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Adoption of contingency crop planning by the farmers of North Karnataka

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Abstract: The descriptive study was conducted during 2014-15 in the purposively selected eight villages representing climate change intensity areas in Northern dry (Zone 3) and Northern transition (Zone 8) of north Karnataka. The results on adoption of contingent *kharif* crop planning in zone 3 revealed that, majority of farmers found to adopt most of the recommended crops except maize, pigeonpea, castor, sesamum, horsegram and blackgram but not adopting recommended intercropping systems, whereas farmers are cultivating inter cropping chilli + onion (1:5), and sorghum+ pigeonpea (6:1). In zone 8, farmers preferred mono crops rather intercropping systems but found to cultivate sunflower, onion, sesamum, littlemillet and cowpea. Similarly during rabi season, farmers of zone 3 and 8 preferred recommended mono crops than recommended intercropping systems, but were following intercropping of safflower with chickpea and wheat. Fodder crops cultivation was not noticed in both zones since dairy component was predominantly absent. The crop productivity levels during kharif season for delayed sowings in both the zones revealed reduced yields in maize (8 to 29%), and groundnut (18 to 47%) when compared to Bt cotton (39 to 60%) and chili (33 to 55%). Similarly, delayed sowings in *rabi* season shown low decreased productivity in safflower (18 to 42%) and sorghum (22 to 47%) as compared to wheat (23 to 67%) and chickpea (36 to 58%) crops. Farmers suggested the need for demonstrating the contingent crops and cropping system (91.32 Garrett score), providing economic support to encourage adoption of contingency crop planning (79.43 Garrett score), fine tuning of location specific climate change resilient practices (78.23 Garrett score) and others for strengthening the capacity of farmers towards climate resilient agriculture.

Key words: Climate change, Contingency crop planning, Crop productivity

Introduction

Climate change is a pertinent issue affecting the livelihoods and food security in both developing and developed countries. It is estimated that climate change will reduce agricultural production by two per cent every decade while demand will increase by 14 per cent in every decade till 2050. Yields of major crops will face an average decline of 8 per cent for Africa and South Asia by 2050. A consensus has thus emerged that developing countries are more vulnerable to climate change than developed countries, because of the predominance of rainfed agriculture, the scarcity of capital for adaptation measures, their warmer baseline climates and their heightened exposure to extreme events (Fischer *et al.,* 2005; Parry *et al.,* 2007; Nnamchi and Ozor, 2009; Anonymous, 2010).

Several adaptation options on farm level *viz.,* diversifying the farming system, the use of new crops and varieties, the use of new livestock species and breeds, the adjustment of planting dates, altering cropping location, improved land management, expanded rainwater harvesting, and improved water use efficiency are being recommended. These improved agricultural practices evolved over time for diverse agro-ecological regions in India have potential to enhance climate change adaptation, if deployed prudently. However, implementation of these measures individually will only have limited effect and therefore a combination of several of the options should be applied. Furthermore, it is important to highlight that not all adaptations may be beneficial to an agricultural system in the long-term.

Of the various interventions towards climate resilient agriculture, the recommended crop contingency plans *viz.,* change in crop or cropping system, agronomic measures, crop management, soil nutrient and conservation measures and *rabi* crop planning for drought situation have the major role to play.

Karnataka state in general, and north Karnataka in particular, is prone to frequent climate change effects and the efforts by various concerned institutions, research centres and development departments are continuing to educate farmers to adopt contingency crop planning. Hence for better understanding of existing contingency crop planning by the farmers the present study was designed with the following objectives.

1. To study the adoption of contingency crop planning measures among farmers of zone 3 and 8
2. To estimate the productivity of crops under normal and delayed farming(sowing) situations and
3. To recommend the suggestions for strengthening capacity of farmers to adapt to climate changes

Material and methods

The study was conducted during 2014-2015 in Northern dry (Zone 3) and Northern transition(Zone 8) of Northern Karnataka. Five villages *viz.,* Dambal (Mundargi tq.), Kurtakoti (Gadag tq.), Hulugur (Shiggaon tq.), Shirur (Saundatti tq.) and Majjigudda (Annigeri tq.) representing Zone 3 and similarly three villages *viz.,* Kamadolli (Kundgol tq.), Chellur (Savanor tq.) and Gudenakatti (Kundgol tq.) representing zone 8 were selected. From each selected village 10 farmers were randomly selected to constitute 80 sample for the study.

Considering the suggested contingency crops/cropping systems and cultivars (Lingappa and Itnal, 2006; Subba Reddy

et al., 2008) for the *kharif* season *viz.,* normal onset of monsoon (1st fortnight of June), delay by two weeks (2nd fortnight of June), delay by 4 weeks (1st fortnight of July), delay by 6 weeks (2nd fortnight of July), delay by 8 weeks(1st fortnight of August) and even 2nd fortnight of August, the information on adoption of contingency crop planning and the productivity were collected. Similar field observations during rabi season for normal sowing (September to October) and delayed sowing (November) were also collected.

The suggestions for strengthening capacity of farmers to adapt to climate changes were recommended based on the expressed views of the sample farmers and were ranked using Garrett's Ranking Technique.

Results and discussion

Adoption of *Kharif* contingency crop planning by the farmers of zone 3 and 8

The results presented in Table 1 revealed that majority of farmers (60-75%) in zone 3, during normal onset and till monsoon delay by six weeks were found to sow the recommended mono crops *viz.,* Bt cotton, greengram, chilli, onion, groundnut, maize, sorghum and pearl millet. Whereas pigeon pea, castor, and sesamum were not cultivated because of not aware of improved production technologies, HYV seeds, and market demand. Similarly most of the recommended intercropping systems pearl millet + pigeonpea (2:1), groundnut + pigeonpea (3:1, 4:2), sorghum + groundnut (2:4), foxtail millet + pigeonpea (4:2), were not practiced due to labour problem and not aware of recommendation. But farmers had the practice of growing sunflower, Foxtail millet, coriander and intercropping of chilli+onion, Bt cotton+ greengram, hybrid sorghum+ matki, chilli+ onion+ corainder and sorghum + tur (6:1) as the traditional practice. Whereas in the situation of monsoon delay by 8 weeks only 25 per cent farmers were found to practice contingent crop planning due to lack of confidence in reaping the crop.

The observation of *Kharif* crop planning in zone 8 as shown in Table 2, highlighted that 70 to 80 per cent farmers during normal onset of monsoon and delay by six weeks were found to cultivate most of the recommended mono crops, but not interested in intercropping systems due to scarcity of labour and problems in post harvest management. Whereas farmers were found to cultivate other than recommended crops *viz.,* onion, sunflower, sesamum, little millet and chilli+onion/garlic intercropping because of perceived profitability and convenience. In this zone also farmers were not interested in growing castor, and intercropping sorghum + pigeon pea, pigeon pea + foxtail millet, horsegram + foxtail millet, pearlmillet+ pigeon pea because of not convinced of improved cultivation practices and less market demand.

In both the zones cultivation of fodder crops was not observed during normal onset of monsoon and also delayed monsoon because of very less adoption of dairy component and also problem of protecting fodder crops in open fields.

Adoption of *Rabi* crop contingency measures by the farmers of zone 3 and 8

It was observed that 65 to 75 per cent of farmers in zone 3 during *rabi* season (Table 3) were cultivating recommended crops *viz., rabi s*orghum, sunflower and safflower but not growing horsegram, cotton, and intercropping sorghum + chickpea, coriander + safflower, safflower + chickpea. Whereas farmers had the practice of growing other than recommended crops such as chickpea, wheat, and maize and also intercropping of chickpea+ safflower (5:1, 6:1), wheat+ safflower (5:1, 6:1) because of usual traditional practice. But contingent crop planning for delayed sowing in 2nd fortnight of November was not noticed because of problem of protecting crop from cattle grazing and very low yield.

The critical observation in zone 8, revealed that majority of farmers (70-85%), till second fortnight of October preferred to take up sowing of recommended mono crops and intercropping chickpea+ safflower (6:1), wheat+ safflower (6:1) with different row proportions. During first fortnight of November, 65 per cent farmers were growing recommended wheat and chickpea, and the local practice of growing sorghum, safflower, chickpea + safflower (6:1), wheat+ safflower (6:1).

In both the zones farmers did not preferred linseed, horsegram and fodder crops as contingency crop planning for *rabi* season because of lack of knowledge about improved cultivation practices and profitability.

These results revealed that farmers still in their own concept of adopting traditional contingent crop planning which has to be looked into critically and implement participatory extension approaches for better convincing of farmers. The similar observation was noticed in the research study of Wang *et al.* (2010) in china.

Productivity of *kharif* crops under normal and delayed farming situations in Zone 3 and 8

The productivity performance of crops and cropping systems in zone 3 as depicted in Table 5, indicated that sowings during 'monsoon delay by two weeks' shown 18 per cent decline in productivity in greengram and sorghum, 12 per cent in onion crop and very less decline in maize(3%) and Bt cotton (4%). The productivity levels of groundnut and chilli crops was normal. The subsequent sowings during 'monsoon delayed by four to six weeks' shown a highest decline in productivity in onion (40 to 62%), Bt cotton (39-60%) and chilli (33 to 55%), followed by groundnut (18 to 47%) and maize (8 to 29%). Similarly sowing in situation of monsoon delayed by eight weeks, the higher decline in productivity was noticed in Bt cotton (70%), followed by chilli (67%) and maize(52%).

The observation in zone 8(Table 6) revealed that, *Kharif* contingent crop planning in the situation of 'monsoon delayed by two weeks' shown a highest declined productivity in greengram (31%), followed by maize (10%). With still delayed

Table 1. Adoption of contingency crop planning by the farmers of Zone 3 (*Kharif*)

Time of sowing	Recommended crop/ cropping system	Adoption of recommended crop/cropping system		Crop/ cropping system other than recommended	Non-adoption of recommended crop/ cropping system
		Particulars of recommended crop/ cropping system adopted	Per cent of adoption		
i) Normal onset of monsoon: May last week	Maize, Chilli	Chilli	60.00	Bt cotton, Groundnut, Greengram, Sorghum, Sunflower,	Maize
June 1st fort night	Bt Cotton, Maize, Pearl Millet, Sorghum, Groundnut, Greengram, Chilli, Onion, Pigeonpea, Castor, Sesamum, Cowpea, Pearl Millet + Pigeonpea (2:1), Blackgram, Groundnut + Pigeonpea(3:1, 4:2), Sorghum + Groundnut (2:4), Foxtail millet + Pigeonpea (4:2), Horse gram	Bt Cotton , Greengram,Chilli, Onion, Groundnut,Maize, Sorghum,Pearl Millet	75.00	Chilli+Onion (1:5), Sunflower, Sorghum+ Pigeonpea (6:1), Foxtail millet, Bt cotton+ Greengram, Coriander, Chilli+Onion, Hybrid sorghum+ Matki	Pigeonpea, Castor, Sesamum, Cowpea, Pearl Millet + Pigeonpea (2:1), Blackgram, Groundnut + Pigeonpea(3:1, 4:2), Sorghum + Groundnut (2:4), Foxtail millet + Pigeonpea (4:2), Horse gram
ii)Monsoon delay by two weeks (June 2nd fort night)	Bt Cotton, Pearl Millet, Sorghum, Groundnut, Chilli, Onion, Greengram, Pigeonpea, Castor, Sesamum, Cowpea, Pearl Millet + Pigeonpea (2:1), Groundnut + Pigeonpea, Sorghum + Groundnut (2:4), Foxtail millet + Pigeonpea (4:2), Horse gram	Bt Cotton , Groundnut, Greengram, Onion, Chilli, Sorghum, Pearl Millet	70.00	Maize, Chilli+Onion, Sunflower, Sorghum+ Pigeonpea, Foxtail millet, Bt cotton+ Greengram, Coriander,Chilli+Onion, Hybrid sorghum +Matki	Pigeonpea, Castor, Sesamum, Cowpea, Pearl Millet + Pigeonpea (2:1), Groundnut + Pigeonpea, Sorghum + Groundnut (2:4), Foxtail millet + Pigeonpea (4:2), Horse gram
iii)Monsoon delay by four weeks (July 1st fort night)	Bt Cotton, Pearl Millet, Groundnut (Spreading), Greengram, Onion, Pigeonpea, Castor, Sesamum, Niger, Foxtail millet, Cowpea, Pearl Millet + Pigeonpea (2:1), Foxtail millet + Pigeonpea (4:2), Horse gram	Bt Cotton, Onion,Groundnut (Spreading),Pearl Millet, Foxtail millet	75.00	Maize, Chilli, Sunflower, Onion+Chilli	Greengram, Pigeonpea, Castor, Sesamum, Niger, Cowpea, Pearl Millet + Pigeonpea (2:1), Foxtail millet + Pigeonpea (4:2), Horse gram
iv)Monsoon delay by 6 weeks (July 2nd fort night)	Bt Cotton, Pearl Millet, Maize, Groundnut (Spreading), Pigeonpea, Castor, Sesamum, Niger, Foxtail millet, Horsegram, Cowpea, Pearl Millet + Pigeonpea (2:1), Foxtail millet + Pigeonpea (4:2), Fodder crops	Bt Cotton, Groundnut(Spreading), Maize, Pearl Millet, Foxtail millet	60.00	Chilli, Onion, Sunflower , Pearl Millet	Pigeonpea, Castor, Sesamum, Niger, Horsegram, Cowpea, Pearl Millet+Pigeonpea (2:1), oxtail millet + Pigeonpea(4:2), F Fodder crops
v)Monsoon delay by 8 weeks Aug. 1st fort night	Castor, Foxtail millet, Horsegram, Cowpea, Sunflower + Castor (4:2), Fodder crops	Foxtail millet	25.00	Maize , Chilli, Sunflower, Bt Cotton (short duration)	Castor , Horsegram, Cowpea Sunflower + Castor (4:2), Fodder crops
Aug. 2nd fort night	Castor, Horsegram, Cowpea, Sunflower + Castor (4:2), Fodder crops	-	-	Jayadar cotton, Chilli+ Jayadar Cotton	Castor, Horsegram, Cowpea Sunflower + Castor (4:2), Fodder crops

Table 2. Adoption of contingency crop planning in Zone 8 (*Kharif*)

Time of sowing i) Normal onset of monsoon:	Recommended crop/ cropping system	Adoption of recommended crop/cropping system		Crop/ cropping system other than recommended	Non-adoption of recommended crop/ cropping system
		Particulars of recommended crop/ cropping system adopted	Per cent of adoption		
May last week	Sorghum, Maize	Sorghum	35.00	Bt cotton, Groundnut, Greengram	Maize
June 1st fortnight	Bt Cotton, Sorghum, Maize, Chilli, Bajra, Save, Pigeon pea, Soybean, Greengram, Castor, Niger, Groundnut (Spreading), Cowpea, Sorghum + Pigeon pea, Pigeon pea + Foxtail millet, Horsegram + Foxtail, Pearlmillet+Pigeon pea, Fodder crops	Bt Cotton, Groundnut, Greengram, Chilli,Maize, Bajra, Niger, Save, Sorghum, Soybean, Pigeopea, Cowpea	75.00	Onion, Sunflower , Seasamum, Little millet, Chilli+Onion/Garlic	Castor, Sorghum + Pigeon pea, Pigeon pea + Foxtail millet, Horsegram + Foxtail millet, Pearlmillet+Pigeon pea, Fodder crops
ii)Monsoon delay by two weeks (June 2nd fortnight)	Bt Cotton,Sorghum, Maize, Chilli, Bajra, Save, Pigeon pea, Soybean, Greengram, Castor, Niger, Groundnut (Spreading), Cowpea, Sorghum + Pigeon pea, Pigeon pea+ Foxtail millet, Horsegram + Foxtail millet, Pearlmillet+Pigeon pea, Fodder crops	Bt Cotton, Groundnut, Maize, Bajra, Save, Greengram, Chilli, Niger, Sorghum, Soybean, Pigeonpea, Cowpea	80.00	Onion, Sunflower, Seasamum, Little millet	Castor, Sorghum + Pigeon pea, Pigeon pea + Foxtail millet, Horsegram + Foxtail millet, Pearlmillet+Pigeon pea, Fodder crops
iii)Monsoon delay by four weeks (July 1st fortnight)	Bt Cotton, Sorghum, Maize, Chilli, Bajra, Foxtail millet, Finger millet, Savi, Soybean, Pigeon pea, Sunflower, Castor, Groundnut (Spreading), Cowpea, Chilli + Cotton (1:1), Niger, Fodder Sorghum, Fodder Maize, other Fodder crops	Bt Cotton, Groundnut (Spreading), Niger, Maize, Chilli, Savi, Soybean, Pearl millet, Cowpea, Chilli+Cotton	75.00	Onion, Sunflower, Chilli+ Onion	Sorghum, Foxtail millet, Finger millet, Pigeon pea, Castor, Fodder Sorghum, Fodder Maize, other Fodder crops
iv) Monsoon delay by 6 weeks (July 2nd fortnight)	Bt Cotton, Chilli, Maize, Groundnut (Spreading), Soybean, Castor, Finger millet, Niger, Cowpea, Fodder Sorghum, Pigeon pea, Savi, Fodder Maize, Fodder Cowpea, Fodder Bajra	Bt Cotton, Groundnut (Spreading), Maize, Chilli, Soybean	70.00	Onion, Pearl millet, Sunflower	Castor, Finger millet, Niger, Fodder Sorghum, Pigeon pea, Savi, Fodder Maize, Fodder Cowpea, Fodder Bajra
v) Monsoon delay by 8 weeks Aug. 1st fortnight	Chilli, Maize, Sunflower, foxtail, Cowpea, Castor, Horsegram, Niger, Fodder Sorghum, Chilli+Cotton, Fodder maize, Fodder Bajra, Fodder Cowpea, Fodder Horsegram	Sunflower, Chilli, Maize	30.00	Bt Cotton	Foxtail, Cowpea, Castor, Horsegram, Niger, Fodder Sorghum , Chilli+Cotton, Fodder maize, Fodder Bajra, Fodder Cowpea, Fodder Horsegram
Aug. 2nd fortnight	Sunflower, Castor, Cowpea, Niger, Fodder Chilli Sorghum , Fodder maize, Fodder Bajra, +Cotton, Fodder Cowpea, Fodder Horsegram, other Fodder crops	-	-	-	Sunflower, Castor, Cowpea, Niger, Fodder Sorghum, Fodder maize, Fodder Bajra, Chilli+Cotton, Fodder cowpea, Fodder Horsegram, other Fodder crops

Table 3. Adoption of contingency crop planning in Zone 3 (*Rabi*)

Time of sowing	Recommended crop/ cropping system	Adoption of recommended crop/cropping system		Crop/ cropping system other than recommended	Non-adoption of recommended crop/ cropping system
		Particulars of recommended crop/ cropping system adopted	Per cent of adoption		
September 1st fortnight	Sorghum, Safflower, Sunflower, Horsegram, Sorghum + Chickpea (2:1), Cotton, Safflower+Chickpea (2:4), Fodder crops	Sorghum, Sunflower, Safflower	65.00	Chickpea, Wheat, Maize	Horsegram, Sorghum + Chickpea (2:1), Cotton, Safflower+Chickpea (2:4), Fodder crops
September 2nd fortnight	Sorghum, Safflower, Sunflower, Horsegram, Sorghum + Chickpea, Coriander + Safflower (4:2), Safflower+Chickpea (2:4), Fodder crops	Sorghum, Safflower, Sunflower	70.00	Chickpea, Wheat, Chickpea + Safflower (5:1, 6:1), Wheat +Safflower (5:1, 6:1)	Horsegram, Sorghum + Chickpea, Coriander + Safflower (4:2), Safflower+ Chickpea (2:4), Fodder crops
October 1st fortnight	Sorghum, Safflower, Sunflower, wheat , Chickpea, Horsegram, Sorghum + Chickpea, Safflower+Chickpea (2:4), Coriander + Safflower (4:2), Wheat+Safflower (5:1, 7:1), Fodder crops	Chickpea, Sorghum,Wheat, Safflower , Wheat+Safflower (5:1, 6:1)	60.00	Chickpea+Safflower (5:1, 6:1)	Horsegram, Sorghum + Chickpea, Coriander + Safflower (4:2), Fodder crops
October 2nd fortnight	Sorghum, Safflower, Sunflower, Chickpea, Wheat, Horse gram, Linseed, Safflower+ Chickpea (2:4), Wheat + Safflower (5:1, 7:1), Fodder crops	Chickpea, Sorghum, Wheat, Safflower , Wheat+Safflower (5:1, 6:1)	75.00	Chickpea+Safflower (5:1, 6:1)	Sunflower, Horse gram, Linseed, Fodder crops
November 1st fortnight	Chickpea, Wheat, Fodder crops, Linseed, Chickpea+Linseed, Sorghum+Cowpea	Chickpea, Wheat	75.00	Sorghum, Chickpea+ Safflower (5:1, 6:1)	Fodder crops, Linseed, Chickpea + Linseed, Sorghum+Cowpea
November 2nd fortnight	Chickpea, Fodder crops, Linseed, Wheat, Sorghum+Cowpea	-	-	-	Chickpea, Fodder crops, Linseed, Wheat, Sorghum+Cowpea

Table 4. Adoption of contingency crop planning in Zone 8 (*Rabi*)

Time of sowing	Recommended crop/ cropping system	Adoption of recommended crop/cropping system		Crop/ cropping system other than recommended	Non-adoption of recommended crop/ cropping system
		Particulars of recommended crop/ cropping system adopted	Per cent of adoption		
September 1st fortnight	Sorghum, Sunflower, Castor, Cotton	-	-	-	Sorghum, Sunflower, Castor, Cotton
September 2nd fortnight	Sorghum, Sunflower, Safflower, Castor, Chickpea, Wheat, Coriander+Safflower(3:1), Sorghum+Chickpea(2:1), Chickpea+ Safflower(4:2)	Wheat, Chickpea, Sorghum, Safflower, Sunflower	85.00	Chickpea+Safflower(6:1), Wheat+Safflower(6:1)	Castor
October 1st fort night	Sorghum, Sunflower, Safflower, Wheat, Chickpea, Castor, Horsegram	Sorghum, Wheat, Chickpea, Safflower, Sunflower	80.00	Chickpea+Safflower(6:1), Wheat+Safflower(6:1)	Castor, Horsegram
October 2nd fortnight	Sorghum, Sunflower, Safflower, Wheat, Chickpea, Fodder crops	Sorghum, Wheat, Chickpea, Safflower , Sunflower	70.00	Chickpea+Safflower(6:1), Wheat+Safflower(6:1)	Fodder crops
November 1st fort night	Wheat, Linseed, Chickpea, Horsegram, Fodder crops	Wheat, Chickpea	65.00	Sorghum, Safflower Chickpea+Safflower(6:1), Wheat+Safflower(6:1)	Linseed, Horsegram, Fodder crops
November 2nd fortnight	Linseed, Horsegram, Fodder crops	-	-	Sorghum, Wheat, Chickpea, Safflower, Chickpea + Safflower(6:1), Wheat+Safflower(6:1)	Linseed, Horsegram, Fodder crops

sowing, till monsoon delayed by 8 weeks the highest decreased yields was noticed in chilli (upto 69 %) and Bt cotton (upto 67 %) as compared to maize (upto 36%).

Productivity of *rabi* crops under normal and delayed farming situations in Zone 3 and 8

The average productivity levels of *rabi* crops in zone 3 (Table 7) revealed that, the crop productivity for the delayed sowings in 'October 2nd fortnight to November 1st fortnight' shown the highest decline in wheat (33 to 67%), and chickpea (36 to 57%), followed by sorghum (23 to 47 %) and safflower (18 to 36%).

The performance of productivity levels in zone 8 as shown in table 8 highlighted that the contingent crop planning for delayed sowing upto 2nd fortnight of November revealed the highest decrease in productivity levels of chickpea (50 – 67%), and sorghum (22-67%) followed by wheat (23 – 62%) and safflower (33-42%).

Suggestions for strengthening capacity of farmers to adapt to climate changes

An analysis of suggestions made by farmers of Zone 3 and 8 (Table 9) indicated that the need for demonstrating recommended contingent crops and cropping system (with Garrett score of 91.32) was ranked as the first suggestion. The suggestions of providing of economic support to encourage adoption of contingency crop planning (with Garrett score of 79.45), research emphasis on fine tuning of location specific climate change resilient practices (with Garrett score of 78.23), and strengthening R-E-F linkages through participatory approaches (with Garrett score of 76.78) were ranked as second, third, and fourth rankings respectively.

Similarly, the studies conducted by Ishaya and Abaje (2008) and Nzeadibe *et al*. (2011) in Nigeria, reported the suggestions of access to timely weather information, updating adaptation strategies, awareness of climate change, institutional capacity and favourable government policies to climate change adaptation is very much required.

Conclusion

The results on overall situation of contingency crop planning among the farmers of zone 3 and 8 revealed that, farmers during kharif were preferring mono cropping than recommended intercropping systems in spite of maximum declined productivity (60-70%) in Bt cotton and chilli with delayed planting till first fortnight of August. Similarly, farmers during rabi were found to practice monocropping in spite of highest decreased yields (50-70%) in sorghum, chickpea, wheat and safflower. Hence, there is an utmost need to convince the economics of contingency crop planning. On the other side farmers were not adopting castor, minor millets and other short duration drought resistant crops because of not aware of improved production technologies and potential market demand which highlight the greater attention by the transfer of technology centres to demonstrate and showcase the success stories for greater witnessing of results. Similarly,

Table 5. Percentage change in productivity across the different sowing time in Zone 3 (*Kharif*)

Crops	Average productivity(q/ha) in different dates of sowing				
	Normal onset of monsoon (June 1st Fort night)	Monsoon delay by two weeks (June 2nd fortnight)	Monsoon delay by four weeks (July 1st fort night)	Monsoon delay by six weeks (July 2nd fortnight)	Monsoon delay by eight weeks (Aug. 1st fortnight)
Bt Cotton	23	22 (4%)	14(39%)	9(60%)	7(70%)
Maize	38	37(3%)	35(8%)	27(29%)	25(52%)
Groundnut	17	17(0%)	14(18%)	9(47%)	-
Onion	92	81(12%)	55(40%)	35(62%)	-
Greengram	11	9(18%)	-	-	-
Chilli	9	9(0%))	6(33%)	4(55%)	3(67%)
Sorghum	11	9(18%)	-	-	-

Figures in parentheses indicate percentage decrease in productivity levels over normal season

Table 6. Percentage change in productivity across the different sowing time in Zone 8 (*Kharif*)

Crops	Average productivity(q/ha) in different dates of sowing				
	Normal onset of monsoon (June 1st Fort night)	Monsoon delay by two weeks (June 2nd fort night)	Monsoon delay by four weeks (July 1st Fort night)	Monsoon delay by six weeks (July 2nd Fort night)	Monsoon delay by eight weeks (Aug. 1st Fort night)
Bt Cotton	18	18(0%)	13(27%)	8(56%)	6(67%)
Maize	50	45(10%)	38(24%)	35(-30 %)	32(36%)
Groundnut	17	17(0%)	14(18%)	11(35%)	-
Greengram	8	5.5(31%)	-	-	-
Chilli	8	8(0%)	6(25%)	3(62 %)	2.5(69%)

Figures in parentheses indicate percentage decrease in productivity levels over normal season

Table 7. Percentage change in productivity across the different sowing time in Zone 3 (*Rabi*)

Crops	Average productivity(q/ha) in different farming situations				
	September 2nd Fort night	October 1st Fort night	October 2nd Fort night	November 1st Fort night	November 2nd Fort night
Sorghum	17	16(6%)	13(23%)	9(47%)	6(65%)
Wheat	9	9(0%)	6(33%)	3(67%)	-
Chickpea	14	14(0%)	9(36%)	6(57%)	-
Safflower	11	11(0%)	9(18%)	7(36%)	-
Safflower + Wheat	6+9	6+9(0%)	4.5(25%) +4(55%)	2.5(58%) +2(78%)	-

Figures in parentheses indicate percentage decrease in productivity levels over normal season

Table 8. Percentage change in productivity across the different sowing time in Zone 8 (*Rabi*)

Crops	Average productivity(q/ha) in different farming situations				
	September 2nd Fort night	October 1st Fort night	October 2nd Fort night	November 1st Fort night	November 2nd Fort night
Sorghum	18	18(0%)	14(22%)	11(39%)	6(67%)
Wheat	8	8(0%)	6(23%)	5(35%)	3(62%)
Chickpea	12	11(8%)	6(50%)	5(58%)	4(67%)
Safflower	12	11(8%)	8(33%)	7(42%)	6(50%)
Sunflower	9	8(11%)	6(33%)	-	-

Figures in parentheses indicate percentage decrease in productivity levels over normal season

problems of non availability of labour for carrying out timely field operations for practicing intercropping systems has to critically looked into through introduction of suitable farm machineries and fine tuning of location specific climate change resilient practices.

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Table 9. Suggestions based on perception of sample farmers for strengthening the capacity towards climate resilient agriculture (n=80)

Sl. No.	Suggestions	Garrett Mean Score	Rank
1	Availability of updated personalized weather forecast (Short range and also medium range) information to farmers in time	69.27	V
2	Demonstrating the contingent crops and cropping system	91.32	I
3	Convincing production technologies and economics of cultivating castor, minor millets and other unfamiliar crops	67.45	VII
4.	Developing appropriate production technologies to increase profitability of traditional crops cultivation	68.36	VI
5	Timely availability of seeds to take up sowing of recommended contingent crops	54.82	XII
6	Providing economic support to encourage adoption of contingency crop planning	79.43	II
7	Revalidation of recommended production practices for delayed sowing situations	56.32	XI
8	Strengthening R-E-F linkages through participatory approaches	76.78	IV
9	Documentation of successful climate resilient technologies adopted by the farmers	57.46	X
10	Research emphasis on fine tuning of location specific climate change resilient practices	78.23	III
11	Promoting policies and programmes to encourage adoption of community based soil and water conservation and management practices	58.37	IX
12	Popularizing livestock and forest based farming systems	64.31	VIII

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