Research on Site Selection of Ecological Buildings Based on GIS Technology

Yongbiao Jin¹, Hechun Quan², *

¹ Yanbian University Hospital, Jilin, China
² Department of Civil Engineering, College of Engineering, Yanbian University, Jilin, China

*Corresponding author e-mail: hcquan@ybu.edu.cn

Abstract. The design and construction of buildings have a great negative impact on the natural environment. For the sustainable development of human society, the use of ecological architecture design occupies a very important position in the concept of architectural design at this stage. Because ecological buildings can protect the environment, save energy, and develop in harmony with nature. However, due to various problems in site selection and design of ecological buildings, there are relatively few examples of using ecological buildings in real life. In this paper, an effective method of ecological building site selection based on GIS (Geographic Information System) and BP neural network technology is proposed, which effectively solves various problems in the process of ecological building site selection.

1. Introduction

In the traditional construction process, people do not pay enough attention to the protection of the surrounding environment, resulting in a large number of ecological environment damage, directly affecting people's living and living environment. Eco-architecture is the product of the times, and it comes into being to meet the needs of the development of the times. Through the design and use of ecological buildings, we can solve the adverse effects on the natural environment caused by many building construction processes, and bring people a healthy and comfortable living environment. The characteristics of ecological buildings are mainly embodied in health, energy saving, pollution control and recycling. Therefore, eco-building is a kind of building with low energy consumption, can reduce the environmental burden and protect the environment. It can make rational use of resources and energy, and is also a safe, comfortable, healthy and environmental protection building [1]. Therefore, the location of ecological buildings occupies a very important position in the design process of ecological buildings.

In order to effectively analyze the site selection of ecological buildings, this study uses the combination of GIS and BP neural network technology. GIS integrates many disciplines, including geography, cartography and so on. The system, together with global positioning system and remote sensing system, called 3S system, has been widely used in different fields. Modern engineering construction has high requirements in function and accuracy. GIS has powerful regional map and database management functions and three-dimensional scene simulation functions, which can be widely used in site selection, approval, construction planning, engineering survey, construction management,
engineering information management, etc. [2]. In this study, by effectively utilizing the powerful spatial analysis function of GIS and BP neural network technology, the site selection of ecological buildings is studied, and the feasibility of this method is proved.

2. Influencing factors analysis of ecological building site selection

According to the characteristics of local ecological environment, eco-architecture needs to comprehensively apply the basic principles of building technology science, ecology and modern architectural technology, reasonably adjust the relationship between architecture and ecological environment, promote the integration of architecture and ecological environment, and form an organic whole, so that the building has better indoor climate conditions, and at the same time has the function of Bio-Climate regulation. It can satisfy people's more ecological and comfortable living environment, and let residents, buildings and ecological environment coexist in harmony [3]. Therefore, in the design of ecological architecture, it is very important to choose a reasonable site according to the function of the building, the characteristics of the ecological environment and the regionality.

The natural environment and social environment should be taken into account when selecting ecological building sites based on GIS. Mainly include: topography and geology, climate conditions, biodiversity, land use, hydrological conditions and hydrogeology, existing buildings and facilities, existing social and economic conditions, existing greening and environmental protection. Using the functions of spatial analysis, buffer and paper folding of GIS can effectively deal with the problems caused by multiple factors in the site selection of ecological buildings.

In this study, Yanbian Prefecture is taken as the research object. According to the topographic and geomorphological characteristics of the study area, the factors such as elevation, slope, aspect, river, road, soil, land use and so on are selected to analyze the location of ecological buildings.

3. Weight analysis of location factor of eco-building based on BP neural network technology

Neural network model is proposed on the basis of neuroscience research. Artificial neural network imitates the form of human brain activity, and the most popular application is error back propagation training algorithm, namely artificial neural network (BP neural network for short) [4]. BP neural network is a three-layer feedforward hierarchical network composed of input layer, hidden layer and output layer. Each neuron in the adjacent layer is fully connected, but there is no connection between each neuron in each layer. The prediction model studied in this paper uses 7 input layers, 14 hidden layers and 1 output layer as BP neural network structure. The parameters are set as table 1.

| Setting factors                        | Values |
|----------------------------------------|--------|
| Input layer                            | 7      |
| Hidden layer                           | 14     |
| Output layer                           | 1      |
| The number of weights between input and hidden layer | 98     |
| The number of weights between hidden and output layer | 14     |
| Learning cycles                        | 2000   |

The sinusoidal S-type transfer function is used as the transfer function between neurons in each layer. In this study, the BP learning rule with momentum term is used as its learning function, and the combination algorithm of gradient descent method and quasi-Newton method is used as its training function. The learning period is 2000, and the mean square error is 0.001.
Seven input layers are elevation, slope, aspect, soil, land use, roads and rivers. The process of determining the weight of factors by BP neural network is shown in Figure 1, and the weights of each factor are obtained as shown in Figure 2.

Figure 1. The flowchart of the neural network training for weight determination.

Figure 2. Weight Percentage of Site Selection Factors.

4. Analysis of site selection of ecological buildings based on gis technology
In order to effectively carry out the site selection analysis of ecological buildings, this study will use the weight of factors calculated by BP neural network technology, use the overlay analysis function of raster data of GIS, according to the weight size, overlay the seven factor layers, and draw the level map of the site selection of ecological buildings, as shown in Figure 3.

The grade map of ecological building site selection is divided into five grades. The most reasonable area belongs to the extremely high (red) part of the map, and the most unreasonable area is the low (gray) part.

Figure 3. Grade map of site selection of ecological buildings.
5. Conclusion

In order to effectively analyze suitable sites for ecological building construction, the weight of ecological building site selection factor is calculated by BP neural network, and each factor is superimposed according to the weight by using GIS function, and the grade map of ecological building site selection is drawn. Through this study, the following conclusions are drawn:

(1) In order to analyze the site selection of ecological buildings, seven factors related to the site selection of ecological buildings are adopted in this study. Through comparison, three factors, aspect, road and land use have a greater impact on the site selection than other factors.

(2) Using the re-classification value and relative weight value of each factor to overlay the raster data and draw the grade map of ecological building location, which meets the accuracy requirements, and proves the validity and feasibility of this method.

References

[1] Du hui, The development trend of green ecological architecture in china under the concept of building environmental protection, Drama House, 2018(1), pp. 177-178.

[2] Ma chong, management and application of gis in architecture, geomatics & spatial information technology,2017,40(1): pp. 119-120.

[3] Jing xing, Analysis of architectural design strategies based on green eco-building evaluation criteria, China Standardization, 2018, 514(1): pp. 71-73.

[4] Tian xiang, Wang zuohui. Prediction of mechanical properties of recycled concrete based on artificial neural network. Anhui Architecture, 2013,20(3) :pp. 210-211.