

**IMPACT OF AGROMETEOROLOGICAL ADVISORY  
SERVICES ON ECONOMIC LEVEL OF FARMERS  
FROM NANDED DISTRICT UNDER CLIMATE  
CHANGE PATTERN**

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IN  
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PARBHANI - 431 402 (M.S.) INDIA**

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FROM NANDED DISTRICT UNDER CLIMATE  
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**BY**

**RATHOD SANDIP BHIMRAO**

B.Sc. (Agriculture)

A thesis submitted to

Vasantnao Naik Marathwada Krishi Vidyapeeth, Parbhani

in partial fulfillment of the requirement for the degree of

**MASTER OF SCIENCE**

**IN**

**AGRICULTURE**

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PARBHANI – 431 402 (M.S.) INDIA**

**2021**

## DECLARATION BY THE CANDIDATE

I hereby declare that the thesis entitled “**Impact of Agrometeorological Advisory Services on economic level of farmers from Nanded district under climate change pattern**”, submitted by me is based on the actual work carried out by me under the guidance and supervision of **Prof. P. K. Waghmare**. The extent of information derived from the existing literature have been duly cited and referenced. The existing research work or its any part is not submitted anywhere else for the award of any degree or diploma.

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*“If you think yourself strong, strong you will be.”*

*-Swami Vivekananda*

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## ABBREVIATIONS

@	:	At the rate of
%	:	Percent
AAS	:	Agrometeorological Advisory Service
AMFUs	:	Agro- Meteorological Field Units
Avg.	:	Average
BSS	:	Bright Sunshine Hours
B: C	:	Benefit cost ratio
<sup>o</sup> C	:	Degree Celsius
CC	:	Correlation Coefficient
Cm	:	Centimeter
CSI	:	Critical Success Index
DAAS	:	District – Level Agro meteorological Advisory Services
ESSO	:	Earth System Science Organization
<i>Et al.</i>	:	<i>etalli</i> (and others)
FAR	:	False Alarm Rate
Fig.	:	Figure
FWD	:	Farmers Weather Bulletin
GKMS	:	Gramin Krishi Mausam Sewa
Ha	:	Hectore
HKS	:	Hanssen and Kuiper Score
HSS	:	Heidke Skill Score
hrs.	:	Hours
i.e.	:	ldest (that is)
ICTs	:	Information and Communication Technology
IMD	:	Indian Meteorological Department
ISRO	:	Indian Space Research Organization
Kg	:	Kilogram
M	:	Meter
MAAS	:	Micro-level Agro-Advisory Services
Max	:	Maximum
Min	:	Minimum
MRWF	:	Medium Range Weather Forecast
MW	:	Meteorological Week
NCMRWF	:	National Center for Medium Range Weather Forecast
NWP	:	Numerical Weather Prediction
POD	:	Probability of Detection
RD	:	Rainy Days
RF	:	Rainfall
RH	:	Relative Humidity
RMSE	:	Root Mean Square Error
RS	:	Ratio Score
SMS	:	Subject Matter Specialist
Temp	:	Temperature
Tmax	:	Maximum Temperature
Tmin	:	Minimum Temperature

# **THESIS ABSTRACT**

## THESIS ABSTRACT

1. Title of the Thesis : **“IMPACT OF AGROMETEOROLOGICAL ADVISORY SERVICES ON ECONOMIC LEVEL OF FARMERS FROM NANDED DISTRICT UNDER CLIMATE CHANGE PATTERN”**
  2. Name of student : Rathod Sandip Bhimrao
  3. Name of Research Guide : Prof. P. K. Waghmare
  4. Department : Agricultural Meteorology
  5. University : VNMKV, Parbhani
  6. Degree to be awarded : M.Sc. (Agriculture)
- 

### ABSTRACT

A study was, therefore undertaken on the comparison of district level weather forecast with observed weather data for Nanded district during *Kharif* season 2020. The major findings of the study revealed that, the impact Agrometeorological Advisory Services (AAS) advice to farmers production potential of *Kharif* crop in Nanded district. Cost of cultivation practices and best management are identified on the basis of weather based Agro advisory during *Kharif* season 2020 has been done for assessing the impacts of Agro advisory services, 40 users of Agromet Advisory Services (AAS) and 40 non-users of Agromet Advisory Services (non-AAS) were selected from Nanded district.

The study has revealed that, the information gathered through agro-advisory services has been very useful and helpful to the farmers. The AAS farmers are benefitted with the agro- advisory to crop management and animal husbandry. The field operations in management of crop and rainfall, temperature and relative humidity information has been the major aspects on which farmers were interested to get information. Since, the initial stage of the programme, sufficient numbers of farmers have been found to be benefitted through the agro-advisory service.

The results from the investigation revealed that, the economic benefit of AABs to farmers during 2020 in Nanded district was maximum. Amongst 80 farmers, 27 farmers were benefitted with below Rs. 10,000; 21 farmers were benefitted

between Rs. 11,000 to 20,000 and 21 farmers were benefited between Rs. 21,000 to Rs. 30,000 amount. While, 11 farmers were benefitted with an amount of more than Rs. 30,000.

The verification analysis was carried out on weekly, monthly, and seasonal in rainfall, temperature and relative humidity. On the basis of using various verification techniques *viz.*, Ratio score (RH), Root mean square error (RMSE), Crop coefficients (CC), Probability of detection (POD), Heidke skill score (HSS), Hassen and Kuiper (HK), False alarm rate (FAR) and usability analysis during 2020.

The forecast were found depicted that the rainfall correlation coefficients and HSS on weekly basis highest on 0.18 and 0.06, respectively. The monthly basis highest on RS and RMSE value is 78.17 and 7.86, respectively. The seasonal basis found highest on CSI, POD, HK, FAR value is 26, 24.75, 0.24 and 1.85 respectively. The forecast were found depicted that the temperature correlation coefficients highest in season maximum temperature and minimum temperature for 0.49 and 0.38 respectively. The RMSE highest in season for maximum temperature 2.91 and minimum temperature monthly is highest for 3.75 represents. The forecast were found depicted that the relative humidity correlation coefficients highest in season maximum and minimum relative humidity is 0.16 and 0.21 respectively. The RMSE highest in season for maximum and minimum relative humidity is 18.90 and 22.78, respectively.

It was concluded that agro- advisory services have helped in bringing out substantial awareness among farmers about adoption of weather- based advisories, their timely availability and quality of service. It has also helped in encouraging the adaption and use of modern agricultural production technologies and practices, in promoting weather based irrigation management, pest and disease management etc. along with greater use of post- harvest technologies.

**(Keywords:** Agrometeorological, Weather, Forecast, Impact, Temperature, Season)

**CHAPTER – I**  
**INTRODUCTION**

## **CHAPTER - I**

### **INTRODUCTION**

Agriculture in India is dependent on monsoon and under such circumstances the farmers are unaware of the future behavior of monsoon for making decisions on their day-to-day agricultural operations. Farming community needs to be advised on time by producing custom-tailored weather forecasts to initiate suitable measures to increase the production and to minimize the impact of unfavorable weather on agriculture. Weather is an important element for success or failure in agriculture production and economy of the nation. Weather varies with space and time; hence medium range forecast can help to curtail the farm losses through proper management of agricultural operations.

In agriculture, location specific weather forecast in the medium range (3-10 days) holds a greater potential. Keeping this in mind, the National Center for Medium Range Weather Forecasting (NCMRWF) was established in 1988 by the Government of India as a scientific mission operational Numerical Weather Prediction (NWP) model for forecasting weather in the medium range.

India's integrated agrometeorological advisory services are one of the largest agrometeorological information programs in the world. The India meteorological department (IMD) started weather broadcasting services for farmers by radio in 1945. In 1988, the National Center for Medium Range Weather Forecasting (NCMRWF) began piloting agrometeorological advisory services based on 5 days forecasts.

Weather forecast and weather based agrometeorological advisories help in increasing the economic benefit to the farmers. Results have showed that farmers who follow the agrometeorological advisories are able to reduce the input cost and increase their net profit as compared to the non-AAS farmers.

To help farming society in transfer of weather-related farm management practices, IMD is implementing a project called "Gramin Krishi Mausam Sewa" (GKMS). The Government of India has focused on strength and knowledge of farmers on sustainable farm practices in the overall food security of the nation. In agricultural practices and technologies, Indian farmers are facing multiple

problems of sustaining the crop productivity which are linked to variability in weather and climate. To address this issue effectively, the government launched District-Level Agro Meteorological Advisory Services (DAAS) in June 2008. Presently, the weather based agro-advisories are disseminated to the farming community at district level through mass media (radio, print and TV). The outreach of Integrated Agromet Advisory Services system to deliver the information at Block and Panchayat (village) level in a timely manner needs to be stepped up. The Common Service Centre (CSC) department of reformation technology is a good solution to bridge the information gap by exploiting advances in Information technology (IT) in the recent past.

Presently, IMD (preciously NCMRWF), generates location specific medium range weather forecasts for different weather parameters for five days. These are communicated to the AAS units in real time using fast communication facilities like VSAT/ FAX/STD etc. previously and now, by email. On receipt of the forecast at an AAS unit, nodal officer prepares the medium range weather forecast based agrometeorological advisory service in consultation with a panel of experts in various subject matter specialists of agriculture for the farmers through different mass media and subsequently, feedback is obtained. On the basis of local agrometeorological farming information and weather forecasts received from NCMRWF, The Subject matter specialists discuss about options and consequent effects and then decide advices for action by farmers in respect of the items related to their expertise.

AAS bulletins are prepared and disseminated as location, season, weather and crop specific farm level advisories in local languages.

AAB is prepared in four parts *viz.*, 1. Last week observed weather

2. Weather forecast for next five days

3. Alert message

4. Weather based agro advice.

The content involved in AAB is generally given in following aspects:

1) Weather information

2) Weather forecast

3) Alert message

4) Crop information

National Agromet Advisory Bulletin is prepared for national level agricultural planning and management being issued by National Agromet Advisory Service Centre, Agricultural Meteorology Division and Indian Meteorology Department. Prime users of this bulletin are Crop Weather Watch Group (CWWG), Ministry of Agriculture and it is also communicated to all the related ministries (State and Central), organizations and NGOs for their use.

State Agromet Advisory Bulletin is prepared for state level agricultural planning and management. These bulletins are issued from 22 AAS unit at different state capitals. Prime user of this bulletin is State Agricultural Crop Weather Group (ACWWG). This also meant for other users like fertilizer industry, pesticide industry, irrigation department, seed corporation, transport and other organizations which provide inputs agriculture.

District agromet advisory bulletin is prepared for the respective district farmers. The bulletins are issued from 30 AMFUS through 11 centers functioning at state agricultural universities. This contains advisories for all the weather sensitive agricultural operations from sowing to harvest. These weather-based advisories are disseminated to the farmer through mass media (*viz.*, Television, Radio, Newspaper, Internet, etc.)

<http://www.imd.gov.in/services/agromet/agromet-advisory-services.html>

Agromet advisories bulletin are prepared and issued in English as well as local language. However, the quantitative aspects have been analyzed by many AAB units and qualitative aspects are yet to be studied. AAB cannot be commercially viable unit and unless the improvement in the content of AAB and required soil, water and weather-based crop management advice is not involved. Hence, this innovative study has been undertaken entitled “Impact of Agrometeorological Advisory Services on economic level of farmers from Nanded district under climate change pattern” by considering the following objectives:

### **1.1. Objectives:**

- To verify weather forecast and impact of Agrometeorological Advisory Services in Nanded district.
- To identify the proper crop cultivation practices within selected farmers in Nanded district.

**CHAPTER – II**  
**REVIEW OF LITERATURE**

## CHAPTER - II

### REVIEW OF LITERATURE

#### 1) To verify weather forecast and impact of Agrometeorological Advisory Services in Nanded district

Rathore *et al.*, (2004) reported that, weather forecast help in the development of sustainable and economically viable agricultural system and land use management. It also led to an increase in area of agricultural production, reduced losses and risk, increased efficiency in the use of water, labour and energy and judicious use of agricultural chemicals or other agents that contributed to the degradation of the environment. The short rain forecasts though useful for certain applications were inadequate for planning.

Devi and Rao (2008) showed that, the AAS using farmer got- positive impact on farm income during *Kharif* season. In *Rabi* season, apart from area, investments in farm yard manure and plant protection were found to have significant impact. AAS facilitated the management of labour and plant protection effectively through forewarning of pests and diseases, as well as regulating the cultural operations based on weather forewarning. The results also suggested a reorganization of resources for realizing better allocative efficiency for reaping maximum profit. Hence, AAS may be strengthened to include all aspects of farm management.

Rajegowda *et al.*, (2008) stated that, two groups of farmers were formed namely, a group adopting the agromet advisories regularly in their operation and the other group of farmers not adoption of agromet advisories and were compared. For this purpose, about 50 farmers from four villages were identified and agromet advisories were selected. Only to forty farmers in two villages during *Kharif* and *Rabi* seasons and care was taken of implement the advisories by this group. The farmer's using AAS from land preparation to harvest at every stage was worked at and crop growth and yield were monitored regularly in the farmers' field belonging to both groups.

Jagadeesha *et al.*, (2010) reported that, 80 farmers (both using AAS and non using AAS) from 4 villages were identified and AAS information was issued for only 40 farmers in two villages during *Kharif* season and care was taken to implement the advisories by this group. Crop situation of these farmers was compared with nearby fields having the same crops where forecast was not adopted in non-AAS

using farmers. The crop growth and yield was observed to be good and high in case of farmers who adopted the AAS information regularly, compared to the farmers who had not adopted the AAS information.

Imaduddin *et al.*, (2012) reported that, reduction in cost and increases in yield in chilli crop were the two parameters which were studied in order to evaluate the impact on farmers' income. Since RCAC provided crop advisory services to farmers on soil testing, seed, fertilizer and pesticides to be used, costs involved particularly under these four heads were collected. The added returns worked out for the RCAC user-farmers were found to be Rs. 20294/acre. The evaluation clearly indicated that there was a substantial impact of RCAC activities in improving the income levels of the farmers.

Manjappa, *et al.* (2013) stated that, the usability of different forecasted weather elements was more than 70 per cent in most of the years except for wind direction which was less than 50 per cent in most of the years. Further, the survey data revealed that the forecast and related advisories issued for day to day farm activities were found to be excellent in 30.6 cases and satisfactory in 35.3 cases. The economic impact studies indicated that there was considerable benefit to farmers who adopted the advisories made from Agromet Advisory Service (AAS) Unit, Sirsi.

Mummigatti *et al.*, (2013) reported that, the usability of different weather forecast elements was more than 70 per cent in most of the years except for rainfall which was less than 50 per cent. Further, the feedback from farmers revealed that the advisories issued for day to day farm activities, indicated 35 per cent as excellent and 32 per cent as satisfactory. The economic impact varied from 4.76 to 16.66 per cent economic gain to the AAS using farmers over non using AAS, farmers based on the crops they cultivated. It was concluded from the above findings that the medium range forecast issued by Indian Meteorological Department, New Delhi on various weather parameters *viz.*, amount of rainfall, cloud cover, maximum and minimum temperature and wind direction were useful to the farming community to improving the agricultural activity with increasing the farm production.

Rana *et al.*, (2013) reported that, the forecast of rainfall, max and min temp were realized as high as 93.9, 85.2 and 84.1 percent respectively during the post monsoon (October to December) season, compared to 53.2, 71.6 and 74.9 percent in the South West (June to September) monsoon period. The ratio score for all the seasons ranged from 57.6 to 83.6 and HK scores ranged from 0.14 to 0.48. For

rainfall, highest RMSE of 27.1 was recorded in South West monsoon season indicating lower accuracy. The mean annual usability of rainfall, max and min temperature was 74.8, 64.7, 62.1 and 63.3 percent respectively. RMSE for min temperature was found higher than max temperature indicating lower accuracy. The medium range forecasts tested for major crops showed profit due to weather forecasts based on AAS on farmers' field (2.1 to 5.4%) and university farm (8.9 to 14.7%).

Vashisth *et al.*, (2013) the farmers, using agromet advisories, showed increase in the net profit and reduced input cost compared to non-AAS users. The agromet advisory bulletin, based on current and forecasted weather was a useful tool for enhancing the production and income. AAS farmers received weather forecast based agro-advisories, including optimum use of inputs for different farm operations. The increased yield level and reduced cost of cultivation led to increased in net returns.

Khobragade *et al.*, (2014) studied and concluded that, an agro advisory service (AAS) was an effective communication media for transfer of technology regarding climate changes information. Agro advisory services (AAS) provided basic, timely and accurate pre-information of different climate and weather conditions of different crops. Agro advisory services (AAS) were helpful to farmers for increasing their interest, knowledge, adoption and impact of climate changes on agricultural practices.

Tall (2014) stated that, India's integrated Agro-meteorological Advisory Service (AAS) program was one of the largest agrometeorological information programs in the world. The Indian Meteorological Department (IMD) started broadcasting weather services for farmers by radio in 1945. In 1976, IMD started working with state governments to issue forecast-based advisories. In 1988, the National Centre for Medium-Range Weather Forecasting (NCMRWF) began piloting agro-meteorological advisories based on 5 days forecast. IMD took over leadership of the AAS in 2007 and launched a District level Agrometeorological Advisory Service (DAAS) in 2008 with the aim of providing relevant weather information and management advisories at a district scale across the country.

Venkatasubramanian *et al.*, (2014) reported that, the evaluation uncovered a number of effective practices for equitably reaching farmers with relevant and timely agro-meteorological information. The intent was to provide lessons that could be transferred to other locations facing similar challenges in

supporting farmers with climate information services in a variable and changing climate, and used to guide investment in climate/agro-meteorological advisory services elsewhere in the world. Advisories needed to be locally salient for farmers to use and benefit from them. Investment in local down scaling capacity and value-addition was paramount to ensure local salience and usability.

Arunkumar *et al.*, (2015) reported that, the influence of weather on agriculture was essential to plan the activities like sowing, irrigation and plant protection etc. The ratio score (%), H.K. score and RMSE values proved that the predicted rainfall forecast was higher on day 4 for both the identified villages. Through reduced input cost *viz.*, reducing the cost of irrigation and the cost of plant protection, the AAS farmers received an increased net profit of 8.9 per cent at Vavidamaruthur and 7.3 percent at Aylankudi, when compared to the non-AAS farmers. The rainfall forecast received by the AAS farmers helped to save the extra expenditure likely to occur in irrigating the fields and also the advisories provided excellent information regarding the control of various pest and diseases of chilli which rendered the farmers to reduce the input cost and obtain maximum benefit compared to the non-AAS farmers.

Sarmah *et al.*, (2015) carried out an, analysis for the verification of the forecast data, on seasonal and annual (March-February) basis using various verification techniques, *viz.*, ratio score, Hanssen and Kuipers (H.K) Score, Probability of Detection (POD), Heidke Skill Score (HSS), False Alarm Ratio (FAR), Critical Success Index (CSI) and RMSE for rainfall, and RMSE for other parameters (*viz.*, max and min temperature, morning and afternoon relative humidity), usability analysis and correlation approach during March, 2009 to February, 2014. Very good performance was observed for rainfall during pre-monsoon and post- monsoon season. During monsoon season, performance of rainfall was found poor and other parameters were found excellent. In winter, the forecasting performance of rainfall was excellent during all years. Correlation-coefficients were derived between the forecasted and observed values during different seasons. Rainfall was highly correlated during all seasons except monsoon and annual basis. Hence, the forecast was found widely applicable among different user groups.

Ray *et al.*, (2016) tested the validity of weather forecast for monsoon and post-monsoon season separately with real time data observed from station observatory. The ratio scores on Yes/No basis *viz.*, Forecast Accuracy (ACC), Critical

Success Index (CSI), Heidke Skill Score (HSS), Hansen and Kuipers (HK) scores were used for testing of only rainfall prediction. Rainfall was the most important weather parameter in agricultural production and management practices. Therefore, there was need to improve in accurate weather forecasting especially with respect to rainfall because this could be used to facilitate the farmers to make broad decision on crop management operations.

Kothiyal *et al.*, (2017) stated that, the forecast was provided biweekly, Tuesday and Friday while the observed data for the same was collected from IMD approved agrometeorological observatory situated at different SAUs. IMD criteria was followed for assignment of correct, usable and unusable percent and different scores along with statistical interpretation were calculated to test the weather forecast for the weather parameters during 2016-17. The rainfall represented an average good forecast over the year. Maximum temperature had a high usable percent over the year. The overall forecast for minimum temperature was slightly good. FAR was the correct skill score for false alarms while, FAR in combination with POD represented a reliable skill score for rainfall forecast.

Nesheim *et al.*, (2017) reported that, the increased variability of weather patterns placed a huge constraint on farmer's ability to make strategic agricultural practice decisions. In response, public and private agro-met information services could disseminate agro-met information to farmers. An agro-met information service could be based on scientific input from meteorology coupled with agricultural information and this information package could be disseminated by several factors which could play an important role in farmer's agricultural decision making. The usefulness of the agro-met information from farmer perspectives depended on the access, salience and credibility of the information to farmers.

Ray *et al.*, (2017) selected two groups of farmers namely, AAS farmer (a group adopting the agro met advisories regularly in their operation) and non-AAS farmer (group of farmers not aware of agromet advisories). The AAS farmers' crop growth and yield was observed to be good and high as compared to non- AAS farmers. This profit was due to the crop management done by the farmers according to agromet advisory bulletins. Thus, the application of agromet advisory bulletin, based on current and forecast weather could be a useful tool for enhancing the production and income.

Chattopadhyay and Chandras (2018) reported that, Indian Meteorology Department (IMD) National Agro-meteorological Advisory Service (NAAS) program; Gramin Krishi Mausam Seva (GKMS) farmer was receiving the weather-based, crop-focused agro-meteorological advisories at district level for a number of years. With an objective of preparing customized advisory at sub district/block level with medium range block level weather forecast. Thus, small and marginal farmers would be benefitted by these services.

Chaubey *et al.*, (2018) studied that, Agrometeorological advisory services (AAS) communicated to the farmers on daily weather data and weather forecasting was given to the newspapers on phone call. Under increasing threat condition, it was becoming increasingly important for farmers to proactively manage the weather and climate risks to agriculture to protect their livelihoods. Farmers needed both weather and climate services for better crop production. Agromet advisory services were the provision of accurate and locally-appropriate climate and weather information play a vital on risk mitigation in agriculture.

Das *et al.*, (2018) results showed that, the usability of rainfall was higher in pre monsoon, post monsoon and winter seasons. However, during monsoon, the accuracy of rainfall forecast was 78 per cent with RMSE value of 15.3 that indicated the lower accuracy. The maximum temperature forecast accuracy was very good varied from 76 to 88 per cent in different seasons. Similarly, minimum temperature forecast was excellent in monsoon season (88%), and poor in winter season (57%). The wind speed forecast was excellent in all the seasons.

Das *et al.*, (2018) reported that, agrometeorological field unit under the project of Gramin Krishi Mausam Sewa provides weather based crop and location specific advisories and disseminated to the farmers. Studies of different location showed an increase in benefit of farmers those are followed weather based advisories as compared to no advisory followed farmers. The additional benefit was due to the crop management done by the farmers according to weather condition. Study also revealed that, the farmers received more benefit were those who followed weather based advisories in their agricultural operations.

Jaybhaye *et al.*, (2018) reported that, substantial variation in the format of issued AAB by all the stations was observed and formats were not easily usable to print media, SMS through multimedia. Advice on post-harvest technology, processing of agricultural produce, marketing and transport was not observed in AAB. It was

suggested to 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 were most useful weather smart agriculture technological tools that could minimize climatic risks and build a resilient agricultural production.

Ramachandrappa *et al.*, (2018) reported that, Agro advisory services (AAS) were formed to help the farmers in managing climate risks effectively for sustainable and profitable agricultural production. The study showed that the agromet advisory services, for current and forecasted weather were useful farmers to increase the profit and reduced the cost of cultivation and also useful for selection of suitable crops and varieties on real time basis.

Roy (2018) reported that, the main aim of AAS was to gather information on weather and climate, soil related information, and crop based knowledge and combine them with weather forecast in order to provide farmers the vision to manage their decision, which ultimately would bring maximum productivity with minimum loss. While solving the problems of farmers, AAS itself evolved in due course of time. Specific tools were developed to assess weather information for greater efficiency.

Sharma *et al.*, (2018) reported that, correct forecast for rainfall was found to be maximum (99.26%) in post monsoon season, followed by winter season (70.58%), pre monsoon season (59.23%) and monsoon season (40.22%). The correct maximum temperature values were found to be maximum in the post monsoon season (55.50%), followed by monsoon season (34.45%), pre monsoon season (32.63%) and winter season (31.89%). The minimum temperature values were found to be least predicted. The maximum correct values of morning relative humidity (max. RH) were found in the monsoon season (57.08%) followed by post monsoon season (41.65%). In the pre monsoon season and winter season the correct values were 34.39 and 14.76 per cent, respectively. Correlation coefficients were derived between the forecasted and observed values during different seasons. RMSE calculated for all the five days during all the seasons indicated forecast value in agreement with observed value.

Sharma *et al.*, (2018) stated that, medium range weather forecast was provided by IMD using T-80 model at district level for five days in advance. The forecast was provided for seven weather parameters and accurate forecasting of these continued to be a major challenge for scientific community. The forecast was

provided biweekly, Tuesday and Friday while the observed data for the same was collected from IMD approved agrometeorological observatory situated at different SAUs. IMD criteria was followed for assignment of correct, usable and unusable percent and different scores along with statistical interpretation were calculated to test the weather forecast for the weather parameters during 2012-2018.

Sharma and Singh (2018) found that, the medium range weather forecasts with rainfall was one of the most important parameters used for preparing agromet advisory bulletins for the farmers of study area which were very useful for scheduling of sowing, irrigation, agricultural operations and management of pest and diseases of field crops. As weather forecast was in agreement with observed weather, user community based on these forecast and its use in agromet advisory services could save losses /damages of the crops. The farmers felt it to be useful since they received weather based advices on appropriate field operations and management.

Singh *et al.*, (2018) reported that, for assessing the impacts of agromet advisory services, users of Agromet Advisory Services (AAS) and Non-users of Agromet Advisory Services (non-AAS) were selected from different villages of Mahasamund district. Results showed that the farmers, who followed the agromet advisories, were able to reduce the input cost and increased the net profit as compared to the non-AAS farmers in wheat; this profit was due to the crop management done by the farmers according to agromet advisory services.

Kale *et al.*, (2019) undertook a study on, the weather forecast suggesting to farmers for suitable management practices to the weather through timely and accurate weather information. Contingent cropping plans and best management practices were identified on the basis of weather based agro advisory during *Kharif* 2016. The management practices suggested in advisory were easy to understand and could be easily adopted by the farmers on their farm. The farmers also appreciated the management practices given in advisory like sowing, weed management, insect pest and disease management, fertilizer management, cultural practices, harvesting and storage.

Kaur *et al.*, (2019) observed that, the ratio scores were higher in monsoon seasons to compare the values during post- monsoon and winter seasons, indicating the performance of forecast models to be better in post-monsoon and winter seasons than in the summer and monsoon seasons. The relatively higher usability of maximum temperature and minimum temperature was observed during post-monsoon

season, which was important to the farmers in pre-sowing operations of the *Rabi* crop the accuracy of forecast of weather parameters in advance was useful for farmers for doing appropriate field operations and crop management practices.

Dupdal *et al.*, (2020) studied about economic impact of micro-level advisories. Two groups *i.e.* AAS and non-AAS farmers, consisting of 40 farmers in each group were selected through multi-stage stratified random sampling technique. Majority of non-AAS farmers were aware about micro-level AAS but lagged in adopting the service. Farming experience, education, land holding size and income were found to be most important factors influencing the farmer's willingness for pay-based services. Results of economic impact revealed that there was 12 to 33 per cent increase in profit for AAS farmers as compared to non-AAS farmers.

Paparrizos *et al.*, (2020) observed that, verification of European Centre for Medium-Range Weather Forecasts' System 5 (ECMWF SEAS5) seasonal prediction system was performed against ground observations. The results indicated that the skill of both examined products was limited during the pre-monsoon and monsoon periods, especially in the west side of the Bay of Bengal. However, during the dry winter season, skill is high, which could lead to potential agricultural benefits concerning irrigation planning. Inter annual variability and trend indicated that onset dates became later and that the length of the rainy season reduced.

Prasad *et al.*, (2020) reported that, if farmers were aware about the weather factors such as temperature, relative humidity, wind speed, wind direction and rainfall effectively to prevent the crop failure thus could achieve high yield with better economic returns. The correct weather information was necessary to the farmers to plan agricultural operations from selection of crops to post harvest to avoid crop losses. To study the effect of weather based agro-advisory services, a random sample survey was conducted from 60 farmers from villages of Tiruvallur and Tiruttani block of Tiruvallur district. Results indicated that agromet advisory aware farmers increase the income level and reduced cost of cultivation to compare non-AAS farmers.

## **2) To identify the proper crop cultivation practices with in selected farmers in Nanded district**

Rathore *et al.*, (2001) reported that, AAS farmers received medium range weather forecast based agro-advisories including optimum use of inputs for

different farm operations. Due to judicious and timely utilization of inputs, cost of production for the AAS farmers reduced approximately by 3-6 per cent. For AAS farmers at the same time yield level, net returns also increased and reduced the cost of production. Survey is going on data is being to be analyzed by farmers.

Boote *et al.*, (2008) reported that, seasonal daily variations in weather were major determinant of cropping practices, crop yield, disease and crop quality. Crop simulation model had capabilities to predict crop growth response to weather, soils, crop management and genetic factors. It was hypothesized that crop growth model could be used as strategic planning tools with historical weather to improve production as in season agro advisories to advice on weather induced production problems and disease management.

Dakhore *et al.*, (2008) reported that, nearly 18 per cent higher net return was obtained by AAS farmers as compared to non-AAS farmers in tobacco crop which could be attributed to timely agricultural operations, soil moisture management and plant protection majors during crop growing period. In case of potato crops farmers net return increased to the tune of 12 per cent as compared to non-AAS farmers. AAS farmers adopted optimum planting time of potato, while non-AAS farmers not adopted optimum planting time. Delay in planting caused yield reduction of non-AAS farmers as compared to AAS farmers. Thus, by adopting weather based agro-advisory bulletin, AAS farmers had significantly reduced input cost and by this, in an indirect way their net return increased significantly.

Kushwaha *et al.*, (2008) resulted that, the AAS farmers harvested an average of 18.0 and 19.2 q acres<sup>-1</sup> as compared to 17.3 and 18.1 q acre<sup>-1</sup> yield of rice crop, which was 6.8 and 8.9 per cent more than non-AAS farmers for both the *Kharif* seasons of 2004 and 2005, respectively. The AAS farmers were able to reduce 7.6 and 9.0 per cent input cost as compared to non-AAS farmers for both the year 2004 and 2005, respectively. The benefit cost (B/C) ratio of AAS and non-AAS farmers were 1.7 and 1.8 and 1.5 and 1.6 for both the *kharif* seasons of 2004 and 2005, respectively.

Kushwaha *et al.*, (2008) stated that, the AAS farmers were able to reduce 7.6 and 9.0 per cent input cost as compared to non-AAS farmers for both the year 2004 and 2005, respectively. Ultimately the AAS farmers gained 21.8 and 24.3 per cent more income than non-AAS farmers for the year 2004-05 and 2005-06, respectively.

Manikandan Narayanan (2008) reported that, weekly agromet advisory services bulletins on medium range weather forecasting were effectively disseminated to assess the economic impact, involving 40 AAS farmers and 40 non-AAS farmers. The study was taken up weather forecast for 3-4 day ahead, state and of crops that were grown in the region and advisory to be followed on crop management and crop protection measure based on weather forecast. The agro- advisory services based on weather forewarning had significantly impacted on farm management practices and the farmers were really benefited through weather- tuned farming.

Rajegowda *et al.*, (2008) reported that a, the three years study indicated that the farmers who adopted the agromet advisories realized grain yield of 1289 kg/ha<sup>-1</sup> of red gram. The farmers who were not aware of agromet advisories had a grain yield of 1118 kg/ha<sup>-1</sup> in red gram. The farmers who adopted the agromet advisories in their day to day operation realized an average additional benefit of 24.65 per cent in red gram indicating the benefit of agromet advisory.

Rao *et al.*, (2008) found that, the weekly agromet advisory taken up weather, weather forecast for 3-4 days ahead. The benefits in terms of crop yield varied from 6.3 per cent to 19.2 per cent, 6.4 per cent to 12.2 per cent and 7.3 per cent to 8 per cent in rice, banana, and coconut respectively. Hence, the agromet advisory services had positive impact on farmers.

Maini *et al.*, (2011) studied the, percentage increase/decrease in the yield and net return due to AAS. Despite positive effects of AAS on adoption of improved production technologies and practices, marginal differences were found in the yield obtained by AAS and Non-AAS farmers for some crops. Results obtained revealed that the AAS farmers accrued a net benefit of 10-15 per cent in the overall yield and a reduction by 2-5 per cent in the cost of cultivation over the non-AAS farmers.

Vashisth *et al.*, (2013) reported the, impacts of agromet advisory services. The users of agromet advisory services (AAS) and non-users of agromet advisory services (non-AAS) were selected from different villages of NCR. Results showed that users who followed the agromet advisories were able to reduce the input cost and increase the net profit as compared to the non-AAS farmers in wheat, carrot and rice. This profit was due to the crop management done by the farmers according to agromet advisory bulletins.

Murthy *et al.*, (2015) revealed that, the gross returns obtained per acre by medium farmers were high (Rs. 36103.38/acre) as compared to small farmers (Rs. 33318.69/acre) and marginal farmers (Rs. 31371.91/acre) in Dharwad district and medium farmers (Rs. 21318.93/acre), small farmers (Rs. 20438.53/acre) and marginal farmers (Rs. 20361.31/acre) in Haveri district. With respect to net returns obtained, it was also high in case of medium farmers as that of small and marginal farmers. Benefit cost ratio was also high in case medium farmers (1.72), followed by small farmers (1.61) and marginal farmers (1.58) in Dharwad district and medium farmers (1.68), small farmers (1.65) and marginal farmers (1.59) in Haveri district.

Radhika *et al.*, (2015) revealed that, the average total cost of cultivation and net returns of BT cotton was higher in Adilabad district (Rs. 69607 and Rs. 36781.15 ha<sup>-1</sup> respectively) as compared to Guntur district (Rs.63793.2 and Rs. 21901 ha<sup>-1</sup> respectively). The average total cost incurred in the processing of kapas to lint and lint to yarn worked out to be Rs. 4630.87 and Rs. 17201.64 q<sup>-1</sup> of kapas. The gross returns obtained from ginning one quintal of kapas were Rs. 4970.41, of which the returns from main product (lint) were Rs. 3978.81 and that from by product (seed) were Rs. 991.6. The value addition to the product in the process was Rs. 732.41. The net value added as a result of processing of lint to yarn was Rs. 5933.36 q<sup>-1</sup> of lint processed. The ginners had maximum financial profitability (1.86) followed by spinners (1.62) and farmers (1.39).

Pal *et al.*, (2016) showed that, average land holding size of pigeon pea seed farmers was higher in comparison to grain farmers and district average. The study illustrated a ratio of 32:68 towards fixed and variable costs in pigeon pea certified seed production with a total cost of Rs. 39,436 and the gross and net returns were Rs. 73,300 and Rs. 33,864 per hectare, respectively. The total cost of cultivation, gross return, and net return in pigeon pea seed production were higher by around 23, 32, and 44 per cent than grain production, respectively. Hence, production of certified seed resulted in a win-win situation for the farmers with higher yield and increased returns.

Sharma *et al.*, (2016) revealed that, the decrease in price realised from soybean was faster than the real cost of production, indicating declining profitability of soybean cultivation, though it started improving recently. As the productivity of crop was the major factor in reducing the relative cost of production, government

should focus on the non-price incentives to increase the productivity and also to reduce the cost of cultivation, apart from price incentives.

Shelke *et al.*, (2016) revealed that, per hectare cost of cultivation of Bt-cotton was Rs. 67137.76. Among individual items of expenditure, the share of rental value of land was 31.85 per cent, followed by hired human labour (13.79 %), bullock labour (9.21), irrigation (8.17%), seed (7.51%), fertilizers (6.19%), family human labour (5.64%), manure (5.45%), plant protection (3.75%) and machine labour (2.15%), respectively. Per hectare gross returns and net profit were Rs. 129111.85 and Rs. 61974.09, respectively. Output-input ratio was 1.92.

Kumar *et al.*, (2017) found that, total cost of cultivation of red gram for small, medium and large size farms were Rs. 39792.2/ha, Rs. 38504/ha and Rs. 37003.8/ha, respectively. The gross returns obtained per hectare by large size farms were high (Rs. 86025/ha) as compare to medium and large size farms (Rs. 83250/ha and Rs. 80475 /ha), respectively. The net returns per hectare were highest in Large size farms (Rs. 49021.20/ha) as compared to the medium and large size farms (Rs. 44746/ha and 40682.8/ha), respectively. Input-output ratio per hectare was highest in large size farms (1:2.32) compared to medium and small size farms (1:2.16 and 1:2.02).

Pushpa *et al.*, (2017) revealed that, the average, the cost of production on a average was Rs. 78.29 per quintal and the net return per hectare after subtracting the total cost from the gross return was Rs. 54956.01/ha. Whereas, production and returns from wheat and paddy crop were Rs. 714.13/q and Rs. 8614.32/ha and Rs. 614.93/q and Rs. 10870.71/ha, respectively. All the major crops *viz.*, paddy, wheat and sugarcane were profitable for the farmers, but sugarcane was the most profitable crop when compared to the rest, because the per quintal cost of production as well as the per hectare return were more economic than wheat and paddy crops.

Verma *et al.*, (2017) found that, when yield and net return increased in each size group, percentage of yield increased in comparison to local cheque also. The result of productivity clearly showed that the norms of advance package of practices were not properly followed. It showed that results would be better in future when the cultivation process of red gram had good farm planning manner along with the application of better fertilizers, irrigation, inter-cultural and insect pest management resulting better yield and more net returns.

Diwate *et al.*, (2018) collected primary data from 120 farmers by personal interview method with the help of pre-tested schedule. Simple tabular analysis was applied for the comparison of yields and inputs used by the farmers. Results showed that, total cost higher found in FS-1 (Rs. 109617) and least total cost in FS-IV (Rs. 68436). The irrigated plantations played a very dominant role in profitability of the farming systems. Thus, the proper balance between livestock enterprises and crop enterprises needed to be encouraged to bring remaining farming systems more profitable.

Gandhi *et al.*, (2018), showed that the farmers, who followed the agromet advisories, were able to reduce the input cost and increased in the net profit as compared to the non-AAS farmers in wheat. This profit was due to the crop management done by the farmers according to agromet advisory services. Thus, the application of agromet advisory services based on current and forecast weather was a useful tool for enhancing the production and income. It was observed that cost of cultivation came down by 5.3 per cent by the farmers who followed AAS. Net cost: benefit ratio of AAS and non AAS farmers was found to be 1:1.31 and 1:1.19, respectively.

Hagos *et al.*, (2018) revealed that results of the gross margin analysis showed total gross revenue of Birr 10566.38 ha<sup>-1</sup> generated from sales of soybean grain. The average variable cost incurred was 6634.43 Birr/ha. The gross margin and net-farm income was estimated to be 3931.956 and 3629.956 Birr/ha, respectively. The benefit cost ratio amounted to 1.52 which implied for every Birr incurred in costs, the farmer could expect a benefit of 1.52 Birr. Moreover, the sensitivity analysis indicated that profitability of soybean production was more sensitive to reduction in price than to increases in yield.

Maurya *et al.*, (2018) surveyed 60 farmers and the selection of farmers was targeted to only those who cultivated Swarna Sub1. The Swarna Sub1 was the version of Swarna and differences prevailed in their performance on farmers' field during the occurrence of submergence for 1-2 week. However, it could be concluded that swarna sub1 was successfully grown in the area where flood/submergence was not constraining rice cultivation. It was up to farmers to choose them on the basis of best bet whether swarna or swarna sub1, which one was suitable for them. Although Swarna Sub1 was recommended for flood/submergence-prone areas to minimize yield losses, there was no harm if cultivated in flood free area too.

Nayak *et al.*, (2019) stated that, the data collected was analysed using tabulation method along with required statistical tool. Production the productivity but it largely depended on other factors like rainfall and price of the crop. Cost of red gram varied according to size groups of holding. The per hectare cost of cultivation of red gram was highest in small size farms and lowest on large size farms. The cost of cultivation varied among the size groups of red gram growers. The input output ratio is highest on large size farms and lowest on small size farms.

Nirwal *et al.*, (2019) reported that, from two villages total 80 farmers were identified, the 40 farmers AAS in two villages during *Kharif* season are implemented the advisories by the group. The crop situation of these farmers was compared with nearby with non- AAS farmers. The crop was same as in field. The studies showed that the application of agromet advisory bulletin, based on current and forecasted weather, was a useful tool for enhancing the production and income of AAS farmers.

Roessali *et al.*, (2019) showed that, soybean price stability was low, indicating that soybean prices fluctuated with a coefficient of variation of 15.70 per cent. Soybean farming income showed the positive R/C values in Grobogan and Wonogiri, namely 1.18 and 1.15, respectively. The profitability achieved was above the credit interest rate, demonstrating that soybean farming is still feasible. The percentage of the contribution to farm and household incomes was 37.77 and 18.87 per cent, respectively.

Dupdal *et al.*, (2020) reported that, there were considerable economic benefits to farmers who adopted farm advisories issued by AICRPAM centres regularly as compared to non-adopted farmers. Higher crop yields and net returns of AAS farmers as compared to non-AAS farmers were attributed to timely adoption of AAS and better crop management practices like timely sowing, selection of improved crop cultivars, life saving irrigation and management of pest and disease under climatic variability conditions.

Singh *et al.*, (2020) revealed that, the AAS farmers 22 per cent higher net return in wheat crop compared to non-AAS farmers were benefited by timely agricultural operations, rainfall forecasting, recommended dose of fertilizers and efficient irrigation management and standard plant protection. Agromet advisory services (AAS) would be helpful to the farmers in changing weather for decreasing

input cost in agriculture and obtaining profitable agricultural production by adoption of weather based agromet advisory.

**CHAPTER – III**  
**MATERIALS AND METHODS**

## CHAPTER - III

### MATERIALS AND METHODS

The effort was made to adopt appropriate methods, procedure in order to reach reliable unbiased and practical conclusions. This chapter deals with description of the procedure followed for carrying out the investigation. It contains the tools and techniques employed for data collection, the data studying procedure adopted as well as the methods used for analysis of data.

The purpose of this chapter enables the readers to judge the validity of conclusions of the study.

The present investigation was undertaken as studies of Agromet Advisory Bulletin (AAB). The experiment was based on the data collection across the district basically in Marathi language. A questionnaire was prepared as per suggestions given by different experts of various agricultural disciplines and circulated to the farmers and their response was collected through that questionnaire. The details of the materials used and methods adopted for conducting the present investigation are described in this chapter under appropriate heads.

The medium range weather forecast (MRWF) on all weather parameters *viz.*, rainfall, maximum temperature, minimum temperature, RH-I and RH-II received from MRWF for three to four days for the 2020. Attempts to verify the accuracy of weather forecasting as received from MRWF for the year 2020. The forecasts were compared with daily observed weather data for the respective days from the actual data recorded at KVK, Nanded.

The weather forecast was verified by calculating the error structure. To assess the reliability of different weather parameters of the forecast, different validation methods were used. The forecasts of rainfall, temperature, relative humidity were validated by calculating the error structure. The correct and usable cases were summed up and combined values indicated the percent usability of the forecasts. Root Mean Square Error (RMSE), Correlation Coefficient (CC), Ratio Score (RS), Critical Success Index (CSI), Probability of Detection (POD), Heidke

Skill Score (HSS), Hanssen and Kuiper (HK), False Alarm Rate (FAR) was calculated for all the parameters. (Kothiyal *et al.*, 2017).

**Error structure:**

Rainfall: Correct  $\pm 10$ mm, Temperature: Correct  $\pm 1^\circ\text{C}$ , Relative humidity:  $\pm 10\%$ .

**Root Mean Square Error (RMSE):**

$$\text{RMSE} = [1/N \sum (P_i - O_i)^2]^{1/2}$$

Where,

Pi and Oi are predicted and observed values and N is the total number of observations.

**Table 3.1: Ratio score and Hanssen and Kuiper score**

		Observed	
		Rain (Y)	No rain (N)
Forecasted	Rain (Y)	YY	YN
	No rain (N)	NY	NN

$$\text{Ratio score} = (YY+NN) / (YY+NN+YN+NY)$$

$$\text{CSI} = YY / (YY+YN+NY)$$

$$\text{POD} = YY / (YY+YN)$$

$$\text{HSS} = [(NN*YY)-(NY*YN)] / [(NN+YN)*(YN+YY) + (NN+NY)*(NY+YY)] / 2$$

$$\text{HK} = (NN*YY - NY*YN) / (NN+NY)*(YN+YY)$$

$$\text{FAR} = NY / (YY+NY)$$

(Kothiyal *et al.*, 2017).

The verification analysis was carried out on weekly, seasonal (as per IMD standard) as well as yearly basis using various verification techniques *viz.* ratio score, Hanssen and Kuiper score, root mean Square error (RMSE) and usability analysis (Das *et al.*, 2018) during 2020, the correlation analysis showed that there was high correlation between observed and predicted values over the years (Ray, 2016).

The validation of weather forecasts was done for four seasons, *viz.* pre monsoon (March to May), South West monsoon (June to September), post monsoon (October to December) and winter season (January to February) as defined by Indian Meteorological Department. The validation methods suggested by Das *et al.*, (2018) were used.

The utility of the forecast is defined as the percentage of useful cases of all advisories issued irrespective to the specific field operations. This was assessed by seeking an answer to this effect through pre-tested well designed questions in the questionnaire. The economic impact of the agro advisories based on medium range weather forecast was studied on farmers through survey and feedback from the selected representative farmers of the study area to whom agro advisory services (AAS) were provided. The feedback obtained was summarized to draw significant inferences in terms of utility of weather forecasts. The sample size of 80 farmers (40 each AAB and non-AAB) were selected from Nanded district.

The AAB for Nanded district during one year data was collected from GKMS centre, VNMKV, Parbhani and daily weather data collected from KVK, Nanded.

### **3.1 Location of study**

The present study was conducted purposively in Nanded district of Marathwada region of Maharashtra state.

#### **3.1.1 Salient features of the Nanded districts**

Nanded district lies between 18<sup>0</sup>15' to 19<sup>0</sup> 55' North latitude and 77<sup>0</sup> 10' to 78<sup>0</sup> 25' East Longitude at about 489 m. above mean sea level. Nanded is located in the south eastern part of Maharashtra state. It is bounded on the north by Yavatmal district, on the north west by Parbhani district of Maharashtra state, on the east and south east by Adilabad and Nizamabad districts of Andhra Pradesh and on the south by Bidar district of Karnataka state.

#### **3.1.2 Selection of respondents**

Forty farmers each comprising of AAS users and non-AAS users, respectively from randomly selected to form a total sample size of 80 respondents. Respondents were further categorized into marginal, small, medium and large farmers based on holding size of the group's viz., AAS and non-AAS holders. Farmers who were reading and following micro-level agro-advisories displayed by FIFs or receiving information from Department of Agriculture and Cooperation and Farmers Welfare (DAC and FW) through bulk messaging issued by Department of Agrometeorology were termed as AAS farmers. While farmers not caring about display of AABs and non registered farmers in agro-advisory bulk dissemination were termed as non-AAS farmers.

### **3.2 Collection of data**

- a. Medium range forecast by Indian Meteorological Department, Pune
- b. Agrometeorological advisory bulletin collected from Vasantrya Naik Marathwada Krishi Vidhyapeeth, Parbhani
- c. Information regarding dissemination of agrometeorological advisory bulletin through mass media communication agencies and through direct contact with farmers
- d. KVK, Nanded and Cotton Research Centre, Nanded

### **3.3 Study of the structure, forecasting and advisory system of Agrometeorological Advisory Bulletin (AAB) for Nanded district**

For Nanded district, AAB was provided under the project GKMS service by Vasantrya Naik Marathwada Krishi Vidhyapeeth, Parbhani.

### **3.4 Content of weather based AAB, its impact and farmers feedback**

The content of weather based AAB was studied by using previous one year agro-advisory bulletins. Prepared questionnaire as suggested by NCMRWF was circulated to these farmers.

#### **3.4 Impact of AAB**

Through this investigation impact of AAB on the production potential of *Kharif* crops in Nanded district was studied.

#### **3.4.2 Farmers feedback**

The sample size of 80 farmers (40 using AAB and non using AAB) were selected. To have farmer views about the utility of these advisories issued by university experts, a questionnaire as suggested by National Centre for Medium Range Weather Forecast (NCMRWF) was circulated to farmers.

### **3.5 Source of weather information (%)**

AAS farmer received weather bulletins from different sources, *viz.*, radio, television, newspaper, whatsapp group, SMS etc. An attempt has been made by questionnaire ask from AAS farmer about different coverage of farmers by weather information in percentage.

### **3.6 Preparation of questionnaire**

Questionnaire prepared as per suggestions given by NCMRWF was circulated to the farmers. Questionnaire was used on the basis of qualitative and

quantitative aspects included in AAB. The aspects considered for preparation of the questionnaire have been described as below:

### **3.6.1 Observed and predicted weather data availability**

Weather parameters covered in the given forecasting of AAB are:

1. Temperature
  - a. Maximum temperature ( $^{\circ}\text{C}$ )
  - b. Minimum temperature ( $^{\circ}\text{C}$ )
2. Relative Humidity
  - a. RH-I (%)
  - b. RH-II (%)
3. Wind
  - a. Wind speed (km/hr)
  - b. Wind direction (Geographical direction)
4. Rainfall (mm)
5. Cloud cover (Cloudy, partially cloudy and clear)
6. Bright sunshine hours (hrs)

### **3.6.2 Weather forecasting given in AAB:**

1. Weather forecasting given as it is
2. Weather forecasting modified into local input

### **3.6.3 Alert message given in AAB**

### **3.6.4 AAB is weather based**

### **3.6.5 Agriculture advice based on current weather condition (coming week forecasting) and covered aspects stated as below:**

1. Crops covered in particular AMFU's *i.e.* Agronomic crops and Horticultural crops
2. Livestock (*i.e.* Animal and Poultry)
3. Post Harvest technology
4. Processing techniques
5. Soil conservation practices
6. Agricultural marketing
7. Any other information
  - a. Photos
  - b. Graphs
  - c. Tables

### 3.7 Study and analysis of AAB

The collected AAB for the year 2020 and its content was studied by using the data sheet given in Table 3.2.

#### 3.7.1 Statistical analysis

The collected data was tabulated and analyzed by frequency distribution method *i.e.* SPSS (Computerized Software of Statistical Package for Social Science) processed and after the analyzes, the standard format of AAB was suggested.

**Table 3.2: Format data sheet for questionnaire of AAB**

**Date:** / /

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 3.3: Format of monthly, annually and seasonally data sheet used for weather parameter analysis by using SPSS mode**

**A. Monthly different weather parameters covered (%) in AAB**

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	
				As it is		Local inputs					
				No.	%	No.	%				
Rainfall											
Temp	T Max										
	T Min.										
Relative Humidity	RH1										
	RH2										
Sunshine											
Wind	W.S.										
	W.D.										
Cloud Cover											

**3.7.2 Verification of weather forecast data**

The quantitative and qualitative analysis of the forecast in reference to observed real time data were worked out using critical values for various weather parameters as below. The validity and accuracy of forecasts were tested using HK score and RMSE, Correlation Coefficient, Ratio Score, Critical success index, Probability of Detection, Heidke Skill Score, False Alarm Rate.

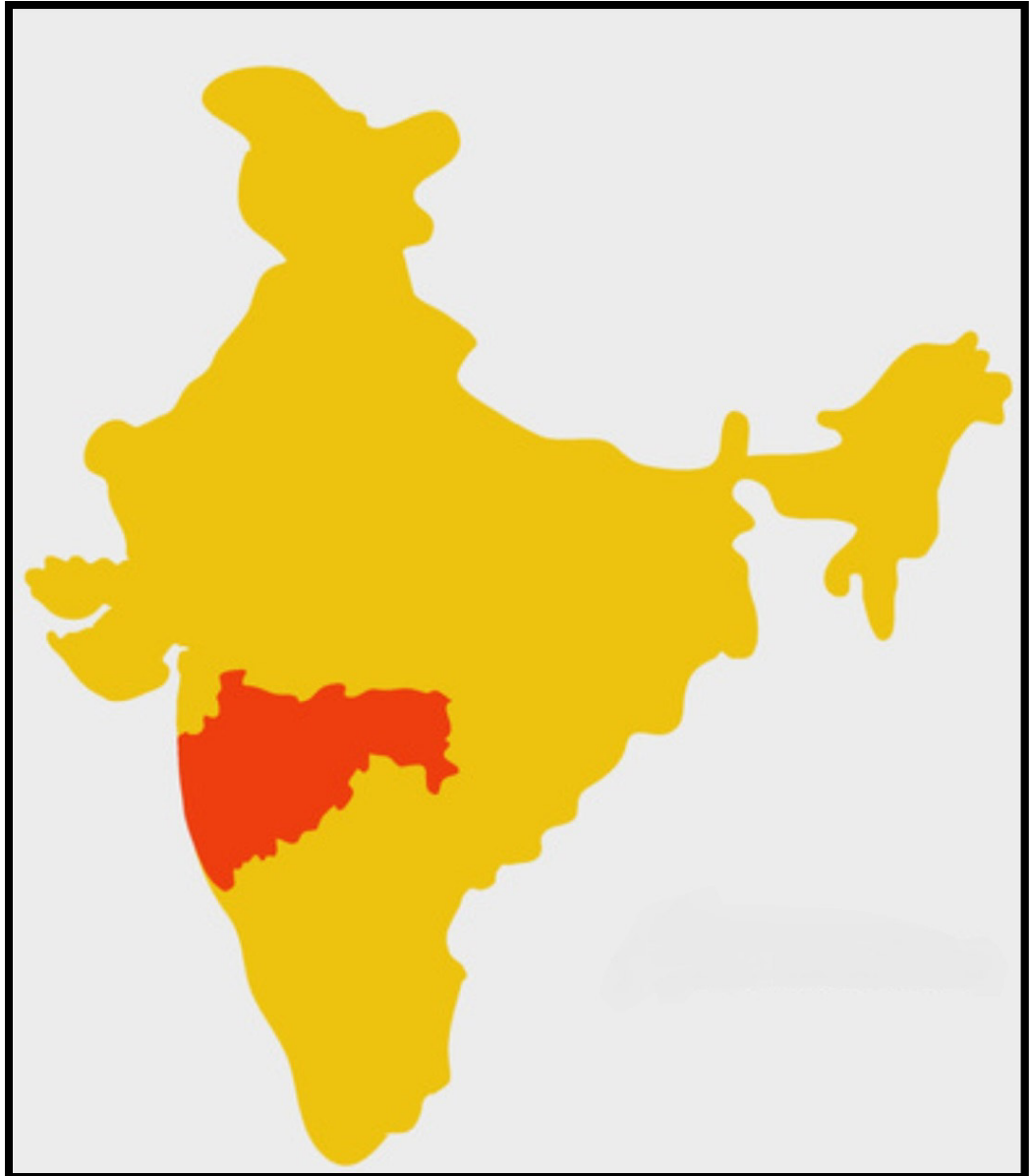
The critical values for individual parameters are presented in Table 3.4 and 3.5

**Table 3.4: Critical values for verification of quantitative precipitation**

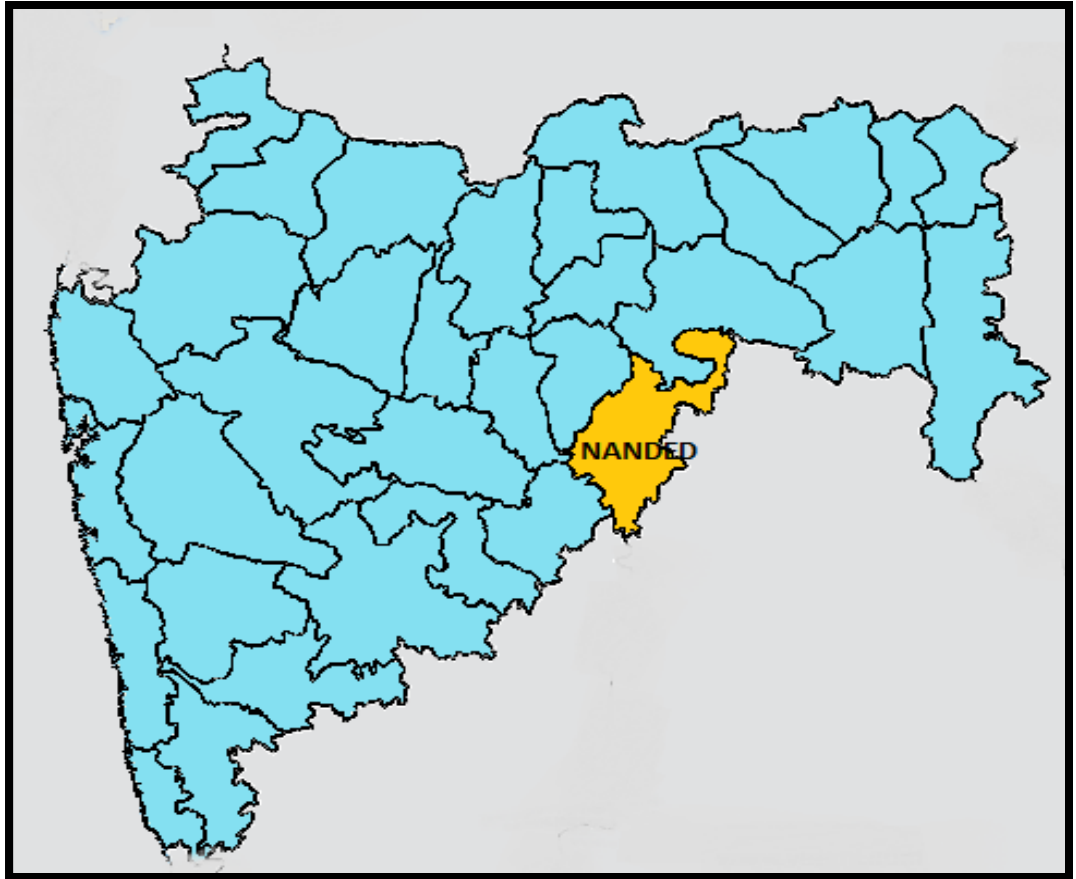
	Error structure	
	Observed < 35 mm	Observed > 35 mm
Corrected	Observed - 5 mm < Fcast < Obs + 5 mm	Observed - 10 mm < Fcast < Obs + 10 mm
Usable	Observed - 10 mm < Fcast < Obs + 10 mm	$0.5 \times \text{Obs} < \text{Fcast} < 2 \times \text{Obs}$
Unusable	Otherwise	Otherwise

**Table 3.5 Critical values of temperature and relative humidity used for verification with real time observation.**

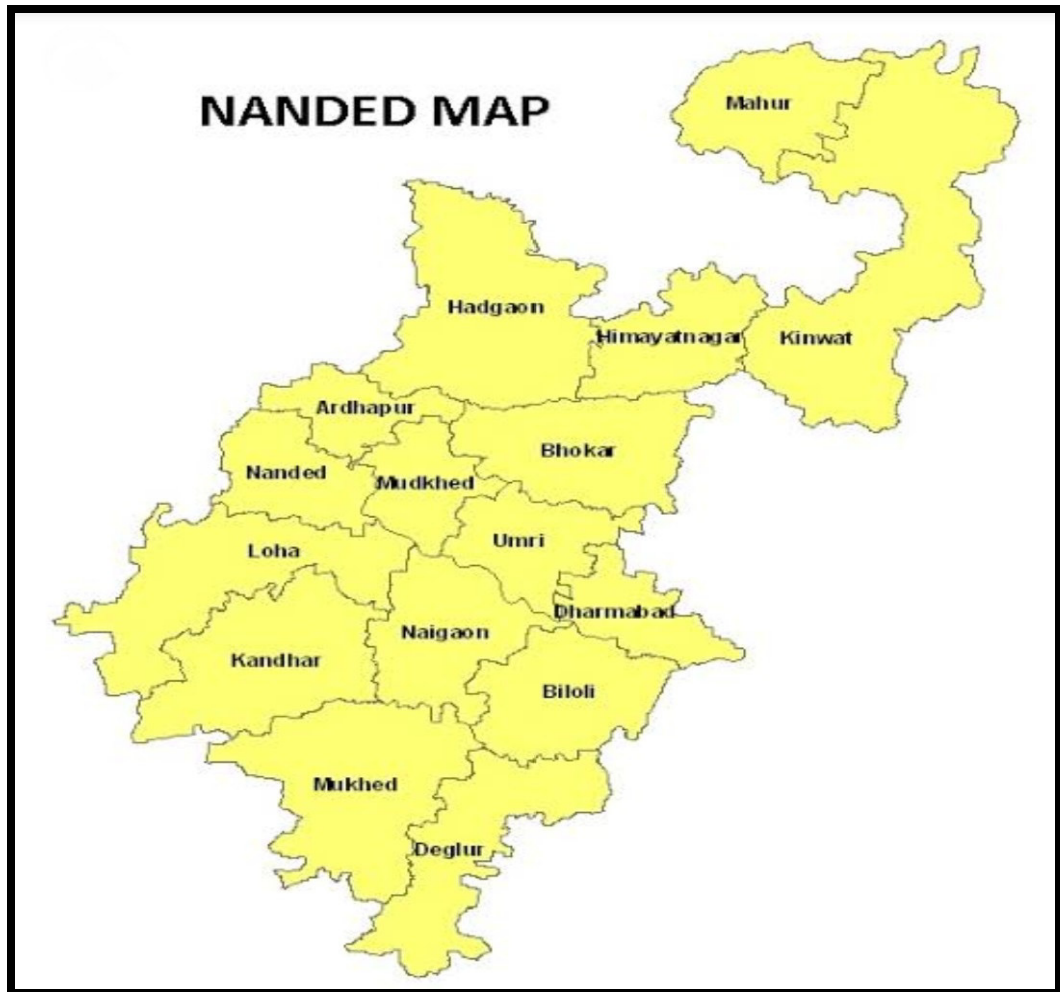
	Temperature <sup>0</sup> C Max. Min.	Relative humidity Max./Min.
Correct	-1 to 1.0	±10
Usable	-2 to 2.0	± 20
Unusable	-3 to > 2.0	> ± 20



**Fig. 3.1: Location of Maharashtra in India map**



**Fig. 3.2 Location of Nanded district in Maharashtra state map**



**Fig. 3.3 Nanded district map**

**CHAPTER – IV**  
**RESULTS AND DISCUSSION**

## CHAPTER- IV

### RESULTS AND DISCUSSION

The present investigation on **“Impact of Agrometeorological Advisory services on economic level of farmers from Nanded district under climate change pattern”** was carried out during the period 2020 at Department of Agricultural Meteorology, Vasantrya Naik Marathwada Krishi Vidyapeeth, Parbhani.

The experimental findings of different aspects of study are discussed for enlightening different objectives of the study in this chapter.

The Agrometeorological Advisory Bulletin (AAB) was started partially since 1987 at selected locations. But nowadays, nearly 130 Agro-Meteorological Field Units (AMFU's) situated across the country which are regularly publishing the AABs twice a week on Tuesday and Friday.

Agrometeorological Advisory Services (AAS) has found the proper crop cultivation practices for transferring the agro techniques and Gramin Krishi Mausam Sewa (GKMS), Parbhani location specific recommendations to the end user. The AAS provides the farmers mitigation techniques on vulnerable information about crop management practices *viz.*, irrigation schedule, pest and diseases management, livestock production and management, marketing and trade management, new scientific storage and processing information. ICTs have become increasingly integrated into the dissemination of information to farmers. For decades “traditional” form of Information and Communication Technology (ICT) have become more prevalent in advisory service provision. The Radio, newspaper, television, sms, and whatsapp sources are providing the weather information for agricultural purpose. National ministry of agriculture has attempted to integrate ICTs into the delivery of information and has established district information centers providing agricultural information. Currently, to most of the farmers' information is provided either by extension workers through libraries or via websites.

The importance of AAS format is brief study of AAS issued alert message and information quality included by GKMS center, VNMKV, Parbhani were studied in respect to format, alert message, given advice on crop, crop management and animal husbandry and dairy science, sericulture management, fodder management etc.

The results obtained from the study and their analysis are discussed in this chapter.

#### **4.1 Advisory system of AAS, Structure of AAS and forecasting of AAS for Nanded district**

##### **4.1.1 Advisory system of AAS**

For Nanded district, AAS is provided under the “GKMS” service by AMFU unit, Vasantnao Naik Marathwada Krishi Vidyapeeth, Parbhani. Details are shown in Table 4.1. The system consists of panel of expert’s preparation of AAS, dissemination of AAS, feedback analysis and verification of forecast.

Presently National Center for Medium Range Weather Forecast (NCMRWF), generates, location specific medium range weather forecasts for rainfall, cloud cover, average wind speed, predominant wind direction and maximum and minimum temperature trends. These are communicated to the AAS units in real time using fast communication facilities like VSAT/FAX/STD/email etc. On receipt of the forecasts at an AAS unit, the nodal officer prepares the medium range weather forecast based agrometeorological advisories in consultation with a panel experts in various subject matters of agriculture and disseminates the same to the farmers through mass media like newspaper, radio, television, personal contacts, Whatsapp, SMS etc. and subsequently, feedback is obtained.

**Table 4.1 Details of Gramin Krishi Mausam Sewa (GKMS) for Nanded district during 2020**

1.	Title of the project	: “Gramin Krishi Mausam Sewa (GKMS)” At Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani- 431 402 (M.S.) India.
2.	D.S.T. sanction No. and date	: NMRF/17/15-93 of May 18, 1993
3.	Name of AAS Unit	: Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani 431 402 (M.S.) India
4.	Agroclimatic Zone AMFU	: Central Maharashtra Plateau Zone Nanded. (M.S.)
5.	Date of start of Agro-Advisory Bulletin	: 18 <sup>th</sup> May, 1993
6.	Weather forecast are received	: Bi-weekly (Tuesday and Friday)
7.	How many times the forecasts were received during the year	: 105 times forecasts were received from 01 January 2020 to 31 December 2020.
8.	How many AAS bulletins were prepared and disseminated to the farmers	: 105 AAS bulletins were prepared for all 08 districts and disseminated to the farmers by direct contact and through mass media communication.
9.	Mode of mass communication adopted for AAS dissemination	: 1) All India Radio Nanded Station. 2) Regional Newspapers. 3) ICTs, VNMKV, Parbhani. 4) Website of VNMKV, Parbhani 5) Website of IMD, Pune 6) By e-mail personally 7) Star Maza, Z-News, DD Sahyadri T.V. Channel and DISH-TV Nanded etc. 8) SMS through KVK'S, District Agril. Officer 9) Audio message by Reliance Foundation. 10) AAB through Whatsapp 11) SMS to farmers through Mkisan portal 12) SMS to Farmers through Mahindra Kisan
10.	Number of AAS bulletins published in newspapers with name of newspapers.	: AAB is published on every Monday regularly in Dainak Lokmat newspaper. Other newspapers are also being provided a copy of AAB regularly. However, they include the same as and when they find space in their newspapers.
11.	Details of AAS bulletin broadcast on AIR/TV	: A copy of AAB is regularly published on IMD website under the state and national AAB. It is also published on the same day on VNMKV, Parbhani web page mkv2.mah.nic.in and broadcasted on AIR, Nanded station on the same day and thereafter, continually.
12.	List of farmer's awareness	: Principal Nodal Officer and Research Associate has participated in various meetings, farmer awareness program etc.

(Source: Annual Progress report of GKMS, VNMKV, Parbhani, 2020)

#### 4.1.1.1 Panel of experts and preparation of AAS

AAS unit constitutes a panel of Subject Matter Specialist (SMS) in agricultural and animal sciences for the preparation of AAS in Marathi and English

language. The expert team at AMFUs consisting of scientists from different disciplines of agriculture includes Agronomist, Plant Breeder, Plant pathologist, Entomologist, Horticulturist, Soil Scientist and also Specialist from Agricultural Extension, Animal Husbandry, etc. These experts meet every week on both Tuesday and Friday, and prepare the agromet advisories for different districts, by analyzing the weather forecast and the previous week's weather conditions confluencing the crop status.

In order to address the problems judiciously, proper knowledge on agricultural situation prevalent in the region is essential. Hence, collected information is discussed prior to the bulletin formulation. These include type, state and stage of crops, prevailing pests and disease, soil moisture status, state of animal health and nutrition. Priority is 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/animal protection from stresses caused by pest and diseases, temperature, wind, rainfall etc. animal shelter, nutrition and their health are affected by weather to a large extent, hence most find place in the AAS bulletin.

#### **A. Techniques used in preparation of AAS bulletins:**

- Soil-water conservation-rain water management through land configurations like BBF to provide adequate drainage needs greater emphases in this crop.
- Efficient use of irrigation water and *in situ* and *ex-situ* rain water harvesting are critical in irrigated and rainfed agriculture, respectively
- Promoting conservation agriculture and other practices to build soil organic carbon.
- The AAS to suggest the farmers for avoiding spraying and irrigation particularly at noontime and high wind speed.
- In early morning or at evening time the sprayings/dustings of various insecticides, pesticides and fungicides were to be done.
- When the predicted rainfall was more than 5.0 mm, the spraying of insecticides, pesticides and fungicides should be avoided.

- Irrigation frequency was to be adjusted according to rainfall situation, soil type and atmospheric evapotranspiration demand and also at critical growth stages of the crop particularly for summer crops.
- Protective irrigation facility should be created by preparation of farm ponds, recharging of tube wells and by saving water per irrigation by adopting drip/sprinkler irrigation in *Rabi/summer* season or in dry spell during *Kharif* season.
- During summer season, to protect the fruit crops from heat stroke, irrigate these orchards with alternate row irrigation technique to save the water and also use of soil mulches to reduce the losses of soil moisture *i.e.* weather modification for microclimate of crop.
- Nursery seedlings in horticultural vegetables were always preferred for planting; it was useful to increasing the net income as well as saving the water and also labour charges.

#### **4.1.1.2 Dissemination of AAS**

The weather based agromet advisory bulletin prepared in both English and Marathi language were disseminated regularly through different means *viz.* newspaper, mobile sms, whatsapp, radio, television, IMD websites, village level agriculture officers etc. To develop confidence in the advisories initially, each unit selected about 40 progressive farmers in Nanded district and disseminated the advisories to them. Farmers made use of these services for planning the operations like sowing, irrigation, application of fertilizer and pesticide, harvest and protection of crops from weather disasters. Farmer's feedback was utilized to improve the advisory system. AAS units utilized services of all the organizations including non-governmental organizations and all available modes of mass dissemination at their disposal to disseminate AAB to help the farmers to increase their income by suggesting them suitable management strategies to alleviate the adverse impact of forecasted weather.

#### **4.1.1.3 Feedback analysis and verification of forecast**

In order to improve the quality of the weather and agro advisory services, regular direct interactions were being made by the Project Officers/Climatologist of this organization with the farmers. The feedback would

comprise information on weather forecast based information provided and how this information helped the farmers for agricultural operation and livestock component as well as any further suggestion. This was being done from the beginning of the advisories under NCMRWF. Farmers had also provided qualitative information regarding economic impact of the advisories in terms of saving in the input costs and better production by scheduling of agricultural practices as per advisories.

#### **4.1.2 Structure of AAS**

Structure of AAS was formulated in three parts. The first part of AAB consisted of weather events occurred during past week and weather forecast for 5 days ahead. The forecast was given to farmers with the expected weather on amount rainfall, maximum and minimum temperature, relative humidity, total of sunshine hours, average wind speed, wind direction and total cloud cover.

The AAS issued by GKMS, Parbhani for Nanded district was in tabular form in which first table adjusted to it contained forecasted weather information for next 5 days.

The middle of bulletin had alert message given on the basis of weather conditions. The last part was based on weather forecast, abiotic weather related stress for crops, livestock and poultry of the district/block need to be formulated. Crop specific advisory took care of the phenological phases of the crop and their relation with the weather variable based on which weather forecast based agromet advisories were formulated.

#### **4.1.3 Forecasting of AAS for Nanded district**

Weather forecasts were divided into three categories, *viz.*

- i. Short range forecast (upto 72 hours)
- ii. Medium range forecast (upto 10 days)
- iii. Long range forecast (more than 10 days)

For Nanded district, GKMS unit of VNMKV, Parbhani published medium range weather forecast for next 5 days in advance. It was helpful in daily operational activities and also for taking measures to offset ill effects on crop in the field and fore planning routine operational activities.

The detailed study of AAS for Nanded district concluded that the weather forecast of GKMS unit related to agriculture for Nanded district included following points.

#### **4.1.3.1 Temperature**

The temperature is more important for growth and development of crop plants as well as its pest and diseases. For most of plant species, vegetative development usually has a higher optimum temperature than for reproductive development. Thermal regime beyond cardinal points is detrimental to the crop activity and their extremes. To predict their growth and development hinges on the skill of the temperature forecasts. It also gives the forecasts for maximum and minimum temperature which is useful for assessing likelihood of frost condition.

#### **4.1.3.2 Wind**

Wind forecast was also included in the forecasting of AAS for Nanded district. The AAS suggested farmers to avoid spraying the insecticides and pesticides, irrigation during high wind speed. Forecast of wind direction and speed included expected variations.

#### **4.1.3.3 Cloud cover**

Cloud cover forecast also was included in the forecasting of AAS for Nanded district. Cloud cover factor decreased bright sunshine (BSS) and temperature and also rainfall parameter dependent on cloud cover.

#### **4.1.3.4 Rainfall**

The rainfall is very important for the survival of plants and animals. The probability of getting certain amount of rain as well as likelihood of dry weather was forecasted which was useful for planning various agricultural operations. AAS also suggested the farmers the spraying of  $KNO_3$  to conserve moisture of crop to increase the yield during drought like conditions.

#### **4.1.3.5 Humidity**

Relative humidity forecast also was included in the forecasting of AAS for Nanded district. The relative humidity was maximum during night and minimum during afternoon time.

### **4.2 Content of weather based AAB, its impact and farmer feedback**

#### **4.2.1 Content of weather based AAB**

##### **4.2.1.1 Agromet advisory contains the following aspects:**

- 1) Field crops
- 2) Fruit crops
- 3) Vegetables
- 4) Cash crops

- 5) Animal Husbandry
- 6) Agril. Engineering
- 7) Sericulture
- 8) Fodder crop

The number of AAB covered different agricultural disciplines an advice under agromet advisory during the period of study 2020 is given in percentage in Table 4.2. The data revealed that the advice or message percentage was more on crop which was major crop of that region.

Total 105 AAB issued by the GKMS unit Parbhani for Nanded district are presented in Table 4.2 which covered the different crops as follows:

The issued agromet advice for sugarcane crop covered most of the time issued AAB percentage (40.0%) followed by cotton and pigeon pea crop (34.3%), soybean and pearl millet (22.9%), wheat (20.9%), chickpea and groundnut (19.0%), safflower (18.1%), green gram and black gram (17.1%), and sunflower (16.2%) was observed.

Amongst the fruit crop crops, citrus spp. covered the most of time in issued AAB i.e. (40.0%), followed by banana (34.3%), mango (32.3%), pomegranate and grape (30.5%), custard apple (28.6%), sapota (27.6%), ber (21.9%) and guava (20.0%) observed.

While, amongst the vegetable crops, turmeric and ginger covered most of time in AAB (32.4%), followed by chilli and cowpea (28.6%), brinjal (27.6%), tomato and okra (23.8%), onion (20.0%), cauliflower (17.1%) and spinach (9.5%) was observed.

Amongst all flower crops rose recorded of the time covered in AAB i.e. (11.4%), followed by marigold (10.5%), gladiolus (9.5%), aster (8.6%), jasmine (7.6%), glaridia (6.6%) and tube rose (4.7%).

Other fodder crop like maize covered the most of time in AAB i.e. (7.6%), followed by berseem (5.7%), sorghum (4.7%) and lucerne (2.8%) was observed.

Amongst livestock management animal and poultry management practices based agromet advice incorporated issued AAB were about (61.9%) and (7.6%), respectively.

It was observed that AAB agricultural engineering aspect was also incorporated during issuing agromet messages and this aspect was found 6.6 per cent.

It was also observed that the AAB sericulture was issuing agromet advice at about 59.0 per cent.

**Table 4.2 The agro advice of AAB covered different agricultural disciplines with required crop season (2020) issued by GKMS Parbhani center for Nanded district**

**(A) Agronomical crop**

A.C.	Groundnut	Pearl millet	Sorghum	Cotton	Soybean	Sugarcane	Wheat	Green gram	Black gram	Pigeon pea	Safflower	Sunflower	Chickpea
No.	20	24	26	36	24	42	22	18	18	36	19	17	20
%	19.04	22.85	24.76	34.28	22.85	40	20.95	17.14	17.14	34.28	18.09	16.19	19.04

**(B) Horticultural crop**

Veg.	Chilli	Brinjal	Tomato	Okra	Onion	Turmeric	Ginger	Garlic	Cauliflower	Spinach	Cowpea
No.	30	29	25	25	21	34	34	12	18	10	30
%	28.57	27.61	23.80	23.80	20	32.38	32.38	11.42	17.14	9.52	28.57

**(C) Fruit Crop**

F.C.	Citrus	Guava	Pomegranate	Mango	Ber	Sapota	Grape	Banana	Custard apple
No.	42	21	32	34	23	29	32	36	30
%	40	20	30.47	32.38	21.90	27.61	30.47	34.28	28.57

**(D) Flower**

Flower	Glardia	Rose	Marigold	Aster	Tube rose	Gladiolus	Jasmine
No.	7	12	11	9	5	10	8
%	6.66	11.42	10.47	8.57	4.76	9.52	7.61

**(E) Fodder crop**

F.C.	Maize	Lucerne	Berseem	Sorghum
No.	8	3	6	5
%	7.61	2.85	5.71	4.76

**(F) Livestock**

Livestock	Animal	Poultry	Fish
No.	65	8	0
%	61.90	7.61	0

**(G) Sericulture**

Sericulture	Seri.
No.	62
%	59.04

**(H) Agricultural Engineering**

A.E.	A.E.
No.	7
%	6.66

#### 4.2.2 Impact of Agrometeorological advisory services on the production potential of *Kharif* crops of Nanded district

By the study of last year's AAB and annual reports of integrated agro-advisory services (AAS), the following events of economic gain or loss were formulated. Usefulness of AAB specified selected cases when advisories were helpful or otherwise will help in assessing the impact of favorable weather on overall growth, development and final yield of the crop.

The ultimate aim of weather based AAS was to help the farmers in enhancing the economic benefit by suggesting management practices suiting the anticipated weather conditions. This would give agromet advisories that would increase profits by consistently delivering actionable weather information, analysis and decision support for farming situations such as pest management through forecast of relative humidity, temperature and wind; water management through rainfall forecasts and crop protection from thermal stress through forecast of extreme temperature conditions. Specific instances of benefit/loss due to AAB with cultural practices, sowing, spraying, pesticides, irrigation, fertilizer application and labour saving etc. were modified as per advisories.

This would help in conducting farm operation in tune with weather forecasts leading to energy- saving, enhancing the efficacy of inputs such as fertilizer, pesticide, etc. cutting the cost of cultivation and saving crop from adverse weather. Moreover, price analysis of inputs and output used was calculated by considering the current price of seeds, fertilizers and pesticides as well as cost of labour (human and machines), cost of irrigation, cost of product/by product and any other associated cost.

**Table 4.3 Indicators for assessment of economic benefits**

<b>Approaches</b>	<b>Indicators</b>
Quality analysis of inputs	(a) Quantity of seed, fertilizers, pesticide.
	(b) Number of labours (human, machine)
	(c) Numbers of irrigation
Price analysis of inputs used	(a) Price of seed, fertilizer, pesticide
	(b) Cost of labours (human, machine)
	(c) Cost of irrigation
	(d) Cost of product /by product
	(e) Any other associated cost

**Table 4.4 Economic impact indicators**

<b>Parameter</b>	<b>Indicator</b>
Yield	Difference in yield of AAS and non-AAS farmers
Cost	Difference between total paid out cost (per acre) of AAS and non-AAS contact farmers
	Changes in cost per unit of output
Profitability	Difference in return over paid out cost (Rs/acre) of AAS and non-AAS contact farmers
Utility	Increase in utilization by farmer for maneuvering cultural operations

**Table 4.5 Economic impact of agromet advisory gain/loss:**

<b>Sr. No.</b>	<b>Forecasted weather parameter event date</b>	<b>Crop cultural operations recommended in AAB</b>	<b>Economic gain/loss</b>
<b>1.</b>	Due to in month of May 2020, summer temperature increased special bulletin was prepared in crop management.	AAB was suggested to farmers to protect the animals and horticultural crops like banana, pomegranate from heat wave.	<b>Gain:</b> In this month temperature increase of 45 <sup>0</sup> C was recorded and due to AABs farmers were protect their crops in heat wave.
<b>2.</b>	During the month June 2020 weather forecast was published for progress of monsoon for sowing purpose and seed treatment of crops.	The good rains received in this week (100/mm) increased sowing percentage and seed were treated before a sowing.	<b>Gain:</b> Seed treatment was must because of increasing the germination percentage and removing the seed borne disease in crop for farmers which saved the cost of seed, fertilizer and labour charges by using AAB.
<b>3.</b>	In month of August 2020, prediction of dry spell.	AAB suggested farmers for mulching, soil moisture conservation, irrigation, spraying of KNO <sub>3</sub> .	<b>Gain:</b> Farmers who adopted AAB techniques saved their crops under the dry spell and increased the survival ability of these crops.
<b>4.</b>	The excess amount of rainfall received was published during month of October 2020.	Farmers were advised to apply for harvesting of soybean crop and store the harvest at safe place.	<b>Gain:</b> Due to adaption of AAB, farmers utilized techniques to save the crop and storage at safe place in rainfall.

From the Table 4.5 it is formulated that the forecasted information through AAB is economically useful to farmer for avoiding the losses of crop yield due to abnormal weather conditions.

**Table 4.6 Economic impact of agromet advisory**

<b>Sr. No.</b>	<b>Points considered</b>	<b>Impact on farmers</b>
1.	Seed treatment mostly useful for crops like soybean, black gram, green gram, pigeon pea.	Seed treatment plot yields increased 20% as compared to non- treated plots
2.	To apply protective irrigation in crops	Appropriate management of water in scarcity condition
3.	Hand hoeing, harrowing between rows of crops like cotton, pigeon pea, soybean	During dry spell, condition most of the farmers applied these practice
4.	Spraying of organic insecticides like Neem Seed Kernel Extract (NSKE)	Organic insecticides gave good result also like chemicals in pest control but had less amount of cost for purchasing
5.	Regarding vaccination to animal for disease like FMD and Deworming, etc.	In vaccinated animals there was no disease caused during entire season, up to 90% cost reduction in those animal vaccinated
6.	Apply fertilizer dose on the basis of soil testing report issued under NICRA demonstration component	Reduction in fertilizer cost up to 30% and also nutrient management of fruit crop like pomegranate, citrus, etc.
7.	Sowing across slope	Reduction in soil erosion, also reduction in fertilizer loss in field during high rainfall intensity
8.	Intercultural operations were done across the slope in fallow land	To conserve soil moisture in soil for <i>Rabi</i> crop
9.	Concerning supplemental irrigation to proper growth stage of <i>Kharif</i> crop	Reduced crop losses against water availability

In all 40 progressive farmers from Nanded district were selected to know their views about the utility of these advisories issued by university experts. A questionnaire as suggested by NCMRWF is circulated to them. In general, the result or the formation of questionnaire collection shown in Table 4.6

The results from the investigation revealed that the economic benefit of AABs to farmers during 2020 in Nanded district was maximum are presented Table 4.7 and Fig. 4.1. Amongst 80 farmers, 27 farmers were benefitted with below Rs. 10,000; 21 farmers were benefitted between Rs. 11,000 to 20,000 and 21 farmers were benefitted between Rs. 21,000 to Rs. 30,000 amount. While, 11 farmers were benefitted with an amount of more than Rs. 30,000.

**Table 4.7 Economic benefit of AAB Farmers:**

<b>Rs./ ha</b>	<b>No. of Farmers</b>
< 10000	27
11000 – 20000	21
21000 – 30000	21
> 30000	11

#### **4.2.2.1 Impact of AAS on Soybean crop production**

##### **A. Comparative analysis of cost of cultivation of sampled farmers:**

The economic benefit obtained by farmers following the agro met has been evaluated for *Kharif* seasons for the period 2020. Total cost of cultivation, crop yield and net returns for soybean crop grown by the AAS and non-AAS farmers during *Kharif* season are presented in Table 4.8 and Fig. 4.2. The analysis was done based on the mean data of 40 AAS and 40 non-AAS farmers in Nanded district. Based on the observed data and the benefit cost ratio, it was assessed that by receiving the AABs in real time, the AAS farmers were able to reduce the input usage by limiting necessity based agricultural practices by changes or variations in the expected weather conditions.

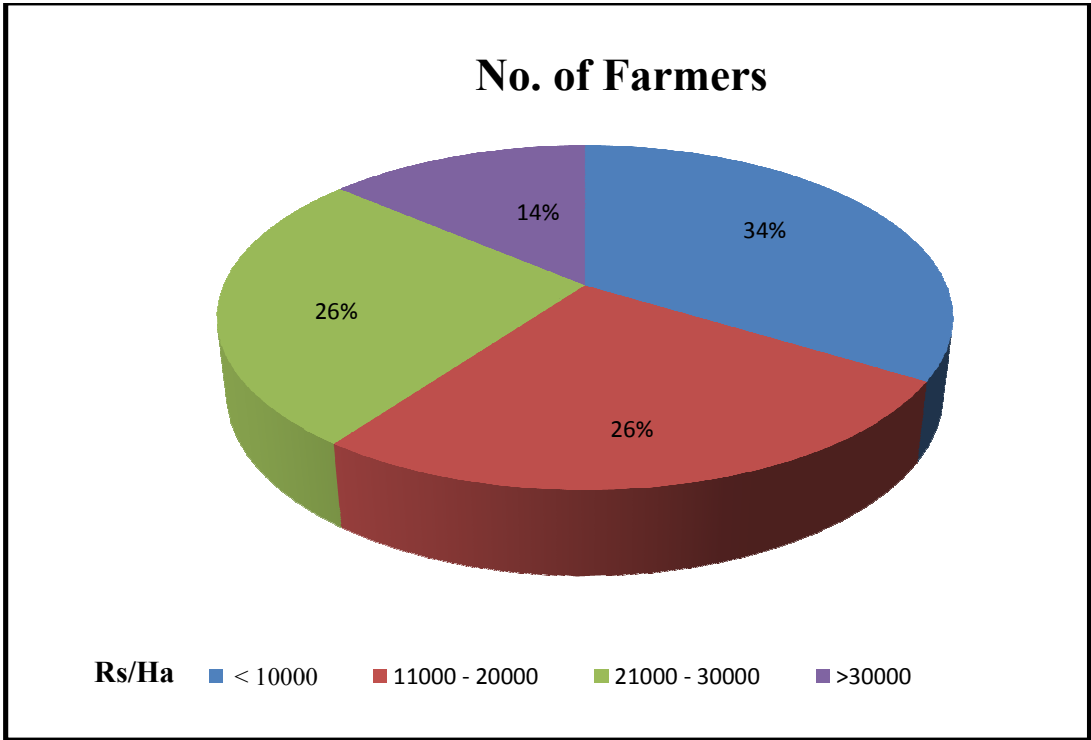
The average cost of cultivation of soybean crop was Rs. 41900/ ha and Rs. 44300/ha at sampled farms of contact and non-contact farmers respectively. Overall, the average cost of cultivation in case of non-AAS farmer was found to be higher by Rs. 2400 as compared to AAS farmer. The total cost of cultivation was found to be lower in the case of AAS farmers who had effectively adopted the agro-advisory compared to non-AAS farmers. From the Table 4.8 and Fig. 4.2 it was observed that the AAS farmers realized good benefit than non-AAS farmers. Similarly, even here also, the yield and other returns were lower in case of non-AAS farmers compared to the AAS farmers. Net cost: benefit ratio of AAS and non-AAS farmers was found 1:1.71 and 1:1.31 respectively.

**Table 4.8: Expenditure under different field operation of Soybean crop of AAS and Non-AAS farmers**

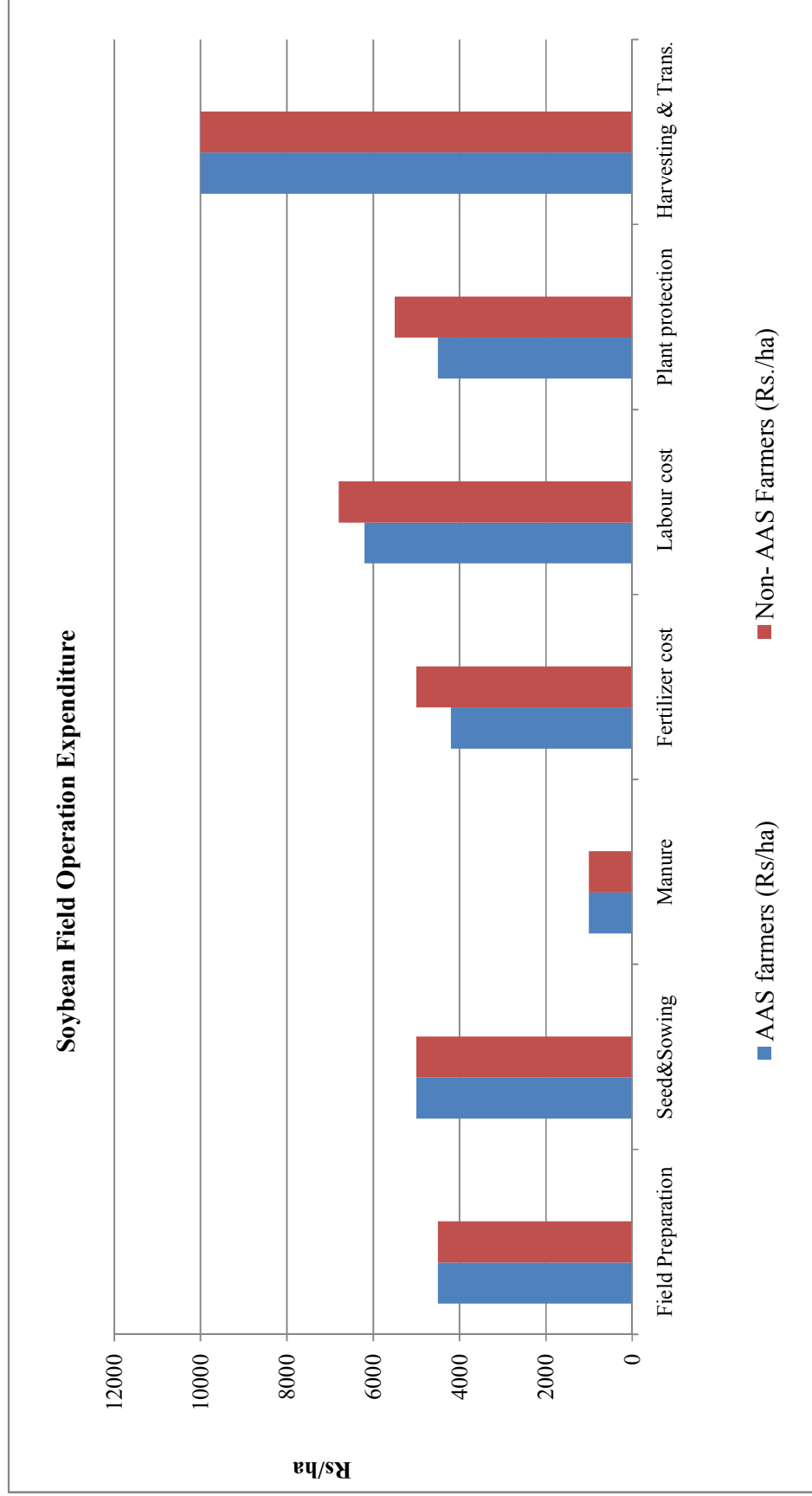
<b>Input Details / ha</b>	<b>AAS farmers (Rs./ha)</b>	<b>Non AAS Farmers (Rs./ha)</b>
1. Field preparation cost / ha	4500	4500
2. Seed cost / ha	5000	5000
3. Manure	1000	1000
4. Fertilizer cost	4200	5000
5. Labour cost including irrigation ( Weeding, spraying, hoeing by bullock)	6200	6800
6. Cost of plant protection /ha	4500	5500
7. Harvesting and Transport	10000	10000
8. Land rent	6500	6500
9. Cost of cultivation	41900	44300
10. Yield (q/ ha)	18	15.50
11. Price (Rs/q)	4000	3750
12. Total Income	72000	58125
13. Net profit	30100	13825
14. Benefit cost ratio	1.71	1.31

#### **4.2.2.2 Impact of AAS on Cotton crop production**

The benefit cost ratio was calculated during the *Kharif* season of 2020 are presented in Table 4.8 and fig. 4.3 at Nanded district based on the data on seed cost, fertilizer cost, irrigation cost, total labour cost, machine charges and various plant protection cost and net profit was calculated per hectare. The analysis was done based on the mean data of 40 AAS and 40 non-AAS farmers in the Nanded district. The average cost of cultivation of cotton crop was Rs. 42000/ha and Rs. 52000/ha at sampled farms of contact and non-contact farmers respectively. Overall, the average cost of cultivation in case of non-AAS farmer was found to be higher by Rs. 10000 as compared to AAS farmer. The gross returns of AAS farmers and non-AAS farmers is Rs. 98050 per ha and Rs. 84000 respectively. Net cost: benefit ratio of AAS and non AAS farmers was found 1:2.33 and 1:1.61 respectively. Based on the observed data and the benefit cost ratio, it was assessed that by receiving the AABs in real time, the AAS farmers were able to reduce the input usage by limiting necessity based agricultural practices by changes or variations in the expected weather conditions.



**Fig. 4.1 Economic benefit of AAB Farmers**



**Fig. 4.2 Expenditure under different field operation of Soybean crop of AAS and Non-AAS farmers**

**Table 4.9 Expenditure under different field operation of Cotton crop of AAS and Non-AAS farmers**

<b>Input Details/ ha</b>	<b>AAS Farmers (Rs./ha)</b>	<b>Non AAS Farmers (Rs./ha)</b>
1. Field preparation cost / ha	4500	4500
2. Seed cost / ha	2200	2200
3. Manure	800	1000
4. Fertilizer cost	6500	7500
5. Labour cost including irrigation ( Weeding, spraying, hoeing by bullock)	6000	7200
6. Cost of plant protection /ha	7500	8100
7. Harvesting (Picking )	8000	8500
8. Land rent	6500	6500
9. Cost of cultivation	42000	52000
10. Cotton yield (q/ ha)	18.50	16.00
11. Price of Cotton (Rs./q)	5300	5250
12. Total Income	98050	84000
13. Net profit	63300	32000
14. Benefit cost ratio	2.33	1.61

#### **4.2.2.3 Impact of AAS on pigeon pea crop production**

The comparative picture of cost of cultivation of pigeon pea crop on the AAS and non-AAS farmers is represented in Table 4.10 and Fig. 4.4. The average cost of cultivation of pigeon pea crop is Rs. 35800/ha and Rs. 38000/ha at sampled farms of contact and non-contact farmers respectively. Overall, the average cost of cultivation in case of non-AAS farmer was found to be higher by Rs. 2200 as compared to AAS farmer. From the Table 4.10 and Fig. 4.4 it was observed that the AAS farmers realized good benefit than non-AAS farmers. Similarly, even here also, the yield and other returns were lower in case of non-AAS farmers compared to the AAS farmers. On the other side the reduced cost of cultivation per hectare in case of AAS farmers showed the application of agricultural inputs judiciously and efficiently as per weather forecast support and including the advisories in operational farm

management. Net cost: benefit ratio of AAS and non-AAS farmers was found to be 1:2.35 and 1:1.73 respectively.

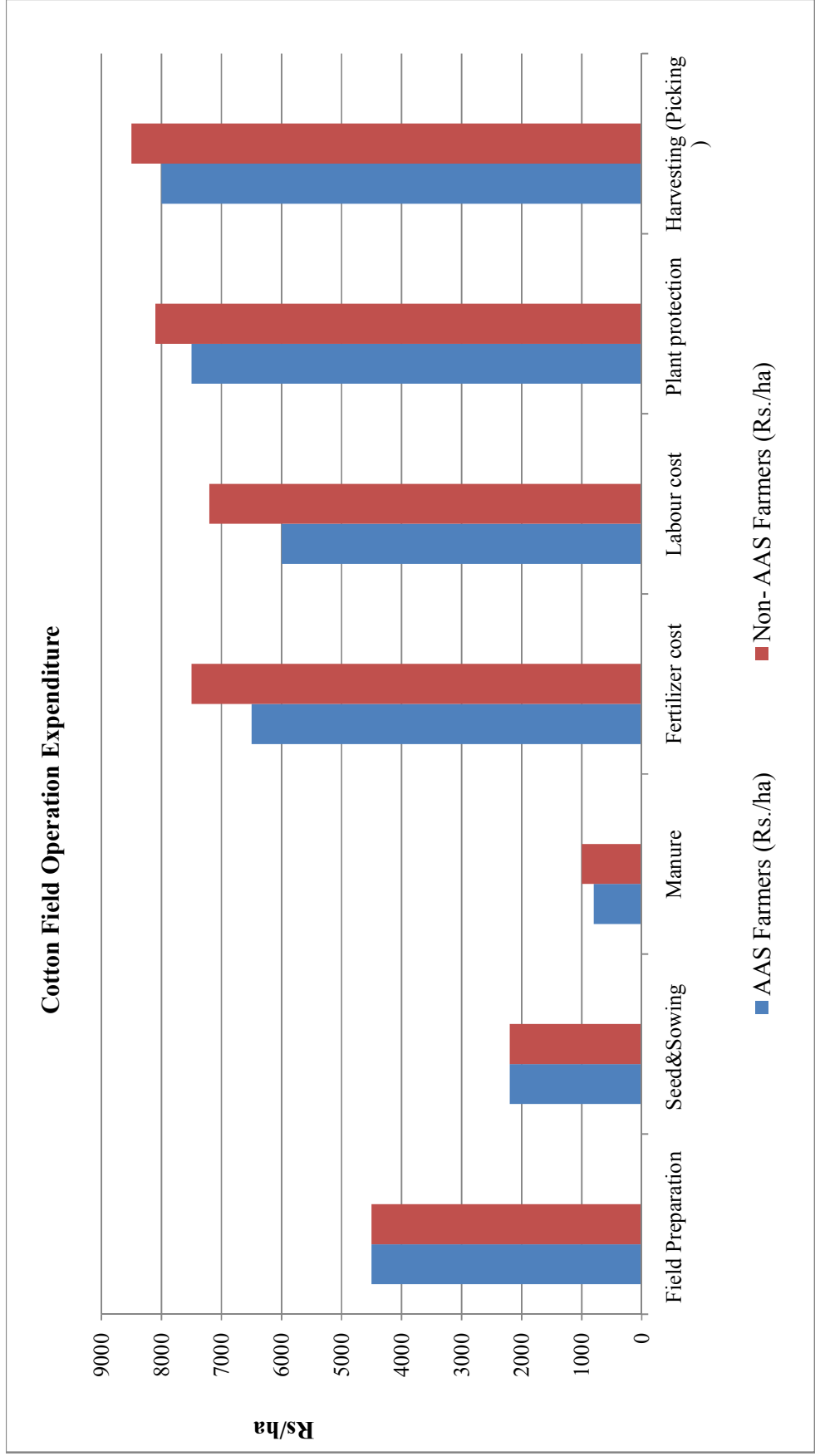
**Table 4.10 Expenditure under different field operation of pigeon pea crop of AAS and non-AAS farmers**

<b>Input Details/ ha</b>	<b>AAS Farmers (Rs./ha)</b>	<b>Non AAS Farmers (Rs./ha)</b>
1. Field Preparation cost /ha	4500	4500
2. Seed cost/ha	3500	3500
3. Manure	500	1000
4. Fertilizer cost	4000	4500
5. Labour cost including irrigation (Weeding, Spraying, hoeing by bullock)	6800	7500
6. Cost of plant protection / ha	4800	5500
7. Harvesting and Thres.	5000	5000
8. Land rent	6500	6500
9. Cost of cultivation	35800	38000
10. Yield (q/ha)	16	14
11. Price of Pigeon pea (Rs./q)	5000	4700
12. Total Income	80000	65800
13. Net profit	44200	27800
14. Benefit cost ratio	2.35	1.73

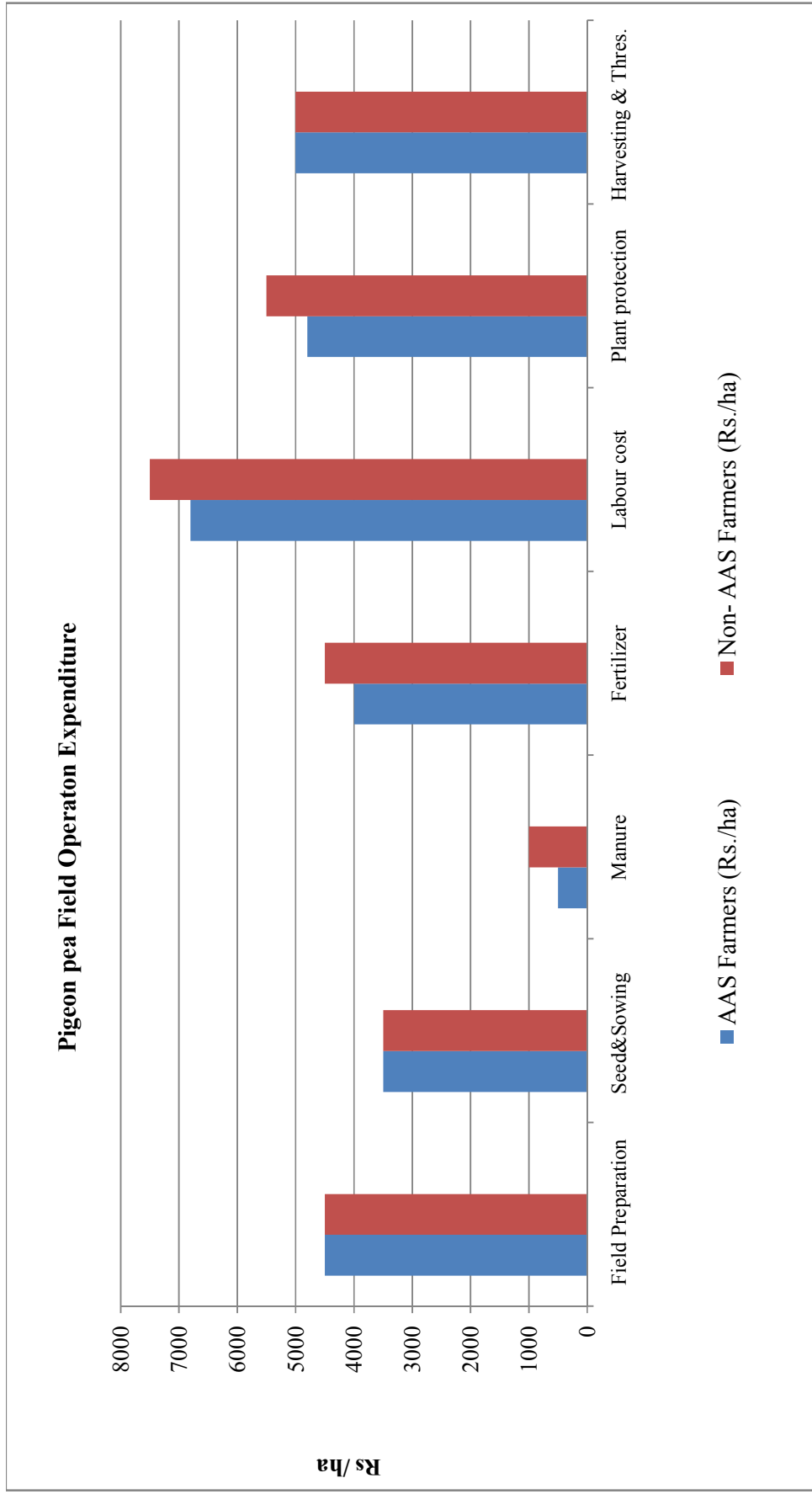
### **4.2.3 Farmer feedback**

#### **A. Collection and compilation of farmers' feedback on AAS**

The documenting of AAS farmers' feedback performance of the project also helped to improve the area's effectiveness at selected villages. At both centres, farmers were asked to rate AAS issued by the Field Information Facilitators (FIFs). At domain villages, feedbacks were collected from them and the results of analysis and the feedback are presented in Table 4.11 and Fig. 4.5. The feedback indicated that at Nanded district, farmers were very satisfied with AAS related to plant protection 60.0 per cent, fertilizer application 62.5 per cent, sowing/transplanting/seed rate manipulation 37.5 per cent respectively, planning of different field operations 45.0 per cent, harvesting of crops at proper stage was 30.0



**Fig. 4.3 Expenditure under different field operation of AAS and Non-AAS farmers**



**Fig. 4.4 Expenditure under different field operation of Pigeon pea crop of AAS and Non- AAS farmers**

per cent respectively and advisories related to water management in field needed improvement 30.0 per cent.

**Table 4.11 Analysis of usefulness of AAS for various crop production activities at Nanded district**

**(N=40)**

Sr. No.	Particulars	No. of farmers	Percentage (%)
1	Planning of farm operation	18	45.0
2	Sowing/transplanting/seed rate manipulation	15	37.5
3	Plant protection	24	60.0
4	Water management in field crops	14	35.0
5	Fertilizers application (Proper dose )	25	62.5
6	Harvesting of crops at proper stage	12	30.0

The sampled farmers were asked to rate the information given in agromet advisory services as excellent, very good, good, satisfactory and irrelevant.

Farmers in Nanded district were interviewed and their ratings are shown in Table 4.12 and Fig. 4.6. As per farmers' feedback, 40.0 per cent of the farmers put the AAB services in excellent category. While, 20.0 per cent farmers put this kind of Micro-level Agro-Advisory Services dissemination (MAAS) in very good category. Even more, 22.5 per cent farmers put the services in good and 12.5 in per cent satisfactory category, 5.0 per cent of the farmers who couldn't understand the objective and services rendered put AAB services in irrelevant category.

**Table 4.12 Rating of AAS issued at Nanded district**

**(N=40)**

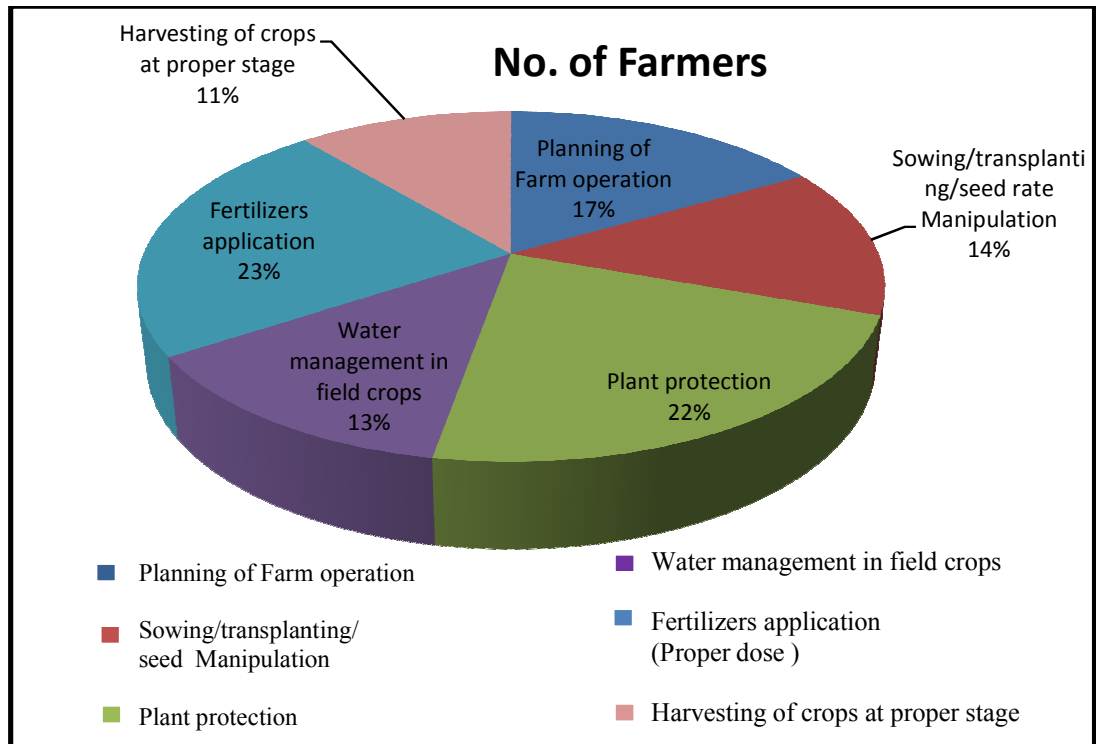
Sr. No.	Parameters	Farmers responded	Rating (%)
1.	Excellent	16	40.0
2.	Very Good	8	20.0
3.	Good	9	22.5
4.	Satisfactory	5	12.5
5.	Irrelevant	2	5.0
	<b>Total</b>	<b>40</b>	<b>100</b>

**Table 4.13 Summary of feedback given by farmers about AAS at Nanded district (N=40)**

<b>Sr No.</b>	<b>Questions that were put to farmers</b>	<b>Farmers' response AAS</b>	<b>Percentage (%)</b>
1.	Whether receiving agro-advisories services?	Yes-35 No-5	87.5 12.5
2.	If receiving ,whether receiving on time	Yes- 26 No-14	65.0 35.0
3.	If receiving by which method?	By Whatsapp- 32 By message-6 By paper display-2	80.0 15.0 5.0
4.	Whether getting benefit from these AAB?	Yes-36 No-4	90.0 10.0
5.	Whether getting benefit from KVK?	Yes-28 No-12	70.0 30.0
6.	Whether using weather based, Whatsapp based weather advisory by NGO?	Yes-05 No-35	12.5 87.5
7.	Whether receiving messages regarding agriculture related information?	Yes-40 No -00	100 0.0
8.	Whether you want improvement in these services?	Yes-29 No-11	72.5 27.5

It was observed from the Table 4.13 that out of these 40 AAS using farmers from Nanded district, this service had reached to 87.5 per cent of the farmers and 12.5 per cent of farmer's not received the advisory services. However, only 65.0 per cent of the covered farmers responded that AAS services were being received in time and rest 35.0 per cent of farmers were not receiving on real time. One effective feedback received from the farmers was that 90.0 per cent of AAS farmers were able to get the benefit out of this service and 10.0 per cent of farmers were not benefited from AAB. Out of sampled farmers, it was found that 70 per cent farmers were getting benefits out of KVK, while 30.0 per cent farmers were not able to get the benefit out of KVK.

To assess the farmers' know how about information technology impact in modern era, a question was raised whether farmers were using weather based-cum-Whatsapp based weather advisory by NGO, it was found that only 12.5 per cent of the farmers were utilizing the advanced source of information. It was found that messaging issued by Department of Agrometeorology, all 100 per cent farmers responded positively. They further said that they were getting this information and mainly these were agricultural related information through messaging. In the end,



**Fig. 4.5 Analysis of usefulness of AAS for various crop production activities at selected Nanded district.**

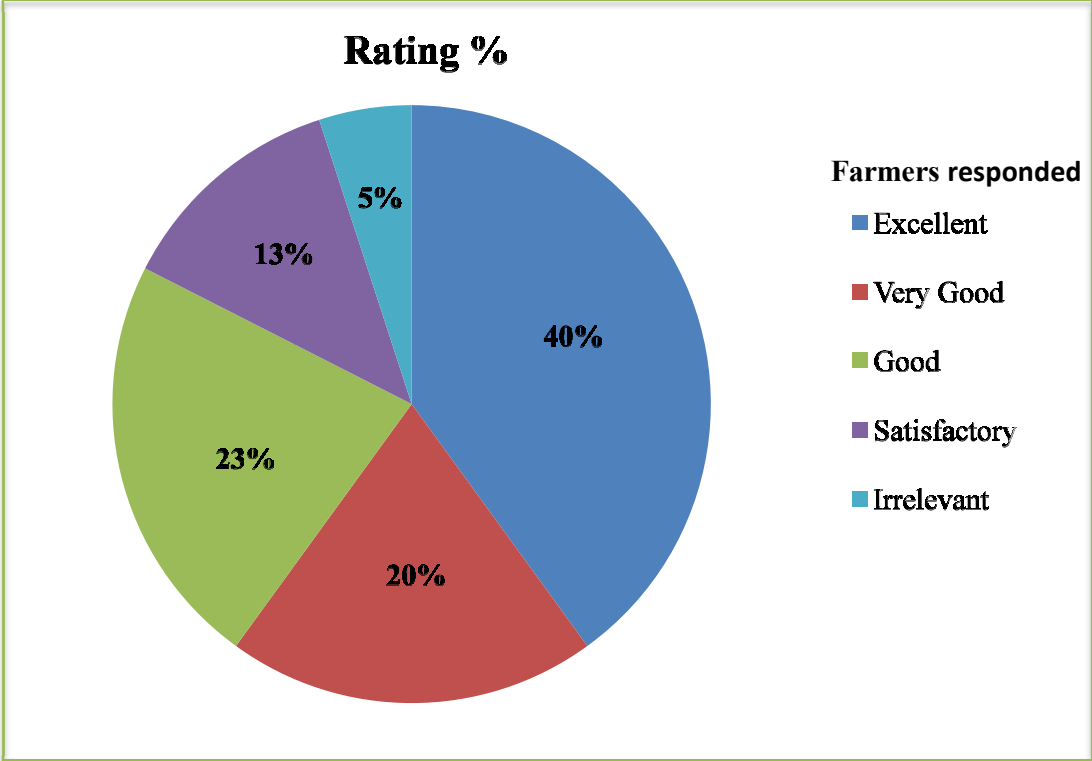


Fig. 4.6 Rating of AAS issued at Nanded district

72.5 per cent farmers responded that though the services were good and satisfactory, still there was scope lies for improvement in the service.

#### A. Sources of weather information

AAS farmers received weather bulletins from different sources, *viz.* radio, television, newspaper, Whatsapp. An attempt was made by questionnaire asked from AAS farmers about different coverage of farmers by weather information shown in Table 4.14 and Fig. 4.7 in which, 30.0 percent of farmers were covered by SMS, 2.5 per cent were covered by newspapers, 17.5 per cent were covered by television, through radio 2.5 per cent and more of farmers preferred as Whatsapp 47.5 per cent were source of weather information in AAS category.

**Table 4.14 Sources of weather information (%)**

(N= 40)

Source	AAS	
	Farmers	Percentage
SMS	12	30
Newspaper	1	2.5
Television	7	17.5
Radio	1	2.5
Whatsapp	19	47.5
<b>Total</b>	<b>40</b>	<b>100</b>

**Table 4.15 Areas of operation (%)**

(N=40)

Source	AAS	
	Farmers	Percentage
Information about rainfall	11	27.5
Details information about agriculture	9	22.5
About seeds/manure	5	12.5
Scheduling irrigation	6	15
About insecticides	5	12.5
About crops harvesting	4	10
Don't know/Can't say	0	0
<b>Total</b>	<b>40</b>	<b>100</b>

An interesting survey was made from the AAS farmers group about what information they were looking from any information flow in Table 4.15 and Fig. 4.8 which that showed about 27.5 per cent AAS farmers were interested in rainfall, 22.5 per cent farmers wanted information about agriculture, 12.5 per cent farmers were utilizing micro- level advisories about seed and manure, 15 per cent farmers were

using advisories for scheduling of irrigation, 12.5 per cent farmers utilizing information of insecticides, 7.5 per cent farmers are utilized to crops harvesting.

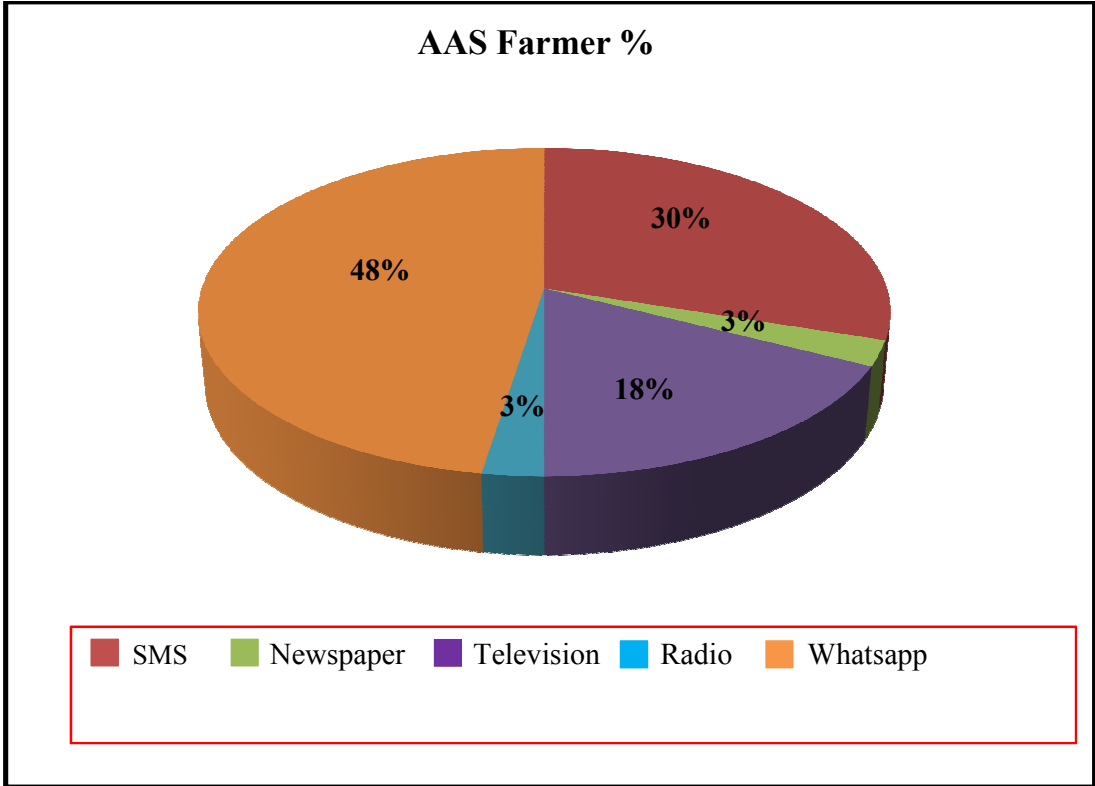
**Major feedback obtained from AAB farmers includes:**

1. Those farmers using weather based AAS issued regularly is helping in increasing the productivity of crops and socio-economic status.
2. The most important role of AAS is planning their agricultural activities.
3. Resource poor farmers were not able to adopt the AAS well in time.
4. Farmers were responsible to believe in adoption of AAS only after the supply of inputs in time.
5. Weather based activities for agromet advisory and weather forecast the AAS farmers were regularly getting.
6. The regular use of AAS farmers are useful in planning of agricultural activities such as sowing, weeding, irrigation, fertilizer application, pesticide spray (time and doses) at right time depending on the suitability of weather conditions which ultimately helped in reducing the cost of cultivation and saving of inputs.
7. The farmers felt that the block level forecast was more useful than the district level forecast.
8. Farmers following new techniques in crop management.
9. Farmers followed most of the agrochemicals recommended in the agromet-advisory services and very few followed the organic recommendations given through AAB.
10. Advisory contains important information about the weather, crops, and need based crop management, plant protection and contingency plans.
11. Farmers were getting AAS regularly but they preferred real time rainfall forecast mostly.
12. Weather and crop advisories facilitate effective crop management. The advisory were most useful for crop protection measures.

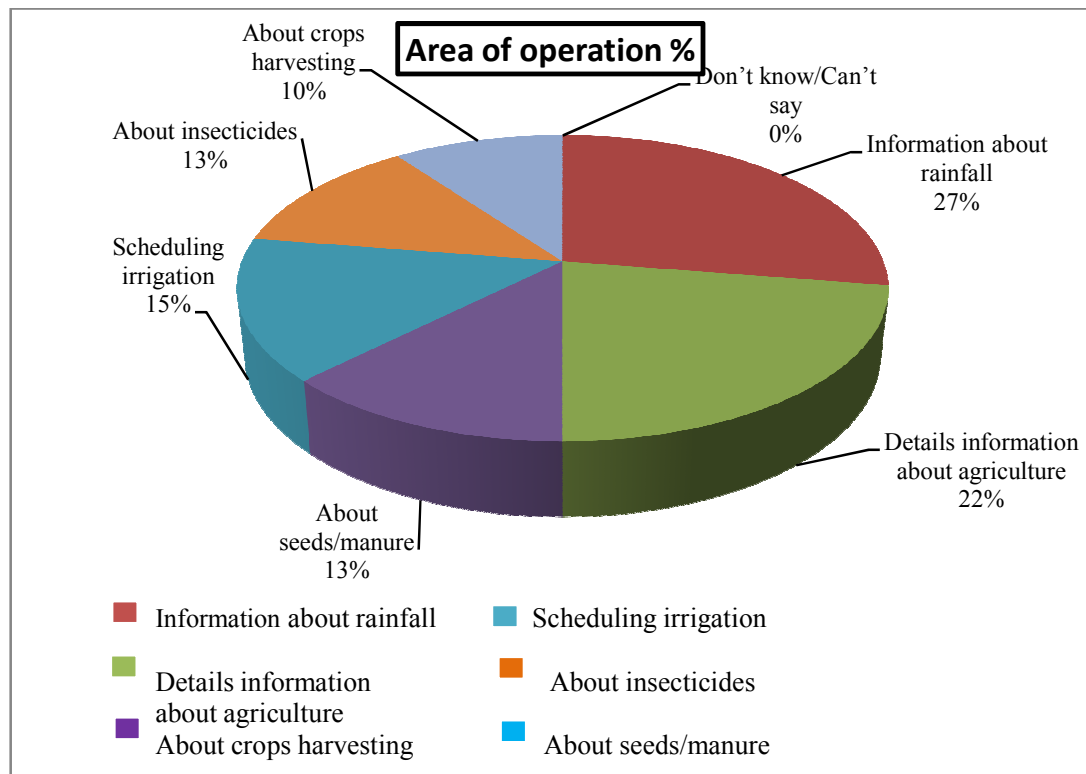
**4.3 To find out weather based Agromet-Advisory, crop cultivation practices and identification of best management for selected of Nanded district**

**4.3.1 Weather based Agromet-Advisory**

Agricultural production depends upon many factors, of which weather is the major factor. Weather varies with space and time; hence, its forecast can help to minimize the farm losses through proper management of agricultural operations.



**Fig. 4.7 Sources of weather information (%)**



**Fig. 4.8 Areas of operation (%)**

Weather factor is not possible for complete avoidance of farm losses but it can be minimized to some extent by adjustments through timely and accurate information about weather forecast.

Weather forecasting can help to farmers for many day/to/day decisions including selection of crops and varieties for sowing, crop irrigation, intercultural operation, time to fertilize and what days are suitable for working in the field. Weather based agromet advisories help in increasing the economic benefit to the farmers by suggesting them the suitable management practices according to the weather conditions. Studies were, therefore, undertaken on adaption of AAS.

**Table 4.16 Adoption of weather based AAB by the following farmers**

<b>Sr. No.</b>	<b>Name of farmers</b>	<b>Feedback received</b>
1.	Patil Balaji Marotirao Mirale Maroti Narayan Nevale Ganapat Dadarao Patil Ashok Shankarrao Patil Jaykumar Chandrabhan Patil Chandrakant Ghansham Ghukar Madhusudan Namdev Kerle Satish Jagdish Thadke Pandurang Hanmant Kamble Bhimrao Mariba	AAB suggested to farmer for control of pest and disease in cotton crops.  AAB was useful for deciding the farmers for selection of varieties, sowing/ planting for agricultural crops.
2.	Hanmantrao Gangaram Kanole Vasudev Pandurang Joshi Balaji Madhav Bachalwad Kharode Udas Madhav Gamod Pundlik Potanna Pawar Swapnil Sambhajirao Tate Amar Ashokrao Jadhav Amol Anand Pimpaldare Satish Baliram Jadhav Rohit Ramesh	Spraying suggested for control of mealy bug, white fly, aphid in pomegranate crop.  The management of pomegranate crop from collection and destroy the infected plant parts and spray the chemicals are suggested in AAB to farmers for protect these crop.
3.	Shinde Dhanraj Ganapat Ingale Madhav Pandharinath Patil Gajanan Sheshrao Desai Shashank Madhavrao Balaji Bhivaji Kadam	Opening of furrow in cotton crop.

**Table 4.17 Weather based agromet advisory given to farmers**

Date	Advisory given	Reason behind the release AAS
22/05/2020	Selection of land for sowing of crop	Select medium to heavy well drained soil for cultivation of crop
29/05/2020	One deep ploughing with mould plough followed by two harrowing	To conserve the water and prevailing dry spell
05/06/2020	Selection of varieties for sowing / seed treatment	Select the high yielding variety and optimum rainfall is received for sowing
12/06/2020	Intercropping	Produce a greater yield and saving space
26/06/2020	Fertilizer application	As per soil test based
03/07/2020	Light harrowing, hand hoeing, between two rows of crop like cotton, soybean, pigeon pea.	Prevailing dry spell
17/07/2020	Spraying of insecticide	Incidence of insect and pest attack of cotton, soybean.
28/07/2020	Intercultural operations	Weed management and to reduce evaporation through soil crusting.
04/08/2020	Spraying of insecticides against attack of sucking pest in cotton, green gram and black gram crop	High incidence of sucking pest.
25/08/2020	Thinning of leaves should be done and remove side sprouting	<i>Downy mildew</i> disease observed in grape
08/09/2020	Take a spray of 5 % NSKE during clear weather condition	Incidence of leaf roller in pigeon pea
15/09/2020	In fallow land intercultural operation are done across the slope	Aim to conserve soil moisture in soil for <i>Rabi</i> crop
22/09/2020	Hoeing between rows of cotton	In situ moisture conservation
29/09/2020	Varietal selection / Seed treatment for <i>Rabi</i> crop regarding harvesting and storage of Soybean.	Sowing of <i>Rabi</i> crop is conducted in village
06/10/2020	Spraying of insecticide on cotton crop	Incidence of <i>grey mildew</i> disease occurred on cotton crop

The management practices suggested in advisory were easy to understand and could easily adopted by the farmers on their farm. The inputs recommended in advisory were helpful to selected villages or nearby villages. The farmers also appreciated the management practices given in advisory like sowing, weed management, insect pest and disease management, fertilizer management, cultural practices, harvesting and storage.

### **1. Interculturing operations**

All the lighter and finer operations were carried out on the soil between sowing and harvesting. The operations like hoeing- In village, rainfall receipt was very less and therefore, in agromet advisory it was suggested to carry out the timely interculture operations like hoeing to conserve the soil moisture and to control the weeds and with this, many farmers carried out the suggested timely interculture operations in standing crops like cotton, soybean, pigeon pea, ginger *etc.*

### **2. Plant protection operations**

The operations like spraying of chemicals - in some crops like cotton, pigeon pea, black gram, green gram, maize, soybean, pearl millet, sugarcane turmeric *etc.* in that crop some incidence of pests like aphid, jassid, mealy bug, white fly, sugarcane pyrilla, rhizome fly and infect disease like rednning, pink bollworm of cotton, pod blight disease in soybean. For the control of these pests and diseases agromet advisory services were regularly suggested to farmers for spraying of chemicals. For management, spray of *Tebuconazole* 10% + *Sulphur* 65% (complex fungicide) @ 500 g or *Tebuconazole* 25.9 % @ 250 ml per acre for control of pod borer of soybean. In sugarcane spray of *Chlorpyrifos* 20 % @ 30 ml per 10 liter of water for control of sucking pests, Rhizome fly in turmeric alternate spray of *Quinalphos* 25 % @ 20 ml or *Diamethoate* 30 % @ 10 ml per 10 liter of water. Fall armyworm in maize crop spray of *Thiamethoxam* 12.6 % + *Lambda – cyhalothrin* 9.5 ZC @ 5 ml or *Spinetoram* 11.7 SC @ 4 ml per 10 liter of water. If infestation is more than spray *Flonicamid* 50 % @ 60 gm per acre during clear weather condition. For management of pink bollworm in cotton install pink bollworm Pheromone trap @ 5 per acre. Initially, take a spray of 5 % NSKE; if infestation is more take a spray of *Profenofos* 50 % @ 400 ml or *Profenofos* 40 % + *Cypermethrin* 4 % (Complex insecticide) @ 400 ml per acre during clear weather condition. *Anthracnose* disease may observed in newly planted mango orchard, For management take a spray of *Carbendazim* 12 % + *Mancozeb* 63 % @ 25 gm per 10 liter of water was suggested.

### **3. Crop residue management**

Crop residue is an effective material that can minimize the erosion of soil by wind and water. The crop residue was used as surface mulching materials. Residues also provide thermal protection to plants from winter temperature extremes. Crop residue absorbs raindrop impact and keeps the wind off the soil surfaces. This reduces soil particles detachment, reducing erosion from the forces of water and wind.

By protecting the soil surfaces, surface crusting is also reduced, improving infiltration and decreasing runoff. The mineralization of breakdown of crop residues, release nutrients, increase the soil organic matter content, which increase the soil cation exchange capacity and thus residues improve nutrient cycling within the farm. It is also beneficial for soil micro-organisms and on degradation adds organic matter to the soil.

#### **4. Measurement of water table depth**

The most reliable method of obtaining the depth to the water table at any given time is to measure the water table in a shallow well with a tape. If no wells are available, surface geophysical methods can sometimes be used, depending on surface accessibility for placing electric or acoustic probes. The water table depth is one of the main factors determining the economics of irrigation. Rapid increase in number of wells and tube wells has resulted in a situation where in large number of well owners are competing to extract water from the limited aquifers, with a concomitant lowering of the ground water table. Hence, it was worthwhile to construct the structures like farm pond, sunken pond etc. to maintain water table. In many areas, overdraft of ground water aggravated surfacing of harmful fluorides and salts.

#### **5. Farm keeps in *Kharif* and wheat is sown in *Rabi***

It refers to keeping the land vacant without raising any crop during a particular season/year. The main objective of fallow in rotation is to give rest to the soil and conserve the soil moisture in the field.

#### **6. Moisture conservation practices**

There were long dry spells in the month of August during critical growth stages of crop, in that AAB suggested to carry out the water conservation practices. Cotton, Pigeon pea were long duration crops and wide spacing crops has to be sown in two rows and soybean, green gram, black gram, groundnut etc. crops are short duration and short spacing to be sown with 4-6 rows to conserve the rain water.

Some of the important following management practices suggested through advisories to the farmers for getting satisfactory crop yield during *Kharif* season.

1. Soil moisture conservation practices *viz*.; hoeing and opening of furrow during dry spell period.

2. Plant protection measures suggested for the control of pest in cotton, soybean, pigeon pea and citrus.
3. Fertilizer application and application of protective irrigation.
4. Spraying of crops for potassium nitrate to conserve the moisture.

**Strategy to mitigate drought:**

1. Reduction in plant population to minimize the transpiration losses.
2. Need based intercultural operations in the form of dust mulching to check the evaporation losses and for efficient soil moisture utilization.
3. Timely weed management to control water loss by evapotranspiration.
4. Spray of anti-transpirants like Kaolin (6%) and Cycocel (0.03%) on the standing crops.
5. Deep tillage to absorb and hold maximum moisture.
6. Doses of fertilizer may be reduced or its application may be delayed depending on the soil- moisture status for good crop growth.
7. Selection of short duration and drought tolerant crops.
8. Mulching with dry leaves, grasses and other organic farm waste also help in lowering the sub- surface temperature and checking evaporation losses.
9. Reduction of plant population to reduce the evapotranspiration.
10. Thinning of foliage to reduce evapotranspiration.
11. To apply protective irrigations.

**Table 4.18 Cultural practices information given in AAB**

<b>Practices</b>	<b>Management</b>
Land selection	Avoid fields with a history of weed problems.
Crop selection	Grow the most competitive crops in field with a history of weed problems.
Crop rotation	Rotate between vegetables in different botanical categories.
Adopted crop varieties	Select crop varieties adapted for your area.
Proper row spacing and plant densities	Use row spacing and plant densities that assure rapid crop-canopy closure.
Correct planting time	Plant crops when soil temperatures favor rapid germination and emergence.
Appropriate fertility, disease and insect management	Vigorous, healthy crops are more competitive against weeds.
Mulch	Natural mulches are different to use over large acreages. Synthetic (plastic) mulches are useful to manage weeds within the row in warm- season crops consider disposal problems when using plastic mulches.

#### 4.4 To compare the district level weather forecast with observed weather data for Nanded district

In this chapter, the last year forecasted weather data from Gramin Krishi Mausam Sewa (GKMS) was verified with real time observed data at KVK, Nanded.

For the analysis of verification of forecasts, the year was grouped into five groups on seasonal basis viz., summer (March to May), monsoon (June-September), post monsoon (October to December), winter (Jan to Feb.), whole year (Jan to Dec).

**Table 4.19 Season wise testing of weather forecast for its realization in respect of rainfall, (year 2020)**

Observed	Predicted									
	Summer (Mar to May)		Monsoon (June to Sept)		Post Monsoon (Oct to Dec)		Winter (Jan to Feb)		Whole year (Jan to Dec)	
	No rain	Rain	No rain	Rain	No rain	Rain	No rain	Rain	No rain	Rain
No rain	65 (71)	23 (25)	3 (2)	53 (44)	73 (79)	12 (13)	51 (85)	7 (11)	192 (53)	95 (26)
Rain	2 (2)	2 (2)	0 (0)	66 (54)	2 (2)	5 (6)	1 (2)	1 (2)	5 (1)	74 (20)
Total	67	25	3	119	75	17	52	8	197	169
Ratio score (%)	87.0		73.0		57.0		85.0		73.0	

(Source:-Observed data base-KVK, Nanded and forecast data-GKMS, Parbhani)

The data on forecast received and its validation with real time observed data on rainfall is presented in Table 4.18 which revealed that the ratio score of successful events for rainfall predictions were 87, 73, 57 and 85 per cent for summer, monsoon, post monsoon and winter season. The overall (March-February) ratio score was 73 per cent. The occurrences of rain forecasted were 74 events (20%) for yearly basis, where as no rain forecast were realized for 192 events (53%).

#### 4.5 Skill Score of observed and forecasted Rainfall during the year 2021

##### 4.5.1 Weekly Skill Score of observed and forecasted rainfall

The forecast accuracy of rainfall for different week is presented in Table 4.20. The results of last year indicated that the correct rainfall 4.07, 0.80 and 2.17 percentage was maximum for compared to average of usable and unusable

percentage respectively. Through, the rainfall prediction should be more accurate during the monsoon season when compared to other season *Kharif* season, most important for crops from farmer point view. The weekly average of RS percentage 70.23 was accurate representing score of out of 100. The HK Score and RMSE value of 0.1 and 7.14 respectively. The results revealed that the HK Score were negative because of few weeks falling the insufficient rainfall. The average of FAR, CSI, HSS and POD value of 0.6, 1.5, 0.06 and 1.89 respectively during the weeks the average of correlation 0.18 represents positive but a weak correlation between forecasted and observed values. Almost similar results were obtained by Das *et al.*, (2018).

#### **4.5.2 Monthly Skill Score of observed and forecasted rainfall**

Monthly observed and forecasted rainfall values for the period of 2020. Were compared the results of last year (2020) indicated that the skill score of rainfall was excellent in all months except summer (Mar- May). The monthly average correct per centage has been recorded was 17.41, followed by unusable 9.25 per cent and usable 3.83 per centage, respectively. The monthly average of RS per centage was 78.17 representing the score was near about the 100 percentages in most of months. The variation of skill score presented in that Table 4.21. The average for HSS and HKS representing the 0.02 and 0.19, respectively was a very lower score in forecast. The average of 0.55 and 10.50, respectively for FAR and POD represented the false alarm lower than probability of detection. The average of CSI was 7.50, RMSE was 7.86 and Correlation Coefficient is 0.11, respectively.

#### **4.5.3 Seasonal Skill Score of observed and forecasted rainfall**

The rainfall forecast was verified with comparative values of different parameters during the year 2020 which is in showed Table 4.22. The maximum correct percentage for the forecast was obtained in Post-monsoon 76, followed by Pre- monsoon 70, Winter 53 and Monsoon 10. Through, the rainfall prediction should be more accurate during the monsoon season when compared to other seasons, since *Kharif* season is most important for crops from farmers' point of view. The usable percent obtained for the monsoon was (22) while pre-monsoon (18), winter (4) and post-monsoon (2). The unusable percent was highest during the monsoon season (90) followed by post- monsoon (14), pre- monsoon (4) and winter (3). This depicts the forecast was found to be very good for all the seasons with the highest percentage for

the correct forecasts (52.25), followed by unusable percentage as (27.75) and usable as (11.50) percentages.

The variation of skill score is presented in Table 4.22. The average for RS was 75.17 percentages representing the score very near to 100 percentages in most of the seasons. The average for HK score and HSS score was 0.24 and 0.02, respectively. The average was 1.85 and 24.75, respectively for FAR and POD representing the probability of detection more than false alarms. The average Critical Success Index (CSI) was 26 represents. The mean value for correlation, 0.14 represent positive but a weak correlation between forecasted and observed values. The RMSE average, 7.13 mm represents the moderate deviation and variation in the data values taken. Almost similar results were obtained by Kothiyal *et al.*, 2017). The skill scores worked efficiently for the monsoon season where maximum rainfall was predicted as well as observed. The HSS, FAR and POD together meant to be good score for depiction of usable unusable rainfall forecasts during the year.

**Table 4.20 Weekly skill score of observed and forecasted rainfall during the year 2020**

<b>Met. Week</b>	<b>Correct</b>	<b>Usable</b>	<b>Unusable</b>	<b>Corr. Coeff.</b>	<b>RS</b>	<b>CSI</b>	<b>RMSE</b>	<b>POD</b>	<b>HSS</b>	<b>HK</b>	<b>FAR</b>
1 MW	5	1	1	0.43	71.4	0.33	5.67	3.00	0.10	0.33	0.00
2 MW	6	0	1	-	71.4	-	3.79	-	0.00	0.00	0.00
3 MW	7	0	0	-	100	-	0.00	-	0.00	0.00	-
4 MW	7	0	0	-	100	0.00	0.00	0.00	0.00	0.00	0.00
5 MW	7	0	0	-	85.7	0.00	1.07	-	0.00	0.00	-
6 MW	4	2	1	-	57.1	0.00	4.22	-	0.00	0.00	-
7 MW	7	0	0	-	100	0.00	0.00	0.00	0.00	0.00	0.00
8 MW	7	0	0	-	100	0.00	0.00	0.00	0.00	0.00	0.00
9 MW	8	0	0	0.00	-	1.00	-	0.00	0.00	0.00	0.00
10 MW	7	0	0	1.00	-	0.86	-	1.13	0.00	0.00	0.00
11 MW	6	1	0	-	85.7	-	1.13	0.00	0.00	0.00	0.00
12 MW	6	0	1	-	85.7	-	2.26	0.00	0.00	0.00	0.00
13 MW	2	3	2	-	28.5	0.17	5.37	6.00	0.01	0.16	0.00
14 MW	4	2	1	-0.35	28.5	0.00	3.33	0.00	-0.07	-0.33	-
15 MW	7	0	0	-	100	-	0.00	0.00	0.00	0.00	0.00
16 MW	6	1	0	-	85.7	0.00	1.13	0.00	0.00	0.00	0.00
17 MW	5	2	0	-	71.4	0.00	2.13	0.00	0.00	0.00	0.00
18 MW	5	2	0	-	0.00	0.00	1.88	0.00	0.00	0.00	0.00
19 MW	6	1	0	-	57.1	0.00	1.68	0.00	0.00	0.00	0.00
20 MW	3	4	0	-0.18	57.1	4.00	2.85	3.00	0.02	0.08	2.00
21 MW	7	0	0	-	100	0.00	0.00	0.00	0.00	0.00	0.00
22 MW	3	1	3	0.16	85.7	4.00	11.39	2.00	0.18	0.18	0.00
23 MW	2	3	2	0.92	14.2	0.14	9.41	7.00	0.00	0.00	0.00
24 MW	2	0	5	-0.36	42.8	0.43	32.68	10.00	0.00	0.00	0.00
25 MW	0	0	7	-0.47	42.8	0.43	16.11	5.00	0.00	0.00	0.00

26 MW	0	1	6	-0.17	14.2	7.00	12.26	7.00	0.00	0.00	0.00
27 MW	0	1	6	-0.10	42.8	5.00	22.87	5.00	0.00	0.00	0.00
28 MW	0	1	6	-0.30	42.8	5.00	14.72	5.00	0.29	0.05	0.00
29 MW	0	1	6	0.95	71.4	0.71	15.79	3.00	0.00	0.00	0.00
30 MW	2	1	4	0.24	71.4	3.00	12.64	3.00	0.72	0.09	0.00
31 MW	1	0	6	-0.12	28.5	6.00	19.97	6.00	0.00	0.00	0.00
32 MW	1	2	4	0.29	85.7	0.83	9.50	2.00	1.47	0.14	0.00
33 MW	0	4	3	0.66	100	1.00	10.05	1.00	0.00	0.00	0.00
34 MW	0	2	5	0.27	71.4	3.00	16.59	3.00	0.00	0.00	0.00
35 MW	2	1	4	0.84	57.1	4.00	5.56	4.00	0.33	0.05	0.00
36 MW	0	0	7	-	0.00	-	19.19	0.00	0.00	0.00	0.00
37 MW	0	1	6	0.12	100	1.00	29.27	1.00	0.00	0.00	0.00
38 MW	0	2	5	-0.10	70	1.00	16.18	1.00	0.00	0.00	0.00
39 MW	1	1	5	0.60	57.1	0.57	13.15	4.00	0.00	0.00	0.00
40 MW	5	1	1	0.80	57.1	4.00	4.81	4.00	0.31	0.07	0.00
41 MW	1	0	6	0.14	57.1	0.57	16.20	3.00	0.23	0.05	1.25
42 MW	1	0	6	-0.55	14.2	0.00	12.62	-	-0.41	-0.20	-
43 MW	7	0	0	-	100	-	0.00	0.00	0.00	0.00	0.00
44 MW	7	0	0	-	100	-	0.00	0.00	0.00	0.00	0.00
45 MW	7	0	0	-	100	-	0.00	0.00	0.00	0.00	0.00
46 MW	7	0	0	-	100	-	0.00	0.00	0.00	0.00	0.00
47 MW	6	0	1	-	100	-	0.00	0.00	0.00	0.00	0.00
48 MW	7	0	0	-	100	-	0.00	0.00	0.00	0.00	0.00
49 MW	7	0	0	-	100	-	0.00	0.00	0.00	0.00	0.00
50 MW	7	0	0	-	100	-	0.00	0.00	0.00	0.00	0.00
51 MW	7	0	0	-	100	-	0.00	0.00	0.00	0.00	0.00
52 MW	7	0	0	-	100	-	0.00	0.00	0.00	0.00	0.00
Avg	4.07	0.80	2.17	0.18	70.23	1.50	7.14	1.89	0.06	0.01	0.06

**Table 4.21 Monthly skill score of observed and forecasted rainfall during the year 2020**

<b>Month</b>	<b>Correct</b>	<b>Usable</b>	<b>Unusable</b>	<b>Corr. Coeff.</b>	<b>RS</b>	<b>CSI</b>	<b>RMSE</b>	<b>POD</b>	<b>HSS</b>	<b>HK</b>	<b>FAR</b>
Jan	28	1	2	0.67	87.0	0.20	3.24	0.20	0.07	0.20	0.00
Feb	25	3	1	-	267.8	0.00	2.16	-	0.07	-0.03	-
March	23	5	3	-	3.2	9.00	2.88	9.00	0.07	0.11	0.00
April	23	6	1	-	70.0	-	2.06	-	-0.01	-0.04	-
May	24	7	0	-1.00	74.1	9.00	1.84	8.00	0.02	0.08	2.00
June	4	4	22	0.06	-10.7	0.33	21.00	19.85	0.00	0.00	-
July	2	4	25	0.56	54.8	15.00	16.96	15.00	0.01	0.53	0.00
Aug	2	9	20	0.36	74.1	9.00	13.24	9.00	0.03	0.70	0.00
Sept	2	5	23	0.23	63.3	12.00	19.68	12.00	0.02	0.62	0.00
Oct	17	1	13	-0.06	61.2	13.00	10.02	11.00	0.05	0.20	2.40
Nov	28	1	1	-	93.3	-	1.31	-	0.00	0.00	-
Dec	31	0	0	-	100	-	0.00	-	0.00	0.00	0.00
Avg	17.41	3.83	9.25	0.11	78.17	7.50	7.86	10.50	0.02	0.19	0.55

**Table 4.22 Seasonal skill score of observed and forecasted rainfall during the year 2020**

<b>Parameters</b>	<b>Pre- monsoon</b>	<b>Monsoon</b>	<b>Post- Monsoon</b>	<b>Winter</b>	<b>Average</b>
Correct (%)	70	10	76	53	52.25
Usable (%)	18	22	2	4	11.50
Unusable (%)	4	90	14	3	27.75
RS (%)	86.6	72.8	56.6	84.7	75.17
HKS	0.10	0.05	0.55	0.26	0.24
HSS	0.006	0.01	0.08	0.006	0.02
FAR	2.00	3.00	0.00	2.40	1.85
CSI	9.00	26.00	54.00	15.00	26
POD	8.00	24.00	54.00	13.00	24.75
Corre. Coeff.	0.53	-1.00	0.28	0.78	0.14
RMSE (mm)	2.77	2.30	17.60	5.86	7.13

## **4.6 Skill score of observed and forecasted temperatures during the year 2021**

### **4.6.1 Weekly skill score of observed and forecasted maximum and minimum temperature**

The comparative and average value for the parameter during the year 2020 is presented in Table 4.23. The average for the maximum temperature correct percentage of the forecast was highest at 3.76 followed by unusable as 2.30 per cent and there after the usability per cent was 1.03. This depicts the correct forecast, thus determining the forecast to be good for the year. The correlation coefficient with the value of 0.19 represents the positive high correlation between the observed and predicted value. The average of RMSE value 2.59 represents a low error along with a low difference between the values. The overall forecast for maximum temperature is good with good correlation coefficient for the year.

The average minimum temperature unusable percentage of the forecast was higher at 4.05, followed by average correct percentage 2.05 and usable 0.82 per cent. This represents a good for the minimum temperature over the year. The average correlation coefficient with the value of 0.13 represents a positive correlation of the observed and predicted values and average RMSE value is 3.58 represent. Similar findings of temperature forecast were also reported by Kothiyal *et al.*, (2017).

### **4.6.2 Monthly skill score of observed and forecasted maximum and minimum temperature**

The analysis of monthly maximum data revealed that correct forecast percentage for maximum temperature was 16.33, the usable forecasts were 4.07 per cent and unusable was 10.10 per cent. Temperature forecast also helped the farmers to take care of cattle, sheep, goat, poultry birds and bee hives for proper feeding, watering and maintaining ventilation during summer season. The average correlation coefficient with the value of 0.22 and average value of RMSE is 2.72 represents a low error along with a low difference between the values.

Similarly, for minimum temperature average of correct forecast for minimum temperature was 10.59 per cent the usable forecasts were 3.16 per cent and unusable was 16.66 per cent. The minimum temperature helped in mitigation of the effects of cold and frost and also protection of crops from injury during the winter season. The average of correlation coefficient with the value of 0.16 and average value of RMSE was 3.75 represents a low error along with a low difference between

the values. Similar findings temperature forecast were also reported by Sharma *et al.*, (2018).

#### **4.6.3 Seasonal skill score of observed and forecasted maximum and minimum temperature**

The comparative and average value for the parameter during the year 2020 is presented in Table 4.25. The average for the max correct percentage of the forecast was highest at 49 followed by unusable as 29 per cent and there after the usability per cent as 13.5. This depicts the correct forecast, thus determining the forecast to be good for the year. The correlation coefficient with the value of 0.49 represents the positive high correlation between the observed and predicted value. The average of RMSE value 2.91 represents a low error along with a low difference between the values. The overall forecast for maximum temperature was good with good correlation coefficient for the year with the best for the post monsoon season.

The average minimum temperature unusable percentage of the forecast was higher at 50.25 followed by average correct percentage 30.5 and usable 10.75 per cent. This represents a good for the minimum temperature over the year. The average correlation coefficient with the value of 0.38 represents a positive correlation of the observed and predicted values. The average RMSE 3.73 determines the low amount of error. The result in the unusable percent being highest, since, difference between forecasted and observed if more than 2<sup>0</sup>C, it is taken as unusable. Almost similar results were obtained by Kothiyal *et al.*, (2017)

**Table 4.23 Weekly skill score of observed and forecasted maximum and minimum temperature during the year 2020**

Met. Week	Correct		Usable		Unusable		Corre. Coeff.		RMSE	
	Max °C	Min °C	Max °C	Min °C	Max °C	Min °C	Max °C	Min °C	Max °C	Min °C
1 MW	2	3	1	1	4	3	-0.8	0.8	4.3	2.6
2 MW	0	2	0	1	7	4	0.6	0.5	4.1	3.4
3 MW	0	1	0	2	7	4	0.8	-0.2	6.7	3.4
4 MW	2	2	0	1	5	4	-0.4	-0.4	5.7	4.3
5 MW	3	3	1	2	3	2	-0.1	0.4	4.8	2
6 MW	5	0	1	0	1	2	0.70	0.8	1.5	4.2
7 MW	3	3	3	2	1	2	0.5	0	1.8	2.5
8 MW	4	3	1	4	2	0	-0.48	0.6	1.64	1.5
9 MW	2	3	3	3	3	2	-0.62	-0.5	2.25	2.0
10 MW	7	6	0	0	0	1	0.49	0.6	0.77	1.7
11 MW	4	3	2	1	1	3	0.72	0.3	1.92	3.3
12 MW	1	3	1	2	5	2	-0.29	-0.4	3.86	2.8
13 MW	1	5	1	1	5	1	-0.60	0.3	5.18	1.5
14 MW	6	5	1	1	5	1	0	0.7	1	1.8
15 MW	6	5	1	1	0	1	0.52	0.8	1.14	1.5
16 MW	5	5	1	0	1	1	0.01	0.4	1.84	1.3
17 MW	7	3	0	1	0	3	0.50	-0.1	0.63	3.0
18 MW	6	0	1	0	0	7	0.84	0	1.14	5.7
19 MW	2	1	1	0	4	6	0	-0.6	4.51	6.0
20 MW	6	2	0	1	1	4	0.11	0.5	1.61	3.5
21 MW	6	1	0	1	1	5	0.61	0.6	1.37	3.0
22 MW	3	0	0	0	4	7	0.67	0.3	4.92	7.2
23 MW	4	1	1	3	2	3	0.53	0.5	1.7	3.0
24 MW	1	3	1	0	5	4	-0.57	-0.6	5.12	5.5

25 MW	3	2	1	2	3	3	-0.72	0.1	3.27	2.9
26 MW	4	0	2	0	1	7	0.15	0.9	1.61	4.5
27 MW	2	3	1	1	4	3	0.64	-0.6	2.44	2.6
28 MW	1	1	2	0	4	6	-0.34	-0.4	3.44	4.4
29 MW	5	0	2	0	0	7	0.49	0.5	1.18	5.3
30 MW	4	1	1	1	2	5	-0.63	-0.8	3.06	5.6
31 MW	3	0	3	1	1	6	0.32	-0.6	1.84	5.2
32 MW	2	0	0	0	5	7	0.18	-0.9	4.04	5.9
33 MW	3	0	3	0	1	7	0.48	0	1.81	5.9
34 MW	4	0	2	1	0	7	0.64	1.00	1.92	5.5
35 MW	1	0	1	2	5	5	0.24	-0.6	3.56	4.5
36 MW	7	0	0	0	0	7	0.25	-0.2	0.94	4.9
37 MW	3	2	0	0	4	5	0.28	-0.8	4.59	4.9
38 MW	1	0	1	0	5	7	-0.56	-0.1	4.46	6.3
39 MW	4	0	2	0	1	7	0.50	0.4	2.23	5.7
40 MW	0	0	1	0	6	7	0.68	0.6	3.4	4.7
41 MW	2	0	2	0	3	7	0.62	-0.2	2.5	5.2
42 MW	6	1	0	0	1	6	0.44	0.5	1.3	1.9
43 MW	4	2	2	3	1	2	-0.13	-0.3	1.7	5.7
44 MW	2	0	4	0	1	7	-0.7	0.7	2.0	0.8
45 MW	6	5	1	2	0	0	0.09	0.3	1.04	1.3
46 MW	7	6	0	0	0	1	0.38	-0.1	2.44	1.7
47 MW	7	0	0	0	0	7	0.86	0.9	0.63	0.8
48 MW	5	6	0	1	2	0	0.75	0.7	2.72	0.8
49 MW	7	6	0	1	0	0	0.70	0.5	0.77	1.0
50 MW	5	4	1	0	1	3	0	-0.4	3.92	2.8
51 MW	7	4	0	0	0	3	0.71	0.8	0.77	3.0
52 MW	5	1	1	0	2	7	0.1	-0.36	1.8	5.86
Avg	3.76	2.05	1.03	0.82	2.30	4.05	0.19	0.13	2.59	3.58

**Table 4.24 Monthly skill score of observed and forecasted maximum and minimum temperature during the year 2020**

Month	Correct		Usable		Unusable		Corre. Coeff.		RMSE	
	Max °C	Min °C	Max °C	Min °C	Max °C	Min °C	Max °C	Min °C	Max °C	Min °C
Jan	6	9	1	5	24	17	0.1	-0.10	5.1	3.4
Feb	14	15	4	5	11	9	0.5	0.1	1.8	2.6
Mar	14	17	3	5	14	9	0	0.7	3.3	2.5
April	25	20	4	3	1	7	0.4	0.7	1.3	2.0
May	22	4	2	2	7	25	0.3	0.1	2.5	4.9
June	12	6	4	5	14	19	-0.1	0	3.9	4.9
July	14	5	7	3	10	22	-0.2	-0.3	2.6	4.5
August	11	0	9	1	11	30	0.4	-0.1	2.9	5.7
Sept.	15	2	3	2	12	26	0.4	0	3.4	5.3
Oct	12	6	7	3	12	22	0	0	2.3	4.6
Nov	26	27	3	2	1	1	0.6	0.7	1.3	1.1
Dec	25	16	2	2	4	13	0.3	0.2	2.3	3.5
Avg	16.33	10.59	4.07	3.16	10.10	16.66	0.22	0.16	2.72	3.75

**Table 4.25 Seasonal skill score of observed and forecasted maximum and minimum temperature during the year 2020**

Season	Correct		Usable		Unusable		Corre. Coeff.		RMSE	
	Max °C	Min °C	Max °C	Min °C	Max °Cs	Min °C	Max °C	Min °C	Max °C	Min °C
Pre- monsoon	61	41	9	10	22	41	0.8	0.8	2.52	3.33
Monsoon	52	13	23	11	47	98	0.4	0.1	3.22	5.1
Post-monsoon	63	49	12	7	17	36	0.27	0.68	2.06	3.47
Winter	20	19	10	15	30	26	0.52	-0.06	3.87	3.04
Avg	49	30.5	13.5	10.75	29	50.25	0.49	0.38	2.91	3.73

## **4.7 Skill score of observed and forecasted relative humidity during the year 2021**

### **4.7.1 Weekly skill score of observed and forecasted maximum and minimum relative humidity**

The weekly maximum relative humidity percentage forecast is show in Table 4.26. The average relative humidity maximum correct percentage was highest at 3.23 per cent, followed by usable forecast percentage 2.11 and unusable forecast percentage 1.57. The average RMSE values in 16.73 for all weeks during the year. The average correlation coefficient between observed and forecasted value is 0.03 per cent.

The minimum relative humidity correct percentage is highest at 2.73 followed by unusable percentage 2.17 and usability 1.94 per cent. . The average RMSE values in 19.67 for all seasons. The average correlation coefficient between observed and forecasted value is 0.04 represents. Similar findings values for Sharma *et al.*, (2018).

### **4.7.2 Monthly skill score of observed and forecasted maximum and minimum relative humidity:**

The monthly maximum relative humidity percentage forecast is show in Table 4.27. The average relative humidity maximum correct percentage was highest at 14.5 per cent, followed by usable forecast percentage 9.16 and unusable forecast percentage 6.83. The average RMSE values in 18.15 for all months during the year. The average correlation coefficient between observed and forecasted value is 0.07 per cent.

The minimum relative humidity correct percentage was highest at 11.83 followed by unusable percentage 10.08 and usability 8.41 per cent. The average RMSE values in 21.08 for all seasons. The average correlation coefficient between observed and forecasted value was 0.13 per cent.

### **4.8.3 Seasonal skill score of observed and forecasted maximum and minimum relative humidity:**

The monthly maximum relative humidity percentage forecast is show in Table 4.28. The average relative humidity maximum correct percentage was highest at 40.5 per cent, followed by usable forecast percentage 29 and unusable forecast percentage 22. The average RMSE values in 18.90 for all seasons during the

year. The average correlation coefficient between observed and forecasted value is 0.16 per cent.

The minimum relative humidity correct percentage was highest at 36 per cent followed by unusable percentage 31.25 and usability 24.25 per cent. The average RMSE values in 22.71 for all seasons. The average correlation coefficient between observed and forecasted value is 0.21 per cent.

**Table 4.26 Weekly skill score of observed and forecasted maximum and minimum relative humidity during the year 2020**

Met. Week	Correct		Usable		Unusable		Corre. Coeff.		RMSE	
	Max %	Min%	Max%	Min%	Max%	Min%	Max %	Min %	Max %	Min %
1 MW	4	0	2	3	1	4	-0.1	-0.25	15.2	25.9
2 MW	2	0	3	0	2	7	0.60	0.60	21.19	36.25
3 MW	5	0	1	0	1	0	-0.63	-0.45	16.11	45.92
4 MW	1	0	1	1	5	6	0.35	0.16	28.4	35.97
5 MW	3	0	2	2	2	5	0.21	-0.48	19.76	31.9
6 MW	4	1	2	1	1	5	0.16	-0.13	12.54	20.97
7 MW	1	2	1	5	5	0	0.18	0.70	23.24	13.98
8 MW	2	5	1	1	4	1	0.07	0.43	18.09	12.11
9 MW	4	5	3	2	1	1	-0.49	-0.52	18.35	8.35
10 MW	0	7	6	0	1	0	0.87	0.64	15.19	5.97
11 MW	4	6	2	0	1	1	-0.05	-0.02	15.38	19.32
12 MW	2	0	1	2	4	5	-0.49	0.03	29.06	40.45
13 MW	1	3	4	0	2	4	0.01	0.18	16.89	30.35
14 MW	4	4	2	3	1	0	0.10	0.34	11.89	8.81
15 MW	5	2	2	1	0	4	0.42	-0.31	10.69	26.14
16 MW	0	4	3	2	4	1	-0.80	0.26	23.79	24.50
17 MW	1	5	2	2	4	0	-0.27	-0.14	18.74	9.14
18 MW	1	5	5	2	1	0	0.27	0.04	15.47	9.25
19 MW	4	3	3	3	0	1	0.55	-0.54	12	14.91
20 MW	2	5	3	2	2	0	-0.12	-0.29	34.49	9.73
21 MW	1	5	2	2	4	0	0.07	0.20	24.79	8.51
22 MW	3	3	2	1	2	3	0.09	0.42	21.54	26.13
23 MW	3	2	2	2	2	3	-0.24	-0.10	19.6	21.86
24 MW	2	3	4	0	1	4	-0.08	-0.81	22.95	37.65

25 MW	4	4	1	0	2	3	-0.44	-0.91	14.12	17.66
26 MW	3	5	2	2	2	0	-0.2	0.31	0.8	9.65
27 MW	2	2	2	4	3	1	-0.1	0.10	30.2	15.69
28 MW	2	2	3	3	2	2	-0.6	-0.09	17.2	17.40
29 MW	5	0	2	3	0	3	0.3	-0.02	8.2	21.93
30 MW	4	2	1	3	2	2	-0.6	-0.77	16.4	18.74
31 MW	3	4	2	3	2	0	-0.5	0.71	27.3	10.34
32 MW	6	1	1	1	0	5	0.5	-0.5	7.74	25.87
33 MW	6	4	0	3	1	0	0	-0.25	11.3	12.87
34 MW	6	2	1	3	0	2	0.7	0.72	8.0	15.16
35 MW	7	3	0	1	0	2	0.2	0.12	5.4	18.39
36 MW	0	4	1	3	0	0	-0.2	0.22	5.4	8.78
37 MW	7	4	0	3	0	0	0.1	0.73	3.8	11.51
38 MW	6	4	0	3	1	0	-0.2	0.58	10.4	9.79
39 MW	5	3	2	1	0	3	0.3	0.20	9.8	18.27
40 MW	4	0	3	0	0	7	0.49	0.63	12.08	34.81
41 MW	5	4	2	2	0	1	-0.20	0.40	9.52	16.20
42 MW	2	5	4	2	1	0	0.67	-0.38	36.5	8.62
43 MW	5	1	2	4	0	2	0.64	0.41	11.31	7.64
44 MW	6	5	1	2	0	0	0.79	0.33	6.6	9.67
45 MW	3	3	4	4	0	0	0.30	-0.12	10.38	13.48
46 MW	3	4	3	2	1	1	-0.11	0.26	16.49	12.33
47 MW	1	1	2	3	4	3	-0.02	-0.35	30.71	21.57
48 MW	3	2	2	1	2	4	-0.96	-0.72	26.01	34.45
49 MW	2	2	3	1	2	3	-0.16	-0.62	18.27	25.98
50 MW	5	0	1	4	1	3	0.08	0.69	10.86	23.01
51 MW	3	1	2	3	2	3	0.74	0.60	16.27	22.28
52 MW	1	0	4	0	3	8	-0.42	0.27	23.71	36.74
Avg	3.23	2.73	2.11	1.94	1.57	2.17	0.03	0.04	16.73	19.67

**Table 4.27 Monthly skill score of observed and forecasted maximum and minimum relative humidity during the year 2020**

Month	Correct		Usable		Unusable		Corre. Coeff.		RMSE	
	Max %	Min %	Max %	Min %	Max %	Min %	Max %	Min %	Max %	Min %
Jan	12	0	8	3	11	27	0.23	0.28	21.44	36.6
Feb	11	11	7	9	11	9	0.08	-0.08	19.22	17.98
Mar	10	16	13	5	8	10	-0.16	-0.08	18.92	26.15
April	10	17	10	8	10	5	0.01	0.07	16.97	18.46
May	10	20	13	10	8	1	0.14	-0.05	22.8	10.7
June	12	13	10	4	8	13	-0.15	-0.18	19.84	26.2
July	15	7	8	15	8	8	-0.10	0.27	21.77	18.05
August	25	12	4	10	2	9	0.46	0.27	10.17	18.07
Sept.	26	18	4	9	0	3	0.05	0.69	7.84	12.12
Oct	19	13	11	8	1	10	0.33	0.01	19.58	21.37
Nov	11	12	12	12	7	6	-0.16	0.01	21.74	18.82
Dec	13	3	10	8	8	20	0.18	0.39	17.62	28.49
Avg	14.5	11.83	9.16	8.41	6.83	10.08	0.07	0.13	18.15	21.08

**Table 4.28 Seasonal skill score of observed and forecasted maximum and minimum relative humidity during the year 2020**

Season	Correct		Usable		Unusable		Corre. Coeff.		RMSE	
	Max %	Min %	Max %	Min %	Max %	Min %	Max %	Min %	Max %	Min %
Pre- monsoon	30	53	36	23	26	16	0.02	0.04	19.74	19.5
Monsoon	66	52	32	33	24	37	0.10	-0.01	16.08	19.25
Post- monsoon	43	28	33	28	16	36	0.40	0.52	19.7	23.32
Winter	23	11	15	13	22	36	0.12	0.29	20.11	28.8
Avg	40.5	36	29	24.25	22	31.25	0.16	0.21	18.90	22.71

**CHAPTER – V**

**SUMMARY AND CONCLUSIONS**

## CHAPTER - V

### SUMMARY AND CONCLUSION

#### Summary

The present investigations on **“Impact of Agrometeorological Advisory Services on economic level of farmers from Nanded district under climate change pattern”** was carried out during *Kharif* 2020 at Department of Agricultural Meteorology, Vasantrya Naik Marathwada Krishi Vidyapeeth, Parbhani.

The research study was conducted with the following objectives:

1. To verify weather forecast and impact of Agrometeorological Advisory Services in Nanded district
2. To identify the proper crop cultivation practices within selected farmer in Nanded district

For study of AAB for Nanded district during the year 2020, bulletin collected from GKMS Centre, VNMKV, Parbhani and daily weather data was collected from Cotton Research Station, Nanded and KVK, Nanded for the last year 2020.

After that, detailed study of the collected data following suitable recommendation was done.

The study revealed that the information gathered through agro-advisory services was very useful and helpful to the farmers. The AAS farmers were benefitted from the agro-advisory in respect to crop management and animal husbandry. The field operations in management of crops and rainfall, temperature and relative humidity information were the major aspects on which farmers were interested to get information. Since the initial stage of the programme, sufficient numbers of farmers were found to be benefitted through the agro-advisory services.

Advisory content (*i.e.* information of land preparation, crop management practices, post harvesting, production, livestock, poultry, fishery management, sericulture management etc.) varied with location, season, weather, crop conditions and local management practices and precession advice (*i.e.* date of sowing,

exact seed rate, dry spell, fertilizer dose, proper fertilizer application method, irrigation schedule, vaccination schedule and proper method of rationing for cattle).

The issued bulletins were available at the websites of VNMKV, ITC-VNMKV and IMD (Indian Meteorology Department) and they were also broadcasted on AIR, Nanded (*i.e.* Radio). The AABs were disseminated to different media.

The average cost of cultivation of soybean crop was Rs. 41,900/ha and Rs. 44,300/ha at sampled farms of contact and non-contact farmers, respectively. Overall, the average cost of cultivation in case of non-AAS farmers' it was found to be higher by Rs. 2,400 as compared to AAS farmers. Net cost:benefit ratio of AAS and non- AAS farmers was found 1:1.71 and 1:1.31 respectively. It was observed that the AAS farmers received good benefits than non- AAS farmers.

The average cost of cultivation of cotton crop was Rs. 42,000/ha and Rs. 52,000/ha at sampled farms of contact and non-contact farmers, respectively. Overall, the average cost of cultivation in case of non- AAS farmer was found to be higher by Rs. 10,000 as compared to AAS farmers. Net cost:benefit ratio of AAS and non AAS farmers was found 1:2.33 and 1:1.61, respectively. It was observed that the AAS farmers received good benefits than non- AAS farmers.

The average cost of cultivation of Pigeon pea crop was Rs. 35,800/ha and Rs. 38,000/ha at sampled farms of contact and non-contact farmers, respectively. Overall, the average cost of cultivation in case of non-AAS farmers was found to be higher by Rs. 2,200 as compared to AAS farmer. Net cost:benefit ratio of AAS and non AAS farmers was found 1:2.35 and 1:1.73 respectively. On the other side, the reduced cost of cultivation per hectare in case of AAS farmers revealed the application of agricultural inputs judiciously and efficiently as per weather forecast support and including the advisories in operational farm management.

As per farmers' feedback, 40 per cent of the farmers put the AAB services in excellent category while, 20 per cent farmers put this kind of micro-level agro-advisory services dissemination (MAAS) in very good category. More than 22.5 per cent farmers put the services in good category and 12.5 per cent satisfactory category, while, 5.0 per cent of the farmers who couldn't understand the objective and services rendered put AAB services in irrelevant category.

An attempt was made in the questionnaire to know from the AAS farmers about different coverage of farmers by weather information which revealed that 30 per cent of farmers were covered by SMS, 2.5 per cent were covered by

newspapers, 17.5 per cent are covered by television, 2.5 per cent covered by radio and more farmers preferred Whatsapp groups at about 47.5 per cent for receiving the weather information in AAS category.

### **Conclusion**

The results from the investigation revealed that the economic benefit of AABs to farmers during 2020 in Nanded district was maximum. Amongst 80 farmers, (33%) farmers were benefitted of Rs. 10,000; (26%) farmers were benefitted between Rs. 11,000 to 20,000 and (26%) farmers were benefitted between Rs. 21,000 to Rs. 30,000 amount. While, 13.7% farmers were benefitted with an amount of more than Rs. 30,000.

The Agromet advisory service (AAS) was helpfull in bringing out substantial awareness among farmers. It was also encouraging the among the farmers for adoption of real time modern agricultural production technologies and practices like promoting weather based irrigation, pest and disease management, etc. along with use of post-harvest technologies. Despite positive effects of AAS on adoption of improved production technologies and practices, marginal differences of yield among AAS and non-AAS farmers were found.

## **LITERATURE CITED**

## LITERATURE CITED

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# **APPENDIX**



**Collection of questionnaire**



## Format of Questionnaire

वसंतराव नाईक मराठवाडा कृषी विद्यापीठ, परभणी - ४३१४०२

“ग्रामीण कृषी मौसम सेवा सर्वेक्षण प्रोफोर्म”

	विवरण	पर्याय
१.	शेतकऱ्याचे नाव	
२.	दुरध्वनी क्रमांक	
३.	वय	
४.	लिंग	
५.	गाव	
६.	तालुका	
७.	जिल्हा	
८.	शिक्षण	
९.	शेतकऱ्याचा प्रकार	१. सालगडी २. जमीनधारक शेतकरी ३. दोन्ही
१०.	पिकाचे नाव व क्षेत्र	पिकाचे नाव क्षेत्र (हेक्टरी)
		१. १. २. ३. ४.
११.	पिकाचा हंगाम	१. खरीप २. रबी ३. उन्हाळी
१२.	शेतीचा प्रकार	१. बागायत २. कोरडवाहू
१३.	जमिनीनुसार वर्गीकरण	१. लघु २. लहान ३. मध्यम ४. मोठा
१४.	शेतीच्या कोणत्या नियोजनासाठी हवामान अंदाज व कृषि हवामान सल्ला उपयुक्त आहे (एका पेक्षा जास्त पर्यायाची निवड करू शकता)	१. पेरणी / पुर्नलागवडीच्या वेळी २. पाणी व्यवस्थापन ३. खतमात्रा देते वेळी ४. फवारणीच्या वेळी ५. काढणी पश्चात नियोजनासाठी ६. इतर ( नमूद करा )
१५.	आपण आपल्या शेतीच्या नियोजनासाठी हवामान अंदाजाचा उपयोग करता का ?	१. होय २. नाही
१६.	आपण ग्रामीण कृषि मौसम सेवा योजना परभणीद्वारे दिल्या जाणाऱ्या कृषि हवामान सल्ल्याचा उपयोग करता का ?	१. होय २. नाही
१७.	आपणास हवामानाचा अंदाज कितपत उपयुक्त आहे.	१. उपयुक्त नाही २. काही प्रमाणात उपयुक्त ३. अत्यंत उपयुक्त
१८.	आपणास असे वाटते काय की, हे हवामान अंदाज व त्यावर आधारित कृषि हवामान सल्ला पत्रक शेतकरी बांधावाच्या उपयोगाचे आहे, असे असल्यास त्याचे प्रमाण (%) किती ?	१. २५% २. ५०% ३. ७५% ४. १००%
१९.	आपणास हवामानाचा अंदाज व कृषि हवामान सल्ला कोणत्या माध्यमाद्वारे मिळतो ?	१. टीव्ही २. आकाशवाणी ३. बातम्या ४. संदेश ५. व्हॉट्सअॅप ६. संकेतस्थळ ७. इतर ( कृपया नमूद करा)
२०.	ग्रामीण कृषी मौसम सेवा सल्ला मधील हवामान विषयक अंदाजातील पुढील कोणत्या घटकांचा शेती नियोजनात जास्त उपयोग झाला?	१. पावसातील खंड २. पावसाचे आगमन ३. परतीचा पाऊस ४. वादळीवारा ५. वारा ६. तापमान ७. ढग स्थिती
२१.	सदरील सेवा सल्ल्यामुळे शेतीत होणारे कोणते नुकसान टाळता येते?	१. अवकाळी पाऊसामुळे पिकांचे नुकसान २. दोवार पेरणीचे खर्च टाळता येते ३. पिकांतील किडीचे प्रादुर्भाव टाळता येते ४. पाणीचे नियोजन करता येते ५. पीक काढणी वेळेस नियोजन
२२.	शेतकऱ्यांच्या कृषि हवामान सल्ला बदल प्रतिक्रिया?	१. असमाधानकारक २. काही प्रमाणात समाधानकारक ३. समाधानकारक ४. खूप समाधानकारक

२३.	वार्षिक पीक खर्चात बचत झाली का?	होय / नाही
२४.	वार्षिक पीक खर्चात साधारणतः एकरी किती बचत झाली?	१. ५००० पेक्षा कमी १०००० ४. १५००० २. ५००० ५. १५००० पेक्षा जास्त ३.
२५.	वार्षिक शेतीतून साधारतः एकरी किती अधिकचे उत्पन्न मिळाले?	१. ५००० पेक्षा कमी १०००० ४. १५००० २. ५००० ५. १५००० पेक्षा जास्त ३.
२६.	आपणास असे वाटते कि या माहितीचा उपयोग करून पीक उत्पादन प्रक्रियेत होणारे संभाव्य नुकसान टाळता येते?	होय / नाही
२७.	पिकांची योग्य वेळी मशागत करून प्रति एकरी उत्पादन वाढवता येते?	होय / नाही
२८.	आपणास असे वाटते का उत्पादन खर्चात काटकसर करता येते?	होय / नाही
२९.	कृषी सल्ला कोणत्या दिवशी प्रसारित होतो?	१. सोमवार २. मंगळवार ३. गुरुवार ४. शुक्रवार
३०.	आपणास कोणत्या वेळी हवामान अंदाज व कृषि हवामान सल्ला बदल माहिती एकव्यास / पहावयास आवडेल?	१. सकाळी (७ ते ९) २. दुपारी (१२ ते २) ३. दुपार नंतर (३ ते ५) ४. सायंकाळी (६ ते ७) ५. रात्री (८ ते १०)
३१.	आपण, आपणास मिळालेला हवामान अंदाज व कृषि हवामान सल्ला ही माहिती इतरांना देता का?	१. होय २. नाही असल्यास कोणत्या माध्यमाद्वारे १. तोंडी चर्चा २. व्हॉट्सएप संदेश / संदेश पाठवून ३. बैठक / गट चर्चा ४. सार्वजनिक ठिकाणी प्रदर्शित करून
३२.	खराब वातावरणामुळे वार्षिक सरासरी उत्पादनात होणारे नुकसान?	१. शून्य २. ५ टक्के पेक्षा कमी ३. ५ ते १० टक्के ४. १० ते २० टक्के ५. २० ते ३० टक्के ६. ३० टक्के पेक्षा अधिक
३३.	कृषि हवामान सल्ला सुधारण्यासाठी आपल्या सूचना.	
३४.	आपणास हवामान विषयी इतर कोणत्या माहितीची आवश्यकता आहे.	



**AAB (English) format of Nanded district**  
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**Nanded district Agromet Advisory Bulletin No. : 21/ 2020-21**

**Day & Date: Friday, 12.06.2020**

Weather Forecast of Nanded District (Valid for 13 <sup>th</sup> to 17 <sup>th</sup> June, 2020)					
Weather Parameters	13/06	14/06	15/06	16/06	17/06
Rainfall (mm)	34.0	34.0	67.0	23.0	12.0
T <sub>max</sub> (°C)	29.0	29.0	30.0	30.0	30.0
T <sub>min</sub> (°C)	24.0	24.0	24.0	24.0	24.0
Cloud Cover	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy
RH-I (%)	93	93	91	87	87
RH-II (%)	77	81	74	69	72
Wind Speed (km/hr)	12	09	13	21	22
Wind Direction	W	W	W	W	SW

**During next five days weather will be cloudy. Light to moderate rainfall may occur at isolated places in Nanded district. Monsoon arrived in Nanded district; farmer should go for sowing after receipt of 75 to 100 mm seasonal rainfall.**

Name of Crop	Stage	Agromet Advisory
Soybean	Intercropping	For rainfed cultivation use intercropping of soybean + Pigeonpea 2:1 or 4:2 and for irrigated condition use Soybean + cotton 1:1 or 2:1 intercropping should be use in soybean crop.
Kharif sorghum	Intercropping	Kharif sorghum + Soybean 2 : 4 or 3 :6 intercropping system should be use in Kharif sorghum crop keep 45 cm distance between two rows. Kharif sorghum + Pigeonpea 3:3 or 4:2 intercropping is beneficial. If soybean, green gram, black gram such types of short duration crops are selected for intercropping use 2:4 intercropping system.
Pearl millet	Intercropping	Intercropping of pearl millet + pigeonpea 2:1 or 4:2 should be used in pearl millet crop.
Sugarcane	--	--
Turmeric	Intercropping	While selecting inter crop in turmeric, precaution should be taken that the crop must be short duration e.g. Chilli, Coriander etc. Intercropping of maize in turmeric should be strictly prohibited because it results decrease in yield.
Citrus	Growth stage	Apply 500:500:500 gm NPK per plant for sweet orange and 400:400:400 gm NPK for mandarin + FYM.
Pomegranate	Growth stage	Apply 325:250:250 gm NPK per plant for pomegranate + FYM.
Sapota	Growth stage	Apply 500:500:500 gm NPK per plant for sapota + FYM.
Vegetable	Seedling prep.	Prepare the seedling of vegetable crops on raised.
Fodder crop	Selection of variety	For cultivation of maize as a fodder crop select varieties like African Tall, Manjri, Composite, Gangasafed, Vijay etc.
Mulberry sericulture	--	For mulberry plantation avoid the fields where previously chilli and tobacco crops are cultivated. Mulberry saplings get affected with root rot, cercospora leaf spot and other diseases which may affect the plant population per hectore.
Agril. Engineering	--	If possible purchase farm implements which are useful for farm operation, repairing of available implements if they are not working properly must be done.
Other	--	Collective majors should be adopted for management of white grubs at village level, for that collect and destroy the adults of white grubs at evening (7 to 8 pm) from the tree of Neem, Babul and Ber. It is very essential to use light traps by each and every farmer. For biological control of white grub apply <i>Metarhizium anisopliae</i> @ 10 kg per acre in soil.

**This Agro Advisory Bulletin (AAB) is prepared and published with the consolation and recommendation of SMS committee of "Gramin Krishi Mausam Sewa (GKMS)", Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani 431 402 (MS).**

**Principal Nodal Officer**  
**Gramin Krishi Mausam Sewa**  
**(GKMS)**  
**VNMKV, Parbhani**

**AAB (Marathi) format of Nanded district**

ग्रामीण कृषि मौसम सेवा

वसंतराव नाईक मराठवाडा कृषि विद्यापीठ, परभणी - ४३१ ४०२

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नांदेड जिल्हा कृषि हवामान सल्ला पत्रक क्रमांक - २१/२०२०-२१ शुक्रवार, दिनांक - १२.०६.२०२०

नांदेड जिल्हाकरीता दिनांक १३ ते १७ जून, २०२० साठी हवामान अंदाज					
हवामान घटक	१३/०६	१४/०६	१५/०६	१६/०६	१७/०६
पाऊस (मिमी)	३४.०	३४.०	६७.०	२३.०	१२.०
कमाल तापमान (अं.से.)	२९.०	२९.०	३०.०	३०.०	३०.०
किमान तापमान (अं.से.)	२४.०	२४.०	२४.०	२४.०	२४.०
ढग स्थिती (आकाश)	ढगाळ	ढगाळ	ढगाळ	ढगाळ	ढगाळ
सकाळची सापेक्ष आर्द्रता (%)	९३	९३	९१	८७	८७
दुपारची सापेक्ष आर्द्रता (%)	७७	८१	७४	६९	७२
वा-याचा वेग (किमी / तास)	१२	०९	१३	२१	२२
वा-याची दिशा	पश्चिम	पश्चिम	पश्चिम	पश्चिम	नैऋत्य

नांदेड जिल्ह्यात पुढील पाच दिवसात आकाश ढगाळ राहून तुरळक ठिकाणी हलका ते मध्यम स्वरूपाच्या पावसाची शक्यता आहे. जिल्ह्यात मान्सूनचे आगमन झाले आहे. शेतक-यांनी मौसमी पाऊस ७५ ते १०० मीमी झाल्याशिवाय पेरणी करू नये.

पिकांचे नाव	अवस्था	कृषि हवामान सल्ला
सोयाबीन	आंतरपीक	कोरडवाहू परिस्थितीत सोयाबीन + तुर हे आंतरपीक २:१ किंवा ४:२ या प्रमाणात घ्यावे. तसेच ओलीताखाली सोयाबीन + कापूस हे आंतरपीक १:१ किंवा २:१ या प्रमाणात घेता येते.
खरीप ज्वारी	आंतरपीक	आंतरपीक पध्दतीमध्ये खरीप ज्वारी + सोयाबीन २:४ किंवा ३:६ या प्रमाणात दोन ओळीतील अंतर ४५ सेंमी ठेवून पेरणी करावी. तसेच खरीप ज्वारी + तुर ३:३ किंवा ४:२ या प्रमाणात पेरणी करावी. सोयाबीन, सुग, उडीद ही कमी कालावधीची पिके आंतरपीके म्हणून घेताना २:४ या आंतरपीक पध्दतीचा अवलंब करावा.
बाजरी	आंतरपीक	बाजरी पिकामध्ये बाजरी + तुर हे आंतरपीक २:१ किंवा ४:२ या प्रमाणात घ्यावे.
हळद	आंतरपीक	हळदीमध्ये आंतरपिके घेताना पहिल्या चार महिन्यापर्यंत वाढ होतील अशा प्रकाराची आंतरपिके निवडावीत. यामध्ये, मिरची, घेवडा, कोथंबीर इत्यादी सारख्या आंतरपिकांचा समावेश असावा. हळद या पिकामध्ये मका हे आंतरपीक घेऊ नये, त्यामुळे उत्पादनात घट येते.
संत्रा/ मोसंबी	वाढीची अवस्था	संत्रा बागेस ५००:५००:५०० व मोसंबी बागेस ४००:४००:४०० ग्रॅम नत्र, सफुरद, पालाश + ५ टोपले शेणखत प्रती झाड खतमात्रा देण्यात यावी.
डालिंब	वाढीची अवस्था	डालिंब बागेस ३२५:२५०:२५० ग्रॅम नत्र, सफुरद, पालाश + ५ टोपले शेणखत प्रती झाड खतमात्रा देण्यात यावी.
भाजीपाला	रोपे तयार करणे	शेतक-यांनी भाजीपाला पिकाची गादी वाफयावर रोपे तयार करण्यासाठी बी टाकले नसल्यास टाकून घ्यावे.
फुलशेती	रोपे तयार करणे	शेतक-यांनी हंगामी फुलपिकांच्या लागवडीसाठी गादीवाफयावर बी टाकून रोपे तयार केली नसल्यास ती करावी.
चारा पिके	वाणांची निवड	मका या चारापिकाच्या लागवडीसाठी आफ्रीकन टॉल, मांजरी कंपोझिट, गंगासफेद, विजय इत्यादी जातींची निवड करावी.
तुती रेशीम उदयोग	--	ज्या शेतात पूर्वी तंबाखू, मिरची या पिकांची लागवड असेल अशा ठिकाणी तुतीची लागवड करू नये. अशा शेतात लागवड केल्यास तेथे तुती रोपास मुळ कुजव्या, करपा, कडा करपा अशा रोगांची लागण झाल्यामुळे तुतीची मर होते व शिफारशीप्रमाणे प्रती हेक्टर झाडांची संख्या राहूत नाही.
कृषि अभियांत्रिकी	--	शक्य असल्यास शेती कामासाठी लागवणा-या अवजारांची खरेदी करावी तसेच उपलब्ध असलेली अवजारे नादुरुस्त असल्यास दुरूस्ती करून घ्यावी.
इतर	--	सध्या कडुनिंब, बामुळ, बोर या झाडावर सायंकाळी ७ ते ८ दरम्यान जमा होणा-या प्रौढ भुंग्याचे गावपातळीवर सामुदायिकपणे व्यवस्थापन करावे. तसेच प्रत्येक शेतक-याने आपल्या शेतात प्रकाशापाळे लावावेत.

सदर कृषि सल्ला पत्रिका वसंतराव नाईक मराठवाडा कृषि विद्यापीठ, परभणी येथील ग्रामीण कृषि मौसम सेवा योजनेतील तज्ञ समितीच्या शिफारशीवरून तयार करून प्रसारित करण्यात आली.

मुख्य प्रकल्प समन्वयक  
ग्रामीण कृषि मौसम सेवा  
वसंतराव नाईक मराठवाडा कृषि विद्यापीठ, परभणी

**List of Farmer:-**

- 1) Name: Patil Balaji Marotirao  
At: Nevali Tq: Mukhed Dist:  
Nanded  
Mo. No.: 9921045870
- 2) Name: Maroti Naryan Mirale  
At: Adlur Tq: Mukhed Dist:  
Nanded  
Mo. No.: 9730071622
- 3) Name: Nevale Ganapat Dadarao  
At: Nevali Tq: Mukhed Dist:  
Nanded  
Mo. No. 7517373592
- 4) Name: Patil Ashok Shankarrao  
At: Wadgaon Tq: Mukhed Dist:  
Nanded  
Mo. No. 9960308481
- 5) Name: Patil Jaykumar Chandrabhan  
At: Nevali Tq: Mukhed Dist:  
Nanded  
Mo.No. 7776087079
- 6) Name: Papulwad Tirupati Rana-  
ba  
At: Bapsherwadi Tq: Mukhed  
Dist: Nanded  
Mo. No. 9764421349
- 7) Name: Patil Bhaskar Khushalrao  
At: Dormali Tq: Mukhed Dist:  
Nanded  
Mo. No. 9765770492
- 8) Name: Fulari Omkar Ashokrao  
At: Baraghali Tq: Mukhed Dist:  
Nanded  
Mo. No. 9373273647
- 9) Name: Madalapure Achut Go-  
vindrao  
At: Hasnal Tq: Mukhed Dist:  
Nanded  
Mo. No. 8605011666
- 10) Name: Bodakhe Avadhut Datta  
At: Jahur Tq: Mukhed Dist:  
Nanded  
Mo. No. 8408831251
- 11) Name: Zade Shankarrao Nagorao  
At: Ambulaga Tq: Mukhed Dist:  
Nanded  
Mo. No. 9822244516
- 12) Name: Shinde Dhanraj Ganapat  
At: Kalambar Tq: Mukhed Dist:  
Nanded  
Mo. No. 7620203636
- 13) Name: Ingale Madhav  
Pandharinath  
At: Billali Tq: Mukhed Dist:  
Nanded  
Mo. No. 9766479201
- 14) Name: Bodakhe Kiran  
Madhavrao At: Jahur Tq:  
Mukhed Dist: Nanded  
Mo. No. 9960760607
- 15) Name: Gutte Ashok Madhavrao  
At: Savargaon Tq: Mukhed Dist:  
Nanded  
Mo. No. 8668456355
- 16) Name: Tarate Amar Shankarao  
At: Sanghavi Tq: Mukhed Dist:  
Nanded  
Mo. No. 7030147089
- 17) Name: Shinde Aniruddha Ra-  
mesh  
At. Dhosani Tq: Mukhed Dist:  
Nanded  
Mo. No. 8600480011
- 18) Name: Kambale Ramesh Chan-  
dranaik  
At. Nivali Tq: Mukhed Dist:  
Nanded  
Mo. No. 7083648038
- 19) Name: Somavar Thamnesh Su-  
ryakant  
At. Hatral Tq: Mukhed Dist:  
Nanded  
Mo. No. 9823214785
- 20) Name: Kothare Prashant Gopal  
At. Hatral Tq: Mukhed Dist:  
Nanded  
Mo. No. 997518014
- 21) Name: Patil Chandrakant  
Ghansham  
At: Gavandgaon Tq: Deglur Dist:  
Nanded  
Mo.No.: 9172715253

- 22) Name: Ghukar Madhusudan  
Namdev  
At: Degaon Tq: Deglur Dist:  
Nanded  
Mo.No: 8484868118
- 23) Name: Kerle Satish Jagdish  
At: Degaon Tq: Deglur Dist:  
Nanded  
Mo.No.: 8806028406
- 24) Name: Thadke Pandurang  
Hanmant  
At: Khanapur Tq: Deglur Dist:  
Nanded  
Mo.No: 9960141454
- 25) Name: Thadke Hanmant  
Gangaram  
At: Degaon Tq: Deglur Dist:  
Nanded  
Mo.No: 9881729035
- 26) Name: Deshmukh Digambar  
Madhavrao  
At: Kavalgaon Tq: Deglur Dist:  
Nanded  
Mo.No: 9498618521
- 27) Name: Nanderwad Anil  
Antesharrao  
At: Kavalgaon Tq: Deglur Dist:  
Nanded  
Mo.No:8600847978
- 28) Name: Thezage Kailas  
Madhavrao  
At: Kavalgaon Tq: Deglur Dist:  
Nanded  
Mo.No: 9960547008
- 29) Name: Kodekar Ashok Shamrao  
At: Khanapur Tq: Deglur Dist:  
Nanded  
Mo.No: 9922103626
- 30) Name: Gaykambale Ankush  
Sudam  
At: Tadsel Tq: Deglur Dist:  
Nanded  
Mo.No: 8007869335
- 31) Name: Chakkawar Rajesh  
Ramrao  
At: Undri Tq: Deglur Dist:  
Nanded  
Mo.No: 7758897078
- 32) Name: Gaykambale Banti  
Gangaram  
At: Deglur Tq: Deglur Dist:  
Nanded  
Mo.No. 8806496707
- 33) Name: Thadke Rajesh Ramrao  
At: Degaon Tq: Deglur Dist:  
Nanded  
Mo.No. 8624844964
- 34) Name: Shinde Shubham Bhimrao  
At: Bhashegaon Tq: Deglur Dist:  
Nanded  
Mo.No. 9158646206
- 35) Name: Sheikh Bablu Sheikh  
Ahemad  
At: Deglur Tq: Deglur Dist:  
Nanded  
Mo.No.: 7058020822
- 36) Name: Thadke Bablu Akash  
At: Degaon Tq: Deglur Dist:  
Nanded  
Mo.No: 9960376064
- 37) Name: Patil Nursing Baliram  
At: Sanghavi Tq: Deglur Dist:  
Nanded  
Mo.No.9764622997
- 38) Name: Patil Gajanan Sheshrao  
At: Sanghvi Tq: Deglur Dist:  
Nanded  
Mo.No. 9404951000
- 39) Name: Desai Shashank  
Madhavrao  
At: Mujlga Tq: Deglur Dist:  
Nanded  
Mo.No. 7798114001
- 40) Name: Panare Eresh Venktarao  
At: Khanapur Tq: Deglur Dist:  
Nanded  
Mo.No. 9404428056
- 41) Hanmantrao Gangaram Kanole  
At: Ballal Tq: Bhokar Dist:  
Nanded  
Mo.No.: 9370529723
- 42) Name: Vasudev Pandurang Joshi  
At: Ballal Tq: Bhokar Dist:  
Nanded  
Mo.No.: 9421759741

- 43) Name: Balaji Madhav Bachalwad  
At: Bendri Tq: Bhokar Dist:  
Nanded  
Mo.No.: 9764151074
- 44) Name: Ramdas Maroti  
Bachalwad  
At: Bendri Tq: Bhokar Dist:  
Nanded  
Mo.No.: 9765769319
- 45) Name: Kharode Udas Madhav  
At: Dorli Tq: Bhokar Dist:  
Nanded  
Mo.No.: 7709540776
- 46) Name: Gamod Pundlik Potanna  
At: Jamdari Tq: Bhokar Dist:  
Nanded  
Mo.No.: 7264903113
- 47) Name: Vijay Chandar Hatagade  
At: Jamdari Tq: Bhokar Dist:  
Nanded  
Mo.No.: 8806653089
- 48) Name: Jadhav Nirmala  
Karimsing  
At: Jamdari Tanda Tq: Bhokar  
Dist: Nanded  
Mo.No.: 9923597994
- 49) Name: Balaji Bhivaji Kadam  
At: Laglud Tq: Bhokar Dist:  
Nanded  
Mo.No.: 9325654824
- 50) Name: Bhimsingh Kishansingh  
Chavan  
At: Laglud Tq: Bhokar Dist:  
Nanded  
Mo.No.: 9403004078
- 51) Name: Dilip Kerba Jadhav  
At: Laglud Tq: Bhokar Dist:  
Nanded  
Mo.No.: 8698675046
- 52) Name: Jadhav Pratap Kerbarao  
At: Laglud Tq: Bhokar Dist:  
Nanded  
Mo.No.: 9423441119
- 53) Name: Jayprakash Madhavrao  
Kadam  
At: Laglud Tq: Bhokar Dist:  
Nanded  
Mo.No.: 7798698699
- 54) Name: Kadam Chandrkant  
Digambar  
At: Laglud Tq: Bhokar Dist:  
Nanded  
Mo.No.: 9421624794
- 55) Name: Digambar Malkaram  
Puranwad  
At: Pimpaldhav Tq: Bhokar  
Dist: Nanded  
Mo.No.: 9011603051
- 56) Name: Gangadhar Santram  
Chavan  
At: Pimpaldhav Tq: Bhokar  
Dist: Nanded  
Mo.No.: 9421849577
- 57) Name: Vasant Pandhari Jadhav  
At: Pimpaldhav Tq: Bhokar  
Dist: Nanded  
Mo.No.: 9421849577
- 58) Name: Sagar Maroti Lolpod  
At: Pimpaldhav Tq: Bhokar  
Dist: Nanded  
Mo.No.: 9359106588
- 59) Name: Anandrao Kishanrao  
Kadam  
At: Rawangaon Tq: Bhokar Dist:  
Nanded  
Mo.No.: 9403070233
- 60) Name: Bhimrao Mariba Kamble  
At: Rawangaon Tq: Bhokar Dist:  
Nanded  
Mo.No.: 9403070233
- 61) Name: Pawar Swapnil  
Sambhajirao  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No. 7620063999
- 62) Name: Pawar Sambhajirao  
Gangaram  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No. 9420667918
- 63) Name: Pawar Sandip Vitthalrao  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No.: 8805087777

- 64)** Name: Pawar Sharad Hanumant  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No.: 8421858888
- 65)** Name: Pawar Akash Gulabrao  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No.: 7972332180
- 66)** Name: Pawar Arvind Ashok  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No. 9049490123
- 67)** Name: Jadhav Suresh  
Hanumantrao  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No.: 9423924380
- 68)** Name: Umberkar Dinesh  
Sakharam  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No.: 8767697230
- 69)** Name: Pawar Yuraj Gunwant  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No.: 7768977130
- 70)** Name: Pimpaldare Anil  
Digambarrao  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No.: 7588067599
- 71)** Name: More Akash Digambarrao  
At: Devgao Tq: Naygao Dist:  
Nanded  
Mo. No.: 8177969565
- 72)** Name: Chaunde Nilesh  
Janardhan  
At: Shelgaon Tq : Naygao Dst:  
Nanded  
Mo. No.: 8956333033
- 73)** Name: Tate Amar Ashokrao  
At: Mugaon Tq : Naygao Dst:  
Nanded  
Mo. No.: 8390816416
- 74)** Name: Jadhav Amol Anand  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No.: 9637751790
- 75)** Name: Pimpaldare Satish  
Baliram  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No.: 9860747999
- 76)** Name: Wadje Venkatesh  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No.: 9975350999
- 77)** Name: Jadhav Rohit Ramesh  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No.: 9764459295
- 78)** Name: Pimpaldare Baliram  
Dhondiba  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No.: 9420451009
- 79)** Name: Pawar Balaji Vasant  
At: Hotala Tq: Naygao Dist:  
Nanded  
Mo. No.: 9766281427
- 80)** Name: Tate Sharad Uttamrao  
At: Narasi Tq: Naygao Dist:  
Nanded  
Mo. No.: 9011144132

# **CURRICULUM VITAE**

## CURRICULUM VITAE

**Name** : Rathod Sandip Bhimrao  
**Date of birth** : 12<sup>th</sup> July 1997  
**Nationality** : Indian  
**Domicile** : Maharashtra  
**Permanent Address** : At. Rathodnagar, Post. Ner, Tq. Jalna  
Dist. Jalna, Maharashtra  
Pin code: 431203  
**Mobile No.** : 7066777094  
**Email ID** : [sandeepathod2107@gmail.com](mailto:sandeepathod2107@gmail.com)  
**Languages known** : Marathi, Hindi, English  
**Educational Qualification** : B.Sc. (Agri.)  
**Field of interest** : Research in Agricultural Meteorology

### Academic record

Sr. No.	Name of exam/ degree	University/Board	Year of passing	Percentage/ CGPA	Class
1.	B.Sc. (Agri.)	VNMKV, Parbhani	2019	7.4	Second Division
2.	HSC	Maharashtra State Board (Aurangabad)	2015	69.38	First
3.	SSC	Maharashtra State Board (Aurangabad)	2013	70.80	First

Place: Parbhani

Date: 06/12/2021

  
Signature of student

**Rathod Sandip Bhimrao**