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Research Article

CAUSES FOR CROP LOSS IN SELECTED CEREAL CROPS- AN INSIGHT FROM NSSO DATA

Chandrashekar H[1], Vedamurthy K.B[2] and Rangegowda R[3]

[1]Former Professor of Statistics (Rtd), University of Agricultural Sciences, Bengaluru, 560065, Karnataka, India
[2,3]Department of Dairy Business Management, Dairy Science College, Hebbal, 560024, Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, 585401, Karnataka, India

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A B S T R A C T

In the present study we have attempted to address three major issues for crop loss as perceived by agricultural households using the data available from situation assessment of agricultural households and land and holdings of households in rural India 2019, NSSO 77th round report. Three major cereal crops viz., paddy, wheat and maize crops are selected for the study. The issues addressed are, identify major factors responsible for crop loss, to what extent farmers are satisfied about the market price they receive in local markets and APMCs. Whether the farmers are utilising the some of the instruments like making use of MSP to sell their crop and crop insurance to insulate them from production risk. Majority of the agricultural households across all the states have expressed concern that inadequate rainfall/ drought and diseases and insect and animal are the major cause for the crop loss. Majority of agricultural households continue to depend on local markets and APMCs to sell their produce and not satisfied with the price they receive for their produce. Though there has been awareness regarding MSP but very few farmers are taking advantage of the same. Programmes like, rejuvenation of small tanks / water bodies along with water efficient method of irrigation like drip / sprinkler irrigation system will ensure more crop for a drop and insulate farmers from deficient rain fall and drought situations. Watershed development programme shall be taken up in dry land areas to conserve water and ensure its judicious utilisation. Agro-service centre should be put in place at panchayat level for effective and quick dissemination of not only weather situation but also related farming practices to be taken up by farmers such as protecting crop from pest and diseases etc. that enhances farmers' income. Farmers shall be encouraged to use e-NAM facilities to sale their produce. Insurance agencies have to put more efforts to motivate farmers to go for crop insurance and instil confidence among farmers regarding proper assessment of crop damage and timely settlement of the claims.

INTRODUCTION

Risk faced by the Indian agriculture has been broadly classified as, production risk, market risk and institutional risk. Constraints posed by these risks make farmers to realise sub-optimal output. The production risk faced by the farmers can be categorized based on weather conditions, pre-sowing, sowing and post-sowing seasons. Postponement of monsoon or delayed occurrence of rains influence farmers' decision regarding sowing dates thereby choice of crops themselves. On the other hand, during sowing season, either heavy rains or occurrence of intermittent dry spells will considerably vary the crop yields. Besides outbreak of pest and diseases make an impact on crop yields. During post-sowing or during harvest seasons, variation in weather and climatic conditions make an impact on harvesting process thereby influencing crop yields. In respect of market risk, uncertainty about the availability of inputs and uncertainty about the output prices push them into sever crop loss. Regarding institutional risk, policy intervention by government like announcing of Minimum Support Price (MSP) to crops, availability of subsidies and certain decisions import/ export of crops also make impact on farmers' income.

The situation assessment of agricultural households and land and holdings of households in rural India 2019, NSSO 77th round, ministry of statistics and programme implementation has documented the constraints faced by the farmers under all three categories of risks mentioned above. Under production constraints, the data collected by the situational assessment survey comprises of crop loss experienced by the rural households due to, inadequate rainfall/drought, disease/insect / animals, flood, other natural causes and others. Similarly, on market risks, survey has documented the sales of crops by farmers to different agencies, level of satisfaction of sale of outcome, farmers having awareness about MSP for selected crops and percentage of output sold under MSP. In regard to institutional risks, the survey documents, percentage of

Corresponding author:* **Chandrashekar H
Former Professor of Statistics (Rtd), University of Agricultural Sciences, Bengaluru, 560065, Karnataka, India

household insuring crop. The data has been documented across different states. It is worthwhile examine how far farmers have responded to different risks across states, whether the responses are different across states based on the developmental infrastructure created by the states like, adequate irrigation facilities, good market yards, development of cold chains, custom hiring services and procurement operations for crops for which MSP has been announced by union government. The study has restricted itself to three major cereal crops, paddy, wheat and maize crops.

The present study is an attempt to capture the farmers' response on selected indicators that represent three categories of risks mentioned above. The specific objectives of the study are as follows;

Objectives of the study

1. Examine the reasons for crop loss by Agricultural households in India across states.
2. Examine the pattern of sales across agencies and disposal of crop by level of satisfaction of sales of outcome across states.
3. Examine the awareness about Minimum Support Price among rural households and extent of crop insurance done by the rural households across states.

MATERIAL AND METHODS

The data required for the present study was collated from the NSSO report, situation assessment of agricultural households and land and holdings of households in rural India 2019, NSS 77th round. To keep the analysis simple, tabular analysis is employed. The key indicators representing production, marketing and institutional risks was collected from NSSO 77th round report across major states. In respect of production risks, we have attempted to collect data on three crops namely, paddy, wheat and maize crops since these three crops are the major cereal grown across all the states. The NSS 77th round documents reasons for crop loss experienced by the agricultural households, they are, inadequate rainfall / drought, disease/insect/animals, flood, other natural causes, and others. Since more than 90% of agricultural households have reported that inadequate rainfall/drought and disease/ insect/animals are the causes for crop loss, we have considered these two indicators to assess production loss or risk. In order to assess the market situation, agricultural households reporting disposal of major selected crops by agency have been collected across states. Besides we have also collected data on sale of crop by level of satisfaction of sale outcome especially with regard to sale of produce lower than the market price. In regard measuring institutional risks, the data on awareness about MSP announced by the CACP by the agricultural households and extent of households who have insured their crops was collected across the states.

RESULTS AND DISCUSSION

Production Risks

As mentioned in the method & material section we have selected three crops, namely, paddy, wheat and maize crops for detailed analysis about the causes for crop loss experienced by the rural households. Paddy and maize crop are predominantly grown in Kharif season while wheat crop is mainly grown in Rabi season. Paddy or rice is grown in 43.86 million hectares under varied soil and climatic conditions. Rice growing areas of the country are broadly classified into five regions. North-Eastern region comprising of Assam and north-eastern states that receive heavy rainfall and rice is grown under rain fed conditions. Eastern region comprising of Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Eastern Uttar Pradesh and West Bengal that also receive heavy rain fall, crop is mainly grown under rain fed conditions. Single crop of rice is grown in Northern region comprising of states, Haryana, Punjab, Western Uttar Pradesh, Uttarakhand, Himachal Pradesh and Jammu & Kashmir, where it experience low temperature. Gujarat, Maharashtra and Rajasthan that falls under Western region rice is grown under rain fed conditions. Southern region mainly comprising of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu rice is grown under irrigated conditions. It may be further noted that rice, wheat and sugarcane which occupy 41% of the gross cropped area consume more than 80% irrigation water (Mihir Shah, *et.al*, 2021).

Keeping this background in view, we shall begin our analysis with reference to paddy (rice) crop by glancing at Table-1. In 70% of the states, that is, in 14 out of 20 states considered for the analysis, the major cause for the crop loss in paddy crop was inadequate rainfall/ drought. Occurrence of floods are the major cause for crop loss in respect of Assam and Kerala states. Field survey undertaken in Haryana state indicate that there is tendency among farmers to use input more than optimum level especially in the case of water use for irrigation. Though the optimum number of irrigation recommended for paddy crop is 15-20, it is found that the actual number of irrigation provided in respect of electric tube well, diesel pump sets and other sources were 46,37 and 40 respectively(Sucha Singh Gill, Kulwant Singh Nehra, 2018). Next to natural calamities, diseases and pests are the other major factor that influence crop loss in rice cultivation. Bacterial leaf blight and blast are the major disease causing maximum yield loss of 26% of the average farm level yield. In respect of insect pests, white backed plant hopper causes major crop loss in rice cultivation incurring a loss of nearly 9% of total average yield (Roy.B.C and K.K.Datta, 2000). In southern region, stem borer followed by brown plant hopper, leaf folder and thrips are the major loss causing pests. Thus it may be inferred that situation assessment survey under taken by NSSO has rightly identified the constraints responsible for crop losses in rice cultivation.

Next to rice, wheat is the second most important cereal crop in India. Wheat is grown mainly in rabi season, data has been collected during the second visit, i.e from Jan-2019 to June-2019. Wheat crop is grown in six diverse agro-climatic zone in India.

Table 1 Percentage of Agricultural Households Experiencing crop loss by causes

State	Paddy		Wheat		Maize	
	Inadequate rainfall/ Drought	Disease/ Insect/ Animal	Inadequate rainfall/ Drought	Disease/ Insect/ Animal	Inadequate rainfall/ Drought	Disease/ Insect/ Animal
Andhra Pradesh	47.5	16.0	-	-	-	-
Assam	38.6	21.8	-	-	-	-
Bihar	84.6	3.5	68.0	16.0	51.1	0.3
Chhattisgarh	92.4	7.0	76.4	21.5	99.4	0.2
Gujarat	24.1	52.6	6.3	59.5	29.6	54.1
Haryana	41.9	22.2	63.5	14.2	-	-
Himachal Pradesh	-	59.8	5.4	76.1	4.6	84.9
Jammu & Kashmir	44.6	11.3	52.2	31.2	45.1	30.0
Jharkhand	99.1	0.6	71.0	13.7	84.0	6.8
Karnataka	49.8	31.7	-	-	90.9	0.4
Kerala	12.4	37.4	-	-	-	-
Madhya Pradesh	72.4	20.3	35.2	25.1	69.7	9.8
Maharashtra	88.5	6.6	74.1	18.7	-	-
Odisha	34.7	28.7	-	-	-	-

Punjab	45.8	20.7	41.2	-	-	-
Rajasthan	-	-	53.4	29.8	90.2	8.0
Tamil Nadu	76.2	1.9	-	-	98.1	1.5
Telangana	44.7	45.6	-	-	83.8	11.2
Uttarakhand	11.5	78.2	20.3	73.7	-	-
Uttara Pradesh	38.2	42.7	12.8	79.9	32.3	42.8
West Bengal	44.0	16.0	-	-	27.5	38.2
All India	57.2	23.3	33.6	52.0	61.5	24.3

Note: Data for paddy and Maize is collected from NSSO 77th round Visit-1: July-2018 to DEC 2018.
Data for Wheat crop is collected for the period Jan-2019 to June-2019.

Out of eleven states consideredfor the analysis for which data on crop loss in wheat was available in the assessment report, four states namely, Chhattisgarh, Maharashtra, Jharkhand, and Haryana, agricultural households have opined that more than 60% of crop loss are due to inadequate rainfall / drought. In Punjab and Haryana the major source of irrigation has shifted from canal water to ground water resources. The power subsidies extended to farmers constitute large part of the state budgets of Punjab and Haryana. Obviously this led to depletion of groundwater resources leading to scarcity of water especially for wheat crop grown in rabi season. The crop loss due insect and pests are relatively less in Punjab and Haryana, while it is considerable in states like Uttara Pradesh, Uttarakhand and Himachal Pradesh. The situational assessment survey adequately captures the existing scenario of crop loss in wheat which more or less corroborates with other studies (Wheat cultivation in India, pocket guide, 2014).

The other crop considered for the analysis is maize crop. Andhra Pradesh, Karnataka, Rajasthan, and Maharashtra nearly contribute more than 55% of maize production in India. Though the Andhra Pradesh contribute nearly 20% of maize production in India, the state has not found place in assessing crop loss, instead Telangana state which was part of erstwhile Andhra Pradesh state has been included for the crop loss assessment exercise. Generally, maize is cultivated during monsoon season, thus 80% of the crop is cultivated under rain fed conditions. Out of 13 states considered for the analysis, six states namely, Chhattisgarh, Jharkhand, Karnataka, Rajasthan, Tamil Nadu and Telangana states more than 80 per cent of the households indicate that inadequate rainfall / drought are the reason for crop loss under maize crop. Except in Himachal Pradesh where households have indicated that 85% of crop loss is due to disease and insects all other states have less incidence of crop loss due to disease and insects. Private players are playing significant role in production of high quality hybrid seeds which ensure resistance to disease and pests. Report also highlight the fact that 71% of households use purchased seeds which are of good quality. The situational assessment survey aptly points out that the seed sector has played a vital role in evolving drought resistant hybrids to reduce crop loss in maize cultivation.

Market Risks

Paddy is one of the most important crops that has been brought under price support through announcing MSP by Government of India. Elaborate arrangements are made at least in a fewstates for procurement of paddy crop from the point of meeting the demand for public distribution system and also from the point of view of ensuring food security. Interestingly the data documented by NSSO 77th round farmers' assessment survey indicate that more than two-thirds of farmers' sell their produce to local markets. At all India, only seven per cent of the produce is sold through government agencies which mainly participate in procurement operations. APMCs have very negligible role in facilitating farmers selling their produce. But in Kerala nearly two-third of sales of paddy is through government agencies particularly due to effective state intervention. Except in a few states like Chhattisgarh, Punjab and Telangana, government intervention is highly dismal in other states. NSSO 77th round report documents the non-satisfaction of sale out come by rural households due to several factors. Among them the most significant being the non-satisfaction of sale of outcome due to receiving lower than the market price has been presented in last column of Table-2 in respect of paddy crop. At all India, little more than one-third of households have expressed their dissatisfaction due to receiving lower than the existing market price. Proportion is considerably high in West Bengal, Bihar, Jammu &Kashmir, Odisha, Jharkhand and Tamil Nadu states. Even other states, level of dissatisfaction among farmers' ranges from 10 to 35 per cent. Thus in most of the states, farmers are incurring loss due to price distortion despite the fact that MSP for paddy being in operation.

Table 2 Agricultural Households reporting sale of Paddy* by agencies and reporting non-satisfaction of sale outcome due to lower than market price (in %)

States	Reporting sales by agency			Reporting non-satisfaction of sale outcome
	Local Market	APMC Market	Government agencies.	Lower than market price
Andhra Pradesh	80.5	0.3	5.4	30.6
Assam	91.6	-	-	25.7
Bihar	89.8	0.9	1.0	51.4
Chhattisgarh	26.2	1.4	27.2	9.3
Gujarat	76.1	1.0	-	33.1
Haryana	48.1	35.5	8.0	17.5
Himachal Pradesh	45.8	33.8	-	20.4
Jammu & Kashmir	83.9	-	1.0	50.2
Jharkhand	97.7	0.2	0.6	42.9
Karnataka	92.0	4.4	-	35.7
Kerala	19.8	-	66.6	3.7
Madhya Pradesh	65.1	9.0	6.9	35.0
Maharashtra	67.9	3.0	1.9	34.0
Odisha	69.2	0.2	9.1	49.1
Punjab	52.2	11.0	23.9	17.7
Tamil Nadu	77.9	3.4	1.9	42.4
Telangana	39.0	12.8	34.3	26.0
Uttarakhand	74.6	5.8	7.5	26.1
Uttara Pradesh	88.3	1.0	2.7	35.9
West Bengal	85.5	1.0	3.9	55.8
All India	75.1	3.2	7.3	37.1

- July-2018 to Dec-2018 , during visit -1

In respect of wheat crop, agricultural households reporting sale by different agency and non-satisfaction of sale outcome due to lower market price is presented in Table-3. During 2021, the government's procurement of wheat was 43.3 million tonnes. Despite of enormous quantity of wheat being procured by the government, it is disheartening to note that 87 per cent of rural households depend on local markets and APMCs to sell their produce. Dependence on APMC is negligible as only six percent of them have only indicated that they have sold through APMCs. Dependence on local market is very high in almost all the states. Procurement process is restricted to only Punjab and Haryana states. Coming to non-satisfaction of sale outcome due to receiving lower than market price, we may note that except Chhattisgarh, Haryana, and Punjab where per cent of non-satisfaction reported by agricultural households are 15.8%,18.0%, and 8.9 % respectively, in all other states extent of non-satisfaction due to receiving lower price vary from 23% to 47%.

Wheat procurement has benefited 17.50 lakh farmers and paddy procurement has benefitted 117 lakh farmers

(krishijagran.com). As per the NSSO 77th round situational assessment of agricultural household survey there are 172.4 million rural households in India, of which 93.09 million are agricultural households accounting for 54% of total rural households in India. Considering only agricultural households, procurement operation of both wheat and paddy has benefited only 14% of agricultural households. Thus 86% of agricultural households have to depend on either local market or APMCs to sell their produce.

Table 3 Agricultural Households reporting sale of Wheat **by agencies and reporting non-satisfaction of sale outcome due to lower than market price (in %)

States	Reporting sales by agency			Reporting non-satisfaction of sale outcome
	Local Market	APMC Market	Government agencies.	Lower than market price
Bihar	86.8	0.3	-	41.6
Chhattisgarh	89.8	-	6.8	15.8
Gujarat	76.2	16.7	-	25.7
Haryana	48.8	19.4	21.7	18.0
Himachal Pradesh	84.6	1.2	-	46.8
Jammu & Kashmir	81.6	-	0.1	31.0
Jharkhand	99.3	-	-	35.8
Madhya Pradesh	79.0	8.0	2.5	36.1
Maharashtra	71.5	8.9	4.9	23.2
Punjab	51.5	10.3	31.0	8.9
Rajasthan	75.1	13.1	3.5	32.1
Uttarakhand	77.3	14.4	1.4	30.6
Uttara Pradesh	89.9	1.1	1.8	24.9
All India	81.0	5.7	4.0	30.5

** Jan-2019 to June-2019, during Visit-2

Sales pattern of maize crop as indicated by agricultural households are presented in Table-4. Local market dominate over other agencies in respect of sale of maize. At all India level, 88% of agricultural households depend on local market and role of APMC is negligible. Similar pattern is being exhibited by almost all the states. Except in Telangana and to some extent in Madhya Pradesh there is no procurement operations in any other states in the country. Nearly one-third of agricultural households are unsatisfied due to the lower market price they receive. In many states, proportion of agricultural households who were unsatisfied due to lower than market price they receive are considerably high , exception being Gujarat state where only 1.5% of agricultural households are unsatisfied about market price they receive.

Table 4 Agricultural Households reporting sale of Maize*** by agencies and reporting non-satisfaction of sale outcome due to lower than market price (in %)

States	Reporting sales by agency			Reporting non-satisfaction of sale outcome.
	Local Market	APMC Market	Government agencies.	Lower than market price
Bihar	91.5	0.4	-	31.3
Chhattisgarh	99.8	-	-	-
Gujarat	96.5	2.4	-	1.5
Himachal Pradesh	90.0	-	-	34.5
Jammu & Kashmir	94.4	-	-	44.7
Jharkhand	100.0	-	-	21.1
Karnataka	79.2	8.4	-	31.6
Madhya Pradesh	91.6	2.1	4.8	41.4
Rajasthan	78.8	18.2	-	46.1
Tamil Nadu	87.4	0.9	-	-
Telangana	69.2	4.0	15.4	41.5
Uttara Pradesh	98.7	-	-	41.9
West Bengal	86.2	-	-	32.1
All India	87.5	5.0	1.0	34.6

*** July-2018 to Dec-2018, during visit -1

Policy Interventions

The Commission for Agricultural Costs and Prices (CACP), Government of India fixes Minimum Support Price (MSP) to 23 crops based on detailed data collected on cost of production and other factors like demand and supply, market price trends, etc., of the crops. CACP considers A2+FL that include cost of all expenses in cash and kind on account of hired labour including human, bullock, machine, seed, insecticide, pesticide, manure, fertilizer, irrigation charges and misc. expenses and imputed cost on family labour while arriving at MSP to the crops. On the other hand farmers are demanding considering cost C2 while arriving at MSP, where C2 is a more comprehensive cost that factors in rentals and interest forgone on owned land and fixed capital assets, on top of A2+FL. Besides farmers are also demanding 1.5-times MSP formula - originally recommended by the National Commission for Farmers headed by agricultural scientist M S Swaminathan (Chandrashekar. H, *et.al,* 2022).

The situation assessment of agricultural households, 77th NSSO report has collected data on indicators that provides us the clue that how far the policy intervention initiated by the government has reached the farmers and to what extent farmers are benefited out the intervention. We have only considered three indicators to enable us understand the effectiveness of the policy interventions. They are, extent of awareness about MSP among agricultural households, extent of output sold at MSP and percentage of agricultural households who insured their crop. We have selected paddy, wheat and maize crop for the analysis. The information collated from situation assessment survey is presented in Table-5.

It may be noted from the Table-5 that there has been a wide variation even in respect of awarenessabout the MSP being announced by the union government prior to the sowing season among the rural households. Awareness regarding MSP is as low as 3.2% in respect of maize crop in Jharkhand state to as high as 84.4% in Kerala state in case of paddy crop. Coefficient of variation calculated for the percent of agricultural households who were aware of MSP across state works out to be, 52%, 59% and 62% for paddy, wheat and maize crops respectively, indicating high variation in respect of awareness of MSP across states.

The other policy based instrument to insulate farmers from risk is crop insurance. Extent of households who have insured their crop in respect of paddy is only 8%, and in case of wheat and maize crop it is 7% and 6% respectively. Highest number of households who are brought under crop insurance is respect of paddy crop in Haryana state. Even the paddy and wheat crop do not attract the attention of farmers to insure their crops. In many of the states there appear to be no efforts to promote crop insurance. There is an urgent need to put more concerted efforts by extension wing of agriculture department in particular and rural development departments in general in creating awareness about MSP and as well motivate farmers to go for crop insurance as climate change adaption strategy.

Table 5 Agricultural Households Aware of MSP (in %), percent of output sold at MSP and percent of agriculture households insuring the crop.

State	Paddy		Wheat		Maize		Agri. Households Insuring Crop		
	Aware of MSP	% of output sold at MSP	Aware of MSP	% of output sold at MSP	Aware of MSP	% of output sold at MSP	Paddy	Wheat	Maize
Andhra Pradesh	45.7	18.0	-	-	-	-	18.3	-	-
Assam	10.5	-	-	-	-	-	0.1	-	-
Bihar	31.6	5.3	24.9	3.1	23.6	27.7	2.5	1.4	1.1
Chhattisgarh	81.2	84.7	18.7	0.8	13.9	-	33.5	23.1	0.5
Gujarat	27.5	5.6	28.8	6.7	11.9	0.6	0.9	2.9	-
Haryana	32.8	21.3	63.1	32.9	-	-	41.4	32.1	-
Himachal Pradesh	66.2	10.6	21.2	32.5	21.2	4.5	1.4	1.8	1.5
Jammu & Kashmir	13.7	1.3	1.8	-	10.4	-	-	0.2	-
Jharkhand	32.9	2.0	8.9	-	3.2	-	6.5	1.2	1.5
Karnataka	9.3	1.3	-	-	21.7	3.5	3.7	-	10.2
Kerala	84.4	82.8	-	-	-	-	25.2	-	-
Madhya Pradesh	55.9	34.0	45.0	37.8	15.7	8.1	9.1	15.3	8.1
Maharashtra	24.4	4.8	27.5	1.8	-	-	9.9	15.4	-
Odisha	65.5	34.1	-	-	-	-	12.9	-	-
Punjab	52.1	30.4	65.5	31.8	-	-	1.1	0.3	-
Rajasthan	19.7	0.9	35.2	7.9	19.0	0.7	-	18.5	7.5
Tamil Nadu	32.4	1.7	-	-	8.4	-	26.0	-	10.0
Telangana	54.9	33.4	-	-	42.8	15.7	25.3	-	16.0
Uttarakhand	45.4	22.3	57.5	4.8	-	-	5.4	8.6	-
Uttara Pradesh	31.6	7.6	36.7	18.1	38.2	2.6	2.6	1.6	2.3
West Bengal	47.1	13.5	-	-	9.8	-	6.0	-	0.3
All India	40.7	23.7	37.1	20.8	21.3	5.8	8.3	6.8	5.6

Note: Data for paddy and Maize is collected from NSSO 77th round Visit-1: July-2018 to DEC 2018. Data for Wheat crop is collected for the period Jan-2019 to June-2019.

CONCLUSION

In the present study we have attempted to address three issues using the data available from situation assessment of agricultural households and land and holdings of households in rural India 2019, NSSO 77th round report. The study focuses on three major cereal crops, paddy, wheat and maize crops. The issues that are addressed, as per situation assessment report, what are the major factors responsible for crop loss perceived by agricultural households.To what extent farmers are satisfied about the market price they receive in local markets and APMCs. Whether the farmers are utilising the some of the instruments like making use of MSP to sell their crop and crop insurance to insulate them from production risk.

Majority of the agricultural households across all the states have expressed concern that inadequate rainfall/ drought and diseases and insect and animal are the major cause for the crop loss. It is essential address these issues to reduce crop losses. Droughts or floods that last a few months can be highly damaging but when it last for decades the effects can be devastating or even irreversible (Conway, 2008). The construction of major dams for irrigation purposes face many hurdles either by environmental scientists or due to inter-state disputes, therefore translating them into reality may not be feasible in near future. The rejuvenation of small tanks / water bodies may be the next best option to expand area under irrigation (Ashok Gulati, *et.al*, 2020). Such programmes should be supplemented by adopting water efficient method of irrigation like drip / sprinkler irrigation system that ensure more crop for a drop. Watershed development programme shall be taken up in dry land areas to conserve water and ensure its judicious utilisation. Implementation of watershed development programme on scientific footing will enable to draw water budgets for each of the micro or sub-watersheds so as to facilitate in conserving water by taking up appropriate vegetative, mechanical and agronomic measures for *in-situ* conservation and as well to store the surplus runoffs. Besides, participatory groundwater management have to be supported and guided for efficient use of water resources.

The Indian Meteorological Department (IMD) are issuing short, medium and long range weather forecasts. IMD has been operating the District-level Agrometeorological Advisory Service (DAAS) since 2008. Presently Agromet Services are implemented on experiment basis at about 125 locations in India. For instance Meghdooth – a mobile App to access the location specific weather based agro-advisories pan India was launched as join initiative of the IMD, Indian Institute of Tropical Meteorology (IITM), Indian Council of Agricultural Research (ICAR), and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).Meghdoot has received a favourable response. In order upscale this model it is necessary to involve private Sector and start-upsto make the programme more effective. Such agro-service centre should be put in place at panchayat level for effective and quick dissemination of not only weather situation but also related farming practices to be taken up by farmers such as protecting crop from pest and diseases etc. that enhances farmers' income.

Information and Communication Technology (ICT) can play big role in providing information on market intelligence at grassroots. FPOs can also take up the role of aggregators on specific commodities to avoid farmers from distress sale and establish cold storage facilities on co-operative basis. Such measures will go a long way in ensuring that farmers at least to get remunerative price for their produce. Presently there are only 1.73 crore farmer stakeholders on e-NAM portal. This constitutes only 18% per cent of agricultural households as reported by the situational assessment survey. The researchers have highlighted that e-NAM suffer from three major bottle necks, time cost of transactions, quality assessment challenges and transportation logistics (Ashok Gulati, *et.al*, 2020). These problems have to be addressed on war footing to build confidence among farmers and ensure better participation from them in market transactions. The participation of farmers in e-NAM transactions will also educate them about prevailing price situation in the market and thereby empower them to demand MSP to their produce.

Despite the concerted efforts made by both by Union and State governments, farmers opting to take up crop insurance appear to be on low priority. Farmers are supposed to pay only 2% of sum insured or actuarial rate, whichever is less for cereals and oil seed crops and 5% for annual commercial or annual horticulture crops. PMFBY covers almost all type of risks faced by the farmers. The coverage of PMFBY is better compared to previous crop insurance scheme. As per 77th NSSO report, the agricultural households who are not insuring their crop as they are not interested, range from 17.4% in soybean crop to 26.3% in respect of cotton crop. The percentage households who are not interested in insuring crop for other crops fall between minimum and maximum range mentioned above. Therefore, insurance agencies have to put more efforts in educating the importance of crop insurance in distress conditions and as well motivate them to insure their crops. Besides insurance agencies should aim at a proper assessment of crop damage and timely settlement of the claims.

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