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Evaluation and efficiency of AAS by economic impact analysis in various microclimatic zones in Panipat

Ashish Kumar, Rahul Punia, Divya and Shweta

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Abstract
The current study was carried out at the Krishi Vigyan Kendra District Agro-Meteorological Units (DAMU) in Panipat. CCSHAU, Hisar, and the several villages in this district are part of the India Meteorological Department's (IMD) GKMS (Gramin Krishi Mausam Sewa) project. A diverse group of approximately 400 farmers was chosen for this study from six Panipat blocks (Bapouli, Madlouda, Panipat, Samlkha, Sanoulikhurd, and Israna). Of these, one group used the agro-met advisory services (AAS), while the other group did not. In the district of Panipat, which is located in Haryana's trans-Gangetic plain area (VI), data were gathered throughout the Rabi and Kharif seasons in 2021–2022 and 2022–2023 in order to examine the economic impact analysis of AAS by looking at their possible advantages and efficacy. Agro-met advisory bulletin (AAB) information was frequently provided to those farmers, who were identified, in both seasons, and attention was taken to apply the advisories in accordance with the advice. These farmers' crop situations were contrasted with those in adjacent fields growing the same crop, when the farmers did not follow the forecast. From the time the land was prepared until the rice, wheat, summer moong, and maize crop was harvested, the farmers continued to reap net benefits. Compared to non-AAS (non-agro-met advisory services) farmers, the net income of AAB followed farmers was approximately Rs. 7860 in wheat, Rs. 7776 in rice, Rs. 7800 in summer moong, and Rs. 14800 in maize. The effectiveness of AAB in rice crops was measured in terms of dynamic feedback collection during the crop's successive phenophases. The primary goals of this feedback were to improve rice yield and farmers' perception and use of the prediction at a weather-sensitive stage of rice crop development. The application of AAB based on current and anticipated weather is a beneficial instrument to protect farmers against weather anomalies and was able to boost their productivity as well as income. Farmers who have implemented the AAB in their daily operations have realized additional benefits.

Keywords: Agromet advisories services, feedback analysis, impact assessment

Introduction
Human survival depends on agriculture, which also has a significant economic impact on the country. Variations in the weather have a direct impact on all agricultural operations, occasionally leading to production losses. According to reports, between 2003 and 2013, weather-related agricultural losses and damages reached 25% in developing countries (FAO, 2016) [3]. Climate change is making extreme weather events like heat waves, droughts, floods, and hailstorms more frequent, which raises the danger to agricultural productivity (Bal and Minhas, 2017) [1]. With access to up-to-date weather information and precise weather forecasts, farmers might potentially decrease weather-related losses and boost agricultural output (Weiher *et al*., 2007) [16]. In all temporal ranges, weather forecasts are helpful for organizing agricultural activities and assisting farmers in making important decisions about farm management (Gadgil *et al*., 2002; Maini and Rathore, 2011) [5, 7]. Due to the importance of timely and accurate weather forecasts, farmers must heed cautions regarding weather forecast-based field operations (Daron *et al*., 2015; Hansen, 2002) [3, 6]. Agriculture is probably going to suffer from climate hazards including heat waves, rainfall, monsoon, and others. People are now aware of the IMD (India Meteorology Department), which is putting into practice a program called DAMU (District Agriculture Meteorology Unit) throughout the country. With assistance from the Ministry of Earth Sciences, ICAR/SAUs/NGOs/ Met Centers/AMFUs/KVKs (from tier 1 to 5) and other PPP (Public-Private Partnership Mode) through various Agromet Advisory Services,

the department is able to issue Agromet Advisory Bulletins (AAB) at the district or block level. As part of the GKMS program, which attempts to lower weather-related losses by giving farmers timely information, IMD provides AAS to farmers (Maini and Rathore, 2011) [7]. Numerous DAMUs units have been established to investigate the relative risk and profitability of crop management choices as part of an agreement between IMD and ICAR. As this system develops, weather scenarios for each block will now need to be independently produced for both past and future weather, and they will need to be connected to the Agro-DSS Portal. Thanks to the introduction of District Agromet Field Units and the availability of high-resolution NWP Models, weather scenarios for every block may now be integrated with micro-level agromet advising services (Rathore and Maini, 2008) [10]. In order to help farmers make tactical decisions about irrigation, fertilizer application, and other agricultural activities, we have effectively transferred agrometeorology knowledge to them at the field level. (NCAER report, 2010; 2015; 2020; Rathore and Maini, 2008) [10]. Chandran *et al*. (2017) [2] recently assessed the role of AAS in reducing weather-related threats to agriculture in India. The statistics showed that compared to farmers who did not use the AAS, farmers who promptly and locally implemented the AAB (Agromet Advisory Bulletin) were able to reduce input costs and increase net profit. Because of this, utilizing AAS to increase productivity and profitability based on current and predicted weather conditions is an important technique. Manjusha *et al*. (2019) [8] conducted a regional level study in the National Capital Region. (NCR). The experts estimate that growers of rice and carrots may save 9.6% and 3.0%, respectively, on input costs. Farmers in Anand, Gujarat who followed AAS benefited economically more than farmers who did not (ICEA Report, 2020), which looked at the perception and value of AAS services in Anand. Weather changes with time and location, so farmers can minimize losses by managing agricultural operations more effectively when they anticipate it. Changes based on early and accurate weather prediction information may be able to decrease weather-related losses, even though it is difficult to predict every kind of loss. Through the recommendation of appropriate management measures based on meteorological conditions, the Agromet Advisory Bulletin assists farmers in increasing their income. In order to better understand the effects of both AAS users and non-users on farmers from a variety of northwest Indian locales, research was conducted on the adaptation of the economic impact of AAS for Rabi and Kharif crops in 2021–2022. The results showed that, in comparison to farmers who did not use the AAS, farmers who adhered to the timely and location-specific AAB (Agromet Advisory Bulletin) were able to lower input costs and enhance net profit. Because of this, employing AAS depending on actual and predicted weather is a useful strategy for raising output and income. Based on the present weather, these AABs help farmers increase their profit margin by suggesting suitable management techniques. To fully comprehend the possibilities and responsibilities of any service, regular monitoring, feedback gathering, and economic impact analysis are all essential. An evaluation of the economic impact of AAS for the Rabi and Kharif crops in 2022–2023 was carried out in order to look at the effects of AAS users and non-users from different regions in North West India. Comparing AAS farmers to non-AAS farmers, the results showed that farmers who adhered to the timely and location-specific AAB (Agromet Advisory Bulletin) were able to reduce input costs and increase net profit. Because of this, using AAS depending on current and predicted weather conditions is a helpful tool for raising output and revenue.

Materials and Methods

The current study was carried out by DAMU, which is located in the North Western Trans-Gangetic Plain Region of India at longitude 77.027824 N and latitude 29.365194 E and 250 meters at Krishi Vigyan Kendra (KVK) Panipat, under CCSHAU Chaudhary Charan Singh Haryana Agricultural University, Hisar. A survey instrument was created to gather information from the farmers. This survey, created by the KVK, Panipat DAMU unit, was distributed. The primary focus of this questionnaire was to gather data regarding the farmers' adoption of advisories for various farm operations, such as planting dates, tillage operations, fertilizer application, irrigation, spraying, and harvesting; as well as the profits and losses resulting from following or disregarding those advisories prior to performing farm operations. Summer moong, rice, wheat, and maize were the main crops. Five farmers were chosen at random from each of the eighty villages to participate in this study. For this study, 80 villages spread over the eight blocks of Panipat, comprising 400 farmers, were chosen between January 2021 and December 2022. Using a pretested interview schedule, data were gathered through in-person interviews. The study's goals were communicated to the farmer, and data for Rabi 2020 and Kharif 2022 were recorded. Since the study necessitated regular communication with the farmers, telephone interviews were also used because it was not financially feasible to pay many visits to the same farmers.

Results and Discussion

For the purpose of comparison of the socio-economic profile of the farmers of Panipat district

Age

The age range of 36 to 50 years old accounted for 53% of farmers. Just thirty percent of farmers fell into the category of those who are under 35 years old, and seventeen percent are over fifty years old. This result indicates that youth involvement in agriculture was low in the research area, indicating a lack of interest in agriculture among the younger generation (Figure 1).

Educational

According to the pie chart, 28% of farmers were graduates, 23% were higher secondary graduates, 17% were 10th grade grads, and 5% were illiterate. Furthermore, just 5% of farmers held a postgraduate degree; there are very few farmers that lack literacy. Additionally, 5% of postgraduates are engaged in agricultural techniques (Figure 2).

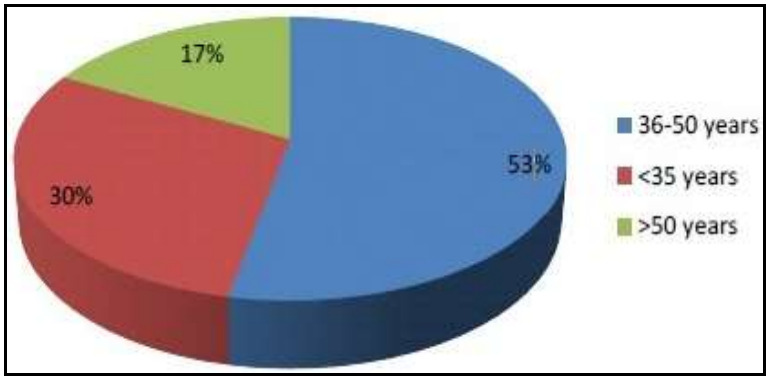


Fig 1: Pie Chart depicting the age group of farmers in Panipat District

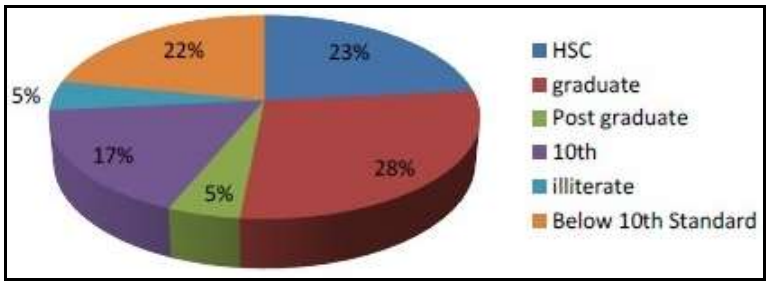


Fig 2: Pie Chart depicting the percentage of education background of farmersPanipat District

Size of land holding: The bulk of farmers in the Panipat district (43%) belonged to the middle category, followed by large (30%) and small (27%) farmers (Figure 3).

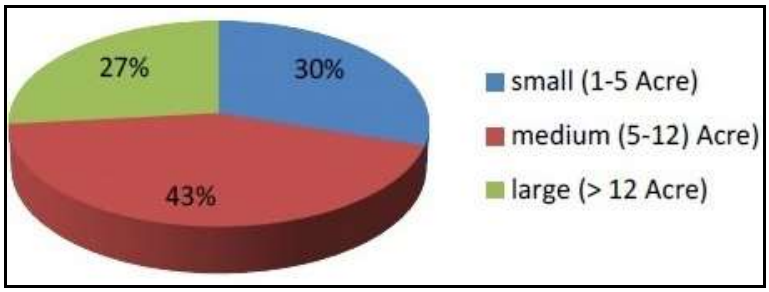


Fig 3: Pie Chart depicting the percentage of land holding of farmers in Panipat

Communication behaviour of the farmers: For 27% of the farmers, social media, particularly WhatsApp, was their primary information source. The other information sources for the farmers in the research area were newspapers (16%), mobile phones (14%), television and radio (12%), newspapers (7%) and Twitter (5%). Results unmistakably show that farmers are using all available technological methods to find information about the weather and crops (Figure 4).

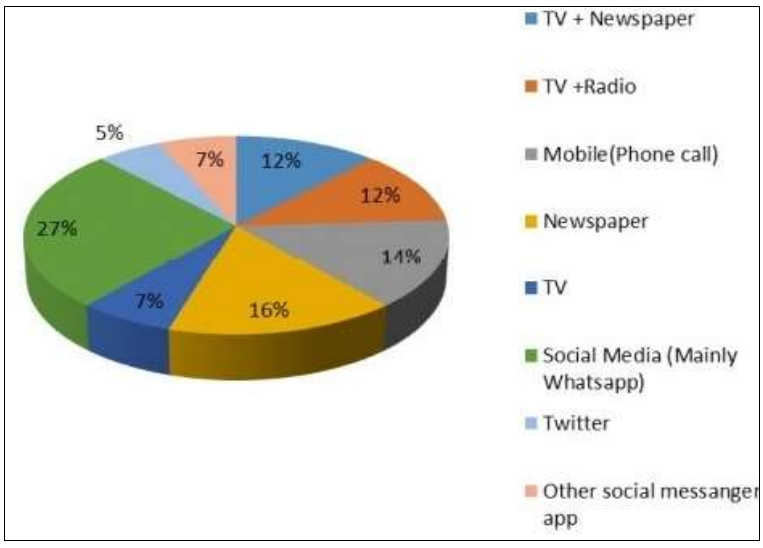


Fig 4: Pie Chart depicting the percentage of farmers gathering weather information on mass media in Panipat

400 feedbacks were gathered from a diverse group of farmers in Panipat District. Through these feedbacks, different types of information were gathered from AAS and Non-AAS farmers, including the cost of cultivation, irrigation, fertilizer and insecticide application and its costs, harvesting operations, and all management practices. The fact that AAS farmers have higher net returns than non AAS farmers could be attributed to a number of factors, including effective input use, timely weather advisory services that save input costs, adherence to weather-based management strategies, and prompt weed, pest, and disease control. Crop management decisions, including preparation of the land, sowing, timely weeding, irrigation, nutrient management, preventive and control measures against weeds, pests, and diseases, scheduling of all cultural operations, harvesting and threshing, transportation, and storage, may be the cause of increased profit. Both kinds of farmers produced almost the same amount of wheat and rice, but beneficiary farmers' cultivation costs were Rs3000–4,000 less per acre than those of non-beneficiary farmers. For each of the farmers who benefited, the greatest cost savings was seen in the areas of pest control and irrigation. In comparison to non-AAS farmers, there were improvements in net profit of Rs. 78600/acre for rice and Rs. 7776/acre for wheat (Table 1), as well as percentage increases in yield of around 11.9% and 18.5% for both rice and wheat (Table 1). In a similar vein, compared to non-AAS farmers, the increase in net profit for summer moong and maize was Rs. 7800/acre for summer moong and Rs. 14800/acre for maize (Table 2). The percentage increases in yield for summer moong and maize were around 37.1% and 40%, respectively. Compared to rice and wheat, summer corn and maize yielded a higher percentage rise because they were more susceptible to weather-related events like flooding and unfavorable weather. The lower input costs, adherence to AAB-based management strategies, and prompt management of pests and diseases may be the reasons why AAS farmers have higher net returns than non-AAS. Better crop management practices by farmers who adhere to the predicted AAB, timely land preparation and sowing, adoption of recommended seed rate and suitable varieties, timely weeding, preventive measures on pest and disease forecasts, irrigation and harvesting, applications of pesticides, fertilizer, and manure, and scheduling of cultural operations were all contributing factors to this profit. Although the cost of cultivation decreased, the production of rice and wheat remained nearly unchanged, improving the net benefit to farmers by approximately Rs. 7 to 8 thousand per acre (Table 1).Summer moong and maize yields are more profitable by Rs. 8,000 and Rs. 15,000 per acre, respectively (Table 2), as farmers who employ the AAB's recommended crop management techniques will be better able to withstand weather variations and produce more of both crops. When it comes to pesticide application (Summer moong and maize) and irrigation (Rice and wheat), the highest B: C ratio was seen. According to Vashisth *et al*. (2013) [15], Manjusha *et al*. (2019) [8], and Rathore (2020) [9], the results are in line.

Perception and usefulness of agromet advice services in Panipat rice crop through dynamic feedback

- During the seeding phase, 50% of the farmers complied with the advice. Eighty-three percent of farmers expressed complete satisfaction with the recommendations they got, compared to 16 percent who expressed only moderate satisfaction (Figure 5).
- During the emerging period, almost 50% of the farmers complied with the advice. About 75% of farmers expressed complete satisfaction with the recommendations they received, whereas 24% expressed only moderate satisfaction (Figure 5).
- Half of the farmers adhered to the advice throughout the transplanting phase. Approximately 70% of farmers expressed complete satisfaction with the recommendations they received, whereas 29% expressed only moderate satisfaction (Figure 5).

Table 1: Economic impact analysis in Wheat and rice (Rs./acre) during 2022-2023 in KVK Panipat

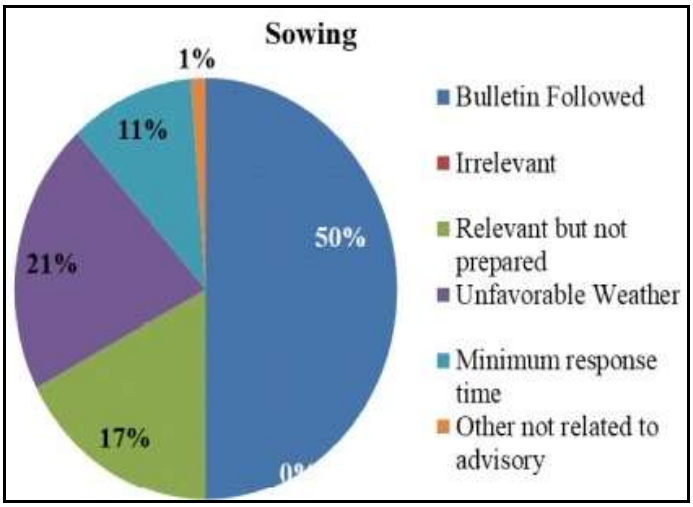
Type	Wheat					Rice				
	AAS	Non AAS	Economics Gain	Percentage Increase in Yield	B:C Ratio	AAS	Non AAS	Economics Gain	Percentage Increase in Yield	B:C Ratio
Land preparation/ Sowing	5000	6600	1600	24.24	0.17	6700	7300	600	8.2	0.08
Seed fertilizer & manure	4920	5990	1070	17.86	0.18	1725	2525	820	32.2	0.35
Pesticides/insecticides/ herbicides	1960	2290	350	15.28	0.16	2900	3700	800	21.6	0.25
Irrigation	2600	3400	800	23.52	0.25	800	1260	460	36.5	0.45
Harvesting/ Threshing	1290	1370	80	5.8	0.05	1200	1400	200	14%	0.16
Grain Yield (Rs.)	28.0(q/acre) =28x1925 =53,900/-	26.4(q/acre) =26.4x1925 =50,280	3080	6%	0.05	35.3(q/acre) =35.3x1868 = 65940		4296	6.9%	0.07
Straw Yield (Rs.)	24.3(q/Acre) =24.3x500 =12150	22.5(q/acre) =22.5x500 =11250	900	8%	0.08	33.5 (q/acre) =33.5x600 =20100		600	3%	0.03
Benefit (Rs.)	50280	42420	7860	18.5%	-	72715		7776	11.9%	-

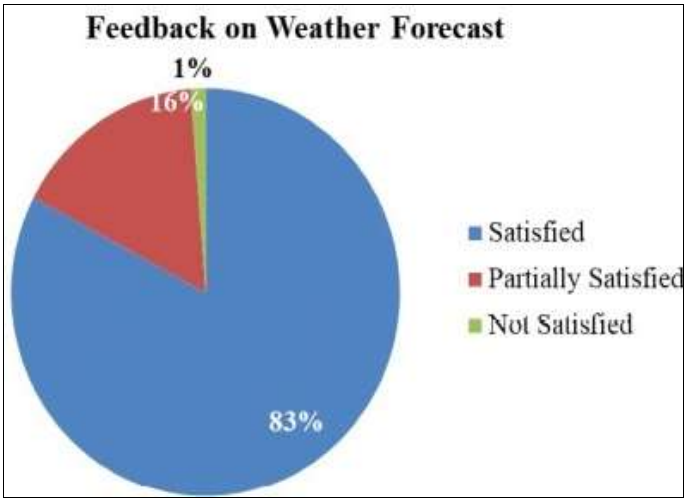
*MSP price of wheat (Rs. 1925/-), Rice (Rs. 1868/-) during 2021-22

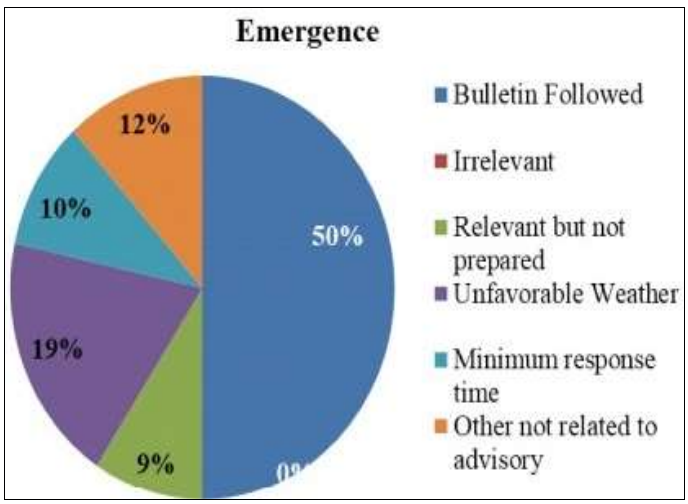
Table 2: Economics impact analysis in summer moong and maize (Rs./ acre) during 2021-2022 in KVK Panipat

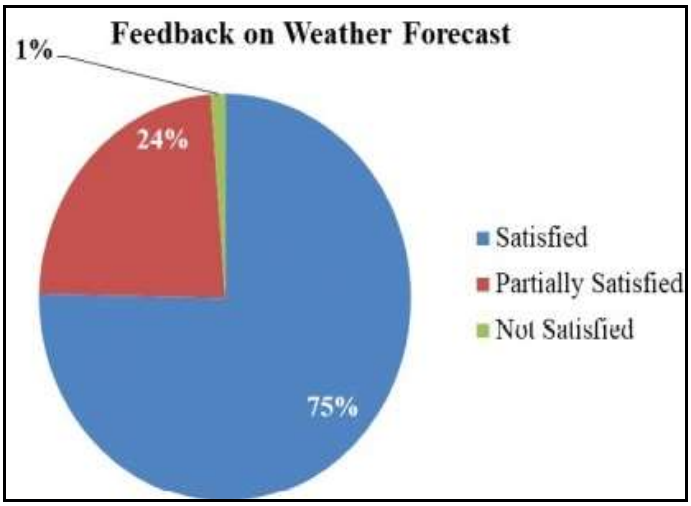
Type	Summer moong					Maize				
	AAS	Non AAS	Economics Gain	Percentage Increase in Yield	B:C Ratio	AAS	Non AAS	Economics Gain	Percentage Increase in Yield	B:C Ratio
Land preparation/ Sowing	1500	2000	500	2.5	0.25	1700	2200	500	22.72	0.22
Seed fertilizer & manure	2200	2600	400	15.38	0.15	2800	2800	400	14.28	0.14
Pesticides/insecticides/ herbicides	500	1000	500	50	0.50	1500	1500	500	33.33	0.33
Irrigation	100	200	100	50	0.50	250	250	100	40	0.40
Harvesting/ Threshing	1500	2200	700	31.8	0.32	2000	2000	700	35	0.35
Grain Yield (Rs.)	4.8(q/acre) =4.8x6000 =28800	3.5(q/acre) =3.5x6000 21000	7800	37.18	0.37	28 (q/acre) =28x1850 =51800	20 (q/acre) =20x1850 =37000	14800	40	0.40
Benefit (Rs.)	28800	21000	7800	37.14	0.37	51800	37000	14800	40	0.40

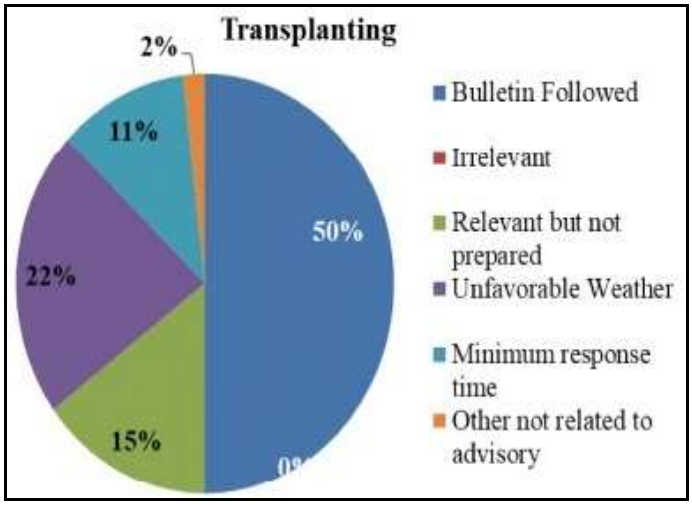
*MSP price of summer moong (Rs. 6000/-), Maize (Rs. 1850/-) during 2021-22.







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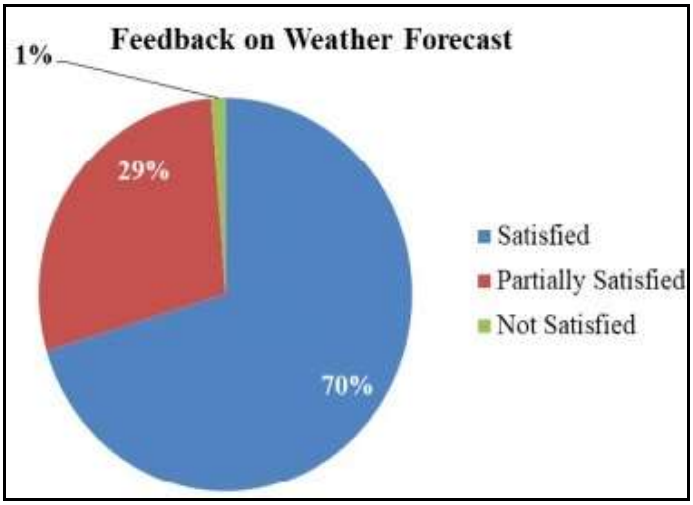
Feedback on Weather Forecast
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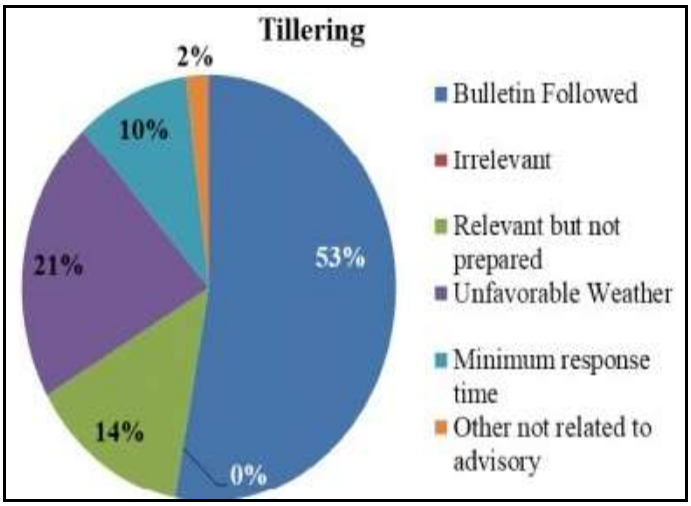
Partially Satisfied
Not Satisfied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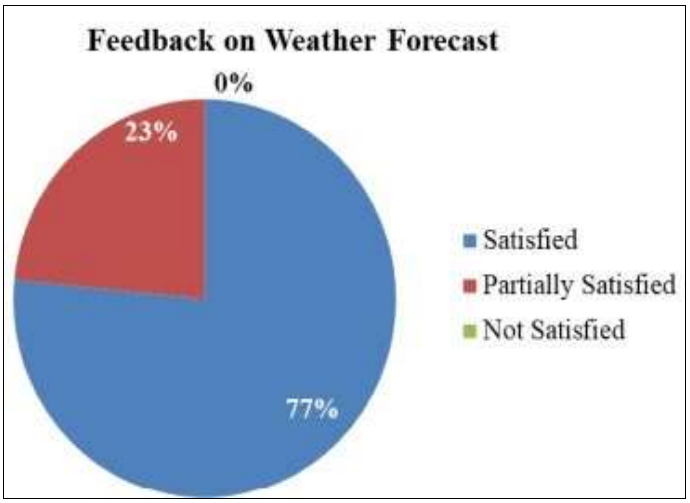
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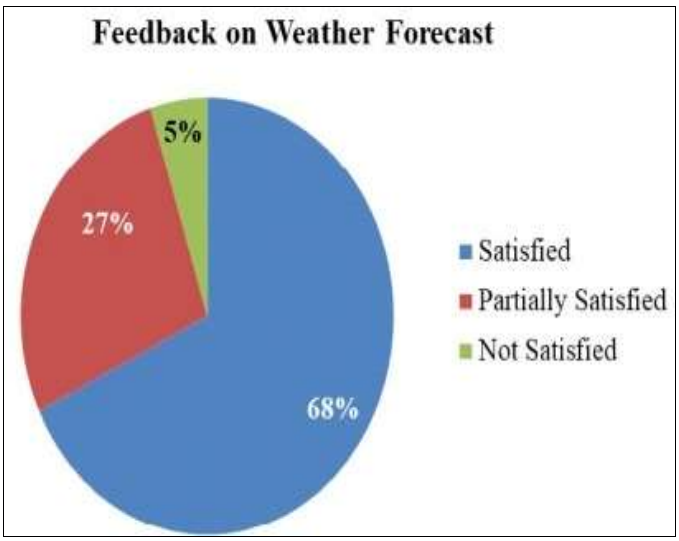
Feedback on Weather Forecast
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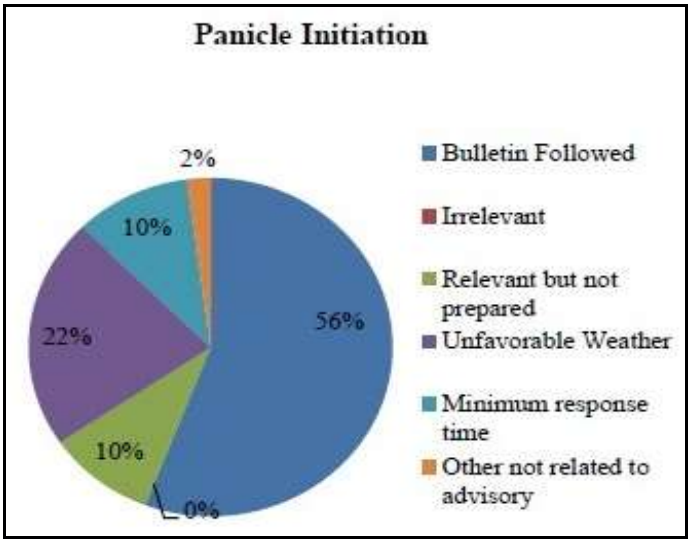
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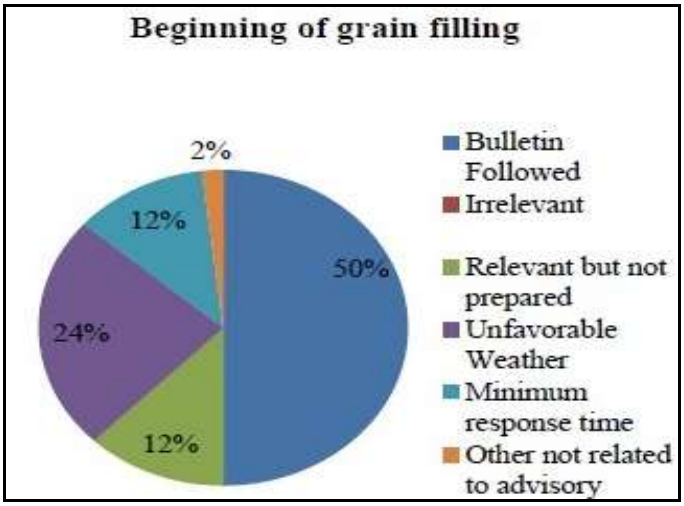
Beginning of grain filling
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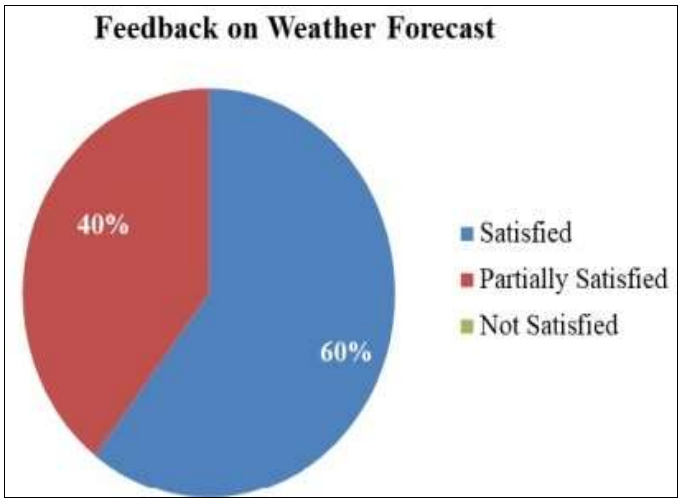
Unfavorable Weather
Minimum response time
Other not related to advisory


Feedback on Weather Forecast
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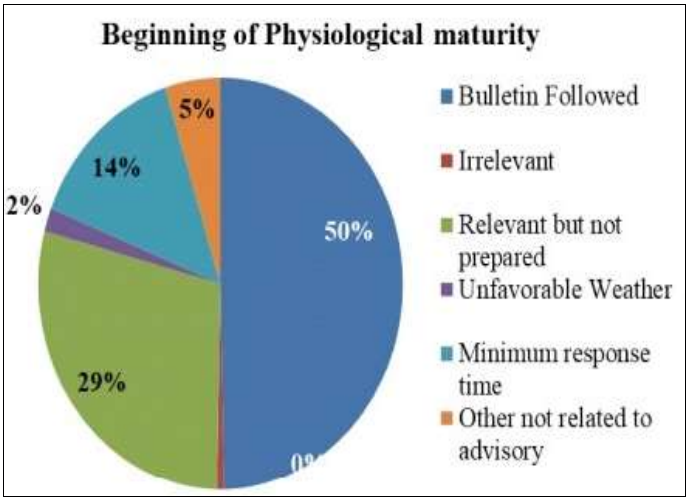
Partially Satisfied
Not Satisfied


Beginning of Physiological maturity
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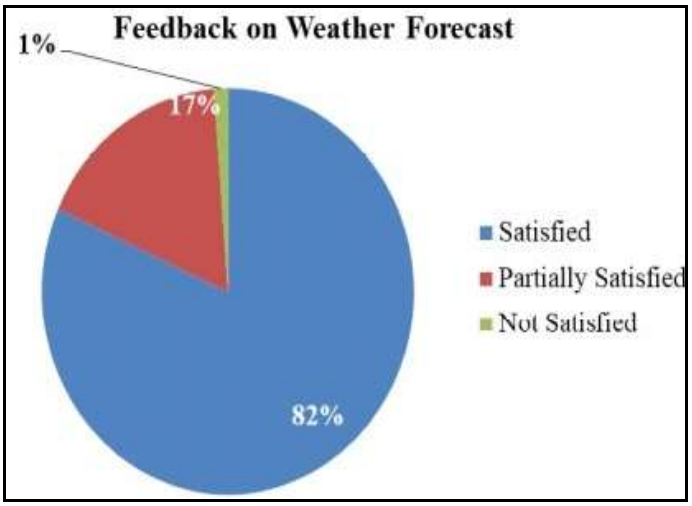
Feedback on Weather Forecast
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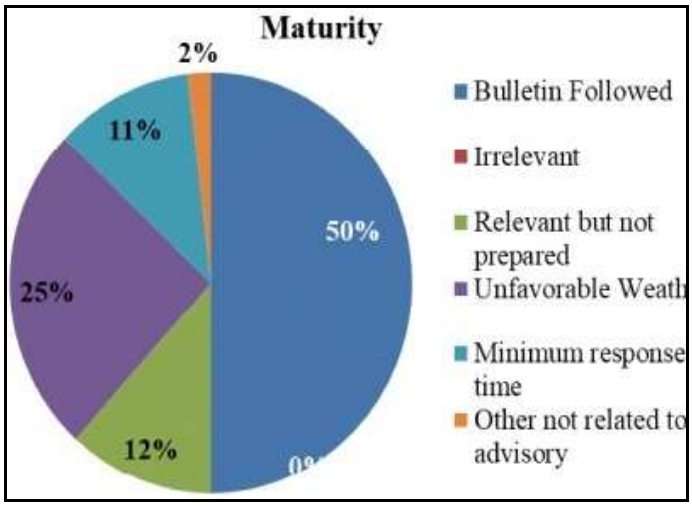
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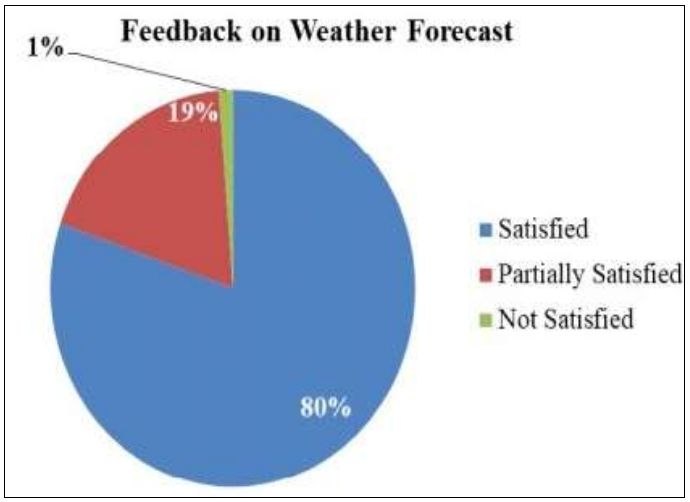
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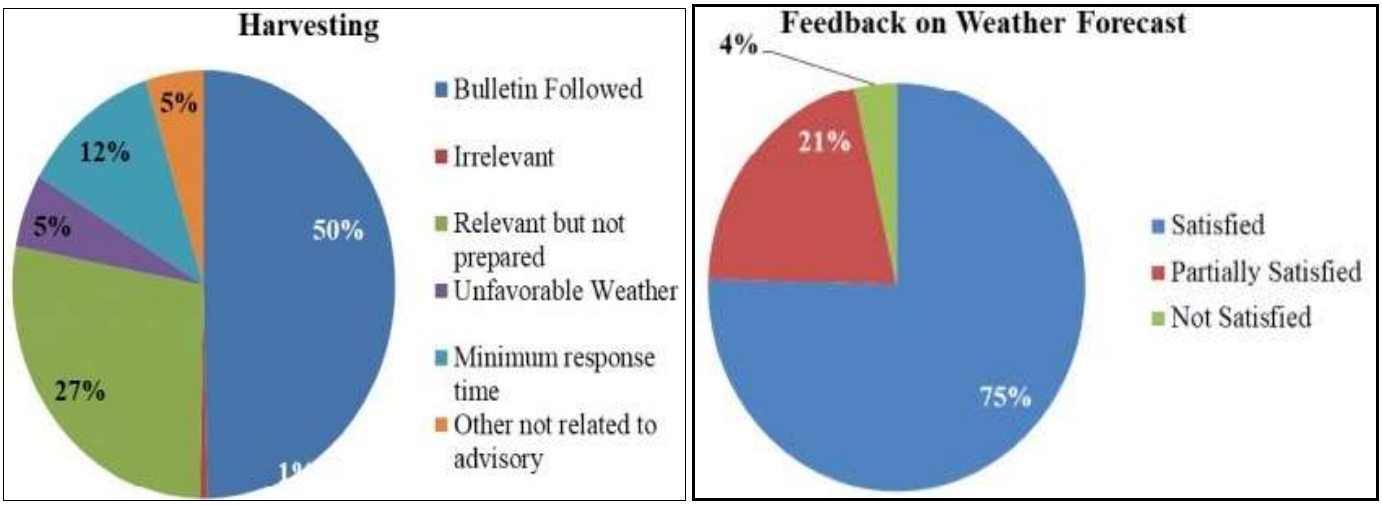

Fig 5: Pie Chart depicting the dynamic feedback collected from farmers at different phenophases occurences in rice crop in Panipat

- Fifty-three percent of farmers heeded the advice at the tillering stage. Roughly 77% of farmers expressed satisfaction with the recommendations they received, although 23% expressed only moderate satisfaction (Figure 5).
- Approximately 56% of farmers complied with the announcement regarding the start of panicles. Sixty-eight percent of farmers expressed complete satisfaction with the recommendations they received, whereas twenty-seven percent expressed moderate satisfaction (Figure 5).
- At the onset of grain filling, half of the farmers adhered to the advisory. Forty percent of farmers expressed only moderate satisfaction with the recommendations they received, compared to about sixty percent who expressed complete satisfaction (Figure 5).
- At the beginning of physiological maturity, 50% of the farmers complied with the advice. Figure 5 shows that 82% of farmers expressed satisfaction with the recommendations they got, and 17% expressed just moderate satisfaction.
- Half of the farmers at the maturity stage adhered to the bulletin. Eighty percent of the farmers expressed satisfaction with the advisories they received, while 19% expressed limited satisfaction (Figure 5).
- Fifty percent of the farmers followed the bulletin during the harvesting phase. Of the farmers surveyed, almost 75% expressed satisfaction with the advisories they received, whereas 21% expressed just moderate satisfaction (Figure 5).

Conclusion

This paper evaluated data obtained from DAMU units in Panipat District, North West India, with respect to the adoption of AAS and its suitability for the farming population. It is evident from the data that 74.44% of farmers expressed complete satisfaction with the use of agro-met advisory bulletins (AAS), compared to 24% who expressed partial satisfaction. This highlights the importance and practicality of these services for farmers. Farmers used the information provided to them almost at every level and expressed satisfaction. It has been discovered that using the AAS bulletin, which is based on current and predicted weather, is a good way to maximize the use of farm inputs and overall returns. Beneficiary farmers saw higher profitability and returns even if their yields were comparable to those of non-beneficiary farms. In order to improve the production levels of farmers who get assistance, a recommended package of techniques for various crops must be included, along with weather-related information, to make the information distribution process more efficient and inclusive. To implement remedial actions, it is necessary to regularly gather farmer feedback via online-generated forms.

Limitations of the study

Accurate and realistic data on the date of sowing, varieties used, yields, cultivation costs, and income were obtained during the experiment. Since the majority of farmers do not keep farm records, it is exceedingly challenging to evaluate the impact and effectiveness of advising services. Farmers must be made aware of the value of maintaining records in order for them to make informed decisions about farm management. Additionally, it will aid in preventing personal bias in the many types of information produced at their farms.

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