

# Empowering Rural Revitalization: Dilemmas and Innovative Practices of Agricultural Meteorological Services in China

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**Abstract** From the perspective of rural revitalization, this paper systematically analyzes the current dilemmas and innovative practices of agricultural meteorological services in China. At present, China is faced with single dissemination channels and delayed access to agricultural meteorological information. Farmers have weak awareness of disaster prevention and lack professional relevant knowledge. Meanwhile, inadequate agricultural meteorological science popularization and a shortage of professional service talents jointly restrict the quality improvement and upgrading of grassroots meteorological services. In response to the above dilemmas, it is essential to improve the channels for meteorological information release and transmission and establish a sound system for information collection and dissemination, optimize the prevention system of rural meteorological disasters and enhance the training of farmers' meteorological knowledge, strengthen the publicity of knowledge about the prevention and mitigation of meteorological disasters in rural areas, and attach importance to the cultivation of meteorological professionals.

**Key words** Agricultural meteorological services; Rural revitalization; Dilemmas; Innovative practices

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Rural revitalization is one of the important strategies for China's economic development, aiming to achieve modernization of agriculture and rural areas. On February 28, 2026, the Working Mechanism Conference on Meteorological Support for Rural Revitalization of the China Meteorological Administration was convened to study and arrange meteorological support services for the comprehensive revitalization of rural areas in 2026. The meeting stressed that meteorological services for agriculture remain a top priority among meteorological services. It is necessary to clarify the historical orientation and role of meteorological support for agriculture, rural areas and farmers, enhance extreme weather response capabilities, accelerate AI-enabled meteorological innovation and application, and systematically plan meteorological services for agriculture during the "15<sup>th</sup> Five-Year Plan" period.

With the full implementation of rural revitalization strategy and the continuous improvement of agricultural modernization in China, agricultural production has become increasingly dependent on meteorological services. Agricultural meteorological services play an increasingly important role in agricultural production, and there is an urgent need for refined meteorological services to scientifically guide agricultural production to seek benefits and avoid risks, thereby significantly enhancing the capability for disaster prevention and mitigation. Currently, the development of agricultural meteorological services in China still faces many constraints, such as poor information dissemination, insufficient disaster prevention awareness and knowledge among farmers at the grassroots

level, weak meteorological science popularization, a shortage of professional talents, and an imperfect disaster prevention system. These factors have seriously affected the efficiency and quality of agricultural production. This paper explores the challenges faced by agricultural meteorological services in the context of China's rural revitalization strategy, and proposes targeted development strategies to give full play to the role of agricultural meteorological services in agricultural production.

## 1 Dilemmas of agricultural meteorological services in China

**1.1 Single channel for weather information dissemination and inadequate timeliness of acquisition** Although the information dissemination system has matured and the technical means have become increasingly improved at present, due to the uneven economic development levels across regions and the differences in the allocation of resources among mainstream media, the efficient transmission and wide coverage of meteorological information are significantly restricted<sup>[1]</sup>. Currently, the channels for disseminating meteorological information are not diverse enough, which limits the effectiveness of agricultural meteorological services.

Disastrous weather such as hailstorms and rainstorms typically exhibit the characteristics of high probability of occurrence and short warning periods. This necessitates that meteorological professionals promptly issue monitoring and warning alerts. In actual agricultural production scenarios, the majority of farming groups are old and predict weather changes mainly according to traditional production experience, but unable to use online platforms to query

precise meteorological data, which results in poor effectiveness of meteorological services<sup>[2]</sup>. In addition, when grassroots meteorological institutions carry out agricultural-related meteorological support work, the degree of integration and application of the multimedia communication model is insufficient. As a result, farmers obtain meteorological information by relatively limited ways, and are difficult to reach various disaster prevention and early warning messages efficiently. Only by breaking through information dissemination barriers and expanding service push channels can production entities be guided to promptly implement disaster prevention and mitigation measures, so as to minimize the economic losses caused by adverse weather conditions to agricultural production to the greatest extent.

**1.2 Farmers have weak awareness of disaster prevention and insufficient professional knowledge about disaster prevention** Due to the constraints of regional development conditions, there is a significant imbalance in domestic economic development. Many rural areas still have obvious shortcomings in the construction of basic supporting facilities. The majority of rural residents generally have insufficient concepts of disaster prevention and escape, and have not systematically mastered professional knowledge for disaster response, which has greatly affected the prevention and mitigation work of meteorological disasters. At the same time, some functional departments have insufficient attention to grassroots meteorological support work, and the implementation of disaster prevention and mitigation science popularization is insufficient, which not only hinders the popularization and promotion of knowledge about disaster prevention but also restricts the improvement and development of the grassroots meteorological service system. In addition, farmers' subjective willingness to actively learn about knowledge of meteorological disaster prevention is weak. When facing production problems caused by various meteorological disasters, they are unable to effectively respond and handle them properly through scientific means.

**1.3 Inadequate popularization of agricultural meteorological knowledge** Currently, the social acceptance and influence of agricultural meteorological knowledge in rural areas are generally low, and there is a shortage of professional personnel dedicated to the popularization of agricultural meteorological knowledge. Most existing meteorological science popularization activities are concentrated on urban online platforms, schools, and community scenarios. The specialized dissemination channels for meteorological knowledge in rural areas are relatively limited, and the promotion models of meteorological services for agricultural activities are also relatively monotonous. Among various meteorological services, farmers have relatively higher awareness of artificial weather modification operations such as hail prevention, but the actual effectiveness and timeliness of the overall knowledge dissemination work fail to meet expectations. The popularization and promotion activities of basic meteorological knowledge mainly cover urban areas, and there is no effective connection between the popularization of agricultural meteorological knowledge and agricultural pro-

duction entities. Farmers still have limited access to precise meteorological services, resulting in a significant disconnection between the popularization of agricultural meteorological knowledge and the target audience.

**1.4 Shortage of professional service personnel** To comprehensively optimize the agricultural meteorological service system, the comprehensive capability of the personnel plays an indispensable core role. Relevant staff need to systematically collect and deeply analyze various meteorological data in their daily work, and use diversified communication channels to provide precise information to agricultural production groups, providing reliable support for the stable operation of agriculture. Currently, there is a widespread shortage of meteorological service personnel in rural areas. In addition, the workload of agricultural meteorological positions is relatively large, and the salary and welfare levels lack competitiveness, making it difficult to effectively attract and retain high-quality professional talents. To enhance the quality of grassroots meteorological support work, meteorological workers should have a solid theoretical foundation, and be able to independently complete professional tasks such as data organization, meteorological analysis, and disaster prediction. Besides, front-line service personnel also need to transform their expression form, interpret professional content in plain language, help grassroots producers quickly understand meteorological information, and effectively lower the threshold for knowledge acquisition and application.

## 2 Suggestions for the development of agricultural meteorological services in China

**2.1 Improving the channels for meteorological information release and transmission, and establishing a sound system for information collection and dissemination** The channels for information transmission should be improved to address the issue of a single channel for meteorological information dissemination and inefficient transmission. It is needed to build a more convenient information transmission network, enhance the information service capacity in rural areas, and increase the investment in information transmission facilities to improve the efficiency of information transmission.

In the context of rapid technological evolution in the digital age, various new methods of information processing continue to emerge, and the release carriers and transmission modes of warning information of meteorological disasters urgently need to be optimized and upgraded. According to the actual situation of rural information infrastructure, it is necessary to accelerate the construction and improvement of the early warning information release platform for sudden disasters, fully integrate various communication carriers such as social media, communication channels, radio and television, and text message notifications, and continuously expand the coverage of warning information, so that grassroots agricultural practitioners can efficiently obtain accurate early warning information about disasters. Additionally, local meteorological management institutions need to strengthen the collaboration and

coordination with the media convergence center and emergency management departments. When the risk of major meteorological disaster occurs, the emergency broadcasting system should be used to urgently push key warning information and meteorological forecasts, leaving sufficient time for the public to prevent and respond to disasters. At the same time, a systematic and comprehensive grassroots meteorological service network should be constructed to ensure the efficient and smooth release and transmission of meteorological information, and provide a solid guarantee for agricultural production activities.

To obtain information in a timely manner, a sound system for information collection and dissemination should be established, and the collection and dissemination of agricultural meteorological information should be strengthened. Modern meteorological information collection equipment should be utilized to improve the collection speed and quality of meteorological information. Meanwhile, an agricultural meteorological information dissemination platform should be established to promptly and effectively disseminate meteorological information to farmers.

**2.2 Optimizing the prevention system of rural meteorological disasters and enhancing the training of farmers' meteorological knowledge** Currently, there is still room for optimization in the prevention mechanism of rural meteorological disasters in China. Grassroots farmers generally lack timely, accurate and effective access to meteorological forecast information. To enhance farmers' comprehensive capability to prevent and respond to meteorological disasters, it is practically essential to improve the rural prevention and control system of meteorological disasters and enhance the effectiveness of disaster prevention and mitigation. Compared with meteorological professionals, grassroots agricultural practitioners have relatively limited knowledge of meteorological science. Their disaster prevention and mitigation behaviors mostly rely on traditional production experience, and their ability to respond to extreme climate events is relatively weak. Relying on paired assistance, and publicity of disaster prevention and mitigation theme, meteorological authorities can systematically promote meteorological science popularization work, and effectively enhance farmers' awareness of disaster prevention and their ability to respond to emergencies and avoid risks. For typical disasters such as mountain floods, lightning, and hail, graphic and understandable scientific popularization materials should be compiled and freely distributed and promoted through rural science popularization platforms. In addition, targeted special training on the emergency response of meteorological disasters should be carried out to further strengthen the emergency risk avoidance ability of grassroots groups.

To improve farmers' utilization efficiency of meteorological information, the training of farmers on meteorological knowledge should be strengthened. Farmers' ability to understand and apply meteorological information can be improved by holding lectures and carrying out publicity activities of meteorological knowledge, thereby enhancing the utilization efficiency of meteorological infor-

mation by farmers.

### **2.3 Strengthening the publicity of knowledge about the prevention and mitigation of meteorological disasters in rural areas**

Meteorological science popularization in rural areas has long been a weak link. Grassroots farmers generally have a limited knowledge of disaster prevention and mitigation, and have insufficient awareness of potential threats to personal safety and property damage caused by meteorological disasters. The overall ability to respond to and handle disasters is relatively weak. Therefore, meteorological management institutions should rely on special actions, such as disaster prevention and mitigation publicity, science, technology, culture, and health services at the grassroots level, as well as targeted assistance, to promote the popularization of meteorological science resources in rural areas. For high-frequency disasters such as rainstorms, mountain floods, and lightning, it is needed to develop intuitive and easy-to-understand scientific popularization materials that are suitable for the needs of different age groups and cultural backgrounds in rural areas, and widely distribute them to grassroots farmers. At the same time, a self-service science popularization experience platform can be built in villages and towns to strengthen the publicity of disaster avoidance knowledge, organize training on disaster prevention and mitigation emergency skills, and gradually enhance the disaster prevention awareness and emergency avoidance level of rural residents.

### **2.4 Attaching importance to the cultivation of meteorological professionals**

Meteorological authorities should continuously enhance the construction of talent teams and reserve of technical capability in the field of agriculture-related meteorology, and improve the comprehensive quality and professional skills of on-the-job personnel such as grassroots meteorological workers and village-level information service personnel<sup>[3-5]</sup>. Comprehensive technical talents having knowledge in multiple fields are cultivated to continuously enhance the accuracy of various weather and climate monitoring and forecasting, thereby providing high-quality and refined agricultural meteorological guarantee services to rural areas. Relevant units can regularly organize experts in the fields of meteorology and agriculture to carry out offline activities such as technical guidance, outcome demonstration, practical experiments, and experience exchanges in rural areas. This measure can further strengthen the sense of responsibility of grassroots service personnel for rural development and construction, enhance the collaboration level and overall cohesion of service teams, and continuously provide stable and high-quality professional talent support for the all-round development of rural areas.

## **3 Conclusion**

Rural meteorological support has long been a core component of the public meteorological service system. With the comprehensive implementation of the rural revitalization strategy, the construction standards and supply quality of grassroots agricultural meteorological services have been given new requirements. This

field is simultaneously facing new development opportunities and also needs to address various practical challenges. Therefore, meteorological departments should improve the channels for the release and transmission of meteorological information, establish a sound information collection and dissemination system, improve the prevention system of rural meteorological disasters, strengthen the training of farmers' meteorological knowledge, strengthen the publicity of knowledge about the prevention and mitigation of meteorological disasters in rural areas and the cultivation of meteorological professionals, promote the standardized and long-term development of meteorological services for agriculture, and contribute meteorological strength to rural revitalization.

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(From page 69)

on canopy ventilation and light penetration as well as water and nutrient distribution have not been fully elucidated. Future research could combine light simulation, root distribution analysis, and nutrient use efficiency assessments to further optimize the spatial arrangement of relay strip intercropping, thereby maximizing both stable maize yield and increased soybean income.

In conclusion, this paper verified the feasibility of maize – soybean relay strip intercropping in the northern margin of the Jiangnan Plain. The M-S7 treatment pattern performed best in terms of yield and economic benefits, and can be recommended as the preferred pattern for extension in this region. Meanwhile, the results could provide a theoretical basis and technical reference for optimizing relay strip intercropping patterns in different ecological zones.

## 4 Conclusions

Under the experimental conditions at Huangji Town, Xiangzhou District, Xiangyang City, different bandwidth and row ratio configurations significantly affected the equivalent yield and comprehensive economic benefits of the maize – soybean relay strip intercropping system, but had no significant effect on the maize growth period and most agronomic traits. Among the intercropping patterns, M-S7 (bandwidth of 2.8 m, maize-to-soybean row ratio of 2 : 4, maize density of 35 700 plants/hm<sup>2</sup>, soybean density 285 720 of plants/hm<sup>2</sup>) showed the best overall performance, ensuring stable maize yield while achieving a marked increase in soybean production. The equivalent yield of the system reached 7 200 kg/hm<sup>2</sup>, and the net return reached 20 661 yuan/hm<sup>2</sup>, representing an increase of 19.8% compared with sole maize. With its prominent relay strip intercropping advantage, it can be recommended as the preferred pattern for extension and application in Xiangyang City and similar ecological zones of the Jiangnan Plain.

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