CRIDA Technical Bulletin 1/2015

Compensatory *Rabi* Production Plan-2015

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad
Natural Resource Management Division
Indian Council of Agricultural Research, New Delhi

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Ch Srinivasa Rao, KV Rao, G Ravindra Chary, YG Prasad, AVM Subba Rao, DBV Ramana, JVNS Prasad, CA Rama Rao, PK Pankaj, KA Gopinath, BK Kandpal, M Maheswari, VUM Rao and AK Sikka

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Citation: Ch Srinivasa Rao, KV Rao, G Ravindra Chary, YG Prasad, AVM Subba Rao, DBV Ramana, JVNS Prasad, CA Rama Rao, PK Pankaj, KA Gopinath, BK Kandpal, M Maheswari, VUM Rao and AK Sikka. 2015. Compensatory *Rabi* Production Plan-2015. Technical Bulletin 1/2015. Central Research Institute for Dryland Agriculture and Natural Resource Management Division, Indian Council of Agricultural Research, Hyderabad. 66p.

Copies: 1000

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Published by

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Printed at:

Balaji Scan Pvt. Ltd.,
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FOREWORD

The India Meteorological Department predicted that there would be deficit rainfall (8% and subsequently raised to 12%) from LPA during the monsoon season of 2015. As sufficient rains were received during month of June, actual sown area of cereals, oilseeds, pulses is almost equal to normal sown area except for coarse cereals. The prolonged dryspell between 3rd week of June to 3rd week of July witnessed large scale withering of rainfed crops. The entire season recorded 14% deficiency in monsoon at the country level. Every region recorded deficiency in rainfall ranging from 6% in Central region to 17% in North West region. Rainfall deficiency of 15% in Southern region and 17% in North West region expected to impact productivity and production of rainfed crops. About 303 districts recorded scanty to deficient rains (more than 20% deficiency) in the country. The deficit rainfall also impacted water storage in reservoirs as less water is available (61%) compared to average water storage (77%) of last 10 years. Southern region is the most affected one with reservoir storage being only 34% against the 10 years average of 81%. Ground water recharge due to current monsoon rainfall is extremely low to very low in about 187 districts of the country.

CRIDA, a nodal institute for developing district level contingency plans, also issues contingency bulletins from time to time. The *rabi* cropping is predominant in 419 districts in the country. As significant rainfall was received during September, 2015, it is possible to make up the agricultural production losses during *kharif* 2015. Compensatory *rabi* production plan strategies are identified focusing more on utilization of soil moisture for enhancing production of pulses and oilseeds through short duration varieties. The initiatives under different developmental programmes such as IWMP, RKVY, NMSA etc. could be integrated to augment the production of oilseeds and pulses. The plan consists of strategies for normal and alternative crop management, fodder production along with suggestions for possible convergence and policy formulation for effective implementation of compensatory plans. I am hopeful that the information in this document shall be useful to all the relevant stakeholders in enhancing agricultural production and productivity during *rabi* 2015-16.

I appreciate the initiative and guidance of Dr A.K.Sikka, DDG (NRM) for bringing out this unique and timely publication. I also appreciate the efforts of Dr Ch. Srinivasa Rao, Director, CRIDA and his team for compiling this document.

(S. Ayyappan)

CONTENTS

1.0 Background

The south west monsoon accounting for nearly 75% of the annual rainfall during the period from June to September is important for food grain production. Deviation from normal monsoon pattern affects crop production specially oilseeds, pulses and nutritious cereals which are grown in rainfed regions, fodder availability to livestock and causes huge losses to farmers. Adequate rainfall during south-west monsoon not only supports production of major commodities like nutritious cereals, oilseeds and pulses but also determines the success of *rabi* crops through carryover of sufficient moisture in the soil profile.

Drought is the most common weather aberration and widespread in India. At country level, during last 15 years, 7 years recorded lower than normal rainfall, 6 years recorded more than normal rainfall and 2 years recorded average rainfall. The deficit was more than 10% in 4 years i.e. 2002, 2004, 2009 and 2014 with maximum deficit being 22% in 2002 followed by 21% during 2009. During 2004 and 2014 the deficit recorded was 12% in both years. This lead to widespread drought in many parts of the country. In 2002, the advancement of monsoon witnessed intermittent delays and the coverage over the entire country by the monsoon could happen only by 15th August. In 2009, despite early onset of monsoon and its coverage over the entire country by 15th July, the lowest mean annual rainfall was recorded during the year with a deficit of 21%. In 2012, the onset of monsoon was delayed up to 2 weeks with subsequent slow progress towards north-west with frequent breaks leading to deficit rainfall situation till end of July and late withdrawal of monsoon by three weeks in September. In 2014, the onset of monsoon was delayed and its progress across the country was erratic which impacted the sowing of food grain crops to an extent of 2.5 Mha. In all these four drought years, significant negative departure occurred during the south-west monsoon period affecting *kharif* agricultural production. During the year 2014, though the deficit was 12%, the estimated reduction in production compared to 2013-14 was about 16.5% in oilseeds, 9.7% in pulses, 6.6% in nutritious cereals and 5.3% in total food grains.

Monsoon failures result in drought which has serious implications for small and marginal farmers and livelihoods of the rural poor. Rainfed areas constitute nearly 54% of the net cultivated area and account for 40% of the country's food production and support 40% of human and 60% of the livestock population and are most vulnerable to monsoon failures. The frequency of deficient rainfall (75% of normal or less) is once in 5 years in West Bengal, Madhya Pradesh, Konkan, Bihar and Odisha; once in 4 years in south interior Karnataka, Eastern Uttar Pradesh and Vidarbha; once in 3 years in Gujarat, East Rajasthan & Western Uttar Pradesh; once in 2.5 years in Tamil Nadu, Jammu & Kashmir and Telangana; and once in 2 years in Western Rajasthan.

2.0 Monsoon 2015

a. Onset of 2015 southwest monsoon and its progress

Southwest monsoon was set in over Kerala on 5th June 2015 and covered entire country by 26th June as against the normal dates of 1st June and 15th July, respectively (Fig. 1). Out of the 36 meteorological sub divisions, 18 divisions received excess rainfall, 13 received normal and the remaining 5 divisions were under deficit conditions by the time the monsoon covered entire country. The country as a whole received 16% surplus rainfall during the month of June.

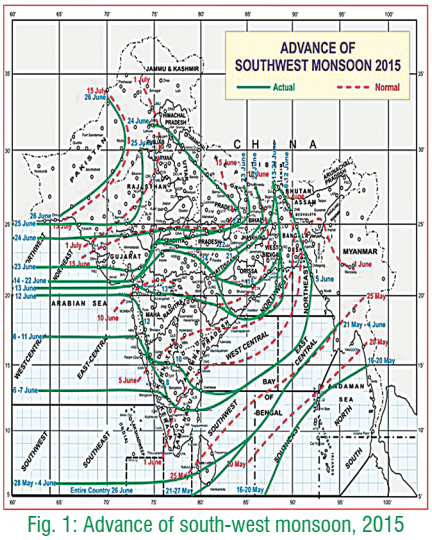

Fig. 1: Advance of south-west monsoon, 2015 (Data source: IMD)

b. Advance of southwest monsoon 2015

- Southwest monsoon set in over Kerala on 5th June and covered Assam during 6th to 12th June. Further, monsoon advanced into coastal regions of Karnataka and Konkan & Goa during 8th to 11th June. On 12th June, it reached up to Mumbai and covered south-interior Karnataka and parts of Rayalaseema (Andhra Pradesh).
- By 13th June, the monsoon covered remaining regions of Rayalaseema, entire coastal Andhra, Telangana, Madhya Maharashtra, Marathwada and Vidharba regions of Maharashtra, Chhattisgarh, Odisha and West Bengal. Thereafter, the monsoon advancement was at slow pace and touched the southern part of Gujarat, entire Madhya Pradesh, Jharkhand and Bihar by 23rd June.
- By 25th June, the monsoon covered all regions of Gujarat, Uttar Pradesh, Himachal Pradesh, Punjab, Haryana, Delhi, Jammu & Kashmir and regions of Rajasthan.
- On 26th June, the monsoon covered entire country.

c. Rainfall variability during southwest monsoon 2015: Month-wise analysis

June

- Overall, 13 subdivisions received excess, 20 subdivisions received normal and 3 subdivisions received deficit rainfall during June. The country as whole received 16% excess rainfall during the month.
- Excess rainfall was received in many subdivisions including Jammu & Kashmir (89%), Western Rajasthan (78%), Eastern Rajasthan (54%), Saurashtra & Kutch (59%), Western Madhya Pradesh (46%), Madhya Maharashtra (22%), Vidarbha (52%), Chhattisgarh (41%), Telangana (59%), Coastal Andhra Pradesh (97%), South Interior Karnataka (55%), Tamil Nadu & Puducherry (36%) and Arunachal Pradesh (27%). Deficit rainfall was received in Andaman Nicobar Islands (-21%), Bihar (-28) and NMMT(Nagaland, Manipur, Mizoram, Tripura) (-31%) subdivisions (Fig. 2).
- Remaining all subdivisions got normal rainfall in the country.

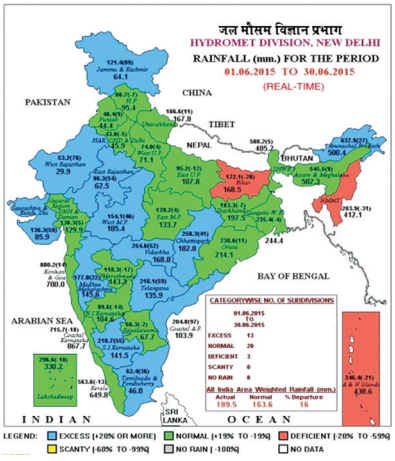

Fig. 2: Rainfall distribution during June, 2015 (Data source: IaMD)

July

- Drought like situation was experienced by 23 subdivisions during July.
- In July, 19 subdivisions *viz*,. Punjab (-30%), Haryana (-21%), Uttarakhand (-21%), Western Uttar Pradesh (-25%), Eastern Uttar Pradesh (-40%), Bihar (-33%), Sub-Himalayan West Bengal (-36%), Assam, Meghalaya (-46%), Arunachal Pradesh (-39%), Eastern Madhya Pradesh (-25%), Chhattisgarh (-34%), Vidarbha (-56%), Madhya Maharashtra (-54%), Coastal AP (-41%), Konkan & Goa (-49%), South Interior Karnataka (-48%), Kerala (-44%), Tamil Nadu & Puducherry (-36%) experienced deficit conditions.

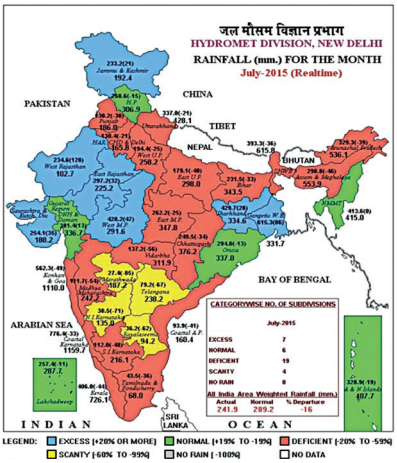

Fig. 3: Rainfall distribution during July, 2015 (Data source: IMD)

- Four subdivisions recorded scanty rainfall conditions including Marathwada (-86%), North Interior Karnataka (-71%), Telangana (-67%) and Rayalaseema (-62%).
- Seven subdivisions received excess rainfall while six subdivisions recorded normal rainfall distribution in the month of July (Fig. 3).
- The country as a whole received actual rainfall of 241.9 mm against the normal (289.2 mm) with a overall of departure -16%.

August

- Overall, the country received -13% deficit rainfall.
- During August, 16 subdivisions experienced deficit rainfall condition and 29 subdivisions received normal rainfall and one subdivision received excess rainfall (Fig. 4).
- Sub divisions of Himachal Pradesh (-22%), Punjab (-31%), Haryana (-36%), Western Uttar Pradesh (-42%), Eastern Uttar Pradesh (-47%), Bihar (-26%) and Eastern Madhya Pradesh (-28%) received deficit rainfall. In the North Eastern, NMMT (-29%) was under deficit condition. Whereas in the western side of the country, Gujarat Region (-26%), Konkan & Goa (-30%), Madhya Maharashtra (-31%), Marathwada (-38%), North Interior Karnataka (-27%), Coastal Karnataka (-25%) and Kerala (-27%) experienced deficit condition (Fig. 4).

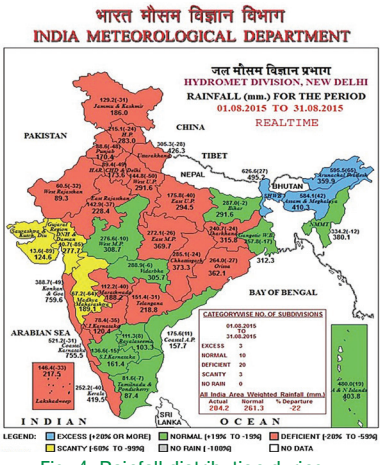

Fig. 4: Rainfall distribution during August, 2015

September

- Cumulative rainfall for the country as a whole during September was 24% below the LPA.
- In the last week of September 2015, four subdivisions *viz*. Rayalaseema, Kerala, Andaman and Lakshadweep received normal rainfall, Tamil Nadu and south interior Karnataka received excess rainfall and the rest of the country was under deficient and mostly scanty rainfall condition.

Seasonal rainfall variability (June to September)

- From June to the end of September, the country as a whole received 760.6 mm rainfall against 887.5 mm (normal) with a negative departure of 14% (Fig. 5).
- 17 subdivisions recorded deficient condition and 18 subdivisions recorded normal and one subdivision received excess rainfall.
- Based on percentage of area of the country, 6% area received excess rainfall, 55% area received normal rainfall and 39% of the area received deficit rainfall (Table 1).

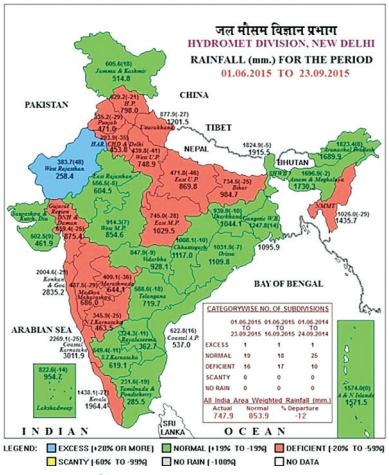

Fig. 5: Seasonal rainfall during June to September, 2015 (Data source: IMD)

District-wise Analysis

- From the data of 5 years from 2010 onwards, it was observed that the percentage of districts which received deficit rainfall was increased during 2015 (Fig. 6). The percentage of districts in the country that received deficit rainfall was 29, 23, 37, and 25 during 2010, 2011, 2012 and 2013, respectively. However, during 2015, it was observed that 44% of the total districts in the country were under deficient condition. During 2015, out of 614 districts, 10% of the districts (62) received excess rainfall in which majority of the districts belong to Jammu & Kashmir (11) and Rajasthan (12) followed by West Bengal (7), Madhya Pradesh (6) and Gujarat (4).
- 250 districts received normal rainfall and majority of these districts were from Madhya Pradesh (23), Odisha & Assam (21), Bihar (16), Tamil Nadu (15), Karnataka (15), Maharashtra (13), Jharkhand (12), Chhattisgarh (11) and Andhra Pradesh (10) (Table 1).
- About 272 districts had deficient rainfall. Majority districts were from Uttar Pradesh (51), Bihar (22), Maharashtra (22), Madhya Pradesh (21), Haryana (17), Tamil Nadu (13), Karnataka (12), Kerala (11), Punjab (11), Uttarakhand (10) and Jharkhand (1). Scanty rainfall was recorded in 30 districts, in which major 17 districts out of 75 districts of Uttar Pradesh have experienced scanty rainfall (Table 2).

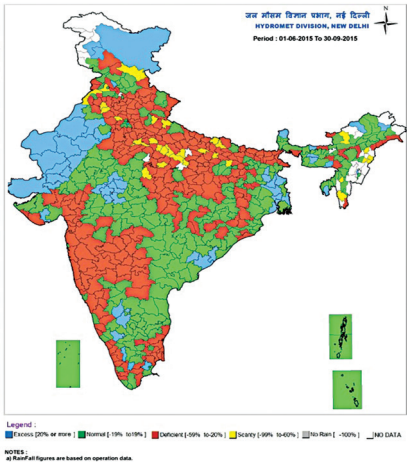

Fig. 6: District-wise rainfall distribution (Data source:IMD)

Table 1: State-wise rainfall distribution during June to September, 2015

S.No.	States	Period: 01.06.2015 To 30.09.2015			
		Actual (mm)	Normal (mm)	% Dep	Category
East & North East India					
1	Arunachal Pradesh	1875.0	1768.0	6	N
2	Assam	1440.1	1523.4	-5	N
3	Meghalaya	2837.1	2786.8	2	N
4	Nagaland	660.4	1329.9	-50	D
5	Manipur	1004.3	1404.5	-28	D
6	Mizoram	1013.4	1708.3	-41	D
7	Tripura	1499.9	1489.1	1	N
8	Sikkim	2014.6	1800.8	12	N
9	West Bengal	1407.0	1390.4	1	N
10	Jharkhand	941.9	1091.9	-14	N
11	Bihar	742.3	1027.6	-28	D

North West India					
1	Uttar Pradesh	459.3	846.1	-46	D
2	Uttarakhand	881.5	1229.1	-28	D
3	Haryana	285.4	459.8	-38	D
4	Chandigarh (UT)	548.3	844.2	-35	D
5	Delhi	598.5	636.2	-6	N
6	Punjab	336.3	491.9	-32	D
7	Himachal Pradesh	638.3	825.3	-23	D
8	Jammu & Kashmir	614.0	534.6	15	N
9	Rajasthan	460.4	419	10	N
Central India					
1	Odisha	1034.4	1149.9	-10	N
2	Madhya Pradesh	840.2	952.3	-12	N
3	Gujarat	568.7	657.6	-14	N
4	Dadra & Nagar Haveli (UT)	1667.4	2316.9	-28	D
5	Daman & Diu (UT)	882.5	1720.4	-49	D
6	Goa	2353.1	2970.3	-21	D
7	Maharashtra	732.5	1007.3	-27	D
8	Chhattisgarh	1009.8	1147.3	-12	N
South Peninsula					
1	A & N Island (UT)	1678.5	1682.5	0	N
2	Andhra Pradesh	522.8	504.3	4	N
3	Telangana	600.8	755.2	-20	D
4	Tamil Nadu	285.9	317.0	-10	N
5	Puducherry (UT)	269.5	355.0	-24	D
6	Karnataka	666.9	832.2	-20	D
7	Kerala	1514.7	2039.6	-26	D
8	Lakshadweep (UT)	860.9	998.5	-14	N
Country as a whole		**760.6**	**887.5**	**-14**	

(Data source: IMD)

Table 2: State-wise distribution of districts with rainfall condition during June to September, 2015

S.No.	States	Period: 01.06.2015 To 30.09.2015					
		E	N	D	S	ND	Total
1	A & N Island (UT)	0	3	0	0	0	3
2	Arunachal Pradesh	2	6	3	1	4	16

3	Assam	2	21	3	0	1	27
4	Meghalaya	2	3	2	0	0	7
5	Nagaland	0	2	1	3	5	11
6	Manipur	1	2	0	0	6	9
7	Mizoram	0	2	1	2	4	9
8	Tripura	1	3	0	0	0	4
9	Sikkim	1	3	0	0	0	4
10	West Bengal	7	9	3	0	0	19
11	Odisha	1	21	8	0	0	30
12	Jharkhand	2	12	10	0	0	24
13	Bihar	0	15	22	1	0	38
14	Uttar Pradesh	0	3	51	17	0	71
15	Uttarakhand	0	3	10	0	0	13
16	Haryana	0	2	17	2	0	21
17	Chandigarh (UT)	0	0	1	0	0	1
18	Delhi	1	5	3	0	0	9
19	Punjab	0	6	11	3	0	20
20	Himachal Pradesh	1	7	3	1	0	12
21	Jammu & Kashmir	11	4	2	0	5	22
22	Rajasthan	12	13	8	0	0	33
23	Madhya Pradesh	6	23	21	0	0	50
24	Gujarat	4	6	16	0	0	26
25	Dadra & Nagar Haveli (UT)	0	0	1	0	0	1
26	Daman & Diu (UT)	0	1	1	0	0	2
27	Goa	0	1	1	0	0	2
28	Maharashtra	0	13	22	0	0	35
29	Chhattisgarh	0	11	7	0	0	18
30	Andhra Pradesh	2	10	1	0	0	13
31	Telangana	0	5	5	0	0	10
32	Tamil Nadu	3	16	13	0	0	32
33	Puducherry (UT)	0	0	2	0	2	4
34	Karnataka	3	15	12	0	0	30
35	Kerala	0	3	11	0	0	14
36	Lakshadweep (UT)	0	1	0	0	0	1
	Total	62	250	272	30	27	641
Category wise distribution of districts out of the 614 whole data received		10%	41%	44%	5%		

(Data source: IMD)

E-Excess (+20% or more), N-Normal (+19% to -19%), D-Deficient (-20% to -59%), S-Scanty (-60% to -99%) and ND-No Data

State-wise distribution of months with rainfall condition in individual months of June, July, August & September is given in Annexure 1.

3.0. Impact of Monsoon 2015

3.1. Water storage in reservoirs

The Central Water Commission (CWC) monitors the storage available in 91 major reservoirs across the country and a weekly report is issued. Information available from the latest report made on 30th September, 2015 indicated that the northern region had more storage of water compared to 2014 as well as last 10 years average. At all India level, the storage available is lower than last year and last 10 years average. Central region is also reported to have lower storage than last year but higher than last 10 years average. Reservoirs in Eastern, Western and Southern regions have lower storage than last year as well as last 10 years average. Southern region is worst affected as it had only 34% storage compared to last years storage of 71% and last 10 years average storage of 77% which might impact even the drinking water availabiltity in *rabi* and summer seasons (Table 3).

Table 3. Water storage levels in reservoirs monitored by CWC

Region	Total live storage avaiable capacity (BCM)	% Storage capacity		
		Average storage during last 10 years	Storage during last year	Storage during current year
Northern	18.01	84	82	86
Eastern	18.83	78	82	71
Western	24.54	83	83	62
Central	42.3	70	84	77
Southern	51.37	81	71	34
All India	157.799	77	77	61

Source: Central Water Commission, Ministry of Water Resources, Govt. of India

- At the basin level, better than normal storage (more than last 10 years average) is available in Ganga, Indus, Narmada, Sabarmati and rivers of Kutch.
- Close to normal (deficit is up to 20% of normal) storage is available in Tapi, Mahi and Mahanadi & neighbouring east flowing rivers (EFRs).
- Deficient (deficit is between 20 to 60% of normal) storage is prevailing in Godavari, Cauvery & neighbouring EFRs and west flowing rivers of South and highly deficient (more than 60% deficit) storage is prevailing in Krishna basin (only 32% of live storage capacity compared to last year's i.e. 72% storage).
- Except for basins of Indus, Sabarmati and rivers of Kutch, all other basins have storage lower than the last year for the corresponding period.
- At the state level, Himachal Pradesh and Tripura are reported to have better storage than last year for corresponding period.
- States having lesser storage than last year for corresponding period include Punjab, Rajasthan, Jharkhand, Odisha, West Bengal, Gujarat, Maharashtra, Uttar Pradesh, Uttarakhand, Madhya Pradesh, Chhattisgarh, Andhra Pradesh, Telangana (as combined project in both the states), Karnataka, Kerala and Tamil Nadu.

Out of 91 reservoirs, 39 reservoirs reported more than 80% of normal storage while 52 reservoirs reported 80% or below of normal storage.

Information on storage reservoirs having culturable command area of more than 2,00,000 ha and having less than that compared to last 10 years average is given below.

- Punjab: Thein dam (58% storage)
- Jharkhand: Maithon (58%)
- Rajasthan: Rana Pratap Sagar (77%)
- West Bengal: Mayurakshi (53%), Kangsabti (29%)

- Gujarat: Ukai (78%), Kadana (63%)
- Chattishgarh: Mahanadi (63%)
- Telangana: Sriramsagar (10%), Lower Manair (18%)
- Maharashtra: Jaikawadi (4%)
- Andhra Pradesh: Nagarjunasagar (1%)
- Karnataka: Tungabhadra (61%), Ghataprabha (41%), Narayanpur (40%), Malaprabha (27%), Hemavathy (45%)

3.2. Progress in sown area of *kharif* crops

- Progress in sowings of crops in *kharif* 2015 indicated that the sown area at national level was almost equal to the normal sown area. The sufficient quantity of rainfall received during June month helped in sowing of major oilseeds, nutritious cereals and fibre crops in time. Actual and normal sown area for nutritious cereals, total cereals, total pulses, total food grain crops and all crops is shown in Fig. 7.

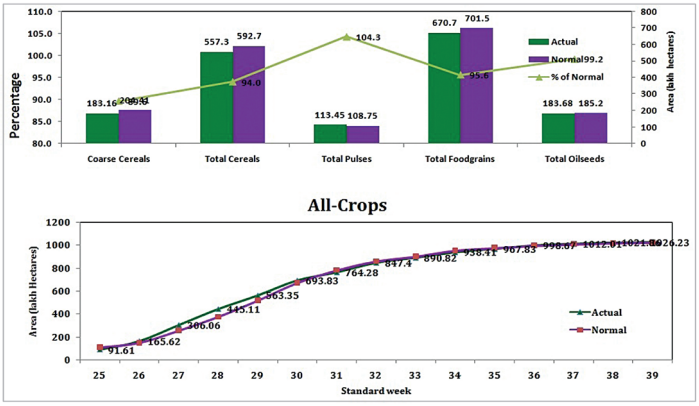

Fig. 7: Actual versus normal sown area of cereals, oilseeds, pulses, total food grains and all crops during *kharif* 2015-16

- The total cultivated area under nutritious cereals and cereals was less by 10% and 6% compared to normal sown area, respectively. Area under total food grians is marginally lower by 4% than normal area. In case of pulses, the total sown area during the season is higher by 4% over normal sown area of 10 Mha. Among cereals, rice crop was cultivated in 37.2 Mha against the normal area of 38.8 Mha, recording a deficit of 3.2%. Maize was sown in 7.67 Mha against the normal sown area of 7.25 Mha with increase in area by 5.7%. Sorghum and pearlmillet were sown in 1.95 Mha and 7.04 Mha, respectively with a decline in the area by 28.5% and 17%, respectively against the normal sown area. Among pulse crops, pigeonpea recorded a shortfall of area by 3.8% against the normal (3.93 Mha). Among oilseed crops, area sown under groundnut was less by 18.7% agianst the normal (4.5 Mha). However, soybean recorded 11% more sown area than the normal (10.4 Mha). Area sown under cotton was almost normal (11.5 Mha).

- Amongst the states, more than normal cultivated area was reported in northern states (Uttar Pradesh, Haryana and Punjab). Among eastern states, Bihar and Jharkhand showed an increase in sown area under rice. The southern states (Andhra Pradesh, Telangana, Karnataka and Tamil Nadu) recorded significant decline in rice cultivated area (Fig. 8).

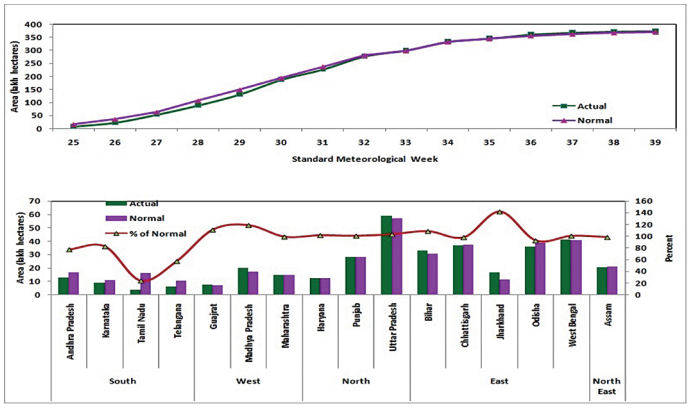

Fig. 8: Actual versus normal sown area of rice crop during *kharif* 2015-16

- Though the area under maize crop at national level was more than the normal, Andhra Pradesh, Tamil Nadu, Telangana, Gujarat, Rajasthan states recorded lower than normal sown area. Madhya Pradesh in Central region, Uttar Pradesh and Punjab in northern region, and all states in eastern region recorded more than the normal sown area (Fig. 9).

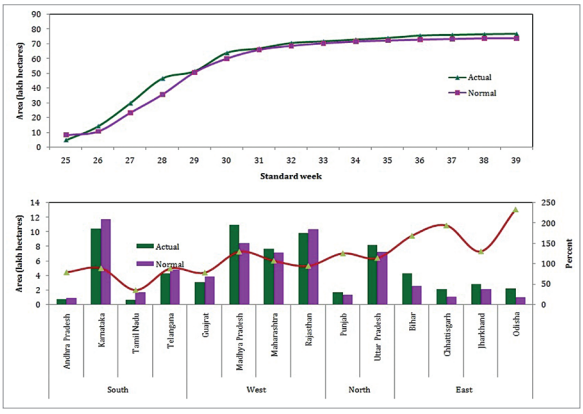

Fig. 9: Actual versus normal sown area of maize crop during *kharif* 2015-16

- Actual area sown under pigeonpea was higher only in the states of Madhya Pradesh, Uttar Pradesh and Chattisgarh and all other states recorded lower than the normal sown area (Fig. 10).

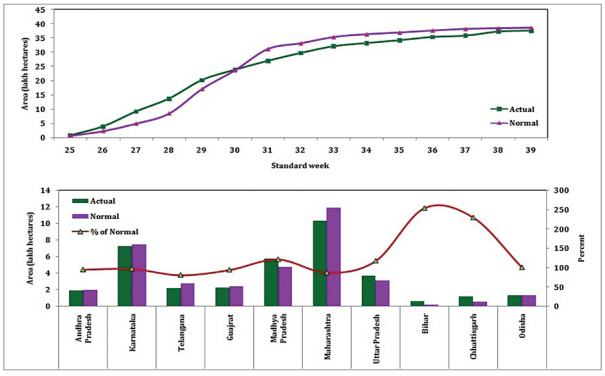

Fig. 10: Actual versus normal sown area of pigeonpea crop during *kharif* 2015-16

- Better rainfall (more than the normal) during June month encouraged farmers to take up sowings in more area under soybean crop in traditionally dominant areas of Madhya Pradesh, Maharashtra and Rajasthan (Fig. 11).

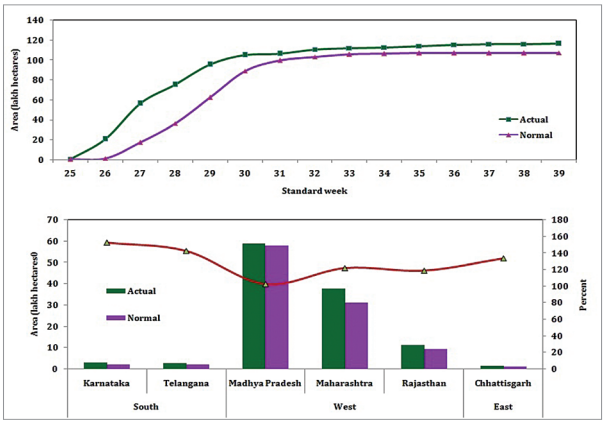

Fig. 11: Actual versus normal sown area of soybean crop during *kharif* 2015-16

- Andhra Pradesh recorded less than the normal groundnut sown area and the total sown area in the entire country was lower than the normal sown area. Gujarat and Karnataka also recorded lower groundnut sown area than the normal sown area (Fig. 12).

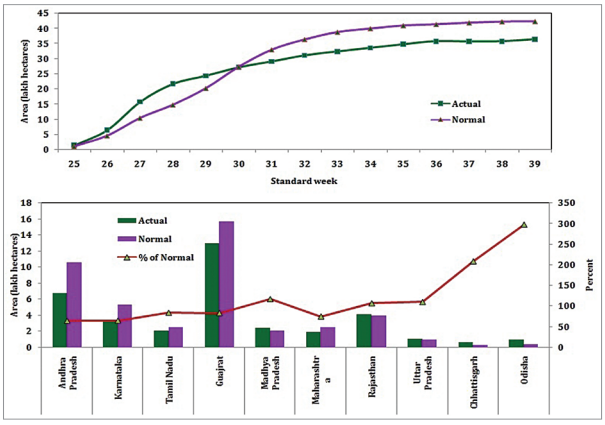

Fig. 12: Actual versus net sown area of groundnut crop during *kharif* 2015-16

- The actual sown area under cotton crop is almost normal across many states (Fig. 13).

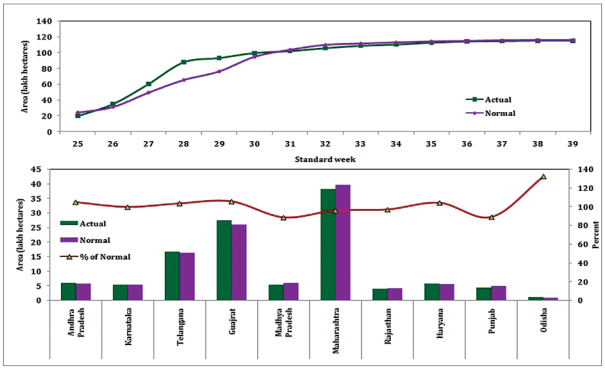

Fig. 13: Actual versus net sown area of cotton crop during *kharif* 2015-16

3.3. Prospects of groundwater recharge

The rainfall distribution coupled with total rainfall greatly influences the ground water recharge during the monsoon period. Actual estimation of groundwater recharge would require considerable time and large quantities of data. On the other hand, qualitative estimation of groundwater recharge prospects was attempted by interpreting the rainfall received on a week to week basis for each district. For example, if scanty rainfall is received in more than 65% of weeks or deficit rainfall received are more than 80% of weeks on cumulative basis, the recharge possibility is considered to be extremely low. Criteria followed for groundwater recharge prospects are given below (Table 4).

Table 4: Criteria for groundwater recharge assessment

S. No.	Percent of deficit rainfall weeks	Percent of scanty rainfall weeks	Groundwater recharge prospects
1	80	65	Extremely low
2	70	50	Very low
3	50	30	Low
4	30	10	Medium
5	10	0	Normal

Rainfall data available from IMD (www.imd.gov.in) and other states (Andhra Pradesh, Telangana, Karnataka, Gujarat, Rajasthan) during the current monsoon was utilized for the analysis purpose. Based on the above criteria, the ground water recharge due to monsoon rainfall was extremely low to very low in about 189 districts (30% of total districts). About 46% of total districts had low to extremely low prospects for groundwater recharge. About 16 districts each in Uttar Pradesh, Bihar and Maharashtra, 12 districts in Gujarat and 11 districts in Karnataka are among these 189 districts. Less than normal rainfall in states like Kerala, Manipur, Mizoram and Nagaland affected the groundwater recharge prospects. Prospects for groundwater recharge are normal in about 225 districts with majority of them in Madhya Pradesh, Rajasthan, West Bengal, Jharkhand, Odisha and Andhra Pradesh.

Prospects of groundwater recharge in *rabi* cropped areas

Districts with significant area during *rabi* season for different crops were identified. These districts cover 80% of *rabi* area under each crop. The crops considered for the study included wheat, chickpea, rice, sorghum, rapeseed & mustard, maize and groundnut. Out of 419 districts identified to be dominant for *rabi* areas, 72 districts had extremely low to very low groundwater recharge prospects. These 72 districts are spread over Uttar Pradesh (17), Bihar (13), Maharashtra (9), Gujarat (6), Karnataka (5), Andhra Pradesh (4), Telangana (4) and remaining are in other states. Another 97 districts had the low prospects for groundwater recharge during the current monsoon and are spread in Uttar Pradesh (28), Madhya Pradesh (5), Gujarat and Haryana (7 districts each), Punjab, Chhattisgarh and Haryana (6 districts each), Rajasthan (4), Maharashtra (9) and Madhya Pradesh (5). About 240 districts had the possibility of medium to normal prospects for groundwater recharge with majority of them spread in Rajasthan, Madhya Pradesh, Uttar Pradesh, West Bengal, Odisha etc. The prospects of groundwater recharge, *rabi* crop-wise area, is given below.

a. Rice growing areas

About 109 districts are identified to be growing rice under *rabi* season and are spread out in Andhra Pradesh, Assam, Bihar, Jharkhand, Karnataka, Kerala, Odisha, Telangana, Uttarakhand and West Bengal. Based on the *rabi* cropped area, area with different sources of irrigation available, these districts have been categorized into canal irrigated, well irrigated, residual moisture dependent etc. For the present analysis, states of Andhra Pradesh, Bihar, Jharkhand, and Telangana were considered due to availability of irrigation information. Among these 4 states, about 11 districts are dependent on canal irrigation system and are in Andhra Pradesh (7) and Bihar (4) while 17 districts are dependent on well irrigation and are in Bihar (9), Telangana (7) and Andhra Pradesh (1) (Table 5). Among these 17 districts, the groundwater recharge prospects are extremely low to very low in 8 districts and are in Bihar (4 districts), Telangana (3 districts) and Andhra Pradesh (1 district). Attempts to grow rice during *rabi* season in these districts would deplete the available groundwater and also may have the problem of non availability of irrigation water as the season progresses. Hence, growing of rice during *rabi* season is to be dissuaded in these districts. The districts include Araria, Darbhanga, Patna and Supaul in Bihar; Mahabubnagar, Nizamabad and Medak in Telangana; Kurnool in Andhra Pradesh; Saran, Siwan, East Champaran, Kishanganj and Madhubani in Bihar and Ranchi in Jharkhand, which grow rice in *rabi* season with residual moisture and/or with well irrigation could also suffer due to very low to low prospects of ground water recharge during the current season.

Table 5: Prospects of groundwater recharge in rice growing areas

State	Irrigation system (well/ residual moisture)	Recharge prospects	District
Andhra Pradesh	Well	Extremely low	Kurnool
Bihar	Residual moisture	Very low	Muzaffarpur, Siwan
	Well	Extremely low	Araria, Supaul
		Low	Nalanda, Purnea
		Medium	Banka, Gaya, Katihar
		Very low	Darbhanga, Patna
Jharkhand	Residual moisture	Low	Ranchi
		Normal	East Singhbhum, Giridish, Gumla, West Singhbhum
Telangana	Well	Low	Karimnagar
		Normal	Khammam, Nalgonda, Warangal
		Very low	Mahabubnagar, Medak, Nizamabad

b. Wheat growing areas

About 170 districts are identified to be growing wheat crop and located in Uttar Pradesh (62), Madhya Pradesh (32), Punjab, Haryana and Rajasthan (16 districts each), Bihar (13 districts) and others in states of Gujarat, Himachal Pradesh, Jammu & Kashmir etc. Among these 170 districts, canal irrigation is predominant in 45 districts (Punjab, Haryana, Rajasthan and Uttar Pradesh). Wheat grown under well irrigated systems (95 districts) is dominant in Uttar Pradesh, Madhya Pradesh, Rajasthan, Bihar and Gujarat. Other systems present include canals and wells, residual moisture and well irrigation (Table 6). A total of 30 districts had the possibility of extremely low to very low groundwater recharge prospects during the current *kharif* season. 50% of these 30 districts are in Uttar Pradesh. Among the districts with canal irrigation facility for wheat crop, only 5 districts out of 45 districts had extremely low to very low ground water recharge prospects. However, considering the storage available in the reservoirs which support these districts, there may not be any deficiency in availability of canal irrigation and normal area could be sown during *rabi* crop. About 95 districts, where groundwater plays a dominant role in wheat cultivation, 19 districts spread in Uttar Pradesh (14 districts), Bihar (3 districts), one district each in Gujarat and Maharashtra had extremely low to very low ground water recharge prospects during the current monsoon, which could impact the wheat cultivation & production. About 27 of 95 districts, in Uttar Pradesh (17), 3 districts each in Rajasthan and Bihar, 2 districts in Madhya Pradesh and 1 district each in Gujarat and Maharashtra had low prospects for groundwater recharge. About 49 districts had a possibility of medium to normal recharge prospects which indicates opportunities for better wheat cultivation under well irrigated areas as well.

Table 6: Prospects of groundwater recharge in wheat growing areas

State	Irrigation system (well/ residual moisture)	Recharge prospects	District
Bihar	Residual moisture	Very low	Darbhanga
	Well	Low	Bhojpur, Champaran (East), Nalanda
		Medium	Buxar
		Normal	Aurangabad
		Very low	Madhubani, Saran, Siwan
Gujarat	Well	Low	Kheda
		Medium	Banaskantha, Mehsana
		Normal	Rajkot, Sabarkantha
		Very low	Junagadh
Himachal Pradesh	Residual moisture	Normal	Kangra
Madhya Pradesh	Well	Low	Bhind, Tikamgarh
		Medium	Ashoknagar, Chhatarpur, Damoh, Jabalpur
		Normal	Betul, Bhopal, Chhindwara, Dewas, Dhar, Guna, Indore, Khandwa (East Nimar), Khargone (West Nimar), Rajgarh, Ratlam, Sehore, Shajapur, Shivpuri, Ujjain
Maharashtra	Well	Low	Ahmednagar
		Medium	Nasik
		Very low	Solapur
Rajasthan	Well	Low	Alwar, Dausa, Karauli
		Medium	Jaipur
		Normal	Baran, Bharatpur, Bikaner, Chittorgarh, Jhunjhunu, Nagaur, Sikar
Uttar Pradesh	Well	Extremely low	Ambedkar Nagar, Fatehpur, Kanpur (Dehat), Kushi Nagar, Sultanpur
		Low	Ballia, Balrampur, Barabanki, Deoria, Farrukhabad, Firozabad, Gonda, Hamirpur, Hathras, Kannauj, Lalitpur, Meerut, Rampur, Saharanpur, Sant Kabir Nagar, Shahjahanpur, Siddharth Nagar
		Medium	Azamgarh, Bahraich, Bareilly, Basti, Bijnor, Budaun, Bulandshahar, Ghaziabad, Hardoi, Kheri, Moradabad, Muzaffarnagar, Pilibhit, Sitapur
		Normal	Ghazipur
		Very low	Agra, Aligarh, Etah, Faizabad, Gorakhpur, Jaunpur, Lucknow, Mau Unnao

c. Rapeseed and mustard growing areas

More than 80% rapeseed & mustard is cultivated in 70 districts spread in Rajasthan, Madhya Pradesh, Haryana, West Bengal and Uttar Pradesh etc. Among these 70 districts, well and canal irrigation systems are dominant in 45 and 11 districts, respectively (Table 7). In about 9 districts, residual moisture plays a dominant role. About 11 districts with canal irrigation system spread in Haryana, Rajasthan and Uttar Pradesh had the possibility for low to normal groundwater recharge prospects and the cropped area may not reduce as the storage in reservoirs

which support the canal systems is sufficient. Among 45 districts, where well irrigation is dominant, spread in Rajasthan (25), West Bengal (8), Madhya Pradesh (5), Gujarat (3), one district each in Madhya Pradesh (Sheopur Kalan district), Uttar Pradesh (Agra district) had extremely low prospects for ground water recharge which may result in reduction in cropped area. About 9 districts, spread in Rajasthan (4), Madhya Pradesh (1), Gujarat (1), Uttar Pradesh (1), West Bengal (2) had low prospects for groundwater recharge. About 34 districts had medium to normal prospects for groundwater recharge. With 19 districts in Rajasthan having normal recharge prospects, better production of rapeseed and mustard could be realized. Among the districts (9) which are dependant on residual moisture for crop production, only 3 districts had extremely low to low prospects for groundwater recharge and remaining 6 districts had medium to normal prospects for groundwater recharge.

Table 7: Prospects of groundwater recharge in rapeseed and mustard growing areas

State	Irrigation system (well/ residual moisture)	Recharge prospects	District
Assam	Residual moisture	Extremely low	Karbi-Anglong
		Medium	Dhemaji, Lakhimpur
		Normal	Kokrajhar
Bihar	Residual moisture	Extremely low	Champaran (West)
Gujarat	Well	Low	Patan
		Medium	Banaskantha, Mehsana
Haryana	Residual moisture	Medium	Mewat
Jammu & Kashmir	Well	Normal	Anantnag
Madhya Pradesh	Residual moisture	Normal	Dindori, Gwalior
	Well	Low	Tikamgarh
		Medium	Chhatarpur, Neemuch
		Normal	Mandsaur
		Very low	Sheopur Kalan
Rajasthan	Well	Low	Alwar, Dausa, Dholpur, Karauli
		Medium	Bhilwara, Jaipur
		Normal	Ajmer, Baran, Barmer, Bharatpur, Bikaner, Bundi, Chittorgarh, Churu, Jalore, Jhalawar, Jhunjhunu, Jodhpur, Kota, Nagaur, Pali, Sawai Madhopur, Sikar, Sirohi, Tonk
Uttar Pradesh	Residual moisture	Low	Balrampur
	Well	Low	Aligarh
		Medium	Budaun
		Very low	Agra
West Bengal	Well	Low	Dinajpur (Dakshin)
		Low	Dinajpur (Uttar)
		Normal	24-Parganas (North), Birbhum, Burdwan, Malda, Murshidabad, Nadia

d. *Rabi* sorghum growing areas

About 35 districts are found to be growing sorghum in *rabi* season and are spread in Maharashtra (19), Karnataka (11), Madhya Pradesh and Telangana (2 each), and Andhra Pradesh (1). *Rabi* sorghum is grown under residual moisture conditions in about 32 districts. The quantum and distribution of rainfall would influence the moisture availability in the root zone for its use during *rabi* season. Among 32 districts, where sorghum is grown under residual moisture conditions, 11 districts, spread in Maharashtra (5), Karnataka (4), Telangana (1) and Andhra Pradesh (1) had extremely low to very low prospects for recharge, which may impact the *rabi* sorghum area and productivity (Table 8). These districts include Bagalkot, Bidar, Gulbarga and Haveri in Karnataka, Hingoli, Jalna, Nanded, Osmanabad and Solapur in Maharashtra, Mahabubnagar in Telangana and Kurnool in Andhra Pradesh. However, the prospects for successful crop could improve due to rains in the month of October.

Table 8: Prospects of groundwater recharge in *rabi* sorghum growing areas

State	Irrigation system (well/ residual moisture)	Recharge prospects	District
Andhra Pradesh	Residual moisture	Extremely ow	Kurnool
Karnataka	Residual moisture	Extremely low	Bagalkot, Bidar, Gulbarga, Haveri
		Low	Belgaum, Bijapur, Dharwad, Gadag, Koppal, Raichur
	Well	Normal	Bellary
Madhya Pradesh	Residual moisture	Normal	Barwani Khargone (West Nimar)
Maharashtra	Residual moisture	Extremely low	Hingoli, Jalna, Nanded, Osmanabad, Solapur
		Low	Ahmednagar, Aurangabad, Beed, Buldhana, Latur, Parbhani, Pune, Sangli, Yavatmal
		Medium	Nandurbar
		Normal	Akola, Amravati
Telangana	Residual moisture	Extremely low	Mahabubnagar
		Medium	Adilabad

e. Chickpea growing areas

About 80 districts are identified to be growing chickpea during *rabi* season and are spread in Madhya Pradesh (26), Maharashtra (18), Rajasthan (11), Karnataka (8), Uttar Pradesh (7), Andhra Pradesh (4), Chhattisgarh (3) and one district each in Telangana, Gujarat and Haryana. About 16 out of 80 districts spread in Andhra Pradesh (3), Karnataka (3), Madhya Pradesh (2), Maharashtra (5), Uttar pradesh (2) and Telangana (1) had extremely low to very low groundwater recharge prospects (Table 9). However, the shortfall, if any, in these could be overcome by the better prospects in others (more than 50% of chickpea growing districts) where possibility of medium to normal recharge prospects are available. In more than 50 districts among these 80 districts, the crop is grown under residual moisture conditions in 39 districts and in another 16 districts, it is grown under both residual moisture and well irrigated conditions. Among 55 districts, where residual moisture content and well irrigation plays an important role, about 13 districts, spread in Andhra Pradesh (3 districts), Karnataka (3), Madhya Pradesh (2), Maharashtra (2), Telangana (1) and Uttar Pradesh (2), had extremely low to very low recharge prospects, which may impact chickpea area and production. Whereas, 16 districts out of 55 districts had the prospects of medium to normal ground water recharge.

Table 9: Prospects of groundwater recharge in chickpea growing areas

State	Irrigation system (well/ Residual moisture)	Recharge prospects	District
Andhra Pradesh	Residual moisture	Extremely low	Kadapa, Kurnool
		Normal	Prakasam
		Very low	Anantapur
Karnataka	Residual moisture	Extremely low	Bidar, Gulbarga
		Low	Belgaum, Bijapur, Dharwad, Raichur
		Normal	Mysore
		Very low	Bagalkot
Madhya Pradesh	Residual moisture	Extremely low	Ashoknagar
		Medium	Rewa, Seoni, Betul, Mandsaur, Ratlam, Satna
	Well	Normal	Shajapur, Ujjain, Vidisha
Maharashtra	Residual moisture	Low	Buldhana, Latur, Parbhani, Sangli
		Medium	Washim
		Normal	Akola, Amravati, Nagpur
		Very low	Osmanabad
	Well	Very low	Jalgaon
Rajasthan	Residual moisture	Normal	Bikaner, Churu, Tonk
	Well	Normal	Ajmer, Jaisalmer, Jhunjhunu, Sikar
Telangana	Residual moisture	Very low	Medak
Uttar Pradesh	Residual moisture	Extremely low	Fatehpur
		Low	Hamirpur, Jalaun, Jhansi, Mahoba
		Medium	Banda
		Very low	Chitrakoot

4.0 Compensatory *Rabi* Production Plan

The agriculture production losses during *kharif* need to be compensated with a suitable *rabi* production plan (practices & technologies) both in districts that experienced deficit rainfall and also the districts which received normal rainfall, with deployment of necessary inputs such as better management practices, quality seed, fertilizer, farm implements, institutional credit and other production incentives.

Rainfall during September month-2015

Rabi crops which are cultivated with residual mositure are dependent on September / October month rainfall. The district-wise rainfall received during September month is shown in Fig. 14. Rainfall received during September month in many districts of Southern region is more than 100 mm and there could be a better possibility of residual soil moisture building up for cultivation of short duration crops.

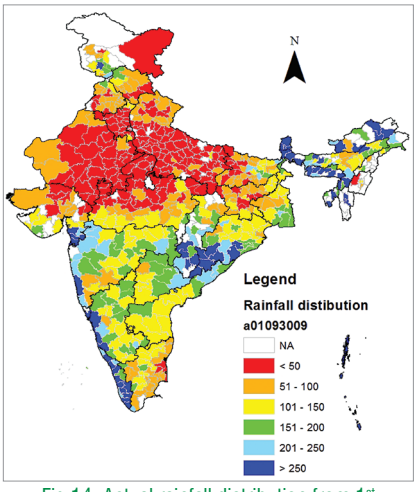

Fig.14: Actual rainfall distribution from 1st September to 30th September (Data source: IMD)

The soil water index (SWI) derived from remote sensing is also shown in Fig. 15. Soil moisture information, shown as percentage of saturation, is in the range of 51% and above in many districts which indicate better prospects for *rabi* season.

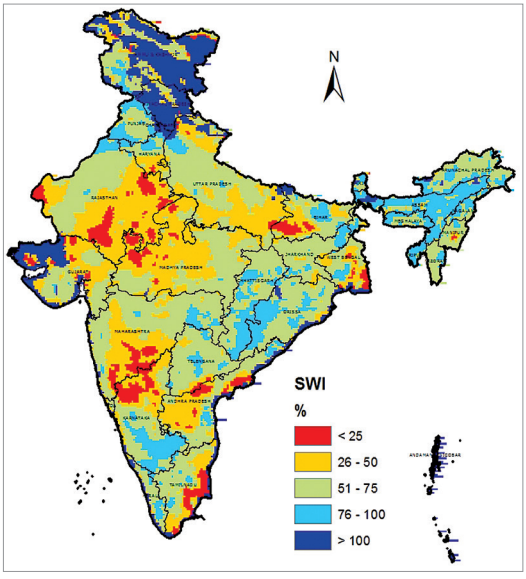

Fig.15: Soil Water Index as on 28th September, 2015 Data source: ASCAT

Additional interventions to be adopted for higher productivity and production in the *rabi* season include:

- Varieties suitable for early sowing of chickpea and wheat under residual moisture conditions in black soils of Central India should be encouraged.
- Basal application of $ZnSO_4$, $FeSO_4$, $MnSO_4$ @ 25 kg/ha based on soil test values, $CuSO_4$ and borax @ 10 kg/ha and Ammonium molybdate @ 1 kg/ha. In case basal application is not done in deficient soils, apply 0.5% micronutrients ($ZnSO_4$, $FeSO_4$, $MnSO_4$) along with 0.25% unslaked lime solution; 0.2% ($CuSO_4$ / borax) along with 0.25% unslaked lime solution; 0.05-0.1% ammonium molybdate along with 0.05% unslaked lime solution. The micronutrients are to be applied 2-3 times at 10-15 days interval.
- Rapeseed-mustard responds to basal application of 20- 40 kg Sulphur as Zypsum; Zinc as Zinc sulphate (25 kg/ha) and Boron as Borax (10 kg/ha) in all types of deficient soils.
- In calcareous alkaline soils of semi-arid rainfed areas, basal application of $FeSO_4$ @ 50 kg/ha is recommended based on soil test values to alleviate iron deficiency.
- To make best use of residual soil moisture, wheat can be planted with minimum tillage by using zero till drill which also eliminates paddy straw burning. Zero till drilling saves time (up to 10 days), cultivation cost (Rs 2000-3000/ha), diesel and energy, and produces 5-10% higher yield. Importantly, it saves first irrigation water and permits effective weed control (*Phalaris minor*) in North-west India. Adoption of early maturing wheat varieties of 100-110 days duration for zero tillage planting in Eastern and North-eastern states in problem soils (acidic soils) is recommended.
- Furrow-irrigated raised bed (FIRB) system in wheat saves water (25-40%), inputs (25% of seed and nitrogen fertilizer) and promotes higher water productivity and energy efficiency (up to 25%). FIRB planted wheat increases resilience as the crop is less affected due to unseasonal rains in February/March associated with hailstorm due to vigorous plant growth and root system.
- Precision seeding and fertilizer application with roto till drill provides rotary tillage of top 10 cm with simultaneous placement of seed and fertilizer at desired depth and can boost wheat productivity in Haryana.
- Bioinoculation of seed with biofertilizers (*Bacillus spp., Azotobacter, Azospririllum,* PSB, VAM, *Rhizobium* etc.) can promote plant growth and increase yield of wheat, *rabi* pulses and *rabi* oilseed crops by about 15%. Seed priming in chickpea to be promoted on a large scale.
- Seed treatment with fungicides (@ 2 to 3 g/kg seed) prevents seed borne diseases, promotes better germination and crop stand leading to higher productivity in all *rabi* crops.

- Adoption of micro-sprinkler/sprinkler/drip irrigation systems in wheat, maize, oilseed crops and vegetable crops results in water saving upto 50% and yield improvement on an average by about 25% in all *rabi* production zones wherever suitable quality water is available for irrigation through micro-irrgation systems.

- Special emphasis need to be given for enhancing productivity of *rabi* pulses *viz*. chickpea, lentil and fieldpea in the North-eastern states. Measures recommended include adoption of high yielding varieties, seed priming in chickpea, and seed treatment with fungicides @ 3 g/kg seed, bactericides @ 1 g/kg seed and bio-inoculants (*Rhizobium* @ 200 g/10 kg seed, *Trichoderma* @ 6 g/kg seed), efficient weed control and if available irrigation at flowering/pod filling stage.

- Special emphasis may be given to production technology of *rabi* pulses (chickpea, blackgram, greengram and lentil) in rice fallows for achieving higher land productivity per unit area. The additional interventions include higher seed rate (20 to 25% in lentil), seed priming in chickpea (soaking of seed for 4 to 5 hours in water, application of micronutrients in deficient soils, seed treatment with bioinoculants (PSB /VAM @ 200 g culture/10 kg seed) or soil application of PSB (5 kg/ha and VAM @ 10 kg/ha) in all *rabi* pulses. Foliar application of 2% urea/DAP at flowering and pod formation stage in lentil and chickpea, monitoring and efficient management of pod borer in chickpea, thrips and powdery mildew in blackgram and greengram.

- In Central India, to achieve higher productivity of bold seeded chickpea (*kabuli*), a presowing irrigation may be given wherever possible. Additional interventions include seed priming with molybdenum @ 4 g/kg seed in chickpea taken up after soybean.

- Effective integrated weed management through hoeing, hand weeding coupled with herbicide application (pre and post-emergence) can boost crop yield in pulses and other *rabi* crops.

- Seed production of *rabi* fodder crops (lucerne, berseem and oats) may be encouraged along with adoption of better management practices.

- Special emphasis should be laid on adoption of pest and disease resistant/tolerant cultivars in *rabi* crops for higher productivity such as:

    - Wheat: yellow rust tolerant varieties such as GW322, PBW502, DBW17, Raj 4037, PBW550, GW366, DBW621/50, HD2733, HD2864/2824, HUW510, NW2036, K0307

    - Blackgram: YMV resistant short duration varieties for spring/summer season in Uttar Pradesh and Bihar (WBU-109, Uttara, Azad Urd-1, Pant U 31) and for *rabi*/spring season in Odisha (IPU-7-3, BGG-04-008, LU-391, IPU-2-43, KU-301, TU-94-2)

    - Greengram: YMV resistant varieties for Uttar Pradesh/Bihar (HUM-16, Pant M5, IPM 2-3, Samrat); for Odisha (IPM 2-14, COGG 912, OUM 11-5, TARM-1)

4.1. Early *Rabi* Production Plan

In *kharif* cultivated fallows and in areas where crop performance is severely affected due to moisture stress (mid-season and terminal drought) during *kharif*, early *rabi* cropping assumes importance for compensating the loss in production. Early *rabi* plan for different agro-climatic zones covering various states in India is given in Table 10.

Table 10: Suggested crops & cultivars for early *rabi* cropping

Maharashtra

Agro-climatic zone & districts	Suggested crops & cultivars for early *rabi* situation
Western Vidarbha Zone, Maharashtra (Akola, Buldhana, Washim, Amravati and Yavatmal)	Sorghum for grain & fodder: CSH- 9 & 14, CSH- 15R, CSH-19R, AKSV- 13R, SPV- 504, CSV- 14R, CSV- 18R, SPV- 1359, Maldandi 35-1, Ringni Safflower: AKAS- 207, Bhima, Nari- 6, PKV Pink AKAS 311, Nari- NH-1 Sesamum: N- 8 Chickpea: BDN- 9-3, Vijay, Vishal, Jaki 9218, Phule G- 5, ICCV- 2, PKV Kabuli 2 &4, Gulak- 1, D- 8 Sunflower: PKVSH- 27, KBSH- 1 & 44, DRSH-1, PKVSF- 9, Modern, TAS- 82
Central Maharashtra Plateau Zone (Parbhani, Aurangabad, Nasik, Nanded)	Soil type/depth-wise suggested crop and varieties Shallow (<22.5 cm): Linseed (NL 260, LSL 93 (ready for release), RLC 4). Medium (22.5 to 45 cm) & medium deep (45 to 60 cm): Sunflower (LSF8, LSFH35, SS2038 i.e. Bhanu), Safflower (Sharda, Bhima, PBNS12, PBNS40, PBNS86) and *Rabi* sorghum + safflower (6:3). Deep (>90 cm): *Rabi* sorghum (Parbhani Moti, Maldandi i.e. M-53-1), Safflower (Sharda, Bhima, PBNS12, PBNS40, PBNS86), Chickpea (BDN797 i.e. Aaksh, Vijay, BDN 9-3), after *kharif* Soybean, Greengram (BM2002-1, BM 2002-3, BM-4), Blackgram (TAU 1).
Scarcity zone (Solapur, Ahmednagar, Western part of Beed, Osmanabad, Eastern part of Pune, Sangli, Dhule, Nandurbar)	Soil type/depth-wise suggested crop and varieties Shallow (<22.5 cm), medium (22.5 to 45 cm) & medium deep (45 to 60 cm): Sorghum- Phule Amruta, Phule Godhan Sorghum for fodder: Phule Amruta, Ruchira Medium deep (45 to 60 cm) Sorghum- Phule Amruta, Phule Godhan; Maize- African Tall; Sunflower: Bhanu, SS-56 Deep (>90 cm): Maize: African Tall ; Safflower: SSF 708, 748, 733 and Bhima; Sunflower: Bhanu, SS-56

Karnataka

Agro-climatic zone & districts	Suggested crops & cultivars for early *rabi* situation
Central, eastern and southern dry zone (Tumkur, Bangalore (Rural and Urban), Kolar, Chitradurga, Mysore, Ramanagara, Chikkaballapur)	Up to first week of November: Chickpea: Annigeri-1, JJ-11, KAK-2, Vishal Finger millet: Indaf-7, 9, 15, ML-365 Field bean: HA-3, HA-4 Cowpea: IT-38956-1, KBC-2 Sunflower: KBSH-1, 41, 42, 44, 53 Soil type/depth-wise suggested crop and varieties: Shallow (<22.5 cm): Finger millet: Indaf-7, 9, 15, ML-365 Medium (22.5 to 45 cm), medium deep (45 to 60 cm) & deep (>90 cm): Chickpea: Annigere-1, JJ-11, KAK-2, Vishal Field bean: HA-3, HA-4 Cowpea: IT-38956-1, KBC-2 Sunflower: KBSH-1, 41, 42, 44, 53

Northern dryzone (Bijapur, Bagalkot, Gadag, Koppal, Bellary, part of Dharwad, Belgaum, Raichur and Davangere)	Soil type/depth-wise suggested crop and varieties Medium (22.5 to 45 cm): Sunflower (DSFH-3/ KBSH 53/ KBSH44), Sorghum (M35-1/ BJV 44/CSV 9R), Chickpea (A 1/ JG 11/ Jaki 6218 / BGM 2), Safflower (A1)/ Sorghum + Chickpea (2:4)/ Safflower+Chickpea (2:4) Medium deep (45 to 60 cm): Sunflower (DSFH-3/ KBSH 53/ KBSH 44), Sorghum (M35-1/ BJV 44/ CSV 9R), Chickpea (A1/ JG11/ Jaki 6218/ BGM 2), Safflower (A1)/ Sorghum + Chickpea (2:4)/ Safflower+Chickpea (2:4) Deep (>90 cm): Sunflower (DSFH-3/ KBSH 53/ KBSH 44) Sorghum (M35-1/ BJV 44/ CSV 9R), Chickpea (A1/ JG11/ Jaki 6218/ BGM 2), Safflower (A1)/ Sorghum + Chickpea (2:4)/ Safflower+Chickpea (2:4)

Andhra Pradesh

Agro-climatic zone & districts	Suggested crops & cultivars for early *rabi* situation
Scarce rainfall zone- Southern AP (Kurnool)	Up to third week of October: Chickpea, Safflower, Greengram, Sorghum Soil depth-wise suggested crops Shallow (<22.5 cm): Clusterbean, Coriander, Horsegram, Greengram Medium (22.5 to 45 cm), medium deep (45 to 60 cm) & deep (>90 cm)- Chickpea, Sunflower, Sorghum, Greengram Rainfed red soils Foxtail millet (Surya Nandi, SiA 3085, 3156, Horsegram (PDM 1, VZM 1, PHG9, 6) Cowpea (C152, Co 702, Co 4,5, GC3), Greengram (LGG 407, LGG 450, LGG 460, MGG 295) Fodder sorghum (SSG 59-3, 988, PC 23, 106), Fodder Pearlmillet (Jaint Pearlmillet, APFB2, Raj Pearlmillet, Chari 2) Rainfed black soils: Chickpea: JG 11, NS 1, JAKI 9218

Tamil Nadu

Agro-climatic zone & districts	Suggested crops & cultivars for early *rabi* situation
Southern plateau and hills and East coast plains and hills regions (Thoothkudi, Tirunelveli, Virudhanagar and Madurai)	Sorghum: K8, K11 Blackgram: VBN 5&6, CO-6 Greengram: VBN 3 CO-8, CO-7

Chhattisgarh

Agro-climatic zone & districts	Suggested crops & cultivars for early *rabi* situation
Basthar Plateau zone (Bastar, Bijapur, Kondagaon, Narayanpur)	Soil type/depth-wise suggested crop and varieties Shallow (22.5 cm): Coriander – hybrid (M-1) Medium (22.5 to 45 cm): Wheat – GW 273, Sujata, Ratan Medium deep (45 to 60 cm): Relay cropping of chickpea (JG11) and lentil (Kiran) in rice fallows; Chillies -Pusa Jwala, Deep (> 90 cm): Vegetables – Brinjal (VNR1, Pusa purple long).

Odisha

Agro-climatic zone & districts	Suggested crops & cultivars for early *rabi* situation
Eastern Ghat zone of Odisha	Soil type/depth-wise suggested crop and varieties Shallow (<22.5 cm): As the *kharif* crop has not been harvested yet due to late sowing. The pre *rabi* crops will be taken up during *rabi* season.

Gujarat

Agro-climatic zone & districts	Suggested crops & cultivars for early *rabi* situation
Northern Gujarat zone (Banaskantha, Sabarkantha, Palanpur, Surendranagar)	Castor: GCH -5, GCH – 7 Up to last week of October: Mustard: GM 1, GM 3 and GDM 4 Up to second week of October Fennel (GF 2, GF 11 and GF 12) From second to third week of November: Cumin (GC 4) From second week of November to first week of December: Wheat (GW 496 and GW 322) From last week of October to second week of November: Chickpea (GC 1 and GC 2) Soil type/depth-wise suggested crop and varieties Medium deep (45 to 60 cm) to deep (>90 cm): Mustard (GM 1, GM 3 and GDM 4) Fennel (GF 2, GF 11 and GF 12), Cumin (GC 4), Wheat (GW 496 and GW 322) and Chickpea (GC 1 and GC 2)

Madhya Pradesh

Agro-climatic zone & districts	Suggested crops & cultivars for early *rabi* situation
Malwa zone	Up to second week of October: Chickpea: JG 412, JG 11, JG 130, RVS 2001, RVS 2003, JG 16, JAKI 9218 Safflower: JSF1, JSF 7, RVS 113, JSF 73, JSF 97. Soil type/depth-wise suggested crop and varieties Medium (22.5 to 45 cm): Torea (JT 1) Mustad (RVM 2) Medium deep (45 to 60 cm): Safflower (JSF 1, JSF 7, RVS 113, JSF 73, JSF 97) Chickpea (JG 412, JG 11, JG 130, RVS 2001, RVS 2003, JG 16, JAKI 9218) Deep (>90 cm): Safflower (JSF1, JSF 7, RVS 113, JSF 73, JSF 97) Chickpea (JG 412, JG 11, JG 130, RVS 2001, RVS 2003, JG 16, JAKI 9218)
Kymore plateau and satpura hill zone of Madhya Pradesh	Up to second week of October: Toria (T9), Mustard (Pusa Bold, JM 1), Lentil (JL 1, JL 2, JL 3), Linseed (JLS 9, JLS 29) Up to last week of October: Lentil (JL 1, JL 2 , JL 3) Chickpea (JG 130, JG 322, JG 74); Berseem (JB 1); Chickpea+ Mustard; Soil type/depth-wise suggested crop and varieties Shallow (<22.5 cm): Toria (Type 9), Mustard (JM 1, Pusa bold) Linseed (JLS 23, JLS 9, R 552), Safflower Medium (22.5 to 45 cm): Lentil (IPL 81, JL 3) Chickpea (JG 74, JG 218, JG 11); Pea Medium deep (45 to 60 cm): Chickpea (JG 16, JG 7, JG 315) Wheat (Sujata, JW 17, JW 3020) Deep (>90 cm): Wheat (Amar, Sujata, JW 3020) Chickpea (JG 130, JG 16, JG 11)

Rajasthan

Agro-climatic zone & districts	Suggested crops & cultivars for early *rabi* situation
Southern zone of Rajasthan	Up to 4th November: Taramira (T27, RTM 2002 and RTM 314); Mustard (BIO 902 Laximi, Vasundhara and jagannath) Chickpea (RSG 973, Pratap Raj 2012 and Aruna) Soil type/depth-wise suggested crop and varieties Medium (22.5 to 45 cm): Mustard and Taramira Medium deep (45 to 60 cm): Chickpea, Mustard and Taramira Deep (> 90 cm): Chickpea (RSG 963, RSG 945 and RSG 902)

Uttar Pradesh

Agro-climatic zone & districts	Suggested crops & cultivars for early *rabi* situation
Eastern plain zone (Faizabad, Sultanpur, Gonda, Basti, Barabanki, Jaunpur, Ambedkar Nagar).	Toria: T9 Pigeonpea: Bahar with high plant population Maize: Pragati Pearlmillet: BJ for fodder Mustard: Bio-902 Pusa Jaikisan, T-59 (Varuna), Pusa Bold, Rohini, RH-30
Eastern plain and Vindhyan zone of U.P.	Up to second week of October: Mustard (Varuna, Vardan); Pea (Arkel), Lentil (HUL-57, Pant L- 406); Vegetable (Radish) Soil type/depth-wise suggested crop and varieties Shallow (22.5 cm): Lentil (HUL-57), Linseed (Neelam, Garima) Medium (22.5 to 45 cm): Mustard (Varuna), Pea (HUDP-15), Wheat (HUW-234, C-306) Medium deep (45 to 60 cm): Chickpea, Wheat (HUW -234, PBW-343), Barley (HUBR-113) Deep (> 90 cm): Chickpea (Awrodhi, Pusa-256, K-850)
South-western semi arid zone of U.P.	Upto second week of October: Mustard (Rohini, Urvashi, NRCHB-101, RH-406, RH-749, Laxmi); Taramira (RTM-314, T-27, RTM-202)

Punjab

Agro-climatic zone & districts	Suggested crops & cultivars for early *rabi* situation
Kandi region (Nawanshahr, Hoshiarpur, Gurdaspur and Roopnagar)	Pearlmillet (FBC 16) Fodder Toria (TL-17)
	Soil type/depth-wise suggested crop and varieties Shallow (<22.5 cm) & Medium (22.5 to 45 cm): Toria (TL 15 and TL 17)

Jammu & Kashmir

Agro-climatic zone & districts	Suggested crops & cultivars for early *rabi* situation
Low altitude sub-tropical zone (Kathua and parts of Udhampur)	Toria: RSPT-1 Toria (RSPT-1) + Gobhi sarson (DGS-1, GSL-1, GSL-2)

4.2. Normal *Rabi* Production Plan

To enhance production of *rabi* crops, suggested practices / technologies include: optimum sowing time, location specific high yielding cultivars, seed treatment and improved agronomic, soil and water management practices (Table 11). Resource conservation technologies recommended include planting methods for increasing the efficiency of applied water and nutrients for increased production and profitability.

Table 11: Suggested measures for normal *rabi* situation

Haryana (South-western dry zone)

Crop	Suggested measures for *rabi* crops
Chickpea	Sowing time: Second week of October to first week of November Varieties: C-235, H-208, HC-1, HC-5 Seed treatment: Bavistin @ 2.5 g/kg seed and *Rhizobium* culture For termite control: Monocrotophos @ 800 ml/2 lt of water and mix in 100 kg seed Seed rate: 70-75 kg/ha Spacing: 30 cm x 15 cm Fertilizer dose: 20:40 kg/ha NP as basal Interculture: One hoeing at 35-40 DAS. One interculture at 35-40 DAS with wheel hand hoe and *kasola*
Mustard	Sowing time: Second week of October to first week of November Varieties: RH-30, RH-819, RH-8812, RB 24, RB-50 Seed treatment: *Azotobacter* culture @ 25 g/kg seed Seed rate: 5-6 kg/ha Spacing: 45 cm x 15 cm Fertilizer dose: 40:20 kg/ha NP as basal Interculture: One hoeing interculture at 35-40 DAS with Wheel hand hoe and *kasola*
Barley	Sowing time: Third week of October to first fortnight of November Varieties: BH-393, BH-87 Seed rate: 112.5 kg/ha Fertilizer dose: 40:20 kg/ha NP as basal Interculture: One interculture at 35-40 DAS with Wheel hand hoe and *kasola*

Jammu & Kashmir (low altitude sub-tropical zone)

Crop	Suggested measures for *rabi* crops
Chickpea	Sowing time: Up to third week of October Varieties: PBG-1, K-468, C-235, Gaurav, SCS-3, GNG-469 Seed rate: 75-80 kg/ha Spacing: 30 cm x 15 cm Seed treatment: Captan or Thiram or Bavistin @ 3 g/kg seed and *Rhizobium* culture. Fertilizer dose: 15:40 kg/ha NP as basal. Interculture: Two hand weedings at 25 and 40 DAS Weed management: Pre-emergence application of Pendimethalin @ 1.0 kg a.i./ha just after sowing

Lentil	Sowing time: Last week of October to second week of November Varieties: L-9, L-12 & PL-406 Seed rate: 40 kg/ha Spacing: 20 cm x 5 cm Seed treatment: Captan or Thiram or Bavistin @ 3 g/kg seed and *Rhizobium* culture. Fertilizer dose: 15:40 kg/ha NP as basal. Interculture: Two hand weedings at 25 and 40 DAS Weed management: Pre-emergence application of Pendimethalin @ 1.0 kg a.i./ha just after sowing
Wheat	Sowing time: Last week of October to last week of November Varieties: PBW-396, PBW-175, RSP-81, Raj-3077, PBW-226 Seed treatment: Chlorpyrifos 20 EC @ 4.5 ml/kg of seed *fb* Bavistin @ 2 g/kg of seed Seed rate: 100 kg/ha Spacing: Inter-row 25 cm Fertilizer dose: 60:30:20 kg/ha NPK. 2/3rd of N and full dose of P & K as basal, 1/3rd N at 60 DAS with first winter rain. It should not be applied if boot stage has passed. Interculture: One hoeing at 30 DAS Weed management: Post-emergence spray of Isoproturon @ 0.75 kg a.i/ha + 2,4-D @ 0.5 kg a.i./ha at 30-35 DAS or Post-emergence spray of Metribuzin @ 200 g a.i./ ha at 30-35 DAS Application of Vesta (Clodinafop + Metsulfuron) RM @ 400 g/ha at 25-30 DAS or tank mix application of Clodinafop @ 60 g + Sulfosulfuron @ 25 g a.i./ha in 500 lt water at 25-30 DAS.
Oats	Second week of October to first week of November
Gobi sarson	Sowing time: First week of October to last week of November Varieties: GSL-1, GSL-2 & DGS-1 Seed rate: 5 kg/ha Spacing: 45 cm x 15 cm Fertilizer dose: 50:30:15:20 kg/ha NPKS. 2/3rd of N, full dose of P, K & S as basal and 1/3rd N as top-dressing at 20-30 DAS with winter rains. Interculture: One hoeing at 30 DAS Weed management: Pre-emergence application of Pendimethalin/Isoproturon @ 1 kg a.i./ha One hoeing must be done with wheel hand hoe within 30 DAS to control weeds & conserve moisture.
Mustard	Sowing time: First week of October to last week of November Varieties: RLM-198, Pusa Bold (second fortnight of October); RSPR-01, RLM-514, RLM-519, Kranti, Pusa- Basant, Pusa-Bahar, RH-30, Varuna (first week of October to last week of November) Seed rate: 5 kg/ha Spacing: 45 cm x 15 cm • Fertilizer dose: 60:30:15:20 NPKS kg/ha. Half of N and full dose of P, K and S as basal, Half of N at 20-30 DAS with winter rains. • Interculture: One hoeing at 30 DAS • Weed management: Pre-emergence application of Pendimethalin /Isoproturon @ 0.75-1.0 kg/ha in 500-600 lt of water. One hoeing must be done with wheel hand hoe within 30 DAS to control weeds & conserve moisture

Toria	Sowing time: Up to first week of October Variety: RSPT-1 Seed rate: 5 kg/ha Spacing: 30 cm x 15 cm Fertilizer dose: 15:18:10 kg/ha NPK as basal. 15 kg N/ha at 30 DAS. Interculture: One weeding and hoeing at 3 weeks after sowing

Punjab (Kandi region)

Crop	Suggested measures for *rabi* crops
Wheat	Sowing time: Last week of October to second week of November Varieties: PBW 175, PBW 527, PBW 644 Seed treatment: Chlorpyrifos 20 EC @ 12.5 ml/kg seed *fb* Bavistan @ 2.5 g /kg seed Seed rate: 100 kg/ha Spacing: Inter-row 22.5 cm. Fertilizer dose: 40:40:30 kg/ha NPK as basal and 40 kg N/ha about 30-60 DAS with winter rain. Interculture: One hoeing with kurpa 4-6 weeks after sowing or spray of 2,4-D @ 500-750 g/ha in 500 lt of water 30-35 DAS in sole wheat crop or post-emergence application of Metsulfuron @ 4 g/ha at 30 DAS.
Barley	Sowing time: First week of October Variety: PL 419 Seed treatment: Vitavax and Thiram each @ 3 g/kg seed Seed rate: 112.5 kg/ha Spacing: Inter-row 20 cm. Fertiliser dose: 40:30:15 kg/ha NPK as basal Interculture: One hoeing with kurpa 4-6 weeks after sowing Weed management: Spray 2,4-D @ 500 g/ha in 500 lt of water 30 DAS in sole Barley crop
Chickpea	Sowing time: Up to second week of November Varieties: PBG 1, PBG 5, C 235 Seed treatment: Bavistin or Captan @ 3 g/kg seed and *Rhizobium* culture Seed rate: PBG 1(37.5-45.0 kg/ha) and PBG 5 (60.0 kg/ha) Spacing: 30 cm x 15 cm Fertiliser dose: 15:20 kg/ha NP as basal Interculture: Two hoeings at 30 DAS and 60 DAS Weed management: One or two hand hoeing with *kasola* at 30 and 60 DAS or if moisture is enough, go for pre-plant application of Trifluralin @ 1.0 kg/ha or pre-emergence application of Pendimethalin @ 0.5-0.75 kg/ha.

Lentil	Sowing time: Up to last week of October Varieties: LL 699, LL 147, LL 931 Seed treatment: Captan @ 2.0 g/kg seed and *Rhizobium* culture Seed rate: 35 kg/ha Spacing: 22.5 cm x 10 cm Fertiliser dose: 12.5:20 kg/ha NP as basal Interculture: Two hoeings at 30 and 60 DAS Weed management: Pre-emergence application of Pendimethalin 30 EC @ 0.75 kg a.i./ha
Toria	Sowing time: First week of October Variety: TL 15 Seed rate: 3.75 kg/ha Spacing: 30 cm x 15 cm Fertilizer dose: 50:20 kg/ha NP as basal Interculture: One hoeing with wheel hand hoe 3 weeks after sowing
Raya	Sowing time: Third week of October to second week of November Varieties: RLM-619, PBR-97 Seed rate: 3.75 kg/ha Spacing: 30 cm x 15 cm Fertilizer dose: 37.5:20 kg/ha NP as basal Interculture: Two hoeings at 3 and 6 weeks after sowing
African Sarson	Sowing time: Up to second week of October Variety: PC-5 Seed rate: 3.75 kg/ha Spacing: 30 cm x 15 cm Fertilizer dose: 37.5:20 kg/ha NP as basal Interculture: Two hoeings at 3 and 6 weeks after sowing
Linseed	Sowing time: Up to third week of October Variety: LC-2023, LC-2063 Seed rate: 25 kg/ha Spacing: 23 cm x 10 cm Fertilizer dose: 37.5:20 kg/ha NP as basal Interculture: Two hoeings at 3 and 6 weeks after sowing
Taramira	Up to last week of October: TMLC 2

Uttar Pradesh (Central zone)

Crop	Suggested measures for *rabi* crops
Mustard	Sowing time: Third week of September to second week of October Variety: Bio-902, Rohini, Urvashi, NRCHB-101, RH-406, RH-749, Laxmi Seed treatment: Thiram/Tricoderma/Agrosen GN @ 3 g/kg seed Seed rate: 5-6 kg/ha Spacing: 5 cm x 15 cm Fertilizer: 60:40:40:25 kg NPKS/ha as basal Interculture: one hoeing must be done with wheel hand hoe at 30-35 DAS to control weeds and conserve moisture One life saving irrigation of 4 cm at siliquae formation stage (70-80 DAS)

Chickpea	Sowing time: First week of October to last week of October Varieties: Avrodhi, K-850, Udai, BG-256, C-235, C-214, RGS-44 Seed treatment: Bavistin+Thiram (1:1) @ 3 g/kg seed and *Rhizobium* culture @ 200 g/kg seed Seed rate: 80 kg/ha Spacing: 30 cm x 10 cm Interculture: one hoeing must be done with wheel hand hoe at 30- 35 DAS to control weeds and conserve moisture Weed management: Pre-emergence application of Pendimethaline @ 0.75 kg/ha
Barley	Sowing time: Third week of October to second week of November Variety: Ratna, DL-70, PL-172 Seed treatment: Thiram/Tricoderma/Agrosen GN @ 3 g/kg seed Seed rate: 90-100 kg/ha Spacing: 25 cm x 10 cm Fertilizer: 60:40 kg NP/ha as basal Interculture: One intercultural operation at 25-30 DAS
Taramira	Sowing time: Up to second week of October Variety: RTM-314, T-27, RTM-202 Seed treatment: Mancozeb @ 2.5 g/kg seed Seed rate: 4-5 kg/ha Spacing: 30 cm x 10 cm Fertilizer: 40:20 kg NP/ha Weed management: One weeding at 30 DAS

Uttar Pradesh (Eastern plain zone)

Crop	Suggested measures for *rabi* crops
Lentil	Sowing time: Up to last week of October Varieties: Narendra Masoor-1, PusaVaibhav, PantL- 406, IPL-81, K-75, Pant L-5, PantL-639, DPL-62, HUL-57 Seed treatment: Thiram or Carbendazim @ 3 g/kg seed and *Rhizobium* culture @ 200 g/10 kg seed. Seed rate: Small seeded: 40-50 kg/ha; Bold seeded: 70-80 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 20:60:20 kg NPK/ha as basal Weed management: Spray Pendimethalin @ 0.5-0.75 kg/ha as pre-emergence at 0-3 DAS, or two hand weedings at 20 and 45 DAS.
Chickpea	Sowing time: Up to last week of October Varieties: Gujrat Chana-4, Pusa-256, KWR-108, Adhar, WCG-2, J.G.- 16, K-850, Radhey, Avarodhi, Type-3, Type-6 Seed treatment: Thiram or Carbendazim @ 3 g/kg seed and *Rhizobium* culture @ 200 g/10 kg seed. Seed rate: 80 kg/ha Spacing: 30 cm x 15 cm Fertilizer dose: 20:60:20 kg NPK/ha Weed management: Spray Pendimethalin @ 0.75-1.0 kg/ha or Oxyfluorfen @ 200 g /ha as pre-emergence at 0-3 DAS, or two hand weedings at 20 and 45 DAS.

Mustard	Sowing time: Up to last week of October Varieties: Narendra Ageti Rai-4, Kanti (RK-9807), Narendra Rai-1, Narendra Swarna Rai-8, Varuna, Vaibhav, Ragini, Maya, Pusa Bold, Urvashi, Kranti Seed treatment: Metoloxyl @ 1.5 g or Thiram @ 2.5 g/kg seed Seed rate: 4-5 kg/ha Spacing: 45 cm x 15 cm Fertilizer dose: 60:40:30 kg NPK/ha as basal Weed management: Spraying of Pendimethalin @ 0.5 to 0.75 kg/ha in 400-500 lt water within 2-3 days of sowing, or two hand weedings at 20 and 45 DAS.
Barley	Sowing time: Up to last week of October Varieties: Narendra Jau-1, Narendra Jau-3, Azad (K-125), K-141, Haritma (K-560), Lakhan, (K-226) Seed treatment: Thiram or Carbendazim @ 3g/kg seed. Seed rate:100 kg/ha. Spacing: 30 cm x 10 cm Fertiliser dose: 60:40:30 NPK kg/ha as basal Weed management: To control broad-leaved weeds, spray 2,4-D @ 500 g/ha at 30-35 DAS in 500 lt water, Isoproturon @ 0.75 to1.0 kg/ha in 500 lt water at 30-35 DAS.
Linseed	Sowing time: Up to last week of October Varieties: Sweta, Garima, Shubhra, Laxmi-27, Padmini, Sharda, Nilam, Mau Azad-1, Type-397, Shekhar Seed treatment: Metalzxyl @ 1.5 g or Thiram @ 2.5 g/kg seed Seed rate: 25 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 40:20:20 kg NPK/ha as basal Weed management: Spraying of Pendimethalin @ 0.5 - 0.75 kg/ha in 400-500 lt water within 2-3 days of sowing, or two hand weeding at 20 and 45 DAS.

Uttar Pradesh (Eastern Plain and Vindhyan Zone)

Crop	Suggested measures for *rabi* crops
Chickpea	Sowing time: Third week of October to second week of November Varieties: Avarodhi, Pusa -256, T-6, KWR-108 Seed treatment: Thiram @ 2 g/kg seed and *Rhizobium* culture @ 200 g/10 kg seed Seed rate: 80 kg/ha Spacing: 45 cm x 10 cm Fertilizer dose: NPK: 20:40:20 kg/ha as basal Weed management: Mechanical weeding by dryland weeder at 20 to 25 DAS or spray Pendimethalin @ 0.9 kg a.i./ha as pre-emergence
Barley	Sowing time: Third week of October to second week of November Varieties: K-125, K-141, K-560, K-226, K-603 Seed treatment: Thiram @ 2.5 g/kg seed Seed rate: 100 kg/ha Fertilizer dose: 40:20:20 NPK kg/ha as basal Weed management: Mechanical weeding by dryland weeder at 45 DAS To control broad-leaved weeds, spray 2,4-D @ 500 g/ha at 30-35 DAS in 500 lt water. Isoproturon @ 0.75 to1.0 kg/ha in 500 lt water at 30-35 DAS

Pea	Up to 29th October: HUDP-15
Lentil	Sowing time: Third week of October to second week of November Varieties: Pant L 406, 639, Narendra masoor -1, HUL-57, K-75, L-4076, KLS-218 Seed rate: 30 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 20:40:20 kg/ha of NPK as basal Weed management: Pendimethalin @ 0.5-0.75 kg/ha (pre-emergence), or mechanical weeding by dryland weeder at 20-25 DAS
Mustard	Sowing time: Third week of October to second week of November Varieties: Varuna, Sanjukta, Vaibhav Seed rate: 5 kg/ha Spacing: 45 cm x 20 cm Fertilizer dose: 40:20:20:20 kg/ha NPKS as basal Weed management: Spray Pendimethalin @ 0.5 to 0.75 kg/ha in 400-500 lt water within 2-3 days of sowing, or two hand weedings at 20 and 45 DAS
Toria	Sowing time: Third week of October to second week of November Varieties: T-9, Bhavani, PT303, Narendra Agetirai Seed treatment: Thiram @ 2 g/kg seed or Mancozeb @ 30 g/kg seed Seed rate: 4 kg/ha Spacing: 30 cm x 10-15 cm Fertilizer dose: 40:30:30 kg NPK. Half N and total PK as basal and half N as top dressing at 30-35 DAS Weed management: Spray Pendimethalin @ 0.5 to 0.75 kg/ha in 400-500 lt water within 2-3 days of sowing, or two hand weedings at 20 and 45 DAS
Linseed	Sowing time: Third week of October to second week of November Varieties: Garima, Sweta, Shekhar Seed treatmnet: Thiram @ 2 g/kg seed Seed rate: 25 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 40:20:20:20 kg/ha NPKS as basal Weed management: Spray Pendimethalin @ 0.5-0.75 kg/ha in 400-500 lt water within 2-3 days of sowing, or two hand weedings at 20 and 45 DAS

Soil type/depth-wise suggested crop and varieties

Soil type	Depth (cm)	Crop and variety
Shallow	<22.5 cm	Lentil (HUL-57), Linseed (Garima, Neelam, Shekhar)
Medium	22.5 to 45 cm	Mustard (Varuna), Pea (HUDP-15), Wheat (Malviya 234)
Medium deep	45 to 60 cm	Wheat (Malaviya 234 c), Barley (DL-3, K-125)
Deep	> 90 cm	Chickpea (Awrodhi, Pusa-256, K- 850)

Rajasthan (Southern zone)

Crop	Suggested measures for *rabi* crops
Wheat	Sowing time: Up to first third week of November Varieties/Hybrids: Raj-3077, Raj-4037, LOK-1 Raj-3765 and HI-1544: HI-1531, HI-1500, HI-8627, Raj-3777, HI-8498 Seed treatment: Chlorpyriphos 20 EC @ 600 ml/100 kg seed. Thiram or Mancozeb @ 3 g/kg seed + *Azotobacter* + PSB Seed rate: 125-150 kg/ha Spacing: Inter-row 20-23 cm Interculture: One hoeing at 30 DAS Weed management: Application of Metsulfuron methyl @ 4 g/ha in 500 lt of water at 30-35 DAS. Spray 2,4-D Ester salt 500 g/ha at 30-35 DAS or hand weeding after 30 DAS
Barley	Sowing time: Up to third week of November Varieties: RD-2052, RD-2552, RD-2508 Seed treatment: Chlorpyrifos 20 EC @ 600 ml/100 kg seed. Thiram or Mancozeb @ 3 g/kg seed + *Azotobacter* + PSB Seed rate: 100 kg/ha
Chickpea	Sowing time: Up to third week of November Varieties: D-Yellow, ICCV-10, RSG-888, Pratap Chana-1, RSG 963 & ABHA Seed treatment: Thiram or Mancozeb @ 3 g/kg seed + *Azotobacter* + PSB. Chlorpyrifos 20 EC @ 800 ml for 100 kg seed. *Trichoderma* for fungal control. Seed rate: 80-100 kg/ha Spacing: 30 cm x 15 cm Fertilizer dose: 10:30 NP kg/ha as basal Interculture and weeding: Pre-emergence application of Pendimethalin @ 0.5-0.75 kg/ha at 0-3 DAS *fb* hoeing and weeding after 30 DAS as required
Mustard	Sowing time: Up to third week of November Varieties: Bio 902, Laxmi, Varuna, Vasundhara, Arawali Seed treatment: Mancozeb @ 2.5 g/kg seed Seed rate: 4-5 kg/ha Spacing: 30 cm x 15 cm Fertiliser dose: 30:50:40 kg NPK kg/ha. Full dose of P and K half dose of N as basal and half dose of N at grand growth stage. Interculture and weeding: Pre-emergence application of Pendimethalin @ 0.5-0.75 kg/ha at 0-3 DAS *fb* hoeing and weeding after 25-30 DAS as required
Lentil	Up to third week of November: T-36, BL-406 and NOORI
Taramira	Sowing time: Up to second week of October Varieties: RTM-314, T-27, RTM-202 Seed treatment: Mancozeb @ 2.5 g/kg seed Seed rate: 4-5 kg/ha Spacing: 30 cm x 10 cm Fertiliser dose: 30:40 NP kg/ha. Full dose of P and half dose of N as basal and half dose of N at grand growth stage. Interculture: One hoeing/weeding at 30 DAS.

Soil type/depth-wise suggested crop and varieties

Soil type	Depth (cm)	Crop and variety
Medium	22.5 to 45 cm	Wheat-Raj-3077, Raj-4037, LOK-1 Raj-3765 and HI-1544 Barley-RD- 2552, RD-2052 and RD-2035
Medium deep	45 to 60 cm	Lentil- T-36, BL-406 and NOORI Mustard- RH-9802, RGN-73 and Giriraj Chickpea- RSG 963, Pratap channa-1 and ABHA
Deep	> 90 cm	Chickpea- RSG 963, Pratap channa-1 and ABHA

Madhya Pradesh (Malwa plateau)

Crop	Suggested measures for *rabi* crops
Mustard	Sowing time: Second week of October Varieties: T-9, JT-1, (Toria) JM-1, JM2, Pusa bold, Varuna, Type 151 Seed treatment: Bavistin 2 g/kg of seed and *Rhizobium* + PSM @ 5 g/kg of seed Seed rate: 5-6 kg/ha Spacing: 45 cm x 15 cm Fertilizer dose: 40:40:20 kg/ha NPK + sulphur 40 kg/ha as basal Interculture: One intercultivation at 30 DAS Weed management: Application of Pendimethalin @ 0.5-0.75 kg/ha as post-emergence at 0-3 DAS *fb* one hand weeding/hoeing at 25-30 DAS
Wheat	Sowing time: First week of October to second week of November Varieties: Sujatha, C -306, HW 2004 (Amar), Swapnil, HI 1500 (Amrata), HI 1531 (Harshita), JW 3020, Lok-1, MalavKranti (HI 8638), MalavRatna (HD 4672), JW 17, JW3020, Narmada 4 Seed treatment: Thiram 2 g/kg seed and *Azaotobacter* + PSM @ 5 g/kg of seed Seed rate: 100 kg/ha Spacing: 30 cm x 5 cm Fertilizer dose: 40:20:10 kg/ha NPK as basal: 20 kg N/ha with winter rains. Weed management: 2,4-D ester @ 0.4 kg a.i./ha as post-emergence or Isoproturon @ 0.5 kg a.i./ha as post-emergence. Application of Mesosulfuron+ Iodosulfuron or Clodinafop+Metsulfuron @ 400 g/ha as post-emergence at 25-30 DAS. Application of 2,4-D @ 0.5 kg/ha in 500 lt of water at 30-35 DAS
Chickpea	Sowing time: Up to first week of October Varieties: *Desi:* JG-16, JG-412, JG-322, JG-218, JG-11, RVG-201, JG-6, JAKI-9218 *Kabuli*: RVKG-101, RVKG-102, JGK-1, JGK-3, KAK-2 Seed treatment: Bavistin 1.5 g/kg seed and *Rhizobium* + PSM @ 5 g/kg of seed Seed rate: 80 kg/ha (*Desi*), *Kabuli*: 100 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 20:40 kg/ha NP as basal Interculture: One hoeing at 20 DAS
Safflower	Varieties: JSF 7, RVS 113, JSF 73, JSF 97 Sowing time: 2nd and 3rd week of October

Soil type/depth-wise suggested crop and varieties

Soil type	Depth (cm)	Crop and variety
Medium	22.5 to 45 cm	Mustard-RVM 2, Pusa Pragati
Medium deep	45 to 60 cm	Tall wheat-HW 2004, Hashita and MP 1203, H I 1500 Chickpea-JG 412, Vishal Safflower-JSF 7, RVS 113, JSF 73, JSF 97
Deep	> 90 cm	Tall wheat-HW 2004, Hashita, MP 1203, H I 1500 Chickpea-JG 412, Vishal Safflower-JSF 7, RVS 113, JSF 73

Kymore plateau and satpura hill zone of Madhya Pradesh

Crop	Suggested measures for *rabi* crops
Wheat (unirrigated)	Up to last week of October Varieties: C 306, Sujata
Mustard	Up to second week of 6 (November 12-18) October: Mustard-Varuna , Pusa tarak, Krinti
Chickpea	Up to third week of 6 (November 12-18) October: Chickpea- Vijay, JG 218, JG 315

Soil type/ depth-wise suggested crop and varieties

Soil type	Depth (cm)	Crop and variety
Shallow	< 22.5 cm	Lentil-JL 1 Mustard-JL 3, IPL 81 Linseed-JLS 9, P 397, JT 27
Medium	22.5 to 45 cm	Chickpea-JG 130, JG 318 , JG 16 Pea Lentil-JL 3, IPL 81, JL 2
Medium deep	45 to 60 cm	Chickpea-JG 16 , JG 74, JG 218 Wheat-Amar , JW 17, JW 3020
Deep	>90 cm	Chickpea-JG 11, JG 16, JG 218 Wheat-W 320, JW 2004

Madhya Pradesh (Kymore plateau and Satpura Hill zone)

Crop	Suggested measures for *rabi* crops
Wheat	Sowing time: Entire October Varieties/Hybrids: C 306, Sujata, JW-17, HI 1500, Amar, HW 2004, JW 3020 (125-140 days) Seed rate: 100 kg/ha Fertilizer dose: 40:40:20 kg/ha NPK as basal Interculture: One interculture at 25-30 DAS Weed management: Application of Clodinafop + Metsulfuron @ 400 g/ha at 25-30 DAS or Tank mix application of Clodinafop @ 60 g + Sulfosulfuron @ 25 g/ha in 500 lt of water at 25-30 DAS
Barley	Sowing time: Entire October Varieties: JB-1, RD 2552, JB 58, RD 2503, K 603, K 560 (110-120 days) Seed rate: 110 kg/ha, Line sowing by seed drill Fertilizer dose: 60:40:20 N:P:K kg/ha; ½ N with full quantity of P & K applied at sowing remaining ½ N applied after 45 DAS One interculture at 35-40 DAS with hand hoe

Chickpea	Sowing time: First week of October Varieties: JG–130, JG–322, SHAKI, JG–11, JG–16, JG-74, JG–315, JG–218, Vijay, Vishal Seed rate: 75 kg/ha Spacing: 45 cm x 10 cm Fertilizer dose: 20:40:0 kg/ha NPK as basal Interculture: One hoeing at 40-45 DAS Weed management: Pre-emergence application of Pendimethalin @ 1.0 kg/ha just after sowing *fb* 1 hand weeding at 25 DAS or 2 hand weedings at 25 & 40 DAS
Lentil	Sowing time: First week of October Varieties: JL-1, JL-2, Ler 4076, IPL 81, JL-3 Seed rate: 45-50 kg/ha Spacing: 25 cm x 10 cm Fertilizer dose: 20:30:20:20 kg/ha NPKS as basal Interculture: Pre-emergence application of Pendimethalin @ 0.5-0.75 kg/ha just after sowing *fb* 1 hand weeding at 25 DAS or 2 hand weedings at 25 & 40 DAS
Mustard	Sowing time: First week of October Varieties: Pusa Bold, Varuna, Jaikisan, Pusa Tarak, Kranti, JM-1, JM-2, JM-3 Seed rate: 5 kg/ha Spacing: 45 cm x 15cm Fertilizer dose: 30:30:20:20 kg/ha NPKS as basal Interculture: On interculture at 30 DAS
Linseed	Sowing time: First week of October Varieties: JLS-9, JLS–23, JT–27, JLT–26, R-552, T397, J–1 Seed rate: 20-25 kg/ha Fertilizer dose: 60:30:20 kg/ha NPK kg/ha as basal Interculture: One hoeing by wheel hoe at 30 DAS

Soil type/ depth-wise suggested crop and varieties

Soil type	Depth (cm)	Crop and variety
Shallow	< 22.5 cm	Lentil – JL 1 Mustard – JL 3, IPL 81 Linseed – JLS 9, P 397, JT 27
Medium	22.5 to 45 cm	Chickpea – JG 130, JG 318, JG 16 Lentil – JL 3, IPL 81, JL 2
Medium deep	45 to 60 cm	Chickpea – JG 16 , JG 74, JG 218 Wheat – Amar, JW 17, JW 3020
Deep	>90 cm	Chickpea – JG 11, JG 16, JG 218 Wheat – JW 320, JW 2004

Maharashtra (Western Vidarbha zone)

Crop	Suggested measures for *rabi* crops
Safflower	Sowing time: Up to second week of October Varieties: AKS-207, Bhima, NARI-6, NARI Hybrid, NH-1 Seed treatment: Thiram or Captan @ 3 g/kg seed. *Trichoderma* 4 g/kg seed Seed rate: 10-12 kg/ha and 7.5 kg/ha for hybrids Fertilizer dose: 25:25 NP kg/ha Interculture: Two hoeings at 15-20 DAS and 40 DAS Weed management: Pre-emergence spray of Pendimethalin @ 0.75-1.0 kg/ha *fb* one hand weeding at 20-25 DAS, or two hoeings at 15-20 days interval after sowing
Chickpea	Sowing time: Up to last week of October Varieties: Jaki-9218, Saki-9516, Green Chafa, ICCV-10, PKV Harita, PKV Kabuli-2 Seed treatment: Thiram or Captan 3 g/kg seed, *Trichoderma* 4 g/kg seed and *Rhizobium* + PSB @ 25 g/kg seed Seed rate: 80-90 kg/ha (bold seeded), 60-75 kg/ha (medium size seeded) Spacing: 30 cm x 10 cm (bold seeded), 45 cm x 7.5 cm (medium size seeded) Fertilizer dose: 20:40 NP kg/ha as basal Interculture: Two hoeings at 15-20 DAS and 40 DAS Weed management: Pre-emergence application of Pendimethalin @ 0.75-1.0 kg/ha within 2-3 days of sowing *fb* one hand weeding at 20-25 DAS

Maharashtra (Scarcity zone)

Crop	Suggested measures for *rabi* crops
Rabi Sorghum	Sowing time: Up to second week of October Varieties: For shallow soils: Phule Mauli, Anuradha, Selection 3; Medium deep soil: Phule Mauli, Phule Suchitra, M 35-1 and for Deep and very deep soils: Phule Yashodha, Phule Vasudha, Parbhani Moti Seed treatment: 25 g *Azotobacter* + 25 g PSB/kg seed Seed rate: 10 kg/ha Spacing: 45 cm x 15 cm Fertilizer dose: 50:25:25 kg/ha NPK as basal Interculture: Three hoeings at 3, 5 and 8 weeks after sowing Weed management: Atrazine @ 1 to 2 Kg a.i./ha as pre-emergence Hoeings for soil moisture conservation takes care of weeds Up to third week of October: Sorghum (Suchitra, Parbhani Moti, Phule Chitra, Maldandi, Phule Anuradha, Mauli)
Chickpea	Sowing time: Up to third week of October Varieties: Vijay, Digvijay Seed treatment: 2 g Thiram + 2 g Carbendazim/kg seed or 5 g *Trichoderma*/kg seed *fb Rhizobium* @ 25 g/kg seed Seed rate: 65-70 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 25:50 kg N and P/ha as basal Interculture: Two hoeings at 3 and 4 weeks after sowing Weed management: Pendametahlin 30 EC @ 1 to 1.5 kg/ha as pre-emergence
Safflower	Up to third week of October: Phule Chadrabhaga 708, 733
Sunflower	Up to third week of October: Bhanu, Phule SS - 808, Phule Bhaskar

Soil type/depth-wise suggested crop and varieties:

Soil depth	Crop and variety				
	Sorghum	Chickpea	Safflower	Sunflower	Wheat
Shallow (<22.5 cm)	Phule Anuradha, Mauli	---	---	---	---
Medium (22.5 to 45 cm)	Phule Suchitra, Parbhani Moti, Phule Chitra, Maldandi	Vijay/ Digvijay	Phule Chandrabhaga, Bhima	Bhanu, Phule Bhaskar	Phule Samdhan, Netravati, Panchvati
Medium deep (45 to 60 cm)	Phule Suchitra, Parbhani Moti, Phule Chitra, Maldandi				
Deep (> 90 cm)	Phule Vasudha, Phule Revati, Phule Yashoda, Maldandi				

Maharashtra (Marathwada)

Crop	Suggested measures for *rabi* crops
Chickpea	Sowing time: First fortnight of October Varieties: BDN-797 Seed rate: 50 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 25:50 kg/ha NP as basal Interculture: Two hoeings i.e. 3 and 6 weeks after sowing Weed management: Pre-emergence spray of Pendimethalin @ 0.9 kg a.i./ha
Safflower	Sowing time: First fortnight of October Varieties: PBNS-21, PBNS-40 Seed rate: 12-15 kg/ha Spacing: 45 cm x 20 cm Fertilizer dose: 25:50 kg/ha NP as basal Interculture: Two hoeings i.e. 3 and 6 weeks after sowing Weed management: Pre-emergence spray of Pendimethalin @ 0.9 kg a.i./ha
Sorghum	Up to second week of October
Linseed	Up to second week of October

Soil type/depth-wise suggested crop and varieties

Soil type	Depth (cm)	Crop and variety
Shallow	<22.5 cm	Linseed (NL 260, LSL 93, RLC 4).
Medium	22.5 to 45 cm	Sunflower (LSF8, LSFH 35, SS 2038/ Bhanu), Safflower (Sharda, Bhima, PBNS 12, PBNS 40, PBNS 86).
Medium deep	45 to 60 cm	*Rabi* sorghum (Parbhani Moti, Maldandi/ M-53-1), Safflower (Sharda, Bhima, PBNS 12, PBNS 40, PBNS 86), *Rabi* Sorghum + Safflower (6:3)
Deep	>90 cm	*Rabi* sorghum (Parbhani Moti, Maldandi/ M-53-1), Safflower (Sharda, Bhima, PBNS 12, PBNS 40, PBNS 86), Chickpea (BDNG 797/ Aaksh, Vijay, BDN 9-3), after *kharif* Soybean, Greengram (BM 2002-1, BM 2002-3, BM-4), Blackgram (TAU 1)

Jharkhand

Crop	Suggested measures for *rabi* crops
Chickpea	Sowing time: Third week of October to first week of November Varieties: Pant G 114, KPG-59, JG–14 Seed rate: 75-100 kg/ha Spacing: 30 cm x 15 cm Fertilizer dose: 20:40:20:10 kg/ha NPKS as basal Interculture: Two hoeings i.e. 30 DAS and 50 DAS Weed management: Pre-plant incorporation of Fluchloralin 45 EC (0.75 lt/ha)
Wheat	Sowing time: First week of November to second week of December Varieties: K 9107, K 307, Birsa Gehun- 2, Birsa Gehun- 3 Seed rate: 125-150 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 100:60:40 kg/ha NPK. All PK as basal and 25% N as basal, 25% N at 21 DAS and 50% N at 45 DAS. Interculture: Two hoeings at 30 DAS and 50 DAS Weed management: Isoproturon @ 1.0 kg a.i./ha at 25 DAS

North Saurashtra zone of Gujarat

Crop	Suggested measures for *rabi* crops
Cumin	Last week of October to Second week of November: Cummin Guj.-4
Coriander	Last week of October to Second week of November: Coriander Guj.-2
Chickpea	Last week of October to Second week of November: Guj.-3
Wheat	Last week of October to Second week of November: Lok-1, GW-496

Soil type/depth-wise suggested crop and varieties

Soil type	Depth (cm)	Crop and variety
Shallow	<22.5 cm	Cumin (Cummin Guj.-4)
Medium deep	45 to 60 cm	Coriander (Coriander Guj.-2) Chickpea (Guj.-3) Wheat (Lok-1, GW-496)
Deep	> 90 cm	Wheat (Lok-1, GW-496)

Bastar Plateau zone of Chhattisgarh

Crop	Suggested measures for *rabi* crops
Wheat	Up to third week of October: GW 273, Ratan and Arpa
Maize	Up to third week of October: Hybrids
Vegetables	Brinjal (VNR1, Pusa purple long), Chilli-Pusa Jwala, Tomato- Pusa rubi

Soil type/depth-wise suggested crop and varieties	Shallow (< 22.5 cm)- Coriander – hybrid (M-1) Medium (22.5 to 45 cm)- Wheat – GW 273, Sujata, Ratan Medium deep (45 to 60 cm)- Lentil – kiran, Chilli-Pusa Jwala, Deep (> 90 cm)- Vegetables – Brinjal (VNR1, Pusa purple long)

Odisha (Eastern Ghat Zone)

Crop	Suggested measures for *rabi* crops
Mustard	Sowing time: Up to second week of October Varieties: Parvati, Anuradha, M-27 Seed rate: 10 kg/ha Spacing: 45 cm x 15 cm Fertilizer dose: 30:15:15 kg/ha N:P:K as basal Interculture: Two intercultural operations at 25 and 45 DAS Weed management: Spray of Pendimethalin @ 0.5-0.75 kg/ha at 2-3 DAS *fb* 1 hand weeding at 30 DAS, or two intercultural operations at 25 & 45 DAS
Green gram and Black gram	Scond week of November
Groundnut	Second to third week of November

Soil type/depth-wise suggested crop and varieties

Soil type	Depth (cm)	Crop and variety
Shallow	<22.5 cm	Vegetables (cole crops, root crops), Mustard
Medium	22.5 to 45 cm	Vegetables (cole crops, root crops)
Medium deep	45 to 60 cm	Oilseed and pulse crops
Deep	>90 cm	-

Andhra Pradesh

Crop	Suggested measures for *rabi* crops
Chickpea	Sowing time: Second week of October to second week of November Varieties: JG-11, KAK-2, JAKI 9218, Vihar, LBeG 7, JG-130, ICCV-2 Seed treatment: Captan or Thiram @ 2.5 g/kg seed and *Trichoderma viridae* @ 4-5 g/kg seed Seed rate: 70-80 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 20:50 NP kg/ha Weed management: Pre-emergence application of Pendimethalin @ 0.5-0.75 kg/ha within 2-3 days of sowing *fb* one hand weeding at 20-25 DAS Seed rate: 85-90 kg/ha (*Desi*); 100-110 kg/ha (*Kabuli*) Spacing: 30 cm x 10 cm Fertilizers: 20:50:40 kg NPS/ha as basal dose Intercultivation: Twice at 20 and 30 DAS Weed control: spray Pendimethalin @ 0.75-1.0 lt a.i./ha immediately after sowing or the next day to check the weed growth for the first 20-25 days. Irrigation: Rainfed, but one or two light irrigations by supplemental irrigations at flowering and pod formation stage will increase the yields. Adopt IPM practices against *Helicoverpa* ➢ Follow strip cropping of chickpea with coriander (8:2 or 16:4) ➢ Sow 4 rows of sorghum all round the plot ➢ Transplant 50-100 marigold seedlings all round the plot ➢ Pheromone traps @ 10/ha to target the pest at right stages. ➢ Use bird perches (50/ha) ➢ Use neem formulations for insect repelling (NSKE 5%) soon after the pest occurrence. ➢ Use biocides like *Bt* @ 1 kg/ha and NPV @ 500 LE/ha twice at an interval of 7-10 days in the evening hours. ➢ If necessary spray Chlorpyrifos @ 2.5 ml/lt or Quinalphos @ 2 ml/lt or Acephate @ 1.0 g/lt @ 500 lt of spray fluid per ha. *Spodoptera exigua* The incidence of *S. exigua* generally appears at early vegetative stage (up to 20-30 days after sowing). Spray either Monocrotophos @ 1.6 ml/lt or Acephate @ 1.0 g/lt or Quinalphos @ 2.0 ml/lt or Thiodicarb @ 1 g/lt. Wilt: Seed treatment with Captan or Thiram @ 2.5 g/kg seed or *Trichoderma* (4 g/kg). Grow resistant varieties such as JG 11, JG 130, JAKI 9218. Dry root rot: Seed treatment with Captan or Thiram @ 2.5 g or Rhizocin @ 2.5 g/kg seed. Grow resistant variety ICCV 10.
Coriander	Sowing time: October to November Varieties: Sadhana (CS-4), Sindhu (CS-2), Sudha (LCC-128) and Swathi (CS-6) Seed treatment: *Azospirillum* @ 1.5 kg/ha Seed rate: 15 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 30:40:20 NPK kg/ha as basal application

Sunflower	Seed rate and spacing: Rainfed crop requires more seed (7.5-10 kg/ha for varieties and 5-6.25 kg/ha for hybrids) than irrigated (6.25-8.75 and 5 kg/ha, respectively, for varieties and hybrids). In light soils, 45 cm x 20-25 cm and in heavy soils 60 cm x 30 cm Seed treatment: Seed should be treated with Quintal (Iprodione 25 % + Carbendazim 25 %) @ 2 g/kg seed for controlling *Alternaria* leaf spot. In the necrosis prone areas treat the seed with Imidacloprid @ 5 g/kg or Thiamethoxam @ 4 g/kg seed. Seed should be treated with Metalaxyl @ 3 g/kg seed for managing downy mildew. Thinning: Maintain a single seedling per hill by thinning out other seedlings in a hill, 10-15 days after germination for obtaining higher yields. Fertilizers: Apply FYM 7.5 t/ha 2-3 weeks prior to sowing, 60:60:30 kg/ha NPK for rainfed and 75:0:30 Kg/ha NPK for irrigated conditions. First dose as basal and second and third as top dressing at 30 and 50 days after sowing. Prefer single super phosphate as source of P.
Rabi maize	Sowing time: Last week of October to second week of November Varieties: Kaveri 2288, 50, CP818, NMH 731 & 666 Seed treatment: Bavistin + Captan (1:1 ratio) @ 2 g/kg seed; Apron 35 SD @ 4 g/kg seed Seed rate: 20 kg/ha Spacing: 60 cm x 20 cm or 75 cm x 20 cm Fertilizer dose: 90:45 (NP) kg/ha for rainfed condition; 120:60 (NP) kg/ha for irrigated condition. N in 3 splits i.e. 1/4th as basal, 1/2nd at 30 DAS, 1/4th at pre-flowering. In Zn deficient soils, apply 50 kg $ZnSO_4$/ha. If Zn deficiency symptoms are observed in plants, spray 0.2% $ZnSO_4$ solution 2-3 times at weekly intervals Interculture: One intercultivation at 30-35 DAS *fb* ridging/earthing up Weed management: Pre-emergence application of Atrazine @ 0.75-1.0 kg/ha mixed in 500-600 lt of water *fb* 2, 4-D @ 500 g/ha at 20-25 DAS

Soil type/depth-wise suggested crop and varieties

Soil type	Depth (cm)	Crop and variety
Shallow	<22.5 cm	Coriander, clusterbean
Medium	22.5 to 45 cm	Chickpea
Medium deep	45 to 60 cm	Chickpea
Deep	>90 cm	Chickpea

Karnataka (Central, eastern and souther dry zone)

Crop	Suggested measures for *rabi* crops
Rabi Sorghum	Sowing time: Up to second week of October Varieties/Hybrids: M-35-1, Mooguthi, CSH-10 Seed treatment: 2 g Sulphur/kg seed Seed rate: 7.5 kg/ha Fertilizer dose: 50:25 kg/ha NP as basal Interculture: Three to four hoeings at 10-15 days interval within 30 DAS Weed management: Application of Atrazine @ 0.5 kg/ha as post-emergence at 0-3 DAS

Horsegram	Sowing time: Up to last week of October Varieties: KBH-1, PHG-9 Seed rate: 25 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 25:50:25 kg/ha NPK as basal Interculture: Two interculture operations at 20 and 40 DAS. Weed management: Spray of Pendimethalin @ 0.9 kg a.i./ha as pre-emergence
Chickpea	Sowing time: From first week of November to first week of December Varieties: Annigeri-1, JJ-11, KAK-2, Vishal
Rabi sorghum	Sowing time: Up to first fortnight of October Varieties/Hybrid: M-35-1, Muguti (5-4-1), GRS-1, DSV-5, DSH -4, DSV-4, CSH-15R Seed rate: 6-7.5 kg/ha Spacing: 45 cm x 15 cm Fertilizer dose: 50:25 kg/ha NP as basal Weed management: One hoeing at 45 DAS or spray Atrazine 50% @ 1.0 kg a.i./ha as pre-emergence Up to third week of October - M35-1/BJV 44/CSV 9R
Chickpea	Sowing time: First week of October to last week of November Varieties: ICCV-2, Annigeri-1, ICCV-10, JG -11, Jaki 6218/BGM 2 Seed rate: 50 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 10:25 kg/ha NP as basal Interculture: One hoeing at 30 DAS Weed management: Pre-emergence application of Pendimethalin @ 0.5-0.75 kg/ha *fb* 1 hand weeding/hoeing at 25-30 DAS
Safflower	Sowing time: Up to third week of October Varieties: A-1 Seed rate: 8-10 kg/ha Spacing: 60 cm x 30 cm Fertilizer dose: 50:25 kg/ha NP as basal
Horsegram	Sowing time: October Varieties: BGM-1 Weed management: 1 hand weeding/hoeing at 25-30 DAS
Wheat (rainfed)	Sowing time: October Varieties: Kiran Bijga Yellow, DWR-2006 Weed management: 1 hand weeding at 25-30 DAS
Sunflower	Sowing time: Up to third week of October Varieties: DSFH-3/ KBSH 53/ KBSH 44

Tamil Nadu (Southern plateau and hills and East coast plains and hills regions)

Crop	Suggested measures for *rabi* crops
Cotton	Sowing time: Up to last week of October Varieties: KC-2, KC-3 and hybrids Seed rate: 20 kg/ha, hybrids – 1.5 kg/ha Spacing: 45 cm x 30 cm Fertilizer dose: 20:20:40:10 kg/ha NPKS as basal. 20 kg/ha N at square formation. Foliar spray of 1% $MgSO_4$ at 50 and 80 DAS. Foliar spray of 0.5% $ZnSO_4$ at 45 and 60 DAS. Interculture: One intercultural operation with blade harrow at 60 DAS. Weed management: Pendimethalin @ 1.0 kg/ha or Oxyfluorfen @ 200 g/ha *fb* one hand weeding at 25-30 DAS and one mechanical weeding with power weeder at 45 DAS.
Rabi Sorghum	Sowing time: Up to second week of October Varieties: K 8, APK 1, CSV 1, Co 26, K 12, CSH-16, COH-2 Seed rate: 10 kg/ha Spacing: 45 cm x 15 cm Fertilizer dose: 20:20:10 kg/ha NPS as basal. 20 kg N/ha at 40 DAS. Interculture: Two hoeings at 20 and 40 DAS Weed management: Spray Atrazine @ 500 g/ha as pre-emergence within 3 days *fb* one Intercultivation at 20-25 DAS
Maize	Sowing time: Up to second week of October Varieties: CO-H (M) 5, CO-1 Seed rate: 15 kg/ha Spacing: 45 cm x 15 cm for composites, 60 cm x 30 cm for hybrids Fertilizer dose: 20:20 kg/ha NP as basal. 20 kg N/ha as top dressing at 25-30 DAS Interculture: Two hoeings at 20 and 40 DAS Weed management: Application of Atrazine @ 500 g/ha as post-emergence 3 DAS *fb* 2,4-D @ 500 g/ha as post-emergence or one hand weeding at 25-30 DAS
Blackgram	Sowing time: Up to third week of October Varieties: VBN 4, VBN 5, VBN 6, CO 6, Nirmal CO 5, CO 6, VBN 7 Seed rate: 20 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 12.5:25:12.5 kg/ha NPK as basal Weed management: Pre-emergence application of Pendimethalin @ 0.5-0.75 kg/ha at 3 DAS + one hand weeding at 30 days after sowing
Greengram	Sowing time: Up to third week of October Varieties: CO 6, VBN 3, CO 7, VBN 2, CO 8 Seed rate: 20 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 12.5:25:12.5 kg/ha NPK as basal Weed management: Pre-emergence application of Pendimethalin 0.50-0.75 kg/ha at 3 DAS *fb* one hand weeding at 30 days after sowing

Sunflower	Sowing time: Up to first week of November Varieties: TNAU Sunflower Hybrid CO2, Sunbred CO 4, CO SFV 5 Seed rate: 7 kg/ha Spacing: 45 cm x 30 cm Fertilizer dose: 40:20 kg/ha NP as basal Interculture: One hand weeding at 30 DAS Pre-emergence application of Pendimethalin @ 0.75 kg/ha within 3 DAS *fb* one hand weeding at 25 to 30 DAS
Pearlmillet	Sowing time: Third week of October to second week of November Varieties: ICMV 221, Co (Cu) 9, WCC-75, Hybrids-ICH 301 Seed rate: 6 kg/ha Spacing: 45 cm X 15 cm Fertilizer dose: 20:20 kg/ha NP as basal and 20 kg N at 40 DAS Interculture: One intercultivation at 20 DAS Weed management: Spray Atrazine @ 0.25 kg a.i./ha as pre-emergence/early post emergence *fb* one hand weeding at 30-35 DAS
Barnyard millet	Up to first week of November: Barnyard millet (CO2 & MDU1)
Foxtail millet	Up to first week of November: Foxtail millet (CO7)
Kodo millet	Up to first week of November: Kodo millet (CO3)

Soil type/depth-wise suggested crop and varieties

Soil type	Depth (cm)	Crop and variety
Shallow	<22.5 cm	Minor millets, sorghum
Medium	22.5 to 45 cm	Pulses, maize
Medium deep	45 to 60 cm	Pulses, maize, cotton, medicinal senna
Deep	>90 cm	Cotton, medicinal senna

Assam (North Bank plain zone)

Crop	Suggested measures for *rabi* crops
Boro rice	Sowing time: December Varieties: Boro 1, Boro 2, Bishnu prasad, Jyoti prased, Joymoti, Cauvery Seed treatment: Mancozeb @ 2.5 g/l of water under wet method. Captan @ 2.5 g/kg of seed under dry method. Seed rate: Pre-germinated seeds to be sown 650-1000 g/bed. For transplanting 1 ha of main field, 40-45 kg of seeds is required. Maintain water upto 7 cm depth. Fertilizer dose: 40:20:20 kg/ha NPK. Weed management: Application of Butachlor @ 1.0 kg/ha or Pretilachlor @ 0.75 kg/ha as pre-emergence *fb* rotary paddy weeder at 40 DAT or 2 hand weedings at 20 and 40 DAT
Toria	Sowing time: Second week of October to second week of November Varieties: M-27, TS-38, TS-36, TS-29 Seed treatment: Apron 35WS @ 6 g/kg of seed Seed rate: 10 kg/ha Spacing: 30 cm x 10 cm Fertilizer dose: 40:35:15 NPK kg/ha as basal Weeding: One weeding at 20 DAS

Mustard	Sowing time: Second week of October to second week of November Varieties: TM-2, TM-4, Varuna Seed rate: 4-5 kg/ha Spacing: 30 cm - 45 x 15 cm Fertilizer dose: 40:35:15 kg/ha NPK Weeding: Pendimethalin @ 0.5-0.75 kg/ha as pre-emergence or 1 hand weeding at 25-30 DAS
Potato	Sowing time: First week of October to second week of November Varieties: Kufri Jyoti, Kufri Megha, Kufri Sinduri Seed treatment: Mancozeb @ 5 g/lt for 10 minutes and dried in shade for 48 hours Seed rate: 25 q/ha Spacing: 50 cm x 15 cm Fertilizer dose: 60:50:50 kg/ha NPK Interculture: Earthing up at stolon and tuber formation Weed management: Pre-emergence application of Metribuzin @ 500-700 g/ha within 3-4 DAP or early post-emergence application of Metribuzin @ 500 g/ha at 15-20 DAP or 1-2 hand weedings
Pea	Sowing time: First week of October to second week of November Varieties: T-163, Boneville, HUP-2 Seed treatment: Bavistin @ 2 g/kg of seed and *Rhizobium culture* Seed rate: T-163: 50 kg/ha; Boneville: 60 kg/ha; HUP-2: 65 kg/ha Fertilizer dose: 10:46: kg/ha NP as basal Weed management: Application of Pendimethalin @ 0.5- 0.75 kg/ha as pre-emergence (0-3 DAS)

4.3 Late *rabi* production plan

Table 12: Suggested crops & cultivars for late *rabi* situation

Jammu & Kashmir

Agro-climatic zone & districts	Suggested crops & cultivars for late *rabi* situation
Low altitude sub-tropical zone (Kathua and parts of Udhampur)	Sowing time: Last week of November to last week of December Wheat (Raj 3077, HD-228, PBW-226)

Haryana

Agro-climatic zone & districts	Suggested crops & cultivars for late *rabi* situation
Haryana (South-western dry zone) (Hisar)	Sowing time: Last of October to first week of November Barley (BH-902, BH-393)

Uttar Pradesh

Agro-climatic zone & districts	Suggested crops & cultivars for late *rabi* situation
Eastern plain and Vindhyan zone of U.P (Varanasi)	Sowing time: First to last week of November Soil type/depth-wise suggested crop and varieties Shallow (22.5 cm): Lentil (HUL-57), Linseed (Garima, Neelam, Shekhar) Medium (22.5 to 45 cm): Mustard (Varuna), Pea (HUPD-15), Wheat (Malviya 234) Medium deep (45 to 60 cm): Wheat (Malviya 234), Barley (HUBR-113) Deep (>90 cm): Chickpea (Awrodhi, Pusa-256, K- 850)

South-western semi arid zone of Uttar Pradesh (Agra)	Sowing time: Last week of October to first week of November Varieties: Wheat (UP-2338, HD-2204, Lok-1, PBW-154, PBW-343) Seed treatment: Bavistin /Agrosen GN @ 2-5 g/kg seed Seed rate: 100-125 kg/ha Spacing: 22.5 cm x 10 cm Fertilizer: 60:40 kg NP/ha as basal Interculture: One hoeing or normal weeding at 30-35 DAS to control weeds Weed management: Spray 2,4-D @ 500-750 g/ha in 500 lt of water at 40-45 DAS in sole wheat

Rajasthan

Agro-climatic zone & districts	Suggested crops & cultivars for late *rabi* situation
Southern zone	Sowing time: Last week of November to second week of December. Varieties: Wheat (Raj-3077, Raj-4037, LOK-1, Raj- 3765 and HI-1544)

Madhya Pradesh

Agro-climatic zone & districts	Suggested crops & cultivars for late *rabi* situation
Malwa zone (Indore)	Sowing time: Third week of October to first week of November: Varieties: Wheat (HW 2004, Hashita and MP 1203, H I-1500) Chickpea: JG 412, Vishal, Safflower: JSF 7, RVS 113, JSF 73,JSF 97 Soil type/depth-wise crops and varieties Medium (22.5 to 45 cm): Mustard cv T9 Medium deep (45 to 60 cm): Chickpea (JG 412, Vishal), Safflower (JSF 7, RVS 113, JSF 73) Deep (>90 cm): Chickpea (JG 412, Vishal), Safflower (JSF 7, RVS 113, JSF 73, JSF 97)
Kymore plateau and satpura hill zone of Madhya Pradesh	Sowing time (1): Last week of October to first week of November Varieties: Chickpea (JG 130, JG 11, JG 16), Lentil (JL 1, JL 2, JL 3), Chickpea + mustard intercropping Sowing time (2): Last week of November to first week of December Varieties: Wheat (GW 366, JW 320, HW 2004), Barley (JB 1, JB 58, K 560) Soil type/depth-wise suggested crop and varieties: Shallow (< 22.5 cm): Barley (RD 2552, JB 58, K 603), Lentil (JL 1, JL 2, JL 3), Mustard (Pusa Tarak , Pusa Bold, JM1) Medium (22.5 to 45 cm): Chickpea (JG 322, JG 11, JG 16), Wheat (HW 2004, JW 320, JW 17), Chickpea + wheat intercropping Medium deep (45 to 60 cm): Wheat (GW 366, JW 3020) Deep (>90 cm): Wheat (GW 366, JW 3020, HW 2004)

Gujarat

Agro-climatic zone & districts	Suggested crops & cultivars for late *rabi* situation
Northern Gujarat zone (Banaskantha, Sabarkantha, Palampur, Surendranagar)	Sowing time: Second week of November to first week of December Varieties: Wheat (GW 173 and Lok 1)

Maharashtra

Agro-climatic zone & districts	Suggested crops & cultivars for late *rabi* situation
Central Maharashtra Plateau Zone (Parbhani, Aurangabad, Nasik, Nanded)	Sowing time: Up to second week of October for *rabi* sorghum, safflower and linseed Second week of October to Second week of November for Chickpea, safflower and linseed Soil type/depth-wise suggested crop and varieties Shallow (<22.5 cm): Linseed (NL 260, LSL 93, RLC 4) Medium (22.5 to 45 cm): Sunflower (LSF 8, LSFH 35, SS 2038/ Bhanu), Safflower (Sharda, Bhima, PBNS 12, PBNS 40, PBNS 86) Medium deep (45 to 60 cm): *Rabi* sorghum (Parbhani Moti, Maldandi i.e. M-53-1), safflower (Sharda, Bhima, PBNS 12, PBNS 40, PBNS 86), *rabi* sorghum + safflower (6:3) Deep (>90 cm): *Rabi* sorghum (Parbhani Moti, Maldandi/ M-53-1), Safflower (Sharda, Bhima, PBNS 12, PBNS 40, PBNS 86), Chickpea (BDNG 797/Aaksh, Vijay, BDN 9-3), Greengram (BM 2002-1, BM 2002-3, BM-4), Blackgram (TAU 1)
Scarcity zone (Solapur, Ahmednagar, Western part of Beed, Osmanabad, Eastern part of Pune, Sangli, Dhule, Nandurbar)	Sowing time: Up to third week of October Varieties: Chickpea, sunflower, wheat, sorghum, fodder sorghum, sunflower Soil type/depth-wise suggested crop and varieties Medium (22.5 to 45 cm): Sunflower (Phule Bhaskar), Chickpea (Digvijay) Medium deep (45 to 60 cm): Wheat (Netravati, Samadhan), Chickpea (Digvijay), Sunflower (Phule Bhaskar) Deep (>90 cm): Chickpea (Vijay) and sorghum (Anuradha)

Chhattisgarh

Agro-climatic zone & districts	Suggested crops & cultivars for late *rabi* situation
Bastar Plateau zone (Bastar, Bijapur, Kondagaon, Narayanpur)	Sowing time: Up to last week of October for Wheat (Ratan and Arpa) in medium soils (22.5 to 45 cm) Lat week of October to first week of November: Vegetables - Brinjal (VNR1, Pusa purple long), Chilli (Pusa Jwala), Tomato (Pusa rubi) in medium deep (45 to 60 cm) and deep soils(>90 cm)

Andhra Pradesh

Agro-climatic zone & districts	Suggested crops & cultivars for late *rabi* situation
Scarce rainfall zone-Southern AP (Kurnool, Anantapur)	Sowing time: First week to last week of November Soil type/depth-wise suggested crop and varieties Shallow (<22.5 cm): Clusterbean Medium (22.5 to 45 cm), medium deep (45 to 60 cm) and deep (>90 cm): Chickpea Recommended varieties for all situations: Sorghum: Varieties: NTJ-2,4, CSV216R, CSV-14R, M35-1 and Kinnera Hybrids: CSH-15R, CSH-16 Sunflower: Varieties: Morden, DRSF-108 Hybrids: KBSH-1, NDSH-1, DRSH-1, APSH-66 Greengram varieties: LGG 460, LGG 407, MGG 295, MGG 347, MGG 348, TM 96-2, WGG 37 Safflower varieties: Manjira, Sagarmutyalu, TSF-1 Chickpea varieties: *Desi*: JG-11, JAKI 9218, PG 81-1-1 (Vijay), JG-130 NBeG (Nandyala sanaga 1); *Kabuli*: KAK-2, Phule G 95311 and LBeG 7 (Lam sanaga1) Extra large seeded *Kabuli*: MNK 1, Kripa

Karnataka

Agro-climatic zone & districts	Suggested crops & cultivars for late *rabi* situation
Northern dry zone (Bijapur, Bagalkot, Gadag, Koppal, Bellary, part of Dharwad, Belgaum, Raichur and Davangere)	Sowing time: Up to third week of October Soil type/depth-wise suggested crop and varieties Medium (22.5-45 cm): Sorghum (M35-1), Chickpea (A1/ JG 11/ Jaki 6218/ BGM 2), Sorghum + Chickpea intercropping (2:4) Medium deep (45–60 cm): Sorghum (M35-1/ BJV 44/ CSV 9R), Cickpea (A1/ JG 11/ Jaki 6218/ BGM2), Sorghum + Chickpea (2:4) Deep (90 cm): Sorghum (M35-1/ BJV 44/ CSV 9R), Chickpea (A1/ JG11/ Jaki 6218/ BGM 2), Sorghum + Chickpea (2:4)

Tamil Nadu

Agro-climatic zone & districts	Suggested crops & cultivars for late *rabi* situation
Southern plateau and hills and East coast plains and hills regions (Thoothukudi,Tirunelveli,Virudhanagar and Madurai)	Sowing time: First week to second week of December: Medicinal senna-KKM Se 1, Chickpea (CO-3), Horsegram (CO-1) Soil type/depth-wise suggested crop and varieties Shallow (<22.5 cm) - Chickpea, Horsegram Medium to Medium deep (22.5 to 60 cm) - Medicinal senna

4.4. Fodder Production Plan

Livestock production in the mixed farming systems is predominantly dependent on three major sources of fodder supply *viz*., crop residues, cultivated fodder and fodder from common property resources like forests, permanent pastures and grazing lands. Availability of good quality fodder along with wholesome drinking water

is the major constraint faced by animals during deficit rainfall conditions. Drought affects biological system of animals in terms of no thriftiness, reproductive compromise, reduced immunity, greater disease attacks and poor quality feed availability ultimately leading to drop in production and health of the animal. There may be altered plant populations with more toxic plants in grazing lands due to selective grazing. Livestock become deficient in vitamins A, D, and E if they do not have green fodder for more than 30 days. Animals that lack sufficient protein, energy, minerals and vitamins cannot tolerate toxins. Prolonged drought leads to adverse impact on immunity and health of the animal in addition to loss in productivity. Feeding of available poor quality forage and limited energy, protein, essential minerals and vitamins intake adversely affects fertility also. Some parasitic eggs tend to concentrate more in the lower part of the forage plants, thus poor growth of the plant due to drought conditions can increase the potential parasite load in grazing livestock. Crop residues left after combine harvesting need to be used in livestock feeding after proper enrichment and densification. Assuming average dry fodder consumption of 7 kg/ animal/ day, about 700 kg biomass would be required for one animal for 100 days, which may be sufficient to overcome the lean period of about 3 months. For a village having 75-100 livestock units, a bunker with 80-100 MT dry fodder storage capacity should be sufficient. Surplus stovers of sorghum, oat, maize, sugarcane tops, fodder on bunds, tree leaves, silvi-pasture biomass, etc. may be conserved by making silage, hay/ leaf meal. Sugarcane tops can be incorporated @ 30% maximum in the ration of animal along with other fodders.

Drought mitigating interventions for Additional Fodder Development Programme (AFDP) under RKVY: Under additional fodder development programme of Ministry of Agriculture, DAC, New Delhi the seed material of following fodder varieties (Table 13) may be supplied to the farmers.

Table 13: Proposed varieties for inclusion in the kit for fodder production

Type	Proposed varieties for inclusion in the kit
Forage varieties	Avika Pearlmillet Chari, FBC-16, PCB-164, Narender Chari Pearlmillet-2, Proagro No. 1 (multi-cut), JKBH-676 of pearlmillet and Hara Sona, Pant Chari-4, Pant Chari-5, Pusa Chari Hybrid-106, Gujarat Fodder Sorghum-5, CSH-24 MF (low HCN), CSH20MF, Haryana Sorghum-513, Haryana Chari-308, CO(FS) 29 of sorghum
Dual purpose varieties/ hybrids with stay green at maturity	CSH-13, CSV-23, GJ-40, CSH-13 R, SSV-84, CSV-15, DSV-4, SPH-837, Pratap Sorghum-1430, K-11 of Sorghum and Sabara of little millet
Dual purpose varieties/ hybrids of maize	Prakash, JH-3459, Pusa Early Hybrid Makka-3, DMH-2, Gujarat Makka-6 and forage variety like Pratap Makka Chari-6
Fodder varieties of oat	Bundel Jai-851, 992, 991, 2001-03, 2004, Harita
Napier varieties	IGFRI-5, NB-21, NB-37, PBN-223, KKM-1, APBN-1, Suguna, Supria and Sumpurna and other grasses like dinanth grass, sudan grass and guinea grass.

In case of complete or major failure of grain crops in *kharif*, contingency strategies for ensuring fodder supplies during *rabi* include re-sowing with short to medium duration fodder varieties of millets, pulses or forage crops such as:

- Sorghum-varieties/ hybrids CSV-17 and CSH 14 in red soils; CSH 16, CSH 18 and CSH 21 in black soils
- Pearlmillet - short duration varieties like Rajko, JB, PSB-2, GHB-526, HHB-67, ICMH-356, Shraddha, GK-1004 or medium duration varieties like GHB-558, Proagro-9443 and for late assured rainfall areas in light to medium soils of Marathwada region varieties like AHB-251
- Maize – African tall, APFM 8, PEHM-3 and FH-3077 which produce some grain and fodder

- Intercropping of cowpea varieties Bundel Lobia-1, CO 5, CO (FC) 8, IFC 8401, UPC 8705, DFC 1 and UPC- 625 after 8 to 10 rows of fingermillet.
- *Rabi* fodder crops like berseem (Mescavi, Wardan, UPB 110), Lucerne (CO 1, LLC 3, RL 88) should be sown in arable lands and tank beds.
- Current fallows should be used for fodder production by sowing short duration varieties of sorghum or pearlmillet or fingermillet or maize or cowpea in *kharif* season and berseem or lucerne in *rabi* season.
- In wastelands, grasses like *Cenchrus ciliaris*, *C. setigerus*, *Chloris gayana*, *Panicum maximum*, *Desmanthus virgatus, Stylosanthes scabra* can be taken up to increase forage production.
- In areas that receive North-east monsoon rains, multi-cut fodder varieties of sorghum (CO 27, Pant Chari-5 (UPFS- 32), COFS-29 or pearlmillet (Co-8) or maize (African tall) and leguminous fodder crops (lucerne, berseem, horse gram, cowpea) are recommended for fodder production.
- In areas that receive summer rains, fodder crops like cowpea and maize are recommended.

In drought prone areas, the farmers may be encouraged to plant light canopy drought tolerant fodder trees and shrubs (e.g. *Acacia* sp) and perennial Napier grass along agriculture bunds. This form of agro-forestry will not only yield surplus fodder during prolonged dry spell but will also protect crop from wild animal depredation.

Development of seed / germplasm banks and nurseries of fodder species in each state through Central Sector Scheme for Fodder and Grazing Land Management would further help in mitigating fodder scarcity in the country. In case of mid season drought, suitable fodder crops of short to long duration may be sown in *kharif* under rainfed conditions. Mid season drought affects the growth of the fodder crop. Once rains are received in later part of the season the crop revives and immediate fertilization helps in speedy recovery. If sufficient moisture is available, *rabi* crops like berseem (Wardan, UPB 110), lucerne (CO 1, LLC 3, RL 88) can be grown during winter. In wastelands, fodder varieties like Bundel Anjan 3, CO-1 (Neela Kalu Kattai), *Stylosanthes scabra* etc., can be sown for fodder production. As late season drought affects seed setting, normal short duration fodder crops may be sown. Avoid multicut fodder varieties under rainfed conditions. All the available fodder must be harvested before drying out to preserve nutritive quality. Depending on availability of moisture, *rabi* fodder crops especially low water requiring varieties of lucerne may be planted. Normal intensive fodder systems may be followed under irrigated conditions.

The following are some of the state specific compensatory fodder production measures to be followed to augment the availability of feed and fodder resources for optimum production from different categories of livestock (Table 14).

Table 14: Suggested fodder production measures during *rabi*

State	Suggested fodder production measures
Maharashtra	Sowing and establishment of fodder species like *Cenchrus ciliaris, Stylo hamata, Stylo scrabra* etc in inter-row spaces in existing orchards to exploit available moisture due to sufficient rain during September, 2015
	Promotion of horse gram (CRHG-19; CRHG-4, CRHG 18 R) as contingent crop and harvestingit at vegetative stage as fodder in all crop failed areas.
	Progressive farmers may grow fodder crops of sorghum / pearl millet / maize (UP chari, MP chari, HC-136, HD-2, Giant bajra, L-74, K-677, Anand / African Tall, Kisan composite, Moti, Manjari, B1-7) on their own lands in case of some rains in the coming weeks or if sufficient moisture is available.
	Berseem varieties like Mescavi, Wardan, BB-2, BB-3 and oat varieties like JHO-822, Kent, JHO-851, UPO-212 & UPO-94 till the second fortnight of October, whereas, lucerne varieties like Chetak, Sirsa-9, Anand-2 can be sown in October to boost quality fodder production

Compensatory *Rabi* Production Plan-2015

State	Suggested fodder production measures
Madhya Pradesh	Guar varieties like Bundel Guar- 1, 2 and 3, HG-75, HFG-119, FS-277 etc from mid October to early November and sometimes till late December can be cultivated if some withdrawal rain is observed in later part of the year.
	Berseem varieties like Jawahar Berseem-1 (JB-1), JB-5, Bundel Berseem-2 (JHB-146), Mescavi; lucerne varieties like GAUL-1 (Anand-2), Anand Lucerne-3 (AL-3) and where ever irrigation source is there since there is scanty rainfall during September, 2015, Lucerne variety RL-88 can be cultivated as *rabi* crop for fodder production.
	Maize varieties like African tall and sorghum single cut varieties like MP Chari, Pusa Chari–6, Jawahar Chari-6, irrigated- HC-136, Pusa Chari-23, UP Chari-2, Proagro Chari (SSG-988), HC-308; multi cut varieties like Jawahar Chari-69, Proagro Chari (SSG-988), Pant Chari-5 (UPFS- 32); dual purpose (grain and fodder) varieties like CSH 13 can be sown as *rabi* crop for fodder production.
	Oats varieties like JO-1, Bundel Jai-822, OS-6, UPO–212, OL-125, Bundel Jai- 851 for fodder production in *rabi* can be encouraged.
	Cowpea varieties like UPC–287, Bundel Lobia-1 (IFC - 8401), UPC- 9202, UPC–618, UPC- 625 can be grown in October and or late monsoon.
Rajasthan	Since, there was very scanty rainfall in September, 2015, in this region, harvest the top fodder from drought tolerant trees (Khejari, Neem, Subabul, Acasia, Pipal, etc) and create fodder banks at village level.
	Pods of trees like *Prosopis juliflora* can be collected and supplemented as feed source which contain nearly 13% protein. Perennial grasses like sewan, dhaman and moda dhaman grass etc. Which grow naturally during rainy season can also be harvested and used as a fodder. There is need for establishment of silvi-pastoral system in CPRs with *Stylosanthus hamata* and *Cenchrus ciliaris*, Dinanath, Dhaman and Sewan grass etc., as grass with *Leucaena leucocephala*, Khejari, Neem, Subabul, Acasia, Pipal, etc., as tree component.
	Fodder crops *viz*: bajra, maize, jowar and guar crop should be sown along with pulse crops. Sowing of improved varieties of pearlmillet (Giant Bajra, Raj Bajra, Chari 2, AVKB 19), guar (Bundel Guar 1, Bundel Guar 3, Guara 80, HFG 356), sorghum (Harasona 855, Safed Moti, GFS 4, CSH 20), lucerne (RL 88, Anand 2, Anand 1, Anand 3), cowpea (UPC 5287, UPC 5286, UPC 618, UPC 622, CL367), oats (Bundel Jai 851, OL 125, UPO 212, UPO 94, Kent), guinea grass (PGG 14, PGG 616, PGG 101, Bundel G. grass 1), dinanath grass in *rabi* season for fodder production.
	In winter, maize cultivation may be taken up in areas with assured irrigated conditions with the varieties like PEHM 1, PEHM 2, Prakash, HM 2, Pratap Makka Hybrid 1, Mahi Kanchan, Mahi Dhawal, Navjot, GM-6 and GM-138 and Aravali
	Mothbean varieties like RMG-40, RMO-257, G-8 can also be cultivated for fodder purpose
	Under irrigated conditions, grow pearlmillet cultivars like RHB 121, RHB 127, HHB 67, GHB 558, ICMH 356, JBV-3, Raj-171 and CZP-9802 for green fodder production
Karnataka	Since there were few showers during September, 2015, short duration pearlmillet (AVKB-19, Giant Bajra, CO-8) which is hardy and requires less moisture may be cultivated. Short duration dual purpose (grain and fodder) varieties like GPU 26, GPU 45 and GPU 48 for late sown conditions can be cultivated for fodder production.
	Perennial sorghum (CSV-216R) cultivation may be cultivated in canal command areas. Fodder after harvest may be transported to areas of deficit. Short duration varieties like CSH 14 and CSV 17 in red soils, and CSH 16, CSH 18 and CSH 21 may be grown in black soils and in transitional belt in *rabi* season
	Cowpea (Bundel Lobia-2, KBC 2, RBL-6, COFC 8) as fodder crop may also be cultivated and fed to dairy animals as protein source. If adequate moisture is available, farmers may be advised for cultivating maize (African Tall & Pratap Makka varieties).
	Sampoorna (DHN 6), CO-3, CO-4, APBN-1 etc. of Hybrid Napier fodder varieties can be grown whereever assured irrigation facility exists.
	Cultivation of fodder grasses like *Bothriochloa intermedia, Cenchrus setigerus, Dichanthium annulatum, Pennisetum pedicellatum, Panicum maximum* and fodder legumes like *Arachis hagenbackii, Stylosanthes hamata, S. Scabra* may be promoted.
	For utilizing residues of crops, the practice of Total Mixed Ration (TMR) should be propagated. Such non-conventional feed material can be incorporated in TMR at 10–15% level.

State	Suggested fodder production measures
Gujarat	Rains during September month can be exploited by sowing of sorghum (HC- 106, AS-16, SSG-988, Harasona 855, Safed Moti, Pant Chari-5, UPMCH-1101, CSH-13, GFS 4), lucerne (Chetak, GAUL-2, RL 88, Anand 2, Anand 1, LL 3, Anand 3), cowpea (Kohinoor, GFC-1/2/3/4,UPC 5287, UPC 5286), pearlmillet (Giant Bajra, Raj Bajra Chari 2, AVKB 19), guar (T-8, Bundel Guar 1, Bundel Guar 3, Guara 80, HFG 356), oats (Bundel Jai 851, OL 125, UPO 212, UPO 94) in *rabi* season for fodder production
	Promote sowing and establishment of fodder species like *C. ciliaris, S. hamata, S. scrabra* etc. in inter-row spaces in existing orchards
	Round the year forage production in irrigated areas with Napier- pearl millet hybrid + cowpea / lucerne and maize + cowpea / oat or maize + cowpea may be promoted
	The silvipastoral systems involving *Acacia nilotica + Cenchrus setigerus and Leucaena leucacephala + Panicum maximum/ Dichanthium annulatum* can be developed in waste lands
	Cultivation of fodder grasses like *guinea grass (PGG14, PGG 616, PGG 101), dinanath grass (Bundel 2, CO 1) Cenchrus ciliaris, Chloris gayana, Dichanthium, Stylosanthes, Clitori* and legume grasses like *Stylosanthes hamata, S. Scabra* may be promoted in grazing lands.
Chhattisgarh	Good rains in the September, 2015 can be exploited by sowing of sorghum single cut varieties like MP Chari, Pusa Chari–6, Jawahar Chari-6; irrigated-HC-136, Pusa Chari-23, UP Chari-2, Proagro Chari (SSG-988), HC-308; multi cut varieties like Jawahar Chari-69, Proagro Chari (SSG-988), Pant Chari-5 (UPFS- 32); dual purpose (grain and fodder) varieties like CSH 13 as *rabi* crop for fodder production
	Berseem varieties like Jawahar Berseem-1 (JB-1), JB-5, Bundel Berseem-2 (JHB-146), Mescavi; lucerne varieties like GAUL-1 (Anand-2), Anand Lucerne-3 (AL-3) and whereever irrigation source is there, RL-88 can be cultivated as *rabi* crop for fodder production
	Guar varieties like Bundel Guar- 1, 2 and 3, HG-75, HFG-119, FS-277 etc from mid October to early November and sometimes till late December can be cultivated
	Oats varieties like JO-1,Bundel Jai-822, OS-6, UPO–212, OL-125, Bundel Jai- 851 may be encouraged for fodder production
	Cowpea varieties like UPC – 287, Bundel Lobia-1 (IFC - 8401), UPC- 9202, UPC – 618, UPC- 625 can be cultivated in October
	The silvipastoral systems involving *Acacia nilotica + Cenchrus setigerus* and *Leucaena leucacephala + Panicum maximum/ Dichanthium annulatum* can be developed in waste lands.
	Wherever feasible, cultivation of fodder grasses like guinea grass (PGG 14, PGG 616, PGG 101), dinanath grass (Bundel 2, CO-1) *Cenchrus ciliaris*, *Chloris gayana*, *Dichanthium*, *Stylosanthes* and legume grasses like *Stylosanthes hamata*, *S. Scabra* may be promoted in grazing lands.
	Irrigated hybrid Napier fodder with the varieties like CO-3, CO-4, APBN-1 etc., may be promoted.
Southern Tamil Nadu	This area had deficit rainfall during September 2015, so short duration pearlmillet (CO-8, TNSC-1) which is hardy and requires less moisture may be cultivated if there are small rains. Short duration sorghum varieties like CO-27, COFS-29, K-11 can be cultivated for fodder production
	Legume fodder crops like Rice bean (RBL-6), Lucerne (CO-1), Cowpea (CO-1/5, CO(FC)-8) may also be cultivated. If adequate moisture level is available, farmers may be advised for cultivating maize (African Tall & DHM varieties) in winter.
	CO-1/2/3/4, KKM-1, APBN-1 etc., of hybrid napier fodder varieties can be grown where ever assured irrigation facility exists.
	Cultivation of fodder grasses like hedge lucerne- *Desmanthus virgatus*; subabul CO-1 (P), FD 1423; Dinanath grass-COD-1; Guinea grass-CO-1/2; Anjan grass-CO-1; *Stylosanthes hamata, S. Scabra* may be promoted.
	Creation of tree fodder models with subabul, glyricidia, Agathi, prosopis etc. at village level will promote fodder security in the region.

State	Suggested fodder production measures
Andhra Pradesh	Since adequate moisture level is available, farmers may be advised for cultivating sorghum (Proagro Chari (SSG-988), APFB-2, Pant Chari-5 (UPFS- 32) and maize (African tall, APFM-8) for fodder production in *rabi* season.
	In all rice field bunds, para grass may be grown for green fodder production
	Berseem varieties like Mescavi, Vardhan (S99-1), JB-1, JB-2, JB-3 and UPB-103; Cowpea varieties like Vardan or Mescavi; lucerne varieties like T-9, Anand-2, S-244, CO-1, RLS-88 can be cultivated in *rabi* season for leguminous fodder production
	In assured irrigation areas, cultivation of perennial Napier varieties like APBN -1, Co-1, Co-2, Co-3, NB-21, BH-18, Guinea grass, Paragrass etc may be taken up
	Top dressing of N in 2-3 split doses @ 20-25 kg N/ha in common property resources (CPRs) like temple lands, panchyat lands or private property resources (PPRs) like waste and degraded lands for higher biomass production
	Promote tree fodder (Neem, Subabul, Acasia, Pipal etc) in degraded lands.
Telangana	Since adequate moisture is available, farmers may be advised for cultivating sorghum (PC-6, MP Chari, HC-136, Hara Sona, Proagro Chari (SSG-988), APFB-2, Pant Chari-5 (UPFS- 32), maize (African tall, Vijay, Jawahar Moti Composite, APFM-8, HGT-3), Pearlmillet (Rajko, K599, T-55AP, L-72, L-74) and oats (Kent, UPO-94, OS-6, S-2688, OL-9, UPO-212, HFO-114, OS-7, JHO-822) for fodder production in *rabi* season
	Dual purpose crops like barley (RD 2715, RD 2035, RD 2522 and BH 75) may be sown in October. One cutting may be taken for fodder at 50-60 days after sowing and subsequent regenerated crop left for grain production. Cultivate short duration crops like blackgram / greengram / soyabean to facilitate sequence crop with chickpea or coriander or sunhemp or fodder Jowar during December.
	Berseem varieties like Mescavi, Vardhan (S99-1), JB-1, JB-2, JB-3 and UPB-103; cowpea varieties like Vardan or Mescavi for; lucerne varieties like T-9, Anand-2, S-244, CO-1, RLS-88 can be cultivated in *rabi* season for leguminous fodder production.
	In assured irrigation areas, cultivation of perennial Napier varieties like APBN -1, Co-1, Co-2, Co-3, Co-4, Phule Jaywant, NB-21, BH-18, guinea grass, para grass, etc may be taken up.
	The grasses like buffalo grass (Molopo, S-3108, S-3106, CAZRI-75), Dinanath grass (IGFRI-43-1, IGFRI-4-22-1, Bundel-1), Rhodes grass (Callide Kotambore, Pioneer), Urochloa (Nixon) etc., and shrubs like hedge lucerne may be grown in waste lands for quality fodder production.
	Promote tree fodder (neem, subabul, Acacia, Pipal, etc) in degraded lands.
Jharkhand	Jharkhand had experienced heavy rains in few areas. In waterlogged areas, Coix (KCA-3, KCA-4, Bidhan Coix 1) and paragrass may be cultivated.
	Encourage cultivation of lucerne (RL-88), hybrid napier (BNH-10, Co-3), maize (African Tall, Pratap Makka Chari 6), sorghum (CSH-20MF (UPMCH- 1101), CSH-20-MF (UPMCH-1101), pearlmillet (BAIF Pearlmillet-1), berseem (Bundel Berseem-3) in *rabi* season
	Wherever possible, legumes like ricebean (RBL-6, Bidhan-1&2), cowpea (UPC 5286, EC-4216) should be encouraged for leguminous fodder production.
	Fodder tree species like subabul, sesbania species, gliricidia, mulberry, Ficus species, shivan, jackfruit etc. should be planted on field bunds and grasslands.
	Maximum Rice field bunds should be planted with hybrid napier (NH-10) and guinea grass for green fodder production
	The sufficiently available forest grass during rainy season should be harvested at its flowering period and preserved as hay or silage or may be turned into feed blocks.
	In case irrigation facilities are available, cultivate hybrid napier (Jawahar, Pennisetum-12) and guinea grass (Hamil).

State	Suggested fodder production measures
Western Uttar Pradesh	In available fallow lands, with any rainfall, farmers should grow short duration drought tolerant arid type crops like pearl millet (Bajra, Sorghum PC6 and MP Chari) and legumes (Moong, Moth, Cowpea BL1 and BL2) as fodder, and fodder grasses (like *stylo, cenchrus ciliaris, athropogan* etc.) should be cultivated. During following *rabi* season, similar crop of Chinese cabbage can be grown, which has low water requirements and provides fodder during early winter months following low monsoon rainfall.
	If adequate moisture level is available, farmers may be advised for cultivating sorghum (MP Chari, UP Chari-1 (IS 4776), UP Chari-2, Pant Chari- 3, Proagro Chari (SSG-988), Harasona 855, Safed Moti (FSH-92079), UPFS- 32, CSH-13), pearlmillet (Raj Bajra Chari-2, CO-8, TNSC-1, FMH-3, AVKB-19) and maize (African tall, Pratap Makka Chari 6) for fodder production.
	Harvesting potato leaves as fodder in potato growing areas.
	Oats (Bundel Jai-822, Bundel Jai- 851, Bundel Jai 992 (JHO 99-2), Haryana Javi–114, FOS-1/29, Kent, UPO-94) can be cultivated as forage crop in *rabi* season.
	Berseem (Bundel Berseem-2 (JHB-146), Bundel Berseem-3, JB-5, Pusa Giant, Wardan, UPB-10) and lucerne (Chetak (S-244), Sirsa Type 9) may be promoted for cultivation in winter.
	If assured irrigation facilities are available, cultivation of hybrid napier (Hybrid Napier-3 (Swetika), NB-21).
	Silvi-pastoral systems with *Dichrostachys-Cenchrus / Chrysopogon, Leucaena-Cenchrus / Chrysopogon, Albizia lebbek-Cenchrus-Sehima, Albizia procera-Cenchrus, Acacia / Prosopis-Cenchrus-Chrysopogon, Albizia-Leucaena, Bauhinia and Leucaena, Hardwickia binata Cenchrus / Chrysopogon* and *Stylosanthes* may be developed in wastelands
	Cultivation of fodder grasses like *guinea grass* (PGG14, PGG 616, PGG 101), *dinanath grass* (Bundel 2, CO 1) *Cenchrus ciliaris, Chloris gayana, Dichanthium, Clitori* and legume grasses like *Stylosanthes hamata, S. Scabra* may be promoted in grazing lands.
	In sugarcane growing areas, sugarcane tops and dry sugarcane leaves can be utilised, enriched for crude protein content and fed in scarcity areas. 50% sugarcane bagasse + 17% oil cake + 25% molasses mixed with 4% bran, 1% salt, 2% mineral mixture and 1% urea is promising maintenance ration for adult animals.
North-Eastern Region	Most of the fodder, feed and grasses get contaminated, uprooted or even killed during recent floods in Assam. Alkaloid poisoning after eating / grazing wild plants during or after floods are common. Procurement of the bailing and block making machines for efficient transport of densified fodder supply, repairing and servicing of the already existing machines, maintenance and servicing of feed mills, procurement of raw material for feed mills, etc. may be strategized.
	Farmers may be advised for cultivating oats (OS-7, OL-9, Bundel Jai 991 (JHO 99-1), Bundel Jai 2004 (JHO 2000-4) and maize (African tall, Pratap Makka Chari 6) for fodder production in *rabi* season.
	Encourage cultivation of fodder grasses like napier, guniea (Hamil) and Coix (KCA-3, KCA-4, Bidhan Coix 1) in areas with assured irrigation.
	Promote cultivation of *Azolla* in backyard and in paddy fields.
	Rabi fodder with berseem (Pusa Giant, Wardan, Hisar Berseem-1 (HFB-600)), cowpea (UPC-622, UPC – 618) and rice bean (Bidhan Rice Bean 2 (KRB 4)) may be promoted in suitable areas.
	Promote growing of hybrid napier or maize + cowpea - maize-sorghum- oats or guinea (Hamil) alone for fodder production in assured irrigation areas.
	Grassland/grazing land can be improved with forage grasses (*Brachiaria decumbens, B. mutica, Paspalum notatum*), legumes (*Desmodium uncinatum, D. heterophyllum*), shrubs and trees (*Artocarpus heterophyllus, A. lakoocha, Ficus hookeri, F. nermoralis, Parkia roxburghii, Morus alba*) for better fodder availability for the livestock.

Further, fodder block making units costing Rs. 40,000/unit from CIAE, Bhopal may be procured and made available at each mandal which frequently gets affected with drought. Development of seed/ germplasm banks and nurseries of fodder species in each state through Central Sector Scheme for Fodder and Grazing Land Management would further help in mitigating fodder scarcity in the country.

5. Impact of Compensatory *Rabi* Production Plan in 2014-15

The rainfall during the south-west monsoon during 2014-15 was found to be 88% of the long period average though there was spatial and temporal variation in the country. The North-west India was found to be most deficit (79% of LPA) and southern Peninsula received about 93% of LPA. The initial three months of the monsoon witnessed less than normal rainfall though the month of September rainfall was found to be 108% of LPA. These changes in rainfall also had some impact on the area sown to different crops during *rabi* in relation to the what is expected (normal area) and the same are presented in Table 15. The area under crops such as wheat, maize and greengram was found to increase considerably during 2014-15. On the other hand area sown to crops like rice, jowar, and oilseeds decreased considerably. The fall in the area was most prominent in case of sunflower (53.5%), safflower (44.75%) and jowar (20.73%). Thus, there was marginal increase in the area sown to *rabi* pulses and decrease in the area under oilseed crops during *rabi* season of 2014-15.

Table 15. Area, production and yield of major crops (*rabi*) in India, 2014-15 and normal

Crop	Normal (Mha)	2014-15 (Mha)	Change (%)
Wheat	29.044	30.37	4.57
Rice	4.344	4.03	-7.27
Jowar	4.182	3.32	-20.73
Maize	1.32	1.52	15.00
Barley	0.675	0.67	-0.44
Total coarse cereals	6.177	5.50	-10.90
Total cereals	39.565	39.90	0.86
Chickpea	8.414	8.39	-0.30
Blackgram	0.83	0.86	3.37
Greengram	0.706	0.86	21.81
Total pulses	13.208	13.34	1.01
Total foodgrains	52.773	53.25	0.90
Rapeseed & mustard	6.209	6.00	-3.38
Groundnut	0.871	0.81	-7.23
Safflower	0.257	0.14	-44.75
Sunflower	0.727	0.34	-53.51
Linseed	0.346	0.29	-16.18
Total oilseeds	8.656	7.58	-12.48

Impact of contingency measures implemented during *rabi* production in 2014-15

Experiences from NICRA-TDC

Significant quantity of rainfall was received during the month of September 2014 in several parts of the country. The quantum of rainfall received was more than the normal for the month of September, *viz*, Amravati (26%), Bilaspur (6%), Ganjam (13%), Lunglei (24%), Namakkal (8%), Ratnagiri (13%), Saran (2%), Tumkuru (9%), Villupuram (5%) & West Godavari (91%). Some of the districts such as Aurangabad, Bahraich, Davanagere, Hamirpur, Jhunjhunu, Valsad, Muzaffarnagar, Nalgonda, Khammam, Chikkaballapur, Ramanathapuram,

Kushinagar, Nawada, Nandurbar, Raipur, Senapati and Uttarkashi received significant quantity of rainfall generating considerable runoff which was harvested in the ponds, check dams, etc. providing opportunities for *rabi* cropping with the harvested water.

- In Harigaon village, Aurangabad, rainwater storage capacity of 12700 cubic meters was created through 9 ponds in 9 farmers' fields during 2014-15 (Fig. 16). The harvested water was used to irrigate 9.3 ha area for improving yield in lentil (11.2 q/ha), chickpea (9.0 q/ha) and wheat (40.0 q/ha). Irrigated area increased by 69% due to increase in water use efficiency.

Fig. 16: Rainwater harvesting and efficient utilization through sprinkler to chickpea crop in Aurangabad, Bihar

- In Khargahna village of Bilaspur, pre-sowing irrigation in wheat (GW-273) using harvested rainwater in renovated community tank taken up by 50 farmers in 20 ha resulted in higher yield of 22 q/ha as compared to farmer practice (14.8 q/ha) with net returns of Rs. 18500/ha and BC ratio of 2.9. The harvested water was available up to March and irrigated area increased by 20 ha during *rabi* (Fig. 17).

Fig. 17: Good crop stand due to pre sowing irrigation with harvested water at Bilaspur, Chhattisgarh

- In Jalgaon KP village of Baramati, rainwater harvesting and recharging of wells facilitated supplemental irrigation to *rabi* sorghum in 18 ha area. A cement bandhara was constructed during 2014-15 which impounded sufficient water to recharge 6 adjoining wells. Monitoring indicated rise in water level leading to increased water storage and availability for two supplemental irrigations to *rabi* sorghum resulting in 38% increase in productivity (23.7 q/ha). Similarly, 2-4 protective irrigations were given to pearl millet, wheat and onion which increased productivity by 20-30%.
- In Jalgaon, KP village of Baramati, adoption of compartmental bunding (10 m × 10 m) in *kharif* fallows

prepared across the slope in medium black soils in 20 ha area by 50 farmers led to conservation of soil moisture and successful raising of *rabi* sorghum with increased productivity of 19.5 q/ha compared to 11.5 q/ha without the intervention (Fig. 18).

Fig. 18: Recharging of open wells enhances *rabi* sorghum productivity at Baramati, Maharashtra

- In Sitara village, Bharatpur, poor quality of groundwater due to salinity is a problem faced by farmers responsible for low productivity in *rabi* crops. Hence, recharging of all the 54 tube wells was targeted and undertaken in a phased manner in the village. During 2014-15, impact of recharging of 10 tube wells was monitored in farmers' fields by selecting 5 ha area under wheat. Salinity of groundwater was monitored during each of the four-five irrigations that were applied to the wheat crop. Recharging of wells helped in providing better quality irrigation water at early crop growth stages (germination and tillering) as the salinity increased from 5.8 - 9.7 EC (dS/m) at first irrigation to 8.9 - 16.5 EC (dS/m) at last irrigation. As a result farmers were able to realize 18% higher yields (45-54 q/ha) compared to farmers in the nearby village (36 - 48 q/ha).
- In Shikhera village of Baghpat (Uttar Pradesh), demonstration of mustard (PUSA M-27) in raised bed planting facilitated increase in water productivity and increase in yields by 20% over conventional practice (14.8 q/ha) with BC ratio of 3.4.
- In Chomakot village of Kota district, farmers face erratic rainfall with long dry spells affecting soybean in *kharif* and wheat in *rabi* due to water shortages. Furrow irrigated raised bed (FIRB) planting in soybean resulted in a yield increase of 6% compared to conventional sowing (9.6 q/ha). FIRB technique in wheat led to increase in productivity by 4% over conventional practice (41 q/ha) along with water saving of 22-25% and saving in seed requirement with BC ratio of 2.7. The wheat crop planted in FIRBs suffered less damage due to unseasonal rains and hail storm during March, 2015 (Fig. 19).

Fig. 19: FIRB planting in wheat in Kota, Rajasthan

- In Killi Nihal Singh village of Bathinda, demonstration of wheat (HD-2967) with happy seeder resulted in 3% increase in yield (50.4 q/ha) compared to conventional practice and allowed incorporation of paddy straw into the soil improving soil moisture retention and infiltration of excess water due to unseasonal rains.
- In Badhouchhi Kalan village of Fatehgarh Sahib, burning of paddy stubbles is generally practiced by farmers which cause environmental pollution along with nutrient loss. Demonstration of wheat (HD 2967) sowing with happy seeder in 19 farmers' fields in 16 ha area during 2014-15 provided an alternative for rice residue management and resulted in an increase in yield by 11.6% compared to conventional tillage practice (38 q/ha).

- In Pindi Balochan village of Faridkot, demonstration of timely sowing of wheat (PBW 2967) with zero till drill in 30 farmers' fields covering 36 ha area in 2014-15 gave 46 q/ha yield with increase in farmers income by Rs. 2055/ha against conventional tillage practice (42 q/ha).
- In Rasidpur village of Ropar, use of happy seeder for wheat (HD 2967) sowing was demonstrated in 12 farmers' fields in 16 ha area with an yield advantage of 13.6% over farmers' practice of conventional tillage (44.8 q/ha). Further, crop lodging damage due to unseasonal rainfall during March, 2015 was lower in happy seeder sown wheat which was only 2% compared to 15-20% in conventionally sown wheat. In addition, incidence of yellow rust was more in lodged crop than in happy seeder sown wheat.
- In Radauri village of Yamunanagar, happy seeder sown wheat (HD 2967) in 33 ha area involving 84 farmers gave 9% higher yield on an average compared to conventional tillage sown wheat (46.3 q/ha).
- In Seorahi village of Kushinagar, zero till sown wheat (HD 2733) in 20 ha covering 97 farmers gave an yield advantage of 21% compared to farmers' practice (42.3 q/ha). Reduction in cost of cultivation was Rs.6255/ ha along with saving of 15% irrigation water and facilitating early sowing by 10-15 days to reduce exposure to terminal heat stress.
- In Jhangha village of Gorakhpur, wheat (WL-711) was sown directly after harvest of rice using zero till seed drill in 6 ha involving 30 farmers with a mean yield of 35.5 q/ha during 2014-15 season.
- In Sirsuwada village of Srikakulam, rice-rice and rice-pulse cropping systems are practiced. Blackgram taken up in paddy fallows suffers from yellow mosaic virus disease and exposure to low temperature and fog at the time of flowering resulting in low yields. Maize is a possible alternative after rice. Zero till maize was adopted by 15 farmers in 5 ha area to conserve residual soil moisture, save 1-2 irrigations and also to reduce cost of dibbling seed and cost of land preparation (Fig. 20).

Fig. 20: Zero till maize in rice fallows at Srikakulam, AP

Fig. 21: FIRB method in maize at West Tripura, Tripura

- In North Pulinpur ADC village of West Tripura, furrow irrigated raised bed maize cultivation was demonstrated in 17 farmers' fields in an area of 3.5 ha. In FIRB method, maize hybrid (Disha-3502) was sown adopting a spacing of 37.5 cm wide beds and 30 cm wide furrow compared to the farmer's practice of line sowing in flat land at a row spacing of 67.5 cm (Fig. 21). Life saving irrigation was provided from the water harvesting structure constructed under NICRA. FIRB method gave yield advantage of 8 quintal with a BC ratio of 3.0 compared to flat bed method of sowing (33 q/ha, BC ratio of 2.6).
- Zero tillage cultivation of rapeseed-mustard in lowland rice fallows in Mizoram was demonstrated with 3 cultivars ((M-27, NPJ-113 and P-27) in farmer's fields in 80 ha area. Among the varieties, NPJ-113 gave significantly higher grain yield in 90 days (12.35 q/ha), followed by M-27 in 100 days (8.81 q/ha) and P-27 in 120 days (7.9 q/ha) as compared to local variety in 150 days (5.32 q/ha).

- In Chakrayapeta village of Anantapur, cluster bean (HG-365), sorghum and greengram were introduced in place of groundnut for late planting in August. During crop growth period, only 90 mm of rainfall was received in 6 rainy days and the crops experienced dry spells. Cluster bean performed better and recorded higher net returns (Rs. 20625/ha) under late planted conditions and can fit in as a contingency crop in Anantapur in addition to its potential as a dual purpose crop under normal rainfall conditions.

Experiences from AICRPDA-NICRA Centres

During 2014-15, the onset of monsoon was delayed by more than two weeks in NICRA villages located in 10 districts *viz*. Agra (Uttar Pradesh), Akola and Parbhani (Maharashtra), Bhilwara(Rajasthan), Bijapur(Karnataka), Lakhimpur (Assam), Bhiwani (Haryana), Indore (Madhya Pradesh), Jamnagar and Banaskantha (Gujarat). The rainfall was deficit by 45-100% during June 2014 across different NICRA-villages except in Lakhimpur, Kurnool, Bangalore rural, Bhiwani and Thoothukudi districts. In July, the deficit in rainfall was more than 50% in villages of Agra, Kurnool, Bhiwani, Thoothukudi, Parbhani and Samba districts. However, in August, only Hardoiya (Faizabad) and Nignoti (Indore) recorded more than 50% deficit rainfall. In September, NICRA villages in Akola, Kurnool, Faizabad, Bhiwani, Lalitpur, Parbhani and Solapur districts experienced dry spells due to rainfall deficit by more than 50% (Annexure 2). In general, the total rainfall during June-December 2014 was below normal in all NICRA villages except in Chikkamaranahalli (Bangalore Rural), Kavalagi (Bijapur), Chamua (Lakhimpur), Budhadani (Kandhamal) and Khaner (Samba) (Fig. 22).

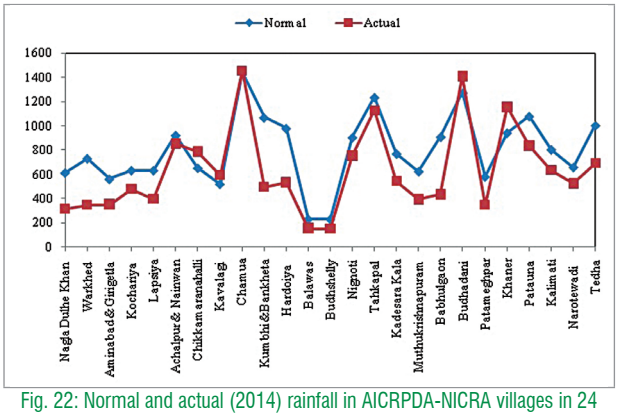

Fig. 22: Normal and actual (2014) rainfall in AICRPDA-NICRA villages in 24 districts across the country during June-December

During *rabi* 2014-15, the emphasis was on compensatory *rabi* contingency crop plan implementation with interventions such as improved/short duration crop varieties, *in-situ* moisture conservation and supplemental irrigation. The impact of compensatory *rabi* contingency plans implemented during *rabi* 2014-15 in some of the NICRA villages is presented below:

a. Southern zone of Rajasthan

In Kochariya village (Bhilwara district), about 38% higher rainfall (397 mm) was received in July resulting in filling up of *kachha* farm ponds. However, the rainfall was deficit by 26 and 47% in September and October, respectively. The harvested rainwater in farm ponds was used for pre-sowing irrigation to *rabi* crops (mustard, barley and chickpea) on 5 farmers' fields covering 2.5 ha. This resulted in increase in *rabi* crops yield up to 55% (3255 kg/ha).

b. North bank plain zone of Assam

In Chamua village (Lakhimpur district), under prolonged dry spell of more than 80 days (24th November 2014 to end of February, 2015), demonstrations on mulching cum manuring with locally available agricultural waste materials (straw of rice and rapeseed) and weeds (water hyacinth) in potato and tomato on 10 farmers' fields covering 5 ha improved *in-situ* moisture conservation and the yield was increased by 47% in potato (20625 kg/ha) and 110% in tomato (16081 kg/ha) compared to farmers' practice of without mulching (Fig. 23).

Fig. 23: Good potato crop with mulching, Chamua village, Lakhimpur district, Assam

In potato (Kufri Pokhraj), supplemental irrigation from harvested rainwater, and mulching was demonstrated in 3 farmers' fields to mitigate dry spell during 24th November 2014 to end of February, 2015. One supplemental irrigation plus mulching gave the highest tuber yield of 26748 kg/ha with net return of Rs. 87216/ha. In case of one supplemental irrigation without mulching, tuber yield was increased by 39% as compared to rainfed crop. B:C ratio also increased considerably when crop was grown with supplemental irrigation plus mulching or only with supplemental irrigation. Similarly, in rapeseed, supplemental irrigation from harvested rainwater resulted in better crop performance in case of late sown crops. The yield increased by 6.8 and 14.2% in rapeseed varieties JT-90-1 and TS-38, respectively as compared to no supplemental irrigation.

c. Southern zone of Tamil Nadu

In Muthukrishnapuram village (Thoothukudi district), under deficit rainfall situation of more than 50% during November and December, *in-situ* moisture conservation through broad bed and furrows in deep black soils was demonstrated in 10 ha on 25 farmers fields with simultaneous sowing of maize during 2nd fortnight of September (Pre-monsoon sowing) and greengram, barnyard millet and sorghum during 1st fortnight of October (monsoon sowing). Adoption of broad bed and furrow resulted in 17, 15, 14 and 20% higher yield in maize (3571 kg/ha), greengram (981 kg/ha), barnyard millet (815 kg/ha) and sorghum (2449 kg/ha), respectively (Fig. 24).

Fig. 24: *In-situ* moisture conservation through formation of broad bed and furrows

Under early onset of north-east monsoon (by 6 days), demonstration of improved pearlmillet entries *viz*. CO (CU) 9 variety, CO9 hybrid and ICMV 221 composite on 10 farmers' fields along with broadbed furrow system for *in-situ* moisture conservation. Among the entries, Pioneer 86M86 produced significantly superior seed yield of 2720 kg/ha with net returns of Rs. 23080/ha followed by TNAU hybrid CO9 (2250 kg/ha). The composite variety ICMV 221 recorded the lowest seed yield of 1313 kg/ha due to delayed maturity (Fig. 25).

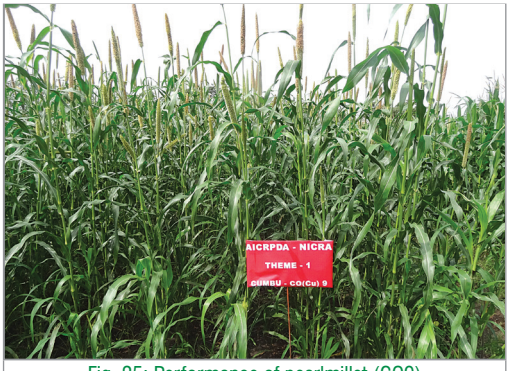

Fig. 25: Performance of pearlmillet (CO9)

d. Scarcity zone of Maharashtra

In Narotewadi village (Solapur district), the rainfall during *kharif* season was deficit by 11.9% (531 mm) followed by deficit rainfall of 82% in September and 83% in October. *In-situ* moisture conservation practice with ridge and furrow system followed by sowing of *rabi* sorghum was demonstrated in 10 ha on 10 farmers' fields. This resulted in better performance of sorghum with yield increase by 29% (1085 kg/ha) and net returns of Rs. 6800/ha (Fig. 26).

Fig. 26: *In-situ* moisture conservation through ridges and furrows system

e. South-western semiarid zone of Uttar Pradesh

In Nagla Duleh Khan village (Agra district), under deficit rainfall of 38% during *kharif* season followed by early withdrawal of monsoon (14th September), four improved varieties of mustard were demonstrated in 4 ha on 8 farmers' fields. Among these, NRCDR-2 variety of mustard gave higher seed yield (965 kg/ha), followed by NRCHB-101 (915 kg/ha), Urvashi (890 kg/ha) and Rohini (840 kg/ha). Similarly, demonstration of chickpea + mustard (5:1) intercropping system in 5 ha on 10 farmers' fields resulted in chickpea equivalent yield of 1389 kg/ha compared to sole chickpea (980 kg/ha) with higher net return (Rs. 33610/ha) and BC ratio (3.14).

f. Eastern plain zone of Uttar Pradesh

In Hardoiya village (Faizabad district), a deficit rainfall of 54% was received during *kharif* season followed by 94% higher rainfall (98 mm) during October. Demonstration of improved chickpea varieties *viz*. Pusa-362, Avarodhi, KWR-108 and PG-186, on 16 farmers' fields resulted in significantly higher seed yield up to 1600 kg/ha with net returns of Rs. 56000/ha.

g. Bundhelkhand zone of Uttar Pradesh

In Kadesara Kala village (Jhansi district), no rainfall was received during October and November months while about 33 mm rainfall was received in December. Six varieties of wheat were demonstrated in 20 farmers' farmers' fields. Among all varieties, Naveen Chaundashi (HI 418) gave higher grain yield (3727 kg/ha) with higher RWUE (26.76 kg/ha-mm) and gross returns (Rs. 61825/ha), followed by variety Raj 3765 with RWUE of (25.15 kg/ha-mm) and gross returns of (Rs. 58704/ha.)

h. Kandi region of Punjab

In Achalpur and Nainwan villages (Hoshiarpur district), the rainfall was deficit by 49% during October followed by no rainfall in November. Demonstration of improved varieties of wheat *viz*. PBW 660, PBW 664, HD 2967 and WH 1105 in 5 ha area on 10 farmers' fields resulted in significantly higher grain yield up to 3560 kg/ha with net returns of Rs. 43996/ha. Further, unseasonal rains during December resulted in higher incidence of alternaria blight and downy mildew in oilseed crops. Farmers were advised to spray Dithane M-45 @ 625 g in 250 litres of water per acre at 15 days interval due to which about 30 % more yield was realized with the control of these diseases compared to fields with no plant protection measures.

6. Conclusions

Though the onset of monsoon and sufficient rains in the month of June ensured timely sowing of many crops, prolonged dryspells at the end of June and July month affected the prospects of many *kharif* crops in almost all regions. The Southern and North-west regions were the most afected ones with a deficit of 15% and 17% respectively. The deficit rainfall also impacted the inflows into several reservoirs and also led to poor prospects of groundwater recharge. Due to insufficient availability of water in reservoirs, water releases to standing rice was abandoned in basin area of river Krishna in Andhra Pradesh and Telangana states. This may affect normal *kharif* output. To compensate the anticipated loss in *kharif,* enhancing production and productivity prospects from *rabi* crops assumes importance. This calls for a two pronged approach of promoting early *rabi* cropping in unsown areas and adoption of additional interventions in normal *rabi* cropping situations. Rains received during September could be effectively used to promote cultivation of short duration oilseeds, pulses and coarse cerelas such as *rabi* sorghum. The detailed location-specific *rabi* production plans are suggested in this bulletin.

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Annexure 1

Rainfall categorization during June-2015 (number of districts)

State	Excess	Normal	Deficit	Scanty
A & N Islands	1	-	2	-
Andhra Pradesh	7	1	5	-
Arunachal Pradesh	5	3	2	6
Assam	10	7	9	1
Bihar	-	2	11	25
Chhattisgarh	13	1	3	1
Delhi	5	3	-	1
Goa	-	1	-	-
Gujarat	9	9	4	3
Haryana	10	2	3	6
Himachal Pradesh	2	7	2	1
Jammu & Kashmir	13	1	3	5
Jharkhand	3	5	15	1
Karnataka	16	7	7	-
Kerala	1	3	10	-
Madhya Pradesh	26	7	11	6
Maharashtra	27	5	3	-
Manipur	1	-		8
Meghalaya	3	2	2	-
Mizoram	-	3	-	6
Nagaland	-	-	2	9
Odisha	12	12	6	-
Puducherry	1	-	-	3
Punjab	8	3	6	3
Rajasthan	21	4	5	3
Sikkim	2	1	1	-
Tamil Nadu	15	11	3	3
Telangana	8	2	-	-
Tripura	-	-	3	1
Uttar Pradesh	4	5	14	48
Uttarakhand	1	3	5	4
West Bengal	2	10	6	1
Total	**226**	**120**	**143**	**145**

Rainfall categorization during July-2015 (number of districts)

State	Excess	Normal	Deficit	Scanty
A & N Islands	-	3	-	-
Andhra Pradesh	-	-	9	4
Arunachal Pradesh	1	1	8	6
Assam	-	4	21	2
Bihar	8	11	16	3
Chhattisgarh	-	4	14	-
Delhi	4	4	1	-
Gujarat	8	8	9	-
Haryana	2	8	10	1
Himachal Pradesh	3	6	2	1
Jammu & Kashmir	13	3	1	5
Jharkhand	17	6	1	-
Karnataka	-	2	16	12
Kerala	-	4	10	-
Madhya Pradesh	18	18	14	-
Maharashtra	-	1	11	23
Manipur	2	1	-	6
Meghalaya	1	-	2	4
Mizoram	-	2	1	6
Nagaland	1	1	-	9
Odisha	8	9	11	2
Puducherry	-	-	1	3
Punjab	1	9	9	1
Rajasthan	24	6	3	-
Sikkim	1	3	-	-
Goa	-	-	1	
Tamil Nadu	6	7	9	10
Telangana	-	-	3	7
Tripura	3	-	1	
Uttar Pradesh	8	24	32	7
Uttarakhand	4	7	2	-
West Bengal	14	1	4	-
Total	**147**	**153**	**222**	**112**

Rainfall categorization during August-2015 (number of districts)

State	Excess	Normal	Deficit	Scanty
A & N Islands	1	1	-	1
Andhra Pradesh	3	7	3	
Arunachal Pradesh	3	4	4	5
Assam	8	10	8	1
Bihar	8	16	13	1
Chhattisgarh	-	3	13	2
Delhi	1	4	4	-
Gujarat	-	-	4	21
Haryana	-	2	12	7
Himachal Pradesh	1	5	4	2
Jammu & Kashmir	2	4	10	6
Jharkhand	4	7	10	3
Karnataka	3	9	18	-
Kerala	-	-	13	1
Madhya Pradesh	6	15	26	3
Maharashtra	3	4	19	9
Manipur	1	1	-	7
Meghalaya	4	2	1	-
Mizoram		2		7
Nagaland	1	-	2	8
Odisha	-	3	25	2
Puducherry	1	-	1	2
Punjab		3	12	5
Rajasthan	5	11	16	1
Sikkim	-	1	3	-
Goa	-	-	1	-
Tamil Nadu	11	10	11	-
Telangana	-	2	8	-
Tripura	-	4	-	-
Uttar Pradesh	-	12	35	24
Uttarakhand	-	3	10	-
West Bengal	7	9	3	-
Total	**73**	**154**	**289**	**118**

Rainfall categorization during September-2015 (number of districts)

State	Excess	Normal	Deficit	Scanty
A & N Islands	1	2	-	-
Andhra Pradesh	2	9	2	-
Arunachal Pradesh	4	4	3	5
Assam	6	15	5	1
Bihar	-	6	17	15
Chhattisgarh	6	7	5	-
Delhi	-	-	-	9
Gujarat	3	5	11	6
Haryana	-	1	4	16
Himachal Pradesh	-	-	8	4
Jammu & Kashmir	11	4	2	5
Jharkhand	-	-	12	12
Karnataka	8	15	7	-
Kerala	3	10	1	-
Madhya Pradesh	-	1	19	30
Maharashtra	6	13	15	1
Manipur	-	2	1	6
Meghalaya	4	-	2	-
Mizoram	-	2		7
Nagaland	-	1	2	8
Odisha	7	10	13	-
Puducherry	-	-	2	2
Punjab	-	5	11	4
Rajasthan	2	2	1	28
Sikkim	2	2	-	-
Goa	-	1	-	-
Tamil Nadu	4	10	15	3
Telangana	4	5	1	-
Tripura	2	2	-	-
Uttar Pradesh	-	-	6	65
Uttarakhand	-		2	11
West Bengal	1	4	12	2
Grand Total	**76**	**138**	**179**	**240**

Annexure 2

Month-wise rainfall in AICRPDA-NICRA villages during September-December, 2014

Villages & District	September			October			November			December		
	N	A	D	N	A	D	N	A	D	N	A	D
Nagla Dulhe Khan (Agra) (UP)	90	54	-40	25	0	-100	2	0	-100	2	0	-100
Warkhed (Akola)	147	0	-100	35	19	-46	18	0	-100	13	0	-100
Aminabad & Girigetla (Kurnool) (AP)	142	60	-58	21	63	200	107	0	-100	5	0	-100
Kochariya (Bhilwara) (Rajasthan)	97	133	37	10	0	-100	7	0	-100	4	0	-100
Lapsiya (Rajsamand) (Rajasthan)	97	94	-3	10	0	-100	7	0	-100	4	0	-100
Achalpur & Nainwan (Hoshiarpur) (Punjab)	161	119	-26	28	15	-47	7	0	-100	27	88	228
Chikkamaranahalli (Bengaluru rural) (Karnataka)	139	202	45	154	247	60	61	12	-80	30	0	-100
Kavalagi (Vijayapur) (Karnataka)	152	100	-34	97	63	-35	30	14	-53	7	0	-100
Chamua (Lakhimpur) (Assam)	241	397	65	130	6	-95	20	0	-100	11	1	-90
Kumbhi & Bankheta (Garhwa) (Jharkhand)	152	100	-34	62	17	-72	10	0	-100	6	26	333
Hardoiya (Faizabad) (UP)	193	42	-79	51	98	94	4	0	-100	11	19	72
Balawas (Bhiwani) (Haryana)	50	25	-50	9	21	144	10	0	-100	3	2	-33
Budhshelly (Bhiwani) (Haryana)	50	29	-43	9	23	162	10	0	-100	3	2	-33
Nignoti (Indore) (MP)	141	176	25	35	31	-10	11	0	-100	3	6	100
Tahkapal (Bastar) (Chattisgarh)	193	267	39	88	103	17	20	1	-95	6	0	-100
Kadesara Kala (Lalitpur) (UP)	128	54	-58	21	0	-100	3	0	-100	5	33	560
Muthukrishnapuram and Thoppureddipatti (Toothukkudi) (TN)	84	69	-19	199	186	-6	139	38	-73	139	38	-73
Babhulgaon (Parbhani) (MH)	167	68	-59	80	25	-69	21	13	-38	9	0	-100
Budhani (Kandhamal) (Odisha)	228	378	66	96	107	12	24	0	-100	5	0	-100
Patameghpar (Jamnagar) (Gujarat)	97	80	-17	22	0	-100	5	0	-100	0	0	0
Khaner (Samba) (J&K)	142	652	360	19	16	-13	6	0	-100	22	0	-100
Patuana & Raura (Rewa) (MP)	199	163	-18	32	92	188	10	0	-100	9	21	133
Kalimati (Banaskantha) (Gujarat)	142	161	13	20	0	-100	3	0	-100	1	0	-100
Narotewadi (Solapur) (MH)	173	32	-82	98	17	-83	22	11	-49	6	7	17
Tedha (Mirzapur) (UP)	228	143	-37	49	61	23	7	0	-100	5	3	-44
Average	**143**	**143**	**0**	**57**	**47**	**-18**	**23**	**4**	**-83**	**14**	**9**	**-36**

N – Normal A – Actual D-% Deviation

Interface Meetings to Enhance the Preparedness for Agricultural Contingencies

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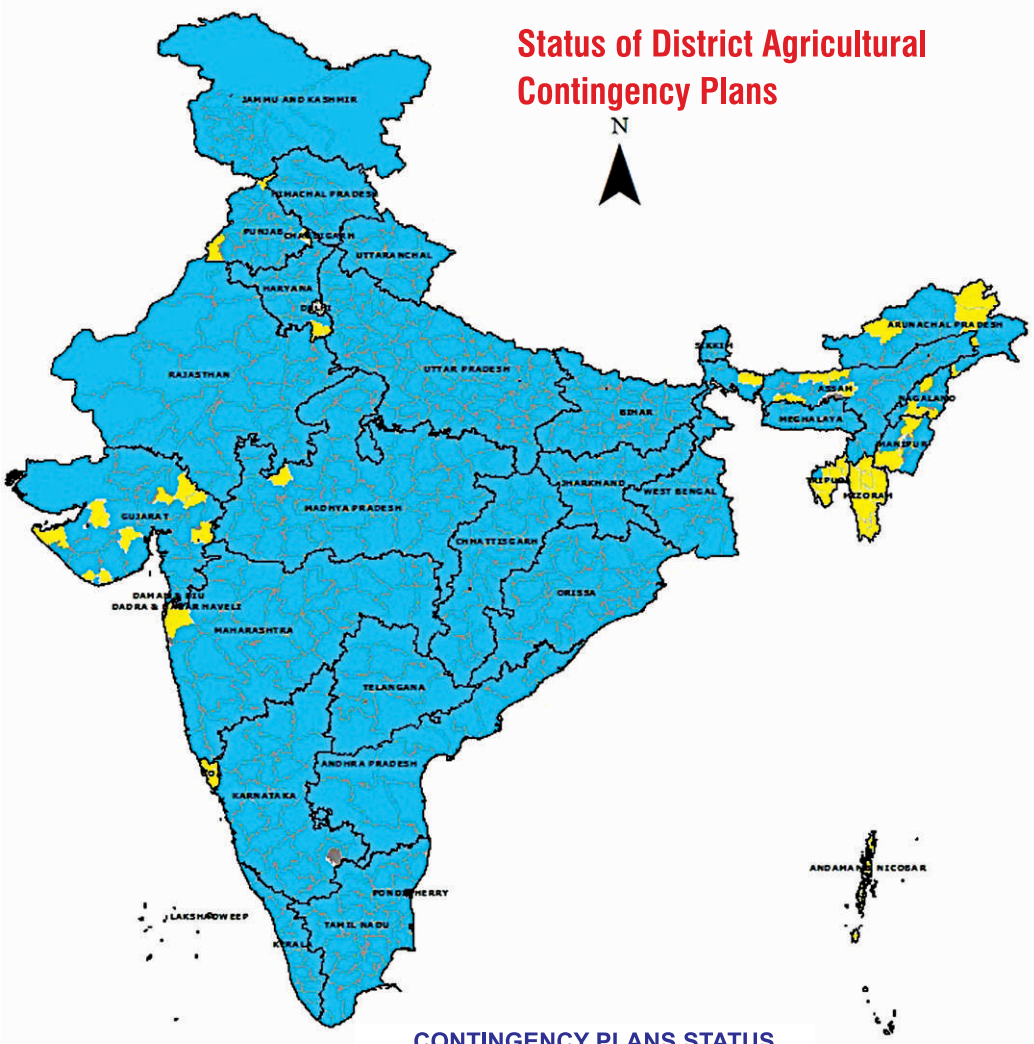
Status of District Agricultural Contingency Plans



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