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Research Article

Agro-Hydrologic Innovations for Ushering Food Security during Drought Year

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Abstract

High technological potential of innovative agro hydrology can reduce adverse impact of droughts. The innovative agro-hydrology prudent technology recommends cultivation of cotton at spacing 60cm x 60cm, plant population 27,777plants/ha, right in last week of April by giving pre sowing irrigation and one irrigation 21 days after the sowing. The crop yield and biomass productivity come to the maximum. For meeting the social preferred consumption need, it recommends cultivation of pearl millet in mere 1/20ha (500 m2 field size) per family and separate block of pearl millet for cattle fodder. These two cropping patterns and land utilization will produce all good effects of sustainable agro ecology for arid and semi-arid regions. The technology is so robust that it will be 100 percent risk free.

Government of India launched Pradhan Mantri Fasal Bima Yojna in the Fiscal year 2016. The nonlife insurance companies have been making their company's business; almost 50 percent from the premium from the Fasal Bima Yojna. The novelty of the Fasal Bima Yojna is provoked in terms of low premium 2% for Kharif, 1.5% for Rabi and 5% for permanent horticulture and cotton of the sum insured. The insurance companies charge premium at market rate. The difference between the market rate and rate ascribed in PMFBY is paid by subsidy by the Government. In this situation the country is not enabled to take advantage of innovative agro-hydrology, insurance companies capture opportunity to make big business and remain least liable to pay claims. The early majority innovation adopting farmers will not gain from PMFBY and Government gets huge cost. There will be compulsion for imposition of other financial measures to compensate the cost on account of PMFBY, bad effect on agro-ecology, mal practice of forged claims by laggards in innovation adoption and maintaining similar disgusting situation of increase in insurance premium in following years. It will be highly advantageous to implement the new agro-hydrology prudent technology and reverse the bad situation during drought to good agro-ecologic sustainable agro-ecosystem in the interest of Indian agriculture.

Keywords: Agro-Ecology; Agro-Hydrology; Drought Year; Innovative Technology; Insurance; Food Security and Forage Availability

Introduction

From nowhere the crop insurance has emerged as a third largest lined business after motor insurance and health insurance following the launch of the Pradhan Mantri Fasal Bima Yojna (PMFBY) in 2016. The Insurance Regulatory and Development Authority (IRDA) show that total premium income jumped to 1.27 lakh crores for the year 016-17. from 96.37376 crores in financial year 2016, due to opening of crop insurance [1]. Of the nearly 32% growth in insurance, nearly 16% came from the crop insurance. It is believed that the business for the top line and the crop insurance as well as the crop loss claims, are expected to be around 75% of the premium received. Some giant private Insurers speculate that the crop insurance will cost only 10% of the premium. This is the first year that there is complete market driven insurance. The main damage to the crop has come in Karnataka and Tamil Nadu as a result of droughts. However, the farmers pay only 2% of the sum insured as premium and rest is subsidized by the Government. One insurer said that severity of claims can be extremely high; loss ratio (ratio of claim to premium) can go up to 200 percent [2]. Thus, there is lot of inconsistency towards payment of compensation. The value of total crop insurance in year 2017 would be in range of 3 lakh cores. Besides providing cover, the non-life insurance companies aim to reduce losses by roping the weather companies and providing advice to the farmers, on the risk involved. Such type

of situations is likely to occur year after year with some marginal modifications.

New development in agro-hydrology has been brought, which have direct bearing in coping up with the likely situation of bad hydrologic years. Altiery [3] identified 11 factors for development of sustainable agro- ecology. The sustainability of ecology of an area gets disturbed due to climate change that results in floods and droughts and prolonged foggy winter or winds, which are beyond one's control. Efforts should be made to reduce adverse impacts and cope up with the situation. Objective of this study was to display newly devised agro-hydrology prudent technology. It also attempts to make contrast of agro hydrologic innovative technology versus other measure viz crop insurance schemes. The study patternises only two cropping patterns viz cotton-wheat and Pearl millet wheat to fulfill all food, fodder, fuel and economic needs.

Crop and cropping practice to use aberrant weather and erratic rainfall distribution where other cropping fail

In many parts of the state there is ongoing practice of cultivation of short duration pulse crop viz green gram after harvest of wheat, with irrigation water, sown in the third week of April. The green gram matures by first week of July and field become free for following rainy season cropping. Since the onset of monsoon season, likely rainfall and distribution of events become uncertain; it was thought to establish a crop which can utilize rainfall, which may occur, in magnitude and distribution pattern. An exemplary two year study was conducted at ICAR CSWCRT, Research Centre, Agra, Uttar Pradesh, in the semi-arid tropics. In the region agriculture often suffers setback by frequent drought. Cotton crop to make use of erratic rainfall distribution during drought that vitiates the cropping patterns and cause suffering to the farmers. The cotton crop was sown after harvest of wheat in last week of April, in year 2004-05 and 2005-06. Cotton crop established with one irrigation 21 days after sowing proved successful. This study was conducted on farmer's field in Biharipur Villge in the vicinity of ICAR CSWCRTI, Research Centre. Agra, Uttar Pradesh. The sandy loam (Typic ustochrept) in 0-15 cm soil layer, has field capacity 15.8%, permanent wilting point 5.2% and bulk density 1.49g/cm^3. Three irrigation levels viz I1, one irrigation 21 days after seeding, I2, irrigation 42 days after seeing and third I3= I1+I2) both irrigation ie 21 days and 42 days after seeding, respectively. Three plant spacing reflecting plant population and planting patterns made total nine treatments, laid out in split plot design of three irrigation levels as the main plots and three planting patter/plant population as subplots. The subplots were of 12 m^2 size.

Figure 1: Cotton crop in field.

Seed yield, stalk yield and total biomass of cotton

Plant growth parameters revealed that I1 significantly recorded higher plant height, mean branches/plant and number of balls/plant. Although plant growth parameters were higher with I2, but I1 recordeed highest cotton seed yield, stalk and total biomass (Table 1). There occurred variable ball drops post monsoon season due to moisture stress. I1 performed better crop establishment due to favourable rainfall distribution in 2004. Although, plant height, no of ball etc were higher in closer spacing, the seed cotton yield and total biomass were maximum at rectangulr planting having lowest plant density. Plant with low density could avail higher plant groth resources, thus it recorded maximum seed cotton.This situation indicates that any measure to alleviate moistru stress will change scenario of yield performance.

The interaction effect showed that irrigation at 21 Days and plant spacing 60cmx60cm. (I_1S_3) produced maximum seed cotton yield (1694 kg/ha), in year 2004-05, 2005 - 06 and mean yield. Dropping of balls in other treatmentsgot adversally affected by moisture stress post monsoon season. The stalk yield was highest with I_1 and maximum population (55555 plants/ha)ie S_1. But when it came to total biomass production, it became maximu with I1 (21 DYS) and S3 (60 x 60cm), ie low plant density ie rectangular plantation. Interaction (I_1S_3) produced maximu seed cotton yield in all the two years as well as the mean yield. The trend of interaction effect on total biomass was moderately differnt.

It is established fact that winter wheat is highly efficient in using moisture and nutrients due to low evaporative demand;

	Seed cotton yield, kg/ha			Stalk yield, kg/ha			Total biomass yield, kg/ha		
	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean
Life saving irrigation, days after planting									
I1:21days	1643	1628	1546	2179	2313	2246	3641	3941	3791
I2: 42 days	1284	1494	1389	2204	2434	2319	3488	3928	3708
T3:I1+ I2	1383	1562	1473	2094	2260	2177	3349	3811	36330
SE (+/-)	27	20	17	2	2	1	27	21	17
CD (P = 0.05)	104	78	66	8	9	3	103	83	65
Spacing /plant density/ planting patternand spacing									
S1:55550plant/ha: close rectangular	1221	1435	1328	2177	2393	2284	3408	3828	3618
S2:37037plants/ha/ Wide rectangular	1336	1551	1444	2137	2271	2208	3480	3822	3651
S3:27,777plants/ ha;Sqauare planting	1532	1698	1615	2157	2343	2250	3689	4030	3859
SE (+/-)	21	11	11	5	2	2	21	12	11
CD (P = 0.05)	63	18	11	16	7	7	63	17	32

Table 1: Seed Cotton, stalk yield and total biomass yield as affected by irrigation, spacing /plant density/ planting pattern. Underline values are maximum and statistically significant.

cultivation of wheat is highly preferred practice. Wheat sown after cotton produced maximum yield of wheat (3786 kg/ha) in treatment plot I_1S_3. The yield of wheat was not statistically significant, as expected. The interaction of I_1S_3 recorded significantly higher yield of cotton (1694 kg/ha) and benefit cost ratio of 1.96. Cotton wheat cropping produced higher wheat yield (3787kg/ha), than wheat after the pearl millet (3416 kg/ha). The cotton in cotton wheat cropping produced highest mean pearl millet equivalent yield (82.70q/ha) than the pearl millet yield in pearl millet wheat system (2394kg//ha). This study produced sufficient substantiation of assured crop by the scientific management.

Figure 2: Cotton crop at maturity and ready for picking up (an example scenario).

Thus, the study substantiated that cultivation of cotton in the third week of April and harvested in last week produced highest yield of seed cotton and improves field condition to produce highest yield of wheat grain and Bhusa. Thus, this cropping pattern performs the best desirable effect of agroecology for bringing sustainable food, fodder and fuel, under the worst come worst hydrologic year in the semiarid tropics. Farmers should be advised to cultivate cotton in rainy season and wheat during the winter season,which is their first automatic preference.

There can be limitation of presowing irrigation and 1st irrigation after 21 days,in some situations. Under such limitation farmers should be advised to raise the cotton seedlings in small shelters near water source and plant the seedling after mosoon rainfall establishes. There is good posssibility of successful yield of cotton. Thus,this cropping pattern will always prove remunerative, andeliminate suicides due to crop loss. Exploratory studies should be conduted at research institutions. This successful cropping pattern will enhance cropping intensity as well as land equivalent ratio (LER).

Prospecting cropping of pearl millet

Several studies were conducted under externally funded National Technology Agricultural Project (NAPT) on moisture conservation NATP -RPPS 10, in district Agra and that at ICAR CSWCRTI, Research Centre Farm Chhalesar, Agra, during drought years of different pattern [4]. These researches provided highly valuable results under real drought and field condition. These results are of great relevance as the experiments produced remarkable yields (Table 2).

S.No	Scientific interventions	Crop yield,q/ha	Crucial factor
Derought year 2001;Early onset and early withdrawal			
1	Farmers practice of broad casting of mixed crops	Crop failed	Moisture stress after tillering
2	Scientific practice of sole cropping, line sowing,weeding and moisture conservation by gurr and plant protection etc, under NATP OFR RPPS 10	20 - 25	Moisture stress at maturity stage
Drought year 2002with late start of monsoon rainfall and early withdrawal			
3	Crops sown in the first or second week of Augustmixed cropping by broad casting	Crops failed	Moisture stress
4	Scientific practice of sole cropping, line sowing,weeding and moisture conservation by gurr and plant protection etc, under NATP OFR RPPS 10 +one supplementary irrigation	22 - 26	Sowing time in 1st week of July got delayed by a month or so
5	Scientific practice of sole cropping, line sowing,weeding and moisture conservation by gurr and plant protection etc at Research Farm Chhalesar, Agra in reclaimed ravine land in terraces.	6 - 8	Class III land
6	Scientific practice of sole cropping by transplantin ot nursery raised seedlings in 1st week of July and transplanted in the second week of August, weeding and moisture conservation by gurr and plant protection etc, +one supplementary irrigation at Research Farm Chhalesar, crop in reclaimed ravines in terraces. But, the soil limitation -Class III	26	Transplanting and supplementary irrigation. compensated delay in sowing, but soil quality limited yield increase.

Table 2: Reamarkable interventions and yield responses during different drought years.

Whereas during the droughts in year 20001 and 2002 pearl millet crops failed on the farmers' fields, the innovative scientific interventions lead to reasonably high yield in both the years. The study enabled knowledge about the crucial factors for acquiring successful cropping in the drought years 2001. Suitable scientific interventions removing the crucial limiting factors produced high yield (Table 2). That reveals that invariably, pearl millet must be sown within 1st week of July. It also displayed that the role of soil health on enhancement of yield during the drought. By utilising this lesson a practice of cultivation was devised.

Figure 3: Scientifically chartered pearl millet crop at farmer's fields during drought of 2001 in Agra district, Uttar Pradesh.

Yield losses due to prolonged foggy winter

Following the drought year, winter season (rabi) cropping was intensively taken up by ground water supported irrigation. An assessment of crop losses due to prolonged winter and foggy, no bright sunshine hour was taken on April 3, 2003 and crop losses were assessed for agriculture, horticulture, forestry and animal husbandry etc. Field visits were conducted by multidisciplinary team, transact walk, feeler assessments and sample measurements and inter action with farmers were made with the farmers in the district, covering stretch of 65 km. The yield losses due to unprecedented drought year the result of the survey provide remarkable feedback, that will be presented in the result part of the study.

Agrohydrologic intervention to reduce calamities of prolonged foggy severe winter

Figure 3 showhows the climatic facors that occurred during the winter in the year 2002, while the rainy season had been a sever drought year. This year was a typical unfaourable situation for Indian Agriculture in the semi arid tropical region. The minimum temperature remined below 5^0C for about 35 days, that harmed winter cropps, The loss in yield wer 30- 50 percent. Mustard suffered almost 50% yield reduction, followed by pulses viz gram and cereal wheat. Horticulture fruit crop viz aonla suffered yield loss of 95 to 60%.

During the assessment survey some bright spots came to notice of the assessment team, which indicate some ways to bring innovative measure in the agrohydrology Table 3. Agroforestryb with ber Zizyphus mauritiana was found to give sustainable production table 3.

S.No.	Cropping practices; -	Rainy season crop, q/ha	Winter season crop wheat,q/ha	Total production, wheat equivalent,q;ha
Drought year 2001: Agrihorticulture				
1	Farmers' practice	12.0	34.0	43.3
2	Sole crop at Researc Farm	20.0	41.5	56.9
3	Agri Horti with ber	16.0	Ber:79 Wheat:38.5	74.0
Drought year2002: Agrihorticulture				
4	Farmers practice	-	30	30
4	Sole crop Research Farm	26.0	32.0	52.0
6	Agri horti with ber	25.6	Ber 78.0 Potato; 200	105
Inter cropping/mixed cropping				
	Yellow mustaedvariety			
7	Grown /sown on border ridges	-	Growing well in April 3 Flowering and pod formation took place after foggy winter	
Mustard potato at Research farm Chhalesar				
8	Potato mustard 3:1	-	Stable net benefit	
Tomato pigeon pea intercropping				
9	Tomato was grown on raised bed at 30 cm and pigeon pea in furrowP. It was a U>P DASP Demonstration	-	This was the only pigeon pea field inflowering and pod formation in entire doundbetteristrict.	
Aonla at Dauki U.P Horti Cultre Departmrnt Nursery				
10	Chakaiya aonla		Chakaiya variety was found in better fruiting than tha Balwat Awnla.	
Home stead dairy				
11	Homestead dairy		Milk ptoduction got reduced to 25-30 of normal level of milk production	

Table 3: Cropping practuces that have saved crop against prolonged foggy winter.

Prices: potato Rs 2/kg,ber Rs 4/kg and wheat Rs 6.5/kg.

Development of innovative agro-hydrology induced agro-ecology

The new cotton wheat cropping pattern brings almost 2.5 times more pearl millet equivalent yield than pearl millet yield. Yield enhancements of wheat after harvest of cotton, under which the cotton field almost rested and restored soil health produced enormous volume of wheat bhusha for animal feed. The new innovative technology created several breakthroughs created in this study. Thus, cotton cultivation during the rainy season and wheat during the winter season is the most suitable cultivation for mitigation of adverse impact on food security. The cotton crop utilizes incidental rainfall in whatever fashion it may occur and produces high yield.

New cultivation practice of direct seeding of pearl millet or transplanting will fulfill the social food preference of the people. Hence, all impact indicators are adequately strengthened. Thus, this study eliminates worry of insecurity of food post occurrence of drought in any nation of the world.

The cotton wheat and pearl millet wheat become set cropping pattern for drought year forecasted by any of weather information releases by the weather agencies. The forecasting conceptual model [5] also enables to know the rainfall event distributions, which enables some deferment of sowing of pearl millet if rainfall events get likely to occur during grain filling and maturity stage that might cause development of pathogenic disease viz black smut. The cropping patterns create good agro-ecology [3]. and impact indicators accumulate (Table 4) to establish good agro-ecology of any nation.

S. No	Agro eco indicating factor	How the new Cotton-Wheat cropping fits in	Level of accomplishment	Final accomplishment
1	Increase in grain yield	Cotton seed yield + high wheat yield	+	
2	Food self sufficiency	High wheat yield and subsequent pearl millet yield	+	
3	Forage availability	Pearl millet fodder and Wheat Bhusa	+	
4	B/C ratio	Cotton	+	
5	System adoptability	Highly Adoptable	+	
6	Erosion level	Cover by cotton and use	+	
7	Diversity of species	Cotton followed by wheat	+	
8	Technical innovation	Most stable and remunerative	++	
9	Tolerance to social and environmental change	Eliminates food and fodder scarcity	+	
10	Independence from external input	All resources at farmers end are utilized	+	
11	Participation	Transplanting induces need of participation	+	

Table 4: Agro ecological results from new agro hydrologic innovative technology for drought mitigation.

+ at level more than one would expect.

New Initiative for drought proofing in agriculture to bring food security

Knowledge acquisition, consultation of crops and cropping practices and sequential steps of field operations have been prescribed and made nitrogen, sulphur, carbon, oxygen endowed and quantum mechanics prudent agro hydrology created. It is experimentally proven that cotton cropping utilizes aberrant weather scanty rainfall, produces under I1-- irrigation 21 days after sowing and plant population 27,777plants/ha planted in square of 60 cm x 60 cm produced yield of cotton which was almost 2.5 times the equivalent yield of pearl millet. The wheat cultivated after the cotton crop also produced high yield (38.37 q/ha). Thus, sufficiency of food and economic returns were achieved, without any worry about rains occurrence either early or late drought, causing operational difficulties.

In spite o this potential result, there will always be desire of the farmers for cultivation of pearl millet to fulfill peoples demand of seasonal use of pearl millet in winter months. The pearl millet can be grown in two sequences, viz if it is good rainfall year, it can be directly seeded within 1st week of July. If the hydrologic year does not permit it, a nursery of pearl millet should be grown in 1st week of July and pearl millet seedlings transplanted in August when rainfall establishes. In this way 36-45 q/ha and 40-47 q/ha pearl millet can be produced on 500 m^2 field size (ie1/20th ha) to get yield 2-2.5q//per family. This pattern of cultivation of assured pearl millet will make farmers free from market price rise. Thus, food security, fodder sufficiency and control of price rise can be created. It requires state governments to extend seed, fertilizer and machine subsidy. Governments have created crop insurance schemes and give compensation when crops fail. For the yield enhancement subsidy will infuse new culture of successful agricul-

ture and make states/other Governments' agriculture very stable, sustainable and assured for all the years.

Technological assurance vs Non-life crop insurance

The yield levels of assured cropping were extracted for cotton and pearl millet to create sound agro-ecology of the regions during the hydro locally drought year or bad weather year. The agro-hydrology has ideal land form, crops and cropping practices soil health rejuvenation, precison planting, weeding, integrated plant protection measures (IPM), ultimate green irrigation, selective harvesting and crop processing.

The crop is assured; hence, there will not be any foreseen loss. These farmers although pay the premium, they will not be benefited by compensation. The likely compensation will be absorbed by the margin loss that will not be justifiable to be paid within the coverage. Further, as there will be no loss, the insurance companies will derive benefits from the innovative agro-hydrology. The insurers have found their efforts to advise farmers take care of risk for their company's advantage. It would have been still better to get advantages from the innovative technologies for creating sustainable agro-ecology. For this, the budget saved against removing subsidy in payment of premium could utilized for subsidizing the seed, fertilizer, machineries and other related operations. The new agro-ecology will be a permanent feature to enable country to come out of mishaps of recurring droughts. In absence of sustainable agroecology, prevalence of insurance by nonlife insurance will get higher and higher when the adverse hydrologic situations will be intense. This will be leading to situation from bad to worst. Under such situation the insurance companies should offer some extra benefit to make insurance attractive to such progressive farmers.

S. No	Established crop yield, q/ha	Yield fixed for insurance, q/ha	Cost as per MSP*	Amount for insurance	Farmers share of premium, 2%	Government subsidy, @ 10% insurance premium+
Cotton in cotton -Wheat cropping system						
1	16.94	17	3860	65628	3210**	3210
Pearl millet equivalent yield						
2	82.7	83	1330	110073	2210	8806
Pearl millet in rainy season						
3	12.0	12	1330	15972	319.4	1277
4	20.0	20	1330	26620	532	2130
5	26.0	26	1330	34606	692	2768

Table 5: Assured crop yield of cotton and pearl millet and insurance premium.

*The minimum support price for the year 2017-18.** For cotton premium 5% of sum assured.

+ the value may change

A new crop insurance scheme 'Pradhan Mantri Fasal Bima Yojana' has been launched by the Government of India. Under this scheme, the premium rates to be paid by farmers are low - 2% of sum insured for all Kharif crops, 1.5% for all Rabi crops and 5% for commercial and horticulture and cotton crops. The insurers charge premium at the market rate. The difference between the premium for insurance chargeable by the insurance companies and the minimum share of farmers is to be subsidized by the Government. This arrangement entails high cost to the Government. The insurers are happy as they collect huge amount in the form of insurance premiums. However, as usual, there will be tendency to keep compensation payment to the minimum. The Government will find no other way to compensate the expenditure, but to find some way to compensate the expenditure. The insurance policy versus scientifically innovative agro hydrologic technologies are in two different pullers to weaken and strengthen the national economy, respectively. The pro-technology governance creates new resource productivity that means a subsidy to promote long term policy for

the nation. The implementation of the insurance scheme by simple IT procedure are always said to be novel policy, but it is in no way beneficial to agro ecology, which can come in big way for drought mitigation. When it comes to the payment of claims on account of crop loss, it will demand standard yield of crop commodity. Thus, system is again reverting back to unscientific management of agriculture. The net result will come in favour of insurance companies and maintain continuous business. The drought hardship cannot be controlled.

Discussion

The experimental studies and their success stories enabled derivation of several lessons of agronomic practices viz, date of sowing of pearl millet under all situations of monsoon rainfall year. If there is no established rainfall, then a nursery should be raised in 1st week of July with assured water source for transplanting of pearl millet by second week of August, when rainfall become certain. The transplanting of pearl millet can be carried out by participatory working to complete labour intensive transplanting work.

Over and above a new cropping pattern of cotton wheat also investigated in the study solves different aspects of good agro ecology. Altieri [3] identified 11 factors of agro-ecology viz increase in grain yield, food self-sufficiency, increase in forage availability, B/C ratio, system adoptability, reduced erosion level, diversity of species, technological innovation, tolerance to social and environmental change, independence of external input and participation. This technology is laced with innovations in every aspect of the requirements for establishing good agro ecology.

Bossio and Gaheb [6] described isolated short lived land and water management technology for degraded lands as case of bright spots. The bright spots are defined as management of sociological and biophysical system in such a way as to yield excellent land and water conservation results. They identified eight impact indicators viz soil quality (SQ), water productivity (WP) low external input (LEI). Integrated pest management (IPM), water cycle (WC), biodiversity (BD) carbon sequestration (CS) and social capital (SC). These impact indicators are equally applicable for the eco-agro-hydrology innovative technology of drought mitigation. These impact indicators reveal high amplitude for the new agro-hydrology arrived at in the present study.

The new cotton wheat cropping pattern bring almost 2.5 times more pearl millet equivalent yield, enhances yield of wheat after almost resting field under cotton and produces enormous volume of whet bhusha for animal feed. The new innovative technology has created several breakthroughs, which have not existed earlier and are newly created in this study. Thus, cotton cultivation during the rainy season and wheat during the winter season is the most suitable for mitigation of adverse impact on food security. New cultivation practice of direct seeding of pearl millet or transplanting will fulfill the social food preference of the people. Hence, all impact indicators are adequately strengthened. Thus, this study eliminates worry of insecurity of food in any nation of the world.

Initiatives need to be taken by the implementer of agriculture programmes and help get relieved from the hard ships. The insurance companies provoke use of IT for simple and smart technology through phones & remote sensing for payment of premiums and early settlement of claims. The Government has also launched crop insurance portal and Mobile app “Crop Insurance” which will help farmers to find out complete details about insurance cover available in their area and to calculate the insurance premium for notified crops. During kharif 2016-17 season, 24 states have already initiated necessary action for implementation in their state. Out of which, 15 states have already completed the biding tendering process for selection of insurance companies.

In this situation innovative agro-technology should also have been called for displaying the scientific measure in contrast with the insurances. The agro hydrologic measures create wealth by using resources of the country for the welfare of people. But insurance companies take advantages of droughts in terms of escalating premiums, adopt very conservative attitude when it comes to payment of compensation to the farmers. The non-life insurance companies have drawn their 50 percent premium from the Fasal Bima Yojna [1]. The advantage of the innovative technology created in the present study will get utilized in reducing crop loss and reduced need of compensation by the insurers for less claims on crop losses. This situation will be getting fatter year after year, benefiting insurance companies and the Government will have to find some means to compensate the budgetary deficits [7-16].

Conclusion

Study recommends cultivation of cotton in last week of April, after harvest of wheat with one irrigation ie 21 days after sowing. Cotton at 60 cm x 60 cm, square planting, accommodating 27,777 plants per ha so as to utilize rainfall in whatever fashion it may occur. It is customary to cultivate wheat after the harvest of cotton in the last week of October. The cotton crop highly rejuvenates soil health. It also recommends to sow pearl millet in the first week of July, invariably, if it is possible, otherwise raise grow pearl millet nursery in the 1st week of July so as to transplant pearl millet in August in atleast 1/20th ha (500 m^2 field size) for harvesting 2-3 q/family pearl millet grain for consumption in winter season. The fodder should be cultivated by sowing pearl millet fodder in separate block. This initiative will help nations get free from worry of bad food security that usually develops post drought. These crops and cropping patterns will be 100 percent risk free during hydrologically drought years. It may not require any insurance and undue payment of insurance premium as these crops and cropping practices are made cent percent risk free.

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