Research Article

Evaluation Model of Rural Ecological Environment Governance Quality Using Decision Tree Algorithm

Yan Yan and Xumeng Feng

College of Humanities and Social Development, Nanjing Agricultural University, Nanjing, Jiangsu 210095, China

Correspondence should be addressed to Xumeng Feng; fengxumeng@njau.edu.cn

Received 11 April 2022; Revised 10 May 2022; Accepted 12 May 2022; Published 4 July 2022

Academic Editor: Liping Zhang

Copyright © 2022 Yan Yan and Xumeng Feng. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

In rural economic development and environmental protection, assessing the quality of rural ecological environment management is critical. This paper uses a decision tree algorithm to assess the quality of rural ecological environment governance based on an in-depth review of related literature. The data are recursively processed from top to bottom in this paper, and a set of disordered and irregular examples is summed up into a set of classification rules represented by a tree structure, and an evaluation model is obtained, in which all pollution parameters are taken as environmental quality factors. It effectively overcomes the traditional environmental quality prediction model’s inflexibility and inaccurate boundary value. The simulation results show that the quality evaluation method in this paper has a classification accuracy of 96.82 percent and a recall rate of 96.63 percent, which is higher than the comparison algorithm. The experimental results support the effectiveness and applicability of the decision tree-based method for assessing the quality of rural environmental governance. This model can not only assist researchers in correctly analyzing and mastering the migration and change rules of pollutants in the air but also has promising social and economic implications.

1. Introduction

Ecology is primarily concerned with human material and spiritual achievements in the process of protecting and constructing the natural ecological environment. It is a positive social ideology in which people live in harmony with their surroundings. All changes in environmental structure or state that endanger the development of humans and other living things are referred to as environmental problems. Environmental pollution and ecological damage are also included [1]. The environment plays a critical role in the growth of the social economy and culture. Any development requires a healthy ecological environment. When people were concentrating on urban pollution control, ecological crises and environmental pollution problems erupted on a regular basis in rural areas, raising public awareness. The national economic and social development will be hampered if rural ecological environment governance and supporting facilities are not in place [2]. To truly achieve sustainable development, we must consider the negative effects of the environment on human production and life, as well as the development of ecological civilization. All aspects of national social development will be influenced by the rural ecological environment. As a result, management of the rural ecological environment can not only promote national economic development but also speed up the modernization process [3]. Ecological construction is a systematic project that requires the participation of both urban and rural areas. In general, the countermeasures for controlling the ecological environment are to internalize external problems, that is, to use administrative and economic means to make the main body responsible for the ecological environment problems bear the economic responsibility and the additional environmental costs incurred by production activities [4]. Government intervention and market incentives are the two main ideas for controlling the ecological environment based on this. The development of ecological civilization is linked to the country’s future. In light of the increasingly...
serious situation of ecological destruction and pollution, it is critical to promote the concept of ecological civilization and the construction of ecological civilization throughout the society [5].

At present, due to insufficient attention to the rural ecological environment, insufficient investment in environmental protection, and farmers’ weak awareness of environmental protection and extensive rural production methods, these factors have led to increasingly serious rural environmental problems. Under the background of modern society, it is necessary to reasonably carry out the natural construction work, especially the rural environmental governance work [6, 7]. At the same time, the quality evaluation of ecological environment management is of great significance to environmental protection. At present, the commonly used air quality evaluation algorithms include the air pollution index method, the fuzzy comprehensive evaluation method, and the Euclid proximity method. However, there are some shortcomings in these algorithms, such as single factor evaluation, artificial factors in the index range, and too clear boundary of index value. There are still evaluation errors in daily use. Based on the in-depth study of related literature, this paper uses a decision tree algorithm to evaluate the quality of rural ecological environment governance. A decision tree is a technology mainly used in classification and prediction. It is an inductive learning algorithm based on examples, which can deduce certain classification rules from messy data. Since the decision tree algorithm was put forward, it has been continuously developed and kept improving. From ID3 and ID4 to the CART decision tree algorithm, then to C4.0 and C4.5, the research of decision tree algorithms has been in progress [8]. The decision tree algorithm is also applied to many fields, such as risk prediction analysis, evaluation, and prediction of environmental governance quality, as studied in this paper [9]. Based on the decision tree algorithm, this paper explores the evaluation method of rural ecological environment governance quality. Its innovations are as follows:

(1) On the basis of discussing the common methods of air quality assessment, this paper puts forward an assessment method combined with a decision tree algorithm. At the same time, the decision tree algorithm is used to evaluate the six pollution parameters that mainly affect the air quality at present, and an accurate evaluation model with clear classification rules is obtained. It can accurately and effectively evaluate the air quality.

(2) The algorithm in this paper can be simplified by an effective formula, which eliminates a large number of logarithmic operations in the formula and optimizes the time complexity of the algorithm, thus reducing the modeling time. At the same time, the attribute selection standard is changed to the information gain rate multiplied by the attribute feature number to reduce the influence of removing the logarithmic operation on accuracy. The results show that this model can not only guide researchers to correctly analyze and master the migration and change rules of pollutants in the air but also has good social and economic benefits and application prospects.

The focus of this paper is on the issues of rural environmental governance. It is divided into five sections based on the requirements, with each section organized as follows. Section 1 covers the background and significance of the topic selection as well as the article’s innovation and organizational structure. Section 2 summarizes relevant research findings from domestic and international literature as well as the paper’s research ideas and methods. The method section is found in Section 3. This paper primarily discusses the decision tree algorithm and rural ecological environment governance, as well as proposes and constructs a decision tree-based model for assessing the quality of rural ecological environment governance. Experiments on the model constructed in this paper are carried out in Section 4. Section 5 summarizes the findings of this paper’s research and looks ahead.

2. Related Work

On the one hand, due to the continuous development of industry and society, many countries have produced large-scale environmental pollution. On the other hand, with the continuous development of the economy and the improvement of living standards, people pay more and more attention to the quality of their living environment. Therefore, the research on the evaluation and prediction methods of environmental governance quality at home and abroad is becoming increasingly active, and various evaluation methods are constantly derived. No matter the amount of data processed, the speed of processing, or the accuracy of prediction, remarkable achievements have been made.

In view of the current situation that traditional numerical models are mostly used for environmental quality forecasting, Chen et al. chose to establish environmental quality forecasting models through clustering algorithms [10] and large-scale training datasets. Chen et al. analyzed and studied common evaluation methods of ecological environment quality, such as the comprehensive evaluation method, the grey clustering evaluation method, the fuzzy evaluation method, the artificial neural network, and other evaluation methods [11]. Starting from the current situation of the rural environment, Oguchi and Esaki discussed the reasons for the destruction of the ecological environment and proposed the significance and specific strategies of rural environmental governance under the background of ecological civilization construction [12]. Bone et al. pointed out that the theory of polycentric governance mainly emphasizes the self-governance of each organization, that is, the participation of other organizations, except the government and the market such as civil organizations, enterprises, and for-profit organizations [13]. Rosi-Marshall et al. calculated a new air pollution index through a multifactor model. Experiments show that this index supports the environmental Kuznitz curve hypothesis and analyzes and compares the impact of coal, industry, and population on environmental pollution in various countries [14]. Holdaway et al. proposed
that, in order to solve the problem of the deteriorating rural ecological environment, we must first improve people’s overall cultural literacy so that people understand that the deterioration of the rural environment will affect the overall ecological environment. In addition, the publicity of environmental protection in rural areas is indispensable so that farmers can pay attention to it from the ideological point of view and subtly change many bad living habits and incorrect ideological consciousness of farmers [15]. Parvathi and Nguyen used a combination of principal component analysis and decision tree to study the environmental quality of a city. The research results show that the quality of the local environment is related to the season, and the main source of local air pollution is the emission of coal and vehicles [16]. Guo and He pointed out that, at this stage, both urban and rural areas have undergone earth-shaking changes. However, the extensive development mode will still bring many problems in the process of gradual transformation. Among them, the rural environment has been severely impacted, and the ecological environment has been severely damaged [17]. Yang et al. proposed that, due to the randomness and ambiguity between different factors in evaluating air quality, the air quality can be evaluated by establishing a fuzzy mathematical model. The evaluation result of the established model is expressed according to the membership degree, which can reflect both the level of air pollution and the membership of various pollutants [18]. Chen et al. mainly analyzed from the perspective of sociology and believed that the existing unequal social relationship between urban and rural areas has further deteriorated the pollution of the rural ecological environment, which is closely related to the long-term lack of effective control of our environment [19]. Schmolke et al. studied the correlation between each pollutant and each meteorological index [20]. The study found that the correlation was much better in the winter than in the summer. This proves that environmental pollution has strong seasonality.

This paper analyses and explores the countermeasures and ideas of rural ecological environment governance from the actual situation of pollution and governance in the current rural ecological environment construction, based on related work, based on the basic theory of polycentric governance, and referring to related research at home and abroad. Simultaneously, the decision tree algorithm is used to evaluate the six pollution parameters that currently have the greatest impact on air quality, yielding an accurate evaluation model with clear classification rules. It has the ability to accurately and effectively assess air quality.

3. Methodology

3.1. Present Situation of Rural Ecological Environment Problems. The ecological environment refers to the collection of various “elements,” such as living things and abiotic things, which is an organic system. It is an integral part of the human ecosystem, and it all reflects the influence of human activities. Rural ecological environment refers to the atmosphere, water source, land, light, and heat on which agricultural organisms depend, as well as the working and living environment of agricultural producers, including vast rural areas, agricultural areas, pastoral areas, and forest areas. It is an important part of the natural environment. The rural ecological environment is the regional division of the ecological environment, which refers to the collection of various “elements” related to agriculture. Based on related work, based on the basic theory of polycentric governance, and referring to related research at home and abroad, this paper analyses and explores the countermeasures and ideas of the rural ecological environment governance from the actual situation of pollution and governance in the current rural ecological environment construction. Simultaneously, the decision tree algorithm is used to evaluate the six pollution parameters with the greatest current impact on air quality, resulting in an accurate evaluation model with clear classification rules. It has the ability to assess air quality accurately and effectively.

Agriculture pollution refers to the destruction of the ecological environment of farmers’ production squadrons. With the increase of China’s population and the expansion of the urban land area, the problem of relatively insufficient per capita resources has become increasingly serious. In order to maximize the yield of crops in a short time and achieve greater economic benefits, people’s pesticide consumption is increasing year by year. As a chemical product, pesticide can indeed increase the output of grain and vegetables in a short period of time. However, due to excessive use, the pesticide content of agricultural products directly exceeds the standard, causing serious harm to the human body [21]. At present, the change of lifestyle has brought a lot of domestic wastes which are difficult to degrade and treat, which completely exceeds the self-purification ability of the environment. At the same time, the extensive use of pesticides and fertilizers in production has reduced the natural productivity of land and also caused the pollution of land, water resources, and household products. With the awakening of “economic consciousness,” no matter the government, the market, or individuals are unilaterally pursuing economic development, the sudden emergence of township enterprises and the relocation of urban industries have brought about the development of the rural economy, but at the same time, they have caused great harm to the rural ecological environment. Moreover, the layout of township enterprises is unreasonable; some industrial projects with backward technology and serious pollution are gradually transferred to rural areas, and the treatment rate of pollution is low, causing serious pollution in rural areas. People overuse and exploit ecological resources, which leads to increasingly serious ecological environment damage, which seriously exceeds the environmental carrying limit.

Human survival is dependent on the environment. Rural residents are currently more reliant on the environment than city dwellers. The rural ecological environment is in bad shape, especially with rising resource and energy consumption. The pollution of township enterprises is currently more serious than the indirect spread of urban pollution in rural areas [22]. Resources are being over-exploited due to economic interests. Problems such as the mismanagement of water resources have not been adequately addressed,
worsening land degradation, desertification, and alkalinization. Natural disasters, such as acid rain, debris flows, soil erosion, floods, and other disasters, have become more common in recent years as a result of environmental destruction, causing significant damage to the agricultural foundation. Heavy metal pollution, pesticide and persistent organic compound pollution, chemical fertilizer application pollution, and other types of soil pollution are currently present. Heavy metal pollution is particularly prevalent among them. Heavy metals have low mobility and a long retention time in soil, and they are not degraded by most microorganisms. Through water, plants, and other media, it has the potential to endanger human health. Several examples show that the rural environment has played an important role in China’s economic development. As a result, while accelerating rural economic development, we must do everything possible to protect the rural ecological environment, which is essential for agriculture and rural economic development to be sustainable.

3.2. Countermeasures of Rural Ecological Environment Problems. Agriculture, as a fundamental industry for a country’s development, inevitably causes environmental damage. Strengthening the construction of rural ecological civilization creates the necessary conditions for urbanization and long-term agricultural development, as well as being an important component of overall socioeconomic development. Rural environmental protection is a precondition for agriculture’s survival and development, as well as a major event affecting the national economy and people’s livelihoods. The environment has an impact on human society, economy, and culture. In rural ecological environments and sustainable development, a good ecological environment is crucial. Any development will be impossible without a healthy environment. To strengthen environmental protection legislation in rural areas, it is currently necessary to embed the concept of environmental protection deep in the minds of rural residents at the fundamental level of law so that they understand the urgency and importance of environmental protection. At the same time, traditional rural social capital continues to exert significant influence. As a result, in order to meet the inherent requirements of modernization, traditional rural social capital must be transformed. The transformation can be started from the following three aspects: (1) increase the benign traditional social capital, (2) restrain the influence of bad traditional social capital, and (3) transform the bad traditional social capital. A market economy is a legal economy. Under the condition of a socialist market economy, protecting and improving the rural ecological environment and improving the rural ecological environment’s quality must rely on the environmental legal system. The evaluation model of rural ecological environment governance quality constructed in this paper is shown in Figure 1.

On the one hand, it is necessary to constantly look for relevant methods adapted to national conditions according to specific conditions in the process of harnessing the rural ecological environment; on the other hand, we must extensively learn from good management experience and combine it to study, discover, and transform it to make it suitable for the management of the rural ecological environment. To improve rural environmental protection, we must refine and improve existing laws and regulations to reflect the various characteristics and situations of different regions; develop a more comprehensive environmental legal system and strengthen environmental pollution prevention and punishment. To strengthen rural environmental governance from the standpoint of ecological civilization, we must adhere to the green development concept, continuously promote agricultural greening, strengthen green technology research and development, promote agricultural model transformation, strengthen rural ecological civilization construction, and pay attention to ecological equity. Rural environmental protection and governance, on the contrary, cannot be separated from administrative management, so a comprehensive environmental protection and governance system must be established from the top down. Ascertain that the environmental protection system can become relatively independent of the administrative system of the government. The government-authorized environmental protection department has the authority to act independently within the scope of applicable rules and laws, and the superior environmental protection department has the authority and responsibility to supervise the lower environmental protection department directly.

There are many forces in the process of rural ecological environment governance, resulting in a multicenter governance structure. We will work together to create an ecological and beautiful environment through the combined efforts of these forces. Government forces, nongovernmental forces, and nongovernmental organizations make up the majority of these forces. The autonomy of grassroots organizations is emphasized in polycentric governance. In general, we must first improve the level of nongovernmental organizations in order to strengthen their construction. We should be able to clearly see our own benefits and drawbacks and gradually reduce our reliance on the government. Second, the government’s management of nongovernmental organizations should be improved. At present, to strengthen the legislation of rural environmental protection, we can start with the following three aspects: (1) amend the basic law of environmental protection in due course, (2) clearly stipulate the basic environmental rights of farmers and related concepts of the rural environment in the constitution, and (3) formulate and improve other laws, regulations, and rules related to the protection of the rural environment. In order to prevent and control the ecological environment in rural areas and realize sustainable development in rural areas, the government must change the role of traditional administrative intervention, make more use of economic means and incentive means, and make production and consumption develop in a way that is more conducive to environmental protection. As the leader of the government’s ecological civilization construction, farmers, as the main body of ecological civilization construction, must stand at the overall height and integrate ecological civilization into all aspects of rural infrastructure construction.
3.3. Construction of the Rural Ecological Environment Governance Quality Evaluation Model Based on Decision Tree.

The quality evaluation of ecological management refers to the evaluation of the quality of the ecological environment in a certain area by using appropriate methods according to the selected index system and quality standards. A decision tree is a tree structure. It is also named because it is shaped like a tree and can help users make decisions. Similar to the flowchart, each leaf node of the tree represents a category, the nonleaf node represents a test on an attribute, and each branch represents the output of a test result. In the decision tree, from the root point to the lowest leaf node, every nonleaf node in the middle corresponds to a noncategory attribute, and the branch of the decision tree represents the value of this attribute. The C5.0 algorithm in decision tree is an improved decision tree construction algorithm based on the C4.5 algorithm. The idea of constructing a decision tree is consistent with that of the C4.5 algorithm, but it has many improvements compared with the C4.5 algorithm. The whole method is to solve a large quadratic programming problem on all training samples at one time and classify them at the same time. The idea of this method is simple, but there are many variables used in the process of solving optimization problems, and the computational complexity is too high to be applicable. Decomposition mainly realizes multicategory classification by constructing multiple 2-category classifiers, including one-to-one classification, one-to-one classification, and decision tree classification. The simulation process of this paper is shown in Figure 2.

The evaluation parameters of rural natural environment governance are divided into gates to ensure the perfection of the analysis logic; that is, the logic gate analysis method of terms is designed to express the evaluation relationship among the factors of the rural natural environment and the discreteness of subsequent governance means. For nonlinear cases, nonlinear mapping can transform the original data into a high-dimensional feature space, where linear support vector machines can be designed and the inner product operation can be realized using the original space’s functions. In this paper, the information gain rate is used to select attributes instead of the information gain rate. From the divided attributes, the attributes with higher information gain than the average level are first identified, and then, the one with the highest gain rate is chosen. Pruning can finish the discretization of continuous attributes and process the default data during the tree-building process. The principle of maximizing sample similarity within classes while minimizing sample similarity between classes is used to cluster and group samples. At the same time, it demonstrates that a cluster of objects has formed. However, the objects in one cluster have a high degree of similarity but are very different from those in other clusters. Each cluster can be thought of as an object class, and rules can be derived by analyzing each cluster.

Assuming that the kernel function $K(x_i, y_i) = \{\Phi(x_i), \Phi(y_j)\}$ is used to map the original data to the high-dimensional feature space, then the kernel function of the feature space is

\[
\begin{align*}
\text{max} Q(a) &= \sum_{i=1}^{k} a_i - \frac{1}{2} \sum_{i=1}^{k} \sum_{j=1}^{k} a_i a_j y_i y_j K(x_i \times x_j), \\
st & \sum_{i=1}^{k} y_i a_i = 0, 0 \leq a_i \leq C, i = 1, 2, 3, \ldots, k.
\end{align*}
\]

The corresponding decision function is

\[f(x) = \text{sgn} \left[ \sum_{i=1}^{n} a_i^* y_i K(x_i \times x) + b^* \right].\]  

Different kernel functions can construct nonlinear decision surfaces of different types of input spaces. The reduced value of information entropy after division and when it is not divided can be regarded as the “purity improvement” brought about by the use of attribute $a_i$ to divide the amount of data, which is called information gain. The value of attribute $a_i$ is

\[\{a_{i1}, a_{i2}, a_{i3}, \ldots, a_{ij}\}.\]

All samples whose value is $a_{ij}$ on attribute $a_i$ are denoted as $D_{ij}$; then,

\[\text{Gain}(D, a_i) = \text{Ent}(D) - \sum_{j=1}^{k} \frac{D_{ij}}{D} \text{Ent}(D_{ij}).\]
The information gain rate is 

\[ \text{GainRatio}(D, a_i) = \frac{\text{Gain}(D, a_i)}{IV(a_i)} , \]

\[ IV(a_i) = \sum_{j=1}^{k} \frac{D_{ij}}{D} \log_2 \frac{D_{ij}}{D} , \]

where \( IV(a_i) \) becomes the inherent value of \( a_i \). The more possible values of the attribute \( a_i \), the larger the \( IV(a_i) \) and the smaller the gain rate.

The kernel parameters are also important to the model accuracy. The kernel is the mapping function of original nonlinear samples in high-dimensional feature space. In fact, the change of kernel parameters implicitly changes the mapping function, thus changing the complexity of the subspace distribution of the sample data that determines the maximum dimension, which also determines the minimum empirical error that the super-optimal classification surface can achieve. There is an inherent bias in the information gain metric, which favors the attributes with more values. For an extreme example, if one attribute is time, there will be a large number of values, and too many attribute values will divide the training sample into a very small space. It is possible to completely predict the target attribute of training data in a single time attribute, so this time attribute may have a very high information gain. The information gain value represents the sample set purity index. The C4.5 algorithm does not directly select the attribute with the highest gain rate to divide, but first finds out the attribute with higher information gain than the average level from the divided attributes and then selects the attribute with the highest gain rate.

In evaluating the comprehensive situation of the rural ecological environment, all environmental protection factors can be simply regarded as various parameter vectors; each parameter represents a logical factor, and all logical factors can jointly construct a logical body. In this paper, the biological abundance index, vegetation cover index, water network density index, land degradation index, and pollution load index are selected to construct a comprehensive evaluation index system of ecological environment quality.

Assuming that the \( i \) pollutant concentration \( C_i \) satisfies \( j \leq C_i \leq j + 1 \), its subindex is

\[ I_i = \frac{C_i - C_{i,j}}{C_{i,j+1} - C_{i,j}} \left(I_{i,j+1} - I_{i,j}\right) + I_{i,j}, i = 1, 2, 3, \ldots , \]

\[ n; j = 1, 2, 3, \ldots , m. \]

When the \( i \) contaminant concentration \( C_i \geq C_{i,m} \), select points \( C_{i,m-1}, I_{i,m-1} \) and \( C_{i,m}, I_{i,m} \) to determine a linear function. Its subindices are

\[ I_i = \frac{C_i - C_{i,m}}{C_{i,m+1} - C_{i,m}} \left(I_{i,m} - I_{i,m-1}\right) - I_{i,m}. \]

Given an instance, the probability that it belongs to class \( C_i \) is

\[ P(C_i) = \frac{|C_i|}{|S|} . \]

Then, the category information entropy of sample set \( S \) is

\[ \text{Info}(S) = - \sum_{i=1}^{n} P(C_i)^* \log_2 P(C_i) . \]
When applying the prediction function for classification, weighted voting is used to determine the category attribution of the predicted instance:

$$h_{fin}(x) = \arg \max_{y \in Y} \sum_{t} \log \frac{1}{\beta_t}$$

(10)

Among them,

$$\beta_t = \frac{\epsilon_t}{(1 - \epsilon_t)}$$

(11)

where $\epsilon_t$ is the fitting error rate of the weak classifier $t$ and $\log1/\beta_t$ is the weight of the weak classifier $t$ in the iteration, that is, the weight of each prediction function is determined by the weight of the corresponding decision tree.

During the training process, the algorithm may regard the attribute features of a single training sample or a small number of training samples as the attribute features of the whole data sample and use this feature as the reference standard for data set classification. We call it “overfitting.” Pruning, as its name implies, is to cut off unreliable branches. Usually, statistical measurement is used for pruning. Pruning is used to solve the problem of “overfitting” in the process of model training. After pruning, the efficiency of decision tree classification is improved, and the reliability of the correct classification of decision tree is also improved. The data sets are effectively sorted based on attribute values, and then the data sets are dynamically divided by different thresholds. If the output changes, then a closed value is determined. The midpoint of the two actual values is usually considered a closed value. Then, divide the samples into subsets, with each subset containing all of the samples. Gains and gain ratios are calculated after all possible closed values have been found. Each attribute will have two values: less than or equal to the closed value and greater than or equal to the closed value. More branches and more detailed classification in the data set process cannot represent the high quality of the decision tree model, which may lead to some self-characteristics of the training data set being applied to all data, resulting in deviation in actual prediction. Traditional rural ecological environment governance methods are ineffective due to the high dispersion of characteristic vectors across all rural natural environments, which leads to a lack of overall hierarchy and logical structure compactness. This paper introduces the static tower logic analysis structure with the static eigenvector as the core to avoid this problem. The training sample set is created using the C5.0 algorithm and the sample point data and segmentation vector are collected. Then, based on the training sample set, a rule set is created, and decision tree classification is performed using the decision tree rule set.

4. Result Analysis and Discussion

In this paper, Weka, an open-source platform, is used as the experimental environment, and the specific data of rural environmental governance quality are used for many experiments. In this section, combined with the five-level standard of eco-environmental quality evaluation, the interval interpolation method is adopted to interpolate 30 sample sets, respectively, and a total of 180 training sample sets and 180 verification data sets are generated by similar methods. Finally, the training sample set and the verification sample set are normalized. Through the analysis of a large number of data sets, a new air quality classification rule is described in the form of a binary tree. When faced with new data, the classification results can be obtained according to the decision tree model. Figure 3 is a comparison diagram of the modeling time of different algorithms.

The modeling time reflects the efficiency of the algorithm, and the shorter the modeling time, the higher the efficiency of the algorithm. As can be seen from Figure 3, the modeling time of this algorithm is obviously lower than that of the other two algorithms, which shows that the efficiency of this algorithm is high. The grading standards of the selected evaluation indexes are shown in Table 1.

The dispersion of natural environmental governance elements is an important index to quantify the pertinence and effectiveness of natural environmental governance measures. The lower the dispersion, the higher the pertinence and effectiveness of measures. The dispersion degree of different rural ecological environment governance strategies is compared, and the results are shown in Figure 4.

From the data in Figure 4, it can be seen that the dispersion of the governance measures adopted in this paper is obviously lower than that of other methods. In this paper, the model has been significantly improved in data processing, processing speed, and prediction accuracy. A tenfold cross-validation method is used to verify the accuracy and recall of this algorithm. The method is described as follows: divide the data set into ten equal parts, then take nine of them as training data and the other as test data in turn, and test the accuracy and recall of each classification. Finally, take the average of these ten results as the classification accuracy and recall results of this algorithm. The recall rate of the algorithm is shown in Figure 5. The classification accuracy of the algorithm is shown in Figure 5.

It can be seen from Figure 6 that the classification accuracy and recall rate of the decision tree algorithm in this
paper are the highest. The quality evaluation method in this paper can achieve 96.82% classification accuracy, and the highest recall rate can reach 96.63%. In this paper, the training sample set is iteratively trained and the training results are verified by the verification sample set. The results are shown in Table 2.

It can be seen that the evaluation result of this method is stricter, which can accurately reflect the situation of each index and reflect the current situation of rural ecological environment governance quality. In this paper, the model analyzes the historical data with definite results, looks for the features in the data, and forecasts the new data results based on these. The prediction results of the ecological environment quality of different models are shown in Figure 7.

### Table 1: Benchmark table of rural ecological environment management quality evaluation.

| Evaluating indicator         | Excellent | Good  | Common | Poor  | Very poor |
|------------------------------|-----------|-------|--------|-------|-----------|
| Vegetation index             | 90~100    | 75~90 | 45~75  | 25~45 | 0~25      |
| Water network density index  | 90~100    | 75~90 | 45~75  | 25~45 | 0~25      |
| Biological abundance index   | 90~100    | 75~90 | 45~75  | 25~45 | 0~25      |
| Land degradation index       | 0~10      | 10~25 | 25~55  | 55~75 | 75~100    |
| Pollution index              | 0~10      | 10~25 | 25~55  | 55~75 | 75~100    |

![Figure 4: Comparison of dispersion.](image)

![Figure 5: The recall result of the algorithm.](image)

![Figure 6: Classification accuracy results of the algorithm.](image)

![Figure 7: Prediction results of ecological environment quality of different models.](image)

### Table 2: Training results of rural ecological environment management quality evaluation model.

| Classifier | Penalty factor | Kernel parameter | Training accuracy | Test accuracy |
|------------|----------------|------------------|-------------------|--------------|
| 1          | 13.25          | 0.216            | 100               | 99.65        |
| 2          | 16.91          | 0.237            | 100               | 99.78        |
| 3          | 18.46          | 0.258            | 100               | 99.97        |
| 4          | 20.78          | 0.269            | 100               | 99.97        |
| 5          | 21.89          | 0.274            | 100               | 99.32        |
| 6          | 23.97          | 0.288            | 100               | 99.89        |
The value of information gain is reduced by the intrinsic information of the attribute in this paper, so the attribute with the largest information gain rate is chosen as the split attribute, avoiding the problem of attribute bias in some cases. The algorithm has a fast convergence speed and high precision, which compensates for the subjectivity of the traditional method, which makes it easy to overlook or overemphasize the role of major pollution indicators in assessing the quality of the ecological environment. Furthermore, the model can evaluate the quality of the ecological environment in various regions, bringing the prediction result closer to reality.

5. Conclusions

People are paying increasing attention to their living environment as their quality of life improves. Rural environmental protection, on the contrary, is critical for the country’s economic and social development. People’s long neglect of rural areas has exacerbated rural ecological environment problems, resulting in numerous accidents and crises that have harmed the country’s and rural areas’ long-term development. We can only find effective solutions to China’s rural environmental problems by fully confronting the current situation, analyzing the causes and fundamental factors that contributed to their deterioration, and promoting the development of new rural construction in a more civilized and healthy direction. This paper analyzes and explores the countermeasures and ideas of rural ecological environment governance in light of related work, based on the basic theory of polycentric governance, and the actual situation of pollution and governance in the current rural ecological environment construction. Simultaneously, this paper proposes an assessment method based on the discussion of common air quality assessment methods. Simultaneously, the decision tree algorithm is used to evaluate the six pollution parameters that currently have the greatest impact on air quality, yielding a precise evaluation model with clear classification rules. Several experiments were carried out in this paper in order to verify all aspects of the model’s performance. The results show that this paper’s quality evaluation method has a classification accuracy of 96.82 percent and a recall rate of 96.63 percent. The effectiveness and practicability of the rural ecological environment governance quality evaluation method proposed in this paper are further confirmed by this experimental result, indicating that the method is feasible. However, given my limited time and knowledge, there are still many issues to be resolved in the algorithm research process, allowing the research to be improved further. This paper will then investigate a more efficient method of discretizing continuous attributes and select a classification algorithm that is better suited for large data sets.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This work was supported by the Youth Foundation of Social Science and Humanity, China Ministry of Education, “Research on Action Logic and Mechanism Innovation of Rural Ecological Cooperative Governance under Rural Revitalization Strategy” (no. 20YJC810016), and the Foundation of Jiangsu Social Science, “Research on Farmers Collective Action and Rural Ecological Cooperative Governance based on Interest Game” (no. 18ZZB006).

References

[1] L. Y. Sun, C. L. Miao, and L. Yang, “Ecological environmental early-warning model for strategic emerging industries in China based on logistic regression,” Ecological Indicators, vol. 84, no. 1, pp. 748–752, 2018.
[2] J. A. Ray, M. U. Taner, K. E. Schlef et al., “Growth of the decision tree: advances in bottom-up climate change risk management,” JAWRA Journal of the American Water Resources Association, vol. 55, no. 4, pp. 920–937, 2019.
[3] J. Burger, M. Göchfeld, A. Bunn et al., “A methodology to evaluate ecological resources and risk using two case studies at the department of energy’s hanford site,” Environmental Management, vol. 59, no. 3, pp. 357–372, 2017.
[4] Y. Zhang, W. Song, S. Fu, and D. Yang, “Decoupling of land use intensity and ecological environment in gansu province, China,” Sustainability, vol. 12, no. 7, p. 2779, 2020.
[5] S. Lu, Y. Liu, and M. Sundhararajan, “Evaluation system for the sustainable development of urban transportation and ecological environment based on SVM,” Journal of Intelligent and Fuzzy Systems, vol. 34, no. 2, pp. 831–838, 2018.
[6] Z. G. Wei, X. F. Cheng, and J. H. Liu, “A finite element model of roll-over protective structures for wheel loader frame,” in Applied Mechanics and Materials, vol. 138, pp. 737–742, Trans Tech Publications Ltd, 2012.
[7] Y. Quanyong and W. ZhanGuo, “Improved Niche PSO to the reverse logistics network design model,” in ISECS International Colloquium on Computing, Communication, Control, and Management, vol. 2, pp. 513–516, IEEE, 2009.
[8] B. B. Cruz, L. E. Miranda, and M. Cetra, “Links between riparian landcover, instream environment and fish assemblages in headwater streams of south-eastern Brazil,” Ecology of Freshwater Fish, vol. 22, no. 4, pp. 607–616, 2013.
[9] P. Peters, A. Gold, A. Abbott, D. Contreras, A. Keim, and R. Oscarson, “A quasi-experimental study to mobilize rural low-income communities to assess and improve the ecological environment to prevent childhood obesity,” BMC Public Health, vol. 16, no. 1, pp. 1–7, 2016.
[10] J. Chen, Y. Zhang, L. Wu, T. You, and X. Ning, “An adaptive clustering-based algorithm for automatic path planning of heterogeneous UAVs,” IEEE Transactions on Intelligent Transportation Systems, pp. 1–12, 2021.
[11] X. Chen and X. Xin, “The core of China’s rural revitalization: exerting the functions of rural area,” China Agricultural Economic Review, vol. 12, no. 1, pp. 1–13, 2019.
[12] R. Oguchi and H. Esaki, “B-7-3 A study about optimizing the delivering order of explicit multicast,” Ecological Modelling, vol. 222, no. 222, pp. 3082–3091, 2011.
[13] J. Bone, M. Head, D. T. Jones et al., "From chemical risk assessment to environmental quality management: the challenge for soil protection,” *Environmental Science and Technology*, vol. 45, no. 1, pp. 104–110, 2011.

[14] E. J. Rosi-Marshall, D. Snow, S. L. Bartelt-Hunt, A. Pasalof, and J. Tank, “A review of ecological effects and environmental fate of illicit drugs in aquatic ecosystems,” *Journal of Hazardous Materials*, vol. 282, no. 123, pp. 18–25, 2015.

[15] R. J. Holdaway, S. J. Mcneill, N. W. H. Mason, and F. E. Carswell, “Propagating uncertainty in plot-based estimates of forest carbon stock and carbon stock change,” *Ecosystems*, vol. 17, no. 4, pp. 627–640, 2014.

[16] P. Parvathi and T. T. Nguyen, “Is environmental income reporting evasive in household surveys? Evidence from rural poor in Laos,” *Ecological Economics*, vol. 143, no. 1, pp. 218–226, 2018.

[17] R. Guo and X. He, “Spatial variations and ecological risk assessment of heavy metals in surface sediments on the upper reaches of Hun River, Northeast China,” *Environmental Earth Sciences*, vol. 70, no. 3, pp. 1083–1090, 2013.

[18] Y. Yang, L. Wang, F. Yang, N. Hu, and L. Liang, “Evaluation of the coordination between eco-environment and socio-economy under the "Ecological County Strategy" in western China: a case study of Meixian,” *Ecological Indicators*, vol. 125, no. 2, Article ID 107585, 2021.

[19] S. Chen, B. Chen, and B. D. Fath, “Assessing the cumulative environmental impact of hydropower construction on river systems based on energy network model,” *Renewable and Sustainable Energy Reviews*, vol. 42, pp. 78–92, 2015.

[20] A. Schmolke, P. Thorbek, D. L. Deangelis, and V. Grimm, “Ecological models supporting environmental decision making: a strategy for the future,” *Trends in Ecology & Evolution*, vol. 25, no. 8, pp. 479–486, 2010.

[21] E. Pante, C. Schoelinck, and N. Puillandre, “From integrative taxonomy to species description: one step beyond,” *Systematic Biology*, vol. 64, no. 1, pp. 152–160, 2014.

[22] J. Park, D. Ki, K. Kim, S. J. Lee, D. H. Kim, and K. J Oh, “Using decision tree to develop a soil ecological quality assessment system for planning sustainable construction,” *Expert Systems with Applications*, vol. 38, no. 5, pp. 5463–5470, 2011.