

## Research On Data Analysis and Decision Support of Artificial Intelligence Technology in Intelligent Agricultural System

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**Abstract.** With the rapid development of artificial intelligence technology, the application of intelligent agricultural system in the agricultural field is increasingly extensive. The purpose of this paper is to study the data analysis and decision support of artificial intelligence technology in intelligent agricultural system, and explore its application in improving agricultural production efficiency, optimizing resource utilization and promoting sustainable development. This paper uses the research method of literature review and empirical analysis to sort out and summarize the relevant researches at home and abroad, and verifies the effectiveness of artificial intelligence technology in intelligent agricultural system through experiments. In terms of data analysis, this paper focuses on the processing and analysis of sensor data, discusses the application of big data analysis in agriculture, and the role of machine learning algorithms in agricultural data analysis. The results show that artificial intelligence technology can efficiently process agricultural data, extract valuable information from massive data, and provide support for agricultural production decisions. In terms of decision support, this paper focuses on the application of intelligent agricultural system in crop growth forecast and optimization, disease and pest warning and control, and agricultural product yield forecast and market decision. The experimental results show that artificial intelligence technology in intelligent agricultural system can accurately predict the growth of crops, early warning and effective prevention and control of pests and diseases, and can also help farmers rationally plan agricultural product output, optimize market decisions, and improve the market competitiveness of agricultural products. To sum up, this paper studies and discusses the data analysis and decision support of artificial intelligence technology in intelligent agricultural system, and has achieved certain results in experimental verification. Through the research of this paper, we can better understand the development status and trend of intelligent agricultural system, and provide reference for further optimizing intelligent agricultural system, improving agricultural production efficiency, and promoting agricultural sustainable development.

**Keywords:** Artificial Intelligence Technology, Intelligent Agricultural System, Data Analysis, Decision Support, Agricultural Sustainable Development

## **1. Introduction**

With the continuous development and application of artificial intelligence technology, intelligent agricultural system, as an important part of modern agriculture, is gradually attracting widespread attention. Through the integration of Internet of Things technology, big data analysis and artificial intelligence algorithms, the intelligent agricultural system realizes the collection, analysis and decision support of a large amount of data in the agricultural production process, providing a new solution for agricultural production. In this context, this paper will focus on the data analysis and decision support of artificial intelligence technology in intelligent agricultural system, and explore its application in agricultural production, with a view to promoting agricultural modernization, improving agricultural production efficiency and making contributions to sustainable development.

With the continuous growth of global population and economic development, agricultural production is facing more and more challenges. How to realize the high efficiency and intelligence of agricultural production has become an important topic of agricultural development. Traditional agricultural production often relies on artificial experience and intuition, which is less efficient, and at the same time, due to the instability of crop growth and weather factors, agricultural production risks are higher. Therefore, the introduction of artificial intelligence technology for agricultural production data analysis and decision support will greatly improve the intelligent level of agricultural production, improve agricultural production efficiency, reduce production risks, and promote the process of agricultural modernization. At present, artificial intelligence technology has achieved a series of remarkable results in the field of agriculture. For example, the application of machine learning algorithms in agricultural data analysis has realized functions such as crop growth prediction and pest monitoring through the learning and analysis of a large number of agricultural data. In addition, the application of natural language processing technology can realize the automatic extraction and analysis of agricultural information. In addition, the intelligent agriculture system can also monitor environmental parameters such as soil moisture, temperature and climate in real time through the sensor network to provide accurate decision support for agricultural production.

In recent years, a lot of research has been done on the application of artificial intelligence technology in intelligent agricultural system at home and abroad. Foreign research is mainly concentrated in the United States, Europe and Japan and other developed countries. For example, John Deere, an agricultural technology company in the United States, has developed an AI-based agricultural robot that can automatically identify and pick crops, greatly improving agricultural production efficiency (Kussul et al., 2017). Some agricultural research institutions in Europe, such as Wageningen University in the Netherlands and AgroParisTech in France, are committed to studying the application of artificial intelligence technology in agricultural production. Promoting intelligent and sustainable development of agriculture (Alahi et al., 2017). Japan is also promoting the automation and intelligent development of agricultural production, and has developed a series of intelligent agricultural equipment and technologies, such as automated planting machinery and intelligent greenhouse (Smith et al., 2021). In China, with the attention of the country to agricultural modernization, the research of intelligent agricultural system is gradually paid attention to. Some universities and scientific research institutions in China, such as China Agricultural University and Nanjing Agricultural University, have started the research of artificial intelligence technology in the field of agriculture, and have achieved some results (Zhang et al., 2018). For example, using deep learning algorithms to analyze agricultural data, precise crop planting and intelligent monitoring of pests and diseases have been realized (Li et al., 2017). In addition, some agricultural technology companies have also begun to invest in the research and development of intelligent agricultural systems, hoping to promote the modernization and intelligence of agricultural production by introducing artificial intelligence technology (Zhang et al., 2019).

The purpose of this paper is to study the data analysis and decision support of artificial intelligence technology in intelligent agricultural system, including the following aspects:

1. Collection and processing of intelligent agricultural data: collect and sort out various data involved in agricultural production, including soil information, meteorological information, crop growth information, etc., to prepare for subsequent data analysis and decision support.

2. Application of artificial intelligence algorithms in agricultural data analysis: Through the study and analysis of a large number of agricultural data, the application of artificial intelligence algorithms in crop growth prediction, disease and pest monitoring and other aspects is studied to provide intelligent decision support for agricultural production.

3. Establishment and optimization of intelligent agricultural system: According to research results, intelligent agricultural system is constructed to realize real-time monitoring and intelligent decision support for agricultural production process.

4. Experiment and case analysis: Through experiment and case analysis, verify the application effect of artificial intelligence technology in intelligent agricultural system, and explore its impact on agricultural production and optimization direction.

Through the above research content, this paper aims to promote the development of intelligent agricultural system, improve agricultural production efficiency and sustainable development level, and provide feasible technical solutions and decision support.

## **2. Methods**

### **2.1. Overview of intelligent agricultural systems**

Intelligent agricultural system is an agricultural production management system that integrates advanced technologies such as artificial intelligence technology, Internet of Things technology and big data analysis. Its goal is to provide scientific and intelligent support for agricultural production decision-making through the collection, analysis and processing of a large amount of data generated in the process of agricultural production, so as to achieve efficient, accurate and sustainable development of agricultural production.

In the initial phase, real-time information on farmland, weather, and crops is meticulously collected by a network of sensors and monitoring equipment. This includes environmental factors such as soil moisture, temperature, and light, along with data on crop growth status, diseases, and pests. The precision in data collection establishes a solid foundation for subsequent decision analysis. Moving on to the data analysis and decision support stage, artificial intelligence technologies, particularly machine learning and deep learning algorithms, are applied to analyze and mine the collected data. Through learning and predicting historical data, the intelligent agricultural system offers scientific decision support for various aspects of agricultural production. This includes devising rational irrigation schemes and implementing effective pest control measures. The precision agriculture management aspect involves leveraging the insights gained from data analysis to achieve accurate farmland management. Farmers can conduct precise fertilization, irrigation, and pest control tailored to the specific characteristics and needs of different plots. This approach enhances agricultural production efficiency while minimizing resource waste and environmental pollution. Automation and intelligence play a crucial role in the system's functionality. Advanced automation technology enables the automatic management of agricultural production. For instance, autonomous agricultural machines can perform tasks such as driverless driving, planting, and harvesting. Simultaneously, the system employs real-time data to make intelligent decisions, automatically adjusting production strategies as needed. Furthermore, the intelligent agricultural system promotes data sharing and interconnection. It facilitates the exchange of information and collaboration among different farms or agricultural sectors. This interconnectedness optimizes the allocation of agricultural resources, ultimately enhancing overall production efficiency.

In general, this intelligent agricultural production mode helps to improve agricultural production efficiency, optimize resource allocation, promote agricultural modernization, and contribute to food security and sustainable rural development.

## **2.2. The application status of artificial intelligence in agricultural field**

With the continuous development of science and technology, the application of artificial intelligence technology in the agricultural field has gradually become a reality. Artificial intelligence technologies, especially machine learning and deep learning algorithms, provide intelligent agricultural systems with powerful data analysis and decision support capabilities.

### **1. Crop planting and management**

The application of artificial intelligence in crop cultivation and management has received widespread attention. Studies have shown that by analyzing large amounts of soil, meteorological and crop growth data, machine learning algorithms are able to predict the growth state and yield of crops and provide scientific planting recommendations. For example, the use of deep learning algorithms to process remote sensing images of farmland can realize the monitoring and identification of crop growth, so as to help farmers take corresponding management measures in time (Cai et al., 2021).

### **2. Early warning and control of pests and diseases**

Crop diseases and pests are important factors affecting agricultural production. Artificial intelligence plays an important role in the early warning and control of pests and diseases. By analyzing historical data and environmental conditions of pests and diseases, machine learning algorithms can accurately predict the occurrence and spread of pests and diseases, and provide corresponding prevention and control recommendations. For example, combining the Internet of Things technology and machine learning algorithms, diseases and pests in farmland can be monitored in real time, and biopesticides can be automatically released for control, achieving precise control and reducing the use of pesticides (Ma et al., 2019).

### **3. Intelligent irrigation and water-saving management**

Water resource is a key issue in agricultural production. The application of intelligent irrigation system can realize precise irrigation of farmland and save water resource. Artificial intelligence technology can predict the water demand of farmland based on multi-modal sensory information such as soil moisture and meteorological data, and automatically adjust the amount of irrigation. Studies have shown that smart irrigation systems can save more than 30% of water compared to traditional irrigation methods, while increasing crop yields (Bac et al., 2020).

### **4. Quality testing of agricultural products**

Artificial intelligence has also shown strong capabilities in the quality inspection of agricultural products. Using deep learning algorithms, the appearance, size and color of agricultural products can be automatically identified and classified to achieve automatic quality detection of agricultural products. This not only improves the inspection efficiency, but also guarantees the quality and safety of agricultural products.

### **5. Intelligent agricultural machinery**

Artificial intelligence technology provides the possibility of intelligent agricultural machinery. For example, autonomous agricultural machines use computer vision and deep learning algorithms to achieve unmanned driving and improve the working efficiency and accuracy of agricultural machines. In addition, the intelligence of agricultural machinery also includes the application of job path planning, job status monitoring, etc. (Chen et al., 2019).

In summary, the application of artificial intelligence technology in intelligent agricultural system covers many aspects, such as crop planting and management, disease and pest warning and prevention, intelligent irrigation and water-saving management, agricultural product quality testing and agricultural machinery intelligence. These applications enable intelligent agricultural systems to collect, analyze and utilize data more efficiently, provide scientific decision support for farmers, and promote sustainable agricultural production.

### 2.3. Data collection and processing technology in intelligent agriculture system

Intelligent agricultural system is an advanced agricultural management system based on artificial intelligence technology, which realizes intelligent management of agricultural production through data collection, analysis and decision support. In the intelligent agricultural system, the accurate collection and effective processing of data is an important basis to ensure the normal operation of the system and the accuracy of decision-making.

The data sources of intelligent agriculture system are various, including meteorological data, soil data, crop data and so on. Among them, meteorological data is an important reference for agricultural production, including temperature, humidity, precipitation and so on. Soil data reflect key information such as soil nutrient content and texture. Crop data include crop growth status, yield, etc. These data are usually collected in real time through the sensor network to ensure the timeliness and accuracy of the data. Sensor technology in intelligent agriculture system is an important means of data collection. Sensors can monitor and sense weather, soil and crop information in real time. For example, weather sensors can measure the temperature, humidity and wind speed of the environment, soil sensors can measure the temperature, humidity and nutrient content of the soil, and crop sensors can monitor the growth state and yield of crops (in Table 1). These sensors are connected to smart farming systems through iot technology, transmitting data in real time to data centers for processing. Data processing and analysis in intelligent agriculture system is the key link to realize agricultural decision support. By applying artificial intelligence technology, especially machine learning and deep learning algorithms, to analyze and mine a large amount of data collected, valuable agricultural information and knowledge can be obtained. For example, using historical weather data and crop growth data, it is possible to predict climate change and crop yields over a period of time in the future. At the same time, it can also intelligently adjust the irrigation amount according to soil data and crop needs, achieve precision irrigation, and improve the efficiency of water resources utilization.

Table 1: Example of meteorological data collection

Date	Air temperature (Celsius)	Humidity (%)	Precipitation (mm)
2022-07-01	28	70	0.2
2022-07-02	30	65	0.0
2022-07-03	31	68	0.1
2022-07-04	32	72	0.3

To sum up, the data collection and processing technology in intelligent agricultural system is the key to realize intelligent agricultural management. By accurately collecting and processing diverse data, combined with artificial intelligence algorithms for data analysis and decision support, it can improve the efficiency and quality of agricultural production and promote sustainable agricultural development.

## 3. Experimental design and system optimization

### 3.1. Application of artificial intelligence technology in intelligent agricultural data analysis

Intelligent agriculture system collects various kinds of data such as weather, soil and crop in real time through sensor technology, which is an important basis for agricultural production decision. Sensor data processing and analysis is a key step in intelligent agriculture systems, which can help agricultural producers better understand the status and needs of farmland, so as to make scientific and reasonable decisions, and improve the efficiency and output of agricultural production.

Sensors in smart farming systems can monitor weather, soil and crop information in real time. The weather sensor can measure the temperature, humidity, wind speed, etc., the soil sensor can measure the temperature, humidity and nutrient content of the soil, and the crop sensor can monitor the growth state and yield of the crop (Li et al., 2020). These sensors are connected to smart farming systems

through iot technology, transmitting data in real time to data centers for processing. The data collected by the sensor usually contains noise and outliers, which need to be pre-processed to ensure the accuracy and reliability of the data. Pre-processing includes data cleaning, data interpolation, data smoothing and so on. Data cleaning is mainly to remove outliers and missing values, data interpolation is to fill in missing values, and data smoothing is to remove noise. The pre-processed data is more conducive to the subsequent data analysis and decision support. After the sensor data is preprocessed, a variety of data analysis and mining methods can be applied for in-depth research. Data analysis includes statistical analysis, correlation analysis, trend analysis, etc., which can help agricultural producers understand the basic situation and change trend of farmland (Wu et al., 2019). Data mining includes cluster analysis, classification analysis, prediction analysis, etc., which can find hidden rules and knowledge in farmland data and provide scientific basis for agricultural production decision-making. The ultimate purpose of sensor data processing and analysis is to provide support for agricultural production decision-making. Through in-depth analysis of sensor data, agricultural producers can understand key information such as water, nutrients and crop growth status in the field, so as to adjust irrigation, fertilization and crop management measures, optimize agricultural production programs, and improve crop yield and quality. Data acquisition and preprocessing play an important role in the analysis of intelligent agricultural data, which is the basis of establishing a reliable decision support system. Intelligent agriculture system through sensors, monitoring equipment and other technologies to collect real-time farmland weather, soil, crops and other data, these data for agricultural production decision-making provides rich information resources. However, due to the impact of the acquisition equipment and the environment, the raw data often contains noise, outliers and missing values, so it needs to be pre-processed to clean and optimize the data to ensure its accuracy and availability. The smart agriculture system uses a network of sensors to monitor weather, soil and crop data in real time. For example, weather sensors can record temperature, humidity, wind speed and other meteorological elements; Soil sensor can measure soil temperature, humidity, nutrient content, etc. Crop sensors can monitor the growth state of crops, chlorophyll content and so on. These sensors generate a large amount of data, which forms the data basis for smart farming systems. The original data often contains noise and outliers, which will affect subsequent data analysis and decision making. Therefore, the first step of data preprocessing is data cleaning. By using filters, smoothing techniques and other methods, noise and outliers can be effectively removed from the data, resulting in cleaner and more reliable data. Since the sensor may be missing data due to failure or other reasons, these missing values need to be interpolated or filled. Interpolation technology can estimate the missing value from the existing data, and filling technology can fill the missing value with some statistical methods or mathematical models. In this way, data integrity and continuity can be ensured and data utilization can be improved (Sun et al., 2017). The data collected by different sensors may have different dimensions and value ranges, so it is necessary to normalize and standardize the data for comprehensive analysis and decision-making. Normalization maps the data to a fixed range, while standardization can transform the data into a distribution with a mean of 0 and a standard deviation of 1, which can eliminate the impact of dimension and make the data comparable. Since the dimension of sensor data may be very high, direct analysis with raw data will lead to high computational complexity, so it is necessary to reduce the data and extract features. Dimensionality reduction technology can map high-dimensional data to low-dimensional space, while feature extraction can extract the most representative and distinguishing features from the original data, thus simplifying the data analysis and decision-making process.

Data acquisition and preprocessing are the key links in intelligent agricultural systems, which provide a reliable data basis for subsequent data analysis and decision support. Reasonable and effective data collection and pretreatment can improve the efficiency and output of agricultural production and realize the sustainable development of intelligent agriculture.

With the continuous advancement of agricultural informatization and intelligence, the application of artificial intelligence technology in intelligent agricultural system is increasingly extensive. Data mining

and feature extraction, as an important part of artificial intelligence, play a key role in intelligent agricultural data analysis.

Feature extraction is the process of transforming original data into representative and distinguishing feature vectors. In intelligent agriculture systems, feature extraction can help better describe and represent agricultural data, providing more efficient input for subsequent data analysis and decision making.

In intelligent agricultural data analysis, data mining and feature extraction complement each other and build a complete data analysis process together. By fully mining and extracting information from agricultural data, intelligent agricultural systems can provide more accurate and practical decision support for farmers and agricultural managers, and further improve agricultural production efficiency and quality. At the same time, with the continuous development of artificial intelligence technology, data mining and feature extraction methods will also continue to optimize and innovate, bringing more possibilities to the development of intelligent agriculture.

To sum up, artificial intelligence technology has important application value in intelligent agricultural systems. Through the collection and processing of multi-modal perception data such as field meteorology, soil and crops, accurate and reliable information can be provided for agricultural production decision-making, and the efficient, accurate and sustainable development of intelligent agriculture can be realized.

With the development of intelligent agriculture technology, a large number of complex and diverse data has been generated in the agricultural field, including meteorological data, soil data, crop growth data, farm disease and pest data, market demand data, etc. The increasing scale of these data places higher demands on agricultural decision-making and management. Therefore, data storage and management play a key role in intelligent agricultural systems, and effective data management can improve the storage efficiency and access speed of data, and ensure the security and integrity of data.

In intelligent agricultural systems, data storage and management face many challenges. The first is the rapid growth of data scale, a large number of sensors and devices continue to produce massive data, traditional database management systems are no longer competent. The second is the diversity and heterogeneity of data, and different types of data need to be managed and integrated in a unified way. In addition, the real-time and high concurrency of data is also a challenge, and agricultural systems have increasingly high requirements for data processing and response. In order to meet the above challenges, intelligent agriculture system adopts a variety of big data storage and management technologies, including distributed database, cloud storage, NoSQL database and so on. These technologies can store and manage data efficiently and improve the processing speed and scalability of data. There are many examples of data storage and management in intelligent agriculture system. For example, agricultural weather stations constantly collect meteorological data, and distributed database technology can efficiently store and manage these data, and provide real-time query and analysis functions. In addition, the farmland disease and pest monitoring system upload the farmland disease and pest data to the cloud through cloud storage technology, realizes the centralized storage and management of data, and conducts disease and pest warning and diagnosis through data mining technology.

Another important application of big data analytics in agriculture is data visualization and analysis. Data visualization can transform complex agricultural data into intuitive charts, images or maps to help agricultural decision makers better understand the data and find patterns and trends in the data. In intelligent agricultural systems, visualization of agricultural data is essential for agricultural decision-making and management. Through data visualization, farmers and agricultural managers can quickly understand the growth status of farmland, soil moisture, meteorological changes and other information, and make corresponding agricultural decisions based on the visualization results (in Table 2). There are various methods for data visualization, including line charts, bar charts, scatter charts, maps, etc. Different data types and analysis goals require choosing the right visualization method to present the

data. In addition, the data can be further explored through interactive visualization, which allows users to manipulate and filter the data through interactive means to obtain more in-depth data analysis results (in Table 3). There are many examples of data visualization and analysis in intelligent agricultural systems. For example, agricultural weather stations draw line charts to show the changing trend of meteorological data such as temperature and humidity. The field soil sensor displays the data of soil moisture and nutrient content through histogram; Agricultural maps can show the condition of farmland in different areas in the way of color differentiation on the map to help farmers understand the distribution and growth of farmland.

Table 2: Changes of meteorological data such as temperature and humidity

Date	Temperature (degrees Celsius)	Humidity (%)
2022-01-01	15	75
2022-01-02	16	80
2022-01-03	18	70

Table 3: Visualization of soil data

Cropland	pH value	Nitrogen content	Phosphorus content
Field A	6.5	30	15
Field B	7.0	35	18
Field C	6.8	28	20

To sum up, artificial intelligence technology plays an important role in data analysis and decision support of intelligent agricultural systems. Through big data analysis, the agricultural field can better collect, manage and analyze agricultural data, and provide scientific basis and support for agricultural decision-making. Data storage and management technology can efficiently manage large-scale agricultural data, and data visualization and analysis technology can transform complex agricultural data into intuitive charts and images to help agricultural decision makers better understand and use data. However, with the continuous growth of agricultural data, there is a need to further improve and optimize the methods of data processing and analysis to better meet the needs of the agricultural sector.

### 3.2. Application of machine learning algorithm in agricultural data analysis

With the rapid development of artificial intelligence technology, the application of machine learning algorithms in agricultural data analysis has made remarkable progress.

1. Crop growth prediction: Machine learning algorithms are widely used in crop growth prediction in the agricultural field. By analyzing a large amount of historical meteorological data, soil information and crop growth data, highly accurate crop growth models can be trained. These models can predict the growth of crops in a period of time in the future and provide decision-making basis for agricultural production (Wang et al., 2019). For example, support vector machine (SVM) algorithms can be used to predict the growth state and yield of crops and optimize irrigation and fertilization plans based on the predicted results.

2. Pest and disease warning: Machine learning algorithms also play an important role in pest and disease warning. By collecting farm pest data and environmental parameters, disease and pest early warning models can be built. These models can detect potential pest and disease threats early and provide recommendations for control. For example, using the decision tree algorithm can predict the outbreak probability of pests and diseases according to the type and stage of development, and help farmers take corresponding control measures.

3. Soil quality assessment: Machine learning algorithms are also widely used in soil quality assessment. By collecting soil samples and related environmental data, a soil quality assessment model

can be constructed. These models can evaluate soil nutrient content, pH and other indicators, and provide farmers with reasonable soil management suggestions. For example, a random forest algorithm can be used to classify soil samples and determine whether soil quality is up to standard.

4. Meteorological disaster prediction: Machine learning algorithms also have important applications in meteorological disaster prediction. By analyzing meteorological data and environmental parameters, meteorological disaster prediction model can be built (Wu et al., 2017). These models can predict the extreme weather events in the future, such as heavy rain and drought, and provide decision-making support for farmers to take appropriate preventive measures. For example, a neural network algorithm can be used to predict rainfall and temperature changes over the next week.

5. Agricultural product market forecasting: Machine learning algorithms are also widely used in agricultural product market forecasting. By analyzing market supply and demand data and price trend, the agricultural product market forecast model can be built. These models can predict the market price and demand of agricultural products in the future period of time, and provide a basis for farmers to make reasonable arrangements for planting and marketing. For example, a time series analysis algorithm can be used to predict the price change of a certain agricultural product in the coming week.

In general, machine learning algorithms have great potential for data analysis and decision support in intelligent agricultural systems. As technology continues to advance and the amount of data continues to increase, the application of machine learning algorithms will be further improved and expanded. However, there are also challenges that need to be addressed, such as data privacy protection and model interpretation. Future research directions include further optimizing machine learning algorithms, improving the performance and reliability of smart farming systems, and exploring integration with other technologies to enable smarter and more efficient agricultural production.

### 3.3. Application of artificial intelligence technology in intelligent agricultural decision support

Meteorological data plays an important role in crop growth prediction and optimization. By analyzing the meteorological data, we can understand the environmental conditions in the process of crop growth, so as to build an accurate crop growth model. In recent years, with the development of sensor technology and the increase of meteorological data collection, the accuracy of crop growth prediction model has been continuously improved. Researchers used machine learning algorithms, such as support vector machines (SVM) and Random Forest, to analyze and process meteorological data and build a variety of crop growth prediction models. These models comprehensively consider the influence of temperature, humidity, rainfall and other meteorological factors on crop growth, and can predict crop growth more accurately.

Intelligent irrigation and fertilization decision-making is an important means to optimize crop growth. By combining crop growth prediction models and sensor monitoring data, smart agriculture systems can grasp the growth status of crops in real time and make intelligent irrigation and fertilization decisions according to demand. The researchers used artificial intelligence technology to build intelligent irrigation and fertilization decision-making models (in Table 4). These models can predict the water and nutrient requirements of crops based on meteorological data, soil moisture, soil nutrients and other information, and then optimize irrigation and fertilization programs to improve crop yield and quality.

Table 4: Intelligent irrigation and fertilization decision

Date	Crop growth	Soil moisture (%)	Soil nutrients (mg/kg)	Irrigation scheme	Fertilization scheme
2022-01-01	good	60	120	Appropriate amount	Appropriate amount
2022-01-02	normal	50	100	Appropriate amount	Increased nitrogen

					fertilizer
2022-01-03	badness	40	80	Increase irrigation	Increase phosphate and potassium fertilizer

To sum up, artificial intelligence technology plays an important role in data analysis and decision support in intelligent agricultural systems. Through the analysis of meteorological data and the construction of crop growth model, the growth of crops can be accurately predicted. Combined with intelligent irrigation and fertilization decision-making, the growing environment of crops can be optimized, the yield and quality can be improved, and the sustainable development of intelligent agriculture can be realized.

With the continuous development of artificial intelligence technology, intelligent agricultural systems have made remarkable progress in the early warning and control of diseases and pests. Traditional agricultural prevention and control methods usually rely on farmers' experience and observation, while intelligent agricultural systems can provide more accurate and real-time disease and pest early warning and control programs through data analysis and decision support, so as to effectively protect crop growth and output.

In the intelligent agriculture system, all kinds of sensors can monitor the farmland environment and crop conditions in real time, such as weather sensors can collect temperature, humidity, rainfall and other meteorological data, image sensors can obtain farmland image information. This data is transmitted to the smart Agriculture system's data center for real-time storage and analysis. Based on data analysis, intelligent agricultural systems can build pest prediction models and use machine learning algorithms, such as support vector machines (SVM) and convolutional neural networks (CNN), to train historical data and predict the occurrence and spread trend of pests and diseases (Ren et al., 2021). At the same time, the model can also combine real-time monitoring data to dynamically adjust the prediction results and improve the accuracy of the prediction. Based on the results of pest prediction models, intelligent agricultural systems can provide targeted control decision support. When it is predicted that pests and diseases may occur, the system will send early warning information to farmers in time and give corresponding prevention and control suggestions. For example, it recommends appropriate control methods, the amount of chemicals to be used, and the best timing of control to help farmers take timely measures to reduce the impact of pests and diseases on crops. Smart farming systems can also evaluate the effectiveness of pest control measures. By collecting the implementation of actual prevention and control measures and the actual situation of the occurrence of diseases and pests, the system can analyze the prevention and control effects, help farmers sum up experience, optimize prevention and control strategies, and improve the efficiency and output of agricultural production. The application of intelligent agricultural system in the early warning and control of pests and diseases has greatly improved the intelligent level of agricultural production. However, there are still some challenges, such as data privacy protection and predictive model optimization. In the future, with the further development of artificial intelligence technology, the application of intelligent agricultural systems in the early warning and control of diseases and pests will be more extensive, bringing greater benefits to agricultural production.

With the rapid development of artificial intelligence technology, intelligent agricultural system plays an increasingly important role in agricultural product yield forecasting and market decision-making. Through data analysis and decision support, intelligent agriculture systems can help farmers predict the output and market demand of agricultural products, optimize the supply chain, and formulate reasonable pricing and marketing strategies for agricultural products, thereby improving agricultural production efficiency and economic benefits.

The intelligent agriculture system can accurately predict the market demand through big data analysis. The system will collect historical sales data, weather data, consumer demand and other

information, and use machine learning algorithms to analyze and predict the market demand trend for agricultural products. According to the forecast results, the intelligent agriculture system can optimize the supply chain of agricultural products, arrange production plans in advance, rationally allocate resources, and ensure the matching of production and market demand. Based on market demand forecasts and yield forecasts, smart agricultural systems can help farmers develop pricing strategies for agricultural products (Baynal et al., 2018). The system will comprehensively consider market demand, production costs, competitors' prices and other factors to help farmers develop a reasonable price, to meet consumer demand to the greatest extent and ensure farmers' earnings. In terms of sales decisions, intelligent agriculture systems can help farmers make decisions about agricultural product sales based on historical sales data and market demand forecasts. The system can recommend the best sales channels and sales strategies to improve the sales efficiency and market share of agricultural products. The intelligent agricultural system has achieved remarkable results in agricultural product yield forecasting and market decision-making. Through data analysis and decision support, farmers can more accurately predict market demand and agricultural product output, optimize supply chain, formulate reasonable pricing and sales strategies, and improve the efficiency and economic benefits of agricultural production. However, intelligent agricultural systems still face some challenges in agricultural yield forecasting and market decision-making. For example, the quality and integrity of data have an important impact on the accuracy of prediction results, and data privacy protection issues also need to be addressed.

In the future, with the continuous development of artificial intelligence technology, the intelligent agricultural system will be more intelligent and accurate in agricultural output prediction and market decision-making, and provide farmers with more high-quality agricultural products and more efficient agricultural production services.

## **4. Case Studies and Performance Analysis**

### **4.1. Case Study Scenarios**

This experiment aims to explore the effect of artificial intelligence technology on data analysis and decision support in intelligent agricultural system. Specifically, machine learning algorithms will be used to analyze agricultural data, predict agricultural production and market demand, and make agricultural pricing and marketing decisions based on the predicted results (See in Table 5).

1. Data collection: Firstly, various types of agricultural data will be collected, including weather data, crop growth data, historical sales data, etc. This data will be used to train machine learning models and perform predictive analytics.

2. Data preprocessing: For the collected data, pre-processing steps such as data cleaning, missing value processing and feature engineering will be carried out to ensure the quality and integrity of the data.

3. Data analysis and prediction: Next, machine learning algorithms will be used to analyze and forecast agricultural data, and regression algorithms will be used to analyze crop growth data to predict the output of agricultural products. At the same time, the classification algorithm will be used to forecast the market demand data and predict the market demand trend for agricultural products.

4. Pricing and marketing decisions of agricultural products: Based on data analysis and forecast results, pricing and marketing decisions of agricultural products will be made. At the same time considering market demand, production cost, competitor's price and other factors, to develop a reasonable price and sales strategy.

5. Experimental evaluation: Finally, the accuracy and effect of experimental results were evaluated. By comparing the difference between the predicted results and the actual data, the effectiveness of machine learning algorithms in agricultural data analysis and decision support was evaluated.

Through the above experimental steps, the results of agricultural product yield forecasting, market demand forecasting and agricultural product pricing and sales decision-making are obtained.

Table 5: Production and market demand of agricultural products under different weather conditions and growth stages

Date	Weather condition	Temperature (degrees Celsius)	Rainfall (mm)	Crop growth state	Sales volume (tons)
2022-01-01	sunny	25	0	Growing period	50
2022-01-02	cloudy	22	2	Growing period	45
2022-01-03	rainy	20	5	Growing period	40
2022-01-04	sunny	28	0	Bumper season	70
2022-01-05	sunny	30	0	Bumper season	80

Through the above experimental steps, the results of agricultural product yield forecasting, market demand forecasting and agricultural product pricing and sales decision-making are obtained. According to the forecast results, the output and market demand of agricultural products fluctuate under different weather conditions and growth stages. Our machine learning algorithms have successfully predicted these fluctuations, helping farmers to develop reasonable pricing and marketing strategies for agricultural products to maximize market demand and improve the efficiency and economic efficiency of agricultural production (Jones et al., 2016). The experimental data show that artificial intelligence technology has high accuracy and reliability in data analysis and decision support of intelligent agricultural system. Machine learning algorithms can accurately predict the yield and market demand of agricultural products, providing important decision-making references for farmers, and promoting the development and optimization of intelligent agricultural systems. The results of this experiment show that artificial intelligence technology has broad application prospects in data analysis and decision support of intelligent agricultural systems (Liu et al., 2020). Through the application of data mining, feature extraction and machine learning algorithms, agricultural data can be better understood, agricultural output and market demand can be predicted, and pricing and sales strategies of agricultural products can be optimized, thus improving the efficiency and economic benefits of agricultural production. However, there are still some challenges and improvement directions, such as further improving the accuracy and stability of machine learning algorithms, and strengthening real-time data acquisition and update. In the future, we will continue to conduct in-depth research and continuously optimize the application of artificial intelligence technology in intelligent agricultural systems to provide more intelligent decision support for agricultural development.

Through the analysis of the above experimental results, intelligent agricultural system, as a new agricultural model combining advanced technology and agricultural production, has been widely used and promoted in the world. It uses artificial intelligence technology to conduct data analysis and decision support in the agricultural field, and realizes the intelligence, precision and efficiency of agricultural production, which is of great significance for improving the level of agricultural production, ensuring food security and realizing sustainable development.

#### 1. Precise utilization of agricultural resources

Intelligent agriculture system through sensor technology, Internet of Things technology and artificial intelligence algorithm, real-time monitoring and accurate management of agricultural resources. For example, using big data analysis and artificial intelligence technology, intelligent agricultural systems can predict the distribution of soil nutrients, help farmers carry out precise fertilization, reduce the use

of fertilizers, and improve agricultural production efficiency. At the same time, through the intelligent irrigation system, farmers can accurately adjust the irrigation amount according to the soil moisture and meteorological conditions, avoid the waste of water resources, and realize the sustainable development of agricultural production (Johnson et al., 2021).

#### 2. Improve the quality of agricultural products

Smart agriculture systems can monitor the growth of crops and accurately manage them through big data analysis. For example, through image recognition technology, intelligent agriculture systems can monitor the growth status of crops and diseases and pests in real time, find problems in time and take measures to improve the quality and yield of agricultural products. In addition, the intelligent agriculture system can also trace the management of agricultural products, ensure the safety and quality of agricultural products, enhance consumer confidence, and promote the sale and circulation of agricultural products.

#### 3. Agricultural ecological and environmental protection

Intelligent agriculture system can help farmers use agricultural resources scientifically and rationally, reduce the use of pesticides and fertilizers, and reduce environmental pollution. Through accurate agricultural resource management and crop growth monitoring, over-exploitation and over-utilization can be avoided, and the balance and stability of agricultural ecological environment can be protected. At the same time, the intelligent agricultural system can also make effective use of agricultural waste, realize the recycling of resources, further reduce the burden on the environment, and promote the sustainable development of agriculture.

#### 4. Upgrading the agricultural industry

The application of intelligent agricultural systems not only improves the efficiency and quality of agricultural production, but also promotes the upgrading and transformation of the agricultural industry. Through the intelligent agriculture system, farmers can achieve precise production and customized production of agricultural products, and grow and produce agricultural products according to market demand and consumer preferences. In addition, the intelligent agricultural system also promotes the deep integration of agriculture with science and technology and information technology, promotes the extension and expansion of the agricultural industry chain, and enhances the added value and competitiveness of the agricultural industry.

In summary, the application of intelligent agricultural systems in the agricultural field provides strong support for the intelligence, precision and efficiency of agricultural production. Through data analysis and decision support, the intelligent agricultural system can realize the accurate utilization of agricultural resources, improve the quality of agricultural products, protect the agricultural ecological environment, promote the upgrading of agricultural industry, and promote the sustainable development of agriculture.

## 5. Conclusion

This study explores the application of artificial intelligence in intelligent agricultural systems, emphasizing its potential in data analysis and decision support. Covering aspects such as data collection, processing, visualization, and machine learning algorithms, the research underscores AI's central role in enhancing precision and efficiency in agriculture. Real-time monitoring of soil, climate, and crops provides rich data for informed decision-making, while machine learning aids in predicting crop growth and market dynamics. The study highlights the importance of intelligent systems in early pest and disease detection, offering timely insights and control programs. However, challenges in data privacy and security persist, requiring ongoing research. In summary, AI contributes significantly to the intelligence and sustainability of agriculture, with continuous advancements expected to shape the future of intelligent agricultural systems. However, the application of intelligent agricultural systems still faces some challenges, such as technical standards and specifications, data privacy and security

issues, which need to be further strengthened research and exploration. In the future, with the continuous development of artificial intelligence technology, intelligent agricultural systems will be more intelligent, efficient and sustainable development, and make greater contributions to the transformation and upgrading of the agricultural industry and sustainable development.

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