

Original Research Article

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Agromet Advisory Bulletin - A Weather Smart Agriculture Technology option for Adaptation and Mitigation of Changing Climate

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ABSTRACT

Agrometeorological Field Unit (AMFU) disseminating agromet advisory bulletin (AAB) are embraced three parts viz., weather condition, crop information and weather based agro advisories. This study enlightens the qualitative and quantitative aspect and gaps between providers and end users of AAB. The AAB issued by 7 AMFU stations was collected for the period 5 years (2007-2011) from IMD, Pune and SAU's of 7 states. The substantial variation in the format of issued AAB by all the stations was observed and formats are not found easily usable to print media, SMS through multimedia. The minimal number of advices observed based on weather and weather element based. The alert message not incorporated in AAB most of the AMFU's except Parbhani and Sehor. Advice on post-harvest technology, processing of agricultural produce, marketing and transport was not observed in AAB. It is suggested that adopt pictographic and colourful format 1 or format 2, for commercialization of AAB through use of e-AAB, TV, internet, specialized App for widespread and usability, which are most useful weather smart agriculture technological tools that can minimise climatic risks and build a resilient agricultural production.

Keywords

AAB, AAB format, AMFU, Agro advice etc.

Article Info

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Introduction

In describing tensions between maximizing global agricultural productivity, increasing resilience of agricultural systems in the face of climate change and mitigating greenhouse gas (GHG) emissions from agriculture, the term climate-smart agricultural development was first used in 2009. A year later, at the First Global Conference on Agriculture, Food Security and Climate Change at the Hague, the concept of climate-smart agriculture (CSA) was presented and defined as agriculture that

“sustainably increases productivity, enhances resilience, reduces/removes greenhouse gas emissions, and enhances achievement of national food security and development goals” (Neufeldt *et al.*, 2013).

Amongst the weather parameters rainfall, wind and cloud cover in *kharif* season and temperature, heavy wind, unseasonal rainfall and hail storm in *Rabi* season having greatest deciding parameters of Agricultural production to success or failure the season. Arun Khatri Chhetri and Pramod K. Aggarwal

(2017) reported that the agricultural production systems in all South Asian countries are well known to be sensitive to long-term climate change and short-term (annual and seasonal) weather variability. Consequently, the production systems in the region need to be adjusted focusing on effective management of current as well as future climatic risks. Recently research in South Asia identified a range of options that can minimise climatic risks and build a resilient agricultural production. Depending on their appropriateness for a particular location, these options include, water, energy, nutrient, carbon, weather and knowledge smart technologies, practices and services.

Weather forecast is becoming more important task for efficient management of farm inputs. The accuracy of forecast for a long period is a great challenge, but the medium range weather forecasts in recent year were improved to a great extent due to modern technology. AAB is the best tool for transferring agro techniques and location specific recommendation of SAU's to the end users. The agricultural productions are generally attributed to the behaviour of weather (space and time). It also provides, mitigation techniques on vulnerable information about crop management practices *viz.*, irrigation schedule, pest and diseases status and control management, livestock production and management, marketing and trade management, new scientific storage and processing information to the farmers (Rathore *et al.*, 2004). Similarly, Rao *et al.*, (2008) and Jaybhaye *et al.*, (2018) reported that the weather based AAB on medium range weather forecast is used to minimize the risk from weather and weather induced pest and diseases.

The demand of the farming community could not be fully met due to certain drawbacks in the agro advisory system, such as non-availability of skilful weather forecast in all

temporal ranges specific to the site of interest to a farmer. Besides this, non-availability of real time crop data lack of decision support system for interpretation of weather forecast into advisories. In order to address the problem judiciously, proper knowledge on agriculture situation prevalent in the region is essential. This may include type, state and stage of crops, prevailing pest and diseases, soil moisture status, state of animal health and nutrition and agricultural marketing situations. Priority should be given to predominant crops of the region and most prevailing problems keeping in view their relative economic importance. Management practices like what, when and how to sow, when and how much to irrigate; what measures to be adopted for plant or animal protection from stresses caused by pest and diseases, temperature, wind and rainfall etc. animal shelter, nutrition and their health are affected by weather to a large extent, hence must find place in the AAS bulletins. The advisories should also serve early warning functions, alerting producers to the implications of various weather events such as extreme temperatures, heavy rains, floods, and strong winds. This article clearly shows that the AAB is one of the technologies for adaptation and mitigation options in agriculture. While, this article are enlighten particular location specific options includes water, energy, nutrient, weather and knowledge smart technologies in AAB, which act as a weather smart agriculture technology option for adaptation and mitigation of changing climate

Materials and Methods

Forecast of weather parameters *viz.*, rainfall, maximum and minimum temperatures, relative humidity, wind speed and direction received from NCMRWF, Govt. of India New Delhi through regional Indian Meteorological Department centre on every Tuesday and Friday. The present investigation was

undertaken during the period 2011-12 at Department of Agricultural Meteorology, Vasantha Naik Marathwada Krishi Vidyapeeth and Parbhani study Agromet Advisory Bulletin to mitigate the impact of climate change on agriculture. AAB were issued by the AMFU's of the last five year. AAB is published regularly twice in a week viz., Tuesday and Friday generally by all AMFU's. The data on AAB issued was collected from Indian Meteorological Department, Pune and State Agriculture Universities across the nation. Data was collected from seven centres of one season for the period of last five year (2007-2011).

The Agromet Advisory Bulletins from seven AMFU stations were collected from four states which are mainly using either Marathi or Hindi language for the present study. The names of AMFU stations were Parbhani, Rahuri, Akola and Dapoli (Maharashtra state), Sehore (Madhya Pradesh), Jaipur (Rajasthan) and Raipur (Chhattisgarh).

The collected data analysed by using prepared questionnaire (Table 1) on the basis of qualitative and quantitative aspect included in AAB. Also, it is based on visualization and requirements statistical analysis input. The collected data was tabulated analysed by frequency distribution method i.e. SPSS (Computerized Software of Statistical Package for Social Science) process and from the analysed the standard format of AAB are suggested. This SPSS model is provided by NIC, Pune.

Results and Discussion

Farmers socio-economic levels without inclusion of weather smart agriculture are couldn't rise. In Weather-Smart agriculture ICT based Weather Forecasts and Crop Agro-advisory, are the technology. Interventions to provide services related to income security

and weather advice to farmers, e.g. climate information based value added agro-advice to the farmers, income loss due to the vagaries of weather having adaptation/mitigation potential (Chhetri and Aggarwal., 2017). Hence, the study was undertaken and the existing AAB data revealed that, precession advice (i.e. exact seed rate, fertilizer dose, proper fertilizer application method, irrigation schedule and proper method of rationing for cattle) was not found in most of AAB issued by AMFU's.

Weather elements based content in AAB

The Table 2 revealed that, the weather based content of AAB was observed very less in percentage and also, it was found that the weather element based advice percent was lowest and it was below 30 % except rainfall and cloud cover (Fig. 1). The data is revealed that the significant difference in percentage of AAB which was based on the different weather element were found amongst the issued AAB by different AMFU's and which was observed 00 to 55 percentage. While, the weather element based rainfall, maximum temperature (Tmax) minimum temperature (Tmin.) relative humidity (Rh), wind speed (WS), wind direction (WD) and cloud cover mean percentage in AAB issued by different AMFU's showed 24.28, 18.14, 20.71, 11.42, 20.05, 26.28, 21.14 and 27.28 percent respectively, of respective centres of Parbhani, Rahuri, Dapoli, Akola, Jaipur, Sehore and Raipur AMFU. It means that, the agro advice based on accurate rainfall prediction played important role in increase the agricultural yield as well as quality. While the Tmax based agro advice in AAB was observed 22, 17, 14, 16, 18, 20, 20 percent of Parbhani, Rahuri, Dapoli, Akola, Jaipur, Sehore and Raipur AMFU's respectively. Whereas, Tmin based agro advice was observed in Parbhani (10%), Rahuri (27%), Dapoli (23 %), Akola (20%), Jaipur (26%), Sehore (17%) and Raipur (22%).

The Table 3 revealed that the Rh based agro advice in AAB was observed 10, 09, 11, 13, 15, 08 and 14 percent of Parbhani, Rahuri, Dapoli, Akola, Jaipur, Sehore and Raipur AMFU, respectively. Whereas, the cloud cover based agro advice in AAB was observed 20, 45, 55, 27, 14, 13, 17 percent in Parbhani, Rahuri, Dapoli, Akola, Jaipur, Sehore and Raipur AMFU, respectively. While, sunshine based agro advice in AAB was observed 27, 23, 21, 00, 24, 17 and 19 percent in Parbhani, Rahuri, Dapoli, Akola, Jaipur, Sehore and Raipur AMFU, respectively. Whereas the WS based agro advice in AAB was observed 27, 30, 29, 25, 31, 22 and 20 percent in Parbhani, Rahuri, Dapoli, Akola, Jaipur, Sehore and Raipur AMFU's respectively. The wind direction based agro advice in AAB was observed 20, 45, 55, 27, 14, 13, 17 percent in Parbhani, Rahuri, Dapoli, Akola, Jaipur, Sehore and Raipur AMFU, respectively.

The weather elements content based AAB (Table 3) was found highest (27.28 %) on cloud cover based and lowest (11.42 %) on Rh based; whereas, it was found decreasing order on cloud cover (27.28 %), WD (21.14 %), Tmin (20.7), BSS (20.05 %) max. temp. (18.14 %) and Rh (11.42 %). The lower percentage of agro advice based on each weather elements of AAB was found may be due to the ignorance of this aspect or lack of knowledge of microclimatic impact on crop at particular crop growth stage and may be due to not special mandatory provision to consider these aspects during preparation of AAB.

Agro advice based on different agricultural disciplines given in AAB

The important all regional agriculture crops, horticulture crops and livestock are considered during the preparation of AAB issued by AMFU's as per regional agricultural pattern. Analysis based on the information given in AAB issued was clearly indicated that there is

lot of variation in content based on different disciplines of agriculture is covered. While, it was found that agro advice based on post-harvest technology, processing of agricultural produce, marketing and transport was not observed in a single AAB. It is necessary; to cover these aspects in AAB on the basis of microclimatic condition and weather forecasting because of it will be useful to increase socio economic status of end users. It was also observed that the soil conservation practices plays vital role in reduction of evaporation losses; as well as improving the fertility and productivity of soil. Though, it is an important aspect which was ignored during preparation of AAB. It may be due to ignorance of water smart technology having adaptation potential through interventions to improve water use efficiency viz., minimisation of surface runoff and water loss from crop fields, effective control of irrigation and drainage.

Alert message based Agromet Advisory Bulletin

The separate column loss by name of alert message provided for highlighting adverse weather condition or weather calamity which causes crop in AAB (Table 3). The data revealed that, out of 7 AMFU centres only 2 AMFU (Parbhani and Sehore) incorporated alert message in AAB during the year 2011. It was found that the Parbhani centre had given weather element based alert message highest on rainfall (81.6%) and lowest on morning relative humidity (RH-I) and evening relative humidity (RH-II) (4.8%); cloud cover (67.2 %). Similarly, weather element based alert message given in AAB was highest in rainfall (14.7%) and lowest on RH-I and RH-II (2.94 %), as well as on cloud cover (5.88 %) was observed. It is also found that the other remaining AMFU's not given alert message throughout the study period (2007-2011). It may be due to the lack of knowledge to use

the weather services product issued by IMD in agriculture sector or may be due to complicated weather related products issued by IMD. These statements are agreement with the statement reported by Rathore *et al.*, (2004).

Existing format of AAB

The large variation observed in cropping pattern, local management practices and content of AAB in the different AMFU's and variation were also observed in the existing format of AAB which were issued by all the AMFU's. While, it was observed that the issued AAB by all AMFU's incorporated advice on different agricultural disciplines *viz.*, agronomical crops, horticultural crops except post-harvest technology, processing of agricultural product, soil conservation practices and agricultural marketing and few of them were given advice for livestock rearing. These results are in conformity with the results of Jaybhaye *et al.*, (2014).

The investigation of the AAB issued by AMFU Parbhani showed that the format of AAB were preciously in the form of paragraph and new existing tabular form. The running AAB provides weather information in first section, separate cell for alert message was allotted in middle section to enlightening aberrant weather condition and last part of the AAB forecasting consisted crop information and livestock rearing management based on current, forecasted weather. The AAB issued by AMFU, Rahuri were studied and it was found that the format of bulletin was similar to Parbhani except a separate column for alert message and information about livestock production is not incorporated. However, the format of AAB issued by all other AMFU's more or less similar to Rahuri and Parbhani.

After review of AAB issued by all AMFU's found that existing AAB bulletin is unsuitable

for the extension purpose through different media *viz.*, print media, Radio, T.V, cellular phone, Internet and other multimedia devices etc. (i.e. I.T. tools and App's).

It is because of different gap are present between in AAB format, content and need of end users. The identified gaps are given as.

Tabular format of AAB was not directly usable to end users.

Academic lengthy and more non useful descriptive wordings were observed in AAB which was the hurdles for dissemination.

Approximation or broad ranges of recommendations given in AAB are not accepted by farming community.

Weather element based and crop growth stage wise agro advice was not found in most of AAB.

Precession recommendation was not observed considering real time local weather and weather forecasting.

Rainfall forecasting was not found more realistic at block level.

Existing format of AAB was difficult to reading and understanding to audio media i.e. AIR and local Radio stations and also it was not found suitable for SMS through cellular phone.

Hence, the number of IT companies trying to develop such types of techniques. Unfortunately, such types of completely success couldn't get to corporate sector till, however it will happen in coming days. While, on the similar line one cellular phone App for pomegranate was started by National Research Centre on Pomegranate, Solapur (MAH) (Anonyms, 2014).

Table.1 Format data sheet for questionnaire of Agro Advisory Bulletin

Weather parameters covered in forecasting of IAAS	Observed weather from previous week		Weather forecasting given in AAB		Alert Message given in AAB		AAB is Weather Base		Agriculture advise covered aspects															
	Yes	No	As it is	Local inputs	Yes	No	Yes	No	Crops				Live Stock		Post Harvest		Processing		Soil Conservation		Marketing		Any other information	
									A.C.	F.C.	O.C.	Veg	Animal	Poultry	Yes	No	Yes	No	Yes	No	Yes	No	Photo	Graph
Temp	T Max.																							
	T Min.																							
R. Humidity	RH1																							
	RH2																							
Rainfall																								
Wind	W.S.																							
	W.D.																							
Cloud Cover																								
Sunshine																								

Table.2 Weather element content based AAB in numbers and percentage
(Data: *Kharif* season, 2007-2011)

Centers		AAB is weather base							
		Rainfall	Temp		RH	Sunshine	Wind		Cloud cover
			Tmax	Tmin			W.S	W.D	
Parbhani	No. 93	23	20	09	11	25	25	31	18
	%	25	22	10	10	27	27	32	20
Rahuri	No.117	35	20	31	10	27	35	23	52
	%	30	17	27	09	23	30	20	45
Dapoli	No.146	58	21	33	16	32	42	32	80
	%	40	14	23	11	21	29	22	55
Akola	No. 69	10	11	14	10	00	17	12	19
	%	15	16	20	13	00	25	17	27
Jaipur	No.138	25	24	36	20	33	42	26	19
	%	18	18	26	15	24	31	19	14
Sehor	No. 96	18	19	16	07	14	21	17	12
	%	19	20	17	08	17	22	18	13
Raipur	No. 44	10	09	10	06	08	09	09	07
	%	23	20	22	14	19	20	20	17
Total	No.703	170	126	140	78	141	182	147	189
	%	24.28	18.14	20.71	11.42	20.05	26.28	21.14	27.28

Table.3 Alert message given in AAB by different AMFU's in numbers and percentage
(Data: Kharif season, 2007-2011)

Centers		Alert Message given in AAB								
		Rainfal l	Temp		RH		Sunshin e	Wind		Cloud cover
			Tma x	Tmi n	RHI	RHI I		W. S	W. D	
Parbhani	No. 21	17	0.0	0.0	01	01	0.0	0.0	0.0	14
	%	81.6	0.0	0.0	4.8	4.8	0.0	0.0	0.0	67.2
Rahuri	No. 25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dapoli	No. 29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Akola	No. 21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jaipur	No. 32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sehor	No. 34	05	0.0	0.0	01	01	0.0	0.0	0.0	02
	%	14.7	0.0	0.0	2.94	2.94	0.0	0.0	0.0	5.88
Raipur	No. 20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	No. 182	22	0.0	0.0	02	02	0.0	0.0	0.0	06
	%	12.08	0.0	0.0	1.09	1.09	0.0	0.0	0.0	8.79

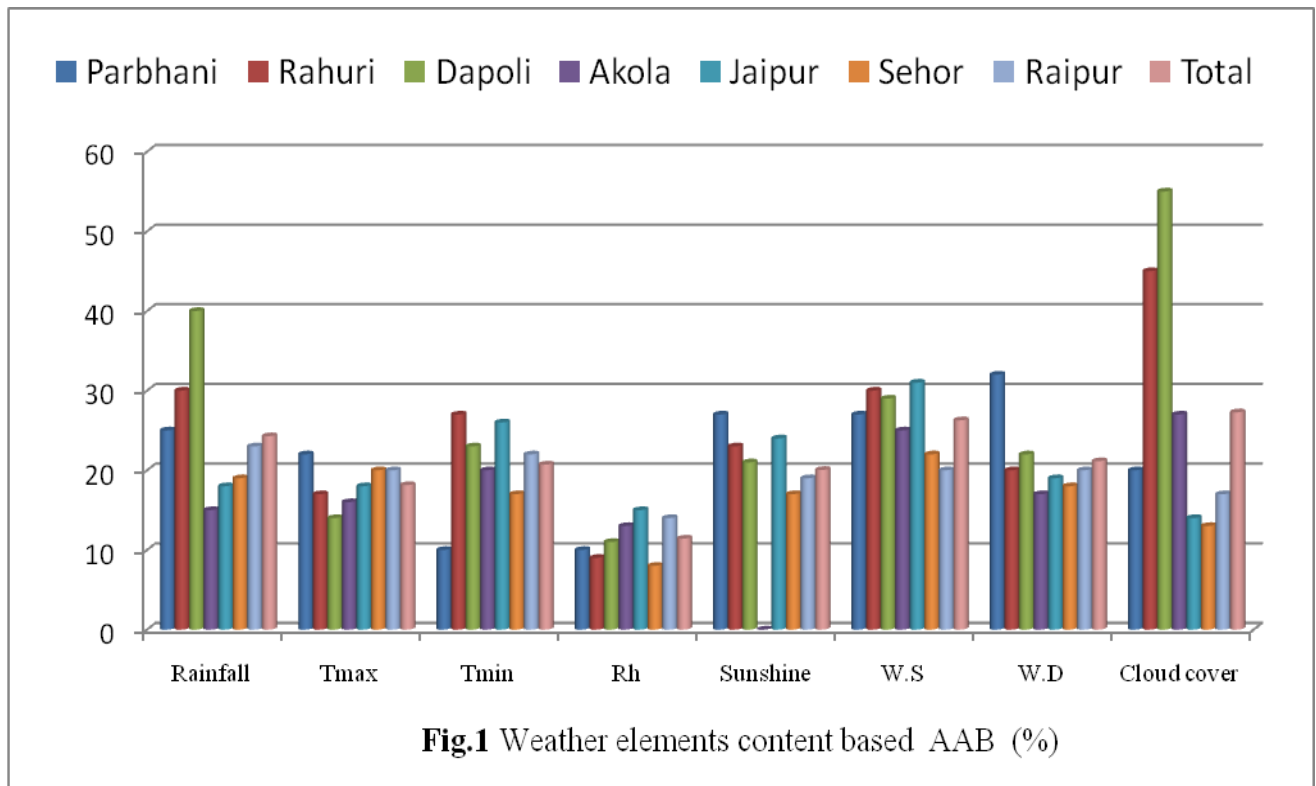


Fig.2 AAB pictures format suitable to multimedia and end users (Format 1)

 <p style="margin: 0;">Vasantrao Naik Marathwada Krishi Vidyapeeth Department of Agricultural Meteorology, Parbhani- 431402 Phone No. 02452-223276 Fax No. 02452-223276 Email : met_mau@rediffmail.com</p> 

Agro Advisory Bulletin (AAB) No. 88/20112 for Parbhani district Date : 20/01/2012	
Previous week weather condition :	Weather condition for 20 to 24 January, 2012
In the previous week weather of Parbhani district was observed clear sky, T_{max} in the range 27.5 to 32.0 °C which is lower by 2.2 °C and higher by 2.5 °C than average, T_{min} in the range 5.2 to 10.8 °C which is lower by 1.7 to 6.9 °C than average and wind speed in the range 2.2 to 4.0 km/hr. which is lower by 0.2 to 1.8 km/hr than average.	In this week weather will be observe clear, wind speed will be blowing by North-East to East direction with 9 to 11 km/hr. speed, maximum temperature are 27.0 to 30.0 °C and minimum temperature are 14.0 to 18.0 °C will be observe and relative humidity will be prevailing 35 to 49 at morning and 22 to 32 at afternoon..

Alert message : In this week temperature may increase and dry and cold wind will blow.

Agromet Advisory :


















Crop Growth Stage	Disease and Pest Incidence	Agro Advise Based on Weather	Crop Growth Stage
			Now the wheat crop is in flag leaf and flowering stage in this critical stage apply the irrigation to wheat. Rust is observed in late sown wheat crop. For controlling rust spray <i>Hexaconazole</i> @ 10 g / 10 lit. of water
			Safflower crop should be irrigated at capsule formation stage. To control aphids spray 4.0 ml <i>imidacloprid</i> or 20 ml <i>dimethoate</i> 30 EC in 10 lit. of water
			Attack of <i>Jassides</i> and <i>Powdery mildew</i> is observed on mango bloom. For controlling <i>Jassides</i> spray of 4.0 ml <i>imidacloprid</i> or <i>thiamethoxan</i> mixed in with 10 lit. of water. For <i>Powdery mildew</i> control spray 1.0 ml <i>Hexaconazole</i> mixed with 10 lit of water.
			Remove the new tillers of banana (De-suckering) and give the soil support at the base of stem. Apply the Nitrogen (Urea) dose 2, 3 and 4 months after plantation of Murgab banana.
			To control gummosis (<i>Phytophthora</i> spp.) apply Bordeaux paste on the stem of plant. For Ambhebar treatment apply soil application @ 20 kg <i>cow dung</i> , 1.5 kg N and 0.7 kg P & K / tree after that give light irrigation to the crop.
	Due to low temperture in last week attack of Foot and mouth disease is observed in Sheep and Goats to control this disease apply 10 gm boric powder + 20 ml glycerine or give B complex tablets to animals by taking the advice of Veterinary Doctor.		

Fig.3 AAB pictures format suitable to multimedia and end users (Format 2)





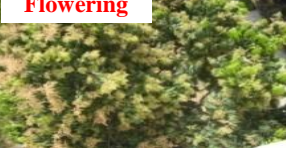

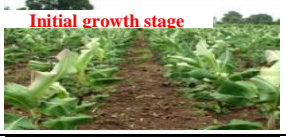




	<p>Vasantrao Naik Marathwada Krishi Vidyapeeth Department of Agricultural Meteorology, Parbhani - 431402 Phone No. 02452-223276 Fax No. 02452-223276 Email : met_mau@rediffmail.com</p>	
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Agro Advisory Bulletin (AAB) No. 88/20112 for Parbhani district Date: 20/01/2012

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Alert message: In this week temperature may increase and dry and cold wind will blow.

Agromet Advisory:

Crop Growth Stage	Disease and Pest Incidence	Agro Advise Based on Weather
		Now the wheat crop is in flag leaf and flowering stage in this critical stage apply the irrigation to wheat. Rust is observed in late sown wheat crop. For controlling rust spray <i>Hexaconazole</i> @ 10 g / 10 lit. of water
		Safflower crop should be irrigated at capsule formation stage. To control aphids spray 4.0 ml <i>imidacloprid</i> 20 ml <i>dimethoate</i> 30 EC in 10 lit. of water
		Attack of <i>Jassides</i> and <i>Powdery mildew</i> is observed on mango bloom. For controlling <i>Jasside</i> stake spray of 4.0 ml <i>imidacloprid</i> or <i>thiamethoxan</i> mixed in with 10 lit. of water. For <i>Powdery mildew</i> control spray 1.0 ml <i>Hexaconazole</i> mixed with 10 lit of water.
		Remove the new tillers of banana and give the soil support at the base of stem. Apply the Nitrogen (Urea) dose 2, 3 and 4 months after plantation of Murgabag banana.
		To control gummosis (<i>Phytophthora</i> spp.) apply Bordeaux paste on the stem of plant. For Ambhebar treatment apply soil application @ 20 kg <i>cow dung</i> , 1.5 kg N and 0.7 kg P & K / tree after that give light irrigation to the crop.
		Due to low temperature in last week attack of foot and mouth disease is observed in Sheep and Goats to control this disease apply 10 gm boric powder + 20 ml glycerine or give B complex tablets to animals by taking the advice of Veterinary Doctor.

However, it was found that a small number of using AAB due to absence of vibrant AAB format and non-photographic information of crop, crop type, growth stage, attack of disease and pest and its control measures, intercultural activities, use of implements and adverse weather condition mitigation practices as well as due to its non-picturesque. To bridge such type of gap, here developed new formats of AAB (Fig. 2 and 3).

The AAB should be weather elements based with a concise and precision advice, focused on season wise agro discipline based covering different aspect viz., crop production, livestock rearing, post-harvest technology, processing, marketing and transport, agro based industries, mechanized farming, soil and water conservation practices etc.; aiming to uplifting socio economic condition of the farming community.

Separate column should be enlightened by the name of 'Alert message' to various adverse weather conditions which would causes extremely damage are lead to crop and livestock rearing. To achieve the visionary target of AAB and for better understanding and utilizable message transfer quicker easily to end users, the format of AAB should readable in local language and easily usable to farmers as well as end users (i.e. information technologist, media peoples and agricultural traders etc.) with attractive mode.

The existing format of AAB was not observed uniform of all the stations and not found easily accessible, usable format to print media. Hence, it is suggested that adopt the concise AAB in simple language and in paragraph format for print media. However, it is recommended that use the AAB Format 1 or Format 2 for extensive publicity and substantial adoptability of AAB through multimedia i.e. cellular phone SMS, through internet and Television etc.

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