

Research on Smart Meteorology Serving Agriculture under the Rural Revitalization Strategy—Taking Mingshan Tea as an Example

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Abstract

It is imperative to prioritize the development of agriculture and rural areas and improve the efficiency of smart meteorological services for agricultural products under the strategy of rural revitalization. In this article, we take Mingshan tea, one of the characteristic industries in Sichuan Province, as an example to explore the related issues of smart meteorology serving agriculture. The status, value, and demand of tea smart meteorological services have been analyzed in this article. In addition, in response to the increasing demand for meteorological services in agricultural production, we have proposed to solve problem of tea meteorological service by strengthening talent, technology, product refinement, and dissemination. We have also proposed specific measures for tea intelligent meteorology to serve agriculture, in order to provide reference for future service practices. We need to continuously improve the methods and content of meteorological services, and improve the level of meteorological services. At the same time, utilizing smart meteorological service methods provides strong support for rural revitalization. This not only increases the income of tea farmers, but also maximizes the technical support role of meteorology in disaster prevention and reduction.

Keywords

Rural Revitalization, Smart Meteorological Service, Agriculture, Tea

1. Introduction

The report of the 19th National Congress of the Communist Party of China clearly proposed the implementation of the rural revitalization strategy and put

it in the Party Constitution. Then the report of the 20th National Congress of the Communist Party of China specifically proposed to comprehensively promote rural revitalization, adhere to the priority development of agriculture and rural areas, and accelerate the construction of an agricultural country. To accelerate the construction of rural meteorological information service system and capacity, it is necessary to improve the level of agricultural meteorological services and rural meteorological disaster prevention, and improve the efficiency of meteorological services targeting specific agricultural products. Many scholars have conducted research on meteorological services for agriculture and have achieved some results. Pu Meijuan analyzed the technology and application of characteristic agricultural meteorological services [1]. Jin Zhifeng analyzed the meteorological support technology for tea production in Jiangnan [2]. Tian Yonghui and others analyzed the impact of catastrophic climate on tea trees [3]. Many scholars [4] [5] [6] [7] [8] have also explored issues related to tea meteorological services. Taking Ya'an Mingshan tea, one of the characteristic industries in Sichuan Province, as an example, the smart meteorological services for agricultural products under the rural revitalization strategy have been discussed in this paper, and there is great potential for future tea meteorological services. By continuously improving service methods and content, and continuously improving service levels, smart weather services for agriculture will have a promising future. In this study, we analyzed the value of tea meteorological services and conducted research on the current status of meteorological services in the Mingshan tea industry. In addition, we analyzed the demand for smart meteorological services for tea. The purpose is to propose five specific measures to enhance the value of tea intelligent meteorological services, and to assist in the better development of meteorological services for agriculture.

2. The Value of Tea Smart Meteorological Service

The growth of tea is highly sensitive to conditions such as temperature, moisture, and light, and its yield and quality are greatly affected by meteorological disasters [2] [9] [10] [11]. The tea industry is very dependent on the weather, so it is particularly important to do high-quality tea meteorological services. There are many types of meteorological disasters in Mingshan tea producing areas, including heavy precipitation, drought, cold wave, high temperature and so on. Through investigation, it is found that the current industry is concerned about the following aspects: meteorological service during the critical period of tea growth, meteorological service for tea growth disease and pest control, and meteorological service for tea related meteorological disasters [12] [13] [14] [15]. Strengthening the application of meteorological data, providing effective intelligent meteorological service products for agriculture, and reducing the losses caused by meteorological disasters to the tea industry are of great significance to ensure the safety of agricultural production.

Personalized and refined smart meteorological services are of great help to tea

cultivation and production. Through such services, it helps tea farmers choose the best picking period, prevent and control diseases and pests, and improve tea yield and quality. Deeply understanding the demand for smart meteorological services for tea is of great significance for the construction of tea industry bases, quality optimization, and brand promotion. Promote the smart tea meteorological services for tea farmers and tea enterprises, making it a reality to shift from “relying on experience” to “looking at data”. The use of meteorological services to promote the improvement of tea production capacity can effectively optimize the industrial structure of the tea industry, and the development of special and efficient agriculture such as smart agriculture and eco-tourism agriculture. Through this approach, it can effectively promote agricultural efficiency and increase farmers’ income, and ultimately helping to achieve rural revitalization.

3. Development Status of Mingshan Tea Industry

Tea is one of the characteristic crops with the most economic value in China, and its yield and quality are greatly affected by meteorological conditions. The growth environment of tea requires sufficient sunlight, water, and moist soil [16] [17] [18]. During the evolution process of tea tree, its suitable growth environment tends to like acid, soft light, warm, wet, while afraid of alkalinity, exposure, cold, and flooding. Tea enjoys a warm and humid climate, with an altitude of 600 to 1200 meters in the mountain area, making it the best growing area for tea. The region has the characteristics of mild climate, with no severe cold in winter and no scorching heat in summer. The temperature range is small every year, and there is abundant rainfall in the tea growing area. The agricultural climate is mainly characterized by scattered light sources. The conditions of light, temperature and precipitation in the key period of tea quality formation are well matched.

Tea planting areas are generally located in areas with cloudy and foggy conditions and natural shade. Such meteorological conditions result in fewer direct light sources and more scattered light sources for tea leaves. Therefore, carbon metabolism is significantly inhibited, while nitrogen metabolism is significantly enhanced. This will cause a decrease in the content of sugars and polyphenols in tea, while an increase in the content of total nitrogen, caffeine, and amino acids reduces the formation of crude fibers in tea. The refraction of light by clouds and mist can also reduce the irradiation of blue and violet light, which is conducive to the improvement of tea quality [19] [20].

The Ya’an Mingshan area, located in Sichuan Province, China, is known as the “largest tea tree gene bank in Southwest China” and is the earliest place in the world with written records of artificial tea cultivation. And the tea industry is the leading industry in Ya’an, with representativeness. As of 2020, the area of Ya’an tea plantation has reached 1 million mu and a tea production of 104,900 tons. The comprehensive output value of Ya’an has been increasing year by year, reaching RMB 19 billion by 2020 (**Table 1**).

Table 1. Basic statistics of tea industry development in Ya'an city from 2016 to 2020.

	2016	2017	2018	2019	2020
Tea Production (10,000 tons)	8.45	8.57	8.60	10.15	10.49
First production output value (100 million yuan)	28.10	31.85	35.05	41.16	44.80
Comprehensive output value (100 million yuan)	150	160	165	180	190

The area of tea plantation in Mingshan District has reached 352,000 mu, which is 2.2 times that of grain cultivation. The per capita tea planting area reaches 1.5 mu, and over 90% of farmers are engaged in work related to the tea industry. The output value of fresh tea leaves is 1.963 billion yuan of that year.

The characteristic agricultural product tea of mingshan District of Ya'an City has obtained a number of national Geographic indication products. The production area has a history of over 2000 years of tea planting and rich cultural heritage. There is a tea modern agricultural park located in the north of Mingshan District, which consists of a core area of national agricultural science and technology Park, a Mengdingshan National Tea Park, three modern tea processing areas, four 10,000 mu of ecological sightseeing tea villages and a breeding base for improved tea seedlings. The area where the park is located has a subtropical monsoon humid climate with abundant rainfall, frequent cloud cover, and less sunlight, providing excellent climatic conditions for tea growing. Driven by the integration of tea and tourism, the tea plantation in Mingshan have gradually transformed into comprehensive parks with synchronous development of tourism and agriculture. And there is a great demand for the full chain meteorological services for tea before, during, and after production.

4. Analysis of Smart Meteorological Service Demand for Tea

4.1. Demand for Smart Meteorological Service in Tea Production

The growth and development of tea plants, the seasonal growth of tea leaves, and their quality are closely related to meteorological elements. At the same time, production activities such as producing tea, fertilizing tea plants, pruning tea branches, and picking fresh tea leaves and other production activities have high requirements for weather conditions. Various tea production entities have a high demand for meteorological information services such as current weather facts, short-term approaching weather forecasts, medium and long term weather forecasts, climate trend forecasts, and agricultural weather forecasts.

4.2. Demand for Smart Meteorological Services for Disaster Prevention and Mitigation in Tea Plantation

The tea plantation is highly sensitive to meteorological disasters. In particular, drought, high temperature, low temperature, frost, wind, hail, continuous rain and other meteorological disasters pose a significant threat to the growth and development of tea. These meteorological disasters directly affect the normal

growth of tea, which causes loss and reduces production, as well as increasing the cost of tea plantation management and tea picking [2]. The meteorological disaster prevention and reduction of tea plantation requires not only the long-duration climate trend forecast, but also the short-time approaching weather forecast and meteorological disaster warning information service.

4.3. Demand of Tea Business Entities for Smart Meteorological Services

Tea business entities require refined meteorological services at all stages of tea growth and development, as well as in all stages of tea production. Smart meteorological services play a crucial role in improving the production efficiency of tea farmers. Farmers can adjust their agricultural production plans in a timely manner through meteorological information. At present, a microclimate station has been established in Mingshan tea plantation area, and the Tibetan Tea Modern Agricultural Park is also providing characteristic meteorological services for the local farmers. For business entities, customized and personalized smart meteorological services are widely concerned. The main requirement is short-term weather forecasts and weather status prompts.

4.4. Demand of Tea Plantation Tourists for Smart Meteorological Services

With the integrated development of tea tourism, tea plantation tourists and visitors are also very concerned about meteorological service content such as human comfort, suitability of tea garden picking, and tourism meteorological index. For tourists, smart weather services on mobile devices are in great demand as well. Short-approach weather forecasting and meteorological disaster warning information services are most needed so that the visitors can make advance decisions about travel times.

4.5. Demand for Smart Meteorological Services for Tea Disease and Pest Control

The occurrence of tea diseases and pests is highly correlated with meteorological factors, and also affects the yield and quality of tea. Tea is a kind of plant which used for drinking, and chemical pesticide control methods are generally less commonly used to prevent diseases and pests. At present, many tea plantation use predatory insects or use a variety of physical methods to control diseases and pests, such as manual hunting, light trapping and so on. The prevention and control of tea pests and diseases require strong support from climate trend prediction and mid-term weather forecasting.

5. Specific Measures to Enhance the Value of Tea Smart Meteorological Services

5.1. Improve the Ability of Tea Smart Meteorological Service

It is important to standardize the service process and scheme in order to provide

meteorological services that users need. Tea meteorological services involve knowledge such as meteorological monitoring, weather forecasting, disaster warning, and agronomy. It requires meteorological service personnel to strengthen their professional knowledge learning, proficient in both meteorological knowledge and theories related to tea growth and development. The use of monitored meteorological data to the user end is the direction we need to strive for. In addition, we also need to strengthen scientific research. For example, studying meteorological indicators during the critical period of tea production and meteorological indicators for tea diseases and pests, continuously improving the accuracy and availability of tea intelligent meteorological service products, etc.

5.2. Strengthen Meteorological Monitoring

To provide intelligent meteorological services for tea, accurate meteorological information monitoring is essential. Real-time monitoring of meteorological conditions in tea planting areas is beneficial for accurately grasping the occurrence of temperature, humidity, precipitation, and meteorological disasters. Modern meteorological monitoring instruments should be applied to tea meteorological services. This also helps growers take different measures according to different weather, and provides important basic monitoring data for meteorological disaster prevention and reduction services in tea production.

5.3. Improve the Ability to Prevent Meteorological Disasters in Tea Production

Studies [19] [21] have shown that meteorological disasters such as drought, high temperature, low temperature, late frost, strong winds, hail, and continuous rain pose a significant threat to the growth and development of tea. It is an important part of tea meteorological service to improve the ability to prevent and reduce the risk of meteorological disasters in tea production. It is necessary to strengthen scientific and technological innovation and continuously improve the accuracy and time advance of forecasting and warning of meteorological disasters that have a great impact on tea production. When necessary, weather modification techniques should be used to mitigate the impact of disastrous weather.

5.4. Strengthen the Construction of Professional Team for Tea Meteorological Service

The high-quality implementation of rural revitalization strategy needs the support of meteorological service personnel for agriculture. At present, agricultural meteorological service talents are very scarce, and strengthening the construction of professional talent teams is the most urgent task to improve the level of tea meteorological service capabilities. Specifically, we can achieve the purpose of enhancing the professional degree of talents by conducting large-scale training. Relevant departments can adopt various methods to train existing staff on tea meteorological service related knowledge. At the same time, recruit talents with majors in agriculture and agricultural meteorology from college graduates,

and create a talent team with comprehensive technical and professional abilities.

5.5. Strengthen the Dissemination and Feedback of Meteorological Service Information on Tea Production

To strengthen the dissemination of meteorological service information for tea production, it is necessary to make full use of various channels such as SMS, internet, phone, WeChat group, TV, mobile app, etc. to release and disseminate service information. It is essential to establish a direct connection with the people you serve. We should carry out refined meteorological services according to the needs of different service objects. Meteorological service information such as tea characteristic meteorological services and meteorological monitoring, prediction, and early warning needs to be widely disseminated. It can encourage tea farmers to take disaster prevention and mitigation measures in advance, in order to prevent and reduce the impact of disasters to the maximum extent possible.

In order to provide accurate and practical meteorological service information for tea production, it is necessary to fully leverage the role of grassroots meteorological information officers in the dissemination and dissemination of service information. By obtaining feedback information in time, constantly improving the content and methods of tea meteorological information service is the direction that we should pay attention to in improving service products in the future.

6. Conclusions

In this article, we elaborated on the value of tea smart meteorological service and researched the development status of Mingshan tea industry. We also conducted an analysis of the meteorological service demand for tea. Through analysis, we have proposed five specific measures to enhance the value of tea smart meteorological services:

- 1) Improving the ability of tea smart meteorological service.
- 2) Strengthening meteorological monitoring.
- 3) Improving the ability to prevent meteorological disasters in tea production.
- 4) Strengthening the construction of professional team for tea meteorological service.
- 5) Strengthening the dissemination and feedback of meteorological service information on tea production

In future service practices, we need to continuously improve service methods and content based on the needs of tea farmers, continuously improve service levels, and use intelligent methods to promote rural revitalization, increase tea farmers' income, and enhance ecological value transformation. Meteorological services for agriculture are an important component of the rural revitalization strategy. Only by continuously improving service capabilities and improving the refinement and targeting of agricultural meteorological service products can we better leverage the scientific and technological support role of meteorology in serving agricultural production and economic development.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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