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Assessment of Spatial multi-criteria decision-making with process of the artificial neural networks Method to Site Selection of the Wastewater Treatment Plant (Case study: Qeshm Island)

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Abstract

Wastewater treatment technology in the cyclic nature of the process that takes a long time. But man tries to rush to their needs with experience and understanding of the natural processes of interaction, and using technology to build their Industrial development is authorized. Sewage treatment reed have been born from the vision of man's increasing need to water daily decreases the natural resources provide. Location of the place is one of the main uses of GIS and GIS Nowadays many ignorant people are familiar with the location. But what is remembered today as the location of the equivalent site selection, the order of analysis that will lead to the best place or places to be for a specific user. Therefore, using multiple and very diverse, the various layers of spatial data according to the criteria considered, together are usually the places where the best places are introduced, and the resulting method. This study is the first layer and standards were prepared from different sources of information, then based on the opinions of experts using analytic hierarchy process weight classes, each benchmark was performed. For network training algorithm of back-propagation and a sigmoidal activation function was used, the results indicate that it is a very high correlation coefficient of the neural network was able to identify suitable areas. Finally, about 104 km Qeshm Island area were suitable for the construction of wastewater treatment plant that requires ground visits is the expert.

Key words: Wastewater treatment, Site selection, ANN, Qeshm Island, GIS

Introduction

Environmental complex set of factors that influence the process and evolution of organisms and components of the earth's surface is formed. When you talk about a sewage treatment plant comes to the first thing that comes to mind is the issue of the environment and keep it from getting infected because the wastewater as a parameter of the main pollutants in natural and human environment. One of the major issues raised with the scarcity and water demand in the city, the problem of how to dispose of sewage.

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The first step for the construction of wastewater treatment is to identify suitable locations. In this study, Qeshm, Hormozgan Province is one of the Cities for construction of wastewater treatment was studied in Qeshm, also noted that the main objective of this research Determine suitable locations for the construction of wastewater treatment according to existing conditions in the study area is. Artificial neural network for the first time by McCulloch and Pete were introduced in 1943 (ASCE, 2000). Dawson and colleagues in 2006, the benefits of this model using a wide variety of fields, such as having the characteristics of the distributed information processing, the relationship between the ability to detect input variables Output without considering the physical phenomena and the good performance of the model, even though the measurement error is expressed (Dawson et all, 2006).Performance of ANN fact of how neurons in the human nervous inspired. In neurons, authentication information are received by the dendrites and cell body (including nuclear and other protected areas) are to stimulate the cells, Provide energy to the cell body of the neuron activity and act on the input signal. The body of a simple act of collecting and comparing the result with a threshold model and are operated by Exxon is transferred to the next cell. A neural network is an almost functional. Neural Net's model of the processes that define a detailed and specific understanding of them, they are very effective. Another feature of these models make them distinguishable than other methods and algorithms are less sensitive to the presence of input errors.

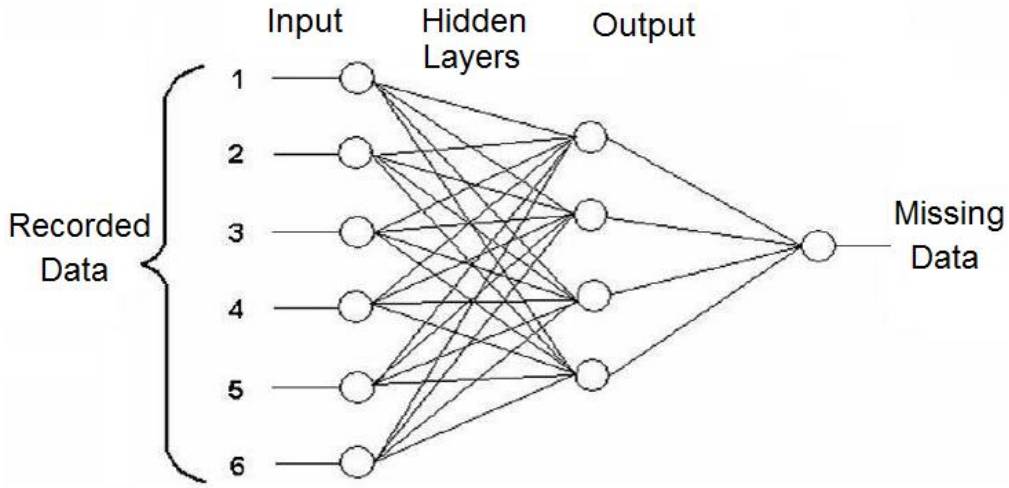

Figure 1 - Example of neural network architecture

Analytic hierarchy process (Ahp) is one of the most widely used multi-criteria decision approach for complex situations with multiple and conflicting criteria are as strong and appropriate decision-making poses. This method is based on analysis of the human mind for complex problems is presented based on paired comparisons or two criteria are founded. In 2009 the plant site optimization, multivariate analysis, and the gis Mahaweli Sri Lanka has been done in this study after providing Ratnaprya and Desilva layers of overlapping Pollen have used in hair analysis (Ratnaprya & Desilva, 2009). on 2009 Zhao et all evaluated biological analysis by hierarchal method for specification of proper indices for wastewater treatment placement and its outpour (Zaho et all, 2009). Also in same year Guiqin et al studied sequence of choosing landfill in Beijing, for municipal wastes with a hierarchal method considering economic

factors and weight of variables. Sener et al performed placement of landfill by combining GIS and multi criteria method on 2010 in Turkey and Kenya (Guiqin et all, 2009). Sener divided variables to environmental and economical categories and provided data layers based on these categories and specified proper places by fuzzy-hierarchal method (Sener et all, 2010). Exponential fit Ekmekcioglu et al 2010 municipal solid wastes landfill after multicriteria fuzzy decision-making method by wigs have done (Ekmekcioglu et all, 2010). The main aim of this study is to determine best places to build Wastewater Treatment due to existing circumstances in the area. The first stem to construct a wastewater treatment is to define the possible proper locations. The economic condition of Qeshm island specially Qeshm city has been considered in this study, which is closely related to domestic and foreign tourism. Increase of water waste, topographic and land limitation like land shortage to allocate to wastewater treatment, high level of underground water, population increase, floating population increase due to tourism, necessitate performing economic and appropriate plan for wastewater treatment station and correct placement of these stations. Additionally shortage of raining and water resources makes the importance of the issue more vivid.

Materials and Methods

Study area at coordinates 26 degrees 32 minutes north latitude and 55 degrees to 27 degrees, 6 minutes, 15 minutes and 56 degrees 30 minutes east is located. Criteria and factors that are considered in this study are based on research studies of various researchers and the island's water and wastewater specialists, including maps and layers of the, the slope of height relative to the, Vegetation, land use, transportation, distance from Qeshm city limits k layer contains a - Privacy river, b - c environmentally protected areas - parts of the population - Privacy is relay. Layers used in this study regarding the environmental impact of Site selection the Software Arc gis10, and Ahp combine methods and areas were identified based on the separation. According to estimates, about 1048 square kilometers and impose restrictions layers Island unusable for the construction and use of about 421 km ² to be refinery. The method of neural network is that the whole data into two groups: training data and test data are divided. Educational model should be possible to cover the entire data space to improve the network generalization capabilities and speed of the network to generalize to every input, the output the corresponding system. Education in artificial neural networks to calculate the weight of different connections for optimal output (Fattahi et all, 2007).. In order to evaluate the results of such statistics is used ‹MAE, r2 and RMSE that is calculated from the relationship.

The first equation is used to calculate the coefficient of determination :

In which the slope of the regression line, the amount estimated street value expresses the observations and modeling

$$R^2 = \frac{b^2\Sigma(V-\bar{X})^2}{\Sigma(V-\bar{X})^2}$$

The value is zero for a perfect model. B value of equation (2) is obtained:

$$b = \frac{\Sigma(V-\bar{V})(X-\bar{X})}{\Sigma(X-\bar{X})}$$

Equation 3 and Equation 4 to calculate the mean absolute error, root mean

$$MAE = \frac{1}{n}\sum_{i=1}^{n}\left|Q_i - \hat{Q}_i\right|$$

Square errors are used. Equations forward Qi The value is observed and predicted values in which the data is QI that I=1,…N number N. Qi average of observed data and Qi modeled values are average $RMSE = \sqrt{\frac{\sum_{i=1}^{n}\left(Q_i - \hat{Q}_i\right)^2}{n}}$

Hierarchy process as a raster map of 40 × 40 meters with income. Map of 119 261 pixels to fit in as many areas were identified as inappropriate. Half of the data was used for training in MATLAB to fit the rest in training data are analyzed the statistics of the observed data and the calculated rate through to find the neural network. In this model, neural networks, feed forward neural network with back propagation learning algorithm is also The sigmoid function is active. To avoid the problems created by poor processing or processing, back-propagation algorithm was used as a criterion to stop training. Figure 2 shows the final map areas suitable and unsuitable.

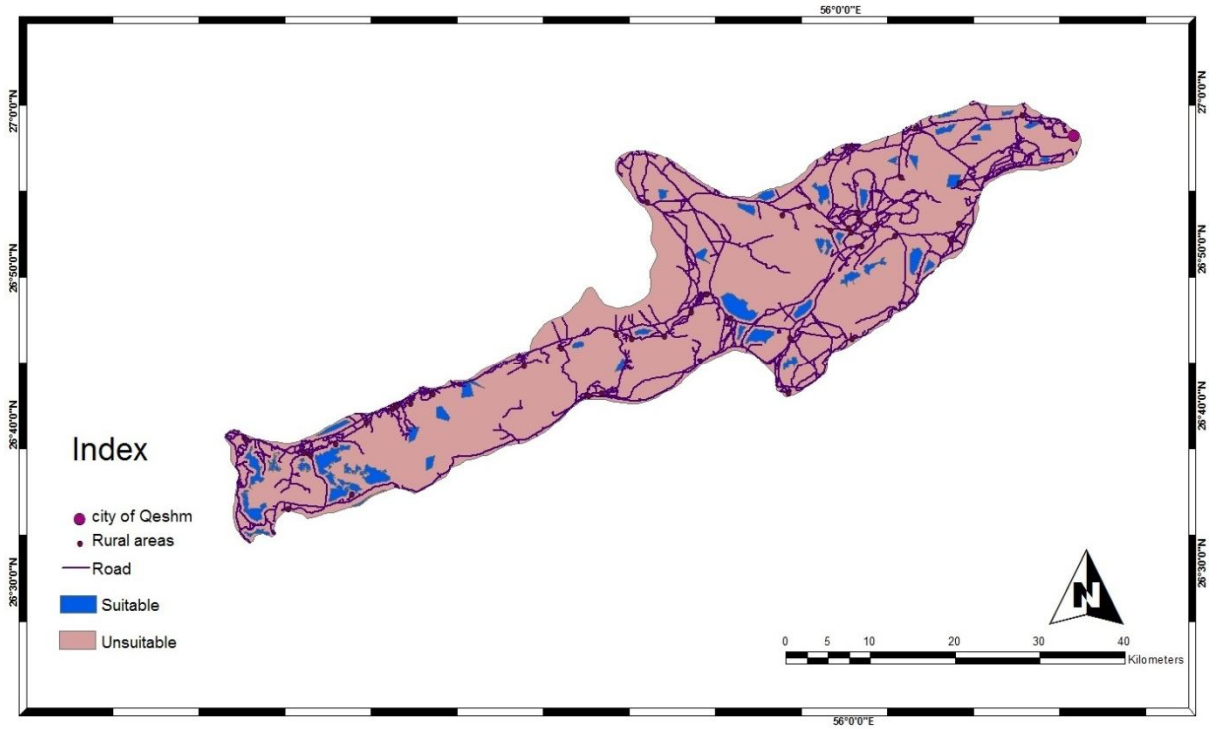

Figure 2 - areas suitable and unsuitable for the construction of wastewater treatment Qeshm

3- Results and Discussion

In the present study we evaluated the multi-criteria decision-making process is a method of artificial neural network. It was attempted to be used to identify areas ahp and artificial networks are comparable. The data classification method is appropriate and inappropriate ahp areas were identified. Also, about half of the data that were used for network training. The rest of the data were predicted r2 values obtained (0/99), suggesting high accuracy in the detection of the model is appropriate and inappropriate. Can be

said about the pixels used in the network due to the high number of training data, half of the data for training, and the mean absolute error and mean square error obtained indicate neural network was able to identify suitable locations and unfit as well. It can be Ahp combine the neural network and to identify suitable locations for the construction of wastewater treatment with low-information can be used in Qeshm.

The placement of the wastewater treatment stations in Qeshm is performed by hierarchy analysis method and the results are presented in final image. Results of decision making are related to the problem (criteria, choices and limitations) and rate of errors in data and uncertainty. This method allows us to have more flexible combination of desired maps and on the other hand linear nature, the performance of the plan would not take long time. Signs of the map can be positive combination or real numbers and there is no limitation on domain of numbers. Considering decision making on place of stations, accurate evaluation of methods and choosing the most appropriate location for project is one of the most important problems of decision makers. In this study proper criteria for construction of wastewater treatment station, is specified by consulting domestic and foreign researchers and also experts of Qeshm organization of water and wastewater and by considering existing data. After weighing by AHP method theses criteria applied to compilation of layers. Assessment of the results by neural network method, shows that they are valid and close to realty. It should be mentioned that presented area as optimal places could not be completely inclusive. Therefore they are introduced just for further detailed studies. In Qeshm due to significant problems like water shortage construction of wastewater treatment station and of course finding proper location of station as first step is huge step to preserve environment and helping tourism industry and sustainable development in Qeshm island.

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