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ICT and Weather Prediction for Agriculture

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Abstract—Approximately, seventy percentage of total population of India belong to the rural areas and main source of their income is farming. One of the major challenges in agriculture is weather. The weather changing is a natural process, the human have no any control over it and directly affects the agriculture. To prevent from weather changing issues, the weather advisory services have been launched. The ICT plays vital role in weather advisory service. The ICT is combination of Hardware, Software and Communication Medium. It provides tools and techniques for weather forecasting services. The ICT tools such as radio, television, mobile phones, smart phones, call centers, SMS/IVRS and mobile application have great contribution in weather advisory services. In this paper a study has been carried out on use of ICT and weather prediction system. Gramin Krishi Mausam Sewa (GKMS) is dedicated to provide the weather related information to the farmers twice a week. This service is provided by the Earth System Science Organization (ESSO) of India Meteorological Department (IMD).

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I. INTRODUCTION

The term ICT is abbreviated as Information and Communication Technology. It can be treated as simplified technology that can easily convey the appropriate information to the required end user using communication technology. This technology is built-up by using two most popular terms i.e. Information and Communication. Information can be defined as interpretation of data and further this information leads to produce good quality of knowledge. Then, knowledge can be used for discovery after it provides the peace.

Communication is act of conveying the meaningful message from one entity or group to another by using mutual understanding. The desired objective or goal of any communication process understanding.

The ICT is responsible for using simplest technology that integrates both information and communication mechanism and convey to the end users.

A. Components of ICT

The components of ICT are shown in figure 1. ICT has three basic components namely Hardware, Software and Communication Medium.

i. Hardware:

Hardware is described as any physical component that contains a circuit board, ICs, or other electronics. These components can be referred as we can touch it.

ii. Communication Medium:

It refers to the means of delivering and receiving data or information. In telecommunication, these means are transmission and storage tools or channels for data storage and transmission.

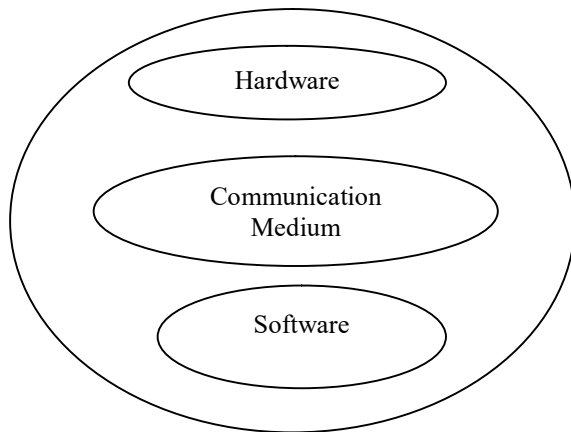


Fig 1: Components of ICT

iii. *Software:*

This is combination of Program, Documentation and Operating Procedures.

B. *ICT Tools*

i. *Radio:*

This is most popular equipments to transmit the message to the end user. In the remote place or remote areas, radio is only one way of communication. It includes only audio data.

ii. *Television:*

This is medium of telecommunication for transmitting moving images in black and white or color form. It includes both audio and video data. It is half- duplex communication.

iii. *Mobile Phones:*

This is portable communication device. It can send or receive information in coverage areas. It is most frequently used device.

iv. *Smart-Phones:*

This is advanced form of mobile phone. It combines the features of a personal computer operating system with other features. It changes the way of communication.

v. *Call Centers :*

The main objective to establish call center is to handle the large volume of telephone requests. It performs best effort to transmit the information to the end user. In India, various call center agencies are established that gives Toll-free number.

C. *Common Use of ICT for Weather Forecasting*

Weather forecasting system helps the farmer in planning for upcoming season to maximize productivity based on expected weather patterns. To help the formers a system should provide the following:

- Transmit the simple weather information including 5 to 10 days or more prediction of weather condition.
- Include the advice/action/tips that should be taken by farmers.

- Warning or Alert that prevents from any natural disaster like as flood, heavy rain, storms, tsunami etc.

Insurance company uses historical weather information to built policies.

Rest of the paper is organized in four sections. Section 2 discusses the status of Indian Agriculture system. Section 3 discusses how ICT can play an important role in weather prediction system. Section four give a study Gramin Krishi Mausam Sewa (GKMS) provided by Indian meteorological department for weather forecasting service. In last section 5 concludes the paper.

II. AGRICULTURE IN INDIA

The India is an agricultural country. Seventy percentage of India belong to rural areas. The people who belongs to rural areas, have main source of income is farming. After this ratio, the agriculture production rate is not enough for its own people. The reason behind this ratio is that Indian farming culture is very backward. The Indian farmers are still working in old fashion. They are hard worker but they do not know how to best utilize their labor.

In 21st century, Indian farmers are gambling on rains. Sometimes, the rain does not fall in time to time or there is not rain at all. It is absolutely leads to highly investment on water. The lowest rate of productivity in agriculture leads to low income and high poverty in India.

A. *Affecting Components of Agriculture Sector:*

There many parameters which affects the agriculture sector. Some of them are discussed in next subsections.

i. *Technology Issues:*

In the field of agriculture, technology is developed day by day. These equipments are sufficient to enhance the productivity. Adoption, training, availability and affordability are major issues with any new technology. Moreover farmer's illiteracy and traditional method of farming creates slow rate of modern technology adoption.

ii. *Soil Testing :*

It is also one of the main issues in lowest growth of productivity. The farmers are not aware about their soil testing. For the best utilization of their land, they must know the value of pH, available Nitrogen, Phosphorous and Potash.

iii. *Rain fed Agriculture :*

The Indian farmers are heavily dependent on Manson. This dependency creates gambling situation for kharif and rabi crops. The irrigation is widely dependent on the diesel creates costly input for both kharif and rabi crops.

iv. *Transportation and marketing problem :*

The transportation of crops is also big issues. If there are no proper transportation from farm to storage place, can lead to crop damaging.

The selection of marketing is another important issue for farmers. Because they have no communication technology that provides list of market places with rates. Actually, they have no any information for Cost-Benefit analysis.

v. *Crop Management System :*

This management system keeps records of ten to twenty years about various crops. The farmers easily use it to take decision for selection of fertilizers, seeds, water levels, soil status etc.

But, the Indian farmers have no such type of management system. They have no any previous records. They always experiments with crops at each year and also not collect feedback from last year production.

vi. *Manpower :*

The human resources are also important issues. To maintain the quality of product, we should best utilize this resource. The most common problems behind these resources are man made mistakes.

vii. *Weather issues :*

Weather is the most challenging issue for agriculture sector as the human has no control over it. It highly affects the production and cultivation of agriculture products.

Human have no control over on weather but human can plan their agriculture activity according to weather. If we can predict the weather behavior then their planning may more effective. The weather changing is a natural process; we can change it and predict it. The weather changing in agriculture is an important issue because it directly effects the agriculture production. The Indian farmers are heavily dependent on weather. It is a fact that without using technology and communication mechanism, we cannot fix the weather estimation issues.

B. *Weather Information used as Decision Support System:*

The weather related information acts as a DSS. There are following type of decision can be easily taken.

- Selection of crops, seeds, fertilizers.
- Irrigation related information such as when we should irrigate the crops.
- Predict the total amount of cost investment using cost-benefit analysis.
- The weather forecasting helps the farmers to determine the time of various activities such as sowing, weeding, spraying and harvesting.
- The weather information becomes more powerful, if action and tips combined that need to be taken by farmers.
- Two and three times delivery of forecasting messages can help more powerful, farmers can make practically decisions. It leads to save the time and money or protect them from weather related damaged.

III. ICT IN WEATHER CHALLENGE

The ICT becomes the heart to fix the weather challenges issues. It plays different role from data collection to information broadcasting.

A. *Data Collection:*

While the availability of satellite data, it is no more need to collect the ground based data. The ICT enable the data collection facility from different weather service agencies. Usually, it collects information on climate changing such as rainfall, temperature, humidity, related impacts on the agriculture ecosystem such as crop species and vegetation cover.

The ICT is also responsible to collect for collecting feedback from farmers for their localized need.

B. *Data Analysis:*

Once the data is collected from various resources it need to analysis for the some useful information which helps former. Soft Computing, Artificial Intelligence, Data Mining techniques plays important role in data analysis. Domain experts are also involved it data analysis.

C. *Weather Related Information Broadcasting*

Once some information is found by data analysis with certain degree of confidence then it need to be broadcast so that farmer can act accordingly. ICT tools can be used to broadcast the information directly to the user in very cost effective ways. It can also customize according to geography, language and specific need of users. The timing also plays a major role in message delivery mechanism. When the farmers get right message at right time then they can take right decision.

With the help of various government and private agencies, it may be possible to transmit the message by using various communication medium such as Television, Radio, Mobile Phones, Smartphone and Call Centers. Following ICT tools contribute in weather forecasting.

i. *Radio:*

In the remote place or rural areas, this is most commonly used communication media. It has only audio interaction. It may become most cost-effective tools for weather forecasting.

ii. *Television:*

Various TV channels are dedicated to handle the weather-related information, such as DD kishan and DD national are two most popular channels.

After each short interval, the updates are displayed of local area wise.

iii. *Mobile Phones:*

SMS is most cost effective and simple form to deliver the information. It is directly attached with the end-users.

iv. *Smart Phones:*

Various applications are now developed that provides only weather-related information. These applications are included GPS system. So, their information becomes more accurate.

v. *Call Centers :*

The farmers can directly communicate with weather information system through call center workers in their localized language and get all farming related information.

IV. GRAMIN KRISHI MAUSAM SEWA (GKMS)

The Indian meteorological department provides a weather forecasting service known as Gramin Krishi Mausam Sewa (GKMS). The GKMS is used as crop specific advisory system. The farmers can get the forecasting services twice in a week at a district level. The ICT has great contribution to GKMS for wider dissemination. For example, we can introduce some ICT tools such as print, visual, radio, Short Message Service (SMS) and Integrated Voice Response System (IVRS). Approximately, 11.46 million farmers in India use the service of GKMS through SMS and IVRS.

A. *Working Strategies of GKMS*

The GKMS provides the weather-related information to the farmers twice a week through Earth System Science Organization (ESSO) of India Meteorological (IMD). This service is available with the association of State Agriculture Universities (SAUs), Institutions of Indian Council of Agricultural Research (ICAR) and IITs.

This advisory service is work in four tier structures. It includes Meteorological, Agricultural, Extension and Information Dissemination Agencies.

i. *Meteorological:*

This structure is responsible to provide the weather observing and forecasting services.

ii. *Agricultural:*

It is used to identify weather sensitive stress and according to it, prepare the suitable advisory.

iii. *Extension:*

It provides bi-directional communication. The user can frequently ask question and get quick response.

iv. *Information Dissemination Agencies:*

These agencies are responsible for disseminating the messages by using media, Information Technology (IT), telecommunication and ICT tools.

B. *GKMS Services Tools*

The GKMS advisory services are available through multi-mode communication channels including mass & electronic media (All India Radio, Television, Print Media), Internet, SMS and Interactive Voice Response Service (IVRS).

i. *SMS Services:*

At present, around 11.47 million farmers are receiving the information through SMS on regular basis. The service helps the farmers not only increasing the crop production but also reducing the losses due to inclement weather and other problems.

ii. *Interactive Voice Response Service (IVRS):*

This technology allows a computer to interact with human through voice. The purpose of using **IVRS** is to take input, process it and return a result as automated system. It provides field level action.

iii. *Mobile Application:*

The mobile application of Indian Weather can be downloaded from Google Play Store at free of cost. Presently, this application provides current weather and four days weather forecast across the country.

C. *Reports by GKMS*

The GKMS generates the report which is easy to understand. The report is available in both Hindi and English languages. It contains the following information.

- First of all, it contains the bulletin number and current date.
- Observation on the weather during the previous forecast records.
- Introduce the Medium Range Weather Forecast including date period and district name.
- It displays a table that contains weather parameters with remarks. These attributes are given as – Rainfall (mm), Max. Temp (0C), Min Temp (0C), Cloud Cover (okta), Max. Relative Humidity (%), Min. Relative Humidity (%), Wind Speed (kmph), Wind Direction (deg.).
- This report also contains advisory for the farmers. This is more useful and important part of report.
- This advisory contains information about name of Crops, and advisory that is based on the weather forecast.

Study shows GKMS give 93% reliable weather forecasting services to the farmers. It provides the weather and rainfall related information on highest priority. It provides the district level advisory services that have enhanced the rain fed agriculture.

The farmers get more than 25% of their total income due to GKMS. The major benefits behind the GKMS service is that it gives the farmers interaction at the regular interval through farmer's awareness programme, roving seminars, krishi mela, agri-vision workshops conducted at different location in the country.

D. *Future Expectation of GKMS*

The service of GKMS is sufficient but it is necessary to make some enhancements make it more effective.

Following points should be considered for enhancement so that this system can be more effective and useful.

i. *Macro-Level Forecasting:*

Till now, this service is sufficient for district level forecasting. The farmers can use this service frequently but sometimes it may not be more effective.

To prevent the farmer from any weather related damaged, it is necessary to provide at least block level forecasting services.

ii. *Indian Tourism Services:*

The GKMS can coordinate the Indian Tourism Services, to enhance the secure travelling. The tourist can take all necessary precaution from weather related damaged. We have already faced some case which caused for grate lost such as Kashmir Flood: year 2014, Uttarakhand Flash Flood: year 2013, The Indian Ocean Tsunami: year 2004 etc.

CONCLUSION

The Weather Prediction is necessary agriculture sector. The weather can directly affect the farming. It is necessary to take precaution from it. It is fact that precaution is not completely safe but must reduce the loss. We should motivate towards Information and Communication Technology (ICT). This is most comfortable zone to enhance the productive in agriculture. The weather advisory service acts as Decision Support System (DSS) for farmers. This service is sufficient to take all necessary decision by farmers.

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