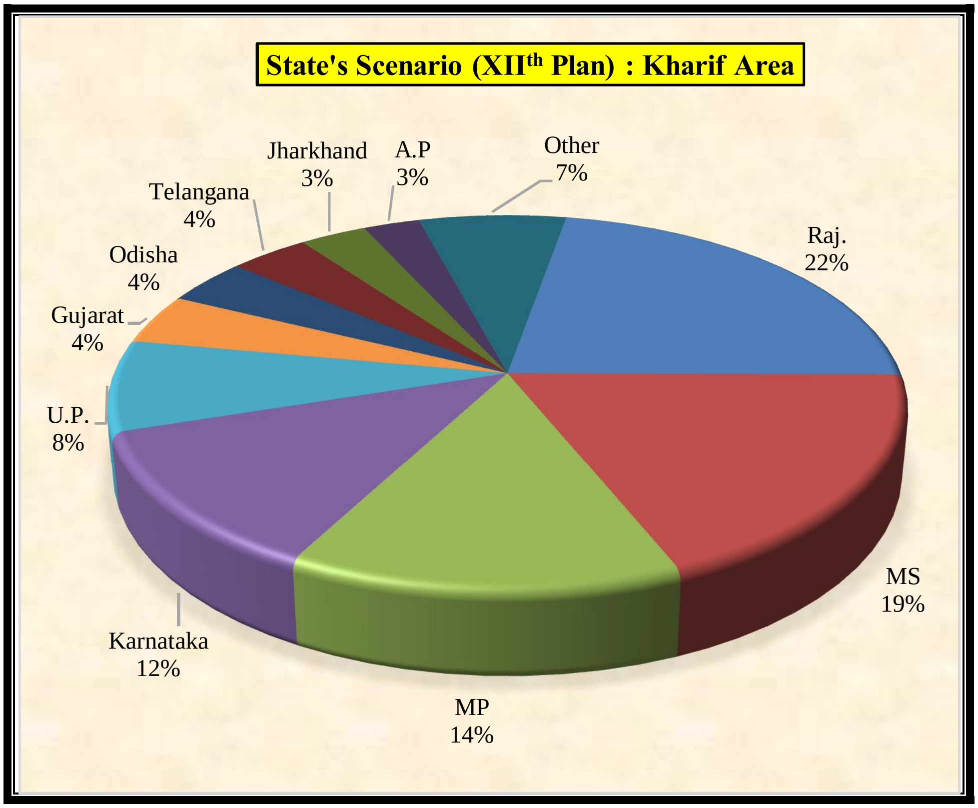
Overall trend of area, production and yield of last three plan periods have shown increasing trend in production and productivity.

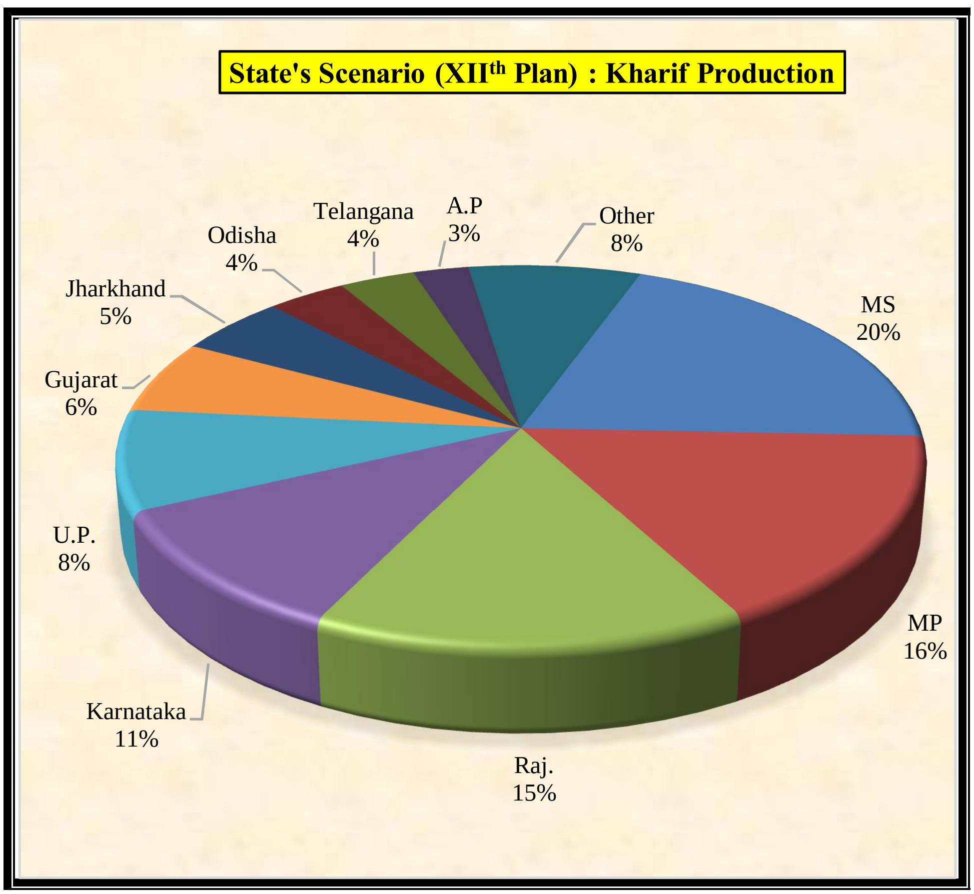
(TABLE-1.14): PLAN-WISE STATES' SCENARIO - MAJOR STATES

{Area-lakh ha, Production-lakh tonnes, Yield-kg/ha}

States		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
A.P	A	9.08	8.36	7.21	6.51	2.99	2.67
	P	3.89	7.87	3.23	5.67	1.67	2.58
	Y	428		448		558	
Bihar	A	0.89	0.82	0.69	0.62	0.57	0.51
	P	0.81	1.63	0.70	1.23	0.67	1.04
	Y	910		1014		1174	
Chhattisgarh	A	2.35	2.17	2.22	2.00	2.08	1.86
	P	0.79	1.60	0.76	1.33	0.83	1.29
	Y	336		342		399	
Gujarat	A	6.31	5.81	6.13	5.53	4.86	4.34
	P	3.79	7.67	4.48	7.87	4.01	6.21
	Y	601		731		826	
Haryana	A	0.62	0.57	0.50	0.45	0.26	0.23
	P	0.4	0.81	0.39	0.68	0.18	0.28
	Y	645		780		697	
Jharkhand	A	2.08	1.92	2.48	2.24	3.56	3.18
	P	1.22	2.46	1.67	2.93	3.28	5.07
	Y	587		673		921	
Karnataka	A	13.59	12.51	14.21	12.83	13.71	12.25
	P	4.81	9.74	6.43	11.29	6.98	10.81
	Y	354		452		509	
Madhya Pradesh	A	9.5	8.75	10.28	9.28	15.66	14.00
	P	4.45	9.00	4.73	8.31	10.60	16.41
	Y	468		460		677	
Maharashtra	A	24.58	22.63	21.99	19.85	21.02	18.79
	P	13.54	27.42	14.08	24.73	13.00	20.13
	Y	551		640		618	
Odisha	A	4.9	4.51	5.06	4.57	4.45	3.98
	P	1.92	3.89	2.38	4.18	2.37	3.67
	Y	392		470		533	
Punjab	A	0.27	0.25	0.16	0.14	0.10	0.09
	P	0.21	0.43	0.13	0.23	0.08	0.12
	Y	778		813		770	
Rajasthan	A	21.97	20.23	26.91	24.29	25.04	22.38
	P	6.06	12.27	9.66	16.97	9.92	15.36
	Y	276		359		396	
Tamilnadu	A	1.88	1.73	1.61	1.45	2.31	2.07
	P	0.77	1.56	0.79	1.39	1.56	2.42
	Y	410		491		676	
Telangana	A			4.79	4.33	4.23	3.78
	P			1.93	3.39	2.26	3.50
	Y			402		534	
U.P.	A	8.8	8.10	8.47	7.65	8.82	7.89
	P	5.59	11.31	5.74	10.08	5.49	8.50
	Y	635		678		622	
West Bengal	A	0.54	0.50	0.49	0.44	0.82	0.73
	P	0.35	0.71	0.33	0.58	0.48	0.75
	Y	648		673		591	
All India	**A**	**108.61**		**110.78**		**111.88**	
	P	**49.39**		**56.94**		**64.57**	
	Y	**455**		**514**		**577**	

**Twelfth plan is the Ave. of 2012-13 to 2016-17 & 2016-17 APY is the IIIrd Adv. Estimates*


State's Scenario (XIIth Plan) : Kharif Area
Jharkhand 3%
A.P 3%
Other 7%
Telangana 4%
Odisha 4%
Gujarat 4%
Raj. 22%
U.P. 8%
MS 19%
Karnataka 12%
MP 14%


State's Scenario (XIIth Plan) : Kharif Production
Telangana 4%
A.P 3%
Other 8%
Odisha 4%
Jharkhand 5%
MS 20%
Gujarat 6%
U.P. 8%
MP 16%
Karnataka 11%
Raj. 15%

1.9 NATIONAL SCENARIO: PLAN PERIODS (RABI PULSES)

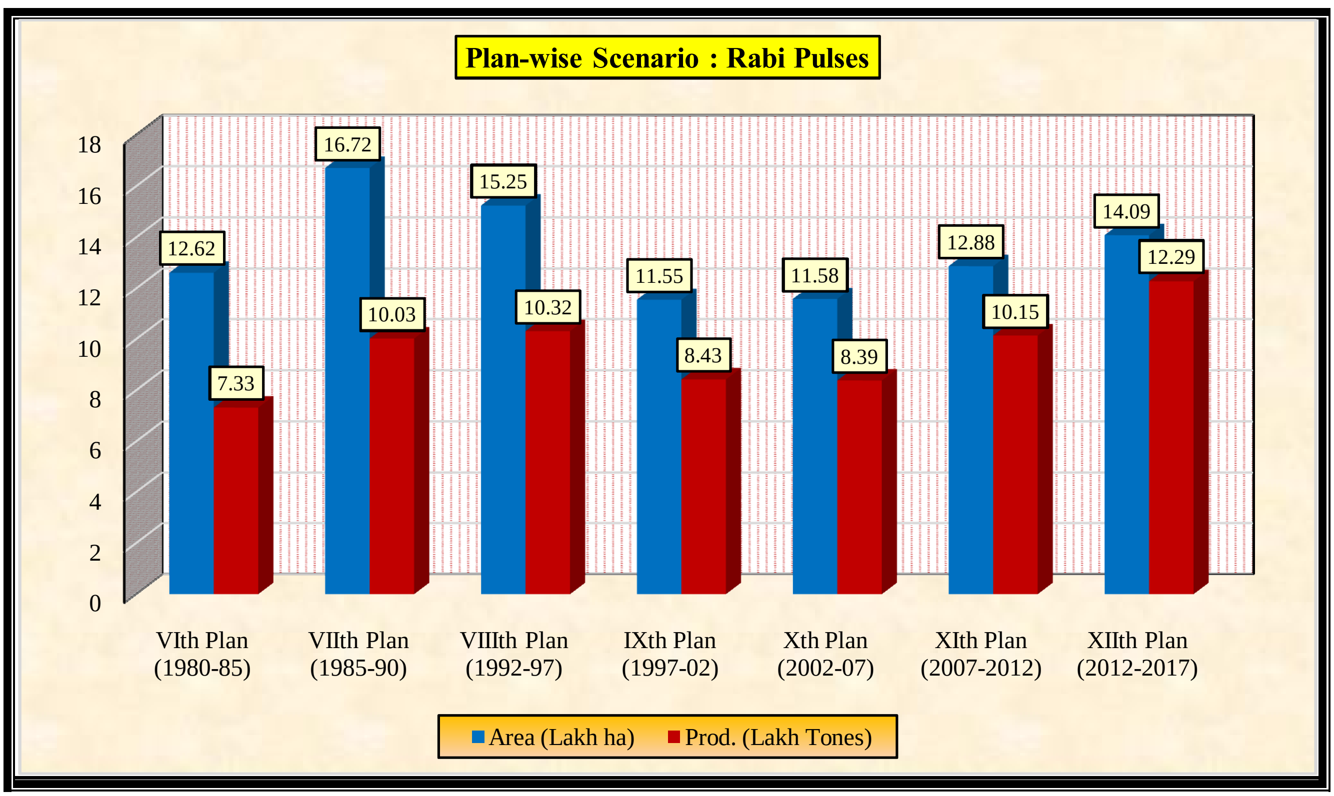
A visit to different plan periods records a growth in VIIth, XIth, & XIIth Plan for area (32%, 11% & 9% and for production (36%, 21% & 21%). The area remained almost stagnant, stabilized up-till XIIth plan. However, the XIIth plan analysis shows that the increasing per cent change trend under area (+ 9%) and production (+21%) of total pulses over previous plan periods (COPP) is given at (Table-1.15). Decreasing trend seen only during VIIIth to IXth Plan.

(TABLE-1.15): PLAN-WISE NATIONAL SCENARIO – RABI PULSES

(Area-Million ha, Production-Million Tonnes, Yield-kg/ha)

Plan	Area	% COPP	Prod.	% COPP	Productivity	% COPP
Sixth Plan (1980-85)	12.62		7.33		581	
Seventh Plan (1985-90)	16.72	32.49	10.03	36.83	600	3.28
Eighth Plan (1992-97)	15.25	-8.79	10.32	2.89	677	12.81
Ninth Plan (1997-02)	11.55	-24.26	8.43	-18.31	730	7.85
Tenth Plan (2002-07)	11.58	0.26	8.39	-0.47	725	-0.73
Eleventh Plan (2007-2012)	12.88	11.23	10.15	20.98	788	8.77
Twelfth Plan (2012-2017)*	14.09	9.39	12.29	21.08	872	10.66

Source: *DES, Twelfth Plan (2012-2017)*& 2016-17 APY is the IVth Advance Estimate; % COPP is percentage change over previous plan.*



1.9.1 STATES' SCENARIO: PLAN ANALYSIS (Xth –XIIth)

Tenth Plan (2002-2007): Total area of (115.99 lakh hectares) and production of 84.10 lakh tonnes of Rabi pulses were observed during the Tenth plan in India. Out of these, 29.11% of area (33.77 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 (18.52 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 9.75% (8.20 lakh tones) of the countryφs total Rabi pulse during the plan period. The highest state average yield exhibited in Punjab (917 kg/ha) followed by Uttar Pradesh (906 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 (418 kg/ha) and Odisha (420 kg/ha).

***Eleventh plan (2007-2012)*:** The total area and production under Rabi pulses during the Eleventh plan were 128.84 lakh hectares and 101.55 lakh tonnes respectively. Madhya Pradesh ranked first both in area and production with 37.47 lakh hectares and 31.24 lakh tonnes which are 29.08% and 37.77% of the countryφs total rabi pulse acreage and production respectively followed by Uttar Pradesh with 11.73 % and 13.88% (15.11 lakh hectares and 14.10 lakh tonnes) and Maharashtra was placed third in area & Production both as 10.60% (13.66 lakh hectares) and 10.59% (10.75 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 (937 kg/ha) has been above the National average yield of 788 kg/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).

***Twelfth plan (2012-17)*:** All India Rabi pulse acreage and production has been recorded at 140.55 lakh hectares and 122.42 lakh tonnes. Madhya Pradesh stood at first in area and production, covering 41.37 lakh hectares (29.44%) with a production of 41.42 lakh tonnes (33.84%). Maharashtra ranked second with 16.54 lakh hectares of area (11.77%), Rajasthan with third position which covered 14.33 lakh hectares of area (10.19 %) and UP shared the fourth rank having an area of 14.03 lakh hectare (9.98 %). However, Rajasthan stood second in terms of production contributing 12.80 lakh tonnes (10.46%), Maharshtra in third position with a production of 12.49 lakh tonnes (10.20%) and UP in fourth position 12.10 lakh tonnes (9.89 %), (Table 1.16). The highest productivity was recorded in plan period in Telangana (1302 kg/ha) followed by Jharkhand (1095 kg/ha) and Gujarat (1060 kg/ha). The lowest yield was noticed in the state of Odisha (500 kg/ha).

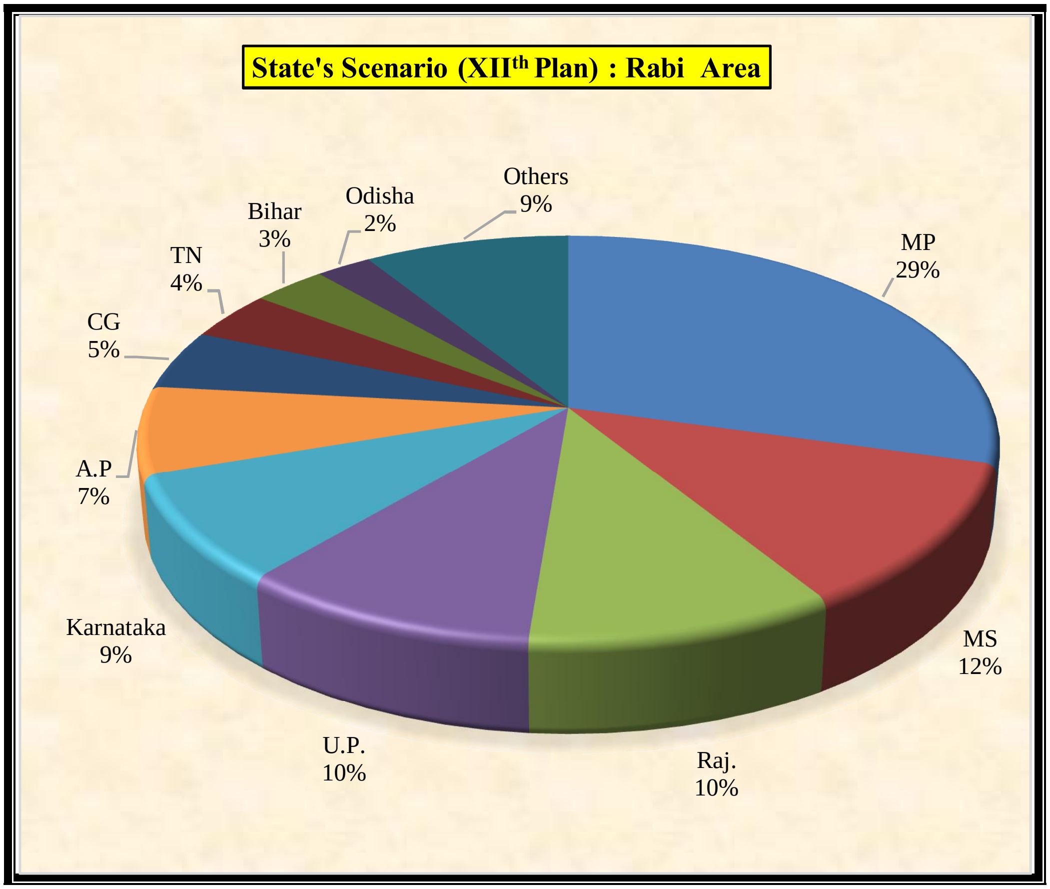
Overall trend of area, production and yield of last three plan periods have shown increasing trend in area however, production and productivity declined during XIth plan period from Xth plan period and significantly increased during XIIth plan period.

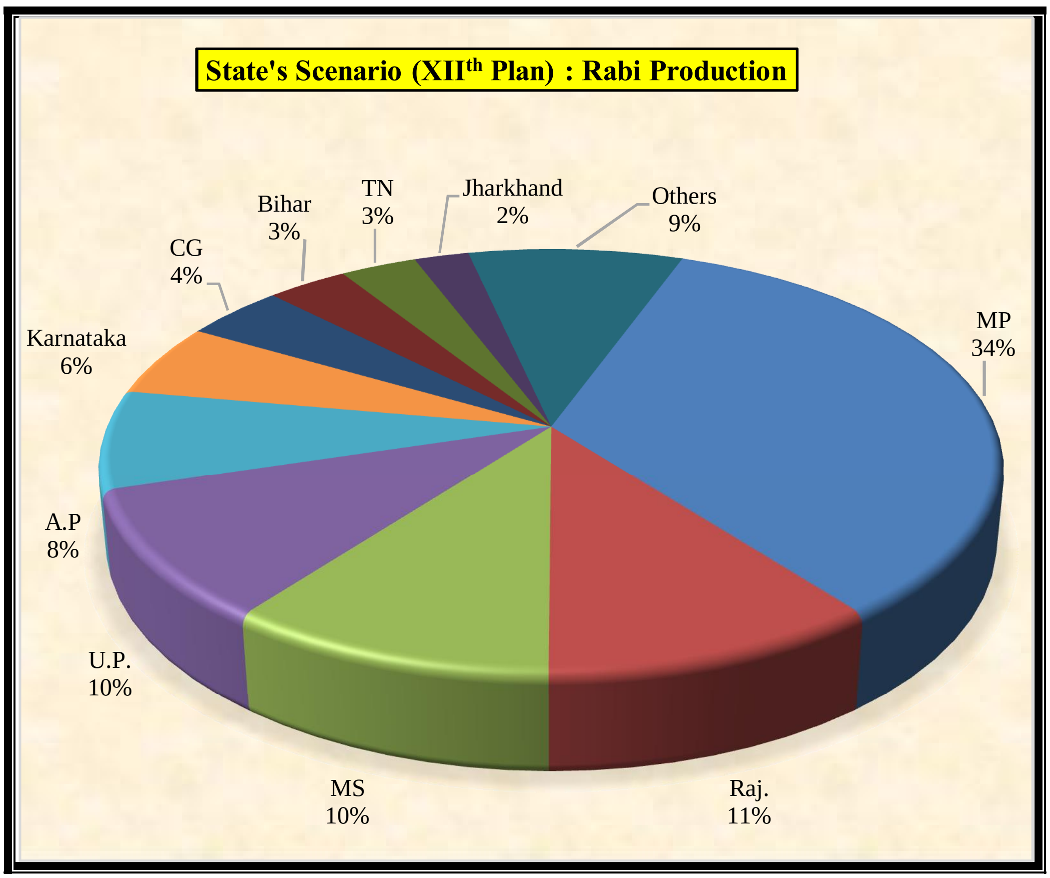
(TABLE-1.16): PLAN-WISE STATES' SCENARIO–MAJOR STATES

{Area-lakh ha, Production-lakh tonnes, Yield-kg/ha}

States		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
A.P	A	10.63	9.16	10.99	8.53	9.80	6.97
	P	8.20	9.75	10.31	10.15	9.19	7.50
	Y	771		937		938	
Bihar	A	5.61	4.84	5.10	3.96	4.60	3.27
	P	4.15	4.93	4.28	4.21	4.14	3.39
	Y	740		839		901	
Chhattisgarh	A	6.70	5.78	6.30	4.89	6.64	4.73
	P	3.73	4.44	4.36	4.29	5.15	4.20
	Y	557		692		774	
Gujarat	A	1.73	1.49	2.36	1.83	2.34	1.66
	P	1.35	1.61	2.27	2.23	2.48	2.02
	Y	780		960		1060	
Haryana	A	1.12	0.97	1.18	0.91	1.07	0.76
	P	0.86	1.02	0.94	0.93	0.81	0.66
	Y	768		798		752	
Jharkhand	A	0.66	0.57	1.53	1.19	2.56	1.82
	P	0.50	0.6	1.42	1.40	2.80	2.29
	Y	758		931		1095	
Karnataka	A	7.20	6.21	9.88	7.67	12.00	8.54
	P	3.01	3.58	5.67	5.59	6.78	5.53
	Y	418		574		565	
Madhya Prd.	A	33.77	29.11	37.47	29.08	41.37	29.44
	P	27.01	32.12	31.24	30.77	41.42	33.84
	Y	800		834		1001	
Maharashtra	A	10.74	9.26	13.66	10.60	16.54	11.77
	P	6.44	7.66	10.75	10.59	12.49	10.20
	Y	600		787		755	
Odisha	A	2.12	1.83	3.22	2.50	3.43	2.44
	P	0.89	1.06	1.50	1.48	1.72	1.40
	Y	420		466		500	
Punjab	A	0.12	0.1	0.06	0.05	0.42	0.30
	P	0.11	0.13	0.07	0.07	0.38	0.31
	Y	917		1063		896	
Rajasthan	A	9.81	8.46	13.60	10.55	14.33	10.19
	P	6.90	8.21	9.91	9.76	12.80	10.46
	Y	703		729		894	
Tamilnadu	A	3.57	3.08	4.36	3.39	5.48	3.90
	P	1.42	1.69	1.55	1.53	3.91	3.20
	Y	398		356		714	
Telangana	A			1.49	1.15	1.27	0.91
	P			1.42	1.40	1.66	1.35
	Y			957		1302	
U.P.	A	18.52	15.96	15.11	11.73	14.03	9.98
	P	16.78	19.95	14.10	13.88	12.10	9.89
	Y	906		933		863	
West Bengal	A	1.78	1.54	1.38	1.07	2.14	1.52
	P	1.40	1.66	1.13	1.12	2.24	1.83
	Y	787		822		1048	
All India	**A**	**115.99**		**128.84**		**140.55**	
	P	**84.10**		**101.55**		**122.42**	
	Y	**725**		**788**		**871**	

**Twelfth plan is the Ave. of 2012-13 to 2016-17 & 2016-17 APY is the IIIrd Adv. Estimates*


State's Scenario (XIIth Plan) : Rabi Area
Others 9%
Odisha 2%
Bihar 3%
TN 4%
CG 5%
A.P 7%
Karnataka 9%
U.P. 10%
Raj. 10%
MS 12%
MP 29%


State's Scenario (XIIth Plan) : Rabi Production
Bihar 3%
TN 3%
Jharkhand 2%
Others 9%
CG 4%
Karnataka 6%
A.P 8%
U.P. 10%
MS 10%
Raj. 11%
MP 34%

CHICKPEA (GRAM)

Botanical Name : *Cicer arietinum L.*
Synonym : Chickpea, Bengalgram, Chana and Gram
Origin : South West Asia ï probably Afganisthan and/or Persia
Chromosome nos.: 2n = 16

2.1 ECONOMIC IMPORTANCE:In India chickpea is the most important pulse crop and mostly grown under rainfed conditions (65%), remaining 35% with critical irrigation support. During XIIth Plan (2012-2017), it was grown in > 35 per cent of total pulse area (252.43 Lha) contributing to about 45% of total pulse production. It is mainly consumed as ôDalô (split cotyledons) and *chole.* Many attractive dishes viz.,ï sweets, snacks and namkeen are also prepared from its flour called besan. Also eaten as whole fried or boiled and salted. Fresh green leaves (sag) are used as vegetables and green grains as *hare chole or cholia.* Straw of gram is an excellent fodder while both husk and bits of ôDalô are valuable cattle feed. Leaves consist of mallic and citric acid and are very useful for stomach ailments and blood purifier.

2.2 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
Fibre	22-23%	Calorific value	368-396 Kcal/100 g

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

2.3 GROWTH RATE

From 1980-81 to 2009-10, the total acreage under pulses has almost slightly (±) being showed, however, the maximum growth rate in area was recorded during 2013-14 and 2016-17 with growth rate of 16% & 13%. Maximum production growth rate of 28% and maximum yield growth rate of 13% were also observed during 2016-17. The highest area (9.93 million ha) and production (9.53 million tonnes) was recorded during 2013-14 followed by 9.53 million ha & 9.08 million tonnes during 2016-17 (Table 2.1).

(TABLE-2.1): **GROWTH RATE OF CHICKPEA**

(A- Million ha, P- Million tones, Y-kg/ha, Growth Rate (GR) - %)

Year	Chickpea					
	Area	GR	Production	GR	Yield	GR
1980-81	4.33		6.58		1522	
1985-86	5.79	33.7	7.80	18.5	1348	-11.4
1990-91	5.36	-7.5	7.52	-3.6	1404	4.1
1995-96	4.98	-7.0	7.12	-5.4	1429	1.8
1996-97	6.85	37.5	5.57	-21.7	814	-43.1
1997-98	7.56	10.5	6.13	10.1	811	-0.3
1998-99	8.47	12.0	6.80	10.9	803	-1.0

(A- Million ha, P- Million tones, Y-kg/ha, Growth Rate (GR) - %)

Year	Chickpea					
	Area	GR	Production	GR	Yield	GR
1999-00	6.15	-27.4	5.12	-24.7	833	3.7
2000-01	5.19	-15.6	3.86	-24.7	744	-10.7
2001-02	6.42	23.7	5.47	42.0	853	14.7
2002-03	5.91	-7.9	4.24	-22.6	717	-15.9
2003-04	7.05	19.3	5.72	34.9	811	13.1
2004-05	6.71	-4.7	5.47	-4.3	815	0.4
2005-06	6.93	3.2	5.60	2.4	808	-0.7
2006-07**	7.49	8.2	6.33	13.1	845	4.5
2007-08	7.54	0.7	5.75	-9.2	762	-9.8
2008-09	7.89	4.6	7.06	22.8	895	17.4
2009-10	8.17	3.5	7.48	5.9	915	2.3
2010-11	9.19	12.4	8.22	10.0	895	-2.2
2011-12	8.30	-9.7	7.70	-6.3	928	3.7
2012-13	8.52	2.7	8.83	14.7	1036	11.7
2013-14	9.93	16.5	9.53	7.9	960	-7.4
2014-15	8.25	-16.9	7.33	-23.0	889	-7.4
2015-16	8.40	1.8	7.06	-3.7	840	-5.4
2016-17	9.54	13.6	9.08	28.6	951	13.2

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*

(TABLE-2.2): PER CENT SHARE TO TOTAL PULSES

(Area- lakh ha, Production-Lakh Tones, Yield-kg/ha)

Year	Gram			Total Pulses			% Share to Total Pulses		
	A	P	Y	A	P	Y	A	P	YI
1980-81	43.28	65.85	1522	224.45	106.24	473	19.3	62.0	321
1990-91	53.56	75.21	1404	372.55	203.68	547	14.4	36.9	257
1995-96	49.79	71.16	1429	331.77	170.10	513	15.0	41.8	279
2000-01	51.85	38.55	744	203.48	110.75	544	25.5	34.8	137
2001-02	64.16	54.73	853	220.08	133.68	607	29.2	40.9	140
2002-03	59.06	42.37	717	204.96	111.25	543	28.8	38.1	132
2003-04	70.48	57.18	811	234.58	149.05	635	30.0	38.4	128
2004-05	67.15	54.69	815	227.63	131.30	577	29.5	41.7	141
2005-06	69.26	56.00	808	223.91	133.84	598	30.9	41.8	135
2006-07	74.94	63.34	845	231.92	141.98	612	32.3	44.6	138

(Area- lakh ha, Production-Lakh Tones, Yield-kg/ha)

Year	Gram			Total Pulses			% Share to Total Pulses		
	A	P	Y	A	P	Y	A	P	YI
2007-08	75.44	57.49	762	236.33	147.62	625	31.9	38.9	122
2008-09	78.93	70.6	895	220.94	145.66	659	35.7	48.5	136
2009-10	81.69	74.76	915	232.82	146.62	630	35.1	51.0	145
2010-11	91.86	82.21	895	264.02	182.41	691	34.8	45.1	130
2011-12	82.99	77.02	928	244.62	170.89	699	33.9	45.1	133
2012-13	85.22	88.32	1036	232.57	183.42	789	36.6	48.2	131
2013-14	99.27	95.26	960	252.18	192.55	764	39.4	49.5	126
2014-15	82.51	73.32	889	235.53	171.52	728	35.0	42.7	122
2015-16	83.99	70.58	840	249.11	163.48	656	33.7	43.2	128
2016-17	95.84	93.26	973	294.64	229.54	779	32.53	40.63	125

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*

2.4 IMPORT/EXPORT

IMPORT: The import of pulses in India during April, 2014 to March, 2015 was 4.19 lakh tonnes worth Rs.1334.96 crores against the value of Rs.17196.87 crore for total foodgrains, Rs.121319.02 crore for total agricultural imports and against Rs.2737086.58 crore for total National Import. The import during April, 2015 to March, 2016 was 10.31 lakh tonnes worth Rs.4453.72 crore against the import value of Rs. 26841.87 crore for total foodgrains, Rs.140288.69 crore for total agricultural import and Rs.2490298.08 crore for total National import respectively during this period. The share of Chickpea import to Agricultural import was 1.10% and 3.17% respectively during April, 2014 to March, 2015 and April, 2015 to March, 2016.

{Chickpeas contribute 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}.

EXPORT: The pulses export of the country during April, 2014 to March, 2015 was 1.90 lakh tonnes worth Rs.1021.57 crore against the value of Rs. 59500.54 crore for total foodgrains, Rs.239681.04 crore for total agricultural exports and against Rs.1896445.47 crore for total National export.The export during April, 2015 to March, 2016 was 2.17 lakh tonnes worth Rs.1337.64 crore against the export value of Rs. 42622.29 crore for total foodgrains, Rs.215395.68 crore for total agricultural export and Rs.1716378.05 crore for total National export respectively during this period. The share of Chickpea export to Agricultural export was 0.43% and 0.62% respectively during April, 2014 to March, 2015 and April, 2015 to March, 2016.

(TABLE-2.3): IMPORTING & EXPORTING COUNTRIES

(Quantity-Thousand Tonnes)

S.No.	Import			Export		
	Country	**Aveg.***	**% Share**	**Country**	**Aveg.***	**% Share**
1	Australia	376.61	53.73	Pakistan IR	63.45	31.00
2	Austria	131.79	18.80	Algeria	32.91	16.08
3	Russia	76.87	10.97	Turkey	24.70	12.07
4	Sri Lanka DSR	32.49	4.64	Sri Lanka DSR	14.77	7.21
5	Tanzania Rep	18.11	2.58	U Arab EMTS	11.26	5.50
6	Thailand	12.63	1.80	Saudi Arab	9.00	4.40
7	Mexico	12.23	1.74	Spain	5.40	2.64
8	U S A	6.89	0.98	Tunisia	5.31	2.59
9	Myanmar	6.31	0.90	Egypt ARP	4.48	2.19
10	Ethiopia	5.72	0.82	Libya	3.94	1.92
11	Canada	4.96	0.71	Iraq	3.43	1.67
12	Argentina	2.30	0.33	Kuwait	2.99	1.46
13	Mozambique	2.15	0.31	Malaysia	2.17	1.06
14	Sudan	2.14	0.31	Jordan	1.99	0.97
15	Uzbekistan	1.95	0.28	France	1.88	0.92
16	El Salvador	1.93	0.27	Iran	1.79	0.88
17	Ukraine	1.91	0.27	Vietnam Soc. Rep	1.75	0.85
18	Others	10.78	1.54	Others	5.27	2.57
	Total	**700.95**		**Total**	**204.70**	

Source: *Ministry of Commerce and Industry; Aveg.*- 2012-13 to 2016-17*

2.5 PRODUCTION TRENDS

2.5.1 GLOBAL SCENARIO

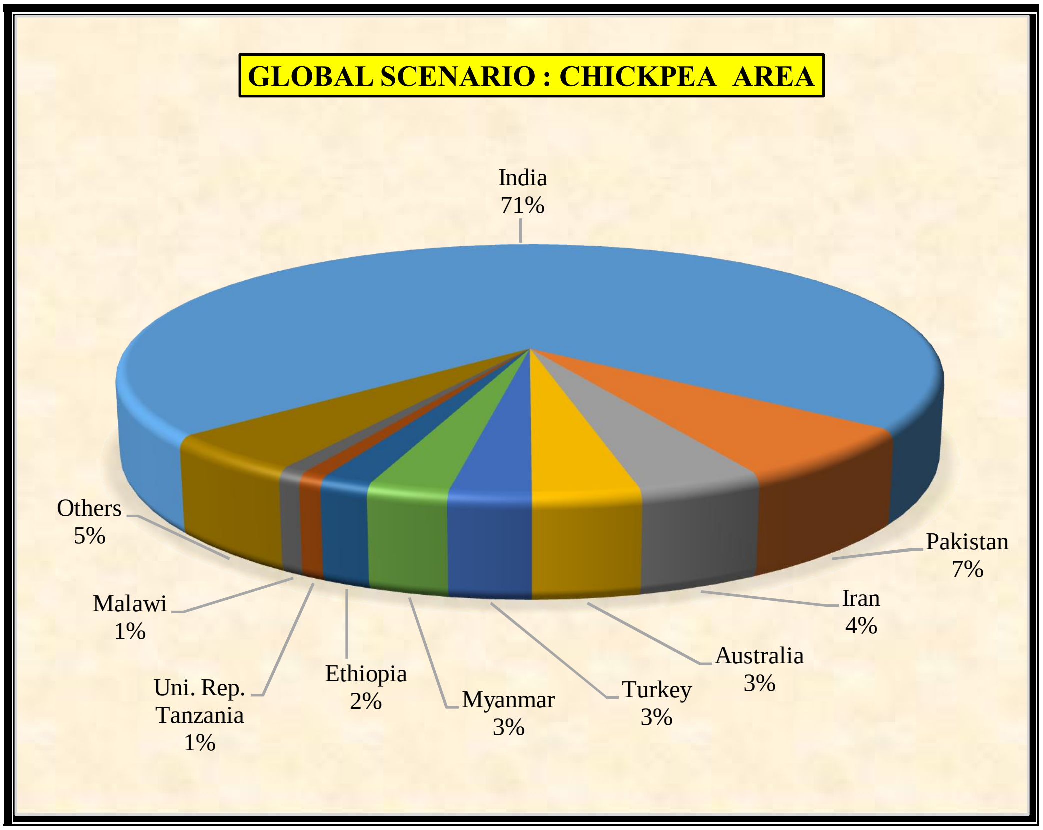
India ranks I[st] in area and production in the world, followed by Pakistan, Iran and Australia. The highest productivity of 3759 kg/ha is observed in China followed by Israel, Repbl. of Moldova and Bosnia &Herzegovina.Indiaȇs productivity was 995 kg/ha.

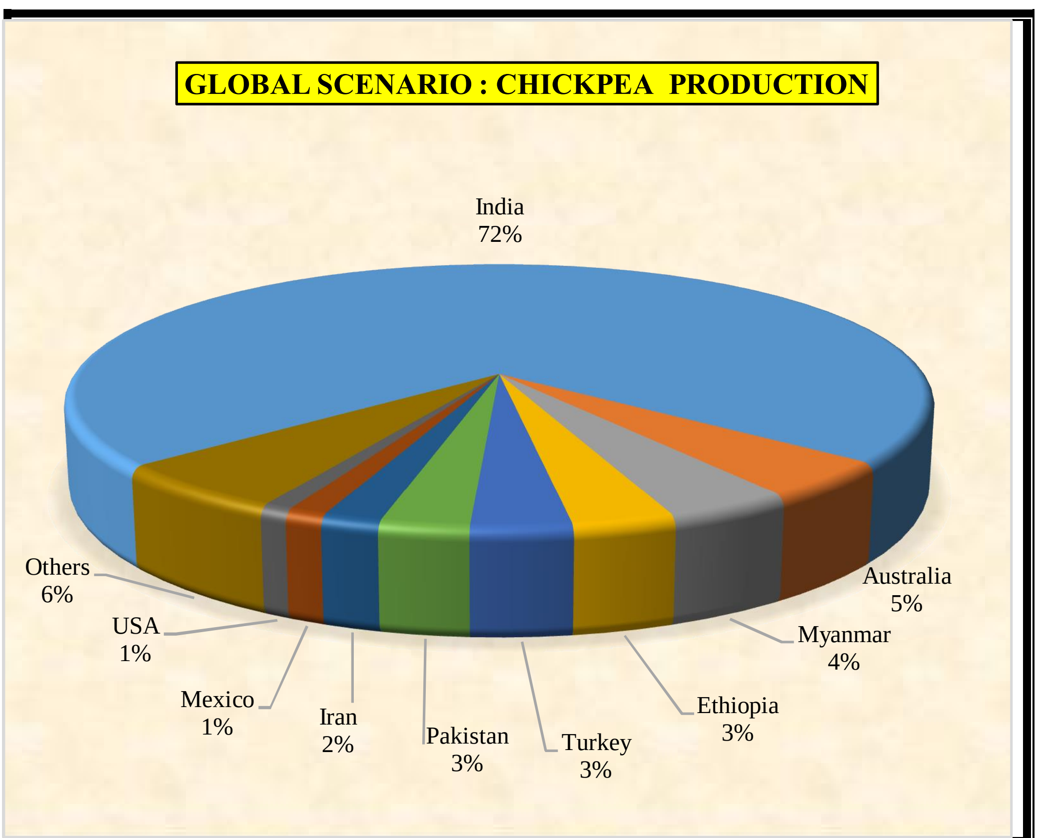
(TABLE–2.4) GLOBAL RANKING: MAJOR COUNTRIES

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

Country	Area	% Cont.	Country	Prod.	% Cont.	Country	Yield
India	99.27	71.00	India	98.80	71.95	China	3759
Pakistan	9.50	6.79	Australia	6.29	4.58	Israel	3559
Iran	5.94	4.25	Myanmar	5.62	4.09	Repbl of Moldova	3556
Australia	5.08	3.63	Ethiopia	4.59	3.34	Bosnia &Herzegovina	3204
Turkey	3.88	2.78	Turkey	4.50	3.28	Yemen	3093
Myanmar	3.84	2.75	Pakistan	3.99	2.91	Jordan	2632
Ethiopia	2.40	1.71	Iran	2.62	1.91	Hungary	2250
Uni. Rep. Tanzania	1.16	0.83	Mexico	1.72	1.25	Uzbekistan	2192
Malawi	1.15	0.82	USA	1.27	0.93	Egypt	2124
World	**139.81**		**World**	**137.31**		**World**	**982**
						India	**995**

Source: *FAO Statistics 2014.*


GLOBAL SCENARIO : CHICKPEA AREA
India
71%
Pakistan
7%
Iran
4%
Australia
3%
Turkey
3%
Myanmar
3%
Ethiopia
2%
Uni. Rep.
Tanzania
1%
Malawi
1%
Others
5%


GLOBAL SCENARIO : CHICKPEA PRODUCTION
India
72%
Australia
5%
Myanmar
4%
Ethiopia
3%
Turkey
3%
Pakistan
3%
Iran
2%
Mexico
1%
USA
1%
Others
6%

2.5.2 NATIONAL SCENARIO : PLAN PERIODS

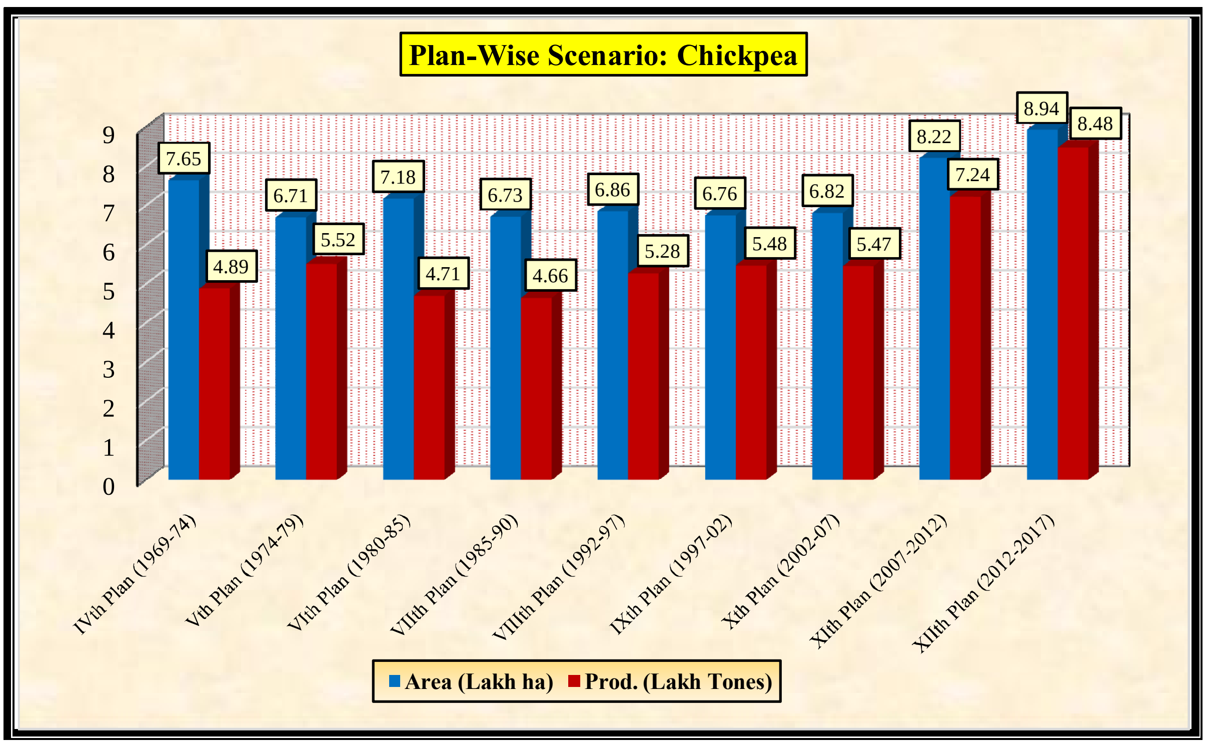
Plan-wise performance revelaed, the highest area and production increased during XIth plan over the previous plan period. The details plan-wise performance is given below:

(TABLE-2.5): PLAN-WISE NATIONAL SCENARIO

(Area-Million ha, Production-Million Tonnes, Yield-kg/ha)

Plan	Area	% COPP	Prod.	% COPP	Yield	% COPP
Fourth Plan (1969-74)	7.65		4.89		639	
Fifth Plan (1974-79)	6.71	-12.29	5.52	12.88	823	28.70
Sixth Plan (1980-85)	7.18	7.00	4.71	-14.67	656	-20.26
Seventh Plan (1985-90)	6.73	-6.27	4.66	-1.06	692	5.55
Eighth Plan (1992-97)	6.86	1.93	5.28	13.30	770	11.16
Ninth Plan (1997-02)	6.76	-1.46	5.48	3.79	811	5.32
Tenth Plan (2002-07)	6.82	0.89	5.47	-0.18	802	-1.06
Eleventh Plan (2007-2012)	8.22	20.53	7.24	32.36	881	9.82
Twelfth Plan (2012-2017)*	8.94	8.76	8.48	17.13	949	7.72

Source: *DES, Twelfth Plan (2012-2017)*& 2016-17 APY is the IVth Advance Estimate; % COPP is percentage change over previous plan*



2.5.3 STATE'S SCENARIO: PLAN ANALYSIS (X^{th} –XII^{th})

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. Madhya Pradesh ranked first in terms of area and production (38.23% and 42.52%) followed by Maharashtra with 13.93% and 10.84% and Rajasthan with 13.77% and 11.60%, respectively. Andhra Pradesh has recorded and yield of 1147 kg/ha followed by Bihar with 913 kg/ha. The lowest yield observed in Karnataka (479 kg/ha) followed by Maharashtra (624 kg/ha) and Odisha (645 kg/ha).

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. The highest productivity was recorded in plan period in Andhra Pradesh (1270 kg/ha) followed by Bihar (1067 kg/ha) and Gujarat (1048 kg/ha). The lowest yield was noticed in the state of Karnataka (600 kg/ha).

Twelfth Plan (2012-2017)**:** The total area and production of gram during twelfth Plan was 89.28 lakh hectares and 83.65 lakh tonnes respectively. Madhya Pradesh ranked first contributing an area of (34.46% and 40.62% of total area and production of country). Maharashtra is on the second rank for area 15.41 lakh ha (17.26%) and third for production 11.98 lakh tones (14.32%).Whereas, Rajasthan stood second in production (14.47%) and third in area (15.37%). The highest yield was recorded in the state of Telangana (1459 kg/ha) followed by Gujarat (1201 kg/ha) and West Bengal (1163 kg/ha). The lowest yield was recorded in Karnataka (578 kg/ha).

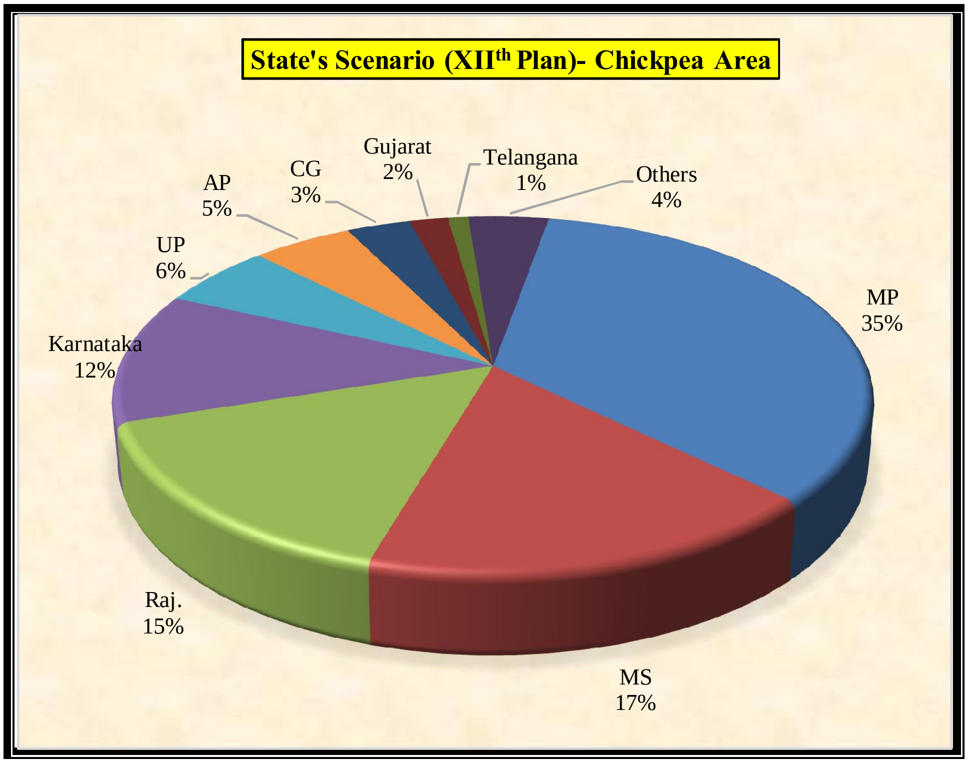
Chickpea is a major pulse in India which contributed about 35% of area & 45% of total pulse production.Overall trend of area, production and yield for the last three plan periods has shown a significant increase.

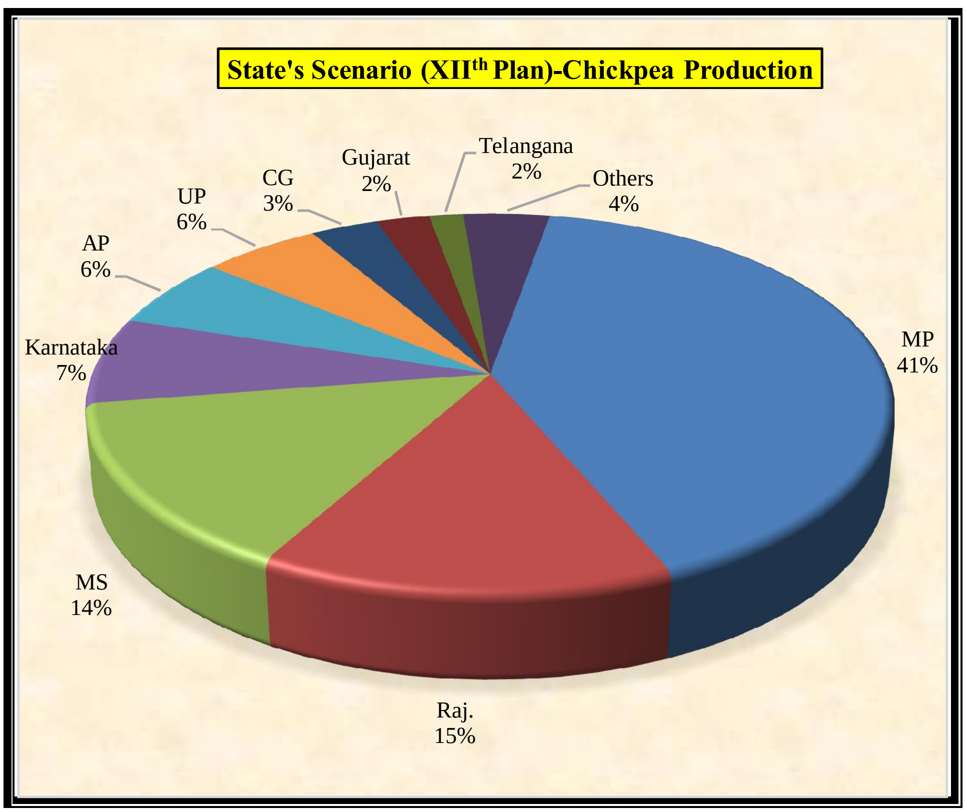
(TABLE-2.6): PLAN-WISE STATES' SCENARIO: MAJOR STATES

{Area- Lakh ha, Production-Lakh Tonnes, 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	4.49	5.03
	P	4.93	9.01	7.71	10.65	5.04	6.02
	Y	1147		1270		1122	
Bihar	A	0.69	1.01	0.60	0.72	0.60	0.68
	P	0.63	1.15	0.64	0.88	0.66	0.79
	Y	913		1067		1098	
Chhattisgarh	A	2.07	3.04	2.44	2.97	2.84	3.18
	P	1.54	2.81	2.22	3.06	2.62	3.13
	Y	744		910		922	
Gujarat	A	1.49	2.18	1.88	2.28	1.73	1.94
	P	1.23	2.25	1.97	2.72	2.08	2.48
	Y	826		1048		1201	
Haryana	A	1.05	1.53	1.01	1.23	0.59	0.66
	P	0.79	1.44	0.85	1.18	0.49	0.58
	Y	752		842		824	
Karnataka	A	4.95	7.26	8.13	9.89	10.60	11.87
	P	2.37	4.33	4.88	6.74	6.13	7.33
	Y	479		600		578	
Madhya Pradesh	A	26.06	38.23	29.04	35.34	30.76	34.46
	P	23.26	42.52	27.60	38.12	33.98	40.62
	Y	893		950		1105	
Maharashtra	A	9.50	13.93	12.55	15.27	15.41	17.26
	P	5.93	10.84	10.24	14.14	11.98	14.32
	Y	624		816		777	
Odisha	A	0.31	0.45	0.40	0.49	0.43	0.48
	P	0.20	0.36	0.29	0.41	0.33	0.39
	Y	645		725		766	
Rajasthan	A	9.39	13.77	13.18	16.04	13.72	15.37
	P	6.35	11.60	9.50	13.12	12.10	14.47
	Y	676		721		882	
Tamilnadu	A	0.06	0.09	0.07	0.09	0.07	0.07
	P	0.04	0.08	0.05	0.07	0.04	0.05
	Y	667		714		649	
Telangana	A			0.97		0.91	1.02
	P			1.10		1.33	1.59
	Y			1135		1459	
Uttar Pradesh	A	7.57	11.11	5.65	6.87	5.14	5.75
	P	6.80	12.43	5.32	7.35	4.63	5.54
	Y	898		942		901	
West Bengal	A	0.41	0.60	0.23	0.28	0.27	0.31
	P	0.37	0.67	0.24	0.33	0.32	0.38
	Y	902		1043		1163	
All India	**A**	**68.18**		**82.18**		**89.28**	
	P	**54.72**		**72.42**		**83.65**	
	Y	**803**		**881**		**937**	

**Twelfth plan is the Ave. of 2012-13 to 2016-17 & 2016-17 APY is the IIIrd Adv. Estimates.*


State's Scenario (XIIth Plan)- Chickpea Area
Gujarat 2%
Telangana 1%
Others 4%
CG 3%
AP 5%
UP 6%
MP 35%
Karnataka 12%
Raj. 15%
MS 17%


State's Scenario (XIIth Plan)-Chickpea Production
Telangana 2%
Gujarat 2%
Others 4%
CG 3%
UP 6%
AP 6%
MP 41%
Karnataka 7%
MS 14%
Raj. 15%

2.5.4 DISTRICT SCENARIO (2012-13) – POTENTIAL DISTRICTS

The intra-regional analysis at the district level as depicted in (Table-2.7)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.

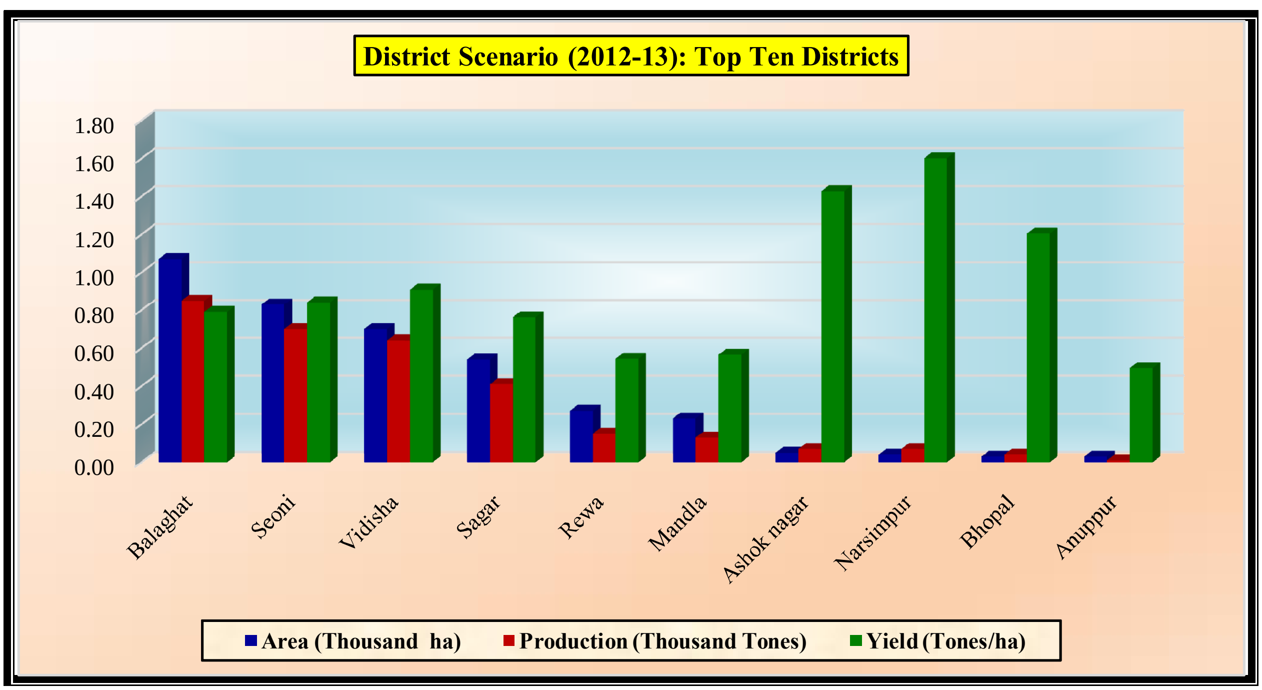
The yield was revealed that the potential districts yield is higher than the National average yield (1036 kg/ha). Out of Ten potential districts nine belongs to Madhya Pradesh whereas, only one district belongs to Andhra Pradesh.

(TABLE–2.7): TOP POTENTIAL DISTRICTS (2012-13)

{Area-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**	

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri. & FW (DAC&FW), Govt. of India.*



(TABLE-2.8): STATE-WISE YIELD GAP AND ADDITIONAL RETURN

(Yield: kg/ha; Return: Rs./ha.)

State	Yield (kg/ha)			Gap over FP		Gap over SAY		Yield 2016-17*	Additional return by bridging yield gap (Rs/ha)	
	IP	FP	SAY	Actual	%	Actual	%		FP	SAY
AP	1651	1553	1085	98	6	566	52	1107	3920	22640
Assam	1082	749	692	333	44	390	56	1000	13320	15600
Bihar	2063	1798	1159	265	15	904	78	986	10600	36160
Haryana	2135	1803	848	332	18	1287	152	810	13280	51480
UP	1518	1522	916	-4	0	602	66	1125	-160	24080
Maharashtra	1441	1125	752	316	28	689	92	869	12640	27560
Gujarat	1620	1379	1179	241	17	441	37	1235	9640	17640
Uttarakhand	2000	1552	868	448	29	1132	130	1000	17920	45280
Tamil Nadu	887	741	648	146	20	239	37	648	5840	9560
Rajasthan	1690	1446	842	244	17	848	101	930	9760	33920
Chhattisgarh	981	911	912	70	8	69	8	1027	2800	2760
Manipur	1142	814	895	328	40	247	28	0.0	13120	9880
MP	1432	1052	1100	380	36	332	30	1101	15200	13280
Karnataka	1459	1231	619	228	19	840	136	380	9120	33600
Punjab	1598	1453	1191	145	10	407	34	1300	5800	16280
J & K	794	619	558	175	28	236	42	0	7000	9440
WB	2033	1402	1157	631	45	876	76	1100	25240	35040
Average	**1502**	**1244**	**907**	**257**	**21**	**594**	**66**	**860**	**10296**	**23776**
Rice fallow chickpea										
Assam	1257	901	692	356	40	565	82	1000	14240	22600
Bihar	1346	1037	1159	309	30	187	16	986	12669	7667
Manipur	1298	950	895	348	37	403	45	0	14616	16926
West Bengal	1198	950	1157	248	26	41	4	1100	10664	1763
Average	**1275**	**960**	**976**	**315**	**33**	**299**	**31**	**772**	**13871**	**13145**

Source-*Annual Report- 2016-17, GoI, DPD, Bhopal (Ave. 2013-14 to 2015-16).*
*State Average Yield - E&S (Ave. 2011-12 to 2015-16) *Third Advance Estimates 2016-17.*
IP: Improved Practise FP: Farmers Practise SAY: State Avergae Yield.

2.6 CHICKPEA AGRONOMY

2.6.1 ECONOMIC CLASSIFICATION

- **Desi or brown gram** (*C arietinum L.*): 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).
- **Kabuli or white gram** (*C. Kabuli anum*): 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 ódesiô (Ch.No. 2n = 16). Some small seeded white coloured grain also comes under this category.

2.6.2 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 ôNô 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 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.*

2.6.3 PRODUCTION TECHNOLOGY

- **Climate**: Being a winter season legume, it requires fairly cold and dry climate. However, severe cold and frost, especially at flowering/pod initiation stage, are injurious for developing flowers into seed. The crop is well suited to the areas having 600-900 mm rainfall. Excessive rains, soon after sowing or at flowering and fruiting or hailstorms at ripening, cause heavy losses.

- **Soil &Field 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. Soils having >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.

- **Sowing time:** *Rainfed* – I^{st} fortnight of October in central and south India and II^{nd} fortnight of October in North India. *Irrigated*– I^{st} fortnight of November in North India and II^{nd} fortnight of October in central and southern India**;** *Late sowing*– I^{st} week of December in rice fallows of NEPZ or in irrigated conditions, where field are vacated very late by kharif crops.

- **Seed Rate& Spacing**: *Small seeded*ï 50-60 kg/ha; *Bold seeded and late sowing*ï 80-90 kg/ha (Small seeded varieties are recommended for late sown conditions). *Rainfed*ï 30cm x 10cm; *Irrigated*ï 45cm x 10cm; *Late sowing* ï 25 cm x 10 cm.

- **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 10 kg seed.
  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 ï 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.

- **Varieties**: Selection of the varieties should be as per the adaptability to the region, availability of resources, time of sowing. etc. Short duration varieties like JG 16, JG 11, JAKI 9218, JG 14, Vijay, Vikas, Vishal, JGK-1, KAK 2 etc. are popular/helped in expanding chickpea area in southern and central part of the country. The yield potential of these early varieties remained almost similar to long duration varieties. The ofther recent released varieties of short durations namely Rajas, Pusa 547, RVG 202, RVG 203, JAKI 9218, JGK 1, KAK 2, Shubhra may be grown for better yield.

  A number of Fusarium wilt resistant varieties which helps to reduce losses due to diseases and stabilise chickpea yield like GNG 1581, CSJ 515, RVG 202, JGK 5, JG 6, JG 16, Digvijay, Gujarat Gram 3, BG 391, Ujjawal, GLK 26155, HK 05-169, BDNG 797, RSG 991 etc may be adopted by the farmers.

  The varieties for specific situations such as **Kabuli** ï 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) ï Udai (KPG-59), Pusa-372, RSG-963, PBG-1, Pant G-186 and JG-74**;mild saline soil** ï Karnal Chana 1 (CSG-8962)**;drought prone areas**ï RSG-888, Annegiri**;high fertile and high rainfall/irrigated areas** ï DCP-92-3 are also recommended.

- **Cropping system**: 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 ï Gram, Paddy ï Gram, Maize ï Gram**,** Bajra ï Gram and Jowar ï 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 + Coriander (2:2).

- **Water management**:óGramô grown as rainfed crop in general in India, invariably suffers from moisture stress as óterminal 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 óNô 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.

- **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.

- **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*.

  Being a dwarf stature crop, gram 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 ôNô 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 @ 0.75-1.0 kg *a.i.*/ha and one hand weeding in between 30-45 DAS. 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.

- **Harvesting and threshing:** 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.

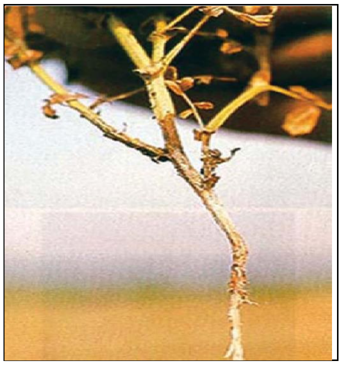
- **Yield:** By adopting good management practices, an average yield of 15-20 Q/ha can easily be obtained.

2.6.4 PLANT PROTECTION MEASURES

A. Disease

The important disease of Chickpea are Collarrot, Sclerotinia stemrot, Botrytis Grey Mold,wilt, Dry root rot. Symptoms of these disease and their suitable control measures are given below:

i) Collor Rot



Symptoms: The collar region of plant is constricted and begins to rot. White mycelia strands with minute mustard seed-sized sclerotial bodies are seen over the affected tissue.The affected seedlings turn yellow and wilt. It may be seen in seedling & vegetative growth stage.

Control Measures

i) Application of calcium fertilizer; ii) Seed treatment with fungicide carboxin @ 3 g /kgofseed; iii) Crop rotations with cereals such as wheat, sorghum and millets, and remove undecomposed debris from the field before sowing.

ii) Dry root rot

Symptoms: The whole plant dries upand turns straw-colored.Roots become black and brittle and have only a few lateral roots eat all. It may be seen in flowering & podding stage.

Control Measures

i) Seed treatment with *Tricoderma viride* @ 4g /kg seed or Thiram(2g)+ Carbandizm(1g) @ 3 g per kg of seed or Carbendazim@g/kgof seed; ii) Follow crop rotation; iii) Timely sowing to avoid post-flowering drought and heat stresses, which aggravate the disease.

iii) Wilt

Symptoms: The main cause of this disease is a fungus (*Fusarium* oxysporum). Plant become yellowish and finally dry out. Roots turn black and ultimately decompose. It may be seen in seedling stage & advance stage of plant growth.

Control Measures

i) Seed treatment with Tricoderma viride @ 4g /kg seed or Thiram (2g + Carbandizm (1g) @ 3 g per kg of seed or Carbendazim@ 2 g/kgof seed; ii) Sowing should be during third week of October; iii) Deep Planting (8-10 cm) in light soil; iv) In case of heavy incidence avoid cultivation for 03 to 04 years; v) Grow resistant varieties: *Desi*- JG 315, JG 322, JG 16, JG 11, JG 12, JSC 37, JSC 55, JAKI 9218; *Kabuli*- JGK 1, JGK 2, JGK 3 (Gulabi)- JGG 1.

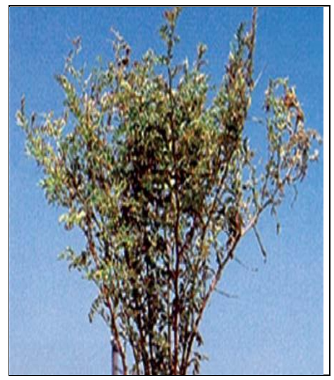
iv) Sclerotinia stemrot

Symptoms: It's initial stage is visible on the stemnear the ground. Brown colour spots may be seen on affected stem which later girdle it White cottony growth of the fungus with hard, black colored sclerotia may be seen on these spots on the stem.

Control Measures

i) Use of disease free seed; ii) Grow resistant varieties like *G-543, Gaurav, Pusa-261*; iii)Deep summer ploughing &avoid flood irrigation iv) Spraying chlorothalonil @ 2 g/ liter of water ; v) After harvest, the diseased plants should not be allowed to stand in the field but should be destroyed by burning.

v) Botrytis Grey Mold



Symptoms: Brown necrotic spots appear on twigs, petioles, leaves and flowers. The affected stem finally breaks and the plant dies. In humid weather, the fungus grows rapidly.

Control Measures

i) Use disease free seed; ii) Seed treatment; iii) Grow resistant varieties like Pusa-1003, K-551, BG 276, GL 92162, IPCK 2004-29; iv) Adopt late sowing (first fortnight of November) and wider row spacing; v) Spray the crop with carbendazim (Bavistin) @ 1.5 g/liter or mancozeb @ 3g/liter of water.

B. INSECT-PEST

i) Cutworm

Nature of Damage: Serious pest in low lying areas where fields are cloddy. The larvae remains hidden under these clods during the day time & cause damage during night. It may be seen in Seedling, vegetative growth stage & reproductive stage.The caterpillar cut the plants at ground level. Larvae feed on leaves, stems and roots.

Control Measures

i) Summer deep ploughing; ii) Crop rotation; iii) Intercropping with wheator linseed or mustard; iv) Grow marigold on bunds; v) Apply phorate 10 G @ 10 kg/ ha before sowing; vi) Spray insecticides like quinalphos 25 EC @ 2 ml /liter or Profenophos 50 EC @ 2 ml /liter.

ii) Gram Pod Borer

Nature of Damage: It damages almost all the pods in and causes nearly 20-30% annual yield losses in India. The eggs (1 mm diameter) are laid singly on the leaflets, flowers, immature pods and stem. Larvae can be green, brown, yellow, or pink, but are usually striped, irrespective of their colour.Larvae feed on leaves during the vegetative phase and on flowers and pods during the reproductive phase; ii) Large larvae cut round holes in the pod wall and devour the seed inside.

Control Measures

i) Earlysowing, grow short duration varieties; ii) Intercropping with coriander, linseed, marigold, mustard, sunflower orwheat; iii) Use moderate resistant cultivars like ICCV10, Vijay,ICCV-7and ICCL-86103, PBG-3; iv) Install bird perches@ 40-50 /ha; v) Spray neem seed extract (5%);vi) Apply HaNPV@250LE/haor Sprayindoxacarb@1 ml/lit or Emamectin benzoate 5 SG @ 0.2 g /lit of water at10-15days interval if needed.

2.7 RECOMMENDATION TO ACHIEVE HIGHER PRODUCTION

To bridge the yield gap of 1014 kg/ha between the potential and realized yield following technologies are recommended:

- Deep summer ploughing once in 3 years to eliminate dormant pupae.
- Application of fertilizer based on soil test value.
- Seed treatment with Trichoderma (6 g/kg) and Carboxin (Vitavax) (1g/kg).
- Grow wilt resistant/ tolerant varieties of the region: JG 315, JG 12, JG 11, JAKI 9218, JGK-1, JGK-2, JGK-3, KAK2 etc.
- Install bird perches @ 50/ha at flowering stage and remove the perches at grain ripening stage.
- Nipping should be done when crop is at 15-20 cm height.
- Two irrigations first at branching and second at pod initiation stage.
- Weed control should be done at right time.
- Seed treatment with Ammonium Molybdate @ 1g/kg of seed in the areas of chickpea-soybean cropping system.
- Spray of crude NSKE 5% or Azadirachtin 0.03% (300 ppm), Neem oil based WSP 2500-5000 ml/ha at pre-flowering stage at 15 days interval.

(TABLE–2.9): RECOMMENDED VARIETIES & THEIR CHARACTERISTICS

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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

(Conti……)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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.

(Conti……)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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/ PKV/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.

(Conti……)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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	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 & WestU.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.

(Conti……)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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

(Conti……)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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

(Conti……)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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

(Conti……)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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.

(Conti……)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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 wt.
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.

PIGEONPEA

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

3.1 ECONOMIC IMPORTANCE: In India pigeonpea (Arhar), the IIndimportant pulse crop after chickpea, is largely cultivated under rainfed conditions (95%), remaining 5% is grown with critical irrigation support. India ranks Ist in area and production in the world with 80% and 67% of worldôs acreage and production respectively *(FAO Stats.,2014).*During XIIth Plan this crop occupied16.6% of the total pulse area contributing to 17% of the total pulse production.
It is mainly consumed in split form as *'dal' and is a preferential* pulse for Indians. *Seeds are also rich in iron, iodine, essential amino acids like lycine, tyrocene, cystine and arginine.* The outer seed layer along with the kernel part provides a valuable feed/concentrate to milch cattle. The husk of pods and leaves constitute a valuable cattle fodder. The dry sticks of the plant are used for fuel, thatches, storage bins (baskets) making etc.

3.2 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
Dietary Fiber	1.5 %	Calorific value	335 Kcal/100 g
Carbohydrate	57.6 %	Moisture	13.4%

AGRONOMIC SIGNIFICANCE:It is favoured legume as component crop in mixed/intercropping, hedge crop on the rice bunds/ vegetable crops. *Pigeonpea is a choice crop for improving soil characteristics due to deep tap root system with valuable properties and bed of fallen leaves besides restorer of nitrogen to the tune of 6-69 kg N/ha in a long duration pigeonpea over a period of 40 weeks (Kumar Rao and Dart., 1987, ICRISAT).*

3.3 GROWTH RATE

From 1980-81 to 2009-10, the total acreage under pulses has almost slightly ($\pm$) being showed, however, the maximum growth rate in area and producton was recorded with 35% & 79% during 2016-17. The highest area (5.39 million ha), production (4.60 million tonnes) and productivity (854 kg/ha) was also recorded during the same period. (Table 3.1).

(TABLE-3.1): GROWTH RATE OF PIGEONPEA

(A- Million ha, P- Million tones, Y-kg/ha, Growth Rate (GR)- %)

Year	Pigeonpea					
	Area	GR	Production	GR	Yield	GR
1980-81	2.84		1.96		689	
1985-86	3.18	12.0	2.44	24.7	767	11.3
1990-91	3.59	12.8	2.42	-1.0	673	-12.3
1995-96	3.45	-4.1	2.31	-4.4	670	-0.4
1996-97	3.51	1.9	2.66	15.2	757	13.0
1997-98	3.36	-4.4	1.85	-30.5	551	-27.3
1998-99	3.44	2.4	2.71	46.4	787	43.0
1999-00	3.43	-0.4	2.69	-0.5	786	-0.2
2000-01	3.63	6.0	2.25	-16.6	618	-21.3
2001-02	3.33	-8.4	2.26	0.6	679	9.8
2002-03	3.36	0.9	2.19	-3.3	651	-4.2
2003-04	3.52	4.7	2.36	7.8	670	3.0
2004-05	3.52	0.1	2.35	-0.4	667	-0.5
2005-06	3.58	1.8	2.74	16.7	765	14.6
2006-07**	3.56	-0.5	2.31	-15.5	650	-15.0
2007-08	3.73	4.6	3.08	32.9	826	27.1
2008-09	3.38	-9.3	2.27	-26.3	671	-18.8
2009-10	3.47	2.6	2.46	8.8	711	6.0
2010-11	4.37	26.0	2.86	16.1	655	-7.9
2011-12	4.01	-8.2	2.65	-7.2	662	1.1
2012-13	3.89	-2.9	3.02	13.9	776	17.2
2013-14	3.90	0.3	3.17	5.0	813	4.7
2014-15	3.85	-1.3	2.81	-11.6	729	-10.4
2015-16	3.96	2.8	2.56	-8.8	646	-11.3
2016-17	5.39	35.9	4.60	79.6	854	32.1

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*

(TABLE-3.2): PER CENT SHARE TO TOTAL PULSES

(Area- lakh ha, Production-Lakh Tones, Yield-kg/ha)

Year	Tur			Total Pulses			% Share to Total Pulses		
	A	P	Y	A	P	Y	A	P	YI
1980-81	28.42	19.57	689	224.45	106.24	473	12.7	18.4	145
1990-91	35.93	24.17	673	372.55	203.68	547	9.6	11.9	123
1995-96	34.47	23.09	670	331.77	170.10	513	10.4	13.6	131
2000-01	36.32	22.46	618	203.48	110.75	544	17.8	20.3	114
2001-02	33.28	22.6	679	220.08	133.68	607	15.1	16.9	112
2002-03	33.59	21.86	651	204.96	111.25	543	16.4	19.6	120
2003-04	35.16	23.56	670	234.58	149.05	635	15.0	15.8	105
2004-05	35.19	23.47	667	227.63	131.30	577	15.5	17.9	116
2005-06	35.81	27.38	765	223.91	133.84	598	16.0	20.5	128
2006-07	35.62	23.14	650	231.92	141.98	612	15.4	16.3	106
2007-08	37.26	30.76	826	236.33	147.62	625	15.8	20.8	132
2008-09	33.78	22.66	671	220.94	145.66	659	15.3	15.6	102
2009-10	34.66	24.65	711	232.82	146.62	630	14.9	16.8	113
2010-11	43.67	28.61	655	264.02	182.41	691	16.5	15.7	95
2011-12	40.07	26.54	662	244.62	170.89	699	16.4	15.5	95
2012-13	38.93	30.23	776	232.57	183.42	789	16.7	16.5	98
2013-14	39.04	31.74	813	252.18	192.55	764	15.5	16.5	106
2014-15	38.54	28.07	729	235.53	171.52	728	16.4	16.4	100
2015-16	39.63	25.61	646	249.11	163.48	656	15.9	15.7	98
2016-17	53.87	45.99	854	292.77	224.01	765	18.4	20.5	112

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*

3.4 IMPORT/EXPORT

IMPORT: The import of pulses in India during April, 2014 to March, 2015 was 5.75 lakh tonnes worth Rs.2635.85 croreagainst the value of Rs.17196.87 crore for total foodgrains, Rs.121319.02 crore fortotal agricultural imports and against Rs.2737086.58 crore for total National Import. The import during April, 2015 to March, 2016 was 4.63 lakh tonnes worth Rs.3318.23 crore against the import value of Rs. 26841.87 crore for total foodgrains, Rs.140288.69 crore for total agricultural import and Rs.2490298.08 crore for total National import respectively. *The share of Pigeonpea import to Agricultural import was 2.17% and 2.37% respectively during April, 2014 to March, 2015 and April, 2015 to March, 2016.*

EXPORT: The pulses export of the country during April, 2014 to March, 2015 was 0.012 lakh tonnes worth Rs.8.82 crore against the value of Rs. 59500.54 crore for total foodgrains, Rs.239681.04 crore for total agricultural exports and against Rs.1896445.47 crore for total National export.The export during April, 2015 to March, 2016 was 0.040 lakh tonnes worth Rs.52.55 crore against the export value of Rs. 42622.29 crore for total foodgrains, Rs.215395.68 crore for total agricultural export and Rs.1716378.05 crore for total National export respectively during this period. *The share of Pigeonpea export to Agricultural export was 0.004% and 0.024% respectively during April, 2014 to March, 2015 and April, 2015 to March, 2016.*

(TABLE-3.3): IMPORTING & EXPORTING COUNTRIES

(Quantity-Thousand Tonnes)

S.No.	IMPORT			EXPORT		
	Country	Avg.*	% Share	Country	Avg.*	% Share
1	Myanmar	235.51	44.05	U S A	0.90	25.50
2	Tanzania Rep	131.21	24.54	U K	0.62	17.54
3	Mozambique	94.70	17.71	U Arab EMTS	0.50	14.17
4	Malawi	38.39	7.18	Canada	0.41	11.64
5	Sudan	17.00	3.18	Singapore	0.21	5.98
6	Kenya	11.15	2.09	Mozambique	0.16	4.60
7	Uganda	4.38	0.82	Thailand	0.16	4.58
8	Nigeria	1.26	0.23	Brunei	0.11	3.20
9	Benin	0.22	0.04	Malaysia	0.09	2.67
10	Afghanistan Tis	0.21	0.04	Saudi Arab	0.07	1.86
11	Canada	0.18	0.03	Australia	0.06	1.76
12	Australia	0.12	0.02	Angola	0.04	1.26
13	Malaysia	0.10	0.02	Sri Lanka DSR	0.04	1.16
14	Sri Lanka Dsr	0.09	0.02	Kuwait	0.03	0.75
15	Ethiopia	0.06	0.01	Tanzania Rep	0.02	0.57
16	U Arab Emts	0.03	0.01	Korea RP	0.02	0.43
17	U S A	0.03	0.005	New Zealand	0.01	0.33
18				Qatar	0.01	0.31
19				Congo D Rep.	0.01	0.25
20				Others	0.05	1.42
	Total	**534.62**		**Total**	**3.53**	

Source: *Ministry of Commerce and Industry; Aveg.*- 2012-13 to 2016-17.*

3.5 PRODUCTION TRENDS

3.5.1 GLOBAL SCENARIO

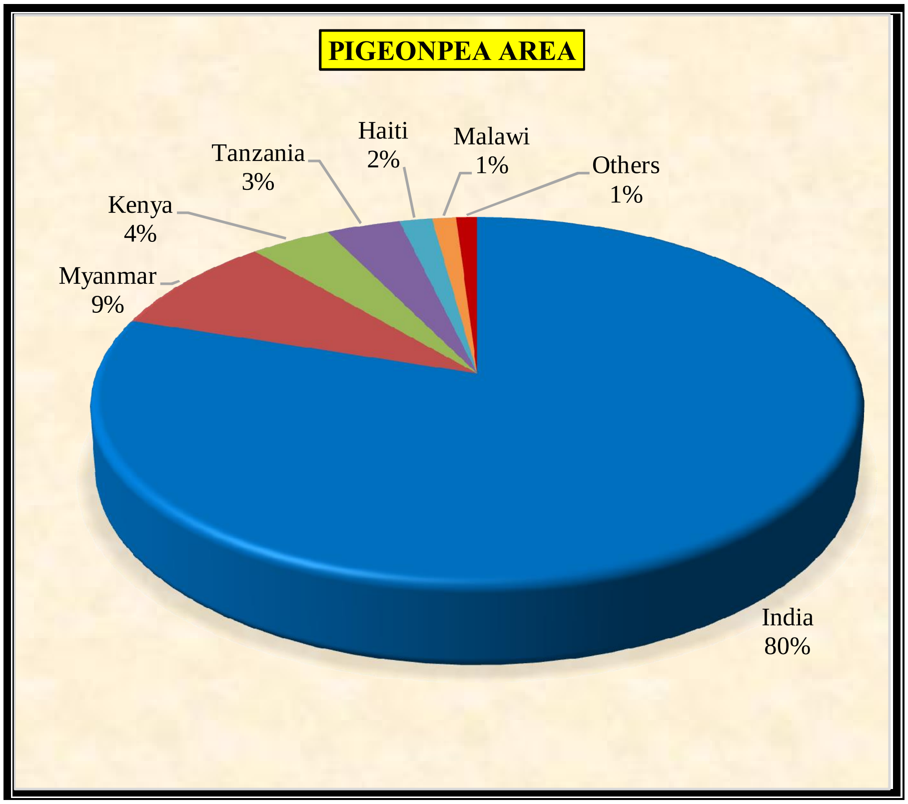
India rank first in area (79%) and production (67%) at Global level. Mynmar stands second position in area (8.70 %) followed by Kenya (3.93 %) respectively. Tanzania occupy forth position in area (3.56 %) and 5th position in production (2.48%). In productivity, Saint Vincent & Grenadines ranked first with 7926 kg/ha followed by Trinidad &Tobago(4103 kg/ha) and Malawi (4100 kg/ha). While, Indiaȏs productivity is only 587 kg/ha.

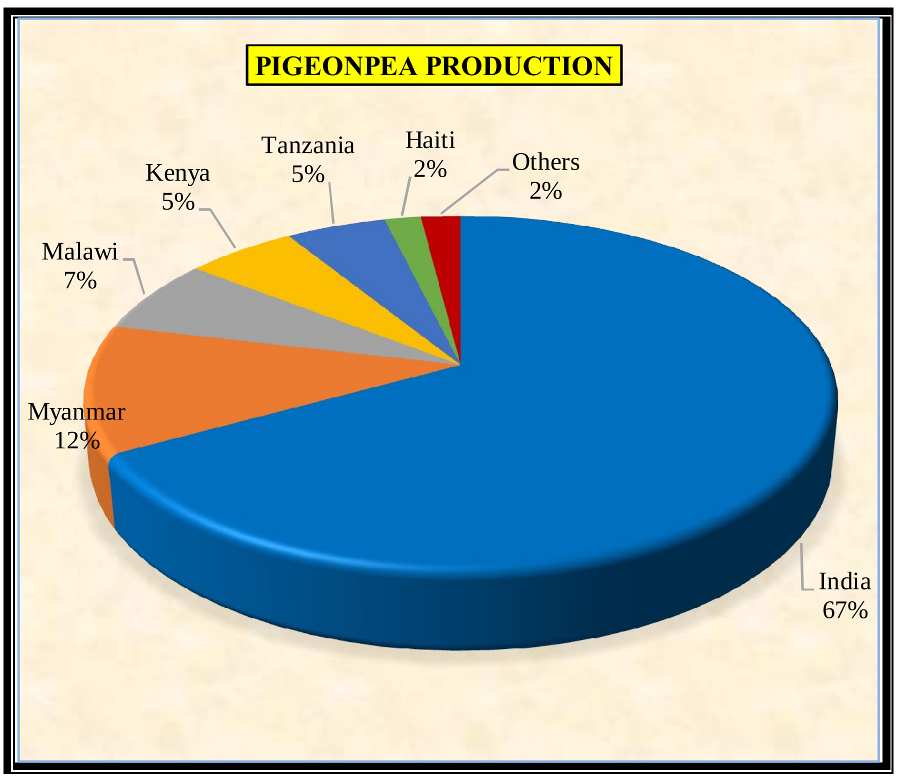
(TABLE–3.4): GLOBAL RANKING: MAJOR COUNTIES

(Area-Lakh ha, Production-Lakh tonnes, Yield- kg/ha)

Country	Area	%Cont.	Country	Prod.	%Cont.	Country	Yield
India	56.02	79.65	India	32.90	67.28	Saint Vincent & Grenadines	7926
Myanmar	6.12	8.70	Myanmar	5.75	11.76	Trinidad & Tobago	4103
Kenya	2.76	3.93	Malawi	3.35	6.85	Malawi	4100
Tanzania	2.51	3.56	Kenya	2.75	5.61	Bangladesh	2500
Haiti	1.11	1.57	Tanzania	2.48	5.07	Philippines	1664
Malawi	0.82	1.16	Haiti	0.90	1.84	Grenada	1451
World	**70.33**		**World**	**48.90**		**World**	**695**
						India	**587**

Source: *FAO, Statistics 2014*


PIGEONPEA AREA
Haiti 2%
Malawi 1%
Tanzania 3%
Others 1%
Kenya 4%
Myanmar 9%
India 80%


PIGEONPEA PRODUCTION
Tanzania 5%
Haiti 2%
Others 2%
Kenya 5%
Malawi 7%
Myanmar 12%
India 67%

3.5.2 NATIONAL SCENARIO: PLAN PERIODS

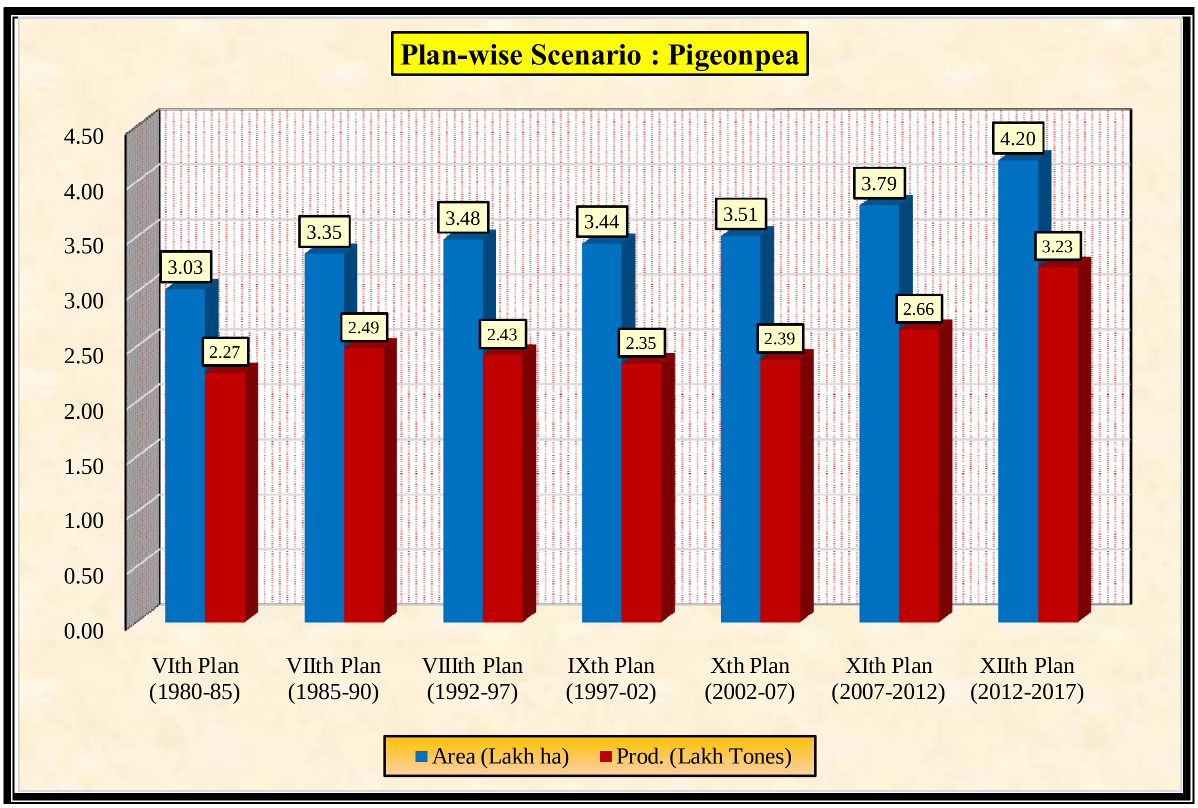
Plan-wise performance revelaed, the highest area and production increased during XII[th] plan over the previous plan period. The details plan-wise performance is given below:

(TABLE-3.5): PLAN-WISE NATIONAL SCENARIO

(Area-Million ha, Production-Million Tonnes, Yield-kg/ha)

Plan	Area	%COPP	Prod.	% COPP	Productivity	%COPP
Sixth Plan (1980-85)	3.03		2.27		749	
Seventh Plan (1985-90)	3.35	10.61	2.49	9.83	744	-0.71
Eighth Plan (1992-97)	3.48	3.75	2.43	-2.59	698	-6.12
Ninth Plan (1997-02)	3.44	-1.13	2.35	-3.12	684	-2.01
Tenth Plan (2002-07)	3.51	2.04	2.39	1.56	681	-0.47
Eleventh Plan (2007-2012)	3.79	8.03	2.66	11.56	703	3.26
Twelfth Plan (2012-2017)*	4.20	10.86	3.23	21.34	770	9.45

Source: *DES, Twelfth Plan (2012-2017)*& 2016-17 APY is the IVth Advance Estimate; % COPP is percentage Change over previous plan*



3.5.3 STATES' SCENARIO:PLAN ANALYSIS (Xth –XIIth)

Tenth Plan (2002-2007): The countryǿs 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 (1194kg/ha) followed by Haryana (1032 kg/ha) and U.P. (953 kg/ha).The lowest yield recorded in the state of A.P. (451 kg/ha) followed by Chhattisgarh (482 kg/ha) and Karnataka (515 kg/ha).

***Eleventh Plan (2007-2012)*:**The countryǿs 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 (1286 kg/ha) followed by Haryana (1080 kg/ha) and Gujrat (1008 kg/ha). The lowest yield recorded in the state of A.P. (450 kg/ha) followed by C.G. (491 kg/ha) and Karnataka (555 kg/ha).

***Twelfth Plan (2012-2017)*:** The countryǿs total area coverage and production of tur were 42.00 lakh hectares and 32.33 lakh tonnes respectively. The state-wise trend shows that Maharashtra ranked first both in respect of area and production (30.00% and 28.90%). Madhya Pradesh stood second position in production (16.09%) followed by Karnataka (15.68%). The third place occupied by Madhya Pradesh (13.26%) in area. The highest yield recorded by Bihar (1679 kg/ha) followed by Haryana (1047 kg/ha) and Gujrat (1103 kg/ha). The lowest yield observed in the state of A.P. (488 kg/ha) followed by C.G. (597 kg/ha) and Karnataka (621 kg/ha).

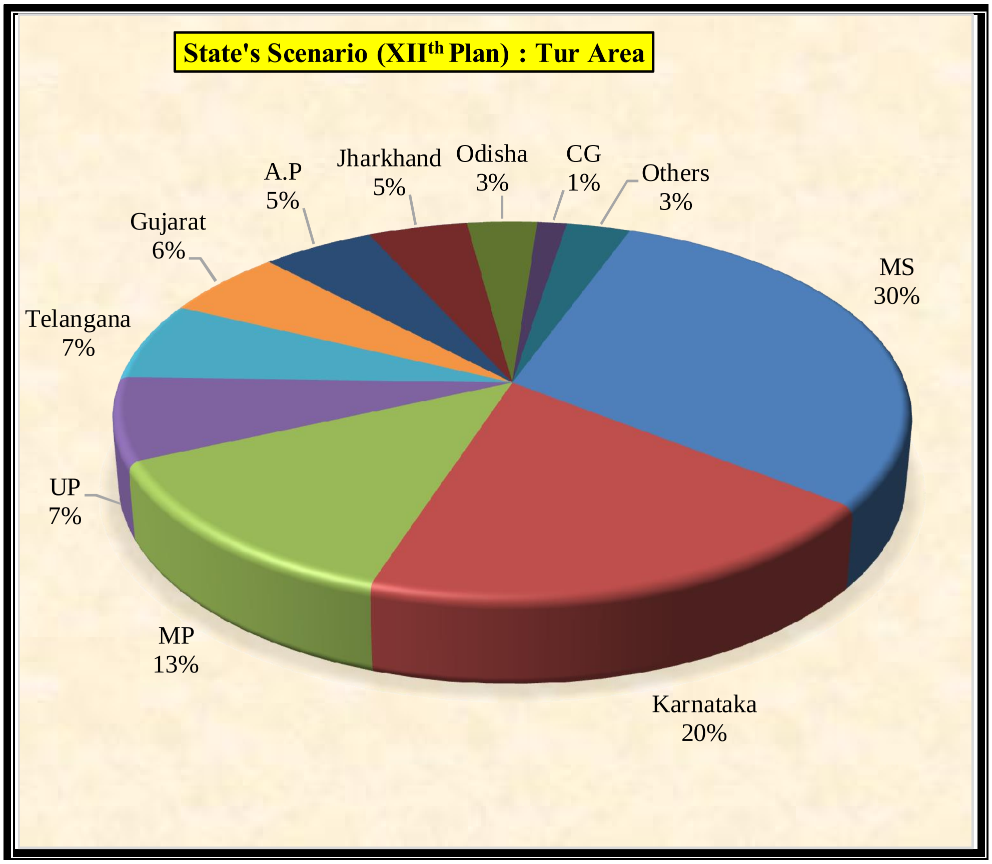
The overall trend of area, production and yield shown increasing trend during the last three Plan Period.

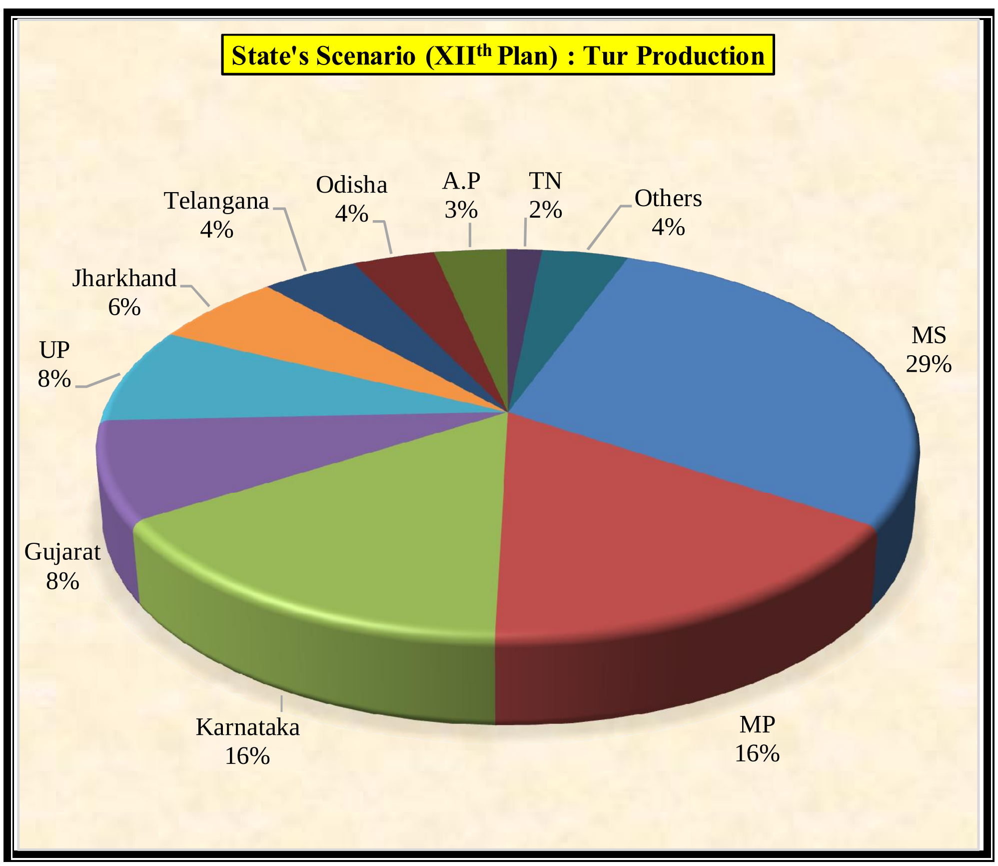
(TABLE-3.6): PLAN-WISE STATES' SCENARIO: MAJOR STATES

(Area-Lakh ha, Production-Lakh tonnes, Yield- kg/ha)

State		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
A.P	A	4.66	13.28	4.98	13.14	2.21	5.27
	P	2.10	8.78	2.24	8.39	1.08	3.34
	Y	451		450	639	488	
Bihar	A	0.36	1.04	0.28	0.73	0.22	0.52
	P	0.43	1.79	0.36	1.35	0.37	1.13
	Y	1194		1286		1679	
Chattisgarh	A	0.56	1.59	0.55	1.46	0.58	1.38
	P	0.27	1.13	0.27	1.03	0.35	1.07
	Y	482		491		597	
Gujarat	A	2.81	8.02	2.64	6.96	2.43	5.79
	P	2.38	9.95	2.66	9.97	2.68	8.29
	Y	847		1008		1103	
Haryana	A	0.31	0.87	0.25	0.67	0.10	0.24
	P	0.32	1.32	0.27	1.02	0.10	0.32
	Y	1032		1080		1047	
Jharkhand	A	0.78	2.21	1.00	2.64	1.96	4.66
	P	0.55	2.30	0.77	2.89	1.97	6.11
	Y	705		770		1008	
Karnataka	A	5.61	16.00	7.08	18.69	8.17	19.44
	P	2.89	12.12	3.93	14.75	5.07	15.68
	Y	515		555		621	
Madhya Prd.	A	3.18	9.07	4.06	10.72	5.57	13.26
	P	2.32	9.71	2.57	9.63	5.20	16.09
	Y	730		633		934	
Maharashtra	A	10.83	30.87	11.62	30.68	12.60	30.00
	P	7.47	31.30	8.91	33.44	9.34	28.90
	Y	690		767		741	
Odisha	A	1.29	3.69	1.37	3.62	1.38	3.29
	P	0.93	3.88	1.16	4.37	1.23	3.80
	Y	721		847		888	
Punjab	A	0.08	0.24	0.05	0.13	0.03	0.08
	P	0.07	0.31	0.04	0.17	0.03	0.09
	Y	875		800		893	
Rajasthan	A	0.18	0.52	0.19	0.51	0.15	0.35
	P	0.11	0.46	0.13	0.50	0.11	0.35
	Y	611		684		755	
Tamilnadu	A	0.39	1.12	0.32	0.83	0.58	1.38
	P	0.24	0.99	0.23	0.86	0.53	1.63
	Y	615		719		909	
Telangana	A			3.20		2.79	6.64
	P			1.21		1.44	4.46
	Y			378		517	
Uttar Pradesh	A	3.80	10.85	3.30	8.72	3.00	7.15
	P	3.62	15.15	2.92	10.97	2.58	7.97
	Y	953		885		858	
All India	**A**	**35.07**		**37.89**		**42.00**	
	P	**23.88**		**26.64**		**32.33**	
	Y	**681**		**703**		**770**	

**Twelfth plan is the Ave. of 2012-13 to 2016-17 & 2016-17 APY is the IIIrd Adv. Estimates*


State's Scenario (XIIth Plan) : Tur Area
A.P 5%
Jharkhand 5%
Odisha 3%
CG 1%
Others 3%
Gujarat 6%
MS 30%
Telangana 7%
UP 7%
MP 13%
Karnataka 20%


State's Scenario (XIIth Plan) : Tur Production
Telangana 4%
Odisha 4%
A.P 3%
TN 2%
Others 4%
Jharkhand 6%
UP 8%
MS 29%
Gujarat 8%
Karnataka 16%
MP 16%

3.5.4 DISTRICT SCENARIO (2012-13) – POTENTIAL DISTRICTS

The intra-state analysis at the district level is presented in Table ï 3.7. 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 countryĝs 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.

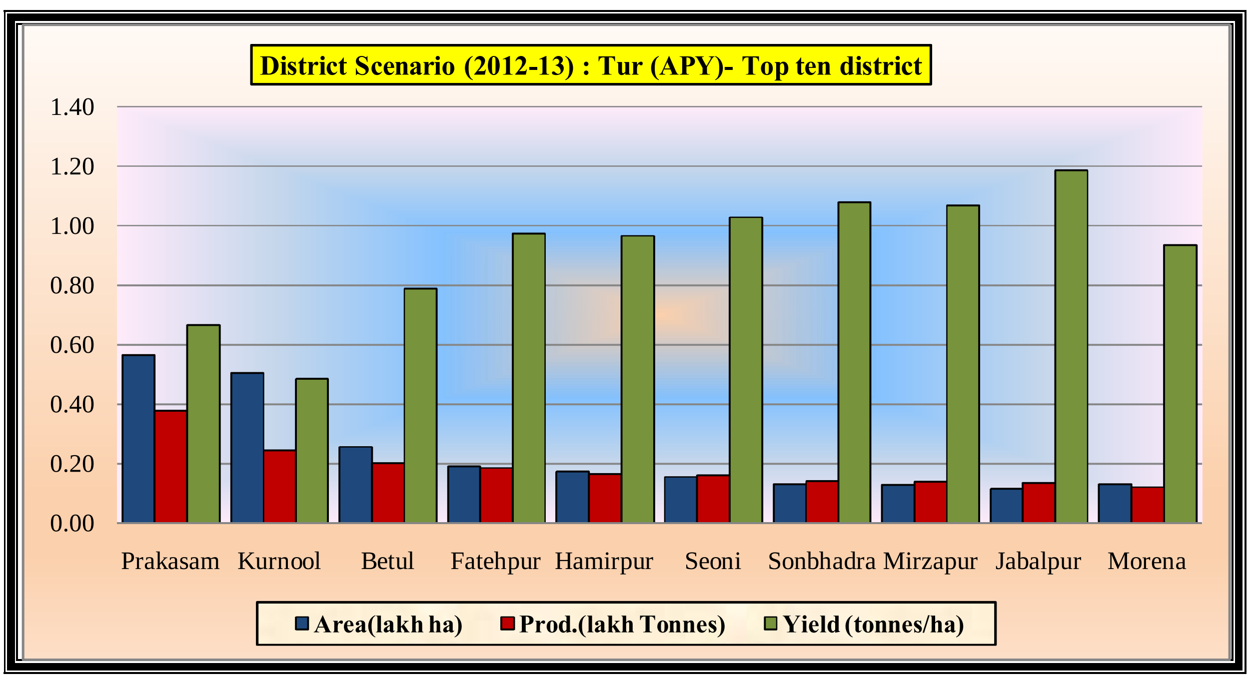
The yield of Potential districts recorded higher than the National average yield except, Prakasham and Kurnool district of Andhra Pradesh.

(TABLE–3.7): 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	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**	

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*



(TABLE-3.8): STATE-WISE YIELD GAP AND ADDITIONAL RETURN

(Yield: kg/ha; Return: Rs./ha.)

State	Yield (kg/ha)			Gap over FP		Gap over SAY		Yield 2016-17 *	Additional return by bridging yield gap (Rs/ha)	
	IP	FP	SAY	Actual	%	Actual	%		FP	SAY
AP	1953	1498	493	455	30	1460	296	376	25025	80300
Bihar	2082	1765	1669	317	18	413	25	1561	17435	22715
Gujarat	1442	1098	1092	344	31	350	32	1105	18902	19250
Haryana	1897	1530	1104	368	24	793	72	915	20222	43633
Jharkhand	1513	1192	987	322	27	526	53	1043	17692	28948
Karnataka	1017	812	557	205	25	460	83	713	11293	25318
MP	1336	1043	819	293	28	517	63	1133	16097	28417
Maharashtra	1189	930	692	259	28	497	72	906	14263	27335
Nagaland	1191	702	891	489	70	300	34	0	26895	16482
Punjab	1542	1282	944	260	20	598	63	825	14300	32890
Odisha	1236	888	880	348	39	356	40	848	19140	19553
Rajasthan	750	632	703	118	19	47	7	879	6490	2585
Telangana	1518	1112	457	407	37	1061	232	555	22367	58373
TN	965	808	940	157	19	25	3	745	8653	1393
Tripura	895	616	716	279	45	179	25	0	15345	9827
UP	1773	1339	867	434	32	906	104	994	23852	49812
Average	**1394**	**1078**	**863**	**316**	**29**	**530**	**61**	**787**	**17373**	**29177**

Source-*Annual Report- 2016-17, GoI, DPD, Bhopal (Ave. 2013-14 to 2015-16)*
*State Average Yield - E&S (Ave. 2011-12 to 2015-16) *Third Advance Estimates2016-17*
IP: Improved Practise FP: Farmers Practise SAY: State Avergae Yield

3.6 PIGEONPEA AGRONOMY

3.6.1 ECONOMIC CLASSIFICATION

Based on plant and pod character and maturity duration, Arhar belongs to two groups.

i) *Cajanus cajan var. bicolor*-group includes late maturing types with tall and bushy character. 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*- 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 crop duration, there are three distinct groups: (i) early duration - 100 to 150 days, (ii) medium duration -150-180 days, and (iii) late duration - 180-300 days.

3.6.2 BOTANICAL DECRIPTION:Thepigeonpea has its origin in India. The plant is an erect shrub with considerable variation in height from 1-4 metre, depending upon the variety, growing season and management practices. Branching mostly begins from 6th to 10th node *i.e.* from 15-25 cm above ground. Leaves are trifoliately compound with central leaflets, longer than laterals. *Inflorescence* is axillary raceme often forming a terminal panicle, open in the evening and remain open for whole night and up to noon of the next day. *Self-pollination is a general rulebefore opening the flowers.* However, cross-pollination may also occur to some extent; *PodLength* varies from 5-10 cm and width from 0.6 to 0.9 cm and colour variation from green to dark brown; *Seeds* are round or lens shaped with colour variationfrom dirty white to silver white, light brown to chestnut brown and dark mottled brown to pinkish black with yellow cotyledons;*Root System*consists of a well developed central tap root with numerous secondary and lateral branches bearing nodules. Usually tall and upright variety produce longer and more deeply penetrating roots whereas spreading type produce shallower, more spreading and denser roots.

3.6.3PRODUCTION TECHNOLOGY

- **Soil & Field preparation:** It is successfully grown in black cotton soils, well drained with a pH ranging from 7.0-8.5. Pigeonpea responds well to properly tilled and well drained seedbed. A deep ploughing with soil turning plough in fallow/waste lands, zero tillage sowing under intensive cropping system and Broad Bed Furrow/Ridge-furrow planting in low lying as well as intercropping areas is recommended. Raised Bed method of planting by dibbling at 2 inches depth with Row to Row distance 4 to 5 feet also 15 feet gap (2 pairs of Tur on bed) under intercropping of soybean under transplanting (Dharwad method/SPI), 5X3 and 3X1.5 feet spacing is recommended.

- **Climate:** The crop prefers warm tropical and subtropical climate with fairly moist and warm weather during vegetative period. During the flowering and ripening stages, it requires bright sunny weather for setting of fruits. Temperature requirement varies from 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. The crop 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.

- **Sowing time:** 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.

- **Sowing Method**:Three systems of sowings are practiced for pigeon pea. The common is flat sowing, the other methods are broadbed-furrow (BBF) for extra-early group and ridge-and-furrow for the late maturity group.

- **Bund Plantation of Pigeonpea:** To meet the pigeonpea *dal* requirement, instead of growing a sole/ mixed crop farmers opt for bund-cropping in rice growing areas in Bihar, Orissa, Chhatttisgadh etc. Such pigeonpea growing areas and mixed cropping areas are not accounted in total cropped area under pigeonpea.Delayed cropping is required under aberrant rainfall condition. So, under compulsion farmers may select suitable varieties
- **Transplanting of Pigeonpea:**Apprehension of crop failure due to delayed monsoon can be managed or avoided by transplanting of pigeonpea. Before the onset of monsoon seedling can be made ready, thus saving 30 to 35 days of seedling stage and crop duration. It gives higher yields with minimized plant population, which is also effective for agronomic management. However, watering need to be ensured at transplanting stage. This technology has a limitation that cannot be adopted at large scale due to lack of irrigation facilities.

- **Seed Rate & Spacing:** The seeding rate of pigeon pea depends on the desired plant density for a genotype (early, medium or late), cropping system (pure crop, mixed crop, or inter crop), germination rate of seed and mass of seed.

Early Maturing Var. - 20-25 kg/ha (Row to Row-45-60 cm & Plant to Plant-10-15 cm)
Medium/Late Maturing Var.- 15-20 kg/ha (Row to Row- 60-75 & Plant to Plant-15-20 cm)

- **Seed Treatment:** *Fungicide:* Thiram (2gm) + Carbendazim (1gm) or Thiram @ 3 gm or Tricoderma virdie 5-7g /kg of seed; *Culture:* Rhizobium and PSB culture 7-10 g /kg seed.

- **Varieties:** The variety may be selectedas per the adaptability to the region, agro-eco sitiation, sowing time and the cropping system (Table ï 3.11).

- **Pigeonpea Varieties identified for delayed planting**

Date of sowing	Promising, Genotypes	Zone
Normal 20 July, Late 9 Aug., (20 days)	JKM 189, Asha, BSMR 853	CZ
Normal July 5, Late Aug., 8 (30-35 days)	TTB 7, LRG 30, LRG 38, LRG 41, WRP 1	SZ
Normal 25 July,Late 31Aug., (30-35 days)	Azad	NEPZ
Pre *rabi*/post rainy season From 1st to 15th September	DA 11, NDA 2, Pusa 9, Bahar	NEPZ

- **Cropping system**: 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: Maizeï Pigeonpea (Rabi); ii) Pigeonpea-Urd-Wheat; iii) Pigeonpea-Sugarcane; iv) Mung + Pigeonpea-Wheat; v) Pigeonpea (early)-Potato-urdbean.

- **State-Wise Prevalent Cropping System**

Cropping System	States
Medium/late pigeonpea (sole cropping)	U.P., Bihar, Karnataka, M.P.
Pigeonpea ï wheat	Haryana, Punjab, U.P, north Rajasthan
Early pigeonpea + groundnut	A.P., Gujarat, T.N.
Late/medium pigeonpea +sorghum/soybean	M.P., Western U.P., Maharastra, T.N
Cotton+ Pigeonpea	Maharashtra, A.P., Gujarat, TN
Maize- rabi pigeonpea	UP., north Bihar, W.B., Assam

- **Intercropping:** Pigeonpea is commonly intercropped with a wide range of crops. In India, it was estimated that 80 - 90 % of the pigeonpea were intercropped:

a) With cereals (sorghum, maize, pearl millet, finger millet and rain-fed rice).
b) With legumes (groundnut, cowpea, mung bean, black gram, soybean).
c) With long-season annuals (caster, cotton, sugarcane, and cassava).

- **State-wise recommended Inter-Cropping**

States	Inter-cropping
Central & Southern States	Tur+Sorghum/Pearlmillet/ G.Nut/ Horsegram/ Cpowpea/ Castor/Urd/Mung/Soybean
Bihar/ UP	Tur + Rice/Pearlmillet/ Sorghum/ Castor/Maize /Urd/Mung
Jharkhand	Tur + Groundnut
Andhra Pradesh	Tur + G.Nut/Castor
Karnataka	Tur+ Horsegram/G.Nut/Cowpea/Millets
Gujarat, Telangana, MS	Tur + Cotton/Soybean/Sorghum/Maize
M.P, A.P, and Gujarat	Tur + Maize/Bajra

- **Zone wise varieties suitable for Inter Cropping**

Pigeonpea Varieties	Associated Crop	Zone
Paras. AL 1455, Pusa 992	Urdbean, mungbean	NWPZ
Asha (ICPL 87119) JKM 7, GT 101, BSMR 853, JKM 189, BSMR 736	Urdbean, mungbean, Soybean, Groundnut maize, Sorghum	CZ
TTB 7, JKM 186 CO 6, LRG 41, WRG 27	Urdbean, mungbean, Groundnut, Ragi	SZ
NDA1, Pusa 9	Urdbean, mungbean, maize	NEPZ

- **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.

- **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 ï 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.

  Plant Nutrient Management in intercropping system: 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.

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

- **Weed management in intercropping system**: An initial 45 and 30 days after sowing period is found very critical for severe weed crop competition causing a loss of about 46 % and 34% in NWPZ, 73% and 81% in CZ and 43 and 56% in NEPZ for pigeonpea intercropping with cereals and short duration pulses like green gram/black gram/cow pea/soybean, respectively.

  Besides manual weeding with hand or wheel hoe, weeds may also be effectively controlled in pigeonpea intercropping system with pre-emergence application of Pendimethalin @ 0.5 ï 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.

- **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.

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

3.6.4 PLANT PROTECTION MEASURES

A. Disease

The important diseases of Pigeon pea are Wilt, Sterility mosaic disease, Phytophthora blight, Alternaria blight, Powdery mildew.Symptoms of these disease and their suitable control measures are given below:

i) Wilt

Symptoms:Xylem gradually develops black streaks, dark purple bands appear on thestem surface plants extending upwards from the base. Main stem of such plants is split open, intensiveblackening of the xylem can be seen. In humid weather, a pinkish mycelial growth is commonly observed the basalportions of the wilted plants.It may be seenin seedling, flowering & vegetative stage.

Control Measures

i)Seed Treatment with Trichoderma viride @ 10 g/kg of seed or Thirum (2 gm) + Carbendazim (1gm)/kg of seed; ii) Soil application- T. virideï 2.5 kg/ha + 50 kg of well decomposed FYM or sand at 30 days after sowing; iii) Mixed cropping with sorghum; iv) Uproot wilted plants; v) Avoid over or under watering plants; vi) Grow resistant varieties like Amar, Azad, Asha (IPCL-87119), Maruthi, C-11, BDN-1, BDN-2, NP-5, JKM-189, C-11, JKM-7, BSMR-853 & BSMR-736 etc.

ii) Sterility mosaic disease

Symptoms: It is caused by mosaic virus & spread from plant to plant under field conditions through *Eriophyid* mite. Leaves become small and cluster near branch tips& reduced in size. Plants are pale green and bushy in appearance, without of flowers and pods. Diseased plants are usually in groups. It may be seenin Vegetative growth & Pre-flowers stage.

Control Measures

Spray Fenazaquin 10 EC (Magister) @ 1 ml/liter of water on 45 and 60 DAS; ii) Rogue out the infected plants in the early stages of growth; iii) Crop rotation with non host crop like,tobacco, sorghum, pearl millet, cotton; iv) Grow resistant varieties like Pusa-885, Asha, Sharad (DA11),Narendra Arhar1, Bahar, BSMR-853, BSMR 736, Rajeev Lochan, BDN-708.

iii) Phytophthora blight

Symptoms: Foliage blight symptoms are circular or irregular water soaked lesions on leaves.The lesions on stems and branchesincreases rapidly, girdles, cracks and dries the stem.Infected stem and branches break easily in the wind.

Control Measures

i) Seed treated with Metalaxyl 35 WS @3 g/kg of seed; ii) Good drainage in the fields and the plants should be protected from stem injury; iii) Crop rotation should be followed; iv) Grow resistant varieties like ICPL 7916/ 12055/12114/12161, JKM-189, JA-4 etc.

iv) Alternaria blight

Symptoms: Symptoms appear on all aerial part of plants are small, circular, necrotic spots that develop quickly, forming typical concentric rings. The spots are initially light brown and later turn dark brown. In severe infection, defoliation and drying of infected leaves, branches and flower buds.

Control Measures

Spray the crop with Mancozeb 75 WP @ 2 g/liter or Carbendazim 50 WP @ 1g/liter of water; ii)Cultivation of pigeonpea on ridges with proper drainage system and avoiding the sowing in heavy soil helpful in disease management; iii) Grow resistant varieties like DA- 2,MA 128-1, MA 128-2.

B. INSECT-PEST

i) Pod borers

Nature of Damage: It is widely distributed and is the most injurious pest of early and medium maturing varieties. The larvae, after hatching, feed on tender leaves and twigs but a pod formation they puncture pods and feed on developing grains. It may be seen in vegetative & podding stage.

Control Measures

Use *H. armigera* pheromone trap @ 12/ha; ii) Spray the crop with Emamectin benzoate 5% SG @220 g/ha. or Indoxacarb 15.8% SC @333 ml/ha; iii) The caterpillar should be picked by hand after shaking the plants and destroyed in the early stages of attack.

ii) Tur Pod fly

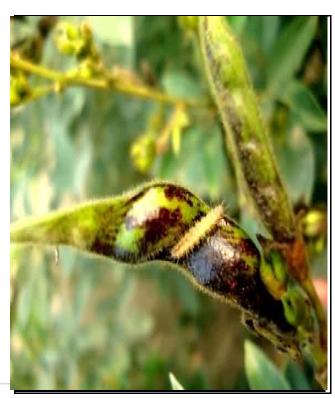
Pod Fly

Nature of damage: Stripes can be seen on the surface of the affected grains, while the attacked pods are somewhat twisted or deformed. In case of severe damage, as many as 80 per cent pods and 60 per cent grains may be damaged.

Control Measures

Spraying Neem seed kernel extract (NSKE) 5 per cent at 50% flowering stage to manage the insectôs populations; ii) Pest can be controlled by spraying the crop with Lemda Cyhalothrin 5 EC 400-500 ml in 800-1000 litres of water per hectare.

iii) Plume Moth



Nature of damage: The larvae damagedseeds as wellcause flowers, buds and pods to drop. The caterpillar is greenish-brown in color and fringed with short hairs and spines. It also enters into the pod and feeds on developing grains.

Control Measures

i) Apply the Neem oil 2%; ii) Spray the crop with Azadirachtin 0.03 % WSP 2500-5000 g/ha or Emamectin benzoate 5% SG @ 220 g/ha or Indoxacarb 15.8% SC @ 333 ml/ha.

iv) Pod-sucking bugs

Nature of damage: Damaged seeds become shriveled, and developdark patches. Shedding of green pods.

Control Measures

Soil application of carbofuran 3G @ 15 kg/ha at sowing; ii) Spray the crop with HaNPV 3 x1012 POB/ha in 0.1% teepol; ii) Immature bugs can be handpicked and destroyed; iii) The main natural enemies of bugs are egg parasitoids, ants and birds reported reduce feeding by green shield bugs; iv) Spraying with aromatic plants (e.g. gums, lantana, Neem-based pesticides).

Pod Sucking Bugs

3.7 RECOMMENDATION TO ACHIEVED HIGHER PRODUCTION

- Deep summer ploughing once in 3 years.
- Application of fertilizer should be based on soil test value.
- Seed treatment should be done before sowing.
- Use wilt and Sterility Mosaic disease (SMD) resistant /tolerant varieties BSMR 736, 853, 846, ICPL 96053, BDN 2010, ICPL 43, 44, IPA 203, 204, 234 and IPH 09-5 as per suitability of region.(IIPR AICRP Pigeonpea).
- Wilt resistant varieties VL Arhar -1, Vipula, JKM -189, G.T.-101, Pusa 991, Azad (K-91-25), BSMR-736, MA-6 etc.
- Use hybrid varieties PPH -4, ICPH-8, IPH 09-5, ICPH -2740 as per suitability of region.
- Weed control should be done at right time.
- Adopt integrated approach for plant protection.

3.8 HYBRID PIGEONPEA

In pulses, self-pollination is a rule and pigeonpea is no exception. However under field conditions, occurrence of hybrid plants in the populations is not uncommon; and it happens due to some degree of natural out-crossing that took place in the preceding generation.
Consequently the crop is considered as partially cross pollinated. Traditionally high yielding purelines *vis-a-vis* single plant selections of different maturity groups have 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* (ii) *stable male-sterile source.*

The hybrid pigeonpea R&D 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.

a) **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. The GMS based hybrid developed are given below.

- **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.

b) 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.

- **CMS BASED PIGEONPEA HYBRIDS**

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

c) Package and Practices of Hybrid Seed Production

The package manual being developed by Dr. A.N. Tikle, Senior Scientist, Pigeonpea breeder, RVSKVV, Gwalior on Hybrid Seed Production is reproduced below:

- **Selection of field:**Select field where pigeonpea was not grown in the previous season. Pigeonpea hybrid and parents seed production should be taken in medium to light soil with good drainage facility.
- **Isolation requirement:**Hybrid seed production field must be isolated by about 200 m from other pigeonpea fields.
- **Sowing time:**Onset of monsoon (IIndfortnight of June ï Istweek of July) or sowing time may be delayed by 10-15 days as late season planting showed relatively short plant height.
- **Seed rate**

  Female -6-8 kg/ha (seed drill)or1 kg/ha (hand dibbling) for medium maturing hybrid

  Male -2-3 kg/ha (seed drill) or 1-1.5 kg/ha (hand dibbling) for medium maturing hybrid.
- **Seed Treatment:**Vitavax 2.5 g + Trichoderma 5 g/kg of seed.
- **Plant spacing and depth:**90 cm between rows and 30 cm within rows, whereas in late sown condition the row to row distance can be reduced. Two seeds may be placed 4-5 cm deep in the soil on raised hill. Only one plant should be allowed to grow per hill which enables easy monitoring.
- **Row ratio of A-line and R-line:**Seed should be sown in the row ratio of 4:2 of A-line and R-line for hybrid seed production. It is advisable to sow 2-4 border rows of R-line in periphery of seed plot for abundance of pollen availability for enhancing pollen load. A-line should be demarketed by sowing of soybean within the rows of A-line.
  - Thinning and re-sowing: It should be completed within 15 days after germination.
  - Inter-culturing & weeding: Crop should be kept weed free by 2-4 inter-culture operation by Kolpa and hand weeding.
  - Fertilizer dose: 25:50:20: 20 NPK & $ZnSO_4$ kg/ha basal dose.
  - Irrigation: If necessary, crop may be irrigated on critical stages of crop growths viz., seedling. However, irrigation at flowering stage increases enhances better pod setting and seed formation.

- **Identification of pollen shedders in CMS (A-) line:**

  Anthers of the male sterile plants are totally devoid of pollen grains. The sterility is confirmed at flowering i.e. anthesis. Anthers of A-line are white and translucent type, while B-lineȇs anthers are full of pollen grains which can be seen by naked eye in the form of pollen mass. Pollen shedder plants in A-line may be identified at flower initiation stage and removed by uprooting the plants.

- **Identification of Off-types:**

  a) Pollen shedder plants may be identified as flowers with full of pollen grain;

  b) A & B plants are morphologically/phenotypically same except for male sterility;

  c) Diagnostic morphological traits are useful in identification of off type plants.

- **Rouging:**Offï type, rogue and pollen shedder plants are being rouged out regularly at different plant growth stages to maintain high genetic purity. Rouging in seed production plots should be carried out first at seedling stage, second at flowering stage, third at pod setting stage and fourth at physiological maturity stage.

- **De-podding:**De-podding in male plant rows ensure continuous pollen availability for subsequent flowering flush for pod setting in A-lines. At 75 % physiological maturity, pods can be harvested by picking or cutting pod bearing portion of the branches of A-line to ensure second flowering flush in ratoon crop to give additional seed yield.

- **Plant protection measures:**First spray of insecticide should be done at flower initiation with any safer insecticide for pollinators viz., Profenofos 1.5 l/ha or Quinalphos 1l/ha and second after 10-15 days with Profenofos 1.5 l/ha, Neem kernel extract 5%. If infestation of pod borer persists, third and fourth spray may be done in the interval of 10-15 days. Sex pheromone trap 25/ha may be installed across the field. Spraying/dusting of Malathion, chlorpyriphos, cypermethrin should be avoided.

- **Harvesting:**

  i. Pods of A-lines can be harvested at 75 % physiological maturity by picking or cutting pod bearing portion of the branches.

  ii. R-lines should be harvested before A-lines to avoid admixture in hybrid seed.

  iii. Matured pod in A-line should be harvested and threshing should be made separately.

- Grading &packing:Seed should be cleaned and graded as per seed certification standards. Seed samples should be taken for seed testing and grow out test (GOT) before packing and labeling.

ICPA 2043 A

Certified seed production of hybrid seed in the Ratio of 4: 2 rows of female (A-lines & R-lines)

Male sterile flower devoid of pollen grains in anther of A-line

Field view of Hybrid seed production of ICPH 2671

3.8.1 CHRONOLOGY OF R&D WORK IN DEVELOPMENT OF HYBRID PIGEONPEA

- In 1991, a milestone in the history of food legume breeding was achieved when the worldôs 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 produce.

3.8.2 SCOPE

The hybrids having more canopy than traditional varieties, consequently need less per hectare seed rate compensating higher cost of hybrid seed. The hybrids have tremendous scope of popularization in northern and central India and other parts growing wheat crop after harvest of hybrid pigeonpea. Similarly in central and southernpart, early and medium duration hybrids are likely to play important role in increasing the area under pigeonpea. The cost of cultivation would automatically reduced with the higher production and increase in cropping intensity due to hybrids.

3.9 SITUATIONS/SEASON OF CULTIVATION

3.9.1RABI 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 C.G 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.
- Spraying of Malathion 0.05% or carbaryl 0.1% at pod formation stage, controls pod borers.

3.9.2 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.

Summer pigeonpea is gaining popularity in Narmadapuram and Jabalpur Division (Hoshangabad and Narsinghpur.

3.9.3 PRODUCTION TECHNOLOGY

Pigeonpea was usually considered a low-input marginal crop and therefore, not much attention was paid for development of improved production technology except for some nutritional requirement. Based on recent studies, production technology was strengthened which are suited to different zones as given below:

(TABLE.-3.9): PIGEONPEA PRODUCTION TECHNOLOGY FOR DIFFERENT ZONES

Zone	Planting time	Seed rate & spacing	Seed inoculation	Fertilizer	Irrigation	Weed management	Cropping system
NWPZ: (Punjab, Haryana, Delhi, Western Uttar Pradesh and North West Rajasthan)	2nd fortnight of May to1st fortnight of June.	18-20 kg/ha 60 x 20 cm.	*Rhizobium* culture @ one packet for 10 kg seed.	N:P:K:S: $ZnSO_4$ @ 20:40:20:20:25 kg/ha.	Pre sowing and in absence of rains at flowering and pod development stage.	Two hand weeding at 25 and 45 days after sowing (DAS) or application of Pendimethalin @ 1.25 kg a.i./ha followed by one hand weeding at 45-60 DAS.	1. Pigeonpea-wheat sequential cropping. 2. Intercropping of mungbean /urdbean with pigeonpea (1:1 row ratio)
NEPZ: (Eastern part of Uttar Pradesh, Bihar, West Bengal, Assam & Jharkhand	Early:1st fort night of June. Late: 1st fortnight of July Pre-rabi: 1st fortnight of Sept.	18-20 kg/ha 60 x 20 cm 12-15 kg/ha 75-90 x 25 cm. 25-30 kg/ha 30 x 10 cm.	-do-	-do-	Early: Pre sowing Pre-rabi: At 45 days after sowing (DAS) and at 100-110 DAS in absence of rains.	-do-	Early: Pigeonpea-wheat sequential cropping. Late: Pigeonpea sorghum mungbean/urdbean/ Sesamum by pairing pigeonpea rows and planting one rows of intercrop.
CZ: (Gujarat Maharashtra , M.P., Rajasthan & Chattisgarh.	Both early and medium: 1st fortnight of July/ on set of monsoon	Early:15-18 kg/ha 60 x 20 cm. Medium: 15-16 Kg/ha 75-90 x 25 cm	-do-	-do-	In absence of rains at flowering and pod development stage.	-do-	Pigeonpea + Groundnut(2:4) Pigeonpea+Soybean (2:4), Pigeonpea + Sorghum (2:1) and pigeonpea+urdbean(1:1)
SZ: (A.P., Karnataka & Orissa)	Early: : 2nd fortnight of June Medium: 1st fortnight of July/ on set of monsoon	-do-	-do-	-do-	-do-	-do-	Pigeonpea+ mungbean/ urdbean /cowpea (1:1), Pigeonpea+ groundnut (4:2).

NWPZ= North West Plain Zone, NEPZ= North East Plain Zone, CZ= Central Zone, SZ= South Zone, DAS= Days after sowing.

(TABLE-3.10):Agronomic recommendations of ICAR-IIPR for increased production under different cropping systems in the country.

Agronomic Practices	Impact
Plant Population: Optimum plant density for early maturing pigeonpea genotypes is 25-33 Plants/m^2. For Pre-*Rabi* planting 22 plants /m^2 and for long maturity group 11 plants/ m^2 are optimum.	Optimum plant population significantly contributes towards the yield and critical solar energy harvest, its conversion and higher production per unit of land.
Cropping system: Pigeonpea + groundnut (first year) followed by Maize + Groundnut (2nd year)	Increased the productivity and has potential to provide increased gross return under sequential cropping system.
Intercropping: • Pigeonpea +Sorghum / Pearl millet / Seasmum (2:1 row ratio) and (2:2 row ratio) • Pigeonpea + Mungbean /Urdbean /Soybean /Maize /Groundnut • Pigeonpea + maize (2:1) supplemented with FYM @ 5 tonnes per hectare. **NWPZ:** • Pigeonpea (Paras, Pusa 992 , AL 1455) +Mungbean/Urdbean/soybean/Groundnut **CZ:** • Pigeonpea (Asha, JKM7, JKM189, GT 101, BSMR 736, BSMR 853) + Mungbean/Urdbean/soybean/Groundnut. **SZ:** • Pigeonpea (TTB 7, JKM 186, Co6, LRG 41) + Mungbean /urdbean/ Urdbean/ Soybean/ Groundnut/ fieldbean.	• Bonus yield of intercrops, highly remunerative as compared to sole crop of pigeonpea both under optimal and sub-optimal fertility levels. • Reduced wilt incidence (12-21%) than sole crop of pigeonpea. • Reduced pod borer incidence 27% than sole pigeonpea damage 49% with the help of bird perches (Sorghum, maize) • Higher pigeonpea equivalent yield (PEY) net return, return /Rs invested and LER. • Bonus yield of intercrops • Spray (2% urea) at 15 and 45 DAH of intercrop is beneficial. • Reduced yield of pigeonpea but higher gross monitory return alongwith additional harvest of fodder sorghum
Ridge and Furrow raised beds planting: • Pigeonpea (ridges) + Rice (Furrow) • Pigeonpea (Ridges) + Intercrops(side of furrow) • Pigeonpea (Ridges) + Urdbean 2:2 (raised beds)	Ensured optimum plant population and higher grain yield as a bonus without any adverse effect on grain yield on pigeonpea.
Weed management: • Raised bed system (2.7 m width) of planting and one hand weeding of 30 DAS. • Pre-emergence application of pendimethalin (1.0-1.5 kg/ha) or Benthiocarb, Metalachlor /Alachlor @ 2.0 kg/ha and hand weeding 25-30 DAS optional second weeding (45-60 DAS) • Pre-emergence spray of Pendimethalin @ 0.75 kg/ha followed by post emergence spray of Paraquot of weeds in Pigeonpea.	Yield advantage (23%) over flat system and sufficient control to seasonal weed.

Agronomic Practices	Impact
Integrated Nutrient management • 40 kg N, 22 kg P_20_5/ha, 20 kg/ha Sulphur(Gypsum& SSP), Sodium molybdate @ 1.0kg/ha and $ZnSO_4$@ 15 kg/ha • Pigeonpea requires fertilizer dose of 20:18:27:20:25 kg N:P:K:S:Zn • Soil application of sodium molybdate @ 4g/kg seed, chelated iron @ 1 kg/ha and RDF + Seed treatment borax (4g/kg of seed) enhances the yield. • Seed treatment with micronutrients such as Zinc, boron, molybdenum and iron has been found as effective as that of soil application. • Application of borax, molybdenum and iron (deficient soil) through soil application, foliar application and seed treatment however, rate will vary depending on extent of deficiency in the soil. • Soil amelioration through lime in low pH soil supplement with molybdenum. • Application of Vermicompost (2.5t/ha) + organic fertilizer (75% RDF) + biofertilizer (Rhizobium+ PSB+ PGPR) enhances the yield and soil physical properties.	• Grain yield advantage as recorded upto 177 kg /ha. • Rabi pigeonpea (Sharad), yield increase 25% over control • Yield advantage 18-20 kg/ha respectively with NPKS (20-18-27-20 kg/ha) as compared to without sulphur application. • No response of Mb in Rabi Pigeonpea. • Application of $ZnSO_4$ with RDF is beneficial.
Agronomic Practices for insect Pest management: • Pigeonpea +Sorghum (1:2) + optimum dose of fertilizer application than sole pigeonpea with sub-optimum dose of fertilizer <50%. • Pigeonpea + Sorghum (1:2)+ RDF+ chemical control (20%).	• Recorded lower pod borer incidence 20%. • Lower wilt incidence (11%)
Cultural Practice: • In P- deficient soils some varieties viz. such as GT-1, VRG 17, TTB 7 and VBN 2 were recorded as efficient user of Phosphorus. • Under delayed planting upto first week of August- use of suitable genotypes such as Asha , JKM 189, BSMR 853(2), TTB 7, LRG 41 30, 38 WRP 1 (SZ) and Azad (NEPZ).	• Efficient use of phosphorus through P ï tolerant varieties for higher yield. • Use of suitable varieties for contingent planning.
Drought Management: • Spray of 2% KCl for minimizing the adverse effect of terminal drought. • Foliar application of urea, KCl and seed soaking with CaCl2 and K_2HPO_4 in reducing the adverse effect of water stress at the terminal growth of pigeonpea. • Cultural mulch and water spray to minimize the adverse effect of terminal drought.	• Drought management with physiological and agronomic practices.
HybridPigeonpea: • For hybrid GTH-1 plant density of 75 x 20-30 cm. and application of 20-60-25-20 and 15 Kg NPKS and Zn was optimum.	• Improved technology through Agronomic management.

Accumulation of run off water in a pond can be successfully utilized for substances of crop during the water scarcity.

(TABLE–3.11): RECOMMENDED VARIETIES/CHARACTERISTICS

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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., MS, Gujarat, Karnataka, AP, 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	Tolerant 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,MS& Gujarat).**SZ** (Odisha, Karnataka, A.P. & Tamilnadu).	18-20	173-180	Tolerant to wilt & Phytophthora blight. Seeds dark brown

(Cont….)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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

(Cont….)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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 (Preï 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

(Cont….)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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*

GREEN GRAM (MUNGBEAN)

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

4.1 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. It is also used as green manuring crop.

In India these crops are cultivated in three different seasons, viz., kharif, rabi and summer. Summer moong can be grown after harvesting of pea, gram, potato, mustard, linseed. Cultivation of Jayad Moong is important to increase soil fertility in these areas where paddy ï wheat crop rotation is used.

4.2 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
Dietary Fiber	16.3%	Calorific value	334 Kcal/100g
Carbohydrate	56%	Moisture	10%

AGRONOMIC IMPORTANCE:Short duration and photo insensitive varieties fit well in many intensive cropping systems accross the country. Spring/Summer mungbean 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.

4.3 GROWTH RATE

From 1980-81 to 2002-03, the total acreage under pulses has almost slightly ($\pm$) being showed, however, a sudden jump in production and productivity was observed in 2003-04 and 2010-11 for production with 96% and 160% growth rate whereas, for productivity it was 66% and 127% (Table 1.28).

(TABLE-4.1): GROWTH RATE OF MUNGBEAN

(A- Million ha, P- Million tones, Y-kg/ha, Growth Rate (GR)- %)

Year	Mungbean					
	Area	GR	Prod.	GR	Yield	GR
1980-81	2.84		0.98		344	
1985-86	3.00	5.6	1.18	20.1	392	13.7
1990-91	3.36	11.7	1.38	17.7	413	5.4
1995-96	2.72	-19.1	1.01	-27.1	372	-10.0
1996-97	3.06	12.8	1.32	30.7	431	15.9

(A- Million ha, P- Million tones, Y-kg/ha, Growth Rate (GR)- %)

Year	Mungbean					
	Area	GR	Prod.	GR	Yield	GR
1997-98	3.02	-1.5	0.95	-28.0	315	-26.9
1998-99	3.05	1.2	1.16	22.3	380	20.8
1999-00	2.91	-4.9	1.08	-7.2	371	-2.5
2000-01	3.01	3.5	1.02	-5.0	340	-8.3
2001-02	3.09	2.6	1.11	8.5	360	5.8
2002-03	3.01	-2.3	0.87	-21.9	288	-20.0
2003-04	3.55	17.7	1.70	96.2	480	66.7
2004-05	3.34	-5.8	1.06	-37.9	317	-34.0
2005-06	3.11	-7.0	0.95	-10.5	304	-3.9
2006-07	3.19	2.8	1.12	17.9	349	14.7
2007-08	3.73	16.7	1.52	36.5	409	17.0
2008-09	2.84	-23.7	1.03	-32.1	364	-10.9
2009-10	3.07	8.0	0.69	-33.1	226	-38.0
2010-11	3.51	14.3	1.80	160.0	513	127.6
2011-12	3.39	-3.5	1.63	-9.2	483	-6.0
2012-13	2.72	-19.7	1.19	-27.4	436	-9.6
2013-14	3.38	24.4	1.61	35.3	475	8.8
2014-15	3.02	-10.7	1.50	-6.4	498	4.9
2015-16	3.83	26.8	1.59	6.0	416	-16.4
2016-17	4.30	12.5	2.07	29.9	481	15.5

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India*

(TABLE -4.2): PER CENT SHARE TO TOTAL PULSES

(Area- lakh ha, Production-Lakh Tones, Yield-kg/ha)

Year	Mung			Total Pulses			% Share to Total Pulses		
	A	P	Y	A	P	Y	A	P	YI
1980-81	28.44	9.80	344	224.45	106.24	473	12.7	9.2	73
1990-91	33.55	13.84	413	372.55	203.68	547	9.0	6.8	75
1995-96	27.15	10.09	372	331.77	170.10	513	8.2	5.9	72
2000-01	30.08	10.23	340	203.48	110.75	544	14.8	9.2	62
2001-02	30.87	11.11	360	220.08	133.68	607	14.0	8.3	59
2002-03	30.15	8.67	288	204.96	111.25	543	14.7	7.8	53
2003-04	35.48	17.02	480	234.58	149.05	635	15.1	11.4	76
2004-05	33.41	10.58	317	227.63	131.30	577	14.7	8.1	55
2005-06	31.09	9.46	304	223.91	133.84	598	13.9	7.1	51
2006-07	31.94	11.15	349	231.92	141.98	612	13.8	7.9	57
2007-08	37.27	15.23	409	236.33	147.62	625	15.8	10.3	65
2008-09	28.43	10.35	364	220.94	145.66	659	12.9	7.1	55
2009-10	30.70	6.92	226	232.82	146.62	630	13.2	4.7	36
2010-11	35.08	18.00	513	264.02	182.41	691	13.3	9.9	74
2011-12	33.87	16.34	483	244.62	170.89	699	13.8	9.6	69
2012-13	27.19	11.86	436	232.57	183.42	789	11.7	6.5	55

(Area- lakh ha, Production-Lakh Tones, Yield-kg/ha)

Year	Mung			Total Pulses			% Share to Total Pulses		
	A	P	Y	A	P	Y	A	P	YI
2013-14	33.83	16.05	475	252.18	192.55	764	13.4	8.3	62
2014-15	30.19	15.03	498	235.53	171.52	728	12.8	8.8	68
2015-16	38.28	15.93	416	249.11	163.48	656	15.4	9.7	63
2016-17	43.05	20.70	481	292.77	224.01	765	14.7	9.2	63

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*

4.4 PRODUCTION TRENDS

4.4.1 NATIONAL SCENARIO: PLAN PERIODS

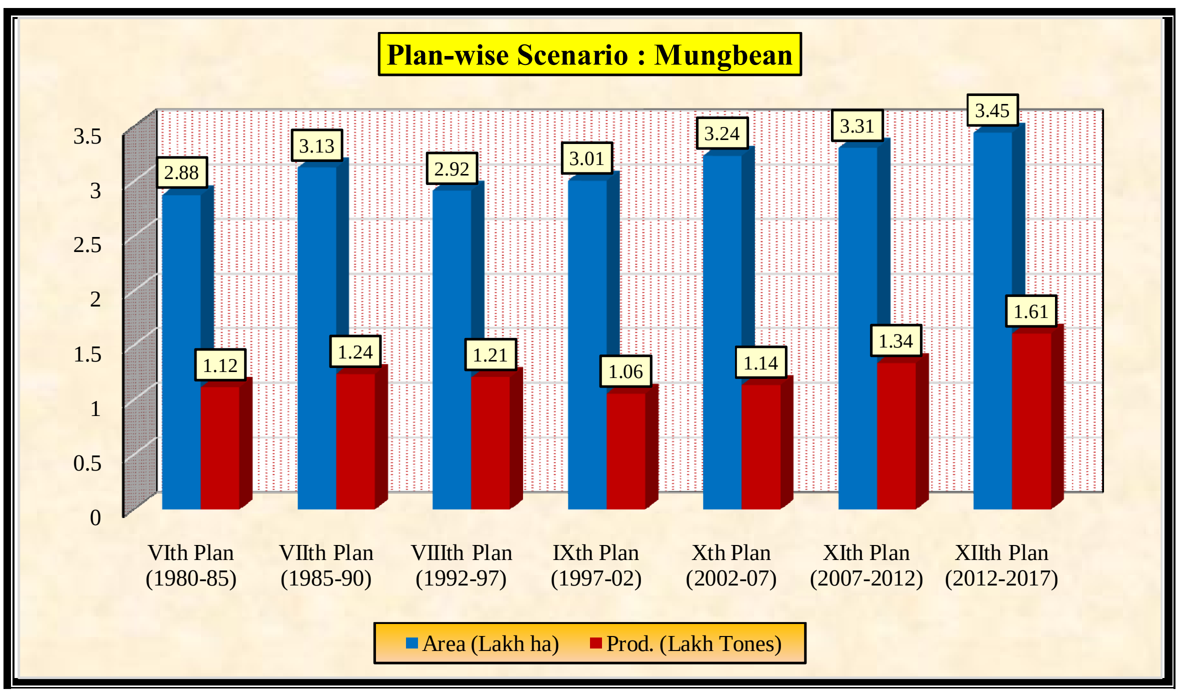
Plan-wise performance revelaed, the highest area VIIth Plan and production & Productivity increased during XIIth plan over the previous plan period. The details plan-wise performance is given below :

(TABLE-4.3): PLAN-WISE NATIONAL SCENARIO

(Area-Mha, Production-MTonnes, Yield-kg/ha)

Plan	Area	%COPP	Prod.	% COPP	Productivity	%COPP
Sixth Plan (1980-85)	2.88		1.12		390	
Seventh Plan (1985-90)	3.13	8.77	1.24	10.42	396	1.51
Eighth Plan (1992-97)	2.92	-6.71	1.21	-2.71	413	4.28
Ninth Plan (1997-02)	3.01	3.19	1.06	-11.84	353	-14.57
Tenth Plan (2002-07)	3.24	7.53	1.14	6.89	351	-0.60
Eleventh Plan (2007-2012)	3.31	2.02	1.34	17.50	404	15.16
Twelfth Plan (2012-2017)*	3.45	4.22	1.61	20.14	466	15.34

Source: *DES, Twelfth Plan (2012-2017)*& 2016-17 APY is the IVth Advance Estimate; % COPP is percentage change over previous plan.*



4.4.2 STATES' SCENARIO: PLAN ANALYSIS (Xth–XII th)

Tenth Plan (2002-2007): The total area under Moong during ninth plan was 32.41 lakh hectares with production of 11.38 lakh tones. Rajasthan stands first in respect of area (22.54%) followed by Maharashtra (17.06%) and A.P. (14.73%). The maximum contribution of production was in the state of Maharashtra (21.61%) followed by Rajasthan (20.23%) and A.P. (15.81%). The highest yield was recorded by the state of Punjab (800 kg/ha) followed by Bihar (548 kg/ha) and Jharkhand (538 kg/ha) with the overall National yield average of 351kg/ha. The lowest yield was recorded in Karnataka (146 kg/ha) followed by Odisha (238 kg/ha) and Chhattisgarh (235 kg/ha).

Eleventh Plan (2007-2012): The total area covered under moong in India was 33.32 lakh hectares with a total production of 13.52 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 (778kg/ha) followed by Bihar (617 kg/ha) and Jharkhand (571 kg/ha). The National yield average was of 406 kg/ha. The lowest yield was observed in Karnataka (202 kg/ha) followed by Odisha (270 kg/ha) and C.G. (250 kg/ha).

Twelfth Plan (2012-2017): The total area covered under moong in India was 34.50 lakh hectares with a total production of 15.91 lakh tonnes. The coverage of area and its production was maximum in Rajasthan (32.76% &30.61%) followed by Maharashtra (11.95 %& 10.58%) of the total area and production. Karnataka ranked third in area (8.81%) and Tamilnadu is on third position for production (7.63%). The highest yield was recorded by the state of Punjab (845 kg/ha) followed by Jharkhand (704 kg/ha) and Andhra Pradesh (696 kg/ha). The National yield average was 461 kg/ha. The lowest yield observed in the state of Karnataka (227 kg/ha) followed by C.G. (326 kg/ha) and Odisha (327 kg/ha).

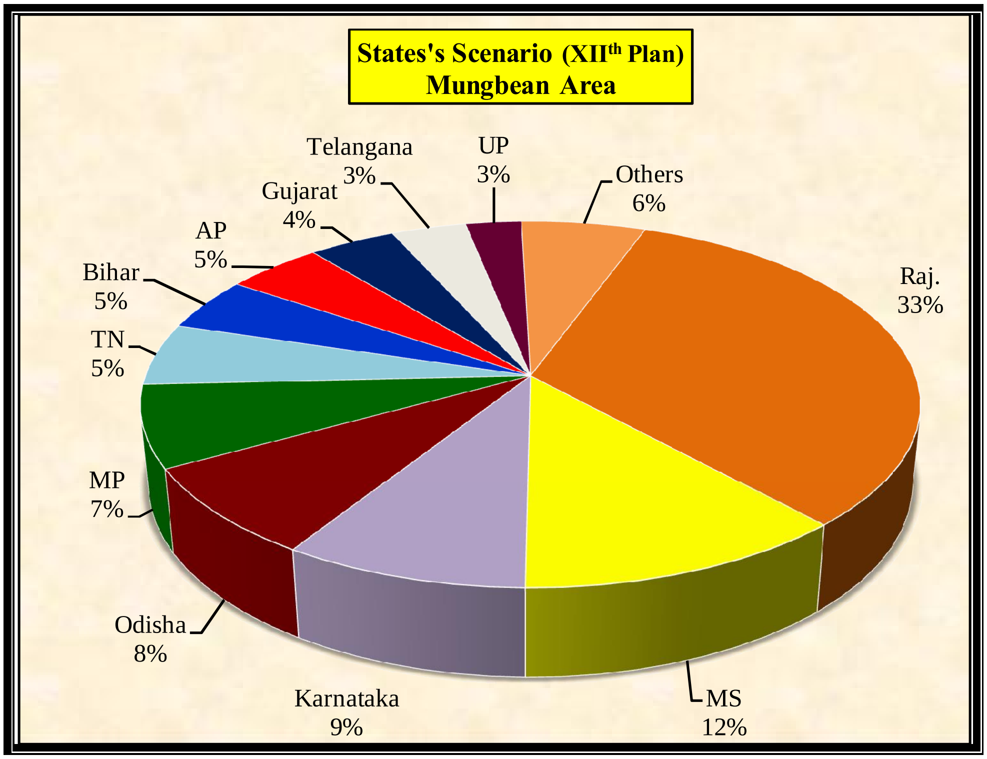
During the last three Plan Period area fluctuating, however, production and productivity showed increasing trend.

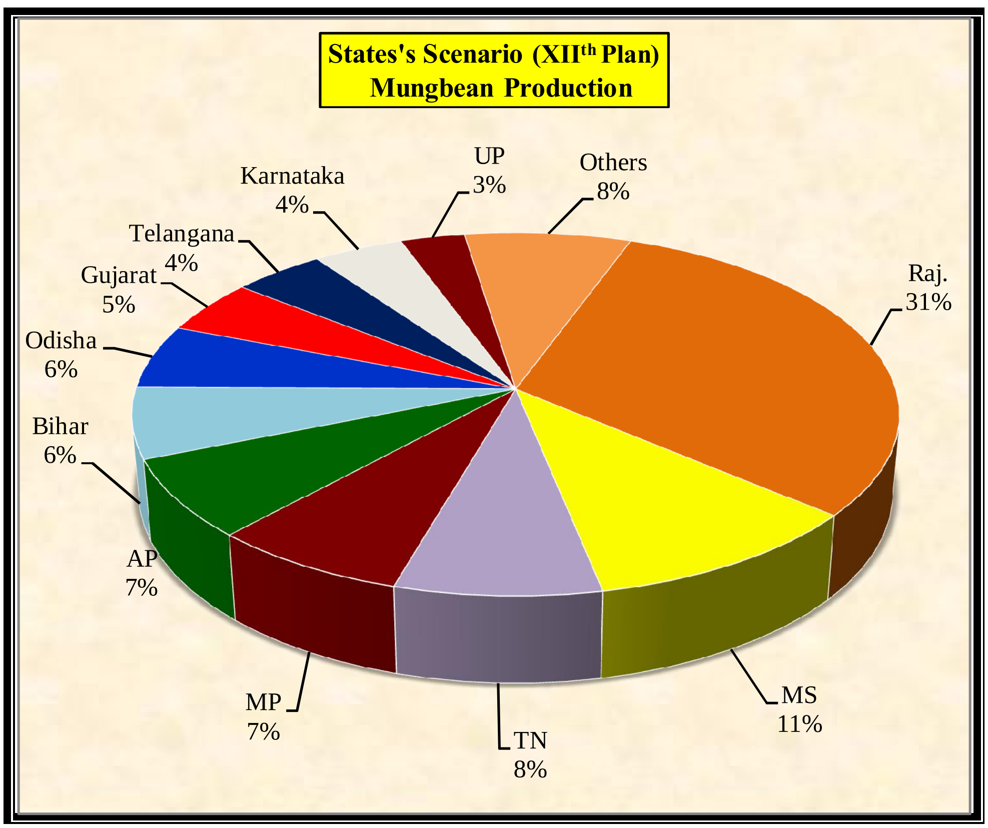
(TABLE-4.4): PLAN-WISE STATES' SCENARIO – MAJOR STATE'S

(Area- lakh ha, Production-Lakh Tones, Yield-kg/ha)

State		X^th Plan	% to AI	XI^th Plan	% to AI	XII^th Plan	% to AI
Andhra Pradesh	A	4.77	14.73	3.45	10.36	1.61	4.68
	P	1.80	15.81	1.44	10.62	1.12	7.06
	Y	377		417		696	
Bihar	A	1.86	5.74	1.67	5.01	1.62	4.71
	P	1.02	8.92	1.03	7.59	1.00	6.27
	Y	548		617		614	
Chhattisgarh	A	0.17	0.53	0.16	0.49	0.16	0.47
	P	0.04	0.38	0.04	0.30	0.05	0.33
	Y	235		250		326	
Gujarat	A	1.73	5.35	2.20	6.62	1.45	4.20
	P	0.70	6.12	1.06	7.84	0.76	4.81
	Y	405		482		528	
Haryana	A	0.22	0.67	0.27	0.80	0.56	1.61
	P	0.07	0.58	0.12	0.86	0.33	2.08
	Y	318		444		597	
Jharkhand	A	0.13	0.40	0.21	0.63	0.24	0.68
	P	0.07	0.63	0.12	0.86	0.17	1.04
	Y	538		571		704	
Karnataka	A	4.11	12.69	3.76	11.27	3.04	8.81
	P	0.60	5.26	0.76	5.61	0.69	4.34
	Y	146		202		227	
Madhya Prd.	A	0.85	2.62	0.86	2.58	2.51	7.27
	P	0.27	2.39	0.28	2.07	1.16	7.31
	Y	318		326		464	
Maharashtra	A	5.53	17.06	5.08	15.26	4.12	11.95
	P	2.46	21.61	2.51	18.57	1.68	10.58
	Y	445		494		408	
Odisha	A	2.23	6.87	2.59	7.76	2.77	8.02
	P	0.53	4.67	0.70	5.16	0.90	5.68
	Y	238		270		327	
Punjab	A	0.15	0.46	0.09	0.26	0.42	1.21
	P	0.12	1.04	0.07	0.50	0.35	2.22
	Y	800		778		845	
Rajasthan	A	7.31	22.54	10.40	31.21	11.30	32.76
	P	2.30	20.23	4.28	31.68	4.87	30.61
	Y	315		412		431	
Tamilnadu	A	1.25	3.87	1.54	4.63	1.89	5.48
	P	0.54	4.73	0.54	3.99	1.21	7.63
	Y	432		351		642	
Telangana	A			0.72		1.25	3.61
	P			0.39		0.70	4.42
	Y			545		564	
Uttar Pradesh	A	0.74	2.30	0.79	2.38	0.93	2.70
	P	0.35	3.05	0.45	3.36	0.49	3.09
	Y	473		570		529	
All India	**A**	**32.41**		**33.32**		**34.50**	
	P	**11.38**		**13.52**		**15.91**	
	Y	**351**		**406**		**461**	

**Twelfth plan is the Ave. of 2012-13 to 2016-17 & 2016-17 APY is the III^rd Adv. Estimates*


States's Scenario (XIIth Plan)
Mungbean Area
Telangana 3%
UP 3%
Others 6%
Gujarat 4%
AP 5%
Bihar 5%
Raj. 33%
TN 5%
MP 7%
Odisha 8%
Karnataka 9%
MS 12%


States's Scenario (XIIth Plan)
Mungbean Production
Karnataka 4%
UP 3%
Others 8%
Telangana 4%
Gujarat 5%
Raj. 31%
Odisha 6%
Bihar 6%
AP 7%
MP 7%
TN 8%
MS 11%

4.4.3 DISTRICT SCENARIO (2013-14) – POTENTIAL DISTRICTS

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 ï 4.5).

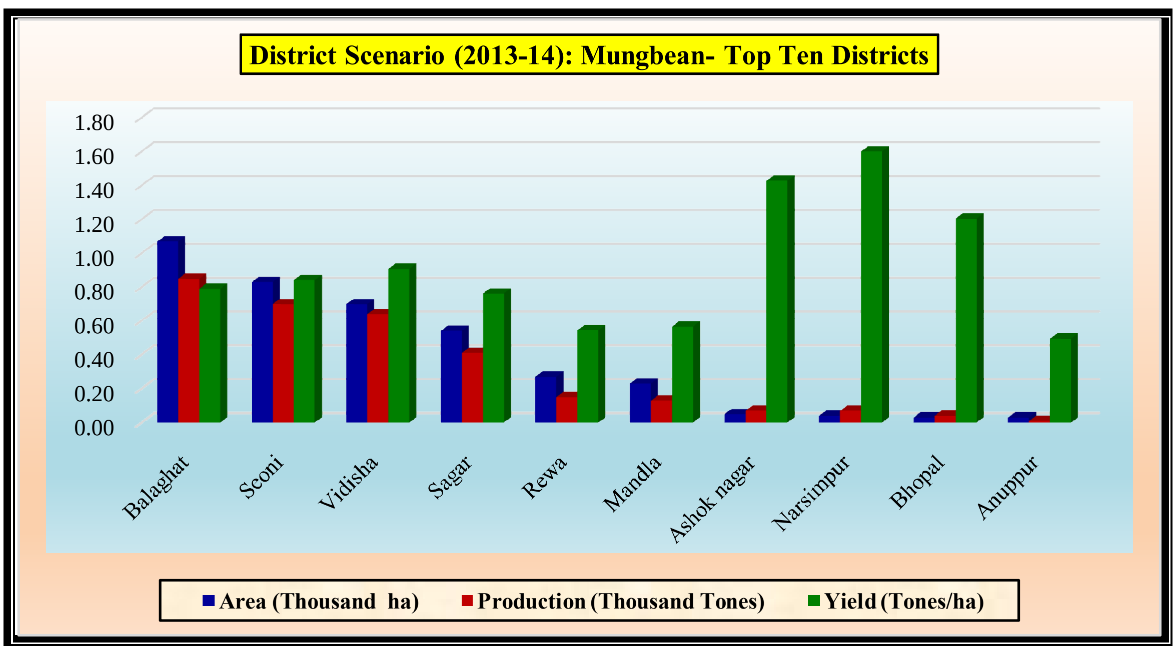
The yield of most of the potential districts were below the National average yield need to be adopt Improved Package of Practices of the greengram to increase the production in districts as well as country.

(TABLE–4.5): 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	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**	

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*



(TABLE–4.6): STATE-WISE YIELD GAP AND ADDITIONAL RETURN

(Yield: Kg/ha; Return: Rs./ha.)

State	Yield (kg/ha)			Gap over FP		Gap over SAY		Yield 2016-17*	Additional return by bridging yield gap (Rs/ha)	
	IP	FP	SAY	Actual	%	Actual	%		FP	SAY
Kharif										
Tripura	1016	782	513	234	30	503	98	0	13104	28168
Gujarat	766	606	501	160	26	265	53	457	8960	14840
Karnataka	655	563	214	92	16	441	206	276	5152	24696
Maharasthra	546	430	418	116	27	128	31	522	6496	7168
Rajasthan	773	600	436	173	29	337	77	475	9688	18872
Tamil Nadu	1000	796	588	204	26	412	70	714	11424	23072
Manipur	642	479	0.00	163	34	642	0	-	9128	35952
WB	1229	915	838	314	34	391	47	727	17584	21896
Average	**781**	**608**	**435**	**173**	**28**	**345**	**79**	**455**	**9682**	**19339**
Rabi										
AP	1398	1228	704	170	14	694	99	508	9520	38864
Rice fallow										
AP	1094	947	704	147	16	390	55	508	8232	21840
Odisha	825	498	359	327	66	466	130	359	18312	26096
Average	**960**	**723**	**532**	**237**	**33**	**428**	**80**	**434**	**13272**	**23968**
Summer/Spring Mungbean										
Bihar	939	735	603	204	28	336	56	548	11424	18816
Uttar Pradesh	1176	953	709	223	23	467	66	631	12488	26152
Haryana	524	487	576	37	8	-52	-9	735	2072	-2912
Punjab	1143	0.00	857	1143	0	286	33	986	64008	16016
Assam	875	622	624	253	41	251	40	686	14168	14056
Average	**931**	**559**	**674**	**372**	**66**	**257**	**38**	**717**	**20832**	**14414**

Source-*Annual Report- 2016-17, GoI, DPD, Bhopal (Ave. 2013-14 to 2015-16)*
*State Average Yield - E&S (Ave. 2011-12 to 2015-16) *Third Advance Estimates2016-17*
IP: Improved Practise FP: Farmers Practise SAY: State Avergae Yield

4.5 MUNGBEAN AGRONOMY

4.5.1 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.

4.5.2 PRODUCTION TECHNOLOGY

- **Climate**: 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.

- **Soil and Field Preparation**: Best soil for its cultivation is loam soil with good drainage. The crop should not be raised on alkaline, saline or waterlogged soils. A well prepared seedbed is required for proper germination and establishment of the crop. For this give 2 ï 3 ploughings followed by planking to make the seedbed free from clods and weeds. For the summer/spring cultivation after the harvesting of last crops, the tillage should be done after irrigation.

- **Sowing Time:** Mungbean should be sown during the last week of June to mid or first week of July. For the summer or spring crop, mungbean should be sown after the harvest of last crop (potato, sugarcane, mustard and cotton, etc). The first fortnight of March is most suitable for spring/summer cultivation. Late sown mungbean takes more loss at the time of flowering stage due to high tempreture and yield affected.

- **Growing seasons:** Mungbean is cultivated in all the three seasons viz., kharif, rabi and zaid (spring/summer). As a catch crop, in between rabi and kharif crops, after the harvest of rabi crops, like wheat, potato, mustard, sugarcane, etc., it is grown under irrigated conditions/rice fallow areas.

  During 2016-17, mungbean recorded the ever highest production at 20.70 lakh tons (kh-15.28 + rabi- 5.42 lakh tons), which is 38% higher over the Normal and 30% higher than the last year. Rajasthan, with 48% of total all India production during kharif and >31 % collectively in a crop year, ranks Ist in the country. During, rabi, TN with 19 % of national production stands at Ist position.

  More than 90% of Mungbean production comes from 10 states, namely Rajasthan, Maharashtra, TN, AP, Bihar, MP, Odisha, Gujarat, Telangana and Karnataka.

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.
B. **Rabi greengram-** Rabi greengram is grown in an area of approx. > 9.54 Lha (Avg. 2011-12-2015-16). The major states are Odisha, Tamil Nadu, Bihar, Andhra Pradesh, Madhya Pradesh Haryana, Uttar Pradesh, Gujarat, Punjab and West Bemngal. 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.

   An area of approximetly 12-20 lakh ha is covered during spring summer season, however, this is not recorded seperatly by the DES and is finally a part of total area coverage during rabi season.
C. **Spring/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*.

- **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.

- **Recommendations for successful cultivation of Rabi Mungbean**

- 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 ōNô fixation.
- Treat the seed with Emidacloprid @ 5 ml/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.

- **Seed Rate &Spacing & Method:** During Kharif season 15-20 kg seed/ha should be sown in rows 45 cm apart while during Rabi and Summer 25-30 kg seed /ha sown in rows 30 cm apart. 30 cm x 10 cm. row spacing is considered optimum, for modern varieties. As a companion crop with sugarcane seed rate should be 7-8 kg/ha. The plant-to-plant distance should be maintained (atleast 5 cm). Sowing can be done behind the local plough or with the help of seed drill.

- **Seed Treatment:**Treat the seed with Thirum (2gm.) +Carbendazim (1gm.) or Carbendazim & Kepton (1gm + 2gm) to control the soil & seed germinated disease. For sucking pest control seed treatment with Imidacloprid 70 WS @ 7g/ kg seed. It is also desirable to treat the seed with Rhizobium and PSB culture (5-7gm/kg seed).

- **Varieties**: The variety may be selectedas per the adaptability to the region, agro-eco sitiation, sowing time and the cropping systemTable-4.7.

- **Cropping systems**: The important crop rotations with moongbean are given as under:

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

- **Intercropping:** During kharif, mungbean are grown generally with maize, pearl millet, pigeonpea and cotton as intercrop. During spring, mungbean is grown in 2:1 ratio with sugarcane with row to row distance of 90 cm. & from mungbean 30 cm distance maintain. Intercropping with sunflower is also suitable with ratio (2:6).

- **Water Management:** Generally the kharif crop requires one life saving irrigation, which may be applied during the early pod formation stage. For the summer/spring mungbean, 3ï 4 irrigations are required. Apply first irrigation after 20-25 days of sowing and repeat after 10-15 days as per need. One irrigation before flowering and another at pod-filing stage would ensure healthy seeds. Water logging in the field should be avoided at all cost. No irrigation should be given when the crop is in full bloom stage.

- **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.

- **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.

- **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.

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

4.5.3 PLANT PROTECTION MEASURES

There are several important disease of mung, yellow mosaic, leaf crinkle, leaf curl, anthracnose, cercospora leaf spot are important one.

A. DISEASES

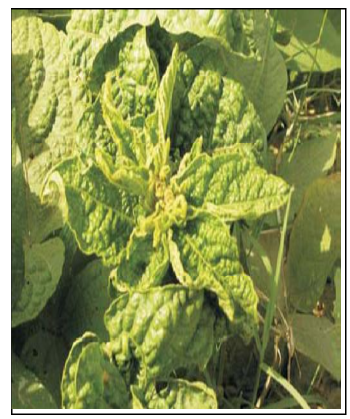
i) Yellow Mosaic Virus

Symptoms: This disease is caused by the mung bean yellow mosaic virus (MYMV) belongin to Gemini group of viruses, which is transmitted by the whitefly (*Bemisia tabaci*). The tender leaves show yellow mosaic spots, which increase with time leading tocomplete yellowing. Yellowing leads to less flowering and pod development. Early infection often leads to death of plants.

Control Measure

i) Diseased plants should be rogued out to prevent further spread of the disease; ii) In order to prevent whitefly (Bemisia spp.) infestation spray with triazophos 40 EC @ 2.0 ml/l or malathion 50 EC @ 2.0 ml/l or oxydemeton methyl 25 EC @ 2.0 ml/l at 10-15 days intervals if required; iii) Grow tolerant/resistant varieties like Narendra Mung1, Pant Mung 3, PDM 139 (Samrat), PDM 11, MUM 2, ML 337, IPM 02-14, MH 421, SML 832 etc.

ii) Leaf Curl

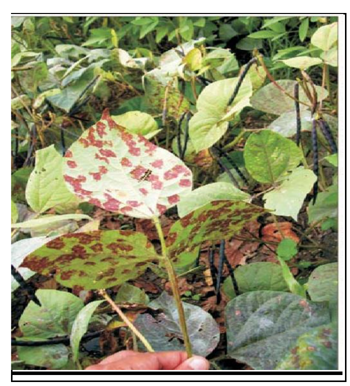


Symptoms: The symptoms are visible first in third leaf after three to four weeks of sowing. These are characterized by enlargement of leaves followed by their crinkling. Later the leaves become thicker an leathery. The affected plants, however, do not die till the harvest of the crop.

Control Measures

i) Treat the seeds with imidacloprid 70 WS@ 5ml/kg; ii) Foliar spray of insecticide (dimethoate 30 EC @ 1.7ml/ha) on 30 days after sowing; iii) Rogue out the infected plants and Field sanitation; iv) Use resistant varieties like D-3-9, K 12, ML 26, RI 59, T-44.

iii) Anthracnose



Symptoms: The fungus Colletotrichum spp. is the causal organism affecting aerial plant parts, however, the leaves and pods are more vulnerable. The characteristic symptoms of this disease are circular brown sunken spots with dark centers and bright red orange margins on leaves and pods. Infection just after germination causes seedling blight.

Control Measures

i) Hot water seed treatment at 58^{o}C for 15 minutes has been found effective in checking the seed-borne infection and increasing proportion of seed germination; ii) Seed treatment with carbendazim 50 WP @ 2g/kg of seed helps in eliminating the seed borne infection; iii) Spray the crop with carbendazim @ 2g/ liter of water with first appearance of symptoms on the crop and repeat after 15 days (if necessary).

iv) Cercospora leaf spot

Symptoms: It is most important fungal disease of mungbean. Leaf spots are circular and irregular in shape with brown to greyish-white centres and reddish-brown to dark brown margins. Such spots are also visible or pods are the affected pods become blackened.

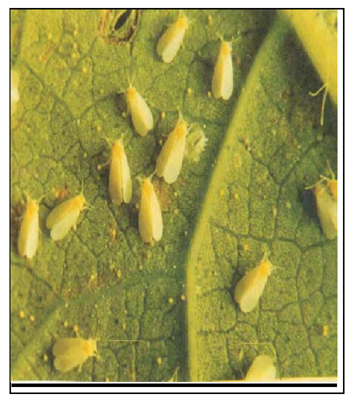
Control Measures

i) Field sanitation, crop rotation, destruction of infected crop debris; ii) Opt for resistant varieties as per recommendation of local agricultural authorities (Like- LM 113, LM 168, LM 170, JM 171, Ganga 1, HUM 12, Pusa 06722); iii) Treat the seeds with thiram or captan @ 2.5g/kg of seed; iv) On appearance of the symptoms spray with carbendazim 50 WP @1.0 g/liter or mancoze 75 WP @ 2.0 g/liter or hexaconazole (contaf 5 % EC) @ 1 ml/ liter of water.Subsequent spray should be done after 10 to 15 days, if required. Spraying with copper oxychloride @ 3 to 4 g /liter water has also been found effective in management of the disease.

B. INSECT-PEST

Numerous insect pests attack the mungbean. The loss in the production caused by them may reach up to 70% depending upon the severity of attack. Some common insect pests of mungbean and their management are as follow:

i) White fly



Nature of damage: The infested plants become very weak showing downward cupping of the leaves giving a sickly look and the plant may die Insect secretes honey dew on leaves results blackening of leaves, drastically reducing photosynthetic rate and drying of leaves. Whitefly is a vector of number of viral diseasesespecially mungbean yellow mosaic virus (MYMV).

Control Measures

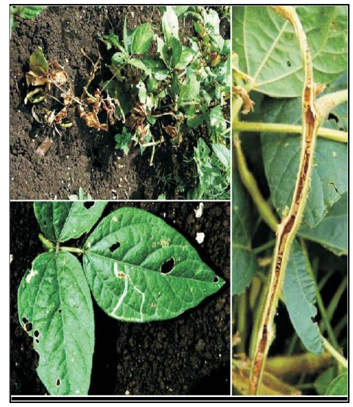
i)Seed treated with Dimethoate 30 EC @ 5ml/kg; ii) Foliar spray of Triazophos 40 EC @ 2.0 ml/l or Malathion 50 EC @ 2.0 ml/l at 10-15 days intervals if required; iii) Grow cotton as a trap crop one month earlier between the mungbean rows; iv) Grow maize, sorghum or pearl millet as a barrier crop to minimize the incidence of whiteflies; v) Install Sticky trap; vi) Opt. resistant varieties e.g. ML 1256, ML 1260 and ML 1191.

ii) Bean Thrips

Nature of damage: The thrips nymphs and adults feed on stigma inside the flower, flower sheds before opening and there is elongation of terminal shoot. Plants attain a bushy growth and the crop looks dark-green in colour, bearing few pods with shrivelled grains.

Control Measures

i) Seed treatment with Thiomethoxam 70 WS @ 2 ml /kg seed + foliar spray of Thiomethoxam 25 WG 0.2 g/liter of water of is quite effective in controlling bean thrips; ii) Spray neem seed kernel extract (50 g/l) and neem oil 3000 ppm @ 20 ml/l; iii) Opt for resistant varieties (Mungbean: PIMS 2, PMS 3, 12-333, Co 3, ML 5, ML 337; iv) Timely irrigation at an interval of 15 days results in low build up of thrips; v) The incidence of bean thrips can be minimized by intercropping mungbean with cotton; vi) Spray of Triazophos 40 EC @ 2.0 ml/liter , Ethion 50 EC @ 2 ml/liter of water.



iii) Stem fly

Nature of Damage: Stem fly (*Ophiomyia phaseoli*) maggots mine the leaves or bore into the leaf petiole or tender stem resulting in withering, drooping and death of plant. The characteristic symptoms of damage include drooping of the first two leaves and yellowing of plants. It can cause 5 ï 20% damage in mungbean.

Control Measures

i) Follow clean cultivation, crop rotation, earthing up, growing trap crop, destroying alternative hosts like *Solanum nigrum* to minimize the stem fly incidence; ii) Opt for resistant varieties (Mungbean: CoGG 912 & CoGG 917; Urdbean: CoBG 671 & AC 222); iii) Seed soaking either in imidacloprid 17.8 SL @ 5.0 ml/kg seed in 100 ml water for one hour or thiomethoxam 25 WG @ 5.0 g/kg seed in 100 ml water to avoid early incidence of stem fly is recommended; iv) Spray either Imidacloprid 17.8 SL @ 0.2ml/l or thiomethoxam 25 WG @ 0.3g/lit at 15 days after sowing.

iv) Bihar Hairy Caterpillar

Nature of damage: Female moths lay eggs on plants in a field.Young caterpillar eat away all the green matter of the leaves and it can be easily recognized by perforated, dustywhite coloured leaves in the field. The grown-up caterpillars feed voraciously on leaves, soft stems and branches. The insect totally denude the crop within few days resulting in total failure of the crop.

Control Measures

i) Uproot the damaged plants along with the young larvae at the gregarious phase and burry under the soil; ii) Spray of Quinalphos 25 EC @ 2.5 ml/liter or Dichlorvos 10 EC @ 1.0 ml/ liter or Fenvalerate 20 EC @ 1.87 ml/ liter of water or dusting with Fenvalerate 0.4% @ 15 kg/ha.

4.6 RECOMMENDATION TO ACHIEVED HIGHER PRODUCTION

- Deep summer ploughing once in 3 years.
- Seed treatment should be done before sowing.
- Application of fertilizer should be based on soil test value.
- In kharif season sowing should be done by ridge & furrow method.
- Yellow mosaic resistant/ tolerant varieties Narendra Mung1, Pant Mung 3, PDM 139 (Samrat), PDM 11, MUM 2, ML 337, IPM 02-14, MH 421, SML 832 etc choose as per suitability of region.
- Weed control should be done at right time.
- Adopt integrated approach for plant protection.

(TABLE–4.7):RECOMMENDED MUNGBEAN VARIETIES/CHARACTERISTICS

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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

(Cont…...)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
Pant Mung-4	GBPUAT	1997	Eas. 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., MS, 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, 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** (Eas. 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

(Cont…...)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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
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

(Cont…...)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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,BADNAPUR	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.

BLACK GRAM (URDBEAN)

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

5.1 ECONOMIC IMPORTANCE: Black gram is one of the important pulse crops grown throughout India. It is consumed in the form of ďdalô(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. It is consumed in variety of ways accross the*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.

5.2NUTRITIVE VALUE

Protein	24%	Calcium	154 mg/100 g
Fat	1.4-1.6%	Phosphorus	385 mg/100 g
Minerals	3.2%	Iron	9.1 mg/100 g
Dietary Fiber	16%	Calorific value	347 Kcal/100 g
Carbohydrate	59.69-63.0%	Moisture	10-11%

It is the richest source of phosphoric acid among pulses (5-6% richer than others)

AGRONOMIC SIGNIFICANCE

Short duration and photo insensitive varieties fit well in different cropping situations, especially intensive crop rotations, including intercropping. The crop is also used for green manuring afterpicking the pods with its characteristics to fix the atmospheric nitrogen. The plant with deep tap roots binds soil particles and helps in conservation of soil.

5.3 GROWTH RATE

From 1985-86 to 1990-91, the total Area, production and Productivity has almost slightly increased with (9%,32% & 21%) however, a good result in production and productivity was observed durimg 2010-11 for production and productivity with 42% and 29% growth rate. (Table 5.1).

(TABLE-5.1): GROWTH RATE OF URDBEAN

(A- Million ha, P- Million tones, Y-kg/ha, Growth Rate (GR)- %)

Year	Urdbean					
	Area	GR	Prod.	GR	Yield	GR
1980-81	2.83		0.96		339	
1985-86	3.19	12.6	1.24	29.2	389	14.7
1990-91	3.48	9.3	1.65	32.8	473	21.5
1995-96	2.80	-19.6	1.32	-19.7	472	-0.1
1996-97	3.01	7.4	1.35	2.0	448	-5.1
1997-98	3.06	1.9	1.38	2.2	450	0.3
1998-99	2.92	-4.8	1.35	-2.0	463	3.0
1999-00	2.94	0.8	1.33	-1.4	453	-2.2
2000-01	3.01	2.4	1.30	-2.6	431	-4.9
2001-02	3.30	9.7	1.50	15.6	454	5.4

(A- Million ha, P- Million tones, Y-kg/ha, Growth Rate (GR)- %)

Year	Urdbean					
	Area	GR	Prod.	GR	Yield	GR
2002-03	3.55	7.5	1.47	-1.7	415	-8.5
2003-04	3.42	-3.5	1.47	-0.2	430	3.5
2004-05	3.17	-7.4	1.33	-9.8	419	-2.6
2005-06	2.97	-6.3	1.25	-6.2	419	0.2
2006-07	3.07	3.3	1.44	15.9	470	12.2
2007-08	3.19	4.0	1.46	1.0	457	-2.9
2008-09	2.67	-16.3	1.17	-19.4	440	-3.7
2009-10	2.96	10.8	1.24	5.2	418	-5.1
2010-11	3.25	9.8	1.76	42.4	542	29.7
2011-12	3.22	-1.0	1.77	0.4	549	1.4
2012-13	3.15	-2.0	1.97	11.6	625	13.8
2013-14	3.06	-2.9	1.70	-13.8	555	-11.3
2014-15	3.25	6.0	1.96	15.3	604	8.8
2015-16	3.62	11.6	1.95	-0.7	537	-11.1
2016-17	4.49	24.0	2.93	50.4	651	21.3

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*

(TABLE- 5.2): PER CENT SHARE TO TOTAL PULSES

(Area- lakh ha, Production-Lakh Tones, Yield-kg/ha)

Year	Urd			Total Pulses			% share to Total Pulses		
	A	P	Y	A	P	Y	A	P	YI
1980-81	28.30	9.59	339	224.45	106.24	473	12.6	9.0	72
1990-91	34.83	16.46	473	372.55	203.68	547	9.3	8.1	86
1995-96	28.00	13.22	472	331.77	170.10	513	8.4	7.8	92
2000-01	30.11	12.96	431	203.48	110.75	544	14.8	11.7	79
2001-02	33.03	14.99	454	220.08	133.68	607	15.0	11.2	75
2002-03	35.50	14.74	415	204.96	111.25	543	17.3	13.2	76
2003-04	34.24	14.71	430	234.58	149.05	635	14.6	9.9	68
2004-05	31.69	13.27	419	227.63	131.30	577	13.9	10.1	73
2005-06	29.69	12.45	419	223.91	133.84	598	13.3	9.3	70
2006-07	30.67	14.43	470	231.92	141.98	612	13.2	10.2	77
2007-08	31.88	14.57	457	236.33	147.62	625	13.5	9.9	73
2008-09	26.70	11.75	440	220.94	145.66	659	12.1	8.1	67
2009-10	29.58	12.36	418	232.82	146.62	630	12.7	8.4	66
2010-11	32.48	17.60	542	264.02	182.41	691	12.3	9.6	78
2011-12	32.16	17.66	549	244.62	170.89	699	13.1	10.3	79
2012-13	31.53	19.71	625	232.57	183.42	789	13.6	10.7	79
2013-14	30.62	16.99	555	252.18	192.55	764	12.1	8.8	73
2014-15	32.46	19.59	604	235.53	171.52	728	13.8	11.4	83
2015-16	36.24	19.45	537	249.11	163.48	656	14.5	11.9	82
2016-17	44.93	29.26	651	292.77	224.01	765	15.3	13.1	85

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*

5.4 PRODUCTION TRENDS

5.4.1 NATIONAL SCENARIO: PLAN PERIODS

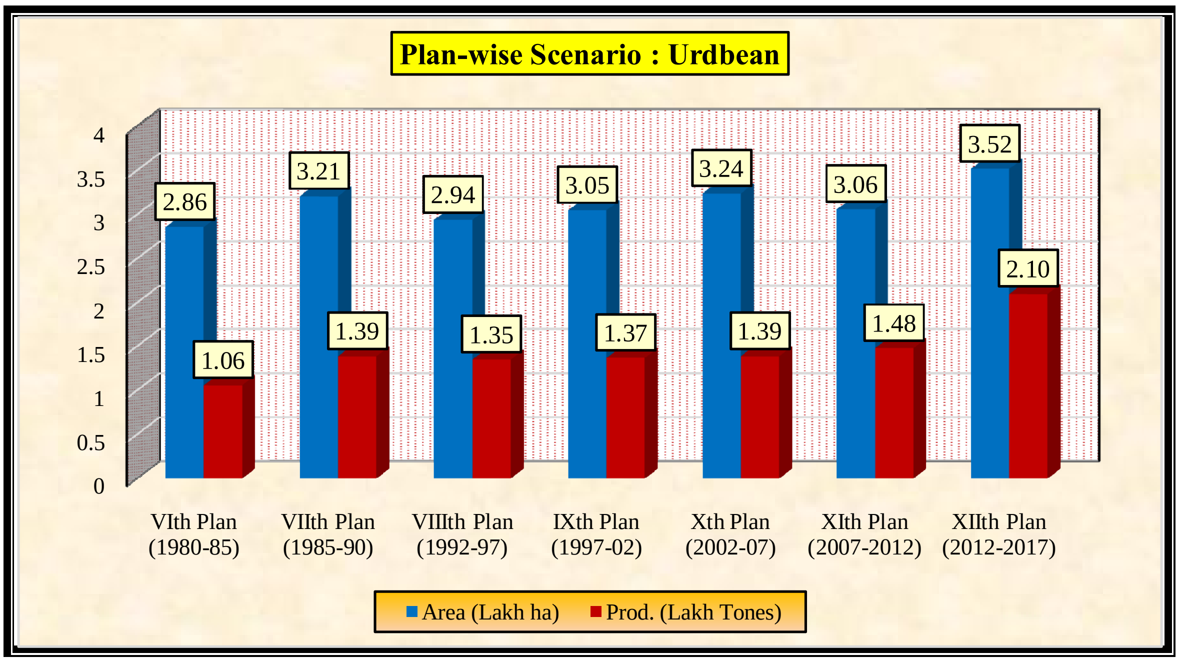
Plan-wise performance revelaed, the highest area and production increased during XIIth plan over the previous plan period. The details plan-wise performance is given below:

(TABLE–5.3): PLAN-WISE NATIONAL SCENARIO – URDBEAN

(Area-Mha, Production-MTonnes, Yield-kg/ha)

Plan	Area	%COPP	Prod.	% COPP	Productivity	%COPP
Sixth Plan (1980-85)	2.86		1.06		373	
Seventh Plan (1985-90)	3.21	12.26	1.39	30.80	434	16.51
Eighth Plan (1992-97)	2.94	-8.42	1.35	-3.09	459	5.82
Ninth Plan (1997-02)	3.05	3.76	1.37	1.60	450	-2.08
Tenth Plan (2002-07)	3.24	6.20	1.39	1.52	430	-4.40
Eleventh Plan (2007-2012)	3.06	-5.56	1.48	6.24	484	12.50
Twelfth Plan (2012-2017)	3.52	15.04	2.10	42.03	597	23.46

Source: *DES, Twelfth Plan (2012-2017)*& 2016-17 APY is the IVth Advance Estimate; % COPP is percentage change over previous plan.*



5.4.2 STATES' SCENARIO: PLAN ANALYSIS (Xth –XIIth)

***Tenth Plan (2002-2007)*:** The total area was 32.39 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 third in area fourth in production (15.95% and 12.77%) respectively. The highest yield was recorded by the state of Bihar (760 kg/ha) followed by Andhra Pradesh (579 kg/ha) and Jharkhand (548 kg/ha) with the overall National yield average of (431 kg/ha). The lowest yield was observed in the state of Karnataka (187 kg/ha) followed by Odisha (268 kg/ha) and C.G. (286 kg/ha).

***Eleventh Plan (2007-2012)*:** The total production was 14.81 lakh tonnes on an area of 30.58 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 (14.87%), whereas in production U.P. stands first (19.00%) followed by Andhra Pradesh (18.37%) and Maharashtra (15.35%). The highest yield was recorded by the state of Bihar (842 kg/ha) followed by Jharkhand (663 kg/ha) and Gujarat (650 kg/ha). The lowest yield was observed in the state of C.G. (294 kg/ha) followed by Odisha (298 kg/ha) and Karnataka (311 kg/ha).

***Twelfth Plan (2012-2017)*:** The total production was 21.00 lakh tonnes on an area of 35.15 lakh hectares. As regards the total contribution from states, Madhya Pradesh stand first in respect of area (24.11%) followed by U.P. (16.71%) and Andhra Pradesh (11.05%), whereas in production M.P. stands first (22.32%) followed by Andhra Pradesh (15.65%) and U.P (14.49%). The highest yield was recorded by the state of Bihar (898 kg/ha) followed by Jharkhand (875 kg/ha) and A.P (846 kg/ha) the National yield average was (597 kg/ha). The lowest yield was recorded in the state of C.G. (310 kg/ha) followed by Odisha (325 kg/ha) and Karnataka (416 kg/ha).

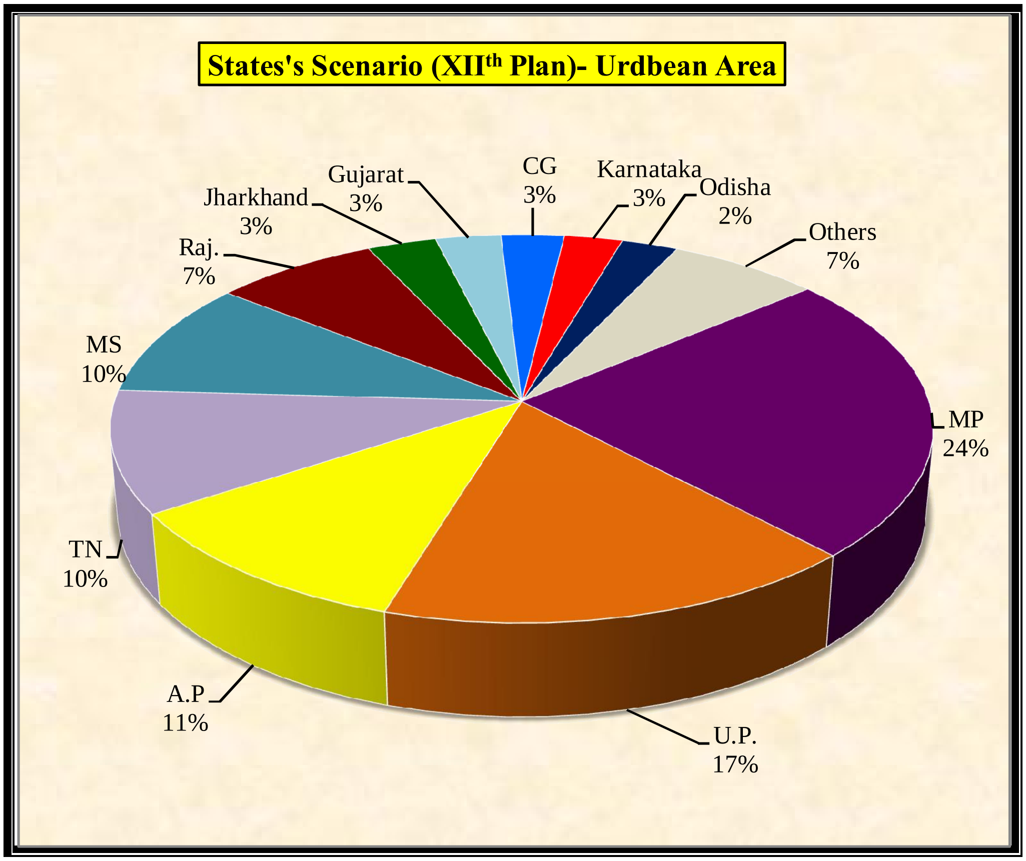
The overall trend during last three plan period was shown increasing trend in Production and Productivity front but, area is fluctuating in the same period.

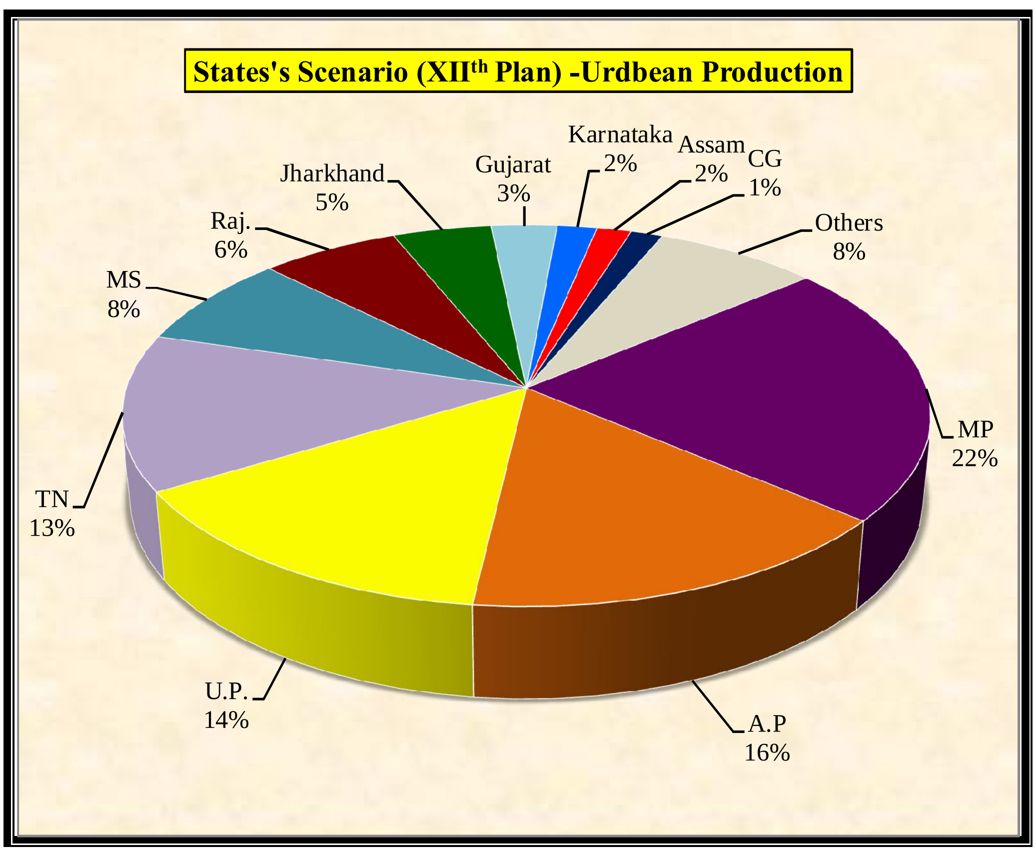
(TABLE–5.4):PLAN-WISE STATES' SCENARIO – MAJOR STATE'S

{Area- lakh ha, Production-Lakh Tones, Yield-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	3.89	11.05
	P	2.87	20.56	2.72	18.37	3.29	15.65
	Y	579		598		846	
Assam	A	0.38	1.17	0.43	1.39	0.54	1.52
	P	0.20	1.40	0.24	1.63	0.33	1.59
	Y	526		558		624	
Bihar	A	0.25	0.77	0.19	0.62	0.15	0.42
	P	0.19	1.34	0.16	1.08	0.13	0.63
	Y	760		842		898	
Chhattisgarh	A	1.19	3.66	1.09	3.57	1.00	2.85
	P	0.34	2.40	0.32	2.14	0.31	1.48
	Y	286		294		310	
Gujarat	A	1.02	3.16	1.00	3.28	1.03	2.94
	P	0.47	3.34	0.65	4.40	0.64	3.03
	Y	461		650		616	
Jharkhand	A	0.73	2.25	0.83	2.71	1.09	3.10
	P	0.40	2.84	0.55	3.70	0.95	4.54
	Y	548		663		875	
Karnataka	A	1.39	4.29	1.22	4.00	0.92	2.62
	P	0.26	1.83	0.38	2.55	0.38	1.83
	Y	187		311		416	
Madhya Pradesh	A	5.17	15.95	5.22	17.08	8.47	24.11
	P	1.78	12.77	1.85	12.50	4.69	22.32
	Y	344		354		553	
Maharashtra	A	5.56	17.15	4.26	13.93	3.40	9.68
	P	2.73	19.53	2.27	15.35	1.64	7.83
	Y	491		533		483	
Odisha	A	1.27	3.93	1.31	4.28	0.89	2.54
	P	0.34	2.40	0.39	2.60	0.29	1.38
	Y	268		298		325	
Rajasthan	A	1.78	5.50	1.56	5.11	2.61	7.42
	P	0.58	4.18	0.75	5.05	1.35	6.41
	Y	326		481		516	
Tamilnadu	A	2.18	6.73	2.88	9.43	3.58	10.19
	P	0.90	6.47	1.11	7.48	2.79	13.28
	Y	413		385		778	
U.P.	A	5.23	16.14	5.06	16.53	5.87	16.71
	P	2.16	15.46	2.81	19.00	3.04	14.49
	Y	413		555		518	
All India	**A**	**32.39**		**30.58**		**35.15**	
	P	**13.96**		**14.81**		**21.00**	
	Y	**431**		**484**		**597**	

**Twelfth plan is the Ave. of 2012-13 to 2016-17 & 2016-17 APY is the IIIrd Adv. Estimate.*


States's Scenario (XIIth Plan)- Urdbean Area
Gujarat 3%
CG 3%
Karnataka 3%
Odisha 2%
Jharkhand 3%
Others 7%
Raj. 7%
MS 10%
MP 24%
TN 10%
A.P 11%
U.P. 17%


States's Scenario (XIIth Plan) -Urdbean Production
Karnataka 2%
Assam 2%
CG 1%
Jharkhand 5%
Gujarat 3%
Others 8%
Raj. 6%
MS 8%
MP 22%
TN 13%
U.P. 14%
A.P 16%

5.4.3 DISTRICT SCENARIO (2012-13) – POTENTIAL DISTRICTS

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

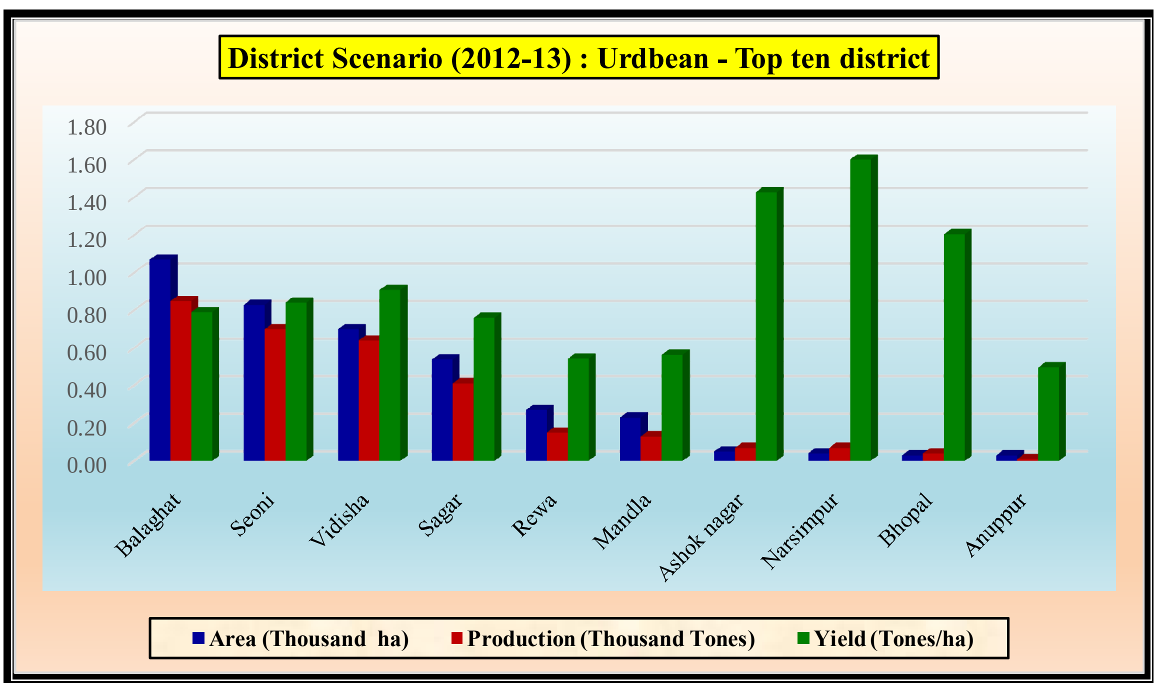
The yield of potential districts was observed in most of the district below the National average yield except first and second ranking districts.

(TABLE –5.5): TOP POTENTIAL DISTRICTS (2012-13) – URDBEAN

{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	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**	

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*



(TABLE–5.6):STATE-WISE YIELD GAP AND ADDITIONAL RETURN: URDBEAN

(Yield: Kg/ha; Return: Rs./ha.)

State	Yield (kg/ha)			Gap over FP		Gap over SAY		Yield 2016-17*	Additional return by bridging yield gap (Rs/ha)	
	IP	FP	SAY	Actual	%	Actual	%		FP	SAY
Kharif										
Assam	868	701	**0**	167	24	868	0	**-**	9018	46872
J&K	576	403	358	173	43	218	61	**-**	9342	11772
Tamil Nadu	907	724	781	183	25	126	16	713	9882	6804
Karnataka	795	672	386	123	18	409	106	494	6642	22086
M.P.	570	393	475	177	45	95	20	660	9558	5130
Maharashtra	668	535	506	133	25	162	32	562	7182	8748
UP	1060	700	536	360	51	524	98	539	19440	28296
West Bengal	1196	927	622	269	29	574	92	692	14526	30996
Manipur	613	466	0.00	147	32	613	-	-	7938	33102
Rajasthan	875	702	474	173	25	401	85	641	9342	21654
Average	**813**	**622**	**368**	**191**	**31**	**445**	**121**	**614**	**10287**	**24019**
Rabi										
AP	1437	1188	831	249	21	606	73	922	13446	32724
Tamil Nadu	969	784	716	185	24	253	35	654	10175	13915
Average	**1203**	**986**	**774**	**217**	**22**	**429**	**55**	**788**	12152	24024
Rabi & rice fallow										
Tamil Nadu	927	764	716	163	21	211	29	848	8802	11394
AP	1442	1240	831	202	16	611	74	728	11110	33605
Average	**1185**	**1002**	**774**	**183**	**18**	**411**	**53**	**788**	**10220**	**22988**

Source-*Annual Report- 2016-17, GoI, DPD, Bhopal (Ave. 2013-14 to 2015-16)*
*State Average Yield - E&S (Ave. 2011-12 to 2015-16) *Third Advance Estimates2016-17*
IP: Improved Practise FP: Farmers Practise SAY: State Avergae Yield

5.5 URDBEAN AGRONOMY

5.5.1 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 05 to 06 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 to 8 am. Self-fertilization is the general rule. 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.

Black gram is divided into two sub species namely i) *V. mungo var. niger*- matures early, having bold seeded with black colour; ii) *V. mungo var. viridis*- a group of longer maturity duration having small seeded size with green colour.

5.5.2 PRODUCTION TECHNOLOGY

- **Climate:** Itôs a crop of tropical region, 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 winter temperature are 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.
- **Soil and Field Preparation:**Black gram can be grown on variety of soils ranging from sandy soils to heavy cotton soils .The most ideal soil is a well drained loam with pH of 6.5 to 7.8. Black gram cannot be grown on alkaline and saline soils. 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.
- **Sowing Time**

  Kharif : In kharif season sowing is done with the onset of monsoon in later part of June or early part of July.

  Rabi : Second fortnight of October (upland) second fortnight of November (Rice fallow).

  Summer: The sowing could be done from the third week of February to first week of April. Sowing should be done in furrows opened at a distance of 20-25 cm. seed drill could be used for this purpose.
- **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 ôNô 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.

- **Seed Rate and Spacing**

  Kharif: During kharif season 12-15 kg seed/ha.The crop should be sown at a distance of 30-45 cm. 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 is used due to delayed in sowing.

  Summer: About 20-25 kg seed is required per ha.Plant to plant spacing should be kept at 5-8 cm depending upon sowing time and varietal behaviour.

- **Seed Treatment**

  Treat the seed with Thirum (2g) + Carbendazim (1g) or Carbendazim @2.5 g/kg seed to control the soil & seed germinated disease.For sucking pest control seet treatment with Imidacloprid 70 WS @ 7g/ kg seed. It is also desirable to treat the seed with Rhizobium & PSB culture (5-7 gm/kg seed).

- **Varieties:** The variety may be selectedas per the adaptability to the region, agro-eco sitiation, sowing time and the cropping system (Table ï 5.7).

- **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

- **Intercropping:**

  Kharif ï Urdbea + Pigeonpea (1:1)

  Spring ï Urdbean+ Sugarcane (2:1); Urdbean + Sunflower (2:6)

- **Water management:** In kharif season irrigation not required, if rainfall is normal & if moisture deficit at pod formation stage irrigation should apply. In summer 3-4 irrigation required according to crop requirement. 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.

- **Plant nutrient management**: For sole crop 15-20 kg/ha Nitrogen, 40-50 kg/ha Phosphorus, 30-40 kg/ha Potash, 20 kg/ha Sulphur is should be applied at the time of last ploughing. However phosphatic and potassic fertilizer should be applied as per soil test value. Fertilizer should be applied by drilling either at the time of sowing or just before sowing in such a way that they are placed about 5-7 cm below the seed. Use of gypsum @ 100 kg/ha would ensures availability of calcium and sulphur at economical rates.

- **Weed management:** 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. 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 Pendimethalin 0.75-1.00 kg a.i. per ha in 400-600 liters of water as pre-emergence application.

- **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.

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

5.5.3PLANT PROTECTION MEASURES

A. DISEASES

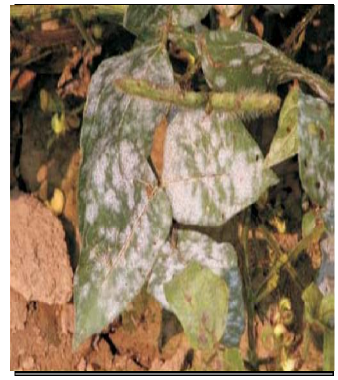
i)Yellow Mosaic Virus

Symptoms: This disease is caused by the mung bean yellow mosaic virus (MYMV) belonging to Gemini group of viruses, which is transmitted by the whitefly (Bemisia tabaci). The tender leaves show yellowmosaic spots, which increase with time leading to complete yellowing. Yellowing leads to less flowering andpod development. Early infection often leads to death of plants.

Control Measures

i) Diseased plants should be rogued out to prevent further spread of the disease; ii) In order to prevent whitefly (Bemisia spp.) infestation spray with triazophos 40 EC @ 2.0 ml/lit. or malathion 50 EC @ 2.0 ml/lit. or oxydemeton methyl 25 EC @ 2.0 ml/lit. at 10-15 days intervals if required; iii) Grow tolerant/resistant varieties like IPU 94-1 (Uttara), shekhar 3(KU 309), Ujala(OBJ 17), VBN(Bg) 7, Pratap urd 1 etc.

ii) Powdery Mildew



Symptoms: The disease appears on all the part of plants above soil surface. Disease initiates as faint dark spots, which develop into small white powdery spots, coalesceing to form white powdery coating on leaves, stems and pods. At the advance stages, the color of the powdery mass turns dirty white. The disease induces forced maturity of the infected plant causing heavy yield losses and its intensity increases in stress condition.

Control Measures

i) Adopt clean cultivation by destroying diseased plant refuge; ii) Delayed sowing of mungbean and urdbean with wider spacings considerably reduce the disease severity; iii) Opt for resistant varieties as per recommendation of local agricultural authorities Urdbean: COBG10, LBG 648, 17, Prabha, IPU 02-43, AKU 15 and UG 301); iv) Spray with NSKE @ 50 g/liter of water or neem oil 3000 ppm @ 20 ml/lit. Twice at 10 days interval from initial disease appearance. Spray with eucalyptus leaf extract 10% at initiation of the disease and 10 days later also if necessary; v) Spray with water soluble sulphur 80 WP @ 4 kg/liter or Carbendazin 50 WP @ 1 g/lit.

iii) Leaf Blight

Symptoms: In pre-emergence stage, the fungus causes seed rot and mortality of germinating seedlings. In post emergence stage, seedling blight disease appears due to soil or seed-borne infection. The fungus attacks the stem at ground level, forming localized dark brown patches which coalesce and encircle the stem. Black dot like sclerotia are formed on the surface and below the epidermis on the outer tissue of the stem and root. The pathogen is most favoured at a temperature of 30°C and 15% moisture.

Control Measures

i) Basal application of zinc sulphate @ 25kg/ha or neem cake @ 150 kg/ha or soil application P. fluorescens or T. viride @ 2.5 kg/ha + 50 kg of well decomposed FYM at the time of sowing helps in prevention of the disease; ii) The diseased plants should be uprooted and destroyed so that the sclerotia do not form or survive; iii) Spray with Carbendazim 50 WP @ 1 g/liter of water at an interval of 15 days with the appearance of the symptoms.

INSECT-PEST MANAGEMENT

i) Aphids

Nature of Damage: Nymphs and adults are seen in large numbers on young plants,leaflets, stem and pods. Young leaves of seedlings become twisted. Excretion of honey dew attracts sooty mold.The adults are black and shiny, upto 2 mm long and some are winged. Nymphs are covered with waxy coating that makes them grey and dull.

Control Measures

i) Spray with 5% crude neem extract or 2% neem oil 3000 ppm; ii) Spray with Dimethoate 30 EC (1.7 ml/ lit.) or Imidacloprid 17.8 SL @ 0.2 ml/liter of water; iii) Conserve coccinellid beetles, their grubs and Chrysoperla.

ii) Tobaco Caterpillar

Nature of damage: Newly hatched tobacco caterpillar (Spodoptera litura) feed gregariously on the leaf surface for about 2-3 days and leave behind the whitish membranous leaf only. The larvae makes irregular holes on the leaf surface and in severe infestation, they skeletonize the foliage. The maximum damage is caused to the young plants, which are often totally destroyed

Control Measures

i) Collection and destruction of egg masses and newly hatched larvae along with skeletonised leaves can reduce infestation; ii) Spray of microbial pesticides like SlNPV [500 LE/ha or or *Bacillus thurengenesis* formulations in synchrony with early larval instars is effective against the pest; iii) Spray Malathion 50 EC @ 2.0 ml/lit. or foliar application of Novaluron 10 EC @ 0.75 ml/lit., chitin synthesis inhibitor against eggs of S. litura.

iii) Spotted Pod Borer

Nature of Damage: The larva webs the leaves, inflorescence and feed inside the flowers, flower buds and pods. Eggs are laid on or in the flowers (inserted between the petals). Young larvae feed inside the flowers before moving to developing pods when mid-sized. A larva may consume 4-6 flowers before larval development is completed. Third to fifth instar larvae are capable of boring into the pods and feeding the developing grains. Seeds in damaged pods are totally or partially eaten out by larvae.

Control Measures

i) Spray Bacillus thuringiensis 5 WG @ 1.0 g/liter of water; ii) foliar spray of Profenophos 50 EC @ 2.0 ml/liter of water; iii) Spray of spinosad 45 SC @ 0.2 ml/liter of water is most effective in controlling this pest; iv) Physical shaking of the infested plants over the vessels of oil and water or oily cloth help reduce the population.

iv) Pod Bug

Nature of Damage: Pod bug (Claivgralla gibbosa) adults and nymphs damage leaves, flower buds, stem and pods by sucking cell sap. Major damage is done to the green pods before the maturity of the crop. The attacked pods show pale yellow patches. The grains in the pods become shrivelled and small in size resulting in considerable yield losses.

Control Measure

i) Physical shaking of the infested plants over the vessels of oil and water or oily cloth help reduce the population; ii) Spray Monocrotophos 36 SL @ 1.0 ml/liter water during flowering and at pod formation stage.

5.6 RECOMMENDATION TO ACHIEVED HIGHER PRODUCTION

- Deep summer ploughing once in 3 years.
- Seed treatment should be done before sowing.
- Application of fertilizer should be based on soil test value.
- In kharif season sowing should be done by ridge & furrow method.
- Yellow mosaic resistant/ tolerant varieties IPU 94-1 (Uttara), shekhar 3(KU 309), Ujala(OBJ 17), VBN(Bg) 7, Pratap urd 1 etc choose as per suitability of region.

(TABLE–5.7): RECOMMENDED URDBEAN VARIETIES/CHARACTERISTICS

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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**
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

(Cont…..)

Variety	**Source**	**Release/ Notification Year**	**Area of adoption (Zone/State)**	**Ave. yield (q/ha)**	**Days to maturity**	**Special characteristics**
Barkha (RBU-38)	RAU, Bansawar	1999	MP, Maharashtra & Central part of Rajasthan	12.0	75	**Bold seeded**,Res. to Cercospora leaf spot
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)	Resea.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

(Cont…..)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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, T.N.	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, 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, TN, 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.

LENTIL (MASUR)

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

6.1 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 ĎDalô 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.

6.2 NUTRITIVE VALUE

Protein	24-26%	Phosphorus	300 mg/100 g
Fat	1.3%	Iron	7mg/100 g
Dietary Fibre	11-12 %	Calcium	69 mg/100g
Carbohydrate	57 ï 60%	Calorific value	343-346 Kcal/100 g
Vitamin C	10-15 mg/100 g	Vitamin A	(450 IU) and Riboflavin

AGRONOMIC SIGNIFICANCE: The crops leaves a reasonable good amounts of atmospheric ĎNô in readily available form (upto 30-40 kg/ha) to the succeeding crop. Associated intercrop (other than legume) also gets benefited by ĎNô 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 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.

6.3 GROWTH RATE OF LENTIL

From 1985-86 to 1990-91, growth rate observed for APY during both years for APY. however, the maximum growth rate in producton and productivity was recorded with 34% & 23% during 1996-97 (Table 6.1).

(TABLE–6.1): GROWTH RATE OF LENTIL

(A- Million ha, P- Million tones, Y-kg/ha, Growth Rate (GR)- %)

Year	Lentil					
	Area	GR	Prod.	GR	Yield	GR
1980-81	0.93		0.47		498	
1985-86	1.09	16.7	0.66	42.4	607	22.1
1990-91	1.19	8.9	0.85	28.5	717	18.0
1995-96	1.26	5.7	0.71	-16.2	569	-20.7
1996-97	1.37	9.1	0.96	34.8	702	23.6
1997-98	1.29	-5.8	0.80	-16.4	623	-11.3
1998-99	1.39	7.7	0.94	16.7	675	8.3
1999-00	1.46	5.3	1.08	15.0	738	9.3
2000-01	1.48	1.1	0.92	-15.2	619	-16.1
2001-02	1.47	-0.8	0.97	6.5	664	7.3
2002-03	1.38	-6.1	0.87	-10.4	634	-4.6
2003-04	1.40	1.4	1.04	18.9	743	17.2
2004-05	1.47	5.5	0.99	-4.2	675	-9.2
2005-06	1.51	2.2	0.95	-4.8	628	-6.9
2006-07**	1.47	-2.4	0.91	-3.5	621	-1.1
2007-08	1.31	-11.2	0.81	-11.1	622	0.1
2008-09	1.38	5.4	0.95	17.5	693	11.5
2009-10	1.48	7.5	1.03	8.2	697	0.6
2010-11	1.60	7.9	0.94	-8.5	591	-15.2
2011-12	1.56	-2.2	1.06	12.2	678	14.7
2012-13	1.42	-8.9	1.13	7.1	797	17.6
2013-14	1.34	-5.8	1.02	-10.3	759	-4.8
2014-15	1.47	9.5	1.04	1.7	705	-7.1
2015-16	1.28	-13.1	0.98	-5.7	765	8.5

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*

(TABLE–6.2): PER CENT SHARE TO TOTAL PULSES

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

ear	Lentil			Total Pulses			% share to Total Pulses		
	A	P	Y	A	P	Y	A	P	YI
1980-81	9.35	4.65	498	224.45	106.24	473	4.17	4.38	105
1990-91	11.88	8.51	717	372.55	203.68	547	3.19	4.18	131
1995-96	12.55	7.14	569	331.77	170.10	513	3.78	4.20	111
2000-01	14.78	9.15	619	203.48	110.75	544	7.26	8.26	114
2001-02	14.66	9.74	664	220.08	133.68	607	6.66	7.29	109
2002-03	13.77	8.73	634	204.96	111.25	543	6.72	7.85	117
2003-04	13.96	10.38	743	234.58	149.05	635	5.95	6.96	117
2004-05	14.73	9.94	675	227.63	131.30	577	6.47	7.57	117

(Area- lakh ha, Production-Lakh Tones, Yield-kg/ha)

Year	Lentil			Total Pulses			% share to Total Pulses		
	A	P	Y	A	P	Y	A	P	YI
2005-06	15.06	9.46	628	223.91	133.84	598	6.73	7.07	105
2006-07	14.70	9.13	621	231.92	141.98	612	6.34	6.43	101
2007-08	13.06	8.12	622	236.33	147.62	625	5.52	5.50	100
2008-09	13.76	9.53	693	220.94	145.66	659	6.23	6.54	105
2009-10	14.80	10.32	697	232.82	146.62	630	6.36	7.04	111
2010-11	15.97	9.44	591	264.02	182.41	691	6.05	5.17	86
2011-12	15.62	10.59	678	244.62	170.89	699	6.39	6.20	97
2012-13	14.23	11.34	797	232.57	183.42	789	6.12	6.18	101
2013-14	13.41	10.17	759	252.18	192.55	764	5.32	5.28	99
2014-15	14.69	10.35	705	235.53	171.52	728	6.24	6.04	97
2015-16	12.76	9.76	765	249.11	163.48	656	5.12	5.97	117
2016-17				292.77	224.01	765			

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*

6.4 IMPORT &EXPORT

IMPORT: The import of pulses in India during April, 2014 to March, 2015 was 8.16 lakh tonnes worth Rs.3418.48 crores against the value of Rs.17196.87 crore for total foodgrains, Rs.121319.02 crore for total agricultural imports and against Rs.2737086.58 crore for total National Import. The import during April, 2015 to March, 2016 was 12.60 lakh tonnes worth Rs.6713.00 crore against the import value of Rs. 26841.87 crore for total foodgrains, Rs.140288.69 crore for total agricultural import and Rs.2490298.08 crore for total National import respectively during this period. The share of Lentil import to Agricultural import was 2.82% and 4.79% respectively during April, 2014 to March, 2015 and April, 2015 to March, 2016.

EXPORT: The pulses export of the country during April,2014 to March, 2015 was 0.080 lakh tonnes worth Rs.49.85 crore against the value of Rs. 59500.54 crore for total foodgrains, Rs.239681.04 crore for total agricultural exports and against Rs.1896445.47 crore for total National export.The export during April, 2015 to March, 2016 was 0.118 lakh tonnes worth Rs.83.05 crore against the export value of Rs. 42622.29 crore for total foodgrains, Rs.215395.68 crore for total agricultural export and Rs.1716378.05 crore for total National export respectively during this period. The share of Lentil export to Agricultural export was 0.021% and 0.0.039% respectively during April, 2014 to March, 2015 and April, 2015 to March, 2016.

(TABLE–6.3): IMPORTING &EXPORTINGCOUNTRIES

S. No.	IMPORT			EXPORT		
	Country	Aveg.*	% Share	Country	Aveg.*	% Share
1	Canada	675.60	81.97	Sri Lanka DSR	1.76	23.50
2	U S A	82.97	10.07	Bangladesh PR	0.98	13.08
3	Australia	46.26	5.61	Myanmar	0.93	12.37
4	Argentina	18.31	2.22	U Arab EMTS	0.62	8.27
5	Myanmar	0.26	0.03	U S A	0.39	5.20
6	Nepal	0.23	0.03	U K	0.39	5.14
7	Turkey	0.16	0.02	Pakistan IR	0.38	5.13

(Quantity-Thousand Tonnes)

S. No.	IMPORT			EXPORT		
	Country	Aveg.*	% Share	Country	Aveg.*	% Share
8	Sri Lanka DSR	0.10	0.01	Iraq	0.30	4.04
9	Mozambique	0.08	0.01	Nepal	0.25	3.28
10	Afghanistan TIS	0.07	0.01	Singapore	0.21	2.75
11	Korea RP	0.06	0.01	Malaysia	0.20	2.72
12	Vatican City	0.03	0.003	Australia	0.14	1.86
13	Uzbekistan	0.03	0.003	Turkey	0.10	1.34
14	Kenya	0.03	0.003	Egypt A RP	0.09	1.25
15	Tanzania Rep	0.01	0.002	Kuwait	0.09	1.25
16	Ukraine	0.01	0.001	Bhutan	0.08	1.07
17	Unspecified	0.01	0.001	Saudi Arab	0.07	0.97
18	Pakistan IR	0.005	0.001	Jordan	0.07	0.97
19	Madagascar	0.004	0.001	Netherland	0.07	0.92
20				Others	0.37	4.91
	Total	**824.23**		**Total**	**7.50**	

Source: *Ministry of Commerce and Industry; Aveg.*- 2012-13 to 2016-17.*

6.5 PRODUCTION TRENDS

6.5.1 GLOBAL SCENARIO

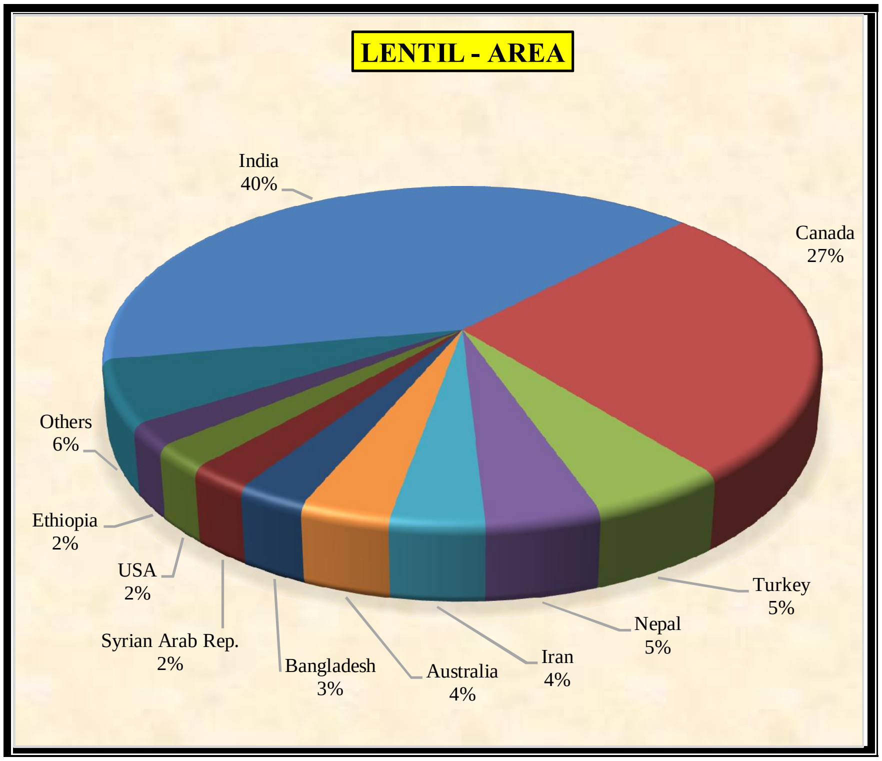
India ranked first in the area (18.00 lakh ha) and second in the production (11.00 lakh tonnes) with 39% and 22% of world area and production respectively. The highest productivity is recorded in Croatia (2862 kg/ha) followed by New Zealand (2469 kg/ha). Canada rank first in production (41%) due to very high level of productivity (1633 kg/ha) as compared to India (611 kg/ha).

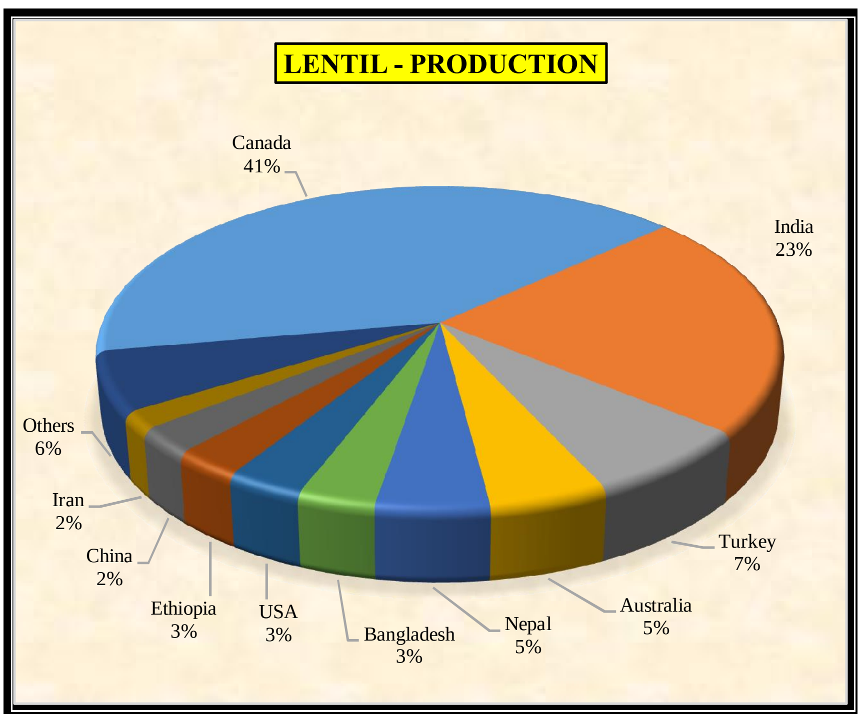
(TABLE–6.4): GLOBAL RANKING : MAJOR COUNTRIES

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

Country	Area	% Cont.	Country	Prod.	% Cont.	Country	Yield
India	18.00	39.79	Canada	19.87	41.16	Croatia	2862
Canada	12.17	26.90	India	11.00	22.79	New Zealand	2469
Turkey	2.43	5.38	Turkey	3.45	7.15	Armenia	2263
Nepal	2.06	4.55	Australia	2.38	4.93	China	2083
Iran	1.68	3.71	Nepal	2.27	4.70	Egypt	2056
Australia	1.62	3.59	Bangladesh	1.57	3.25	Canada	1633
Bangladesh	1.25	2.75	USA	1.56	3.24	Iraq	1566
Syrian Arab Republic	1.11	2.46	Ethiopia	1.37	2.85	USA	1491
USA	1.05	2.32	China	1.25	2.59	Australia	1466
Ethiopia	0.99	2.19	Iran	0.85	1.76	Lebanon	1456
World	**45.24**		**World**	**48.27**		**World**	**1067**
						India	**611**

Source: *FAO 2014*


LENTIL - AREA
India
40%
Canada
27%
Others
6%
Ethiopia
2%
USA
2%
Syrian Arab Rep.
2%
Bangladesh
3%
Australia
4%
Iran
4%
Nepal
5%
Turkey
5%


LENTIL - PRODUCTION
Canada
41%
India
23%
Others
6%
Iran
2%
China
2%
Ethiopia
3%
USA
3%
Bangladesh
3%
Nepal
5%
Australia
5%
Turkey
7%

6.5.2 NATIONAL SCENARIO: PLAN PERIODS

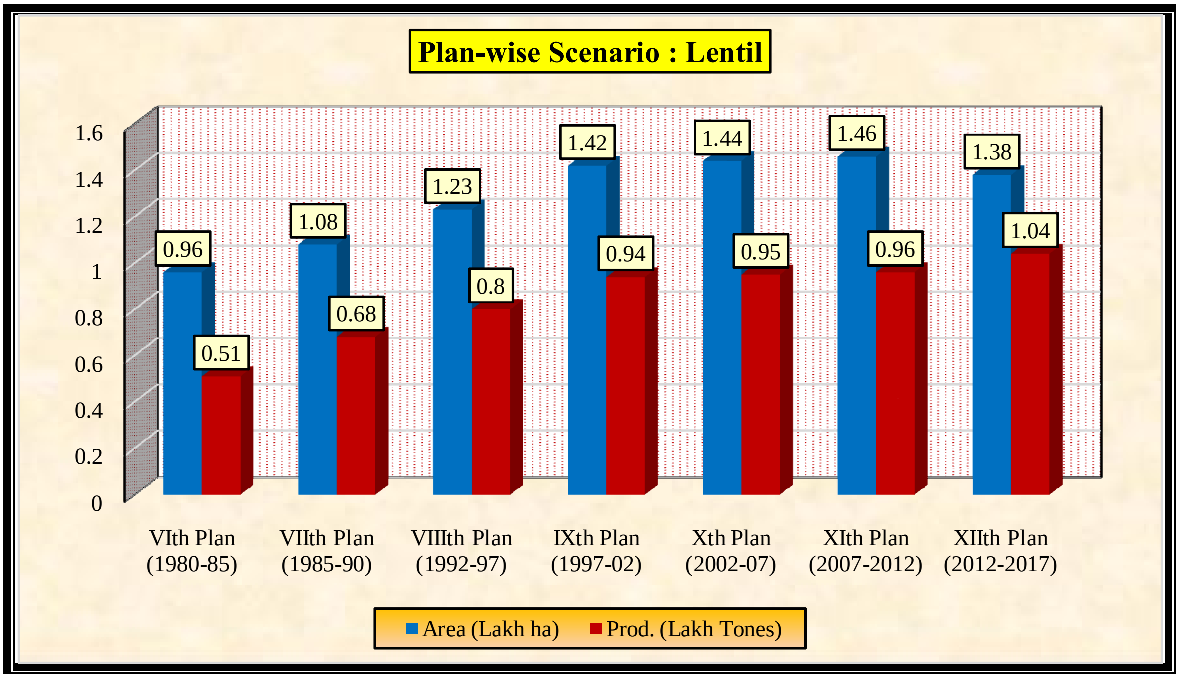
Plan-wise performance revelaed, the highest area during IXth Plan. However, production & Productivity increased during VIIth plan over the previous plan period. The details plan-wise performance is given below :

(TABLE–6.5): PLAN-WISE NATIONAL SCENARIO

(Area-Mha, Production-MTonnes, Yield-kg/ha)

Plan	Area	%COPP	Prod.	% COPP	Productivity	%COPP
Sixth Plan (1980-85)	0.96		0.51		527	
Seventh Plan (1985-90)	1.08	12.69	0.68	35.20	632	19.97
Eighth Plan (1992-97)	1.23	13.98	0.80	16.83	648	2.50
Ninth Plan (1997-02)	1.42	14.85	0.94	17.81	665	2.58
Tenth Plan (2002-07)	1.44	1.95	0.95	1.16	660	-0.78
Eleventh Plan (2007-2012)	1.46	1.37	0.96	0.72	655	-0.64
#Twelfth Plan (2012-2017)	1.38	-5.94	1.04	8.42	756	15.27

Source: *DES, Twelfth Plan (2012-2017)*& 2016-17 APY is the IVth Advance Estimate; % COPP ispercentage change over previous plan.*



6.5.3 STATES' SCENARIO: PLAN ANALYSIS (X^{th} –XII^{th})

***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 (1000 kg/ha) followed by Haryana (833 kg/ha) and Bihar (785 kg/ha). The National yield average was (660 kg/ha). The lowest yield was recorded in the state of C.G. (294 kg/ha) followed by Maharashtra (429 kg/ha) and M.P. (480 kg/ha).

***Eleventh Plan (2007-2012)*:** The countryós 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 (893 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. (313 kg/ha) followed by M.P. (424 kg/ha) and Maharashtra (429 kg/ha).

***Twelfth Plan (2012-17)*:** The countryós area under Lentil was 13.77 lakh hectares with a production of 10.41 lakh tonnes. Madhya Pradesh is on first ranked with respect to acerage 41.04% (5.65 lakh ha) followed by UP 31.17 % and Bihar 12.00% respectively. While in terms of production MP is on first ranked 35.54% (3.70 lakh tonnes) followed by Uttar Pradesh (29.39%) and Bihar (17.14%).The highest yield was recorded by the state of Bihar (1080 kg/ha) followed by W.B. (969 kg/ha) and Rajasthan (909 kg/ha). The National yield average was (756 kg/ha). The lowest yield was observed in the state of Maharashtra (379 kg/ha) followed by C.G. (389 kg/ha) and M.P. (655 kg/ha).

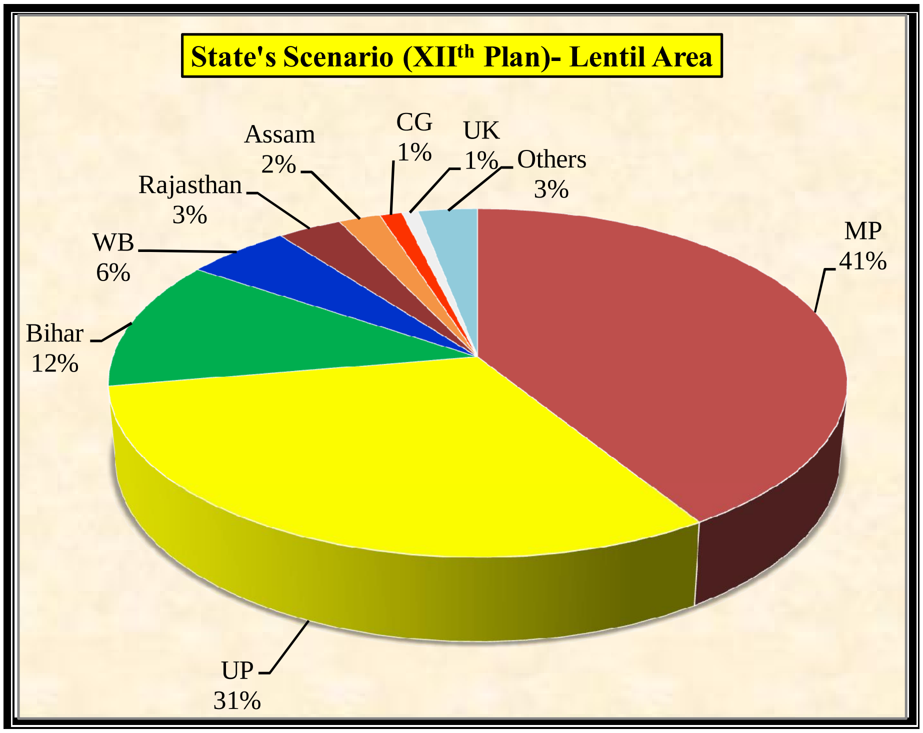
The overall trend of area, production and yield during the last three plan period shows increasing trend in production and productivity however, area decline during XII plan period is a major concern.

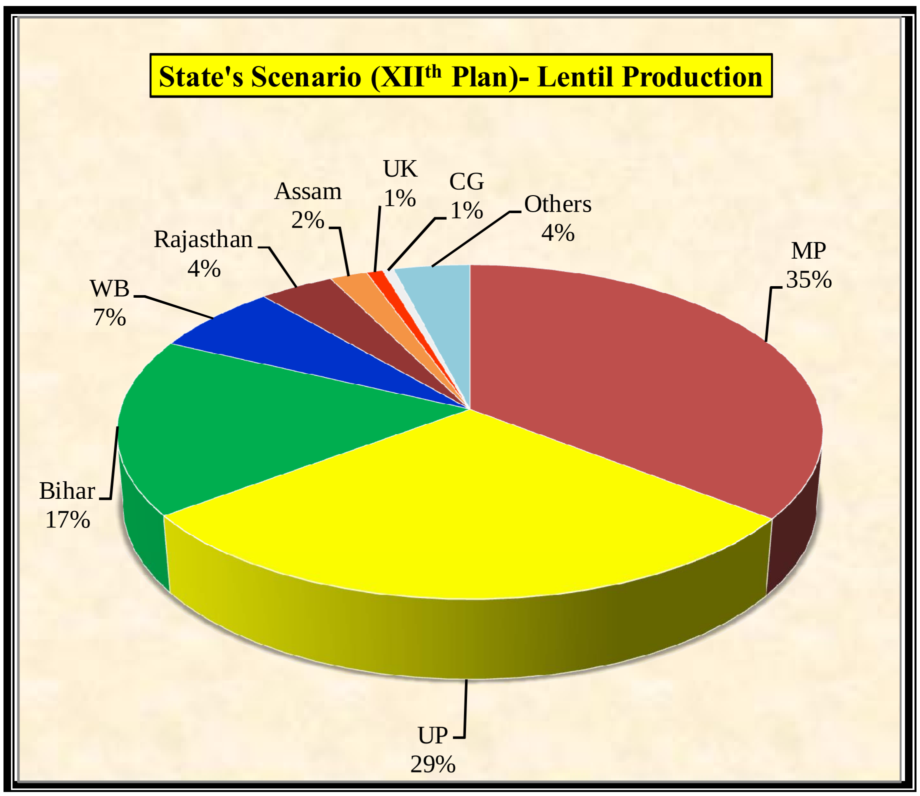
(TABLE–6.6): PLAN-WISE STATES' SCENARIO – MAJOR STATES

{Area- lakh ha, Production-Lakh Tones, Yield-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	2.11
	P	0.11	1.15	0.11	1.15	0.20	1.96
	Y	550		500		701	
Bihar	A	1.72	11.91	1.81	12.36	1.65	12.00
	P	1.35	14.17	1.59	16.56	1.78	17.14
	Y	785		878		1080	
Chhattisgarh	A	0.17	1.18	0.16	1.09	0.16	1.13
	P	0.05	0.52	0.05	0.52	0.06	0.58
	Y	294		313		389	
Haryana	A	0.06	0.42	0.04	0.27	0.04	0.31
	P	0.05	0.52	0.03	0.31	0.04	0.38
	Y	833		750		952	
Madhya Pradesh	A	5.06	35.04	5.5	37.57	5.65	41.04
	P	2.43	25.50	2.33	24.27	3.70	35.54
	Y	480		424		655	
Maharashtra	A	0.07	0.48	0.07	0.48	0.03	0.24
	P	0.03	0.31	0.03	0.31	0.01	0.12
	Y	429		429		379	
Punjab	A	0.03	0.21	0.01	0.07	0.01	0.06
	P	0.02	0.21	0.01	0.1	0.01	0.05
	Y	667		1000		640	
Rajasthan	A	0.19	1.32	0.28	1.91	0.45	3.25
	P	0.19	1.99	0.25	2.60	0.41	3.91
	Y	1000		893		909	
Uttar Pradesh	A	5.96	41.27	5.56	37.98	4.29	31.17
	P	4.65	48.79	4.44	46.25	3.06	29.39
	Y	780		799		713	
Uttarakhand	A	0.16	1.11	0.15	1.02	0.11	0.83
	P	0.08	0.84	0.09	0.94	0.09	0.86
	Y	500		600		782	
West Bengal	A	0.65	4.5	0.55	3.76	0.73	5.28
	P	0.45	4.72	0.44	4.58	0.70	6.77
	Y	692		800		969	
All India	**A**	**14.44**		**14.64**		**13.77**	
	P	**9.53**		**9.60**		**10.41**	
	Y	**660**		**656**		**756**	

**Twelfth plan is the Ave. of 2012-13 to 2016-17 & 2016-17 APY is the IIIrd Adv. Estimates.*


State's Scenario (XIIth Plan)- Lentil Area
Assam 2%
CG 1%
UK 1%
Others 3%
Rajasthan 3%
WB 6%
Bihar 12%
MP 41%
UP 31%


State's Scenario (XIIth Plan)- Lentil Production
UK 1%
CG 1%
Assam 2%
Others 4%
Rajasthan 4%
WB 7%
MP 35%
Bihar 17%
UP 29%

6.5.4 DISTRICT SCENARIO (2013-14) – POTENTIAL DISTRICTS

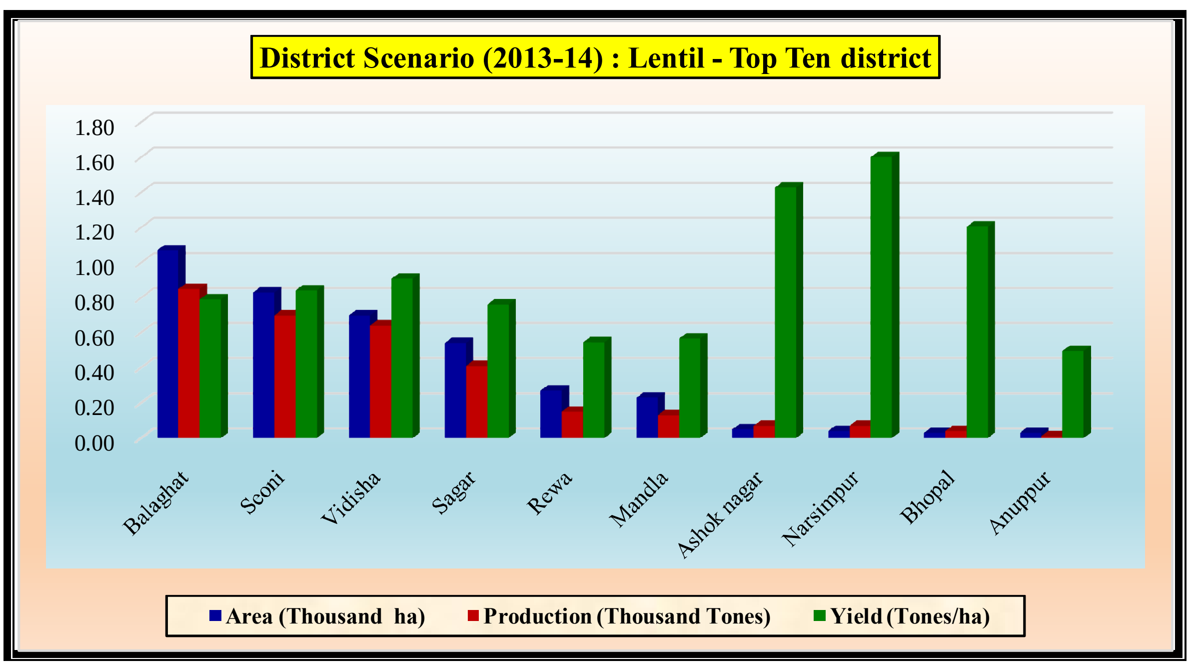
Analysis of the intra-state status of Lentil crop, is presented in table 6.7. Inter district analysis revealed that district Bahraich of U.P. with 3.46% of production has the highest share followed by Sagar. (2.38%), Vidisha (2.23%) and Panna (2.46%) of M.P. District-wise area, production and yield of 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–6.7): 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**	

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*



(TABLE–6.8): STATE-WISE YIELD GAP AND ADDITIONAL RETURN

(Yield: Kg/ha; Return: Rs./ha.)

State	Yield (kg/ha)			Gap over FP		Gap over SPY		Yield 2016-17*	Additional return by bridging yield gap (Rs/ha)	
	IP	FP	SAY	Actual	%	Actual	%		FP	SAY
Assam	1013	770	668	243	32	345	52	693	9720	13800
HP	642	396	567	246	62	75	13	263	9840	3000
Jharkhand	670	520	911	150	29	-241	-26	768	6000	-9640
Bihar	1805	1295	1068	510	39	737	69	932	20400	29480
Chhattisgarh	644	465	378	179	38	266	70	331	7160	10640
M.P.	918	721	594	197	27	324	55	719	7880	12960
Rajasthan	1788	1443	942	345	24	846	90	859	13800	33840
UP	1369	1112	755	257	23	614	81	710	10280	24560
Tripura	933	712	690	221	31	243	35	-	8840	9720
West Bengal	1899	1254	922	645	51	977	106	985	25800	39080
Average	**1289**	**966**	**777**	**323**	**33**	**512**	**66**	**756**	**12920**	**20480**

Source-*Annual Report- 2016-17, GoI, DPD, Bhopal (Ave. 2013-14 to 2015-16)*
*State Average Yield - E&S (Ave. 2011-12 to 2015-16) *Third Advance Estimates2016-17*
IP: Improved Practise FP: Farmers Practise SAY: State Avergae Yield.

6.6 LENTIL AGRONOMY

6.6.1 BOTANICAL DESCRIPTION: Lentil 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.

Based on the seed size and test weight, it is classified into two main groups–

i) **Bold seeded:**Includes sub sp. *macro-sperma*, with the test weight of > 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, <25 g, locally known as *masuri* and primarily grown in Indo Gangtic plains of NEPZ (UP, Bihar, West Bengal and Assam).

6.6.2 PRODUCTION TECHNOLOGY

- **Climate:**Lentil requires cold climate. It is very hardy and can tolerate frost and severe winter to a great extent. It require cold temperature during its vegetative growth and warm temperature at the time of maturity. The optimum temperature for growth is 18-30^{0}C. Unlike Bengalgram, it can thrive well under stress conditions of frost and winter rains, even at flowering and fruiting stage.
- **Soil and Fieldpreparation:**Well drained, loam soils with neutral reaction are best for lentil cultivation. Acidic soils are not fit for growing lentil. The soil should be friable and weed free so that seeding could be done at uniform depth. On heavy soils, one deep ploughing followed by two to three cross harrowing should be done. After harrowing, the field should be levelled by giving a gentle slope to ease irrigation. Like gram, it also require good aeration for nodule development, achieved by one deep ploughing followed by one cross harrowing.

- **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** ï First week of December in rice fallows of NEPZ or on fields vacated very late by kharif crops under irrigated condition.

- **Seed rate & Spacing:** *For small seeded*: 40-45 kg/ha; *Bold seeded*: 45-60 kg/ha; *Late sown condition*: 50-60 kg/ha; *Utera cropping:* 60-80 kg/ha seed is recommended. Sowing should be done in rows 30 cm. apart and it should be sown at a lower depth (3-4 cm). This could be done either by using a Ferti-seed-drill or by seeding behind desi plough.

- **Seed treatment:** *Fungicide:* Thirum (2 gm) + Carbendazim (1gm) or Thirum @ 3 gm or Carbendazim @2.5 g per Kg. of seed; *Insecticide:* Chlorpyriphos 20E.C. @8 ml./Kg. of seed; *Culture:* Rhizobium + PSB, one packet each for 10 kg seed**..**

- **Varieties**:Based on the region, time of sowing and purpose of cultivation, recommendations etc, selection of variety from Table 6.9. However situation specific varieties for Rice-lentil cropping system ar i) *Utera cultivation* - PL-406, PL-639, Arun and, ii) *Late sowings* ï PL-406, PL-639, IPL-15, Narendra Masoor-1.

- **Cropping systems**

  Sequential cropping: 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		

- **Intercropping:**Most common inter cropping systems are:

  i. Lentil + Sugarcane (Autumn) with two rows of lentil at 30 cm row spacing in between two rows of sugarcane.

  ii. Lentil + Linseed (2:2)

  iii. Lentil + Mustard (2:6)

- **Water Management**: Most critical stage for moisture stress is pod formation followed by flower initiation. First irrigation should be given at 40-45 days of planting and second at pod filling stage. 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. More irrigation may affect the crop performance adversely.

- **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 óKô 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 óPô 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 óSô (20-40 kg/ha) giving an average nutrient use efficiency of 10-15 kggrain/kg S especially in light textured sandy loam soils of Northern India. SSP is the best source of ôPô followed by Gypsum and ôPyriteö.

- 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). ôMoô and ôFeô are the integral components of enzyme ónitrogenousô for ôNô fixation. Mo deficiency may create twin deficiency of ôNô and ôMoö. ôBoronô and ôMoô 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 ôKCLô 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 óvermicompostô or 5 t FYM to the ôkharifô crop in rotation and seed inoculation with efficient strain of Rhizobia takes care about initial nitrogen requirement and no need to apply ôNô as booster (required especially in low fertile and paddy soils).
- Dual inoculation with ôRhizobiumô and ôPSBô takes care of ôNô as well as reduces 25-30% of phosphorus requirement by making available the initial fixed soil ôPô 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.

- **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.

6.6.3 PLANT PROTECTION MEASURE

A. DISEASE

i) Seedling Mortality

Symptoms: It is caused by fungi. It appears within a month of sowing when the seedlings start drying up. The drying is mainly two types. (Seedling wilt)- Seedling first turn yellow and dry up. Collar rot- The seedling collapse while still green and then dry out.

Control Measures

i) It can be reduced by delay planting until mid-November; ii) Treat the seed with systemic fungicide Carbendazim @ 2.5 g/kg of seed; iii) Plant resistant varieties like Pant L-406 etc.

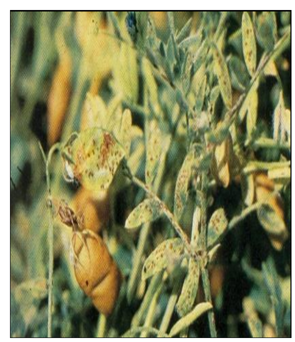
ii) Wilt

Symptoms: This is serious disease of lentil in which the growth of the plant is checked, the leaves start yellowing, plant start drying and finally die. The roots of affected plants remain under developed and look light brown in colour.

Control Measures

i) Keep the field clean and follow a three year crop rotation. This will help in reducing the disease incidence; ii) Use tolerant and resistant varieties like Pant Lentil 5, IPL-316, RVL-31, Shekhar Masoor 2, Shekhar Masoor 3 etc; iii) Seed treatment.

iii) Rust



Symptoms: The disease symptoms start as yellowish pustules on the leaflets and pods. Later; light brown pustules appear on both the surfaces of the leaves and other aerial parts of the plant. The pustules finally become dark brown. The plants give dark brown or blackish appearance visible as patches in the field.

Control Measures

i) After harvest, the affected plant trash should be burnt; ii) In NEPZ, normal and early sowing reduces intensity of rust disease; iii) Grow resistant/tolerant varieties like DPL-15, Narendra Lentil-1, IPL 406, Haryana masur 1, Pant L-6, Pant L-7, LL-931, IPL 316 etc.; iv) Spray the crop with Mancozeb 75 WP@ 0.2 % (2g/liter). 1-2 spray at 50 days after sowing are good for controlling rust.

iv) Stemphylium Blight

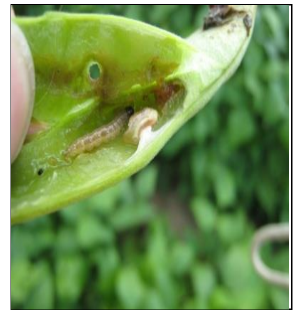
Symptoms: The disease causes angular tan leaf lesions; when it is humid (early mornings or after rainfall events), diseased leaves may appear gray due to sporulation by the causal pathogen. Diseased leaves often fall from plants, leaving plants defoliated except for the youngest leaves at the top of the plant. Red lentils are generally more susceptible to the disease than green lentils.

Control Measures

i) After harvest, the affected plant trash should be burnt; ii) Spray the crop with Mancozeb 75 WP@ 0.2 % (2 g/liter). Two spray may be given at 15 days interval; ii) Grow resistant varieties like Pant L-639, DPL-15, Narendra Lentil-1 etc.

B. INSECT-PEST

i) Pod borer



Nature of damage: The caterpillar defoliates the tender leaves and also bores the green pods and feeds upon the ripening grains. It damages almost all the pods in case of severe damage, but causes nearly 25-30% annual yield losses in India.

Control Measures

v) Sprayneem seed extract(5%) @ 50 ml/ liter of water; ii) Spray of Profenphos 50 EC @ 2 ml/ liter or Emammectin benzoate 5 SG @ 0.2 g/liter of water.

vi) Aphids

Nature of Damage: Aphids suck the sap and in case of severe damage the growth is suppressed.

Control Measures

i) Spray of Dimethoate 30 EC @ 1.7 ml/liter or Imidaclopid 17.8 SL @ 0.2 ml / liter of water.

- **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.

- **Yield**:10-15 q/ha .

6.7 RECOMMENDATION TO ACHIEVED HIGHER PRODUCTION

- Deep summer ploughing once in 3 years.
- Seed treatment should be done before sowing.
- Application of fertilizer should be based on soil test value.
- Wilt resistant/ tolerant ï RVL-31, IPL81 (Noori), IPL -316, Sekhar masoor-2, Sekhar masoor-2. Rust resistant/tolerantï IPL-406, WBL-77, Pant L-6, Pant L-7, Sekhar masoor-2, Sekhar masoor-2, IPL-316.
- Adopt integrated approach for plant protection.
- Weed control should be done at right time.

(TABLE–6.9): RECOMMENDED VARIETIES/CHARACTERISTICS

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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**

(Cont……)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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

(Cont……)

Variety	**Source**	**Release/ Notification Year**	**Area of adoption (Zone/State)**	**Ave. yield (q/ha)**	**Days to maturity**	**Special characteristics**
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.

FIELDPEAS (MATAR)

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

7.1 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 chickpea 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.

7.2 NUTRITIVE VALUE

Protein	22-25%	Calcium	64 mg/100g
Fat	0.8- 1%	Iron	4.8 mg/100g
Dietary Fiber-	13.4%	Moisture	11%
Carbohydrate	62.1%		

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

7.3 GROWTH RATE

Maximum growth for acerage reported during1995-96 (38%) and 2013-14 (25%) and also increasing trend for producton and productivity was recorded during 1990-91 with (40% and 27%).

(TABLE–7.1): GROWTH RATE OF FIELDPEA

(A- Million ha, P- Million tones, Y-kg/ha, Growth Rate (GR)- %)

Year	Fieldpea					
	Area	GR	Prod.	GR	Yield	GR
1980-81	0.42		0.29		688	
1985-86	0.50	18.6	0.43	47.4	855	24.3
1990-91	0.55	10.3	0.60	40.9	1092	27.7
1995-96	0.76	38.0	0.64	5.7	836	-23.4
1996-97	0.74	-3.8	0.72	13.0	982	17.5
1997-98	0.75	1.4	0.61	-15.6	818	-16.8
1998-99	0.84	12.4	0.71	15.8	842	3.0
1999-00	0.80	-5.0	0.82	15.6	1025	21.8
2000-01	0.66	-17.2	0.54	-33.7	821	-19.9
2001-02	0.68	2.3	0.61	12.5	903	9.9
2002-03	0.67	-0.5	0.60	-1.3	896	-0.8
2003-04	0.71	6.2	0.73	20.9	1019	13.8
2004-05	0.80	11.7	0.79	8.9	993	-2.6
2005-06	0.78	-1.8	0.72	-9.0	920	-7.3

(A- Million ha, P- Million tones, Y-kg/ha, Growth Rate (GR)- %)

Year	Fieldpea					
	Area	GR	Prod.	GR	Yield	GR
2006-07**	0.76	-3.0	0.62	-14.3	814	-11.6
2007-08	0.63	-16.9	0.48	-21.6	768	-5.6
2008-09	0.72	13.9	0.66	35.9	916	19.3
2009-10	0.76	6.4	0.67	2.5	883	-3.7
2010-11	0.73	-4.9	0.59	-12.1	816	-7.6
2011-12	0.76	4.3	0.71	19.5	935	14.6
2012-13	0.77	0.8	0.84	18.6	1099	17.6
2013-14	0.96	25.9	0.92	10.0	960	-12.6
2014-15	0.98	1.5	0.89	-3.6	912	-5.0
2015-16	0.90	-7.6	0.74	-16.8	821	-10.0

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*

(TABLE–7.2): PER CENT SHARE TO TOTAL PULSES

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

Year	Peas			Total Pulses			% share to Total Pulses		
	A	P	Y	A	P	Y	A	P	YI
1980-81	4.23	2.91	688	224.45	106.24	473	0.04	2.74	145
1990-91	5.54	6.05	1092	372.55	203.68	547	0.06	2.97	200
1995-96	7.70	6.43	835	331.77	170.10	513	0.08	3.78	163
2000-01	6.60	5.42	821	203.48	110.75	544	0.07	4.89	151
2001-02	6.73	6.07	903	220.08	133.68	607	0.07	4.54	149
2002-03	6.72	6.01	895	204.96	111.25	543	0.07	5.40	165
2003-04	7.13	7.27	1019	234.58	149.05	635	0.07	4.88	160
2004-05	7.99	7.92	992	227.63	131.30	577	0.08	6.04	172
2005-06	7.83	7.20	920	223.91	133.84	598	0.08	5.38	154
2006-07	7.60	6.18	813	231.92	141.98	612	0.08	4.35	133
2007-08	6.30	4.84	768	236.33	147.62	625	0.06	3.28	123
2008-09	7.19	6.59	916	220.94	145.66	659	0.07	4.52	139
2009-10	7.61	6.75	888	232.82	146.62	630	0.08	4.60	141
2010-11	7.27	5.93	816	264.02	182.41	691	0.07	3.25	118
2011-12	7.56	7.06	933	244.62	170.89	699	0.08	4.13	134
2012-13	7.67	8.43	1099	232.57	183.42	789	0.08	4.60	139
2013-14	9.63	9.25	960	252.18	192.55	764	0.10	4.80	126
2014-15	9.75	8.89	912	235.53	171.52	728	0.10	5.18	125
2015-16	9.03	7.42	821	249.11	163.48	656	0.09	4.54	125
2016-17				292.77	224.01	765			

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*

7.4 IMPORT/EXPORT

IMPORT: The import of pulses in India during April, 2014 to March, 2015 was 19.52 lakh tonnes worth Rs.4970.16 crores against the value of Rs.17196.87 crore for total foodgrains, Rs.121319.02 crore for total agricultural imports and against Rs.2737086.58 crore for total National Import. The import during April, 2015 to March, 2016 was 22.45 lakh tonnes worth Rs.5466.94 crore against the import value of Rs. 26841.87 crore for total foodgrains, Rs.140288.69 crore for total agricultural import and Rs.2490298.08 crore for total National import respectively during this period. The share of Fieldpea import to Agricultural import was 4.10% and 3.90% respectively during April, 2014 to March, 2015 and April, 2015 to March, 2016.

{Dry Peas contributes the single largest share in India's import basket of pulses registering in the total pulses import}.

EXPORT: The pulses export of the country during April, 2014 to March, 2015 was 0.039 lakh tonnes worth Rs.13.63 crore against the value of Rs. 59500.54 crore for total foodgrains, Rs.239681.04 crore for total agricultural exports and against Rs.1896445.47 crore for total National export.The export during April, 2015 to March, 2016 was 0.064 lakh tonnes worth Rs.24.32 crore against the export value of Rs. 42622.29 crore for total foodgrains, Rs.215395.68 crore for total agricultural export and Rs.1716378.05 crore for total National export respectively during this period. The share of Fieldpea export to Agricultural export was 0.006% and 0.011% respectively during April, 2014 to March, 2015 and April, 2015 to March, 2016.

(TABLE-7.3): IMPORTING &EXPORTING COUNTRIES

(Quantity-Thousand Tonnes)

S. No.	IMPORT			EXPORT		
	Country	**Aveg.***	**% Share**	**Country**	**Aveg.***	**% Share**
1	Canada	1256.96	62.40	Sri Lanka DSR	3.13	80.55
2	Russia	219.60	10.90	Myanmar	0.21	5.39
3	U S A	158.37	7.86	Nepal	0.20	5.21
4	France	95.41	4.74	Pakistan IR	0.10	2.66
5	Australia	89.57	4.45	Ukraine	0.06	1.42
6	Lithuania	75.47	3.75	Bangladesh PR	0.05	1.32
7	Ukraine	73.20	3.63	Argentina	0.04	1.13
8	Estonia	12.51	0.62	Bhutan	0.03	0.84
9	Argentina	10.23	0.51	U S A	0.03	0.65
10	Romania	8.86	0.44	Maldives	0.02	0.52
11	Germany	4.61	0.23	Kuwait	0.003	0.07
12	Bulgaria	3.24	0.16	South Africa	0.002	0.06
13	Myanmar	1.71	0.08	U Arab EMTS	0.001	0.03
14	Moldova	1.32	0.07	Denmark	0.001	0.03
15	Turkey	0.80	0.04	Singapore	0.001	0.02
16	Others	2.37	0.12	Australia	0.001	0.02
17				U K	0.001	0.01
18				Cambodia	0.0004	0.01
19				Malaysia	0.0003	0.01
20				Others	0.001	0.04
	Total	**2014.26**		**Total**	**3.88**	

***Source**: Ministry of Commerce and Industry; Aveg.*- 2012-13 to 2016-17*

7.5 PRODUCTION TRENDS

7.5.1 GLOBAL SCENARIO: FIELDPEA

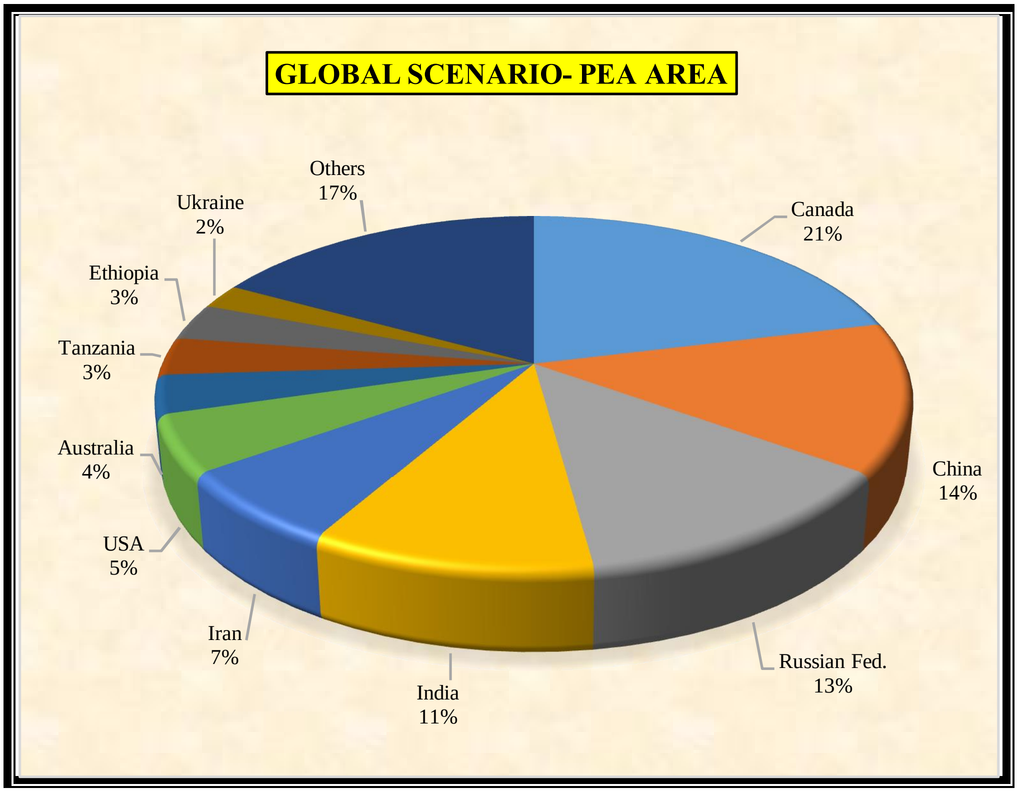
Canada rank first in area (21%) and production (35%) at Global level. China stands second position in area (13.70%) followed by Russian Fed. (12.94 %) respectively. India occupy forth position in area (10.53 %) and 5th position in production (5.36 %). Highest productivity is recorded in Ireland (5000 kg/ha) followed by Netherland (4766 kg/ha), and Denmark (4048 kg/ha). While, Indiaôs productivity is only 822 kg/ha.

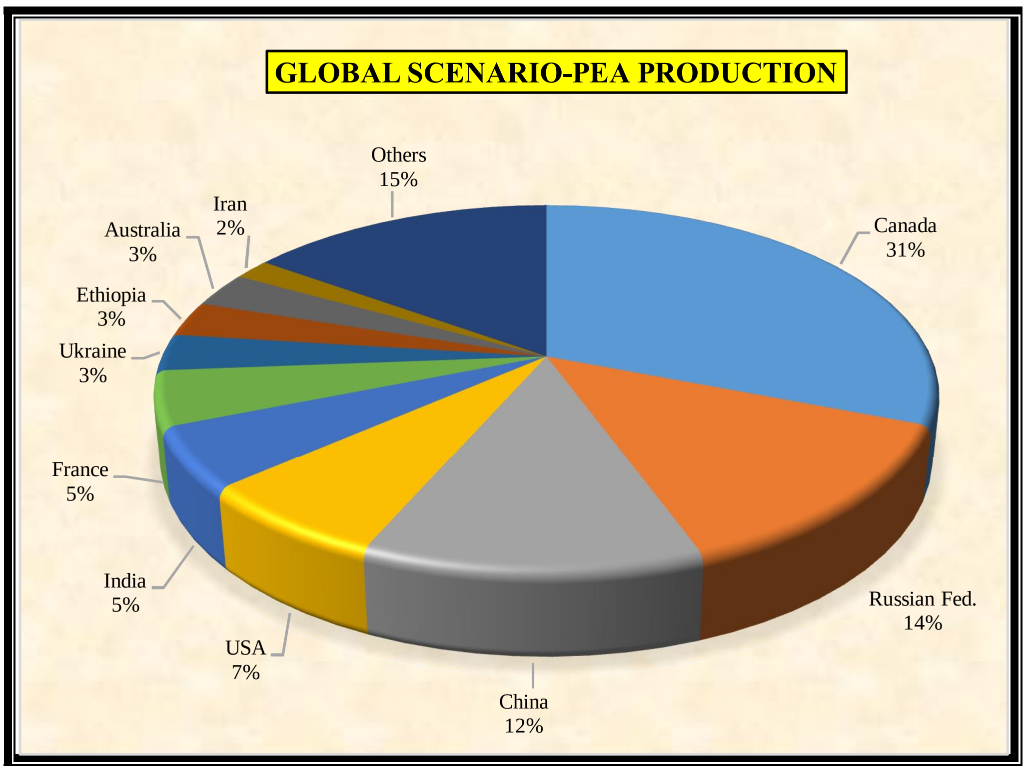
(TABLE–7.4): GLOBAL RANKING : MAJOR COUNTRIES

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

Country	Area	%Cont.	Country	Prod.	%Cont.	Country	Yield
Canada	14.67	21.16	Canada	34.45	30.80	Ireland	5000
China	9.50	13.70	Russian Fed.	15.03	13.44	Netherlands	4766
Russian Fed.	8.97	12.94	China	13.50	12.07	Denmark	4048
India	7.30	10.53	USA	7.78	6.96	U.Kingdom	4000
Iran	4.75	6.85	India	6.00	5.36	Belgium	3873
USA	3.64	5.25	France	5.39	4.81	Switzerland	3744
Australia	2.45	3.53	Ukraine	3.59	3.21	Germany	3724
Tanzania	2.39	3.45	Ethiopia	3.43	3.06	France	3710
Ethiopia	2.31	3.33	Australia	3.42	3.06	Sweden	3218
Ukraine	1.54	2.21	Iran	2.00	1.79	Armenia	3167
World	**69.32**		**World**	**111.86**		**World**	**1614**
						India	**822**

***Source:** FAO 2014*


GLOBAL SCENARIO- PEA AREA
Others 17%
Ukraine 2%
Canada 21%
Ethiopia 3%
Tanzania 3%
Australia 4%
China 14%
USA 5%
Iran 7%
Russian Fed. 13%
India 11%


GLOBAL SCENARIO-PEA PRODUCTION
Others 15%
Iran 2%
Australia 3%
Canada 31%
Ethiopia 3%
Ukraine 3%
France 5%
India 5%
Russian Fed. 14%
USA 7%
China 12%

7.5.2 NATIONAL SCENARIO: PLAN PERIODS

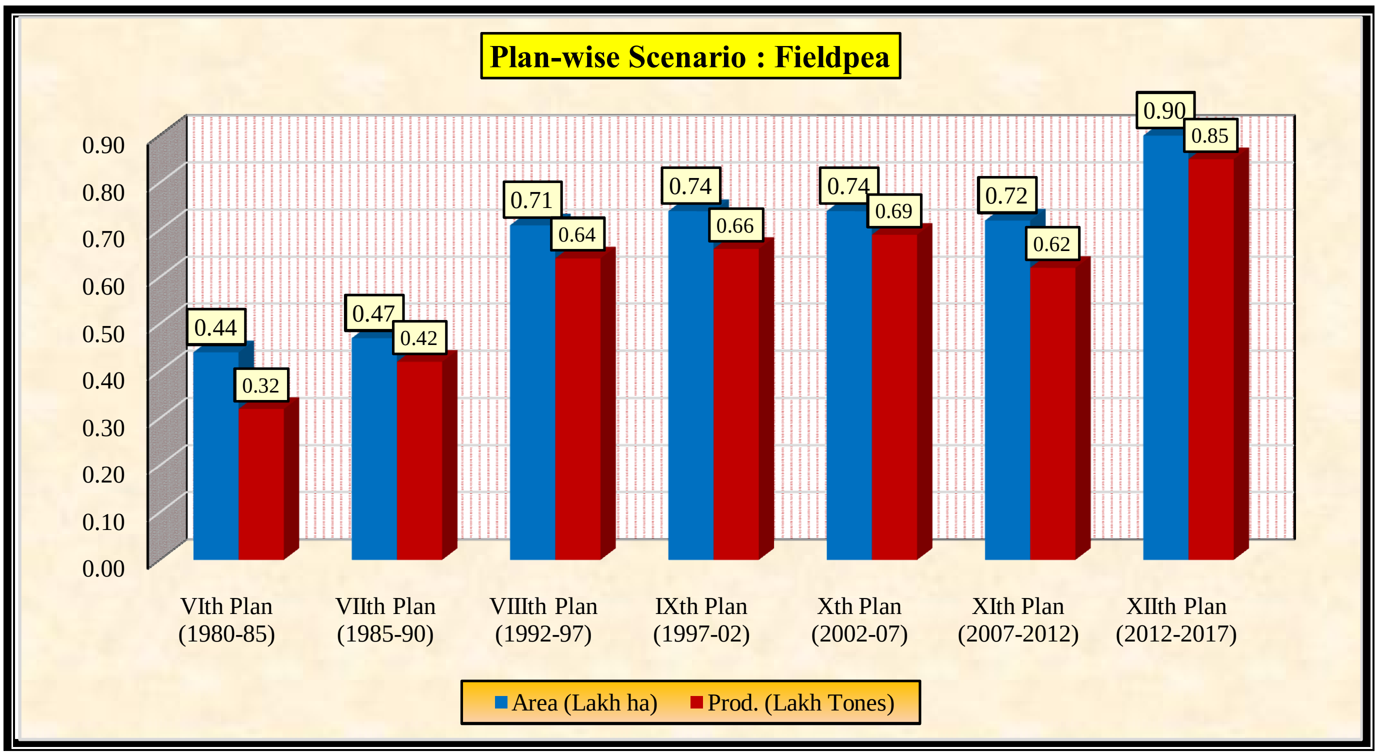
Plan-wise performance revelaed, the highest area & production increased during VIII[th] plan followed by XII[th] Plan over the previous plan period. The details plan-wise performance is given below :

(TABLE–7.5): PLAN-WISE NATIONAL SCENARIO

(Area-Mha, Production-MTonnes, Yield-kg/ha)

Plan	Area	%COPP	Prod.	% COPP	Productivity	%COPP
Sixth Plan (1980-85)	0.44		0.32		740	
Seventh Plan (1985-90)	0.47	7.73	0.42	27.95	879	18.76
Eighth Plan (1992-97)	0.71	50.56	0.64	54.90	905	2.88
Ninth Plan (1997-02)	0.74	4.46	0.66	2.06	884	-2.30
Tenth Plan (2002-07)	0.74	0.22	0.69	5.30	929	5.06
Eleventh Plan (2007-2012)	0.72	-3.36	0.62	-9.80	867	-6.67
#Twelfth Plan (2012-2017)	0.90	25.34	0.85	36.19	942	8.66

Source: *DES, Twelfth Plan (2012-2017)*& 2016-17 APY is the IV[th] Advance Estimate; % COPP is percentage change over previous plan.*



7.5.3 STATES' SCENARIO: PLAN ANALYSIS (Xth –XIIth)

Tenth Plan (2002-2007):The area and production during the plan were 7.45 lakh ha and 6.92 lakh tonnes respectively. The state of Uttar Pradesh ranked first in area and production (53.75% 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. Rajasthan has recorded highest yield (2190 kg/ha) followed by Haryana (1214 kg/ha) and UP (1197 kg/ha) which is greater than the National productivity (929 kg/ha). Lowest yield was observed in Chhattisgarh (352 kg/ha) followed by Maharashtra (395 kg/ha) and M.P. (463 kg/ha).

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 % & 5.04%). Rajasthan ranked first in yield (1327 kg/ha) followed by U.P. (1205 kg/ha) and Punjab (1192 kg/ha).The lowest yield was observed in C.G. (352 kg/ha) followed by Maharashtra (371 kg/ha) and Madhya Pradesh (412 kg/ha).

Twelfth Plan (2012-2017): A total area of 9.01 lakh hectares and a total production of 8.49 lakh tonnes were recorded. Uttar Pradesh ranked first both in area and production (37.90% and 41.58%) followed by Madhya Pradesh (38.67% and 32.98%) and Jharkhand (3.80 % and 4.85%). In case of productivity Rajasthan ranked first with (1867 kg/ha) followed by Punjab (1297 kg/ha) and Jharkhand (1203 kg/ha). The lowest yield was observed in Maharashtra (390 kg/ha) followed by C.G. (437 kg/ha) and Assam (817 kg/ha).

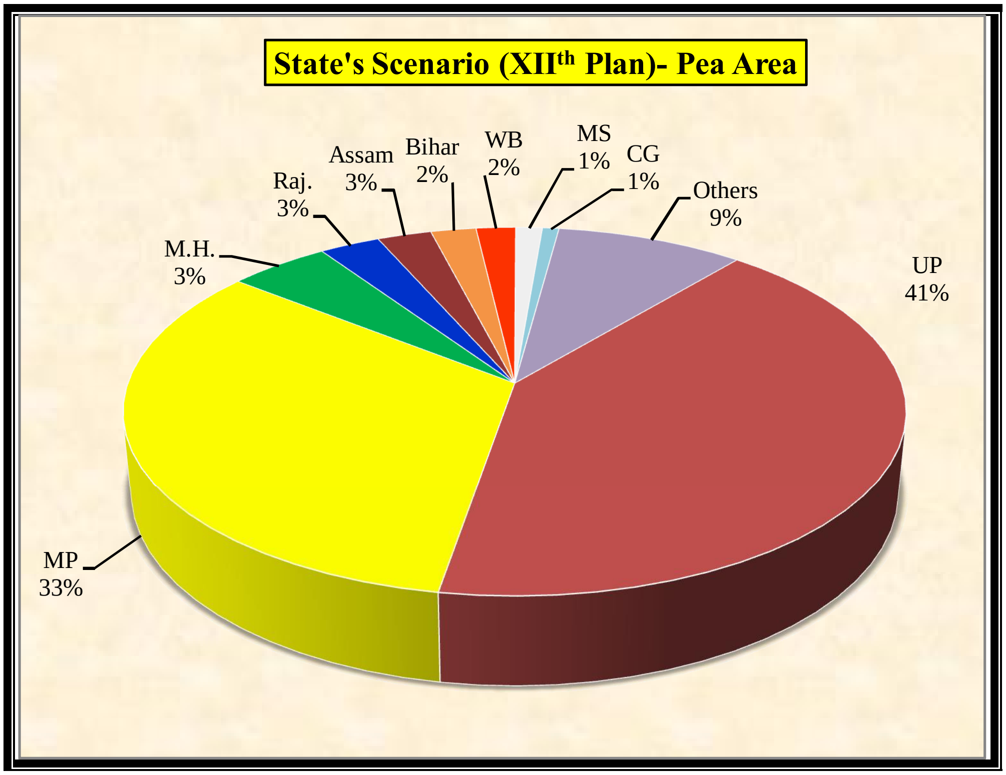
The area, production and yield significantly increased during XIIth plan from previous plan.

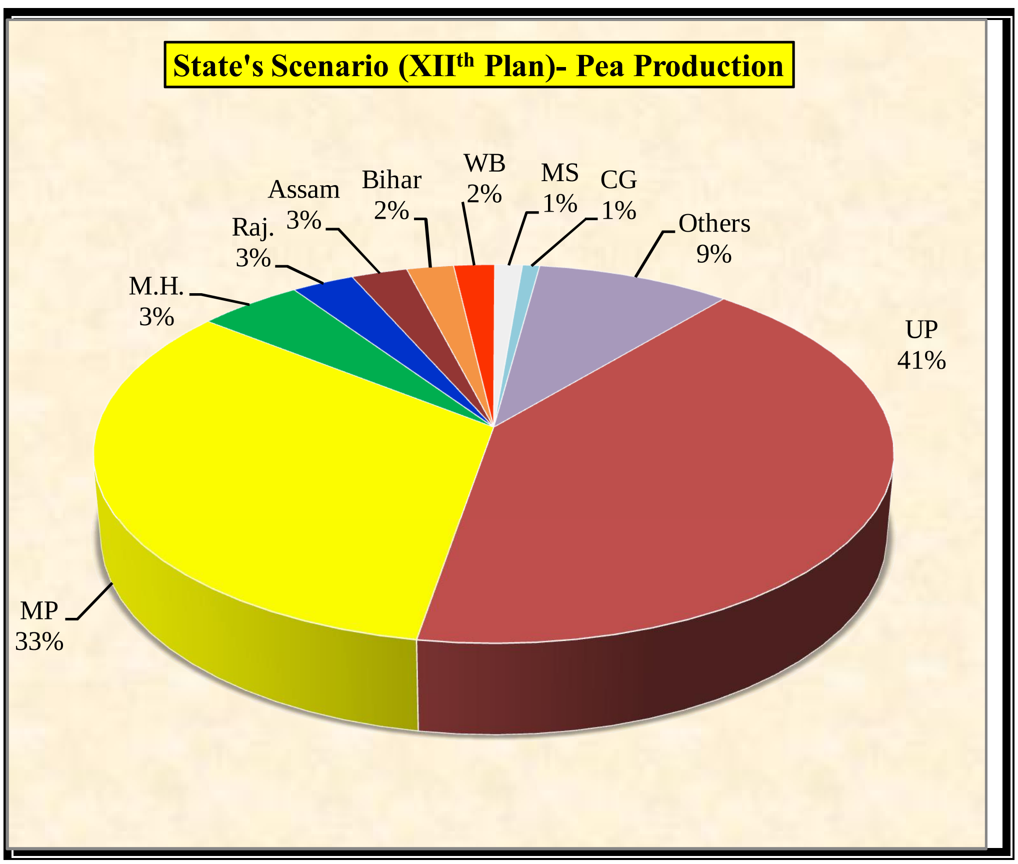
(TABLE–7.6): PLAN-WISE STATES' SCENARIO - MAJOR STATE'S

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

State		Xth Plan	% to AI	XIth Plan	% to AI	XIIth Plan	% to AI
Assam	A	0.22	2.91	0.22	3.03	0.27	2.99
	P	0.13	1.93	0.13	2.14	0.22	2.59
	Y	616		615		817	
Bihar	A	0.24	3.16	0.22	3.00	0.19	2.08
	P	0.21	3.08	0.22	3.47	0.18	2.17
	Y	906		1005		984	
Chhattisgarh	A	0.16	2.17	0.16	2.20	0.15	1.71
	P	0.06	0.82	0.06	0.89	0.07	0.79
	Y	352		352		437	
Haryana	A	0.01	0.19	0.01	0.18	0.01	0.08
	P	0.02	0.24	0.02	0.23	0.01	0.09
	Y	1214		1154		1071	
Jharkhand	A	0.08	1.07	0.31	4.28	0.34	3.80
	P	0.07	0.96	0.31	5.04	0.41	4.85
	Y	838		1019		1203	
Madhya Pradesh	A	2.08	27.93	2.34	32.46	3.48	38.67
	P	0.96	13.92	0.96	15.41	2.80	32.98
	Y	463		412		804	
Maharashtra	A	0.17	2.24	0.22	3.06	0.28	3.09
	P	0.07	0.96	0.08	1.32	0.11	1.28
	Y	395		371		390	
Punjab	A	0.04	0.51	0.03	0.37	0.02	0.25
	P	0.04	0.61	0.03	0.50	0.03	0.35
	Y	1105		1192		1297	
Rajasthan	A	0.12	1.62	0.05	0.68	0.13	1.47
	P	0.27	3.84	0.07	1.04	0.25	2.90
	Y	2190		1327		1867	
Uttar Pradesh	A	4.00	53.75	3.22	44.72	3.42	37.90
	P	4.79	69.25	3.88	62.19	3.53	41.58
	Y	1197		1205		1034	
Uttrakhand	A	0.04	0.56	0.06	0.84	0.06	0.69
	P	0.04	0.57	0.03	0.47	0.06	0.71
	Y	952		500		962	
West Bengal	A	0.13	1.75	0.10	1.44	0.14	1.50
	P	0.11	1.60	0.10	1.58	0.16	1.89
	Y	840		952		1183	
All India	**A**	**7.45**		**7.20**		**9.01**	
	P	**6.92**		**6.24**		**8.49**	
	Y	**929**		**867**		**942**	

*****Twelfth plan is the Ave. of 2012-13 to 2016-17 & 2016-17 APY is the IIIrd Adv. Estimates.*


State's Scenario (XIIth Plan)- Pea Area
Assam 3%
Bihar 2%
WB 2%
MS 1%
CG 1%
Raj. 3%
Others 9%
M.H. 3%
UP 41%
MP 33%


State's Scenario (XIIth Plan)- Pea Production
WB 2%
Bihar 2%
MS 1%
CG 1%
Assam 3%
Raj. 3%
Others 9%
M.H. 3%
UP 41%
MP 33%

7.5.4 DISTRICT SCENARIO (2012-13) – POTENTIAL DISTRICTS

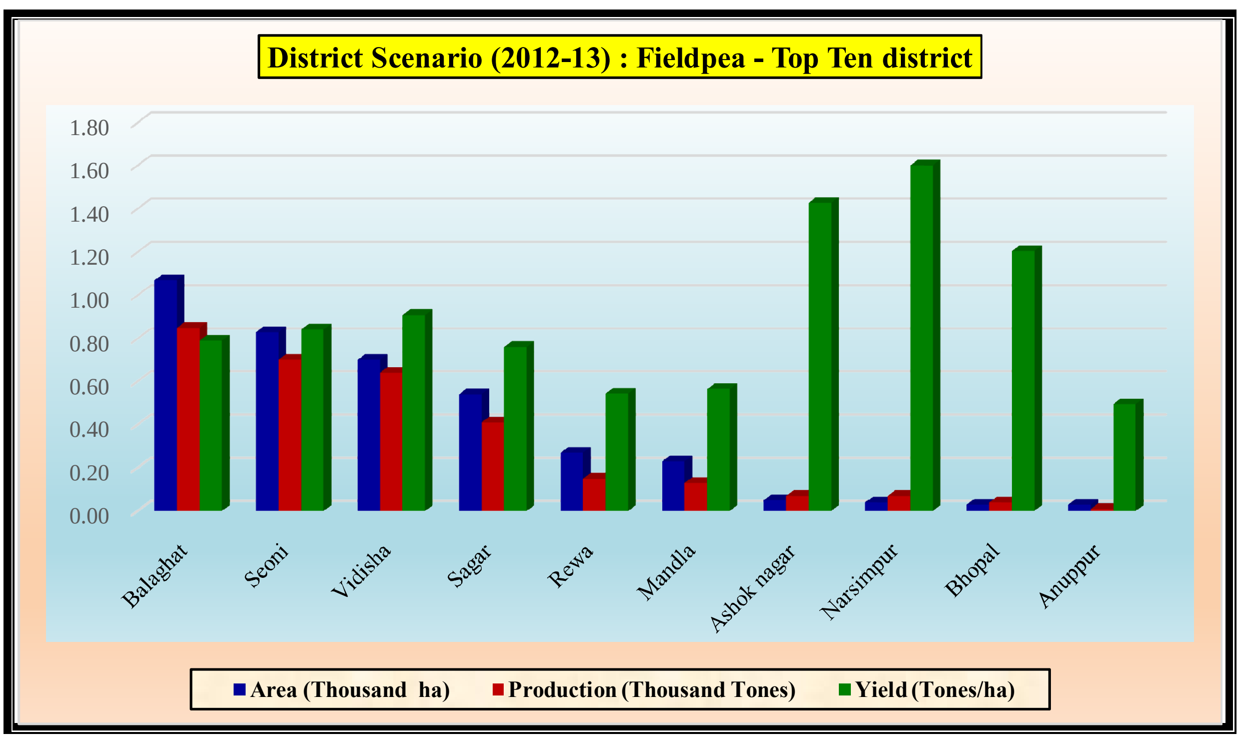
Analysis of the intra-state status of Pea crop, is presented in table 7.7. Inter district analysis revealed that district Jalaun with 13.72% of production has the highest share followed by Lalitpur (11.26%), Jhansi (9.33%) and Mahoba (2.81%) of U.P. District-wise area, production and yield of top ten 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. Reset 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–7.7): TOP POTENTIAL DISTRICTS (2012-13) – FIELDPEA

{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	Narsinghpur	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**	

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*



(TABLE–7.8): STATE-WISE YIELD GAP AND ADDITIONAL RETURN

(Yield: Kg/ha; Return: Rs./ha.)

State	Yield (kg/ha)			Gap over FP		Gap over SAY		Yield 2016-17*	Additional return by bridging yield gap (Rs/ha)	
	IP	FP	SAY	Actual	%	Actual	%		FP	SAY
Assam	1205	960	782	245	26	423	54	782	8575	14805
Bihar	1805	1256	993	549	44	812	82	1053	19215	28420
Chhattisgarh	764	586	419	178	30	345	82	381	6230	12075
J&K	1164	942	831	222	24	333	40	-	7770	11655
Jharkhand	1284	964	1188	320	33	96	8	766	11200	3360
Manipur	784	582	936	202	35	-152	-16	940	7070	-5320
Tripura	1420	1390	850	30	2	570	67	-	1050	19950
UP	1628	1278	1110	350	27	518	47	997	12250	18130
Average	**1225**	**933**	**904**	**292**	**31**	**321**	**36**	**827**	**10220**	**11235**

Source-*Annual Report- 2016-17, GoI, DPD, Bhopal (Ave. 2013-14 to 2015-16)*
*State Average Yield - E&S (Ave. 2011-12 to 2015-16) *Third Advance Estimates2016-17*
IP: Improved Practise FP: Farmers Practise SAY: State Avergae Yield

7.6 FIELDPEA AGRONOMY

7.6.1 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.

- Two types of peas are generally cultivated all over the world as:
- **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.
- **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.

7.6.2 PRODUCTION TECHNOLOGY

- **Climate:** 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.

- **Soil and Fieldpreparation:** 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.

- **Sowing time**: IInd fortnight of October in north Indian condition and Ist week of October in Central India is the optimum sowing time for rainfed conditions.

- **Seed Rate & Spacing**: Tall varieties-70-80 kg./ha & 30-45 X 10 cm;Dwarf varieties-100 kg./ha & 22.5 X 10 cm.; 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.

- **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 7.9.

- **Cropping System**: In general, peas are sown after harvest of kharif crops. The most common rotations are maize ï pea; paddyï peaï wheatï (being popular in Northern India); cotton ï pea;jowarï pea; and bajraï pea.

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

- **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.

- **Plant nutrient management**: Apply 2.5-5 tones biogas slurry/compost per ha, apply 60 kg P_2O_5 per ha as basal dosein furrow bands for higher P useï efficiency for which single super phosphate (contains 12 % S) to di-ammonoum phosphate should be prefered. On light tectured soils of northern region, application of 0.5 kg molybdenum (1 kg sodium molybdate) per ha has additional effect on yield of fieldpea. Foliar spray of B @ 1-1.5 kg B per ha or soil application of 4 kg borax per ha is recommended on boran deficient soils. Apply 20 kg K_2O per ha. alongwith NP is beneficial in K deficient areas.Apply 20 kg sulphur per ha. In acid soils, rhizobium innoculated seed should be treated with 1.5 kg of finaly powdered lime ($CaCO_3$, 300 mesh).
For correcting Zn deficiency, foliar spray of 0.5 kg $ZnSO_4$ with 0.25 kg lime or soil application of $ZnSO_4$ @ 25 kg per ha to one crop on Zn deficient soils is helpful to both the crop of pulse based cropping system**.**

- **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.

- **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.

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

7.6.3 PLANT PROTECTION MEASURES

A. DISEASE

i) Wilt

Symptoms:Thesymptoms may be seen in seedling stage.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.

Control Measures

i) Seed Treatment with Thirum (2gm.) +Carbendazim (1gm.) /kg of seed; ii) Adopt crop rotation; iii) Avoid early sowing in badly infested areas.

ii) **Powdery Mildew**

Symptoms: The symptoms first appears on the leaves then on other green parts of the plant. They are characterized by patchy growth on both the surfaces of the leaf and also on the tendrils, pods and stem. In case of severe infestation the plant dies prematurely.

Control Measures

i) Adopt resistant var. like Pant Pea-5, Malviya-15, JP-885, HUP-2 etc.; ii) Spraying with Karathane @ 1 ml/litre or wettable sulphur @ 3 gm/litre or Dinocap @ 1 ml/litre of water and repeat after 10-15 days, if necessary; iii) Avoid late planting; iv) After harvest collect the plants left in the field and burn them.

iii) **Rust**

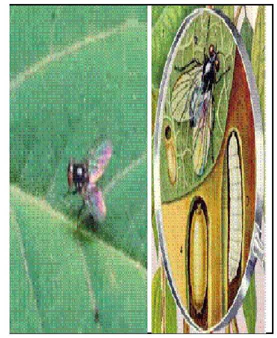
Symptoms: It is caused by fungus. The stem of the plant becomes malformed and the affected plant dies out. All the greenparts of plant are affected. Yellow spots having aecia in round or elongated clusters. Then the uredopustules develop which are powdery and light brown in appearance.

Control Measures

i) After harvest, the affected plants trash should be burnt; ii) Spray the crop with Mancozeb 75 WP @ 2 g / liter of water.

B. INSECT-PEST

i) Pea Stem fly



Nature of Damage: The maggot of the insect damages the internal tissue, consequently the entire plant dies. The damage is more acute when crop is sown early.

Control Measures

i)Mix 30 kg/ ha Carbofuran (Furadon) 3 % granules or 10 kg /ha Phorate (Thimet) 10 % granules in the soils before sowing the crop; ii) Avoid early planting.

ii) Leaf Miner

Nature of Damage: Larvae of the insect makes tunnel in the leaf causing severe damage. The damage is more during the month of Dec.to Mar.

Control Measures

i) 1 liter of Oxydemeton methyl (Metasystox) 25 EC in 1000 liter of water per hectare when the attack begins and repeat at 15 days intervals.

iii) Pea Aphids

Nature of Damage: They suck the sap of the cells, owing to which the leaves turn pale and yellow. In case of severe infestation the plant growth is checked. Ultimately plant growth get stunted.

Control Measures

i) Spray 1.25 liter of Dimethoate 30 EC or oxydemeton methy (Metasystox) 25 EC in 1000 liter of water per hectare. Reperat the spray after 10-12 days.

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.

Control Measures

i) Picking of green pods should be done 15 days after spraying; ii) Spray of 1.25 liter of cypermethrin in 1000 liter of water per hectare is safe and effective.

7.7 RECOMMENDATION TO ACHIEVED HIGHER PRODUCTION

- Deep summer ploughing once in 3 years.
- Seed treatment should be done before sowing.
- Application of fertilizer should be based on soil test value.
- Weed control should be done at right time.
- Powdery mildew resistant varieties : VL matar -42, VL matar -47, IPF - 4-9, Pant P -14, Paras, Prakash(IPFD-1-10), Aman, Gomati(TRCP-8), HFP- 529, HFP-715.
- Late planting should be avoided for preventing powdery mildew.
- Adopt integrated approach for plant protection.

(TABLE–7.9): RECOMMENDED VARIETIES OF FIELDPEAS/CHARACTERISTICS

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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

(Cont……)

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
Jay(KPMR-522)	CSAUAT	2001	**NWPZ** (Punjab, Haryana, Delhi, West UP & North Rajasthan)	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 powdery mildew
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

(Cont……)

Variety	**Source**	**Release/ Notification Year**	**Area of adoption (Zone/State)**	**Ave. yield (q/ha)**	**Days to maturity**	**Special characteristics**
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
Pant p 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.

MOTHBEAN

Botanical Name :*Vigna acontifolia*

Origin : India

Synonym : Moth

Chromosomeno. : 22

8.1 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 ôDalö.

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

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

8.2 NUTRITIVE VALUE

Protein	24-25%	Carbohydrate	61-62%
Fat	1.4-1.5%	Calorific value	330 Kcal/100 g
Dietary Fiber	16%		

8.3 PRODUCTION TRENDS

8.3.1 STATES' SCENARIO: PLAN ANALYSIS (X^{th} –XII^{th})

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.

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.

Twelfth Plan (2012-2016): A total of 10.92 lakh hectares and 3.60 lakh tonnes of Moth production was recorded in the country during the twelfth plan period. Area and production of mothbean highest in Rajasthan contributing (85.81% and 90.74%) followed by Madhya Pradesh (11.90% and 15.83%) respectively. However, yield of Madhya Pradesh (438 kg/ha) was hjigherthan the National average yield of (330 kg/ha). Need to adopt improved package of practices and varietal breakthrough.

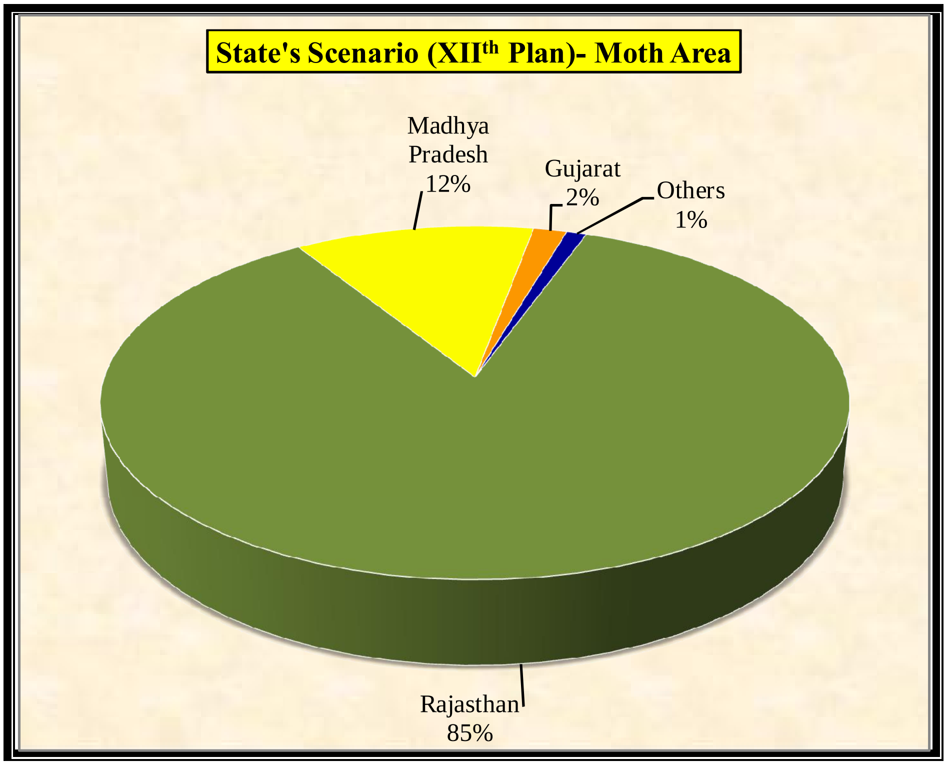
The overall area and production declined during XII plan period from previous plan. Emphasis needed to adopt the improved technology recommendations and varieties to increase the moth production in the country.

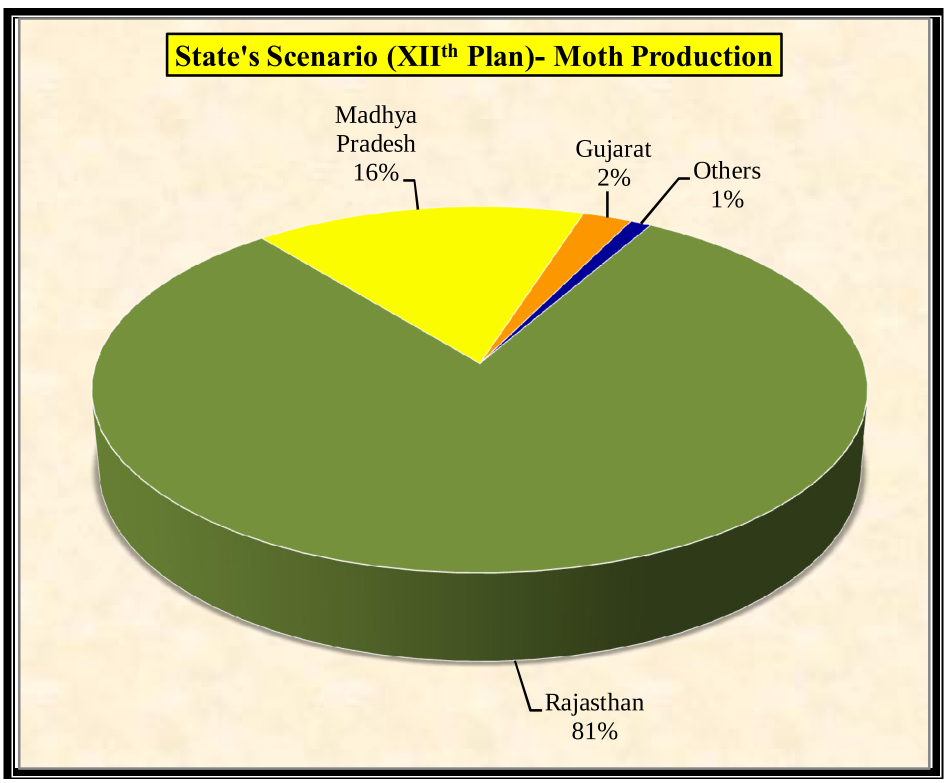
(TABLE–8.1):PLAN-WISE STATES' SCENARIO –MAJOR STATE'S

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

State		X^{th} Plan	% to AI	XI^{th} Plan	% to AI	XII^{th} Plan	% to AI
Gujarat	A	0.44	3.54	0.374	2.659	0.18	1.67
	P	0.16	5.39	0.162	3.798	0.09	2.36
	Y	364		433		466	
Haryana	A	0.05	0.4	0.045	0.319	0.009	0.08
	P	0.01	0.34	0.014	0.323	0.003	0.07
	Y	200		308		286	
Himachal Pradesh	A			0.009	0.062	0.02	0.15
	P			0.012	0.274	0.02	0.55
	Y			1351		1250	
Jammu & Kashmir	A			0.042	0.296	0.04	0.39
	P			0.02	0.465	0.02	0.44
	Y			477		373	
Madhya Pradesh	A					1.30	11.90
	P					0.57	15.83
	Y					438	
Maharashtra	A	0.45	3.62	0.278	1.973		
	P	0.12	4.04	0.096	2.25		
	Y	267		346			
Rajasthan	A	11.48	92.43	13.314	94.661	9.37	85.81
	P	2.68	90.24	3.96	92.819	2.91	80.74
	Y	233		297		310	
All India	**A**	**12.42**		**14.07**		**10.92**	
	P	**2.97**		**4.27**		**3.60**	
	Y	**239**		**303**		**330**	

**Twelfth plan is the Ave. of 2012-13 to 2016-17 & 2016-17 APY is the III^{rd} Adv. Estimates.*


State's Scenario (XIIth Plan)- Moth Area
Madhya Pradesh 12%
Gujarat 2%
Others 1%
Rajasthan 85%


State's Scenario (XIIth Plan)- Moth Production
Madhya Pradesh 16%
Gujarat 2%
Others 1%
Rajasthan 81%

8.3.2 DISTRICT SCENARIO (2012-13)–POTENTIAL DISTRICTS

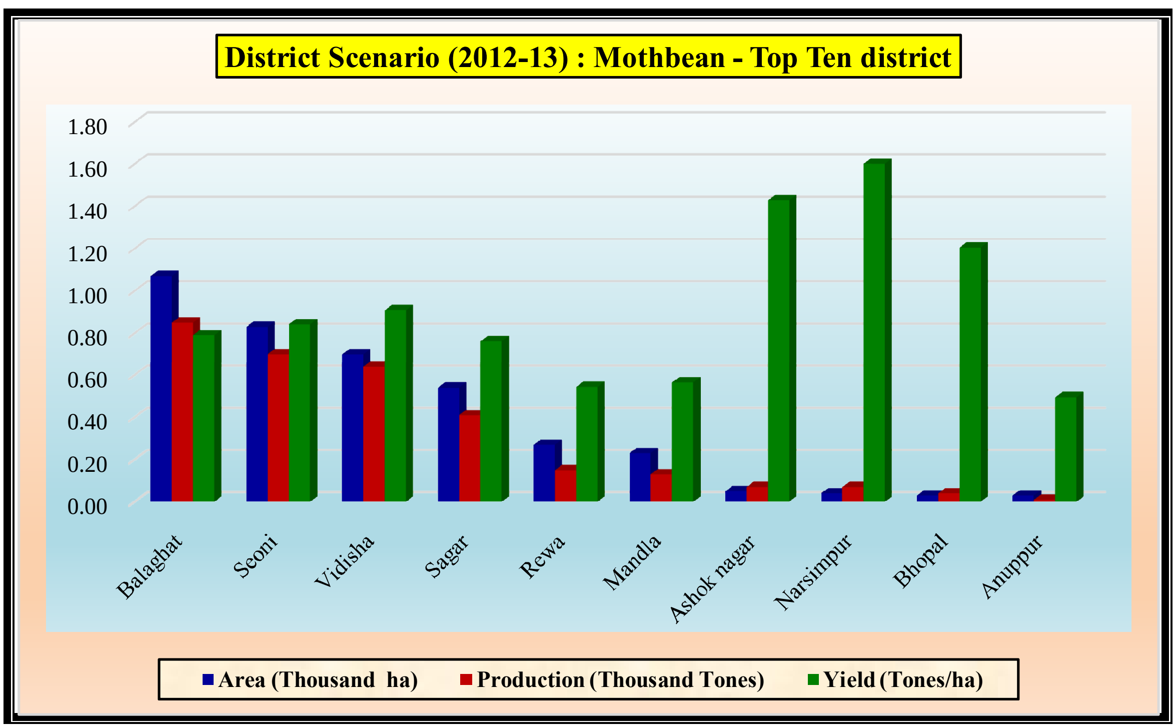
Inter district analysis revealed that the all the potential districts having area and production of the country about 5% and 9% respectively and yield above the National average yield (281 kg/ha) in all the potential districts.

(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**	

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.& FW(DAC&FW),Govt.of India.*



8.4 MOTHBEAN AGRONOMY

8.4.1 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 (>40^0c temp.) desicating wind causing removal of epidermis wilting and death.

ii) Jhola (Hot streaming): When plants are 30-40 days old, 43^0c or more temp in 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.

8.4.2 PRODUCTION TECHNOLOGY

- **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 dry-lands of arid zone with 250-500 mm rainfall requirement with arrangement of proper drainage.

- **Field 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.

- **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.

- **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 & Spacing:** 10-15 kg/ha (short statured, spreading to erect RMO-40 type) for grain and 4-5 kg for mixed crop. For fodder purpose 20-25 kg/ha seed required.; 30-45 cm x 10-20 cm.

- **Seed treatment:** 2 g thiram + 1 g Carbendazim / kg of seed. After fungicide treatment seed inocultion with Rhizobium and PSB culture @ 5-7 g /kg of seed.

- **Varieties:** Other than the following specific, varieties may be selected fromTable 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.

- **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.

- **Water Management:**It is cultivated in dry land and rainfed condition but in long dry spell one irrigation should be given at pod formation stage.

- **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 tones 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.

- **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. As pre emergence use Pendimethalin 30 % EC @ 0.75 -1 kg *a.i./*ha and one hand weeding at 25-30 days after sowing.

- **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.

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

8.4.3 PLANT PROTECTION MEASURES

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 @ 1.25 kg a.i. effective upto 4 week. - Spray with monocrotophos @ 25 kga.i./ha or dimethoate @ 0.15 kg a.i./ha.
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	
	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.

(TABLE–8.3):RECOMMENDED VARIETIES OF MOTHBEAN/CHARACTERISTICS

Variety	Source	Year of Release/ Notifica.	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, Res. 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.	6	65-70	
Rajasthan moth (RMO 257)	RAU, Bikaner	2007	Rajasthan	5-6	66	Tolerant to YMV

YMV= Yellow Moasaic Virus

8.5 RECOMMENDATION TO ACHIEVED HIGHER PRODUCTION

- Deep summer ploughing once in 3 years.
- Seed treatment should be done before sowing.
- Application of fertilizer should be based on soil test value.
- Weed control should be done at right time.
- Adopt integrated approach for plant protection.

HORSE GRAM (KULTHI)

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

9.1 ECONOMIC IMPORTANCE: Horse gram is an important crop of south India. Its grain is used for human consumption as ódalô as well as in preparation of so called órasamô 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.

9.2 NUTRITIVE VALUE

Protein	23-24%	Carbohydrate	59-60%
Fat	2.3-2.4%	Calorific value	321-322 Kcal/100 g
Dietary Fiber	15-16%		

9.3 PRODUCTION TRENDS

9.3.1 STATES' SCENARIO: PLAN ANALYSIS (Xth –XIIth)

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).

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).

Twelfth Plan (2012-2016):In India, the total area under Horsegram and its production during this plan was 4.63 lakh hectares and 2.25 lakh tonnes respectively. In terms of area and production, Karnataka is on the first position on all India basis contributing 38.66% and 37.00% followed by Tamil Nadu (17.24% & 21.37%) and Chhatisgarh (10.71% &7.04%).The highest yield was recorded in the state of Bihar (950 kg/ha) followed by Jharkhand (662 kg/ha) and Tamil Nadu (603 kg/ha).

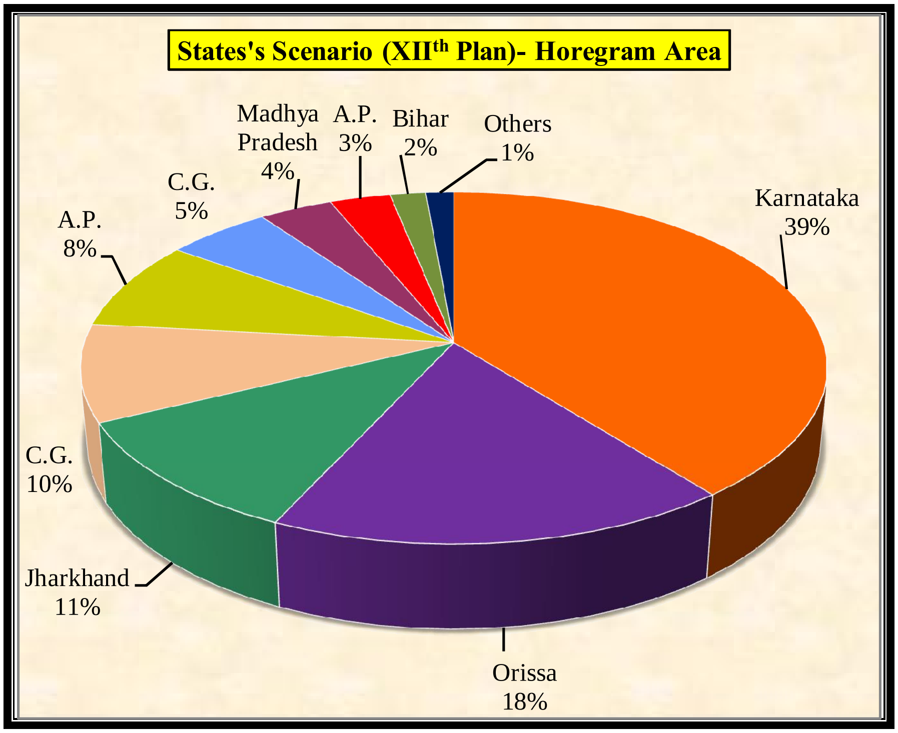
The trend of area and production during the last three plan period showed significant increased.

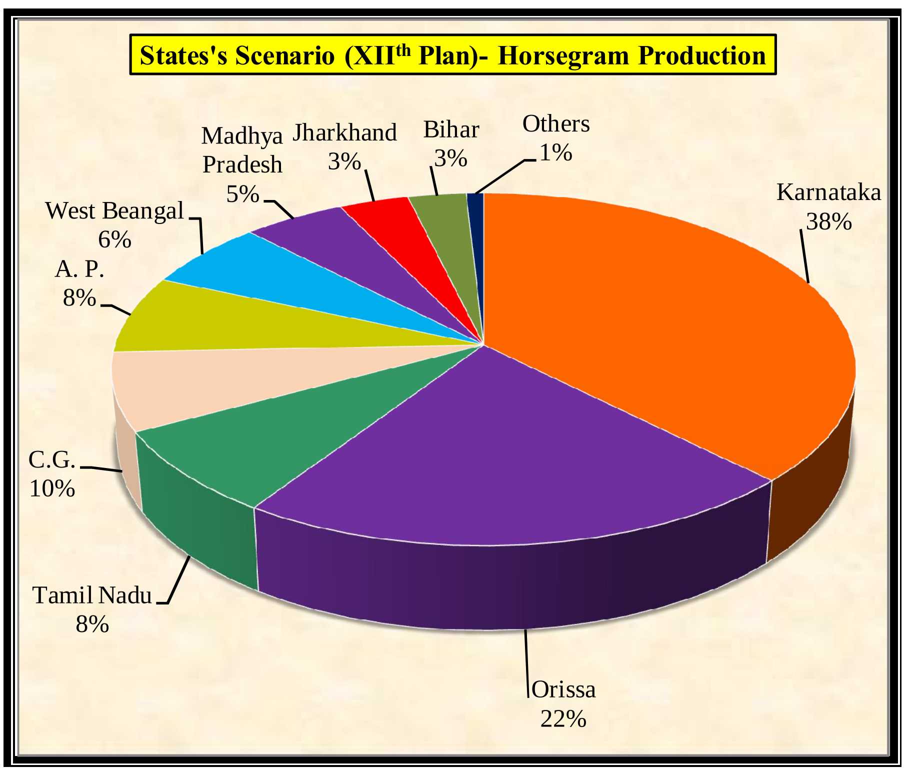
(TABLE– 9.1): PLAN-WISE STATES' SCENARIO - MAJOR STATE'S

{Area- lakh ha, Production-Lakh Tones, Yield-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	0.37	8.05
	P	0.29	11.25	0.05	3.50	0.17	7.77
	Y	413		581		469	
Bihar	**A**	0.14	1.93	0.11	3.32	0.08	1.75
	P	0.11	4.34	0.10	7.15	0.08	3.41
	Y	804		938		950	
Chhattisgarh	**A**	0.55	7.68	0.48	14.48	0.50	10.71
	P	0.16	6.41	0.14	9.94	0.16	7.04
	Y	298		298		319	
Jharkhand	**A**	0.17	2.32	0.16	4.95	0.24	5.17
	P	0.07	2.66	0.09	6.41	0.16	7.04
	Y	410		563		662	
Karnataka	**A**	2.98	41.65	0.93	28.15	1.79	38.66
	P	1.09	42.48	0.47	33.15	0.83	37.00
	Y	365		512		465	
Madhya Pradesh	**A**	0.31	4.33	0.23	7.04	0.17	3.60
	P	0.09	3.40	0.07	4.88	0.06	2.85
	Y	281		301		385	
Maharashtra	**A**	0.65	9.12	0.32	9.65	0.06	1.37
	P	0.20	7.97	0.12	8.48	0.02	0.85
	Y	312		382		303	
Odisha	**A**	0.79	11.09	0.62	18.74	0.41	8.75
	P	0.20	7.97	0.18	12.55	0.14	6.13
	Y	257		291		340	
Tamil Nadu	**A**	0.75	10.43	0.20	5.97	0.80	17.24
	P	0.29	11.14	0.08	5.39	0.48	21.37
	Y	382		392		603	
West Bengal	**A**	0.04	0.50	0.12	3.77	0.03	0.62
	P	0.02	0.63	0.10	7.15	0.01	0.65
	Y	444		825		508	
All India	**A**	**7.16**		**3.29**		**4.63**	
	P	**2.56**		**1.43**		**2.25**	
	Y	**357**		**433**		**486**	

**Twelfth plan is the Ave. of 2012-13 to 2016-17 & 2016-17 APY is the III^{rd} Adv. Estimates.*


States's Scenario (XIIth Plan)- Horegram Area
Madhya Pradesh 4%
A.P. 3%
Bihar 2%
Others 1%
C.G. 5%
A.P. 8%
Karnataka 39%
C.G. 10%
Jharkhand 11%
Orissa 18%


States's Scenario (XIIth Plan)- Horsegram Production
Madhya Pradesh 5%
Jharkhand 3%
Bihar 3%
Others 1%
West Beangal 6%
A. P. 8%
Karnataka 38%
C.G. 10%
Tamil Nadu 8%
Orissa 22%

9.3.2 DISTRICT SCENARIO (2012-13) – POTENTIAL DISTRICTS

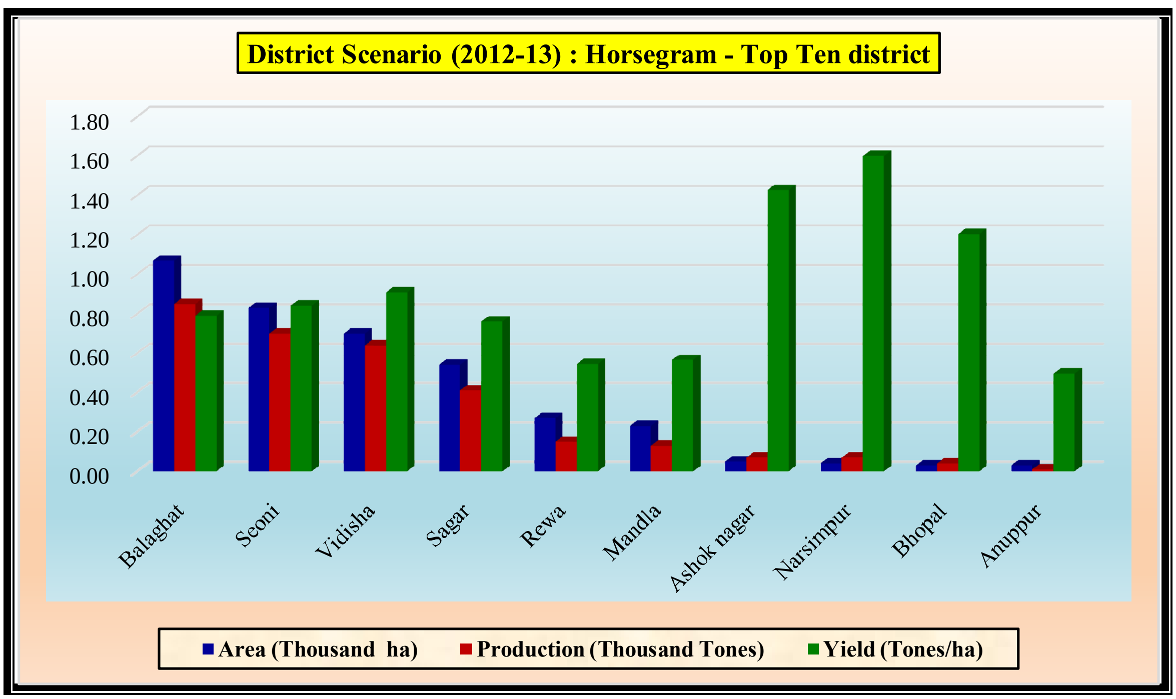
Inter district analysis revealed that the major potential district contribute area and production about (9.5% & 13%) respectively.Most of the potential district having yield above the National average yield (416 kg/ha) except Coimbatore district.

(TABLE–9.2): TOP POTENTIAL DISTRICTS (2012-13)

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

S. No.	Name of District	State	Area		Production		Yield	
			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**	

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*



9.4 HORSEGRAM AGRONOMY

9.4.1BOTANICAL 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.

9.4.2PRODUCTION TECHNOLOGY

- **Climate**:Horsegram is extremely drought-resistant crop. Moderately warm, dry climatic conditions are suitable for its optimum growth. It does not grow well on higher altitudes because of cool and wet climate. Horsegram can be cultivated up to an altitude of 1000 m above the sea level. The temperature range of 25-30°C and relative humidity between 50 and 80% is optimum for its growth. Heavy rains during the initial stages of crop growth affect nodule formation owing to poor aeration in the soil. A well-distributed rainfall of about 800 mm is sufficient for its successful cultivation, but it performs well even under low rainfall areas.
- **Soil type and Field preparation**:Generally grown on lateritic soil (poor in fertility) in south India. The crop can be grown on wide range of soils from light to heavy soils which are free from alkalinity. The crop needs minimum field preparations. Only 1-2 ploughings followed by planking provides desirable seed-bed.
- **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.
- **Seed Rate & Spacing:** Generally sown as broadcast with 40 kg/ha seed rate for dual purpose i.e. grain and fodder. For line sowing 25-30 kg/ha is enough for grain crop. Row Spacing: 40-45 cm during kharif and 25-30 cm during rabi and about 5 cm plant to plant spacing.
- **Seed treatment:** Seeds must be treated with seed treating fungicide to reduce infection by fungal pathogens found in the soil. Horse gram seeds are treated with carbendazim (bavistin) 2g for every kg of seeds. Now-a-days bio fungicide like *Trichoderma viridi* is recommended for pulses at the rate of 4g per kg seed. After fungicide treatment seed should be inoculate with Rhizobium and PSB culture @ 5-7 g/kg of seed.
- **Selection of varieties:** Select a best variety as per the growing season and purpose of cultivation from Table ï 9.3.
- **Cropping System**: Crop is grown as pure crop as well as mixed crop with sorghum, pearl millet, pigeon pea, sesame or niger.
- **Water Management:** Grown as rainfed.
- **Plant Nutrient Management:**20 kg nitrogen and 30 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.
- **Weed Management**: Due to luxuriant growth an early weeding/hoeing is enough for weed. Application of Pendimethalin @ 0.75-1 kg a.i./ha as pre emergence application. After that, one hand weeding at 20-25 days after sowing.

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

9.4.3 PLANT PROTECTION MEASURES

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.	Spray of Oxydemeton methyl 25 @ 1 ml/liter or Dimethoate 30 EC @ 1.7 ml/liter water
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.	
iii. Pod borer	It is a polyphagous insect. Caterpillar makes hole in pods, sometime also feed seed.	Spray of NPV @ 250 LE/ha. or Quinolphos 25 EC @ 2 ml/liter water
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. Spray of Oxydemeton methyl 25 @ 2 ml/liter or Dimethoate 30 EC @ 1.7 ml/liter water and repeat after 15 days, if necessary.
v. Root rot	Roots rot and plants show yellowing of the lower-most leaves followed by wilting.	i. Seed treatment with 2 g Captan or Carbindazim /2 kg of seed. ii. Avoid early sowing in infested areas

9.5 RECOMMENDATION TO ACHIEVED HIGHER PRODUCTION

- Deep summer ploughing once in 3 years.
- Seed treatment should be done before sowing.
- Application of fertilizer should be based on soil test value.
- Weed control should be done at right time.
- Adopt integrated approach for plant protection.

(TABLE–9.3): RECOMMENDED VARIETIES/CHARACTERISTICS

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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 so wing 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)

LATHYRUS (KHESARI)

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

10.1 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.

10.2 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 itĝs a better option to earn income from rice fields. It is also taken as mixed crop and intercrop during *rabi* and sole crop under ñUteraò 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 (*ɓ-N-oxalyl-L-Ŭ, ɓ-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 ñUteraò system, where the seeds of grass pea are broadcasted on the standing water in the paddy field about 10-15 days before harvest.

10.3 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.

10.3.1HIGH 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 ôHigh Power Committeeô under the Chairmanship of Secretary DARE ï 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 ï DG ï 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 ñthreshold levelsò 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 ôParliamentary Standing Committeeô 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 ôExperimental Neuro lathyrism in goats/sheepô 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, Nagpurï 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 ñLathyrismò causing ñCrippling paralysisò 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 ñNo 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 mixtureò. 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.

B. 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.

10.4 PRODUCTION TRENDS
10.4.1 STATES' SCENARIO: PLAN ANALYSIS (X^{th} –XII^{th})

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).

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).

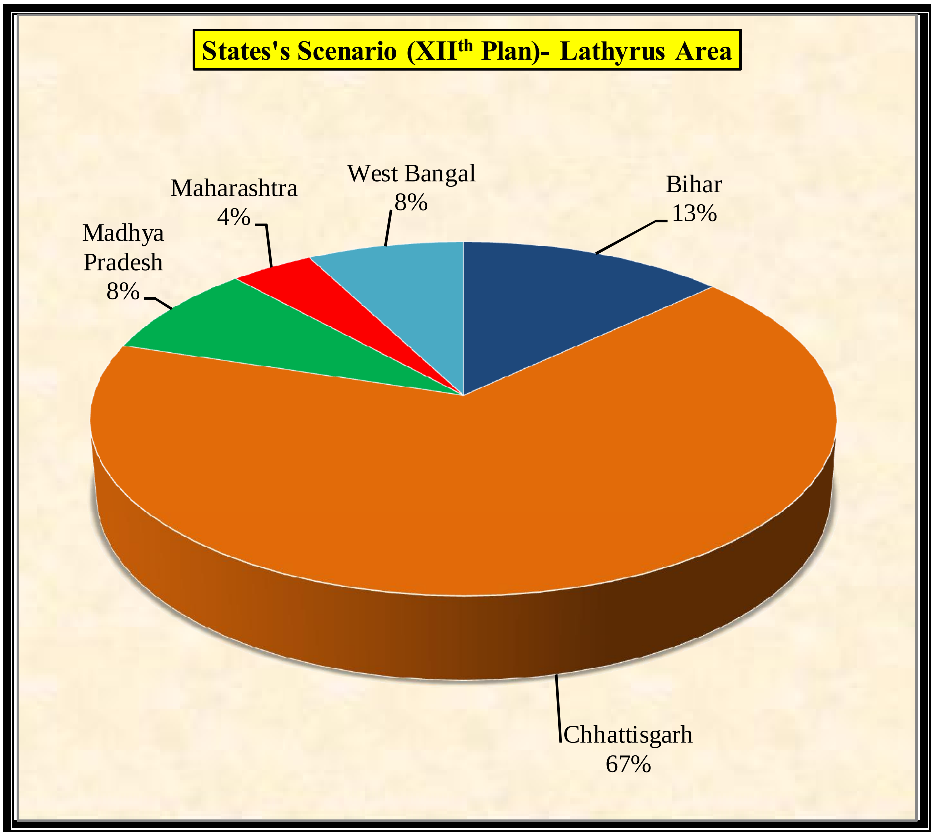
Twelfth Plan (2012-2016): The total area and production of Khesari were recorded at 5.11 lakh hectares and 4.07 lakh tonnes respectively. Chattisgarh ranked the first position both in area and production (66.68 % and 60.54%), followed by Bihar (13.10% and 16.95%). Madhya Pradesh ranked third in area (8.41%), wheres in production W.B. (12.19%), respectively.

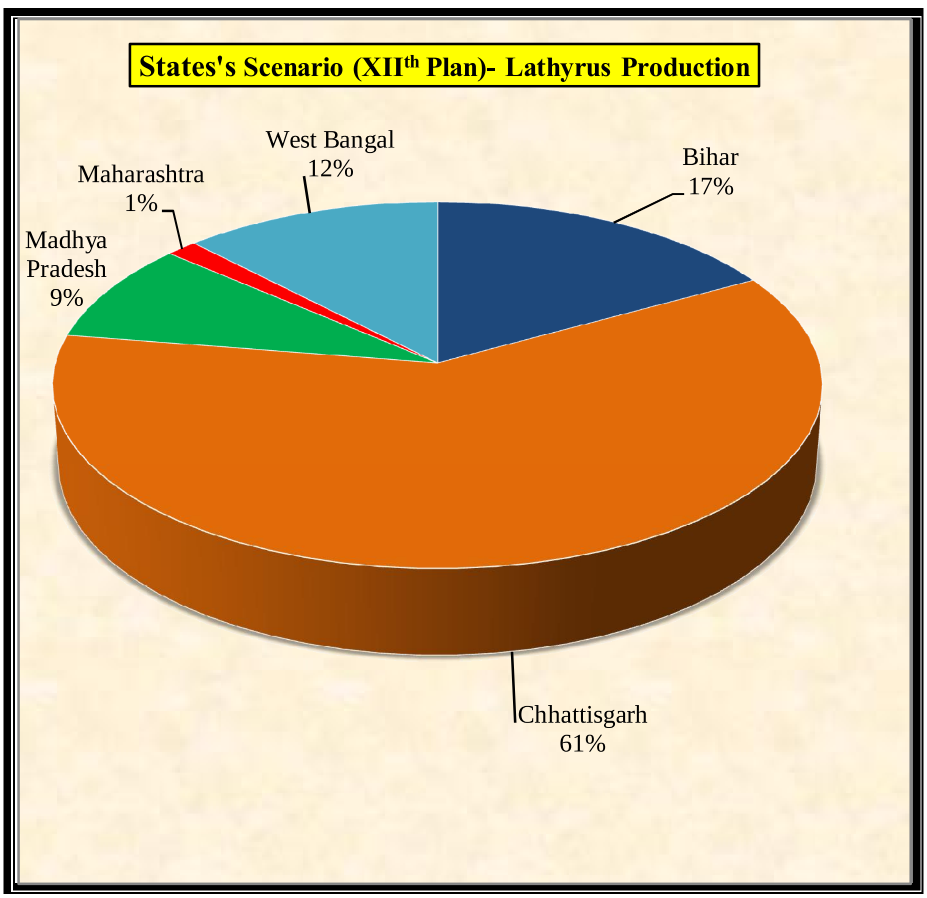
(TABLE-10.1): PLAN-WISE STATES' SCENARIO

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

State		X^th Plan	% to AI	XI^th Plan	% to AI	XII^th Plan	% to AI
Bihar	A	1.17	18.47	0.87	16.83	0.67	13.10
	P	0.97	25.69	0.84	24.53	0.69	16.95
	Y	824		965		1030	
Chhattisgarh	A	4.12	64.89	3.39	65.64	3.41	66.68
	P	2.04	54.32	1.99	58.38	2.46	60.54
	Y	496		589		723	
Madhya Pradesh	A	0.45	7.09	0.47	9.10	0.43	8.41
	P	0.31	8.35	0.31	9.00	0.36	8.84
	Y	697		654		837	
Maharashtra	A	0.27	4.24	0.15	2.97	0.21	4.11
	P	0.11	3.03	0.06	1.69	0.06	1.47
	Y	423		376		286	
West Bangal	A	0.34	5.32	0.28	5.46	0.39	7.71
	P	0.32	8.62	0.22	6.41	0.50	12.19
	Y	960		778		1259	
All India	**A**	**6.35**		**5.16**		**5.11**	
	P	**3.76**		**3.42**		**4.07**	
	Y	**592**		**662**		**796**	

**Twelfth plan is the Ave. of 2012-13 to 2016-17 & 2016-17 APY is the III^rd Adv. Estimates.*


States's Scenario (XIIth Plan)- Lathyrus Area
West Bangal 8%
Bihar 13%
Maharashtra 4%
Madhya Pradesh 8%
Chhattisgarh 67%


States's Scenario (XIIth Plan)- Lathyrus Production
West Bangal 12%
Bihar 17%
Maharashtra 1%
Madhya Pradesh 9%
Chhattisgarh 61%

10.4.2 DISTRICT SCENARIO (2012-13) – POTENTIAL DISTRICTS

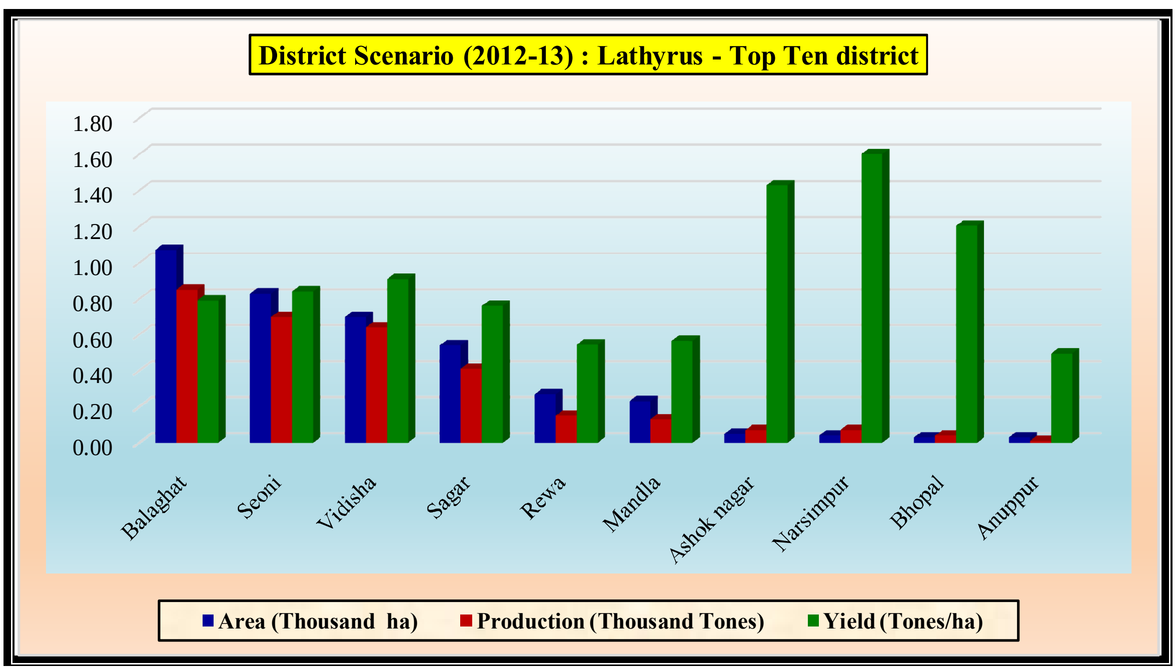
Inter District analysis revealed that major top ten potential district contributing the area and production about 6.5% and 7% respectively. All the Potential districts comes under M.P. and having most of the districts average yield above the National average yield (742 kg/ha) except Rewa (544 kg/ha),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

(TABLE–10.2): TOP POTENTIAL DISTRICTS (2012-13)

{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**	

Source: *Agricultural Statistics at a Glance, 2016.DES, Ministry of Agri.&FW(DAC&FW), Govt. of India.*



10.5 LATHYRUS AGRONOMY

10.5.1 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.

10.5.2 PRODUCTION TECHNOLOGY

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

- **Soil and Field 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.

- **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.

- **Sowing Method: 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.

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

- **Varieties**: Refer table 10.3.

- **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.

- **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.

- **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.

- **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.

- **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).

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

10.5.3 PLANT PROTECTION MEASURES

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

(TABLE–10.3): RECOMMENDED VARIETIES/CHARACTERISTICS

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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

10.6 RECOMMENDATION TO ACHIEVED HIGHER PRODUCTION

- Deep summer ploughing once in 3 years.
- Seed treatment should be done before sowing.
- Application of fertilizer should be based on soil test value.
- In Lathyrus foliar spray of 2% urea or 20 ppm Salicylic acid at flowering and pod formation stage increases the yield.
- Weed control should be done at right time.
- Adopt integrated approach for plant protection.

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

11.1 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.

11.2 NUTRITIVE VALUE

Protein	26-28%	Calcium	260 mg/100g
Fat	0.3-0.5%	Phosphorus	410 mg/100g
Carbohydrate	62-63%	Iron	5.8 mg/100g
Fiber	17-18%	Calorific value	345-346 Kcal/100 g

11.3 RAJMASH AGRONOMY

11.3.1BOTANICAL 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.

10.3.2 PRODUCTION TECHNOLOGY

- **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.

- **Soil&Field Preparation**: 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. 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.

- **Sowing time & spacing**: Kharif (Hills) last week June to first of July; Rabi (Plains) IIndfortnight of October and for spring (Lower hills) IInd 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).

- **Varieties**: Selection of varieties as per the growing season and purpose of cultivation from Table ï 11.1.

- **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.

- **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.

- **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.

- **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).

- **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.

- **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 cattleôs

10.3.3 PLANT PROTECTION MEASURES

A. DISEASES

i) Anthracnose

Symptoms: Pale brown sunken spots may appear on the cotyledons of infected seedlings. Lesions on leaves are dark brown. They are restricted to the veins on lower leaf surface. On stems, lesions are elongated and sunken.

Control Measures: Seed treated with Carbendazim & Thirum (1:1); ii) Spray Mancozeb 0.25 % or Carbendazim 0.1 % of 2-3 foliar spray at 45, 60, 75 DAS; iii) Remove from the field and destroy crop debris after harvest; iv) Practise a 2 to 3 year rotation; v) Avoid overhead irrigation; vi) Avoid movement of workers in the field when wet.

ii) Stem Blight

Symptom: Small water-soaked spots are first symptoms observed on leaves & appear within 4 to 10 days of infection. Develop, centre spots becomes dry and brown. The lesion is surrounded by a narrow band of bright yellow tissue.

Control Measures: i) Foliar spary of Carbandazim @ 0.2 % is recommended ; ii) Early or timely sowing**;** iii)Planting in well drained soil; iv) Avoid dense planting.

iii) Angular leaf spot

Symptoms: Fungus produces a grey mould on the lower surface of the spots. Infected pods have brown blotches. The spots may increase in size, join together, and cause yellowing and necrosis of the affected leaves.

Control Measures: i) Seed treated with Carbendazim @2-3 g/kg. of seeds; ii) 3 Foliar spray of Carbendazim @0.1% (1 gm/lit.) starting at the appearance(5-6 weeks after sowing) at 15 days interval; iii) Plough under bean debris after harvest; iv) Practice a 2-3 year crop rotation without legumes; v) Do not work in bean fields when the plants are wet.

B. INSECT-PEST

i) Leaf Miner

Nature of damage: Severely mined leaves may turn yellow and drop. Severely attacked seedlings are stunted and may eventually die. It may be seen in vegetative stage.

Control Measure: Spray of Oxydemeton methyl (Metasystox) 1 ml/liter of water and repeat at 15 day interval if required; ii) Roughing of infected plants; iii) Handpick & destroy mined leaves; iv) Whenever necessary spray the crop with neem products; v) Neem water extracts and neem oil give good control of leaf miners; vi) Remove and destroy crop residues and all plant parts with symptoms of damage by bean flies.

ii) Stem fly

Nature of damage: Stem becomes to swell and split and reducing formation of lateral roots. Attacked plants produce adventitious roots in compensation. Young seedlings and plants under stress wilt and die.

Control Measures: i)Seed Treated with Chlorphyriphos @8ml/kg seed; ii) Soil application by Phorate 10 G @ 10 kg./hac; iii) Mulch (e.g. with straw and cut grasses) helps conserve moisture, promote adventitious root development and enhances tolerance to maggot damage; iv) Avoid planting beans near cowpea, soybean and many other leguminous crops, that may be the source of bean flies.

iii) Black Aphids

Nature of damage: Aphids feed by sucking plant sap. Heavily infested plants usually have wrinkled leaves, stunted growth and deformed pods. Plants, in particular young plants, may dry out and die under heavy aphid attack.

Control Measures: i) Bio treat.-Inundative release of Coccinella septempunctata @ 1000 adult/400 sqm; ii) Practice a 2-3 year crop rotation without legumes; iii) Spraying the systemic insecticide like Dimethoate or Oxydemeton methyl @1 ml/liter of water.

11.4 RECOMMENDATION TO ACHIEVED HIGHER PRODUCTION

- Deep summer ploughing once in 3 years.
- Seed treatment should be done before sowing.
- Application of fertilizer should be based on soil test value.
- Weed control should be done at right time.
- Adopt integrated approach for plant protection.

(TABLE–11.1): RECOMMENDED VARIETIES/CHARACTERISTICS

Variety	Source	Release/ Notification Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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 Anoop		2012	Karnataka	18-20	70-80	Suitable for eastern dry zone of karnat aka in both kharif a nd rabi season

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

COWPEA

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

12.1 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.

12.2 NUTRITIVE VALUE

Protein	26-28%	Calcium	0.08 ï 0.11%
Fat	0.3-0.4%	Iron	0.005%
Dietary Fiber	18.2%	Calorific value	345-346 Kcal/100g
Carbohydrate	63-64%		

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.

12.3 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.

12.4 COWPEA AGRONOMY

12.4.1 PRODUCTION TECHNOLOGY

- **Climate:** Cowpea is warm weather and semi arid crop, where temperature ranging from 20 ^{O}C to 30 ^{O}C. Minimum temperature for seed establishment is 20 ^{O}C and above 32 ^{O}C temperatures development of root is cease. For maximum production day temperature 27 ^{O}C and night temperature 22 ^{O}C required. It is sensitive to cold and below 15 ^{O}C temperature yield adversely affected. It can grow under shade of tree but can not tolerate cold or frost.

- **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. 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. For summer season crop give a irrigation immediately after harvesting of Rabi crop

- **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.

- **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.

- **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.

- **Seed rate & Spacing:** 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.; Row to row-30(Bushing) to 45 cm (spreading), Plant to Plant-10 (Bushing) to 15 cm (spreading).

- **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)

- **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

- **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.

- **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.

- **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 óKô 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.

- **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.

- **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.

- **Harvesting & threshing:** The crop matures 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%.

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

12.4.2 PLANT PROTECTION MEASURES

A. DISEASES

i) Bacterial Blight

Symptoms: The germinating seedling turn brown-red and die. Irregular to round spots brown in colure with chlorotic halos, appear on leaves, and later spread to stem. Stem may break, pods are also infected leading to shrivelled seeds.

Control Measures:i) Grow resistant varieties; ii) Use healthy and disease free seeds; iii) In case of severe infection, crop may be sprayed with 0.2 % (2g/liter) copper oxychloride (Blitox).

ii) Cowpea Mosaic

Symptoms: It is caused by a virus transmitted by aphids. The affected leaves become pale yellow and exhibit mosaic, vein banding symptoms. The affected leaves become reduced in size and show puckering. Pods are also reduced and become twisted.

Control Measures:i) Use healthy seed from healthy crop; ii) For controlling aphids spray Oxydemeton methyl 25 EC (Metasystox) @ 1 ml/liter or Imidacloprid 17. 8 SL @ 0.2 ml/ liter of water and repeat the spray after 10 days of first spray.

iii)**Powdery mildew**

Symptoms: Powdery mildew are visible on all the aerial parts of the affected plants. Symptoms first start from leaves and then spread to stem, branches and pods. This white growth consists of the fungus and its spores. Affected leaves become twisted and smaller in size.

Control Measures:i) After harvest, collect the plants left in the field and burn them; ii) The disease can be controlled by spray of wettable sulphur @ 3g/liter or carbendazim @1 g/liter of water.

B. INSECT-PEST

i) Cowpea pod borer

Nature of Damage: The caterpillar rolls the leaves and web these with the top shoot. Caterpillar bore into the pods and feed on the seeds, if flower and pods are not available larvae feed on foliage.

Control Measures:i) Collect and destroy the eggs and young larvae; ii) The young caterpillar can be killed by dusting 2% methyl parathion @ 25-30 kg per hectare or spray of quinalphos @2 ml/liter of water; iii) Fix 3 feet stick in the field @10/ha bird parches to attract predatory birds.

ii) Hairy caterpillar

Nature of damage: It is major insect of cowpea. It is cut juvenile plants and eat away all the green matter of the leaves.

Control Measures: Collect and burn the eggs and burn the eggs and larva of insect; ii) The young caterpillar can be control by spray of Chloropyriphos or Quinolphos @ 2ml/liter of water.

iii) Aphids and Jassids

Nature of Damage: The adult and nymphs of these pests suck the juice from the leaves and the damage is more severe when the plants are young. As a result of sucking of sap, the leaves turn brown and crumbled and the plant look sick.

Control Measures: Spray of Oxydemeton Methyl 25 EC (Metasystox) @ 1 ml/ liter or Dimethoate 30 EC @ 1.7 ml/ liter of water.

iv) Bean fly/Stem fly

Nature of damage: Bean fly causes the characteristics swelling of stem at ground level where the maggots burrow onto the stem. The maggots puppets at the base of the plant and the stem grows it often cracks. The petiole often shows dark streaks where the maggots have move through and damage tissue.

Control Measures: Keeping the field clean from legume debris; ii) Application of Phorate (Thimet) 10 G @ 10 kg per hectare in furrows at the time of sowing is effective for avoiding infestation.

12.5 Recommendation to achieved higher production

- Deep summer ploughing once in 3 years.
- Seed treatment should be done before sowing.
- Application of fertilizer should be based on soil test value.
- Weed control should be done at right time.
- Adopt integrated approach for plant protection.

(TABLE–12.1):RECOMMENDED VARIETIES OF COWPEA/CHARACTERISTICS

Variety	Source	Release/ Noti. Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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., 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,

(Cont…..)

Variety	Source	Release/ Noti. Year	Area of adoption (Zone/State)	Ave. yield (q/ha)	Days to maturity	Special characteristics
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
IT ï 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
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)

A. 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 ôDalö. 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 ï 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 ï 1^{st} week of November) with crop spacing as row to row 30 ï 35 cm and plant to plant 10 cm with sowing depth of 7.5 ï 10 cm.

3.5 Seed rate: 70-100kg/ha

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

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 thatôs 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.

2. **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.

3. **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.

3.5 Seedrate: 40-50 kg/ha for grain & 60-75 kg/ha for fodder.

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

3.7 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.

3.8 Plant nutrient management: Grown on residual soil fertility.

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

3.10 Weed management: One hoeing 30 DAS is enough.

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

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

3.13 Threshing: Like moong.; **3.14Yield:** 10 qtl/ha .

MARKET

13. MARKET SCENARIO

13.1 PRODUCTION SCENARIO- 2016-17: AN ANALYSIS

- **Total Pulses**- During, 2016-17 the production of pulses in India has been 229.54 Lakh tonnes *(IVthAdv. Est.)* which is ever highest production. This is 30% higher over the Normal and 40% higher than the last year.

- **Arhar**-During, 2016-17 the production of Pigeonpea has been 47.78 Lakh tonnes *(IVthAdv. Est.)* which is ever highest production. This is 68% higher over the Normal and 87% higher than the last year.

  Maharashtra, with about 30% of National production remains at Ist rank in the country. More than 90% of the production of this crop is contributed by 8 states *viz.,* MS, Karnataka, MP, UP, Gujarat, Jharkhand, Telangana and AP.

- **Urdbean-**During 2016-17, the production of Blackgram has been at 28.05 lakh tonnes (kh-21.70 + rabi- 6.35 lakh tons), the ever highest production. This is 50% higher over the Normal and 44% higher than the last year.

  Madhya Pradesh, with >26 *% of National Production* during kharif and >18% of total production in a crop year *(kh.+ rabi)* ranks at Ist position at all India level. The rabi season, highest urd production is from AP which is >50 % of national production.

  More than 90% of urdbean production comes from MP, AP, UP, TN, MS, Rajasthan, Jharkhand, Gujarat, WB and Karnataka.

- **Mungbean-**During 2016-17, Greengram also recorded the ever highest production at 21.63 lakh tons (kh-16.15 + rabi- 5.48 lakh tons), which is 44% higher over the Normal and 36% higher than the last year.

  Rajasthan, with 48% of total all India production during kharif and >31 % collectively in a crop year,ranks Ist in the country. During, rabi, TN with 19 % of national production stands at Ist position.

  More than 90% of Mungbean production comes from 10 states, namely Rajasthan, Maharashtra, TN, AP, Bihar, MP, Odisha, Gujarat, Telangana and Karnataka

- **Gram-**During 2016-17, Gram production at 93.26 lakh tons, which is 9% higher over the Normal and 32% higher than the last year. The ever highest production of gram was 95.30 lakh tonnes during 2013-14.

  Highest production of Gram is from MP with 41% of contribution to the National Production followed by Rajasthan (14%), Maharashtra (13%), Karnataka (>8%) and AP (>6 %).

- **Lentil-**Lentil and kulthi are considered under *other pulses category* by the DES, which provides the statistics of these pulses only at the final production estimates stage. During 2015-16, the production of lentil was at 9.76 lakh tons which was 7% less than the Normal production.
  UP with 33% of national production ranks at Ist followed by MP (32.75%), Bihar (16.96%) and WB (6%).

During 2016-17, as per the WWWR coverage and the Normal yield, the tentative production of lentil is likely to be 12.74 lakh tonnes.

(TABLE-13.1): NATIONAL PRODUCTION OF PIGEONPEA, URD, MUNG& LENTIL

(Production: Lakh tonnes)

Crop/Year 1st July to 30th June	Normal (Avg. 2011-12 to 2015-16)	2015-16 Final Est.	2016-17 4th Adv. Est.	Change Over Normal	Change Over 2015-16
Pigeonpea	28.44	25.61	47.78	19.34 (68%)	22.17 (87%)
Urd	18.72	19.45	28.05	9.33 (50%)	8.60 (44%)
Mung	15.05	15.93	21.63	6.58 (44%)	5.70 (36%)
Gram	80.90	70.60	93.26	12.36 (15%)	22.66 (32%)
Lentil	10.44	9.76	12.74*	2.30 (22%)	2.98 (31%)
Total Pulses	**176.37**	**163.48**	**229.54**	**53.17 (30%)**	**66.06 (40%)**

Source: *DES (DAC&FW); * Estimated by DPD on the basis of area coverage reported in WWWR & Avg. Yield*

(TABLE-I): STATE-WISE AREA PRODUCTION OF PIGEONPEA

{Area: lakh ha, Production -lakh tonnes}

State	Normal		2013-14		2015-16		2016-17*		Prod. % change over	
	Area	**Prod.**	**Area**	**Prod.**	**Area**	**Prod.**	**Area**	**Prod.**	**Normal**	**2015-16**
Maharashtra	12.00	8.31	11.41	10.34	10.39	4.66	15.33	13.89	20.11	63.96
Karnataka	7.27	4.05	8.24	5.88	6.48	2.63	12.14	8.66	52.80	125.20
M.P.	5.26	4.31	4.64	3.32	5.79	6.25	6.90	7.82	42.10	20.02
Gujarat	2.25	2.46	2.10	2.09	2.27	2.37	3.34	3.69	60.98	65.69
Uttar Pradesh	2.97	2.57	3.01	2.71	2.65	1.83	3.38	3.36	50.87	100.33
Telangana	2.61	1.19	2.64	1.40	2.48	1.04	3.87	2.15	151.83	198.78
Jharkhand	1.80	1.78	1.97	2.05	1.94	1.74	1.94	2.02	63.75	66.72
A.P.	1.88	0.93	1.85	1.04	2.20	1.29	3.48	1.31	151.46	78.72
Odisha	1.40	1.23	1.39	1.24	1.38	1.23	1.36	1.15	76.01	76.01
Chhattisgarh	0.55	0.30	0.51	0.31	0.64	0.30	0.69	0.46	511.11	511.11
Tamil Nadu	0.53	0.50	0.60	0.58	0.60	0.58	0.59	0.44	176.00	130.80
Bihar	0.22	0.37	0.22	0.37	0.22	0.32	0.22	0.34	248.36	332.03
Total Above	38.74	27.99	**38.58**	**31.33**	**37.04**	**24.24**	**53.24**	**45.29**	**5.78**	**7.71**
Others	0.50	0.45	0.46	0.41	0.42	0.34	0.63	0.70	345.68	605.54
All-India	**39.24**	**28.44**	**39.04**	**31.74**	**37.46**	**24.58**	**53.87**	**45.99**	**5.69**	**7.61**

Source: *Normal: DES, (Ave. of 2011-12 to -2015-16), *IIIrd Advance Estimates of Production 2016-17*

(TABLE-II): STATE-WISE AREA PRODUCTION OF *URDBEAN*

{Area: lakh ha, Production -lakh tonnes}

State	Normal		2013-14		2015-16		2016-17*		Prod. % change over	
	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.	Normal	2015-16
Madhya Pradesh	7.25	3.45	6.02	2.26	9.35	5.17	11.68	7.71	123.64	49.17
Andhra Pradesh	3.78	3.17	2.65	2.30	4.56	4.11	5.20	3.84	21.15	-6.57
Uttar Pradesh	5.70	3.09	5.42	2.48	6.17	2.44	6.42	3.48	12.65	42.87
Tamil Nadu	3.30	2.40	3.65	3.11	3.95	2.64	4.49	3.72	54.85	40.80
Maharashtra	3.24	1.64	3.34	2.06	2.86	0.61	4.45	2.50	52.25	309.84
Rajasthan	2.34	1.11	1.96	0.71	2.99	1.15	3.90	2.50	125.48	118.17
Jharkhand	0.94	0.78	0.94	0.88	0.95	0.72	1.52	1.40	77.90	93.72
Gujarat	0.84	0.54	0.91	0.55	0.64	0.38	1.99	1.21	124.91	218.42
West Bengal	0.74	0.49	1.14	0.63	0.74	0.55	0.76	0.55	13.70	1.47
Karnataka	0.93	0.37	1.02	0.50	0.91	0.25	0.88	0.43	16.85	72.00
Chhattisgarh	1.02	0.31	1.08	0.32	1.01	0.30	0.99	0.32	2.26	4.28
Total above	**30.09**	**17.35**	**28.13**	**15.80**	**34.13**	**18.31**	**42.27**	**27.65**	**59.43**	**51.03**
Other	2.55	1.37	2.49	1.19	2.11	1.14	2.66	1.61	17.24	40.90
All India	**32.64**	**18.72**	**30.62**	**16.99**	**36.24**	**19.45**	**44.93**	**29.26**	**56.34**	**50.43**

Source: *Normal: DES, (Ave. of 2011-12 to -2015-16), *IIIrd Advance Estimates of Production 2016-17.*

(TABLE-III): STATE-WISE AREA PRODUCTION OF MUNGBEAN

{Area: lakh ha, Production -lakh tonnes}

State	Normal		2013-14		2015-16		2016-17*		Prod. % change over	
	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.	Normal	2015-16
Rajasthan	10.70	4.68	10.20	3.91	13.64	5.97	15.83	7.52	60.76	25.98
Maharashtra	3.97	1.66	4.31	2.08	3.66	0.69	5.15	2.68	61.86	288.84
Tamil Nadu	1.89	1.15	1.95	1.51	2.39	1.25	1.63	1.16	1.06	-6.95
Andhra Pradesh	1.56	1.12	1.34	1.17	2.12	1.37	1.62	0.83	-25.84	-39.42
Bihar	1.61	0.98	1.55	1.05	1.69	0.94	1.64	1.00	1.11	5.45
Madhya Pradesh	2.10	0.93	3.16	1.46	2.95	1.31	2.94	1.39	49.37	5.81
Odisha	2.66	0.86	2.52	0.89	2.90	0.85	2.66	0.85	-0.37	0.06
Gujarat	1.62	0.83	1.83	1.06	1.29	0.67	1.80	0.86	3.01	28.36
Telangana	1.24	0.69	1.26	0.53	1.11	0.56	1.48	0.88	27.76	57.14
Karnataka	2.80	0.61	3.20	0.81	3.48	0.44	4.14	1.15	89.83	161.96
Uttar Pradesh	0.86	0.47	0.79	0.39	1.11	0.51	1.09	0.59	26.61	15.69
Total above	**31.00**	**13.97**	**32.12**	**14.87**	**36.34**	**14.57**	**39.98**	**18.91**	**35.37**	**29.83**
Other	1.66	1.07	1.71	1.19	1.94	1.36	3.07	1.78	66.27	30.92
All India	**32.67**	**15.04**	**33.83**	**16.05**	**38.28**	**15.93**	**43.05**	**20.70**	**37.57**	**29.93**

Source: *Normal: DES, (Ave. of 2011-12 to -2015-16), *IIIrd Advance Estimates of Production 2016-17.*

(TABLE-IV): STATE-WISE AREA PRODUCTION OF GRAM

{Area: lakh ha, Production -lakh tonnes}

State	Normal		2013-14		2015-16		2016-17*		Prod. % change over	
	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.	Normal	2015-16
M.P.	30.60	32.11	31.60	32.99	30.17	32.65	32.22	35.49	10.53	8.70
Maharashtra	13.71	11.36	18.20	16.22	14.41	7.31	18.95	16.48	45.07	125.44
Rajasthan	15.30	12.98	19.24	16.40	9.42	8.03	14.86	13.82	6.47	72.10
Karnataka	9.23	6.22	9.46	7.16	13.72	8.97	10.25	3.90	-37.30	-56.52
Andhra Pradesh	4.68	5.21	4.72	5.97	4.71	5.00	3.92	4.34	-16.70	-13.20
Chhattisgarh	2.64	2.54	2.77	2.13	3.03	2.19	2.93	3.01	18.50	37.44
Uttar Pradesh	5.77	5.47	5.77	4.75	2.68	2.16	5.62	6.32	15.54	192.59
Jharkhand	1.30	1.48	1.56	1.82	1.64	1.73	1.86	2.19	47.97	26.59
Gujarat	1.99	2.30	2.47	3.09	1.15	1.53	1.70	2.10	-8.70	37.25
Telangana	0.96	1.42	1.14	2.46	0.70	0.49	1.01	1.24	-12.68	153.06
Bihar	0.59	0.70	0.61	0.70	0.61	0.60	0.60	0.59	-15.71	-1.67
West Bengal	0.24	0.28	0.25	0.29	0.31	0.37	0.30	0.33	17.86	-10.81
Total of above	**87.01**	**82.07**	**97.79**	**93.98**	**82.55**	**71.03**	**94.22**	**89.81**	9.43	26.44
All-India	**88.37**	**83.23**	**99.27**	**95.26**	**83.49**	**71.69**	**95.39**	**90.75**	9.04	26.59

Source: *Normal: DES, (Ave. of 2011-12 to -2015-16), *III[rd] Advance Estimates of Production 2016-17.*

(TABLE-V): STATE-WISE AREA PRODUCTION OF LENTIL

{Area: lakh ha, Production -lakh tonnes}

State	Normal		2013-14		2015-16		2016-17*		Prod. % change over	
	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.	Normal	2015-16
UP	5.08	3.8	4.49	3.10	3.35	2.38	**6.63**	**5.01**	31.84	110.50
MP	5.85	2.99	5.30	3.38	5.46	3.92	5.86	3.48	16.39	-11.31
Bihar	1.83	1.92	1.54	1.96	1.51	1.40	2.13	2.28	18.75	62.35
WB	0.62	0.56	0.65	0.63	0.95	0.94	1.13	1.04	85.71	10.64
Jharkhand	0.39	0.36	0.44	0.37	0.15	0.12				
Rajasthan	0.36	0.35	0.34	0.29	0.74	0.64				
Assam	0.27	0.17	0.30	0.22	0.28	0.20	0.33	0.22	29.41	11.99
Total above	**14.40**	**10.15**	**13.07**	**9.95**	**12.45**	**9.60**	**16.08**	**12.03**	**18.52**	**25.31**
Others	0.39	0.23	0.34	0.22	0.31	0.16	0.57	0.25	8.70	57.13
All India	**14.79**	**10.38**	**13.41**	**10.17**	**12.76**	**9.76**	**16.65**	**12.28**	**18.30**	**25.83**

Source: *Normal: DES, (Ave. of 2011-12 to -2015-16), *III[rd] Advance Estimates of Production 2016-17*

13.2 AVAILABILITY STATUS: TOTAL PULSES & CROP-WISE (2013-14 TO 2016-17)

Crop-wise availability of Pigeonpea, Chickpea, Lentil, Mungbean and Urdbean based on domestic production, import and export is summarized under *Table 13.2.* During 2016-17, it is evident from table that the domestic availability of pulses has increased by 34% in total pulses, 77% in tur, -23% in lentil and 33% in urd and mung over the previous crop year 2015-16.

(TABLE-13.2):IMPORT, EXPORT AND AVAILABILITY

(Unit: Lakh Tons)

Year	Domestic Production	Import	Export	Total Availability
Pigeonpea				
2013-14	31.74	4.63	0.04	36.33
2014-15	28.07	5.74	0.09	33.72
2015-16	24.58	4.66	0.001	29.24
2016-17*	47.78	5.75	0.01	53.52
Chickpea				
2013-14	95.26	2.76	3.33	94.69
2014-15	73.32	4.19	1.90	75.61
2015-16	70.58	10.31	2.17	78.72
2016-17*	93.26	10.81	0.88	103.19
Lentil				
2013-14	10.18	7.09	0.01	17.26
2014-15	10.35	8.16	0.08	18.43
2015-16	9.76	12.60	0.12	22.24
2016-17*	12.74	4.48	0.12	17.10
Moongbean /Urdbean				
2013-14	33.04	6.24	0.02	39.26
2014-15	34.63	6.23	0.04	40.82
2015-16	35.38	5.82	0.06	41.14
2016-17*	49.68	4.68	0.08	54.28
Total Pulses				
2013-14	192.53	36.44	3.46	225.51
2014-15	171.52	45.85	2.22	215.15
2015-16	163.48	57.98	2.56	218.90
2016-17*	229.54	66.09	1.37	294.26

Source: *GOI, MoA &FW, Min. of Commerce& Industry; * Domestic production 4rd Adv. Est. & Import & Export 2016-17 (Apr. 2016-Dec, 2016/Feb. 2017).*

13.3 MARKET PRICES/RATES AND ARRIVALS

Crop-wise market prices and arrivals of Pigeonpea, Urdbean, Mungbean, Gram and Lentil, worked out relative change over the period in terms of *arrivals* annually and *prices/rates,* monthly during 2015-16 and 2016-17 and, are summarized.

It is evident from table that the arrivals of pulses has increased by 72% in tur, 58% in urd and 29% in mung and 6% in lentil over the previous crop year 2015-16. It is also observed that the prices/rates are decreased over the period during the month of July by 53% in tur 48% in urd, 23% in mung and 34% in lentil.

(TABLE-I): STATE-WISE MARKET RATES AND ARRIVALS OF PIGEONPEA

(Rate in Rs./Qtls; Arrivals-000 Tonnes)

State	Market Rate		% Change over	Market Arrivals		% Change over
	July, 2016	July, 2017		2016-17	2015-16	
Maharashtra	8644	3689	-57.32	799.71	535.40	49.37
Karnataka	9392	4174	-55.56	416.41	197.23	111.14
Madhya Pradesh	6938	3924	-43.44	321.31	174.53	84.10
Gujarat	7835	3262	-58.37	103.99	38.99	166.73
Telangana	8357	3722	-55.46	102.38	5.79	1668.56
Uttar Pradesh	8849	3999	-54.81	80.29	87.41	-8.14
Rajasthan	7588	4063	-46.45	24.21	14.74	64.23
West Bengal	12199	8342	-31.62	15.71	18.73	-16.16
Chattisgarh	7802	3944	-49.45	9.87	8.77	12.52
Assam	12381	6792	-45.14	7.82	10.96	-28.60
Andhra Pradesh	7799	3810	-51.15	6.26	1.02	512.32
Jharkhand	12901	6072	-52.93	4.68	3.86	21.18
Uttrakhand				2.69	1.11	142.34
Kerala	12919	7601	-41.16	1.42	0.60	134.93
Manipur	16361			1.29	1.37	-6.05
Punjab		2560		0.92	4.41	-79.12
NCT of Delhi	6267	2487	-60.32	0.90	0.81	11.91
Haryana				0.17	0.13	34.11
Tamil Nadu				0.08	1.16	-93.56
Orissa				0.00	0.20	-98.01
Average/Total	**9749**	**4563**	**-53.20**	**1900.13**	**1107.23**	**71.61**

(TABLE-II): STATE-WISE MARKET RATES AND ARRIVALS OF URDBEAN

(Rate in Rs./Qtls; Arrivals-000 Tonnes)

State	Market Rate		% Change over	Market Arrivals		% Change over
	July, 2016	July, 2017		2016-17	2015-16	
Madhya Pradesh	8798	4109	-53.30	349.82	284.01	23.17
Maharashtra	14190	3912	-72.43	123.54	36.16	241.65
Rajasthan	9943	3686	-62.93	113.68	79.98	42.15
Uttar Pradesh	10312	4977	-51.74	93.66	58.23	60.85
Gujarat	10500	3954	-62.34	82.00	18.16	351.53
Assam				77.39	29.90	158.81
Tamil Nadu	9206	5422	-41.10	43.38	22.08	96.51
Karnataka	12512	7660	-38.78	36.38	23.61	54.05
West Bengal	12841	7040	-45.18	23.11	35.71	-35.30
Andhra Pradesh	9246	5127	-44.55	5.00	5.20	-3.73
Kerala	15327	9196	-40.00	2.72	2.47	10.15
Pondicherry	7316	4088	-44.12	1.98	1.95	1.23
Telangana	7046	4050	-42.52	1.91	0.96	99.69
Chattisgarh	9935	4413	-55.58	1.74	2.37	-26.38
Orissa	8024	7515	-6.34	1.54	4.56	-66.15
Manipur	15391		-100.00	1.35	1.40	-3.51
Uttrakhand	7800	5916	-24.15	0.67	0.75	-10.47
Haryana				0.21	0.27	-21.48
Jharkhand		6272		0.12	0.00	5700.00
Punjab	9362		-100.00	0.02	0.05	-68.75
Average/Total	**10456**	**5459**	-47.79	960.22	607.81	57.98

(TABLE-III): STATE-WISE MARKET RATES AND ARRIVALS OF MUNGBEAN

(Rate in Rs./Qtls; Arrivals-000 Tonnes)

State	Market Rate		% Change over	Market Arrivals		% Change over
	July, 2016	July, 2017		2016-17	2015-16	
Rajasthan	5457	4347	-20.34	320.41	268.93	19.14
Madhya Pradesh	5058	5142	1.66	244.12	165.53	47.47
Karnataka	6263	5179	-17.31	127.37	71.27	78.70
Maharashtra	6242	4574	-26.72	39.34	22.22	77.02
Uttar Pradesh	5938	3872	-34.79	33.46	39.03	-14.28
Assam	8758	6774	-22.65	22.19	25.08	-11.55
Gujarat	5717	4592	-19.68	20.19	30.25	-33.24
Telangana	5015	3899	-22.25	18.35	9.93	84.69
West Bengal	10288	8386	-18.49	16.61	20.19	-17.72
Haryana	3800	5000	31.58	5.95	0.08	7245.68
Kerala	9011	7479	-17.00	2.57	2.69	-4.42
Manipur	13348			1.19	1.29	-7.30
Orissa	6242	5427	-13.06	1.11	3.32	-66.69
Andhra Pradesh	5210	5564	6.79	0.90	1.69	-46.71
Tamil Nadu	5070	4029	-20.53	0.86	1.56	-45.13
Pondicherry	5267	4214	-19.99	0.49	0.54	-10.85
Uttrakhand	5200	5644	8.54	0.44	0.91	-51.38
Jharkhand	9315	6341	-31.93	0.27	0.07	300.00
Punjab	5659		-100.00	0.10	0.08	27.85
Chattisgarh	10065	4200	-58.27	0.05	0.03	64.29
NCT of Delhi	4441	3214	-27.63	0.01	0.05	-79.63
A&N Island				0.01	0.01	-16.67
Mizoram				0.00	0.01	-87.50
Average/Total	6732	5151	-23.47	855.96	664.77	28.76

(TABLE-IV): STATE-WISE MARKET RATES AND ARRIVALS OF LENTIL

(Rate in Rs./Qtls; Arrivals-000 Tonnes)

State	Market Rate		% Change over	Market Arrivals		% Change over
	July, 2016	July, 2017		2016-17	2015-16	
Madhya Pradesh	5688	3310	-41.80	279145.64	297636.97	-6.21
Uttar Pradesh	6674	4122	-38.24	122626.96	68523.86	78.96
Assam	8882	6164	-30.59	40626.30	36813.40	10.36
West Bengal	9620	7675	-20.22	28538.25	40004.41	-28.66
Rajasthan	6180	3329	-46.13	10122.80	9242.90	9.52
Maharashtra	7138	5336	-25.24	2295.00	2616.00	-12.27
Jharkhand	7877	5908	-25.00	2236.58	845.60	164.50
Chattisgarh	5159	3155	-38.84	2218.73	2495.60	-11.09
Manipur	11412			1350.19	1373.40	-1.69
Uttrakhand				796.20	811.80	-1.92
Gujarat				36.40	5.10	613.73
Haryana				8.50	6.60	28.79
Telangana				7.40		
Kerala	10433	7749	-25.73	3.70	1.21	205.79
Bihar					52.10	
Orissa					16.00	
Punjab					19.45	
Average/Total	**7906**	**5194**	**-34.30**	**490012.65**	**460464.40**	**6.42**

Source*: GOI, MoA &FW, DMI, Agmarknet*

(TABLE-V): STATE-WISE MARKET ARRIVALS OF GRAM

(Unit- Arrivals in Lakh Tonnes)

State	July 01, 2015 to May 31, 2016	July 01,2016 To May 31,2017	% Change over 2015-16
Andhra Pradesh	0.200	0.040	-79.86
Assam	0.136	0.131	-3.33
Chattisgarh	0.268	0.156	-41.84
Gujarat	0.339	0.520	53.30
Haryana	0.028	0.009	-68.79
Jharkhand	0.009	0.001	-94.26
Karnataka	0.872	0.847	-2.93
Kerala	0.042	0.023	-44.66
Madhya Pradesh	7.050	8.082	14.64
Maharashtra	3.173	3.635	14.57
Manipur	0.013	0.012	-5.58
NCT of Delhi	0.001	0.001	59.19
Orissa	0.000	0.000	-91.71
Punjab	0.030	0.000	-99.90
Rajasthan	1.117	2.381	113.23
Tamil Nadu	0.002	0.000	-91.91
Telangana	0.002	0.015	779.98
Tripura	0.000	0.003	-
Uttar Pradesh	1.838	1.957	6.46
Uttrakhand	0.016	0.006	-60.14
West Bengal	0.063	0.074	17.11
Total	15.199	17.893	17.72

Source: *AGMARKNET*

NOTE: During 2015-16 the AGMARKNET data for Gram was captured under two heads i.e. Bengal Gram and Big Gram and the same was merged and reported in a single commodity name: Bengalgram (Gram) w.e.f 11.03.2016.

(TABLE-VI): STATE-WISE MARKET ARRIVALS AND PRICES OF GRAM

(Rate in Rs./Qtls; Arrivals-lakh Tonnes)

State	***Market Rates***				***Market Arrivals***			
	2014	**2015**	***2016***	***2017***	**2014**	**2015**	***2016***	***2017***
MSP	***3100***	***3175***	***3425***	***4000***				
M.P.	2673	4241	5623	5370	0.967	0.379	1.558	1.942
Maharashtra	2519	4287	5587	5420	0.459	0.311	0.342	0.559
Rajasthan	2710	4201	5566	5229	1.190	0.322	0.252	0.671
Karnataka	2661	4674	5687	6367	0.132	0.068	0.065	0.091
Andhra Pradesh	2824	3712	5061	5954	0.005	0.012	0.000	0.007
Chhattisgarh	2661	4417	5510	5451	0.013	0.011	0.050	0.028
Uttar Pradesh	3350	4218	5735	5793	0.241	0.211	0.232	0.262
Jharkhand	3580	5528	6208		0.017	0.004	0.000	0.000
Gujarat	2698	4412	5719	5352	0.067	0.038	0.041	0.069
Telangana	2474	4229	4390	5756	0.000	0.000	0.000	0.001
Bihar					0.000		0.000	0.000
West Bengal			11250	9100	0.000		0.016	0.008
All-India	**3312**	**4471**	**6135**	**6468**	**3.104**	**1.386**	**2.588**	**3.664**

Source: *AGMARKNET*

- The all India market arrival of gram during May, 2016 was 2.59 lakh tons which was about 3.61% of the total gram production during 2015-16 whereas during May, 2017 it is 3.66 lakh tons which is about 4.04 % of total gram production during 2016-17 which is only 0.43 % higher than the last year.

- The market arrival during May, 2014 was 3.10 lakh tons which is only 3.26% of the total gram production during 2013-14, the ever highest gram production year with 95.25 lakh tons of production of Chana. It reveals that the arrivals percentage of gram during the current year (May 1^{st}-31^{st}, 2017) is higher by 0.78 % than the ever highest gram production year of 2013-14 during corresponding period (May 01^{st}-31^{st} , 2014).

- The trend of monthly wholesale prices of gram during last five years exhibit that the market rates are directly related with the production, the decreasing trend of prices observed during the 2014 and current year 2017 due to record production of gram during 2013-14 & 2016-17. The increasing price trend observed during 2015 and 2016 in view of less production during 2014-15 & 2015-16. During the current year wholesale price of gram during the month of January to May, 2017 show decreasing trend due to increasing trend of market arrivals with 17.72% higher than the last year in the same period.

13.4 FACTORS ATTRIBUTING TO LOWER MARKET PRICES (BELOW MSP)

- During 2016-17, as a result of significant increase in the area coverage and productivity of all major Pulses, total production of pulses is estimated at 22.95 million tonnes which is higher by 3.70 million tonnes (>19 %) than the earlier record production of 19.25 million tonnes achieved during 2013-14.
  The production of total pulses during the year under report is also higher by 4.77 million tonnes (>27%) than its Five yearsô average, as also higher by 6.60 million tonnes (>40%) over the last year i.e. 16.35 million tonnes.
- The availability status of the pulses during the current year, both under total pulses and individual crop category, has increased considerably. Once the availability is sufficient, the prices are bound to be comparatively low.
- The market arrival status of the pulses during the current year under individual crop category has increased significantly. Once the supply increased over its demand, prices/rates are declined.
- It is evident from the table depicting the increasing trend of availability of individual pulses as well as total pulses, the increased availability, may be a major factor for low ruling prices during the current month/year.
- Currency demonetization and implementation of GST may likely to impact the rotation of money under trading, resultantly poor holding of stocks in relation to the capacity of the traders/ processors
- Imposing of 5% GST on *branded dals* and relaxing *non-branded dals* i.e., 0% GST, may also be attributed to comparatively poor procurement by the traders /processors/millers, fearing the assured profit-margin over the investment.
- Except, the big processors/traders, the other small scale entrepreneurs may be reluctant and unwilling to put the *brands*. During the course of interactions/ discussions with the millers, it is given to understand that the traders lobby anticipates the policy decision of the Government to open the export of this commodity.
- It is relevant to mention that the Lentil is exported to Myanmar (>35 %), USA (> 25 %), Kuwait (> 7 %) and Bhutan and Singapore (approx. 6 %). Similarly, tur is exported to Nepal (> 78 %), Canada (> 19 %) and Israel (approx 2%). Mung/Urd is also exported to USA (> 49 % of total export of this commodity) followed by Sri lanka and Canada (> 7 %).
- It should also be noted that the MSP procurement under PSF/PSS are for FAQ Grade, fetching MSP rates. Whereas, the lower prevailing rates of these pulses in the market are for ungraded/below FAQ grade of pulses.

- It is pertinent to record that for a stable remunerative price support under pulses, the stateôs own initiatives on procurement always pays dividends. In Karnataka, > 80000 qtls of tur dal have been procured during 2016-17 here the open market rates have been comparatively much better than the other states having no such provision.

- As per Agmarknet portal, the mandi arrivals of Bengal Gram (Chana) for all the states from 01.07.2016 to 31.05.2017 are 17.72% higher as compared to the corresponding period of last year (2015-16).
- The arrivals during the current year/month are higher than the corresponding year/month of the last year 2016. The probable reasons of higher arrival and prevailing market prices may be attributed to the followings:

  - The higher MSP regime in pulses (Gram) is paying dividends to pulse growers in fetching remunerative prices of their produce. Currently price is above the MSP and is sustaining above MSP, because of procurement by the Government in major gram producing states.
  - There is no carry forward stock (31st March, 2017) with the farmers, millers, stockist, traders and also the public sector agencies like NAFED and the produce being sold both at organized and non-organized trading routes.
  - Holding of stocks by the farmers with access to information network, enhanced holding capacities anticipating further better prices correlating the previous year price regime.
  - Farmersô enhanced access to get finance through sale proceeds of wheat crop and the KCCs and generally not constrained to distress sale.
  - The price trends have been decreasing from March/April onwards during the current year as compared to the corresponding period of last year. It is an indicative that production is more.
  - The status market arrivals during the current year is better than the last year due to excess production of gram during the current year.
  - Generally, of the total production/ quantity of the gram commodity i.e., 42-43 percent of the, Total availability (Total production + Import - Export-Change in stock over year- NSSO based consumption) is retained as stock and the remaining 56-58 percent of the total available quantity remains under trading.

SEED PRODUCTION

1. NEW INITIATIVES PROGRAMME UNDER NFSM-PULSES

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 10-15% increase in the total production of any crop. 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 improved practices (FLD), farmersô practice and statesô average yield. Concerted efforts and proper planning along with realistic execution the seed production programme are required to produce the quality seed of improved varieties insufficient quantities to phase out the old seed of absolete non-descript varieties.

ñ*The Committee for Monitoring Actions/ Strategy for Increasing Pulses Production".*
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 under the Chairmanship of Dr. Ashok Dalwai, Additional Secretary, Govt. of India, following strategic interventions to address the seed sector during 2016-17 have neen initiated;

i) ***Enhancing Breeder Seed Production*** EBSP (*Rs. 20.39 Crore* for*2016-17 to 2018-19,*) isoperational at 08 states in 12 centres (Rajasthan-ARS, Kota/RARI-Durgapur; Bihar-BAU, Sabour;Maharashtra-ARS-Badnapur/MPKVV-Rahuri;Madhya Pradesh-JNKVV, Jabalapur/RVSKVV, Gwalior & IIPR-RS Phanda; Odisha-ARS, Berharampur; Uttar Pradesh- ICAR, IIPR, Kanpur; Andhra Pradesh- ARS-Lam; Karnataka-UAS, Dharwad. Crop-wise/Centre-wise targets for quality seed production for 2016-17 to 2018-19 is as given below:

(TABLE-14.1): ALL INDIA CROP-WISE TARGETS UNDER EBSP

(Qty in qtl.)

Crops	2016-17	2017-18	2018-19	Total
	KVK / AICR/ ICAR	KVK/AICRP/ICAR	KVK/AICRP/ICAR	
Pigeonpea	425	157	168	750
Urd	317	183	212	712
Moong	490	195	244	929
Chickpea	2140	235	277	2652
Lentil	165	140	132	437
Fieldpea	180	68	73	321
Total Pulses	**3717**	**978**	**1106**	**5801**

ii) ***Creation of Seed-Hubs*** (*Rs.225.31Crore* for *2016-17 to 2018-19)* out of which *Rs.86.75 Crore for 2016-17 & Rs. for 2017-18*) is operational at 150 locations at (ICAR Institute/ SAUs-07, AICRPs-46, KVKs-97) in 24 States (Andhra Pradesh, Assam, Bihar, Chhatisgarh, Gujarat, Haryana, Himachal Pradesh, Jharkhand, J&K, Karnataka, Kerela, Manipur, Maharashtra, Madhya Pradesh, Nagaland, Odisha, Punjab, Rajasthan, Tamil Nadu, Telangana, Tripura, Uttar Pradesh, Uttarakhand and West Bengal) in the country.

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)*.Crop-wise/Centre-wise targets for quality seed production for 2016-17 to 2018-19 is as given below:

(TABLE-14.2): ALL INDIA CROP-WISE TARGETS UNDER SEED-HUB

(Qty.: in qtl.)

Crops	2016-17			2017-18			2018-19			Total
	KVK	AICRP	SAU/ICAR	KVK	AICRP	SAU/ICAR	KVK	AICRP	SAU/ICAR	
Pigeonpea	8250	6250	1250	15150	8900	1490	19050	10300	1750	72340
Urd	5300	3075	300	10400	5000	450	12100	5900	600	43125
Moong	10750	4175	1300	19950	7150	1800	23300	8300	2500	79225
Chickpea	13150	6560	800	18850	8750	1100	22450	10250	1450	83360
Lentil	4250	2325	750	7250	3150	1150	8750	3550	1400	32575
Fieldpea	6950	1950	650	9100	2650	780	10450	2900	1150	36580
Lathyrus	150	-	-	250	-	-	350	-	-	750
Rajmash	-	100	250	-	100	350	-	100	450	1350
Cowpea	-	700	200	500	1350	300	400	1250	400	5100
Mothbean	-	-	150	-	300	250	-	400	300	1400
Horsegram	400	-	-	500	100	-	550	100	-	1650
Total Pulses	**49200**	**25135**	**5600**	**81950**	**37450**	**7670**	**97400**	**43050**	**10000**	**357455**

iii) Cluster FLD on Pulses (minimum 10 ha each) by ATARI (*Rs. 26.11 Crore* for*2017-18*) is operational in 31366 ha area @ Rs. 7500/ha (Rs. 750 for monitoring + literature + field day) across the country being conducted by 11 ATARIs through 549 KVKs.

iv) Cluster FLD on Oilseeds (minimum 10 ha each) by ATARI (*Rs. 21.00 Crore* for *2017-18*) is operational in 73275 ha area @Rs. 8500/ha for G.Nut, @Rs.- 6000/ha for Sunflower/R&M and @ Rs. 5000/ha for Sesame, Niger, Safflower, Castor across the country being conducted by 11 ATARIs through 516 KVKs.

(TABLE-14.3): CLUSTER FLD ON PULSES /OILSEEDS: 2017-18

(KVK-Nos.; FLDs-Area in ha; Budget-Rs. in Lakhs)

Implementing Agency/Zone	NFSM-Pulses			NMOOP-Oilseed		
	KVK	FLDs	Budget	KVK	FLDs	Budget
ATARI-I (Ludhina)	52	1522	125.46	42	1950	55.18
ATARI-II (Jodhpur)	49	3520	296.31	48	8725	240.93
ATARI-III (Kanpur)	68	4220	354.80	69	7950	214.23
ATARI-IV (Patna)	62	4350	360.36	60	9575	261.23
ATARI-V (Kolkata)	49	3080	255.81	45	7800	242.83
ATARI-VI (Guwahati)	32	1510	127.26	35	5450	149.83
ATARI-VII (Barapani)	16	880	78.81	23	3100	90.48
ATARI-VIII (Pune)	67	3810	315.36	63	10400	313.53
ATARI-IX (Jabalpur)	**63**	**4440**	**365.91**	**64**	**9300**	244.25
ATARI-X (Hyderabad)	58	2750	222.66	48	6575	20.368
ATARI-XI (Banglore)	33	1284	108.51	19	2450	8.383
Total (2017-18)	**549**	**31366**	**2611.25**	**516**	**73275**	**2100.00**
Total (2016-17)						

2. SEED REQUIREMENT: To achieve the targeted 36%, 38%, 40% & 42% SeedReplacement Rate, the requirement of breeder, foundation and certified seed by the end of2022 is as under:

(TABLE-14.4): SEED REQUIREMENT AT 33% SRR – END OF TWELTH PLAN

(Quantity in Qtl.)

Crop	Normal Area	Certified seed				Foundation seed				Breeder seed			
		2018-19 (36%)	2019-20 (38%)	2020-21 (40%)	2021-22 (42%)	2018-19	2019-20	2020-21	2021-22	2018-19	2019-20	2020-21	2021-22
Arhar	39.25	282.6	298.3	314.0	329.7	7.1	7.5	7.9	8.2	5.7	6.0	6.3	6.6
Urdbean	24.80	178.6	188.5	198.4	208.3	6.0	6.3	6.6	6.9	8.9	9.4	9.9	10.4
Mungbean	23.60	169.9	179.4	188.8	198.3	5.7	6.0	6.3	6.6	8.5	9.0	9.4	9.9
Other Kharif	18.14	130.6	137.9	145.1	152.4	4.4	4.6	4.8	5.1	6.5	6.9	7.3	7.6
Total Kharif	**105.79**	**761.7**	**804.1**	**846.3**	**888.7**	**23.2**	**24.4**	**25.6**	**26.8**	**29.6**	**31.3**	**32.9**	**34.5**
Gram	86.80	875.8	924.5	973.1	1021.8	58.4	61.6	64.9	68.1	87.6	92.5	97.3	102.2
Lentil	14.14	127.3	134.3	141.4	148.5	4.2	4.5	4.7	5.0	6.4	6.7	7.1	7.4
Fieldpea	9.93	357.5	377.3	397.2	417.1	23.8	25.2	26.5	27.8	35.8	37.7	39.7	41.7
Urdbean	7.85	56.5	59.7	62.8	65.9	1.9	2.0	2.1	2.2	2.8	3.0	3.1	3.3
Mungbean	9.26	66.7	70.4	74.1	77.8	2.2	2.4	2.5	2.6	3.3	3.5	3.7	3.9
Other Rabi	11.11	160.0	168.9	177.8	186.7	8.0	8.4	8.9	9.3	8.0	8.4	8.9	9.3
Total Rabi	**139.09**	**1643.8**	**1735.1**	**1826.4**	**1917.8**	**98.5**	**104.1**	**109.6**	**115**	**143.9**	**151.8**	**159.8**	**167.8**
Total Pulses	**244.88**	**2405.5**	**2539.2**	**2672.7**	**2806.5**	**121.7**	**128.5**	**135.2**	**141.8**	**173.5**	**183.1**	**192.7**	**202.3**

3.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.

4.CLASS OF SEED AND THEIR PRODUCTION

i) 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 preand 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.

ii) 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.

iii) 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.***

iv) 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

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

- **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 (NGOôs), 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.

- **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.

- **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 Farmersô 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.

- **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.

- **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 ii) Producer VillageTrader DalMiller Wholesaler Retailer Consumer iii) Producer Dal Miller Retailer Consumer iv) Producer Wholesaler DalMiller Retailer Consumer v) Producer Wholesaler DalMiller Wholesaler Retailer Consumer vi) Producer Wholesaler Retailer Consumer (For whole Green gram) vii) Producer Commission Agent Dal Miller Wholesaler Retailer Consumer	i) Producer ProcuringAgency Dal Miller Consumer ii) Producer Procuring Agency Dal Miller Wholesaler Retailer Consumer iii) Producer Procuring Agency DalMiller 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 farmersô 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 ï 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 ï 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 ï 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 consumersô 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 smallscale 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 ï

- 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 ï

(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, Sundrying).

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 ï 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
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 ï 40 kg per hour • Power ï Nil • Utility ï can process bold pulses, suitable for Home/cottage scale	➢ Suitable for small scale processing ➢ Good quality dal at competitive price ➢ By-products ï 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.

10.1TRADITIONAL 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:

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

• **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

• **DEHULLING OF TUR-SMALL SCALE (DRY METHOD)**

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

10.2.2 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 & Size grading → Pitting in roller → Water mixing (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

10.2.3 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 ñpolishedò 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.

10.2.4 DEHULLING OF GREEN GRAM

Raw pulse ➔ Cleaning& size grading ➔ Pitting in Smooth roller- I ➔ Pitting in Roller- II
↓
Dust, chaff, small grains
↓ (For black gram)
↓
Mechanical Drier (1-3 hrs.) or Sun drying (1 day) ← Tempering (10-16 hrs.) ← Oil mixing (0.3-0.5%)
↓ ↓
Tempering ➔➔➔➔ Water mixing (2-4%) ➔ Tempering (12-24 hrs.) ➔ Dehusking in smooth roller
↓
Dhal polishing ← Splitting in Shellers or Chakki ← DEHUSKED GOTA ← Aspiration & sieving
↓↑ ↓↓
↓↑ Dal Husk powder
↓↑↓brokens
↓←←←←←←←←←←←←
↓
Dal

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.

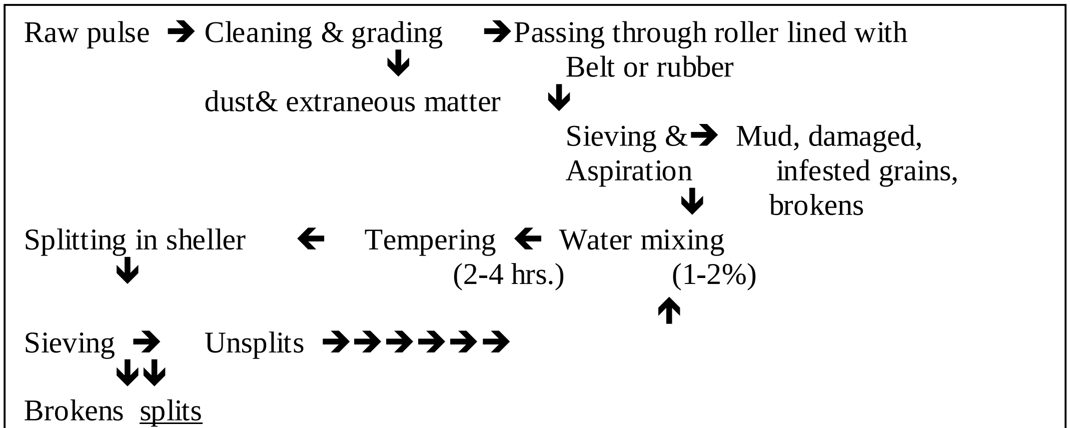


Fig. 6

Fig 6 Green gram/black gram splits-flow chart

10.2.5 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.

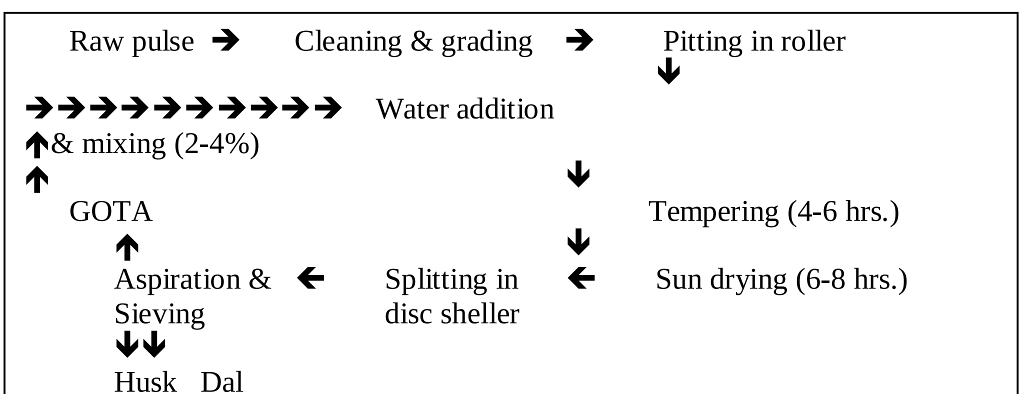


Fig. 7

Fig 7 Process for dehulling peas

Raw pulse → Cleaning & Size grading → Pitting -I → Pitting ï 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

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, statesôprogramme 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

1.1PRODUCTION RELATED

The production potential exhibited under the FLDs conducted by the All India Co-ordinated Research Project (AICRP) in various states during 2013-14 to 2015-16 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) The gap over state average yield and the likely additional return by way of bridging the yield gap over the farmers practices and state average yield. The details crop-wise yield gaps is given as under and also under individual crops is given below:

(TABLE-16.1):TECHNOLOGICAL (YIELD) GAP EXHIBITING THE PRODUCTION RELATED CONSTRAINTS

(Yield: kg/ha; Return: Rs./ha.)

Crop	Yield (kg/ha)			Gap over FP		Gap over SAY		Yield 2016-17 *
	IP	FP	SAY	Actual	%	Actual	%	
Pigeonpea	1394	1078	863	316	29	530	61	787
Chickpea	1502	1244	907	257	21	594	66	860
Rice fallow Chickpea	1275	960	976	315	33	299	31	772
Mungbean(Kh)	781	608	435	173	28	345	79	455
Mungbean(R)	1398	1228	704	170	14	694	99	508
Mungbean(RF)	960	723	532	237	33	428	80	434
MungbeanSummer/Spring	931	559	674	372	66	257	38	717
Urdbean (Kh)	813	622	368	191	31	445	121	614
Urdbean (R)	1203	986	774	217	22	429	55	788
Urdbean (RF)	1185	1002	774	183	18	411	53	788
Lentil	1289	966	777	323	33	512	66	756
Field pea	1225	933	904	292	31	321	36	827
Average	**1163**	**909**	**724**	**254**	**30**	**439**	**65**	**692**

Source-Annual Report- 2016-17, GoI, DPD, Bhopal (Ave. 2013-14 to 2015-16)
*State Average Yield - E&S (Ave. 2011-12 to 2015-16) *Third Advance Estimates 2016-17IP: Improved Practise*
FP:Farmers Practise SAY: State Avergae Yield

1. 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 PULSE 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 ï 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
Podfly and maruca	UP,MP,Bihar, Jhar.,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 & Moongbean	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/intercropping etc.

2. 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.
3. 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.
4. 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.
5. 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.
6. 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.

7. 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 choise 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 2016-17

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
	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

State	Crop	Prevalent Varieties	Recommended Varieties (ICAR/SAUs)
Uttar Pradesh	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 (sometimes 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.

1.3MARKETING CONSTRAINTS

i) Price security, un-organized and distress sale, ruling of open market prices above the MSP, access/connectivity to mandies, farmersô 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 ï foundation ï 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 since 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):CROP-WISE POTENTIAL DISTRICTS WITH 20-30% PROD. SHARE–AI

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
7.	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 ï 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 statesô 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 stateôs potential in a particular/group of pulse crop, may constitute a 'Pulse Board' (similar to'Tur Boardô 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 ôPulse Boardô 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

2.3MARKETING 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, Womenô 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 TARGETS AND STRATEGY TO AUGMENT PRODUCTIION

As per 4th advance estimates for the year 2016-17, total pulses are cultivated on 29.47 million hectares with total production of 22.95 million tonnes. Major states producing total pulses are Madhya Pradesh (6.25 million tonnes), Maharashtra (3.81 million tonnes) Rajasthan (3.08 million tonnes),Uttar Pradesh (2.19 million tonnes) and Karnataka (1.72 million tonnes) followed by Andhra Pradesh, Gujarat, Jharkhand, Telangana, Chhattisgarh, Tamil Nadu and West Bengal producing less than 1.0 million tonnes each.

Total production of gram is 9.33 million tonnes. Major states producing gram are: Madhya Pradesh (3.54 million tonnes), Maharashtra (1.69 million tonnes), Rajasthan (1.39 million tonnes), Uttar Pradesh (0.63 million tonnes), Karnataka (0.58 million tonnes)and Andhra Pradesh (0.42 million tonnes).

Total production of Tur (Arhar) is 4.78 million tonnes. Major states producing Tur (Arhar) are Maharashtra (1.46 million tonnes), Karnataka (0.91 million tonnes), Madhya Pradesh (0.78 million tonnes), Gujarat (0.40 million tonnes), Uttar Pradesh (0.36 million tonnes) and Telangana (0.21 million tonnes).

Moong is cultivated in Kharif and Rabi on 4.33 million hectares with total production of 2.17 million tonnes. Similarly Urd is cultivated in Kharif and Rabi on 4.51 million hectares with total production of 2.81 million tonnes.

1. PRODUCTION PERFORMANCE OF XIIth PLAN &TARGET 2017-18

Commensurate to the tentative demand of pulses by 2017-18 arrived at 22.90 million tonnes, on the basis of behaviouristic approach (including seed, feed and wastage), proposed targets for area, production and productivity are 24.29 million ha, 22.90 million tonnes and 943 kg respectively, which already achieved during 2016-17 as summarized below:

(TABLE-17.1): CROP-WISE PRODUCTION TARGET

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

Crops	Season	XIIth Plan (2012-13 to 2016-17)			Target 2017-18		
		A	P	Y	A*	P	Y
Tur	Kharif	4.20	3.23	769	3.93	4.25	1081
Urd	Kharif	2.70	1.47	544	2.48	1.85	746
	Rabi	0.82	0.63	768	0.79	0.75	949
	Total	3.52	2.10	597	3.27	2.60	795
Mung	Kharif	2.48	1.04	419	2.34	1.65	705
	Rabi	0.97	0.57	588	0.93	0.65	699
	Total	3.45	1.61	467	3.27	2.30	703
Gram	Rabi	8.94	8.48	949	8.68	9.75	1123
Other Pulses	Kharif	1.81	0.78	431	1.81	1.00	552
	Rabi	3.36	2.61	777	3.33	3.00	901
	Total	5.17	3.39	656	5.14	4.00	778
Total Pulses	Kharif	11.19	6.52	583	10.56	8.75	829
	Rabi	14.09	12.29	872	13.73	14.15	1031
	Total	25.28	18.81	744	24.29	22.90	943

Target 2017-18 Area- Normal (Ave. 2011-12 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:

(TABLE-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	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

2.1 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.
- 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.
- 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.

2.2 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 U.P., Central U.P., 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, milletsand groundnut (rainfed upland)	A.P., Malwa Plateau of M.P., Vidarbha ofMaharashtra,North Karnataka,	0.50	0.30	0.30	0.20	0.20	
	Chickpea with barley, mustard, linseed and safflower (rainfed)	South East. Rajasthan, Punjab, Haryana, U.P., Bihar, Vidarbha ofMaharashtra	0.50	0.10	0.20	0.05	0.10	
	Chickpea/lentil with autumn planted /ratoon sugarcane	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,	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	
	Kharif fallow	Urdbean / mungbean in Bundelkhand	1.20	0.30	0.40	0.10	0.15	
	Total		**6.2**	**2.4**	**3.5**	**1.2**	**1.95**	

2.3 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.

(Table-17.4): Comparative analysis of pulses vis-a-vis other cereals like wheat and paddy at enhanced Yields and MSP

S.N.	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

2.4 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): PLANNING FOR REDUCING CROP DURATION

Crop	Present duration	Research strategy	Target	Time frame
Mungbean	65-70 days	Hybridization using cultivated germplasm and wildaccessions 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

2.5 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 and nutrients 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, 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. 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 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.).

2.6 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 744 kg/ha realised during the XIIth Plan, need to be paralleled with the worldôs average yield of 909 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 ôRhizobiumô and ôPSBô takes care of ôNô as well as reduces 25-30% of phosphorus requirement by making available the initial fixed soil ôPô 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 NFSM, need to be ascertained.
- All India district-wise Nutrient map on Micronutrient deficiency prepared by IIPR, Kanpur, IISS, Bhopal,& NBSS &LUP, Nagpur NFSM may be taken by all the states to identify and ensure supply of specific Micronutrient to a particular district under NFSM.

2.7 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 ï 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 ($CaCO_3$, 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 $ZnSo_4$ ha with 0.25 kg lime for Zn deficiency.
- One kg Sodium molybdate per hectare for Mo deficiency.
- Soil application of $ZnSO_4$ @ 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% $FeSO_4$ 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.

2.8 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	Weevilled grains	
Gram	1.0	3.0	3.0	4.0	6.0	5.0	4.0	14.0
Lentil	2.0	-	3.0	4.0	3.0	3.0	4.0	12.0
Arhar	2.0		3.0	4.0	3.0	3.0	4.0	12.0
Urd & Moong	2.0		3.0	4.0	3.0	3.0	4.0	12.0

2.8.1 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	2017-18
Gram	3000	3100	3175	3500**	4000^	4400@
Lentil	2900	2950	3075	3400**	3950@	4250*
Arhar	3850	4300	4350	4625^	5050^^	5450^
Urd	4300	4300	4350	4625^	5000^^	5400^
Moong	4400	4500	4600	4850^	5225^^	5575^

** Including Bonus of Rs. 100 per quintal. ** Including Bonus of Rs. 75 per quintal . ^ Including Bonus of Rs. 200 per quintal. ^^ Including Bonus of Rs. 425 per quintal. @ Including Bonus of Rs. 150 per quintal.*

2.9 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 ñkateela chanaò 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 farmersô 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 Farmersô 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.

2.10 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 ,
Pigeonpea	- 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
Blackgram (Urd)	- 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. - 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
Greengram (Moong)	- 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 ï 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.,

2.11 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

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:

ñPulses Development Schemeò 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 ñSpecial Food Grain Production Programme (SFPP) on Pulsesò 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, ñIntegrated Schemes of Oilseeds, Pulses, Oilpalm and Maize (ISOPOM)ò 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 onò 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 XII Plan. The implementation of the NFSM scheme is continued beyond the XII Plan*i.e.* 2017-18.

  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 ñpulses and oilseeds in dry land areaò under RKVY during 2010-11; Integrated development of 60000 Pulses villages in Rainfed Areas under RKVY during 2011-12 and ñSpecial plan to achieve 19+ million tonnes of Pulses production during Kharif 2012-13ò 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 2017-18, the Pulses development scheme under NFSM was under implementation in 29 states viz. Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Goa, Gujarat, Haryana, Himachal Praedsh, Jharkhand, J&K, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Telangana, Tripura, Uttar

Pradesh, Uttarakhand 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 60:40 per cent up-till 2016-17.

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 ï 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 9% 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), 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) ï 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 farmersô field.

Government of India has allocated Rs.2201.23 crores (CS-1395.00 Cr + SS-806.23 Cr) for NFSM for 2017-18, out of which an amount of Rs. 1371.11 (CS- 850.00 Cr + SS- 521.11 Cr) crores is earmarked for pulses.

- **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)ï Pulses	16
2.	Accelerated Pulses Production Programme (A3P)	16
3.	Special Plan to achieve 19+ million tonnes of Pulses prod. during *Kharif* 2012-13	08
	2014-15 to 2016-17	
1.	National Food Security Mission (NFSM)ï Pulses 2014-15	27
2.	National Food Security Mission (NFSM)ï Pulses 2015-16	27
3.	National Food Security Mission (NFSM)ï Pulses 2016-17	29
4.	Seed Hub-ICAR	150
5.	Breeder Seed Production Programme -ICAR	08
6.	Seed Minikit	NFSM States
7.	Cluster FLDs ï Pulses through 549 KVKs	31366 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

(TABLE-18.3): SUMMARY OF RESEARCH PROJECT FUNDED UNDER OF NFSM-PULSES IN YEAR 2017-18

(Rs. in lakh)

S.No.	Project Title	Implementing Agency	Project Duration	Total Allocation	Allocation for 2017-18	Unspent balance/ Revalid.2016-17	1st Release	2nd Release	Location/ Varieties
1	Enhancing breeder seed production for increasing indigenous production of pulses in India	IIPR, Kanpur	2016-17 to 2018-19	2039.00			407.80 (20 % of allocation)		Rel-2016-17 Rs. 815.60
2	Creation of seed ï hubs for increasing indigenous production of pulses in India	IIPR, Kanpur	2016-17 to 2017-18	22531.08 (150 hubs)	11164.26	768.18	4895.50		
3	Generation advancement and development of new genotypes through pre-breeding in Lentil and Kabuli Chickpea"	ICARDA	2013-14 to 2016-17	320.196 (Revised)		4.89			
4	Enzymatic pre treatment in the processing of Pigeonpea	JAU, Junagarh (Gujarat)	2014-15 to 2016-17			0.21			Junagarh / Var. BDN-2
5	Enhancing productivity through introduction of new high yielding varieties, production technologies in chickpea, green gram, black gram & cowpea.	UAS, Dharwad , Karnataka	2016-17		11.02				
6	Enhancing mothbean and mungbean productivity through high yielding varieties, nutrient management and IPM practices in Western Rajasthan	SKRAU, Bikaner	2014-15 to 2016-17			1.83623			
7	Development of suitable technology for increasing the production of pulses in rice fallows	OUAT, Bhubaneswar	2014-15 to 2016-17	80.37		1.24532			Greengram, Blackgram and Bengalgram
8	Scaling up and popularization of high yielding pigeonpea hybrids for enchancing productivity of small and marginal farmers of Maharashtra,Karnataka& Odisha States of India	ICRISAT, Hyderabad, Telangana	2016-17	77.965				19.49 (committed liability of 2016-17)	ICPH 2740
		ICRISAT, Hyderabad, Telangana	**2018-19**	649.685					Approved for 2018-19 ICPH 2740 & ICPH3762
9	Addressing phytophthora blight disease : An emerging threat of pigeonpea expansion and production	ICRISAT, Hyderabad	2013-14 to 2016-17	400.923 (Revised)		3.33 (committed expen. of 2016-17)	80.0		
10	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)		2.11788			

2. 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- 18.4): 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
IIndPlan (1956-61)	23.71	11.75	494.8	8
IIrd Plan (1961-66)	23.85	11.14	466.8	9
IVthPlan (1969-74)	22.21	10.90	491.4	9
Vth Plan (1974-79)	23.32	11.71	501.4	8
VIthPlan (1980-85)	23.08	11.77	509.8	8
VIIthPlan (1985-90)	23.08	12.54	543.0	9
Post-TMOP Period (includes two annual plans (1990-92)				
VIIIthPlan (1992-97)	22.47	13.34	593.6	12
IXth Plan (1997-02)	21.97	13.15	597.4	13
Xth Plan (2002-07)	22.44	13.35	593.8	14
NFSM Plan Period				
XIth Plan (2007-2012)	23.97	15.85	662	16
XIIth Plan (2012-2017)	25.28	18.81	744	19

2.1 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 significantly increased eleventh to twelfth plan period (2007-12 to 2012-2016). 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, 16% and 19 % of total pulses stablized in irrigated area.

2.2 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)*** and ***Xth Plan (2002-07)*** the country witnessed an average plan period production of 13.34 Million tones and 13.35 million tones respectively, the maximum ever achieved during the pre TMOP Five year plans periods.

During Xth plan (2002-07), inspite of the consecutive droughts/flood in the major pulses growing states of Madhya Pradesh, Rajasthan, Uttar Pradesh, Bihar Andhra Pradesh and Maharashtra and stagnant area coverage, the country harnessed an average production of 13.35 lakh tonnes which may be attributed to TMOPs critical intervention and Central funding support under ***NPDP/ISOPOM*** making a dent on seeds/irrigation and other infrastructural support to farmers.

During the course of implementation of ***NFSM XIIth plan (2013-14 & 2016-17),*** the country witnessed a significant increase in production of pulses *i.e.* ***19.25 Million tons and 22.95 Million tons*** respectively, the maximum ever achieved during ***2016-17.***

2.3 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***, XIth and XIIth plan, productivity was achieved ***662 kg/ha and 744 kg/ha*** respectively. Although this productivity is still below the world's average productivity of 909 kg/ha and as also what has been realized under the frontline demonstrations of ICAR. ***A productivity gap of 56% under total pulses between the FLDs and State average yield is the existing potential and a challenge for both the research and development agencies to harness.***

2.4 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 (VIIIth –Xth plan)***

During the NFSM plan period, irrigation increased upto ***19%,*** attributing the productivity enhancement from 594 kg/ha during Xth Plan (Before NFSM) to ***744 kg/ha during XIIth Plan.***

2.5 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 meet 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 on infrastructure, especially the primary processing storage and value addition.

Policy initiatives must lead for efficiency and help in maintaining balance between domestic production and demand. If 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, however, prevailing market prices of pulses below the MSP need to be strengthened/stabilized for stabilization of area, production and net return of pulses.

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ANNEXURE- I

1. 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	

ANNEXURE-II

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**
*Goa & Kerala States Information updated Ministry Letter No 1-8/2014-NFSM as on Dated:03/02/2016			

PULSES: ALL INDIA- 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)	One irrigation 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 weedings at 25-30 DAS	One hand weedings at 25-30 DAS	One hand weedings at 25- 30 DAS	One hand weedings at 25- 30 DAS	One hand weedings 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 ï 1.25 kg a.i. /ha	Pendimethalin at PE stage @ 1 ï 1.25 Kg a.i./ha	Pendimethalin at PE stage @ 1 ï 1.25 Kg a.i./ha	Pendimethalin at PE stage @ 1 ï 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)	
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

Zone/States / Crop	NWPZ	NEPZ	CZ	SZ	NHZ
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	10gm/kg	10gm/kg	10gm/kg	10gm/kg	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 ï Pre-monsoon irrigation as per requirement Rabi ï 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 ï 1.5 a.i. Kg/ha.	Application of Pre-emergence Pendimethalin /Alachlor/Metachlor @ 1 ï 1.5 a.i. Kg/ha.	Application of Pre-emergence Pendimethalin /Alachlor/Metachlor @ 1 ï 1.5 a.i. Kg/ha.	Application of Pre-emergence Pendimethalin /Alachlor/Metachlor @ 1 ï 1.5 a.i. Kg/ha.	Application of Pre-emergence Pendimethalin /Alachlor/Metachlor @ 1 ï 1.5 a.i. Kg/ha.
Maturity/Harvesting					
Kharif	190-200 DAS Oct.-Dec.	190-200 DAS Nov.-Jan.	175-190 DAS Oct.-Jan.	150-170 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 (1:1 row)	Early - Pigeonpea- wheat Late ï Pigeonpea +Sorghum Moong/Urd/Sesame by pairing pigeonpea row at 40/80 cm & planting one row of intercrop	Pigeonpea+ Groundnut (4 :2)Pigeonpea + Soybean (4: 2) Pigeonpea + Sorghum (2:1) Pigeonpea +Urdbean(1:1)	Pigeonpea+ Sorghum (2:1) Pigeonpea + Groundnut (4: 2) Pigeonpea+Mung/Urdbean / Cowpea (1:1)	Pigeonpea:Sorghum (1:1) Pigeonpea:Pearl millet (1:1) Pigeonpea+ Cauliflower/Capsicum

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	J& K, H.P., Uttrakhand NEH States (Sikkim, Nagaland, Meghalaya, Manipur, Mizoram, Tripura, Aru.Pradesh)
Sowing Time					
Kharif	1^{st} fortnight of July/ Onset of monsoon	1^{st} fortnight of July/ Onset of monsoon	2^{nd} fortnight of June	2^{nd} fortnight of June	1^{st} week of July to 1^{st} week of Aug.
Rabi	-	-	2^{nd} fortnight of Oct.- 2^{nd} fortnight of Nov.	2^{nd} fortnight of Oct.- 2^{nd} fortnight of Nov.	-
Spring/ Summer	2^{nd} fortnight of March - 1^{st} week of April	2^{nd} fortnight of March -1^{st} week of April	2^{nd} fortnight of March -1^{st} week of April	Summer: 2^{nd} fortnight of March -1^{st} week of April Spring: 1^{st} fortnight of Dec.	-
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	20-25 kg/ha; 30X10 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	-
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	-
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; May-June 70-90 DAS; Mar.-April	-
Cropping System	Intercropping of Moong bean /Urdbean with summer planted ï sugarcane (2:1) and Sunflower (6:2 row ratio)	Intercropping of Moong bean /Urdbean with summer planted ï sugarcane (2:1) and Sunflower (6:2 row ratio)	Intercropping of Moong bean /Urdbean with summer planted Sunflower (6:2 row ratio)	Rice ï Rice-Greengram/ Blackgram Mungbean/Urdbean+ Sugarcane(2:1)	Intercropping of Moong bean /Urdbean with summer planted ï sugarcane (2:1) and Sunflower (6:2 row ratio) Moong/Urd: Capsicum

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 10 kg seed	Rhizobium + PSB, one packet each for 10 kg seed	Rhizobium + PSB, one packet each for 10 kg 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 weedings at 30 DAS	One hand weedings at 30 DAS	One hand weedings at 30 DAS	-	One hand weedings at 30 DAS
Chemical	Pre- emergence application of Pendimethalin @ 0.75-1.0 Kg/ha.	Pre-emergence application of Pendimethalin @ 0.75-1.0 Kg/ha.	Pre-emergence application of Pendimethalin @ 0.75-1.0 Kg/ha.	-	Pre-emergence application of Pendimethalin @ 0.75-1.0 Kg/ha.

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
Fieldpea					
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. ï Ist week of Nov.	Third week of Oct. ï Ist week of Nov.	Third week of Oct. ï Ist week of Nov.	2nd week of Oct- 2nd week of Dec	Third week of Oct. ï 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

Zone/States Crop	NWPZ	NEPZ	CZ	SZ	NHZ
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 ï pea	-	Sequential cropping after rice, maize or pearl millet Field pea- Vegetable crops
Lathyrus					
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	-	Rhizobium culture 10gm/kg.	Rhizobium culture 10gm/kg.	-	Rhizobium culture 10gm/kg.

Zone/States Crop	NWPZ	NEPZ	CZ	SZ	NHZ
					Lathyrus Continued
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)
Weed Management					
Manual *(if soil condition permits)*	-	one hand weedings at 30 ï 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 ï 1.5 kg a.i./ha	Application of Pendimethalin as pre-emergence stage @ 1 ï 1.5 kg a.i./ha	-	Application of Pendimethalin as pre-emergence stage @ 1 ï 1.5 kg a.i./ha.
Maturity/ Harvesting	-	110-120 DAS	95-100 DAS	-	110-120 DAS
Cropping System	-	-	Can be grown with Rice as relay/ Utera	-	-
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, Meghalaya, Manipur, Mizoram, Tripura, Aru.Pradesh)
Sowing Time					
Kharif	Last June - last July	-	-	-	Last June ï 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

Zone/States Crop	NWPZ	NEPZ	CZ	SZ	NHZ
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) *(Soil test based applied as basal)*	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 Fluchloralin at pre-emergence stage @ 2 ml/l of water	Application of Fluchloralin at pre-emergence stage @ 2 ml/l of water	Application of Fluchloralin at pre-emergence stage @ 2 ml/l of water	Application of Fluchloralin at pre-emergence stage @ 2 ml/l of water	Application of Fluchloralin at pre-emergence stage @ 2 ml/l of water
Maturity/ Harvesting	80-100 DAS Sep.-Oct.	80-100 DAS Jan.-Feb.	80-100 DAS Dec.-Jan.	80-100 DAS Dec.-Jan.	80-100 DAS Sep.-Oct.

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	2^{nd} fortnight of July	-	2^{nd} 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	2nd fortnight of October	2nd fortnight of October	2nd fortnight of October	2nd fortnight of October	-
Spring	-	-	-	-	Spring (Lower hills) 2nd 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
					Rajmash Continued
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 @ 1 to 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 1 to 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 1 to 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 1 to 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 1 to 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 10gm/Kg.	Rhizobium culture 10gm/Kg.	Rhizobium culture 10gm/Kg.	Rhizobium culture 10gm/Kg.	Rhizobium culture 10gm/Kg.

Zone/States Crop	NWPZ	NEPZ	CZ	SZ	NHZ
Cowpea Continued					
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 @ 1 to 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 1 to 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 1 to 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 1 to 0.75-1 kg a.i./ha in 500-600 liters as pre-emergence	Pendimethalin @ 1 to 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 Oct.-Nov.	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)

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 vitavex 50% WP) or Microbial (Trichoderma viridae)	12-16 g (Urd, Moong, Cowpea, Moth) 60-80 g (Gram, Pea, Lathyrus) 40-45 g (Lentil, Horsegram) 25-35 g (Urd, Moong, Cowpea, Moth & Pigeonpea) 70-100 g Lentil, Lathyrus, Horsegram 100-150 g Gram, Pea & Rajmash
iii.	Fertilizer (DAP) Gypsum	40 kg for Urd, Moong, Cowpea, Moth, Lentil 40-60 kg Pea, Gram, Pigeonpea (High amount for late sown crop) 50 kg (1 bag) DAP+50 kg Urea - Rajmash 40-50 kg
iv.	Herbicides (Pendimethalin 30 EC PE) Lasso/Alachlor 50 ECPE	1.3 to 2 kg commercial product depending on soil type and weed intensity 750 g commercial product depending on soil type and weed intensity
v.	Insecticidal spray Indoxacarb 15.8% EC	300-400 ml in 500-1000 liters of water per spray for all pulse most critical spray at flowering.

ANNEXURE- V

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, As chochyta 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- VI

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.

ANNEXURE– VII

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*
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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

INTERNATIONAL	
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
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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 ï 500 030, Ph: 040-24598444, 24016141 Fax : 040-24017969, Email : director.iior@icar.gov.in
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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
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6	Bidhan Chandra Krishi Viswavidyalaya Website: http://www.bckv.edu.in;Email:bckvvc@gmail.com,sarojsanyal@yahoo.co.in	Mohanpur, Nadia-741252, West Bengal
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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,	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
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

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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 Website: http://www.ouat.ac.in ; Email: ouat_dproy@yahoo.co.in ,	Bhubaneshwar-751003, Orissa
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
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

	Name, email & website	Address
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
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

	Name, email & website	Address
51	University of Agricultural Sciences Website: http://www.uasraichur.edu.in; Email: vcuasraichur10@rediffmail.com	PB 329, Raichur ï 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

ANNEXURE-VIII

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 (AP)
	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
	Varsha Biosciences and Technology 17-1-382/SN/1/2, MNR Colony, Balaji Nagar, Hyderabad (AP)
	Godavari Fertilisers and Chemicals Ltd., Beach Road, Kakinada - 533 003, Dist. East Godavari; Tel: (0884) 2302420-27
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

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 Biofertiliser 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, ñ Makka Buildingò, Jinsi, BHOPAL-462 008
	Agri Business & Development Cooperative, Bhopal, Madhya Pradesh
	Indore Biotech Input & Research (P) Ltd., Indore, Madhya Pradesh
	Jawahar Lai Nehru Krish Vishwa Vidyalaya (JNZKW), Jabalpur, Madhya Pradesh
	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, Email: nafbioind@nafed.nic.in
	National Fertilizers Ltd., Vijaipur-473 111, Dist. Guna, Madhya Pradesh, Fax: (07544) 273109,
	M.P. State Agro Industries Development Corporation, Biofertiliser Plant, Agro Complex, Indrapuri C, Raisen Road, , Bhopal (MP)

Madhya Pradesh	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)
Maharashtra	Regional Bio-fertiliser Development Centre, New Secretariat Building, East Wing,Nagpur-440 001
	Arun Bio-fertilisers, 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, Agri.l Microbiology Section, College of Agri.,Pune-411 005
Orissa	Regional Biofertiliser Development Centre, A-156, Shahid Nagar, Bhubneshwar-751 007 (Orrisa)
	Orrisa Agro Industries Corporation Ltd., 95,Satyanagar, BHUBNESHWAR (Orrisa)
	Deputy Director of Agriculture (PP), Bhubneshwar (Orrisa)
	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) 2503746Fax:(0674) 2503396, Email:oaic7@ hotmail.com
Punjab	Microbiological Laboratory, Punjab Agricultural University, Ludhiana, Punjab.
	Bio-fertiliser Production Unit, Office of the Chief Agriculture Officer, LUDHIANA (PB)
Rajasthan	Nafed Biofertilizer, SPL-80 RIICO Industrial Area, BHARATPUR-321 001 (RAJ)
	Mahaveer Bio Lab, 49, Sunderwas (North), Udaipur, 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
	NAFED Biofertiliser, SPL-80, RIICO Industrial Area, Bharatpur, Rajasthan
	State Biofertilizer Quality Control Laboratory, Department of Agri., Durgapura, Jaipur Rajasthan
	Rhizobia Scheme Agriculture Department , Agri.Research Station, Durgapura, JAIPUR-302 018 , e-mail-mailto:ggopalc@rediffmail.com/ ggopalc@rediffmail.com

Tamil Nadu	Regional Research Station, Tamil Nadu Agricultural University,, Piyur-635 112, Via-Kaveripattinam, Dharmapuri District
	Elbitech Innovations Ltd., 46 & 48, 2nd Floor, Masilamani Road, Balajinagar, Chennai-606 014 Tamil Nadu
	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
	Bio Fertilizer Production Unit, Department of Agriculture, Kudumianmalai - 622 104, Pudukottai
	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
	Innova Agrotech (P) Ltd., 2/527-1, East Street, Kulloorchanadai, Virudhanagar-626 001, Chennai
	Jaypee Biotechs, 25, Chinniah School Street, Virudhnagar- 626 001, Tamil Nadu
Uttar Pradesh	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
	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 DevelopmentCorporation 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

ANNEXURE – IX

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

S. No.	Centres	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, Ranchi, 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
	Total	**3119.23**	**255.30**	**5400.00**	**1350.00**	**8001.00**	**2010**	**13401**	**3360**	**16520.2**	**3615.30**

ANNEXURE-X

CONTACT DETAILS

i) DAC&FW: CROPS DIVISION

Designation	Name	Contact number	Email
Agriculture Commissioner			
Agriculture Commissioner	Dr. S.K. Malhotra	9968978191(M) 011-23383549 (O)	ag.comm@nic.in
PPS to AC	R.N. Sharma	011-23381012(O)	rns119@yahoo.co.in
Joint Secretary (Crops)			
Joint Secretary (Crops)	Dr. B. Rajender	9599428809 (M) 011-23381176 (O)	b.rajender@ias.nic.in
PPS to JS (Crops)	Smt. S. Jayasree	9711123632 (M)	sjayasree1961@gmail.com
PA to JS (Crops)	Shri R.N. Bansal	9810863107 (M) 011-23381176 (O)	rnbansal164@gmail.com
Additional Commissioner (Crops)			
Additional Comm. (Crops)/CC	Dr. A.P. Singh (NFSM)	9811137009 (M)	
DC (Crops)	Dr. M.N. Singh (NFSM & BGREI)	9811572591(M)	mnsingh1959@gmail.com
Director (Crops)	Dr. R.K. Trivedi I/C Director (Crops)	9818713591(M) 011-23382021(O)	rk2001in@yahoo.com
NFSM Cell			
AD (Crops), Pulses	Shri. Ashok Kumar Singh	9650669923(M)	aksadcrops@yahoo.in
AD (Crops),(Coordination & CC)	Dr. Manoj Kumar	9891090571(M)	mksadcrops@gmail.com
AD (Crops), Research Projects	Smt. G. Sandhya	9873319305(M)	gsrani71@gmail.com
Sr. Programmer(NFSM-Website)	Sh. Suraj Prakash	8826836683(M)	suraj0786@gmail.com
Technical Support Group (TSG Cell)			
Consultant(NFSM-Rice)	Sh. Shamsher Singh	9810284556 (M)	shamsher123@yahoo.com
Consultant (Pulses)	Dr. Upkar Singh Sadana	9815118709 (M)	upkar.pau@gmail.com

ii) CROP DEVELOPMENT DIRECTORATES

Dr. Virendra Singh, Director Directorate of Rice Development, DAC&FW, Ministry of Agri.& Farmers Welfare, 5th Floor, 'G' Wing, Karpuri Thakur Sadan, Kendriya Karmachari Parisar (GPOA), Ashiana Digha Road, Patna ï 800 025 Bihar Tel: 0612-2262720, 2262843 Fax: 0612-2262720 E-mail: drdpatna@nic.in	Dr. M N Singh, Director Directorate of Wheat Development, C.G.O.Complex ï I, 3rd Floor,, Kamla Nehru Nagar, Ghaziabad-201002 (U.P.) Tele : 0120 - 2711380, 2710897 Fax: 0120 - 2711380 E-mail:, dwd.wheat@gmail.com Website : http://dwd.dacnet.nic.in
Dr. A. K.Tiwari, Director Directorate of Pulses Development, 6th Floor, Vindhyachal Bhavan, Bhopal-462004 (M.P.) Tel : 0755-2550353, 2572313 Telefax : 0755-2571678 E-mail: dpd.mp@nic.in;Website: dpd.gov.in	Dr. .K. Manoharan, Director Directorate of Jute Development, Nizam Palace Campus ,234/4, Acharya Jagdish Bose Road, Kolkata- 700020 (West Bengal) Tel. no: 033-22879465/9337/9189 Fax :033-22879521 E-mail : djd@nic.in ;Website: djd.dacnet.nic.in
Dr. A.L.Waghmare, Director-Incharge Directorate of Sugarcane Development, 8th Floor, Hall No.3, KendriyaBhavan,Aliganj, Lucknow - 226024 (U.P) Tel. no.: 0522-2323913 Fax: 0522- 2323913 ; E-mail: dsd@nic.in;Website:dsd.dacnet.nic.in	Dr. Subhash Chandra, Director-Incharge Directorate of Millets Development, Kendriya Sadan Room No. 210, 2nd Floor, Block-A,Sector-10,Vidyadhar Nagar, Jaipur-302023 Tel: 0141-2233004 Fax: 0141-2235631 E-mail: dmdrj00@nic.in ;Website:dmd.dacnet.nic.in
Shri R. P Singh, Director Directorate of Cotton Development, Bhoomi Sarvekshan Bhavan, Near Centre Point School, Katol Road,Nagpur-440013 (Maharashtra) Tel. No 0712-2585831 Fax : 0712-2595505 E-mail: directordocd@rediffmail.com Website : dcd.dacnet.nic.in	Dr. K. Ponnuswamy, Director-Incharge Directorate of Oilseeds Development, Telhan Bhavan, Himayat Nagar, Hyderabad-500029 (A.P.) Tel. No.:040-23224381; Fax :040-23224381 E-mail: dod@nic.in ; Website :oilseeds.dacnet.nic.in

iii) METROLOGICAL CENTRE, GOVT. OF INDIA: BHOPAL (MP)

Name of Officer	Designation	Contact No.	Email
Dr. Anupam Kashyapi	Director	9425016480 (M);0755-2552743 (O)	anupamkashapi@gmail.com
Dr. G.D. Mishra	Scientist-A	9425080082 (M);0755-2559892 (O)	gdm.met@gmail.com
Shri K.K. Devangan	Scientist-A	9425028005 (M);0755-2554272 (O)	devangank@gmail.com

iv) AGRICULTURE INSURANCE COMPANY OF INDIA LTD.

Name of Officer	designation	Contact	Email
Shri Krishna Prasad	Regional Manager	7471118605(M) 0755-4026101(O)	krisnap@aicofindia.org
HDFC-ERGO			
Shri Umesh Soni	Regional Manager	9893473192 (M) 0755-2550807 (O)	umesh.soni@hdfcergo.com
ICICI-LOMBARD			
Shri Ravendra Kushwaha	Manager	7389918115 (M)	ravendra.kushwaha@icicilombard.com
Shri Suman Roy Choudury	Regional Manager	9776644458 (M) 0755-3036534(O)	suman.roychoudury@icicilombard.com
NAFED Biofertilizers			
Dr. Alok Dwevedi	Deputy Manager	9302113381(M) 0731-2720450 (O)	nafbioind@nafed.nic.in
Dr. K.R.Rao	Chief Manager	0755-2464775 (O)	bhopal@nabard.org

v) ICAR/ GOVT. OF INDIA INSTITUTIONS IN MP

Name of Officer	Designation	Contact No.	Email Address
Central Institute of Agricutural Engineering, Bhopal			
Dr. K.K. Singh	Director	0755-2737191 (O) 0755-2734016 (F)	director@ciae.res.in
Indian Institute of Soil Science, Bhopal			
Dr. Ashok Kumar Patra	Director	0755-2730946 (O) 0755-2733310 (F)	director@iiss.ernet.in
Directorate of Marketing & Inspection, Bhopal			
Shri L.K. Singh	Dy. Agricultural Marketing Advisor	0755-2551847 (O) 0755- 2551847 (F)	dirmkti@mp.nic.in
Central Farm Machinery Training and Testing Institute, Budni			
Shri J.J.R. Narvare	Director	07564-234729 (O) 07564-234743 (F)	fmti-mp@nic.in
ICAR –Indian Institute of Soybean Research, Indore			
Dr. V.S. Bhatiya	Director	9303224211 (M) 0731-2476188 (O)	dsrdirector@gmail.com, soybean.director@icar.gov.in
ICAR-I.A.R.I., Regional Wheat Research Centre, Indore			
Dr. S.V. Saiprasad	Principal Scientist & Incharge	9425957920 (M) 0731-2702921 (O)	iariindore@yahoo.co.in

vi) MP STATE SEED CERTIFICATION AGENCY (MPSSC)

Division	Name of Officer	Designation	Contact		Email Address
			Office	Mob.	
Bhopal	Shri. K.S. Tekam	Managing Director	2600860	9617879099	mpsscaho@gmail.com

vii) MP STATE ORGANIC CERTIFICATION AGENCY (MPSOCA)

Division	Name of Officer	Contact		Email Address
		Office	Mob.	
Bhopal	Shri. R. S. Chamrakar, Managing Director	2600609	9425087499	md.mpsoca@gmail.com

viii) STATES/UTs: CHIEF SECRETARIES

State	Name of the Officer	Contact No.& Fax	Email
Andhra Pradesh	S.P. Thakur	09490115360 (M) 040-23456604/ 23456028 (O) 040-23451861 (F)	cs@ap.gov.in sptucker@ap.gov.in
Arunachal Pradesh	Smt. Sakuntala Gamlin	09402275048 (M) 0360-2212595/ 2006161(O) 0360-2212446 (F)	cs-arunachal@nic.in
Assam	Sh. V.K. Pipersenia	09435552145(M) 0361-2261403/ 2261120 (O) 0361-2237200 (F)	cs-assam@nic.in
Bihar	Sh. Anjani Kumar Singh	09473191444 (M) 0612-2215804 (O) 0612-2217085 (F)	cs-bihar@nic.in
Chhattisgarh	Shri Vivek K.Dhand	09981107775 (M) 0771-2221207/ 2221208 (O) 0771-2221206 (F)	csoffice.cg@gov.in vivekdhand@nic.in
Gujarat	Shri J.N.Singh	09978405930 (M) 079-23250301/23250302 (O) 079-23250305 (F)	chiefsecretary@gujarat.gov.in
Goa	Shri R.K.Srivastava	07774076440 (M) 0832-2419402(O) 2415201(F)	cs-goa@nic.in
Haryana	Shri Depinder S. Dhesi	09779274455 (M) 0172-2740118(O)2740317 (F)	cs@hry.nic.in
Himachal Pradesh	Shri V.C.Pharka	09418089118 (M) 0177-2621022(O)2621813 (F)	cs-hp@nic.in
Jammu & Kashmir	Shri. Brij Raj Sharma	0191-2544338 (O) 0194-2546188 (F)	cs-jandk@nic.in
Jharkhand	Shri RajBala Verma	09431307171(M) 0651-2400240(O) 2400255(F)	csjharkhand@nic.in
Karnataka	Dr. Subhash Chandra Khuntia	09868247979 (M) 080-22252442(O)22258913 (F)	cs@karnataka.gov.in
Kerala	Shri S.M. Vijayanand	0471-2333147 (O)2327176 (F)	chiefsecy@kerala.gov.in
Madhya Pradesh	Shri Basant Pratap Singh	0755-2441370 (O) 0755-2551521(F)	cs@mp.nic.in
Manipur	Shri O. Nabakishore Singh	09612160645 (M) 0385-2451144 (O) 2452629(F)	csmanipur@nic.in
Meghalaya	Shri K. S. Kropha	09402196384 (M) 0364-2224801(O) 2225978(F)	cso-meg.nic.in
Mizoram	Shri. Lalmalsawma	07085055193 (M) 0389-2322411/2322429(O) 0389-2322745 (F)	cs_miz@rediffmail.com

State	Name of the Officer	Contact No.& Fax	Email
Nagaland	Shri Pankaj Kumar	09436299175 (M) 0370-2270082(O) 2270057 (F)	csngl@nic.in
Orissa	Shri Aditya Prasad Padhi	09937067849 (M) 674-2534300 (O) 2536660 (F)	csori@nic.in
Punjab	Shri Sarvesh Kaushal	09872000616 (M) 172-2740860 (O) 2742488 (F)	cs@punjabmail.gov.in
Rajasthan	Shri. Om Prakash Meena	09928924241(M) 0141-2227254 (O) 2227114(F)	csrajasthan@nic.in
Sikkim	Shri A.K.Srivastava	09434086959 (M) 03592-202315 (O) 204323(F)	csskm@hub.nic.in
Uttarakhand	Shri. ShtrugnaSingh	07409999000 (M) 0135-2712100 (O)2712500 (F)	csuttaranchal@nic.in chiefsecyuk@gmail.com
Tamil Nadu	Dr. P.Ram Mohana Rao	09790311411(M) 044-25671555(O)25672304 (F)	cs@tn.gov.in
Telangana	Dr. Rajiv Sharma	09849026631(M) 040-23452620 (O)23453700 (F)	cs@telangana.gov.in
Tripura	Shri.Yashpal Singh	09436120050 (M) 0381-2323200 (O) 2414013(F)	cstripura@nic.in
UttarPradesh	Shri. Deepak Singhal	09968296672 (M) 0522-2338212 (O) 2239283 (F)	csup@nic.in
West Bengal	Shri. Basudev Banerjee	09903100000 (M) 033-22145858 (O)22144328 (F)	chiefsec@wb.gov.in
Delhi	Shri.K.K.Sharma	09811585352 (M) 011-23392100 (O)23392102 (F)	csdelhi@nic.in
Lakshadweep	Shri.Vikram Dev Dutt	04896-262255(O) 04896-262184 (F)	lk-admin@nic.in
Daman &Diu	Shri. Praful Patel	0260-2230700 (O) 0260-2230775 (F)	Administratordd@gov.in
Andaman & Nicobar	Shri Anindo Majumdar	03192-233110 (O) 03192-232656 (F)	csandaman@nic.in
Pondicherry	Shri. Manoj Parida	07867002024 (M) 0413-2334145 (O) 2337575(F)	cs.pon@nic.in
Chandigarh	Shri. D.S.Dhesi	09779274455 (M) 0172-2740581 (O) 2740557 (F)	cs@hry.nic.in

ix) STATES/UTS: SECRETARY/ PRINCIPAL SECRETARY (AGRICULTURE)

State	Name of the Officer	Contact No. & Fax	Email
Andhra Pradesh	Shri B. Rajshekar Secy (Agri.)	0965225255/ 07032709403 (M) 040-23450356/23450357 (O)	brajsekhar@gmail.com
Arunachal Pradesh	Shri Talem Tapok Secretary (Agriculture)	09436895200 (M) 0360-2213136 (O)	tapok57@gmail.com
Assam	Shri A.Baruah Secretary (Agriculture)	09954088272 (M) 0361-2237277 (O)	amlanbaruah12@gmail.com
	Shri K.K.Mittal APCTelefax	09854080000 (M) 0361-2237267 (O)	agriculturedepartmentassamgmail.com
Bihar	Shri Sudhir Kumar Pr.Secretary (Agri.)	09473191440 (M) 0612-2215373/2217365 (O)	agridepbih@nic.in
Chhattisgarh	Shri Ajay Singh Addl. Chief Secretary (Agri.)	09630030405 (M) 0771-2510962 (O) 0771-2510103 (F)	ajaysingh@nic.in

State	Name of the Officer	Contact No. & Fax	Email
Gujarat	Shri Sanjay Prasad Principal Secretary (Agri)	09978406348 (M) 079-23250803(O) 23252365(F)	secagri@gujarat.gov.in
Goa	Shri B.R.Singh Secretary (Agri.)	09075088399 (M) 0832-2419423(O) 2419649 (F)	secycssect.goa@nic.in
Haryana	Dr. Abhilaksh Likhi Principal Secretary (Agri.)	09417178929 (M) 0172-2740669 (O) 0172-2770203 (F)	acsagriharyana@gmail.com
Himachal Pradesh	Shri Arvind Mehta, Secretary (Agriculture)	096508764515 (M) 0177-2621894 (O)	
Jammu & Kashmir	Shri Sandeep Kumar Nayak Principal Secretary (Agriculture)	09419506789 (M) 0194-2506114 (O) 0194-2506222 (F)	sknjkias@gmail.com
Jharkhand	Dr.Nitin Kumar Kulkarni Secretary (Agri.)	09431121011 (M) 0651-2490578 (O) 0651-2490643 (F)	jhagriculture@gmail.com
Karnataka	Shri Maheshwar Rao Principal Secretary (Agri.)	09448067345 (M) 080-22250284/ 22032595(O) 080-22251420 (F)	secretaryagri.gok@gmail.com
Kerala	Dr. Raju Narayanaswamy Pr. Secretary (Agri.)	09447713372 (M) 0471-2333043 (O) 0471-2333115 (F)	narayan5@ias.nic.in
Madhya Pradesh	Shri Rajesh Rajora Principal Secretary (Agri)	09425680111 (M) 0755-2559542 (O) 0755-2551892 (F)	psagriculture@mp.gov.in
Maharashtra	Shri Vijay Kumar Principal Secretary(Agriculture)	09987109898 (M) 022-22025357 (F)	acs.agri@maharashtra.gov.in
Manipur	Shri T. H. Gopen Metei Secretary (Agriculture)	09436026796 (M) 0385-2451916 (O)	
State	Name of the Officer	Contact No. & Fax	Email
Meghalaya	Shri P Sampat Kumar, Commissioner Secretary (Agriculture)	099184079 (M) 0364-2500019 (O)2225978 (F)	pskumarias@gmail.com
Mizoram	Shri. B.Lalhmingthanga, Secretary (Agri.)	09436369867 (M) 0389-2322252(O)2319233 (F)	hmingtea.ias@gmail.com
Nagaland	Shri T. Imkonglgmba APC (Agriculture)	09436000108 (M) 0370-2270120 (O)2271019(F)	apc-ngl@nic.in
Orissa	Shri Manoj Ahuja Principal Secretary	09937210000 (M) 0674-2391325 (O)2393948(F)	agrsec.or@nic.in
Punjab	Shri N. S. Kalsi Addl. Chief Secretary (Dev)	09999997861(M) 0172-2740459 (F)	nskalsi@gmail.com
Rajasthan	Smt. Neelkamal Darbari Principal Secretary (Agriculture)	09971860444 (M) 0141-5116893(O)5103626 (F)	psacsagr@gmail.com
Sikkim	Shri Puneet Kansal Commissioner-cum Secretary (Agriculture)	09475448463 (M) 03592-231892 (F)	agri.secretary.sikkim.gmail.com

State	Name of the Officer	Contact No. & Fax	Email
Uttarakhand	Dr. Ranvir Singh Addl. Chief Secretary (Agriculture)	09412992136 (M) 0135-2712057(O)2712803 (F)	ranvir0001@yahoo.com
TamilNadu	Shri Gagandeep Singh Bedi Pr. Seceretary (Agri.)	09940067508 (M) 044-25674482(O)25674857 (F)	agrisec@tn.gov.in
Telangana	Shri C.Partha Sarathi APC & Secy (Agriculture)	09440288188 (M) 040-23452269 (O)23457086 (F)	prl.secy.agritelangana@gmail.com
Tripura	Dr.G.S.G.Iyangar Principal Secretary (Agriculture)	09436462735 (M) 0381-2416036 (O)2418065 (F)	dr.gsgayyangar@gmail.com
Uttar Pradesh	Shri Rajneesh Gupta Principal Secretary (Agriculture)	09454410247 (M) 0522-2237617 (O)2235488 (F)	rgupta.up@nic.in
West Bengal	Shri Sanjeev Chopra, Addl. Chief Secretary (Agriculture)	09868504041 (M) 033-22145506 (O)22143045 (F)	ps-agriwb@nic.in
Delhi (UT)	Shri Sandeep Kumar Secretary cum Comm. (Dev)	09825678400 (M) 011-23941773(O)23957289 (F)	cdevlop@nic.in
Andaman & Nicobar	Ms.R.Menaka Secretary (Agriculture)	09434286688 (M) 03192-233345 (O)244201 (F)	devcom@and.nic.in
Puducherry	Shri. D.Manikandan Secretary (Agriculture)	09597706680 (M) 0413-2338300 (O)	secyit.pon@nic.in
Daman & Diu	Shri Umesh Kumar Tyagi Secretary (Agriculture)	7874500222 (M) 0260-2230698 (O)2230049 (F)	collectordaman@gmail.com
Lakshadweep	Dr.TariqThomas Sec. Agri.	09447703001 (M) 04896-262235 (O) 263180 (F)	tariq.thomas@ias.nic.in

x) STATES/UTS: DIRECTOR (AGRICULTURE)

State	Name of the officer	Contact No. &Fax	Email
Andhra Pradesh	Shri Dhananjaya Reddy	09849908692 (M) 0863-2216461(O) 0863-2216463 (F)	comag@nic.in comagr.ap@gmail.com
Arunachal Pradesh	Shri Hage Kano	09436252188 (M) 0360-2244252(O)2244252 (F)	rkvyita@rediffmail.com
Assam	Shri B.N. Faikia	07670004458 (M) 0361-2332215/2333877 (O) 0361-2332796 (F)	agridept@nic.in
Bihar	Shri Himanshu Kumar Rai	09431818704 (M) 0612-2204245/2215895 (O) 0612-2204245 (F)	diragribih@nic.in diragri.bih@gmail.com
Chhattisgarh	Shri M.S. Kerketta	09425542364 (M) 0771-2442015 (O) 2442036 (F)	diragricg@nic.in
Gujarat	Dr. B.R. Shah	09978405999 (M) 079-23256073 (O) 079-23256227/ 23256159 (F)	diragr@gujarat.gov.in
Goa	Shri Ulhas Pai Kakode	09422457328 (M) 0832-2465443/ 2465840 (O) 0832-2465441 (F)	diragri.goa@nic.in
Haryana	Shri Bhupinder Singh	09468296051 (M) 0172-2570662 (O) 0172-2563242 (F)	agriharyana2009@gmail.com agriculture@hry.nic.in
Himachal Pradesh	Shri Somraj Kalia	09418031268 (M) 0177-2830162/ 2830618/ 2830174 (O) 0177-2830612 (F)	krishinidesh@yahoo.com
Jammu & Kashmir	Shri Showkat Ahmad Beigh	09419036454 (M) 0194-2310675 (O) 2311569 (F)	diragrikmr@gmail.com
Jharkhand Shri	Jatashankar Choudhary	09431115706 (M) 0651-6550124 (O) 2233549 (F)	directoragriculture@gmail.com
Karnataka	Shri B.Y. Srinivas	07259004007 (M) 080-22242746 (O)22212818 (F)	agridir@kar.nic.in
Kerala	Biju Brabhakar, IAS	09447063200 (M) 0471-2304480 (O) 2304230 (F)	krishidirector@gmail.com
Madhya Pradesh	Shri M.L. Meena	09425036356 (M) 0755-2551336 (O) 2572468 (F)	mpkrishi@mp.gov.in diragri@mp.gov.in
Maharashtra	Shri Vikas Deshmukh Commissioner of Agriculture	09420490003 (M) 020-26123648/ 26126150 (O) 020-26127707 (F)	commagricell@gmail.com com.pune@agri.maharashtra.gov.in
Manipur	Shri Louis Ngasainao	09436032021 (M) 0385-2452019 (O)	l.ngasainao@gmail.com amdmn@nic.in
Meghalaya	Ms. D.Syiemiong	09436104524 (M) 0364-2222460 (O) 2223228 (F)	directoratejdashillong@gmaill.com
Mizoram	Dr. C. Lalzarliana	09436142745 (M) 0389-2322437 (O) 2322511(F)	Zara.agril@gmail.com
Nagaland	Smt. Rongsdninla	09436001048 (M) 0370-2243116 (O) 2243116 (F)	agrilanngl@gov.in
Punjab	Shri J.S. Bains	09915938757 (M) 0172-2970602(O) 2970609 (F)	director.agri@punjab.gov.in
Rajasthan	Shri Ambrish	09829084089 (M)	dir_agri@rediffmail.com

	Kumar, IAS	0141-2227089 (O)2227088 (F)	
Sikkim	Shri Kiran Pradhan	09832017868 (M) 03592-232942 (O) 231892 (F)	kiran_pradhan_2000@yahoo.com
Uttarakhand	Shri C. Gauri Shankar	09410996912 (M) 0135-2772677 (O) 2771881(F)	dir.agri.uttarakhand@gmail.com
Tamil Nadu	M. Rajendran, IAS	09751534567 (M) 044-28524894 (O) 28521998 (F)	diragri@tn.nic.in
Telangana	Smt. G.D. Priyadarshini	09866894624 (M) 040-23232107 (O) 23383520 (F)	agriculture.telangana@gmail.com
Tripura	Dr. D.P. Sarkar	09436124922 (M) 0381-2323778 (O)2323883 (F)	krishibhawantripura@gmail.com tmcelltripura@gmail.com
Uttar Pradesh	Shri Mukesh Kumar Srivastava	09235629301 (M) 0522-2205869 (O) 2206582 (F)	dirag@nic.in
West Bengal	Dr. Paritosh Bhattacharyya	09433829300 (M) 033-22627713 (O) 22145307 (F)	direct6oragriculturewb@gmail.com
Delhi	Ms Sakshi Mittal	9910182340 (M) 011-23818601(O)23818298 (F)	dagri@sansad.nic.in
Puducherry	Dr.A.Ramamurthy	09443235329 (M) 0413-2336977 (O) 2337121(F)	
Andaman & Nicobar	Shri Anjan Kumar Das	09434272016 (M) 03192-233257 (F)	diragri@gmail.com
Daman & Diu	Shri Debendra Dalai	08980090090 (M) 0260-2230856 (O)	ddir-agri-dd@nic.in
Chandigarh	Shri. Bhupinder Singh	09468296051 (M) 0172-2570662 (O)	agriharyana2009@gmail.com agriculture@hry.nic.in

xi) MADHYA PRADESH

a) JOINT DIRECTOR

Division	Name of the officer	Contact No.	Email
Bhopal	Shri. S.M. Balpandey	9424438655 (M) /0755-2540890 (O)	zmagribho@mp.gov.in
Hòbad	Shri. B.L. Billaiya	9424386019 (M) /07574-254098(O)	zmagrihos@mp.gov.in
Indore	Shri. R.S. Sisodiya	9425369155 (M) /0731-2366967 (O)	zmagriind@mp.gov.in
Ujjain	Shri. D.K. Pandey	9425165585 (M) /0734-2513781(O)	zmagriujj@mp.gov.in
Rewa	Shri. S.C. Singadiya	9826040554 (M) /07662-252078(O)	zmagrirew@mp.gov.in
Shahdol	Shri. K.P. Pandey (I/c)	9424604197 (M) /07652-240005(O)	zmagrishd@mp.gov.in
Gwalior	Shri. Rajeev Joshi	9893287715 (M) /0751-2361250 (O)	zmagrigwa@mp.gov.in
Sagar	Shri. D.L. Kori	9424674942 (M) /07582-222810(O)	zmagrisag@mp.gov.in
Jabalpur	Shri. K.S. Naitam	9425163967 (M)/ 0761-2624390(O)	zmagrijab@mp.gov.in

b) DEPUTY DIRECTOR OF AGRICULTURE

Division/ District	Name of the officer	Contact No.	Email
Bhopal			
Bhopal	Shri. A.K. Nema	9826293761 (M)/ 0755/2542829 (O)	ddagribho@mp.gov.in
Sehore	Shri. Avnish Chaturvedi	9425186313 (M)/ 07562/ 224044 (O)	ddagriseh@mp.gov.in
Vidisha	Shri. P.K. Choukasay	9424729262 (M)/ 07592/ 233153 (O)	ddagrivid@mp.gov.in
Raisen	Shri. A.K. Upadhaya	9926502259 (M)/ 07482/ 222039 (O)	ddagrirai@mp.gov.in
Rajgarh	Shri. R.P.S. Nayak	9926464067 (M)/ 07372/ 255059 (O)	ddagriraj@mp.gov.in
Hoshangabad			
HôBad	Shri. J.S. Gurjar	9424454098 (M)/ 07574/ 251003 (O)	ddagrihos@mp.gov.in
Betul	Shri. Shiv Singh Rajput	9827152096 (M)/ 07141/ 234327 (O)	ddagribet@mp.gov.in
Harda	Shri. M.P.S. Chandravat	9589978791(M)/ 07577/ 225610 (O)	ddagrihar@mp.gov.in

Indore			
Indore	Shri.Rameshwar Patel	9425916760 (M)/ 0731/ 2362767 (O)	ddagriind@mp.gov.in
Dhar	Shri.P.L. Sahu	9425417442 (M)/ 07292/ 222285 (O)	ddagridha@mp.gov.in
Khnadwa	Shri. O.P. Chore	9425086087 (M)/ 0733/ 2223234 (O)	ddagrikhd@mp.gov.in
Jhabua	Shri. G.S. Trivedi	9826213800 (M)/ 07392/ 244241 (O)	ddagrijha@mp.gov.in
Khargone	Shri. Champalal Kevda	9827615021(M)/ 07282/ 232228 (O)	ddagrikhr@mp.gov.in
Barwani	Dr. Ajit Singh Rathore	9827089129 (M)/ 07290/ 223471 (O)	ddagribar@mp.gov.in
Burhanpur	Shri. M.S. Devke	9406637546 (M)/ 07325/ 241753 (O)	ddagribur@mp.gov.in
Alirajpur	Shri. R.S. Solanki	9424535884 (M)/ 07394/ 234144 (O)	ddagriali@mp.gov.in

c) DEPUTY DIRECTOR OF AGRICULTURE

Division/ District	Name of the officer	Contact No.	Email
Ujjain			
Ujjain	Shri. S.K. Sharma	9826212740 (M)/0734/ 2513102 (O)	ddagriujj@mp.gov.in
Dewas	Shri. S.K. Meena	9826364078 (M)/07272/ 222060 (O)	ddagridew@mp.gov.in
Mandsaur	Shri. R.L. Jamre	9826720115 (M)/07422/ 241452 (O)	ddagmds@refiffmail.com
Ratlam	Shri. K.S. Khapediya	9826779447 (M)/07412/ 270447	ddagrirat@mp.gov.in
Shajapur	Shri. Sanjay Doshi	9425490730 (M)/07364/ 228936	ddashajapur@yahoo.co.in
Neemach	Shri. N. Rawat	7697386565 (M)/07423/ 230209	ddagrinee@mp.gov.in
Agar Malwa	Shri. R.P. Kaneriya	9753889914 (M)/07362/ 258554	ddagriaga@mp.gov.in
Rewa			
Rewa	Shri. S.K. Mahore	9589127831 (M)/ 07662/ 250070	ddagrirew@mp.gov.in
Satna	Shri. R.S.Sharma	9424686245 (M)/ 07672/ 223227	ddagrisat@mp.gov.in
Sidhi	Shri. K.K. Pandey	9425830492 (M)/ 07822/ 252254	ddagrisid@mp.gov.in
Singroli	Shri. G.S. Mohniya	9425922984 (M)/ 07805/ 234327	ddagrisin@mp.gov.in
Shahdol			
Shadol	Shri. J. S. Pandram	9425484712 (M)/ 07652/ 241318	ddagrishd@mp.gov.in
Umariya	Shri. N.P. Suman	9425368204 (M)/ 07653/ 222769	ddagriuma@mp.gov.in
Annuppur	Shri. Ashish Pandey	9424315112 (M)/ 07659/ 222349	ddagrianu@mp.gov.in
Gwalior			
Gwalior	Dr. Anand K. Badoniya	9407852416 (M)/ 0751/ 2467920	ddagrigwa@mp.gov.in
Datia	Shri. R.K. Ganeshe	9425374959 (M)/ 07522/ 234582	ddagridat@mp.gov.in
Guna	Shri. U.S. Tomar	9425442794 (M)/ 07542/ 252713	ddagrigun@mp.gov.in
Shivpuri	Shri. R.S. Shakyawar	9826224385 (M)/ 07492/ 234378	ddagrishiv@mp.gov.in
Ashoknagar	Shri.S. S. Marawai	7828912646 (M)/ 07543/ 220361	ddagrish@mp.gov.in
Morena			
Morena	Shri.Vjay K. Chorasiya	9826385520 (M)/ 07532/ 226450	ddagrimor@mp.gov.in
Bhind	Shri.Dilip S. Kushwaha	9926217911(M)/ 07534/ 230525	ddagribhi@mp.gov.in
Sheopurkalan	Shri. Pujya Gujre	9406534523 (M)/ 07530/ 222132	ddagrishe@mp.gov.in
Sagar			
Sagar	Shri. P.S. Kirar	9424470305 (M)/ 07582/ 240334	ddagrisag@mp.gov.in
Damoh	Shri. B.L. Kuril	9425439280 (M)/ 07812/ 222018	ddagridam@mp.gov.in
Chhatarpur	Shri. Manoj K. Kashyap	9826254173 (M)/ 07682/ 248206	ddagricha@mp.gov.in
Tikamgarh	Shri.Ramswarup Gupta	9425046811(M)/ 07683/ 242346	ddatkg@rediffmail.com
Panna	Shri. Ravindra K. Modi	9425372341(M)/ 07732/ 252060	ddagripan@mp.gov.in
Jabalpur			
Jablapur	Dr. Anand M.Sharma	9407852916 (M)/ 0761/ 2624359	ddagrijab@mp.gov.in
Mandla	Shri. R.B. Sahu	9425419673(M)/ 07642/ 250728	ddagrimal@mp.gov.in
Chhindwara	Shri. K.P. Bhagat	9424718910 (M)/ 07162/ 247163	ddagrichi@mp.gov.in
Dindori	Shri. Salil K. Dhagat	9826884595 (M)/ 07644/ 234058	ddagridin@mp.gov.in
Balaghat	Shri. Rajesh Tripathi	9406904009 (M)/ 07632/ 241355	ddagribal@mp.gov.in
Seoni	Shri. Sushil K. Nigam	9039494735(M)/ 07692/ 220509	ddagriseo@mp.gov.in
Narsinghpur	Shri. Jitendra Singh	9425153450 (M)/ 07792/ 230364	ddagrinar@mp.gov.in
Katni	Shri. A.P. Suman	8719984018 (M)/ 07622/ 221982	ddagrikat@mp.gov.in

d) PRINCIPALS OF STATE AGRICULTURE EXTENSION & TRAINING CENTRE

District	Training centre	Officer Name	Contact No.	Email Address
Raisen	Obbedullaganj	Shri. S.D. Raut	9425664299 (M) 07480/ 224058 (O)	priae.oganj@gmail.com
Hôbad	Pawarkheda	Shri. B.R. Lokhande	9826018549 (M) 07574/ 227254 (O)	prnpowar@rediffmail.com
Betul	Betul Bazar	Shri. K.P. Phole	9752453029 (M) 07141/ 268205 (O)	-
Indore	Indore	Shri. R.C. Mahore	9406840160 (M) 0731/ 2360046 (O)	aetcindore@gmail.com
Khargone	Satrathi	Shri. S. Chouhan	9827839980 (M) 07285/ 280834 (O)	-
Ujjain	Ujjain	Smt. Neelum S.Chouhan	9424356521 (M) 0734/ 2521117 (O)	a.e.t.c.ujjain@yahoo.in
Ratlam	Jaora	Shri.Prithvi S. Chouhan	8120435047 (M) 07414/ 228361 (O)	principalaetc.jaora@gmail.com
Sagar	Sagar	Shri. Namdev Hedau	9827851941 (M) 0758 222018 (O)	aetcagrisag@mp.gov.in
	Nogaon	Shri. N.K. Jain	9406948186 (M) 0768 256324 (O)	pringtcnow@yahoo.com
	Jabalpur	Shri. D.D. Vishvakarma	8959841086 (M) 0761/ 2680380 (O)	aetcjbp@rediffmail.com
Balaghat	Baraseoni	Shri. Rajesh Tripathi	9406904009 (M) 07633/ 253026 (O)	prin_cipal@yahoo.com
Narsinghpur		Shri. K.L. Koshta	9926660844 (M) 07792/ 236583 (O)	aetcnarsinghpur@yahoo.in
Dindori		Dr. Suresh K. Patel	9407062973 (M) 07644/ 234713 (O)	aetcdin@mp.gov.in
Gwalior	Aantry	Shri. O.P.S. Narwariya	9425757986 (M) 07525/ 272227 (O)	-
Shivpuri		Shri. R.S. Shakyawar	9826224385 (M) 07492/ 222858 (O)	-
Morena		Shri. Vijay K. Chourasiya	9826385520 (M) 07532/ 234225 (O)	-
Sheopur		Shri. Rajeev Shukla	9827626635 (M) 07530/ 223363 (O)	
Rewa	Kuthlia	Shri. U.P. Bargri	9630720097 (M) 07662/ 296236 (O)	aetc.kuthlia@gmail.com
Singroli		Shri. M.P. Kumhar	9893903836 (M)	principal.singrauli@gmail.com

e) DIRECTORATE OF AGRICULTURE ENGINEERING

Division	Name of Officer	Designation	Contact No.
Directorate	Shri. Rajeev Choudhary	Director	9425152693 (M); 0755-2583313 (O)
	Shri. Pawan Singh Shyam	Joint Director	9425338890 (M); 0755-2589893(O)
	Shri. Santosh Kumar Gorani	Agri. Engineer	9827227828 (M); 0755-2612427 (O)
Bhopal	Shri. Sharad K. Naranvare	Agri. Engineer	9826289760 (M); 0755-2736200 (O)
Indore	Shri. Deepak Padlikar	-do-	9826323082 (M); 0731-2368440 (O)
Gwalior	Shri. Rajesh Tiwari	-do-	90099785588 (M); 0751-2364595 (O)
Rewa	Shri. Gopichand Marssakolle	-do-	9424351916 (M)07662-222223 (O)
Jabalpur	Shri. S.K. Chourasiya	-do-	8871270421(M); 0761-2680928 (O)
Sagar	Shri. Vinaykant Sonwani	-do-	9893421277 (M); 07582-241554 (O)

f) **DIRECTORATE OF HORTICULTURE & AGRO-FORESTRY** *(Website- www.mphorticulture.gov.in)*

Division	Name of Officer	Designation	Contact No.
Directorate of Horticulture			
Bhopal	Shri.Dharam Singh	Deputy Director	7898861196 (M); 0755-2550768 (O)
Directorate of Agro-Forestry			
Bhopal	Shri. Satyanand, IFS	Director	0755-2578491/ 0755-2768159 (O)
	Shri. Anil K. Kharache	Joint Director	9406527414 (M);0755-2760200 (O)
	Shri. M.L. Hirwane	Joint Director	9907081500 (M);0755-2767413 (O)
	Shri. R.B. Patel	Joint Director/I/c	9425406136 (M); 0755-2770889 (O)
Hoshangabad	Shri. S.R. Asati	-do-	9407252016 (M);07574-252160 (O)
Training Centre Panchmarhi	Shri. S.P.S. Parihar	-do-	997178138 (M);0758-252643 (O)
Gwalior	Shri. R.B. Rajodiya	-do-	9425973234 (M);0751-2463722 (O)
Indore	Shri. S.L. Nagar	-do-	9425165038 (M);0731-2710085 (O)
Ujjain			9425165038 (M);0734-2510358 (O)
Rewa	Shri. P.K. Singhal	-do-	9425376757 (M);07662-256516 (O)
Jabalpur	Shri. P.K. Singhal	-do-	0761-4626543 (O)
Sagar	Shri. T.R. Katwale	-do-	9479539356 (M);07582-227879

g) **STATE AGRICULTURE MARKETING (MANDI) BOARD** (Website:www.mpmandiboard.com)

Division	Name of Officer	Designation	Contact No.	Email Address
Head Office Bhopal	Shri. Arun Kumar Pandey (Managing Director)	MD	9425036003(M) 0755-2553429	mdmandiboard@gmail.com
	Shri. Gyan Singh Thakur	Add. Director	9826187751 (M) 0755-4082125(O)	adgstmpsamb@gmail.com
	Shri. Rajesh Singh Kourav	-do-	8989218495 (M) 0755-2556210(O)	jdmsamb@gmail.com
	Shri. A.P.S. Solanki	-do-	9425012170 (M) 0755-4270561(O)	jdmpsamb@gmail.com
	Dr. Hardayal Verma		9893257267 (M) 0755-2577846(O)	adhdvmpsamb@gmail.com
Bhopal	Shri. Vinay Nigam	Additional Director	9425010706 (M) 0755-2550834 (O)	-
Ujjain	Shri. C.S.Vashishta	Joint Director	98262286220 (M) 0734-2518120 (O)	-
Gwalior	Shri. S.K. Kumre	-do-	9425425281 (M) 0751-2472504 (O)	-
Sagar	Shri. R.P. Chakravarthy	-do-	9425174685 (M) 07582-231440 (O)	-
Jabalpur	Shri. Nagesh Singh	Deputy Director	906527240 (M) 0761-2677945 (O)	-
Rewa			07662-221131 (O)	
Indore	Shri. Praveen Verma	-do-	9826468529 (M) 0731-2400487 (O)	-

h) MP STATE SEED & FARM DEVELOPMENT CORPORATION (MPSSFDC) (Website: www.mpsfdc.org)

Division	Name of Officer	Designation	Contact No.	Email Address
Head Office	Dr. R.K. Gupta, IFS	Managing Director	2775048 (O)	-
	Shri. R.G. Gupta	Finance Manager/I/c Marketing Manager	8889514967 (M) 2775045 (O)	-
	Shri. N.K. Agrawal	Ass.Finance Manager	9826648410 (M)	-
Bhopal	Shri. R.L. Aousari	Area Manager	9826391262 (M) 0755-2469924 (O)	mpbeejrobpl@sancharnet.in
Indore	Shri. Virendra Singh Baghel	-do-	94075660400 (M) 0731-2461709 (O)	mpsscind@dataone.in
Ujjain	Shri. S.S. Bariya	-do-	9926531983 (M) 0734-2512181	mpsscujn@sancharnet.in
Gwalior	Shri. B.K. Gupta	-do-	9893602609 (M) 0751-2420322 (O)	mpsscgwl@sancharnet.in
Sagar	V.K.S. Gaur	-do-	9425026281 (M) 07582-236773 (O)	mpseeds@sancharnet.in
Jabalpur	Shri. B.L. Jatav	-do-	9424313621 (M) 0761-2647453 (O)	mpseeds@sancharnet.in
Satna	Shri. P.K. Sahu	-do-	9826576303 (M) 07672-223107 (O)	mpssfd_nigam@dtaone.in

i) SEED TESTING OFFICER

Division	Name of Officer	Contact	
		Office	Mob.
Bhopal	Shri. S.P. Ahirwar	0755-2589971	9993383916
Jabalpur	Shri. S.K. Dhariwal	0761-2681952	9893068697
Indore	Shri. Sheel Kumar Singh	0731-2386285	99264112380
Ujjain	Shri. A.S. Bhanvar	0734-2524968	9425478365
Dhar	Shri. S.S. Verma		9981541580

14. STATE INSTITUTES/SAUs/ORGANIZATION

Office	Name of Officer	Designation	Contact No.	E-mail Address
Disaster Management Institute	Dr. Rakesh Dubey	Director	9893250923 (M) 246671(O); 2466653 (F)	director@dmibhopal.nic.in
M.P. Council of Science & Technology	Prof. Promod K. Verma	DG, Scientific Advisor		dg@mpcost.nic.in
IFFCO	Shri M.L. Joshi	State I/c		iffco@nic.in
KRIBHCO	Shri J K Yadav	Senior Manager (Marketing)	9425301374 (M) 2572164 (O)	-
IFFDC	Dr. Devendra Singh	Project Manager	9425014829/ 9981173983 2481317 (O)	-
NABARD	Shri. R.N. Kulkarni	Chief General Manager	2464775 (O)	-
PHD Chamber of Commerce & Industries	Shri Rajendra Kothari	Resident Director	9893016682 (M)	pdhcci@del2.vsnal.net.in
National Dairy Development Board	Dr. Subhankar Nanda	Deputy Manager	9439542588 (M)	snanda@nddb.coop

Office	Name of Officer	Designation	Contact No.	E-mail Address
Indian Society of Agribusiness Professionals (ISAP)	Shri Suresh Motwani	Regional Coordinator	09329450167 (M)	suresh@isapindia.org
MP Water & Land Management Institute	Shri Rajesh Prasad Mishra	Director	2492673 (O)	walmi@rediffmail.com
M.P. State Warehousing	Mr. Chandrahas Dubey	Managing Director	2600061 (O) 2587095 (F)	mpwlcho@mpwarehousing.com, hompwlc@mpwarehousing.com,
Central Warehousing Corporation	Shri. Arvind Chaudhri	Regional Manager	2571275 (O)	rmbpl.cwhc@nic.in
Deptt. of Economics and Statistics	Dr. Rajendra Kumar Mishra	Commissioner	2551321 (O)	des@mp.nic.in
Indian Institute of Forest Management	Giridhar A Kinhal,	Director	2775998 (O)	
State Cooperative Seed Federation Ltd.	Shri. S.S. Bhatnagar	Advisor	9425602483 (M) 2551493 (O)	dssb.seed@gmail.com, seedfedcomp@gmail.com
National Information Centre	D. Bhaskar Rao		9826987255 (M) 2551265 (O)	rao.bhaskar@nic.in
National Seed Certification	Shri Aseem Gangwar	Regional Manager	9893655474 (M) 2580638 (O)	rm.bhopal@nsc.gov.in
RVSKKV, Gwalior	Dr S K Srivastava,	Director (Extn)	9425682110 (M)	desrvskvv@rediffmail.com
RCVP Noronha Academy of Administration	Smt. Kanchan Jain	Director General	2445000(O)	dgrcvpnaa@mp.gov.in
Commisionarate land Record, Gwalior	Shri. Rajeev Ranjan	Commissioner	9479959313 (M) 0751-2441200(O)	-
Directorate of Economics and Statistics, M.P.	Dr. Rajendra Mishra	Commissioner	9406955822 (M) 2551395 (O)	-
Department of Public Relation	Shri. Anupam Rajan	Commissioner	9425161391 (M) 2556831 (O)	-
M.P. State Sahkari Beej Utpadak Vipdan Sangh	Shri. K. K. Dwivedy	Managing Director	9424652412 (M) 2551493 (O)	seedfedcomp@gmail.com

15. SAUs: RVSKVV, GWALIOR (KRISHI VIGYAN KENDRA)

KVKs	Name of PC	Contact No.	Email Address
Ashoknagar	Dr. B.S. Gupta	9826828842 (M);07543-283505(O/F)	kvkashoknagar@rediffmail.com
KVK, Badwani	Dr. D.K. Jain	9425511228(M); 07290-26330	kvkbadwani@rediffmail.com
KVK, Lahar, Bhind	Dr. Rupendra Kumar	9424601102 (M);07529-262019 (O/F)	kvklahar@rediffmail.com
KVK, Datia	Dr. Rajkumar Singh Tomar	9425893829 (M);07522/235150 (O/F)	datiyakvk@rediffmail.com kvkdatiya@rediffmail.com
KVK, Dewas	Dr. R.P. Sharma	9754032456 (M); 07272/259139 (O/F)	kvkdewas@rediffmail.com
KVK, Dhar	Dr. Ashok Kumar Badaya	8989712677 (M); 07292/223351 (O/F)	kvkdhar@rediffmail.com
KVK, Aron, Guna	Dr. (smt.) Sunita Mishra	9425887198 (M)	kvkguna@rediffmail.com
KVK, Gwalior	Dr. Raj Singh Kushwah	9575336761 (M);0751/2364090 (O/F)	kvkgwalior@rediffmail.com
KVK, Jhabua	Dr. Indra Singh Tomar	9425188028(M); 07392/244367(O/F)	kvkjhabua@rediffmail.com
KVK, Khandwa	Dr. Dharmendra Kumar Vani	9424095701(M); 0733-2225604 (O) /2222119 (F)	kvk_khandwa@rediffmail.com
KVK, Khargone	Shri Y.K. Jain	9425450255(M); 07282-231726 (O)/231500 (F)	kvkkhargone@rediffmail.com
KVK, Mandsaur	Dr. S.K. Badoriya	9425678634 (M); 220746 (O)	kvkmandsaur@rediffmail.com
KVK, Morena	Dr. Satendra Pal Singh	9479309680 (M); 07532/232995 (O/F)	kvkmorena@rediffmail.com
KVK, Neemuch	Dr. C.P. Pachauri	9329468805(M); 07423/228955 (O/F)	kvkneemuch@rediffmail.com
KVK,Rajgarh (Biaora)	Dr. K.S. Kirar	8269820257 (M); 07372-282655 (O) /254405 (F)	kvkrajgarh@rediffmail.com
KVK, Shajapur	Dr. Rajeev Umat	9926879645 (M)/ 222290 (O)	kvkshajapur@rediffmail.com
KVK, Sheopur (Baroda)	Dr. Kayam Singh	9009534624 (M); 07531/276674 (O/F)	kvksheopur@rediffmail.com
KVK,Shivpuri	Dr. M.K. Bhargava	9926360869 (M); 280388 (O)	kvkshivpuri@rediffmail.com
KVK, Ujjain	Dr. A.K. Dixit	9893424607 (M); 0734/2526976 (O/F)	kvkujjain@rediffmail.com

16. SAUs: JNKVV, JABALPUR (KRISHI VIGYAN KENDRA)

KVKs	Name of PC	Contact No.	Email Address
KVK, Badgaon	Dr. R.L. Raut	9425896702 (M);07632/246729 (O)	kvkbadgoan@rediffmail.com
KVK, Betul	Dr. Vijay Verma	9425637718 (M); 07141/229742 (O); 268201 (F)	kvkbetul@rediffmail.com
KVK, Chhatarpur	Dr. (smt.)Veena Pani Shrivastva	9826742776 (M); 07685/244354(O) 256541 (F)	kvk_chhatarpur@rediffmail.com
KVK, Chhindwara	Dr. Surendra K. Pannase	9425844883(M); 07162/225463 (O); 225463(F)	kvk_chhindwara@rediffmail.com
KVK, Damoh	Dr. Alok Kumar Dubey	940707550 (M); 07812/226565 (O); 226565 (F)	kvkdamoh@rediffmail.com
KVK, Dindori	Dr. Harish Dixit	9425029446 (M); 07644/234961(O); 234961 (F)	kvkdindori@rediffmail.com
KVK, Harda	Dr. R.C. Sharma	9009801134 (M); 07577/226021(O) 226021(F)	kvkharda@rediffmail.com
KVK, Jabalpur	Dr. D.P. Sharma	9425156657 (M); 0761/2681626 (O); 2681626 (F)	kvkjabalpur@rediffmail.com
KVK, Katni	Mr. A.K. Tomar	9425085385 (M); 07622/268515 (O); 268515 (F)	kvk_katni@rediffmail.com
KVK, Mandla	Dr. H.S. Rai	9926223756 (M); 07642/260693 (O); 260279 (F)	kvkmandla@rediffmail.com
KVK, Narsinghpur	Dr. D.K. Pahalwan	9716884438 (M); 07792/237015 (O/F)	kvknarsinghpur@rediffmail.com
KVK, Panna	Dr. B.S. Kirar	9425596756 (M); 07732/250510 (O); 253478 (F)	kvkpanna@rediffmail.com
KVK, Powarkheda	Dr. A.K. Shrivastva	9926236942 (M); 07574/227255(O); 227297 (F)	kvkpowarkheda@rediffmail.com
KVK, Rewa	Dr. A.K. Pandey	9425124291 (M); 07662/221426 (O); 220857 (F)	kvkrewa@rediffmail.com
KVK, Sagar	Dr. K.S. Yadav	9425854876 (M); 07582/271339 (O); 288249 (F)	kvk_sagar@rediffmail.com
KVK, Seoni	Dr.N.K. Bisen	9424866714 (M); 07692/233765(O); 233765 (F)	kvkseoni@gmail.com
KVK, Shahdol	Dr.M. Singh	9425181832 (M); 07652/241790 (O/F)	kvkshahdol@gmail.com
KVK, Sidhi	Dr. M.S. Baghel	9827373305 (M); 07822/252384 (O/F)	kvksidhi.2008@rediffmail.com
KVK, Tikamgarh	Dr. B.L. Sahu	9425814518 (M); 07683/245034 (O/F)	kvktikamgarh@rediffmail.com
KVK, Umaria	Dr. K.P. Tiwari	9425888060 (M); 07653/222539 (O/F)	kvkumaria@rediffmail.com

17. KVK NGOs

S.No.	NGOs	Name of Officer	Address
1.	President, Lok Mata Devi Ahilya Ba Holkar Social National Mission,	Dr. Ajeet Singh Programme Coordinator O- 07325-253055 09301227210	Maszid Complex, Shanwara, Village Shankarpura Khurd and Sandas Khurd, Burhanpur-450331,
2.	Secretary, Bhopal Bbhoj Krishi Vigyan Kendra,Near Village Naktara, PDKVAAS, (KVK-Raisen)	Dr. Swapnil Dubey Programme Coordinator kvkraisen@sify.com	PO. Bankhedi, NH-86 Ext., Raisen Sagar Road, Distt. Raisen-466 551 0748-2264791, 2761831 9826499725, 9425019337
3	The Chairman, Centre for Rural Dev. & Environment, Bhopal (KVK-Sehore)	Shri. J.K. Kanojia Programme Coordinator crdekvksehore@gmail.com	Krishi Vigyan Kendra, CRDE, Vill-Sewania Ichhwar, Distt. Sehore-462043 Phone 07561-275075 9926980176,
4	Chairman, Kasturba Gandhi National Memorial Trust, Kasturva Gram, Indore; (KVK-Indore)	Dr. Alok Kumar Deshwal Programme Coordinator kvk_indore@rediffmail.com	Krishi Vigyan Kendra, Kasturba Gandhi National Memorial Trust Kasturabagram , Khandwa Road, Distt. Indore-452 020 Office- 0731-2874552 9826945936, 9425075620
5.	President, Kalukheda Shiksha Samiti, Ratlam (KVK-Ratlam)	Dr. Mukesh Kumar Shrivastava Programme Coordinator kvk_ratlam@yahoo.com kvkratlam@gmail.com	Krishi Vigyan Kendra, Shiksha Samiti, Kalukheda, Distt. Ratlam-457339 O- 07414-276180, 238727, M- 9827317670
6.	Chairman, Deen Dayal Research Institute, Rani Jhansi Road, New Delhi (KVK-Satna)	Shri. R.S. Negi Programme Coordinator O-07670-263440, M-9425887138	Krishi Vigyan Kendra, Majhgaon, Distt. Satna-485 331
7	Ashis Mondal ï Managing Trustee and Director Asha, NGO	info@asabhopal.org	Action for Social Advancement (ASA), E-5/A Girish Kunj, Above State Bank of India, (Shahpura Branch), Arera colony, Bhopal,Madhya Pradesh-462016 Phone :755-2427369, 4057926
8	Smt. Nirmla Buch, Head, Mahila Chetna Manch, NGO	mcm.grants@gmail.com	Kalyani Working Women Hostel Campus, Shivaji Nagar, Bhopal (M.P) Pin ï 462016 Phone No: 0755-25513649752919122
9	Vidisha Social Welfare Organization	Ngo.vsw@gmail.com	MN: 9425148866

18. AGRICULTURE RESEARCH CENTRES

A. JNKVV, Jabalpur

Research Centre	District	Contact No.	Email Address
Zonal Agriculture Research Stations	Chhindwara	07162-225560 (O)/225850 (F)	adrcwa@gmail.com
	Tikamgarh	07683-245136 (O)/ 245034 (F)	deantikamgarh@rediffmail.com
	Powarkhera	07574-227257 (O)/ 22725 (F)	adr_powarkhera@rediffmail.com
	Jabalpur	0761-2681074 (O/F)	drsjnkvv@gmail.com
Regional Agriculture Research Stations	Rewa	07662-220732 (O)/ 220857 (F)	deanrewa@rediffmail.com
	Sagar	07582-288284 (O)/288250 (F)	ps_dhrtc@yahoo.com
	Dindori	07644-234016 (O)/234961 (F)	opdubey_dindori@yahoo.com
	Waraseoni	07633-280177 (O)/280178 (F)	drvntiwari@gmail.com
Agriculture Research Stations	Garhakota	07585-290662 (O)/258775 (F)	ps_dhrtc@yahoo.com
	Tendani	07162-280032 (O)/225850 (F)	adrcwa@gmail.com
	Mohgaon	07162-285023 (O)/225850	adrcwa@gmail.com

(B) **RVSKVV, Gwalior**

Research Centre	District	Contact No.	Email Address
Zonal Agriculture Research Stations	Khargaon	07282-231500 (O)/231500	zars_kgn@rediffmail.com
	Morena	07532-234426 (O)/232287	adrmorena@rediffmail.com
	Jhabua	07392-244367 (O/F)	kvkjhabua@rediffmail.com
Regional Agriculture Research Stations	Ujjain	0734-2517376	rarsujjain2008@gmail.com
Agriculture Research Stations	Bagbai, Gwalior	9926250769	v.kansana@yahoo.com
	Badwah	0731-2701683	sasrvskvv@gmail.com
	Bhind	07534-260005	sars.bhind@rediffmail.com
	Bhopal	0755-2854340	arsentkhedi2008@gmail.com
	Joura	07414-288163	arsjaora2008@gmail.com
	Sirsod, Gwalior	9406785220	dtpmasters@yahoo.com

19. CHHATTISGARH

a) AGRICULTURE DEPARTMENT CONTACT DETAILS

Name	Designation	Contact No.	E-Mail Address
SECRETARIAT			
Shri Ajay Singh I.A.S.	Additional Chief Secretary & Agriculture Production Commissioner	2221150 2510962 (O)	ajaysingh@nic.in
Shri Anoop Kumar Shrivastava I.F.S.	Secretary (Agril.)	2221147 (O) 2510103 (F)	
Shri K.C. Paikara	Joint Secretary (Agril.)	2510933 (O)	kcpaikara61@gmail.com
Shri R. K. Rathore	Under Secretary (Agril.)	2510763 (O)	rkrathore999@gmail.com
Shri Xavier Kerketta	Under Secretary	2510066 (O)	
DIRECTORATE OF AGRICULTURE			
Shri M. S. Kerketta	Director (Agriculture)	2442015 (O) 2442036 (F)	diagricg.cg@nic.in
Shri C.J. Khatri	Addl. Dir. Fin.	2443702	-
Shri D. D. Mishra	Addl. Dir. Agril. Engr.	2442031 (O) 2442018 (F)	-
Dr. S. R. Ratre	Addl. Dir. Agril.	2443733 (O)	-
Shri P.C. Baghel	Joint Dir. Agril.	2442063(O)	-
Shri C.B. Londhekar	Joint Dir. Agril.	2442030(O)	-
Shri S.K. Agrawal	Joint Dir. Agril (Engg.)	2443504(O)	-
Shri R. K. Chandrawanshi	PS to DAG & Dy. Dir. Agril.	2442015	-
Shri L. N. Sharma	Dy. Dir. Agril.	2413523	-
Shri Vikas Mishra	Dy. Dir. Agril.	2442015	-
Shri R.L. Khare	Dy. Dir. Agril.	2443420	-
Shri B.K. Mishra	Dy. Dir. Agril.	2442760	-
Shri C.K. Pardeshi	Dy. Dir. Agril.	2413523	-
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Shri J.P. Pathak	Registrar, Co-operative		
Dr. S. K. Patil	V.C. Indira Gandhi Krishi V.V. Raipur		
Shri Sameer Vishnoe I.A.S.	M.D. (C.G. Rajya BeejAvam Kri shi VikasNigam)	-	-
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Dr. S.K. Pandey	Director, Animal Husbandary	2443124(O)	-
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Dr. N. K. Dixit	Dy. Dir. Agrl. (Fertilizer quality control)	2443595 (O)	-
Shri. C.L. Jain	State Agri. Mgmt. &Exten. Train. Inst, C.G. Govt., SAMETI	9424242600 (M) 2443982 (O) 2443981(F)	-
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Shri P.C. Bghel	Joint Director, Nodal BGREI	94242-13551 (M) 0771-2442063 (O)	-

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