Effectiveness of Mobile Application-based Agromet Advisory Service: Case Study in Telangana, India

Arun Bhagat, Madhav Gholkar, Yogesh Shinde, Nitin Kumbhar and Prithviraj Gaikwad
Senior Researchers, WOTR Centre for Resilience Studies (W-CReS),
Watershed Organisation Trust (WOTR), Pune (India)
Correspondence: **arun.bhagat@wotr.org.in**

Abstract:

In India, climatic factors are changing rapidly, and climate-induced extreme events have increased over the last two decades. Consequently, India is facing a double challenge of sustaining rapid economic growth while combating the threat of climate change, especially regarding its impacts on land, water, and agriculture. To adapt farmers to the changes, the government and other external agencies provide support like crop insurance, subsidies, loans free of interest/lowest rate, and agro-advisories. However, the adaptability is not that high. It means considerable knowledge gaps exist in understanding climate vulnerability, socio-economic impacts, and suitable ways to build resilience. Therefore, through farmers' feedback, the study will assess the effectiveness and improve weather-based location and crop-specific climate-resilient advisories. Advisories were disseminated via mobile application (FarmPrecise app) for the Kharif and Rabi seasons of the year 2020-21 for the paddy crop of the Narayanpet district of Telangana. Results indicate that weather-based climate resilient agriculture (CRA) advisories help to build the resilience of the farming community to climate change, and mobile application (FarmPrecise app) is an effective way of their dissemination. Farmers can reduce the input cost and increase the net profit for the crops. However, farmers' feedback revealed that community-level capacity building is required to increase the adoption of weather-based CRA advisories and communicating advisories in colloquial language will have a greater uptake.

Keywords: Climate Change, Climate Resilient Agriculture (CRA) advisories, Mobile Application, Effectiveness, and Paddy

Introduction:

In the last 30 years, the damage caused by climate change in India has doubled and is increasing daily. The biggest damage to agriculture and its adverse effects must be considered very seriously (ACT, 2018; Jogesh and Paul, 2020). Additionally, with the advent of the green revolution, Indian farming has become increasingly dependent on external inputs, most of which are synthetic and chemical products. Excessive use of synthetic fertilisers and agrochemicals for plant nutrition and protection measures increases the cost of cultivation. It degrades the natural resource base of soil and water (Singh et al., 2019). Given the multidimensional impacts of climate change, climate variability, and faulty agricultural practices, considerable knowledge gaps exist in understanding climate vulnerability, sustainable agriculture practices, socio-economic impacts, and suitable ways to build resilience (Birkmann et al., 2012). This view is strongly underscored by both the IPCC and India's Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), which recommended integrated research on operational strategies and approaches for adaptation of region and sector-specific policy interventions that build resilience and adaptive capacities of communities (Raghunandan, 2020). Reducing the impacts of changing climate on agriculture will require efforts in generating granular climate data, integrating those in informing farming decisions, improving the quality of inputs, enhancing knowledge on better cultivation practices, and adopting better management practices for resource conservation (ISC, 2021). In this view, farmers need a dynamic decision support system that is tailored to their specific farms and provides them weather-responsive advisories across key aspects of agricultural operations. This will help them mitigate weather-induced risks, reduce losses and costs of production, increase productivity and improve incomes (Lobo et al., 2017).

In this regard, Watershed Organisation Trust (WOTR) has developed "FarmPrecise"- an android-based mobile application (app) that provides location and crop-specific weather-based climate resilient agriculture (CRA) advisories on up-to-date farming techniques, fertilizer and nutrient management, integrated pest, and disease management, irrigation water management, and market prices of different crops in nearby markets at a local scale (Bhagat and Gholkar, 2021). Currently, the FarmPrecise app is available for free. It can be downloaded from the “Google Play Store,” which provides advisories to farmers in English, Hindi, Marathi, and Telugu languages, and soon it will be available in other Indian languages. More than 50,000 farmers have downloaded this app (WOTR, 2022). The farmer's feedback has shown that the FarmPrecise app is a boon for profitable farming (Joshi, 2020). Still, there is a great need to develop policy interventions/strategies to improve weather-based CRA advisories into actionable information for farmers to build resilience and adaptive capacities. In this view, to assess the effectiveness and ground feedback on weather-based CRA advisories, there is a need to study the status of the adoption of advisories, their usefulness, improvements needed in advisories, and any modification required in the design of the media of dissemination (FarmPrecise app). Therefore, a study was planned to improve CRA through farmers' feedback into agromet advisories disseminated through the FarmPrecise app.

Material and Methods:

This section presents the study area, design, sampling method, and data collection.

Study Area:

Telangana state is emerging as a key rice-producing state in the country. Also, Telangana called the rice bowl of South India, which grows rice on about 44 lakh acres, has seen its share of the national rice production improve considerably from 29 lakh tonnes recorded in 2015-16 increased by four times to 1.3 crore tonnes in 2019-20 (RBI, 2021). Narayanpet is one of the major rice-producing districts of Telangana state (Sharma and Raju, 2016), and

WOTR is actively engaged in the Narayanpet district through its various project activities. Therefore, for the study, 100 farmers from five villages of Narayanpet block of Telangana state were selected who have been using the FarmPrecise App for paddy. Both qualitative and quantitative data are collected for both the seasons (Kharif and Rabi) of 2020-21. The location map of the study district is shown in Figure 1.

Study Design: Experimental Design, Sampling and Data Collection

As depicted in Figure 2, we designed the trial to assess the farmer's feedback to understand the adoption and appropriateness of agromet advisories disseminated through the app (FarmPrecise). The unit of analysis is an individual farmer. The major crop/most grown crop was preferred for the data collection in the selected villages of the Narayanpet district of Telangana. A questionnaire-based tool was designed in Telugu and English to collect the data and then converted it into Open Data Kit (ODK) format so that it can be assessed online and digital data collection is possible using a mobile or a tab. The sample size was determined at a 95% confidence level and a 10% confidence interval. So, 100 farmers equally divided into study villages who are recipients of FarmPrecise advisories were interviewed to collect feedback on the e-agreement advisory service. The survey team was trained to collect data using the ODK application before the data was collected. The data collection was divided into three stages during the cropping cycle- the crop's early, mid, and end/harvesting stages. The survey team was closely monitored during the data collection process, and required inputs and clarification were given to them to avoid gaps and errors in the data.

Figure 1 Study area- Narayanpet district on the map of Telangana

Village Sample Selection	**Study Site: Telangana** District: Narayanpet Villages: Laxmipur, Ammireddypalle, Perapalla, Appireddypalle, and Lingampalli	**Jan-May 2020**
	Sampling frame of Villages: All 05 villages have been receiving agromet advisories disseminated through the FarmPrecise app	
	A sampling of Villages: Simple random sampling, 05 villages (20 farmers/village/ season) have been using agromet advisories for paddy	
Data Collection	**Face to face interviews: Kharif Season 2020-21** The first round of face to face interviews Interviewed 100 farmers and collected data for paddy (Kharif)	**June-December 2020**
	Face to face interviews: Rabi Season 2020-21 The second round of face to face interviews Interviewed 100 farmers and collected data for paddy (Rabi)	**October-May 2021**
Analysis	**Data Analysis:** Status of adoption, Farmer's feedbacks on agromet advisories for paddy	**June-October 2021**

Figure 2 Study Design

Results and Discussion:

Present Status of Farmer's Adoption of Weather-based CRA Advisories:

Table 1 revealed the status of farmers' adoption (%) of weather-based CRA advisories disseminated through the FarmPrecise app for paddy during the Kharif and Rabi seasons of 2020-21. The average farmer's adoption of advisories of cultural practices is highest (about 85%), followed by advisories of daily weather information and weather alerts (about 83%), and lowest for crop-specific advisories (about 25%). Also, the average farmer's adoption of Integrated Nutrient Management (INM) advisories is about 63%, and for Integrated Pest Management (IPM) is about 40%.

Table 1 Status of Farmers's adoption of Weather-based CRA advisories

Weather-based location and crop-specific climate-resilient advisories		**Adoption (%)**
Advisories of Cultural	Advisory of puddling	92
	Advisory of crop geometry	91

Practices:	Advisory of weeding	72
	Gap filling required in the field	6
	Re-sowing required in the field	4
Advisories of Integrated Nutrient Management:	Advisory to apply organic manures (FYM/ Vermicompost/ Compost) and green manuring	61
	Advisory of Amrutpani and Jeevamruit application	79
	Advisory of Vermi-wash spraying	22
	Advisory of the recommended dose of chemical fertilizer	90
	Advisory of split-dose application	62
	Used the fertiliser calculator tool of the FarmPrecise app	32
	Saved cost on fertilisers by using fertiliser calculator tool	18
Advisories on Integrated Pest Management:	Advisory on seed treatment	98
	Advisory of trap crop	11
	Advisory of pheromone trap	59
	Advisory of the light trap	13
	Advisory of bio-pesticides (Dashparni ark/NSKE/Neemark)	12
	Advisory of chemical pesticides to control the pest/disease infestation	45
Advisories of Daily Weather and Weather Alerts:	Weather alerts (Heavy rainfall/hail storm/pest-disease attacks) are appropriate for your region and agricultural activities in the field	80
	Follow weather alerts (Heavy rainfall/ hail storm/pest-disease attacks) for agricultural activities in the field to save the crops	85
Crop Specific	Advisory on nursery preparation	83

Advisories:	Advisory of Azolla application	3
	Advisory of application of buried green leaves of Gliricidia @ 3 tones/ha during puddling	1
	Advisory of Paddy transplanting at 20 x 20 cm or 25 x 25 cm	91
	Advisory of application of Urea: DAP briquettes	21
	Advisory of silicon spray @ 1-2 grams or 1-3 ml/litre of water	10
	Advisory of a spray of 00:52:34 @70 G, Multi Micro-Nutrients @50 G and Silicon @15 ml in 15 litres of water at Panicle Emergence Stage	22

Impact of Weather-based CRA Advisories:

Table 2 revealed that more than 90% of farmers benefited at least from an increase in crop yield, reduction in the cost of field inputs, reduction in the cost of cultivation and labour cost or saving of irrigation water.

Crop Yield: 43% of farmers observed that crop yield increased by 25% and more by following the agromet advisory, while 57% observed no change concerning the average historical crop yield.

Field Inputs: 91% of farmers observed that the cost of field inputs (like fertilizers, pesticides, insecticides) is decreased by 25% and more by following agromet advisory, while 5% observed not much difference with average historical input cost.

Cost of Cultivation and Labor: 90% of farmers observed that the cost of cultivation and labour decreased by 25% and more by following the agromet advisory. In comparison, 7% observed that the cost of cultivation and labour has not decreased much, but it is approximately equal to the average historical cost.

Water Saved: 93% of farmers observed that irrigation water saved is up to 25% by following the agromet advisory. In comparison, 6% observed that irrigation water is not saved much, but it is approximately equal to the average historical water applied.

Table 2 Impact of weather-based CRA advisories on crop yield, cost of field inputs, cost of cultivation and labour cost, and application of irrigation water of Paddy crop

Crop yield increased by following advisories	Yes (Increased by 25 % and more)	Yes, but crop yield is near about equal to the average historical yield	No
	43	57	0
Cost of field inputs (like fertilizers/Pesticides/ Insecticides) decreased by following advisories.	Yes (Decreased by 25 % and more)	Yes, but the cost of field inputs is nearly equal to the average historical cost.	No
	91	5	4
Cost of cultivation and labour cost decreased by following advisories	Yes (Decreased by 25 % and more)	Yes, but the cost of cultivation and labour is nearly equal to the average historical cost.	No
	90	7	3
Irrigation water saved by following advisories	Yes (Decreased up to 25 % and more)	Yes, but the irrigation water applied nearly equals the average historical amount.	No
	93	6	1

Usefulness (Farmers Rating) of Weather-based CRA Advisories:

Figure 3 revealed that farmers rated the usefulness of advisories disseminated through the FarmPrecise app in the Very Low, Low, Average, Good, and Very Good spectrum. About 70-73% of farmers rated the overall usefulness of advisories as good to very good, and 27% rated it as average.

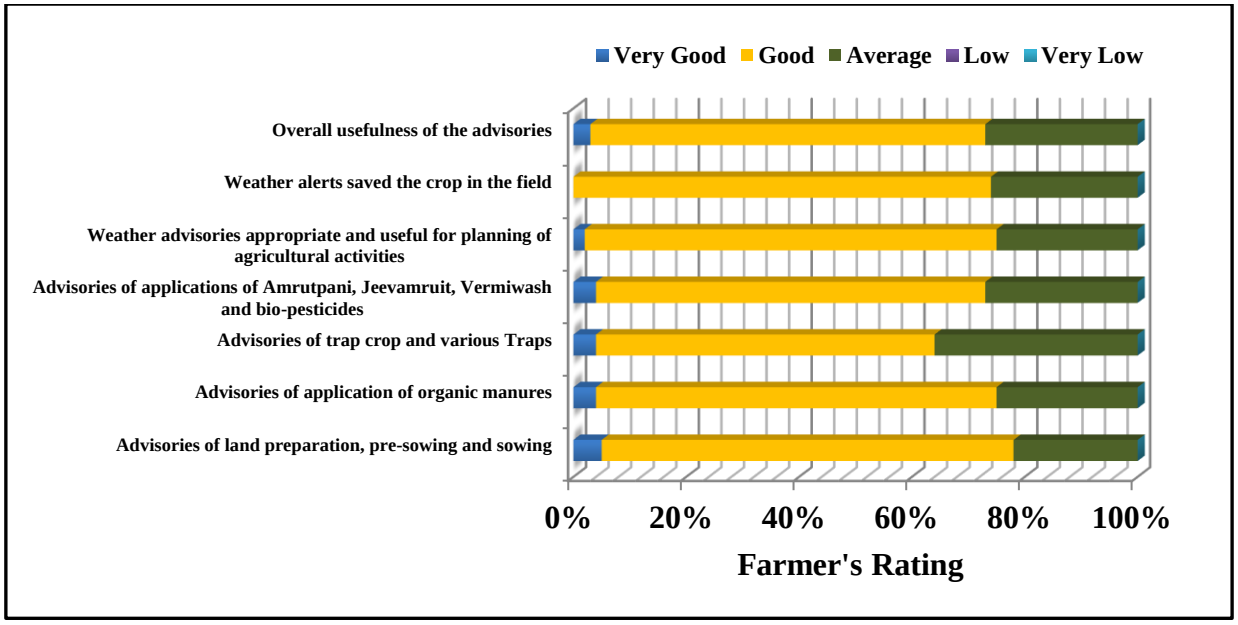

Figure 3 Status of the overall usefulness of advisories for paddy crop

Farmer's Feedback on the Adoption of Weather-based CRA Advisories and Possible Actions:

Farmers' feedback on adopting advisories and possible actions to increase the adaptability through improving advisories and media of dissemination (FarmPrecise app) are discussed below.

Advisory	Adoption	Remark	Action
Advisory of land preparation (Puddling or ploughing and harrowing)	Adoption is about 90%.	Farmers are interested in knowing and using new implements, modern tools, and technologies to save energy and time at the field level.	Advisories must be updated with information on new mechanization techniques (e.g. modern machines /implements /tools for sowing /transplanting /harvesting etc.).
Advisory to incorporate organic manures (FYM, Vermicompost, compost, and green	Adoption is about 60%, lower due to insufficient available manures and was not ready to apply at the	Opportunity to produce the organic manure commercially, else farmers have to develop their capacity to produce	Green manuring is one of the better options to address the shortage of organic manure.

manuring) during land preparation,	household level. Also, 30-35% of farmers are willing to purchase organic manures unavailable locally.	a sufficient amount of organic manure.	
Advisory of seed treatment.	Adoption is about 98%.	Field demonstration is required to increase the accuracy of proper seed treatment.	Scope to spread the technology at scale with proper use of ingredients of seed treatment.
Advisory of crop geometry	Adoption is about 90%.	Farmers are facing the issues of the availability of machines during the period of sowing or transplanting.	Opportunity to strengthen custom hiring centres (CHC) or groups of people can purchase the machines with their contribution or commercially make them available.
Advisory of trap crop	Adoption is about 15%.	Farmers are not aware of the technique and selection of trap crops.	Advisories must be updated with selecting appropriate trap crops—capacity building of the farming community through field training and technology demonstration.
Advisory of pheromone trap	Adoption is about 60%.	20-40% of farmers are unaware of the techniques, 30% observed that lures and traps are unavailable in	Needs to develop a network with the agriculture service centre (ASC) for a smooth supply of

		the local market, and 15-20% observed that it is easy to use chemical spraying traps.	traps and lures in the local market. Train the farmers for the proper installation of traps and make them aware of their features through field training and technology demonstration.
Advisory of the light trap	Adoption is about 13%.	30-70% of farmers don't know the instruments' technology, installation, and features. 15-55% of farmers are willing to follow advisory, but materials/instruments are unavailable locally.	
Advisory of application of Amrutpani and Jeevamruit	Adoption is about 85%.	The raw material was not available to prepare it.	The opportunity for commercial production of biological formulations locally. Raw material (plant leaves) can be available by growing the required plants on field borders. Needs to demonstrate technologies by field training.
Advisory of spraying of Vermiwash	Adoption is about 9-35%.	Farmers don’t have an idea about the technique. Didn't make provision to collect Vermiwash from the Vermi-bed.	
Advisory of application of Bio-pesticides (Dashparniark/ NSKE/Neemark)	Adoption is about 5-15%.	60-70% of farmers are not aware of technology; the raw material was not available to prepare it for 10-50% of farmers, 34% are interested in purchasing from the market but not available in the market.	
Advisories of application of a recommended dose of chemical fertilizer	Adoption is about 90%.	62% of farmers are following the technique of split-dose application. 32% of farmers use the	Needs to develop the user-friendly interface of fertilizer calculator. In-house

		fertiliser calculator tool in the app (FarmPrecise).	training is required to train farmers.
Advisories of application of chemical pesticides/insecticides	Adoption is about 40%.	The application of bio-pesticides reduced the use of chemical pesticides/insecticides.	Advisories for applying pesticides/insecticides need to be updated with information on their latest trade names available in markets.
Advisories of daily weather and weather alerts	Adoption is about 85-100.	Farmers benefited by saving their crops to a different extent.	Scope to increase the accuracy of advisories at the local/micro level.
***CRA advisories must be updated with their exact purpose and benefits, including short videos of best practices, preparation of biological formulations, installation traps, etc.**			

Conclusion:

It may be concluded from the above findings that, at the present level of farmers' adoption of weather-based CRA advisories is behind the expected level, and there is a need for additional support and efforts by the government and other agencies beyond the existing strategies. Adopting weather-based CRA advisories is a broad issue, like adaptation to climate change. Therefore, it must be undertaken at a strong collaborative level between farmers, research institutions, funding agencies, governments, non-government organisations, and private sectors. There is a need to develop strong institutional mechanisms to fine-tune CRA-related knowledge gaps and essential agromet advisories to implement region-specific agriculture action plans successfully. However, weather-based CRA advisories disseminated through the mobile app (FarmPrecise) helped farmers increase their knowledge about sustainable farming practices, including modern technologies and nature-friendly solutions. Farmers can reduce the input cost and increase the net profit for the paddy. Also, the mobile app (FarmPrecise) is an effective way to disseminate agromet advisories and build the resilience of the farming

community to climate change. To enable farmers to adapt to weather-based CRA advisories, continuous community-level capacity building. Dissemination with small videos on the good practices and communicating the advisories in colloquial language will increase uptake.

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