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OPTIMIZING WEATHER INFORMATION DISSEMINATION FOR ENHANCED AGRICULTURAL DECISION-MAKING IN KADAPA AND NELLORE

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ABSTRACT This research examines the dissemination of weather information to village information systems in the agricultural communities of Kadapa and Nellore, India. Effective and timely weather data is crucial for farmers in these regions to make informed decisions regarding crop management, mitigate losses from extreme weather events, and enhance productivity. To address these issues, the study proposes several potential improvements: providing tailored, location-specific, and crop-specific advisories; implementing capacity-building programs to enhance farmers' interpretative skills; developing integrated systems that combine weather data with other agricultural information; fostering community engagement in service design; leveraging social networks for information sharing; and establishing feedback mechanisms for continuous improvement. The document also details the development of a Cyclone Preparedness Programme (CPP) for Nellore and Kadapa, utilizing advanced meteorological instruments and a High-Performance Computational (HPC) facility at Yogi Vemana University, Kadapa, to generate and disseminate hourly weather information during critical periods. Case studies, including the successful forecasting for Cyclones Laila and JAL, demonstrate the efficacy of these enhanced methods. The conclusion emphasizes that effective dissemination of weather information is paramount for supporting agricultural communities in Kadapa and Nellore, ultimately enhancing farmers' decision-making and improving agricultural outcomes through a combination of technological advancement and community-centric approaches.

KEYWORDS : Weather Information Dissemination, Agricultural Decision-Making Village Information Systems, ICT in Agriculture and Cyclone Preparedness

INTRODUCTION

The dissemination of weather information to village information systems is crucial for agricultural communities, particularly in regions like Kadapa and Nellore, where farming heavily depends on weather conditions (Mallikarjun et al., 2022)[1]. Effective dissemination can help farmers make informed decisions regarding crop management, thereby mitigating losses from extreme weather events and enhancing agricultural productivity (Kumar, 2020)[2] (Prasad et al., 2020)[3] (Doss & Asokhan, 2024)[4]. This research paper will explore the current methods, challenges, and potential improvements in disseminating weather information to village information systems in Kadapa and Nellore.

Various channels are used to disseminate weather information, including traditional methods like radio and television, and modern technologies such as mobile phones and ICT-based platforms (Sansa-Otim et al., 2022)[5] (Salim, 2013)[6] . In Nellore, agro-advisory services utilize forecasting technologies to inform farmers about weather impacts on crop growth and yield (Mallikarjun et al., 2022)[1]. The Indian Council of Agricultural Research (ICAR) promotes these services to reach small and marginal farmers, who constitute a major part of the farming community (Mallikarjun et al., 2022)[1]. Studies in other regions, such as the Upper West Region of Ghana, have shown the potential of mobile phones in delivering timely weather and market information to farmers at lower costs compared to traditional extension services (Etwire et al., 2017)[7] .

ICT-based weather and agro-advisory services are designed to minimize agricultural losses from climatic risks such as floods, droughts, and heat waves (Gangopadhyay et al., 2019)[8] . Spatial targeting of these services ensures that vulnerable areas receive timely and reliable information (Gangopadhyay et al., 2019)[8] . In Palghar district, India, the Gramin Krishi Mausam Seva (GKMS) project uses ICT tools to disseminate agromet-advisory bulletins to farmers, aiming to reduce losses from extreme weather events (Sayyad & Jadhav, 2023)[9] .

Despite the availability of various dissemination channels, several challenges hinder the effective delivery of weather information to farmers. These include:

- Many small and marginal farmers still lack access to modern ICT tools and rely on traditional methods, which may not provide timely or detailed information (Mallikarjun et al., 2022)[1].
- The technical nature of weather forecasts can be difficult for farmers to understand and apply to their specific farming practices (Nesheim et al., 2017)[10]
- Generic weather forecasts may not address the specific needs of farmers in different micro-climatic zones or with different crops (Bacci et al., 2020)[11] .
- Farmers' trust in the accuracy and reliability of weather forecasts can affect their willingness to use the information (Nesheim et al., 2017)[10] .

A study in Sidama Region, Ethiopia, analyzing channels for climate information in coffee agroforestry systems, highlights the importance of understanding which channels are most effective for different farming communities (Kaske et al., 2023)[12]. Similarly, research in Maharashtra, India, indicates constraints related to access and understanding of agro-met information, affecting farmers' decision-making (Nesheim et al., 2017)[10] .

To enhance the dissemination of weather information to village information systems in Kadapa and Nellore, (as shown in Fig. 1) the following improvements can be considered:

- Providing location-specific and crop-specific weather advisories that address the unique needs of farmers in different areas (Manzvera et al., 2025)[13] (Bacci et al., 2020)[11] .

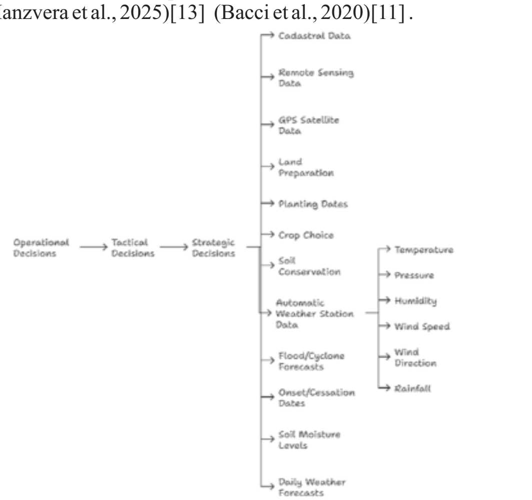


Fig.1: Flow Chart Dissemination of Weather Information to Village Information Systems in Kadapa and Nellore

- Training farmers to understand and interpret weather forecasts, and to apply this information to their farming practices (Thoai et al., 2018)[14].
- Combining weather information with other relevant data, such as market prices and pest/disease forecasts, to provide comprehensive decision support (SINGH et al., 2023)[15] .
- Involving local communities in the design and delivery of weather information services to ensure relevance and build trust (Takenouchi, 2020)[16] .
- Leveraging social networks to disseminate weather information and facilitate knowledge sharing among farmers (Simon et al., 2021)[17].
- Establishing feedback mechanisms to gather farmers' input on the usefulness of weather information and to continuously improve the services (Giraldo et al., 2023)[18] .

This includes wireless smart-farm monitoring systems, agricultural sensing systems with extended signal transmission, wind vector monitoring, and real-time monitoring of crop growth environments (Tang et al., 2024)[19] .

Several case studies demonstrate the effectiveness of improved weather information dissemination. In the Sahel region, agrometeorological forecasts tailored for smallholder farmers have proven to be a powerful tool for weather-informed crop management (Bacci et al., 2020)[11]. These forecasts, when disseminated through local radio and tailored to specific community needs, can significantly improve agricultural productivity (Bacci et al., 2020)[11] .

Fig. 2: Cyclone disaster preparedness programme developed by the Department of Physics, Yogi Vemana University for Nellore and Kaapa districts based on meteorological observations.

Indian subcontinent is highly prone to natural disasters and has been repeatedly subjected to cyclones, floods, tornados (north-eastern region), droughts, erosion, epidemics, etc. However, Southern India is particularly affected by cyclonic storms that come from the Bay of Bengal and which are normally accompanied by a tidal surge. The low-lying coastal area and off-shore islands people are particularly affected mainly along east-coast in the high risk area for cyclonic water surge.

The Cyclone Preparedness Programme (CPP) for Nellore and Kadapa district is developed based on VIS data and also observations from Satellite, Doppler Radar and surface meteorological parameters. For diagnosis of weather and precipitation as rain, hail and snow as well as wind and turbulence that have impact on human activity and agriculture the following scheme (as shown in Fig.2) is utilized.

Fig. 3: High Performance Computational (HPC) facility at SARC – Computer (Terminal) room and HPC installed on a rock in other room.

Fig.4: Cyclone Preparedness Programme (CPP) forecasting domains. In domain 3, Kadapa and Nellore all Village Information Systems are operated

Indian Space Research Organization (ISRO) is supporting semi-arid zonal Atmospheric Research Centres (SARC) at Yogi Vemana University, Kadapa. At SARC, several ground based in-situ and remote sensing meteorological instruments are working round the clock. Apart from these sensor, a High Performance Computational (HPC) facility [as shown in Fig.3] is established to predict and also understand convection processes (updraft and downdraft) those influences the mesoscale convective cloud systems during SW and NE monsoon seasons in this region by using Mesoscale weather research and Forecasting (WRF) model utilized for the development of Cyclone Preparedness algorithm is tested/evaluated by using the HPC/super computer.

For evaluation, we have chosen Laila and JAL cyclone. Both the cyclones have invaded Andhra Pradesh in the year 2010. For better forecasting three domains are chosen as shown in Fig.4.

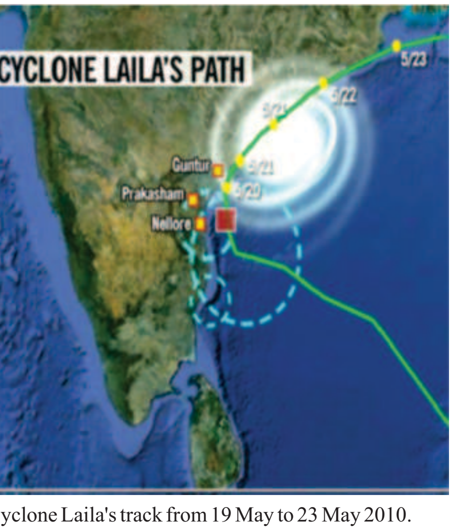


Fig. 5: Cyclone Laila's track from 19 May to 23 May 2010.

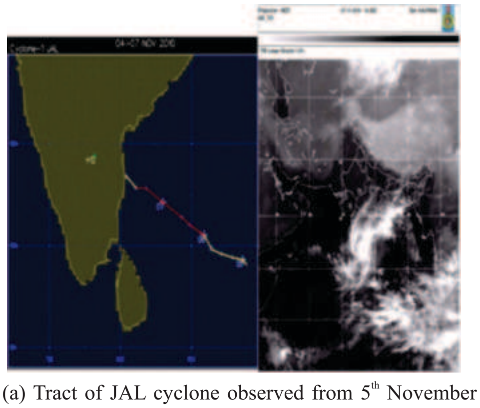


Fig 6: (a) Tract of JAL cyclone observed from 5th November to 8th November 2010. (b) Kalpana satellite image for cyclonic day on 7th November 2010.

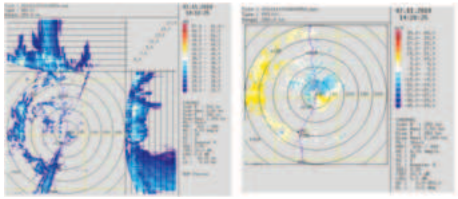


Fig.7: Chennai Doppler Weather Radar observation of JAL Cyclone on 07 November 2010 covering Kadapa and Nellore District. (a) Radar reflectivity (dBZ) and (b) Doppler Velocity snap shot on 7 Nov. 2010 at 14:10:25 hrs LT

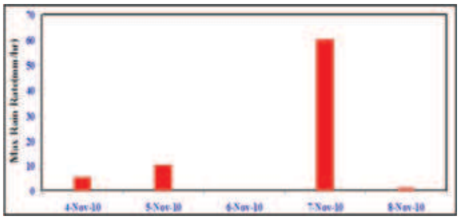
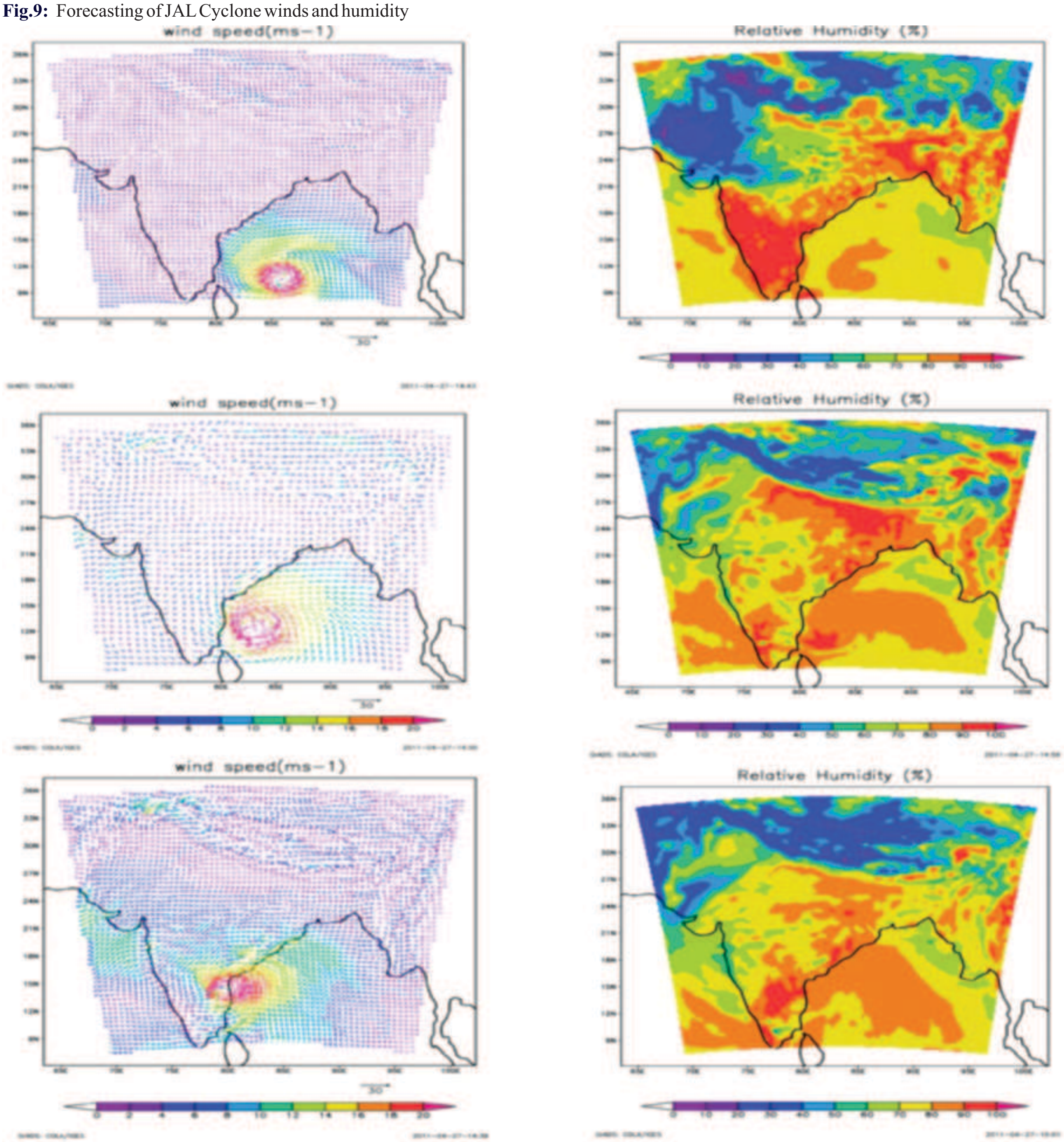


Fig.8 : Maximum rain rate observed over Kadapa during JAL cyclone

Fig.9: Forecasting of JAL Cyclone winds and humidity



passage from 4th to 8th November 2010.

Trust in weather information is deeply intertwined with its accuracy and perceived relevance. If farmers consistently receive information that proves inaccurate or unhelpful, their willingness to act on future advisories will diminish. The successful testing of the Cyclone Preparedness Programme (CPP) for Laila and JAL cyclones in 2010 using the HPC facility at Yogi Vemana University is a strong indicator of the capacity for accurate forecasting in the region. This success needs to be consistently communicated and demonstrated to the farming community to build and maintain trust. Furthermore, incorporating farmer feedback mechanisms, as suggested, is vital for co-producing services that are genuinely useful and trusted.

The existence of a robust scientific and technological infrastructure in the region, including the HPC facility at Yogi Vemana University, is a significant asset. This infrastructure enables the generation of high-resolution meteorological parameters crucial for agricultural planning. The ability to forecast and understand convection processes during monsoon seasons is particularly relevant for a region prone to both drought and heavy rainfall events. The successful application of the WRF model for cyclone preparedness further validates the scientific rigor behind the advisories [Fig. 4 to 9.].

Ultimately, the discussion points to the need for a sustained, collaborative effort involving research institutions, government agencies, local communities, and technology providers. As of June 2025, the advancements in mobile technology and AI are even more pervasive than when some of the referenced studies were conducted. This presents a fresh opportunity to explore innovative solutions for reaching farmers directly, translating complex data into understandable formats, and fostering a culture of weather-informed decision-making in Kadapa and Nellore. The local context, including flood/cyclone forecasts, onset/cessation dates, and soil moisture levels, directly influences the operational, tactical, and strategic decisions of farmers, making the precision & timeliness of information paramount.

CONCLUSIONS

Based on the findings and discussions presented, the following conclusions can be drawn:

The existing scientific and technological infrastructure in Kadapa and Nellore, exemplified by the SARC and HPC facility at Yogi Vemana University, is a valuable asset. This infrastructure possesses the capability to generate highly accurate and timely weather forecasts, including crucial cyclone preparedness information.

The successful implementation and testing of the Cyclone Preparedness Programme (CPP) underscore the potential for regional institutions to develop and deploy impactful weather-related services. This model of real-time, targeted dissemination, as demonstrated during critical weather events, should be expanded and adapted for daily agricultural advisories.

In summation, optimizing weather information dissemination in Kadapa and Nellore requires not only leveraging advanced computational capabilities but also fostering a deep understanding of farmers' needs and building strong community partnerships to ensure that critical meteorological data effectively supports agricultural decision-making and contributes to a more resilient farming future.

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