Evaluating the Potential of Urban Development Areas using Artificial Neural Network (Case Study: Kermanshah City)

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Extended abstract

Introduction

Some of the important phenomena occurred in recent centuries in the social and economic life of different countries of the world are the emergence of numerous new cities, development of ancient cities, advances in urbanization and urban development. Urban development and changes in land use patterns lead to widespread social and environmental impacts including reduction in natural spaces, increases in vehicle accumulation, reduction in agricultural fertile lands with high production potential and degradation of water quality. Urban development in any country is not coincident with other aspects and, on the other hand, controlling future development requires careful planning. Understanding the right patterns of urban growth is needed to manage sustainable urban growth and planning for urban development. The high rates of urban population growth in Iran and the lack of urban infrastructure in one hand and the increasing trend of land use change, followed by the loss of valuable ecological landuses in urban and peri-urban areas andindustrial pollution provide the necessity of modeling for urban development.

Methodology

The data used in this research can be generally divided into two main categories: the data used to extract land uses in the study area, e.g., satellite imagery, and the data considered as effective factors on urban expansion and land use change. Identifying the variables affecting the creation of the main prerequisites for the development of land use models, we try to use independent groups of variables including socioeconomic, biophysical and land use in this study. Since there are several decision-making rules for exploiting these variables, in this study, the distance between these variables was considered as an indicator. To work with the artificial neural network, the effective parameters in urban development should be given as input to the network (INPUT), and then a number of educational points are provided to the network for using these points (TARGET) to measure the impact of each. It determines the input layers, in fact, the

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network has learned the necessary training to deal with new areas. After determining the number of hidden layers in the network structure, the entire study area is provided to train the network for zonnation of the potential areas of urban development. MLP network with 16 input layers (effective factors in urban development), 12 intermediate layers (test and error method), a neuron in the output layer as an outline map (final map of urban development potential), and the Leuvenberg Marquard training algorithm was executed and, thus, the network was trained with new samples.

Results and discussion

The network stopped after 44 repetitions and got the necessary training. In repetition 38, the optimal possible condition has the highest correlation and the least error. Given the 0.93 second factor, it can be ensured that network over-network learning is well prevented. Finally, the total regression coefficient of the network is resulted from the company total data network (95%). Then, the entire study area was evaluated by the network and the network based on the weight of the criteria received the training. The output from this stage was a valuable layer between zero and one.

Conclusion

It can be clearly seen that with the evolution of urban facilities and potentials, the vast majority of regions with urban development potential are located at the closest distance between these facilities and urban areas, especially the main roads of the city. The areas displayed in blue have the greatest potential for urban development. The most potential areas of urban development are located in the southwest of Kermanshah and around the main roads of Kermanshah-Islamabad and Kermanshah-Kangavar. The northern areas of the city have a low development potential due to their height and slope. The results of the study could be used to identify the areas for urban development to prevent development of irregular towns that have severe impacts on urban ecosystems and the lives of urban residents, as well as the loss of city capital. The future planning of the city of Kermanshah is relying on sustainable development with the least damage and inconsistencies in the agenda of urban managers and planners.

Keywords: urban development potential, neural network, classification, MLP.

References

1. Abidin, S. Z., Jamaluddin, M. F., & Abiden, M. Z. (2010). Introducing an intelligent computerized tool to detect and predict urban growth pattern. *WSEAS Trans. Comput,9*(6),604-613.
2. Aronov, Stan (1391), Remote Sensing for GIS Managers, Translation: Ali Asghar Darvish Sefat, Mahtab Pirbabakher, Manijeh Rajabpour Rahmati. Tehran: Tehran University Press.
3. Atkinson, P. M., & Tatnall, A. R. L. (1997). Introduction neural networks in remote sensing. *International Journal of remote sensing*, *18*(4), 699-709.
4. Batty, M. (2007). *Cities and complexity: understanding cities with cellular automata, agent-based models, and fractals*. The MIT Press.
5. Bactrian Newspaper: Creates a wounded marginal belt on the Kermanshah, written on October 20, 1396.
6. Bella, K. P., & Irwin, E. G. (2002). Spatially explicit micro-level modeling of land use change at the rural-urban interface. *Agricultural Economics*, *27*(3), 217-232.
7. Dewan, A. M., & Yamaguchi, Y. (2009). Land use and land cover change in Greater Dhaka, Bangladesh: Using remote sensing to promote sustainable urbanization. *Applied Geography*, *29*(3), 390-401.

8. Del Frate, F., Schiavon, G., & Solimini, C. (2005, March). Change detection in urban areas with QuickBird imagery and neural networks algorithms. In *III ISPRS International Symposium Remote Sensing and Data Fusion Over Urban Areas (URBAN'05)* (pp. 14-16).

9. Galdavi, S., Mohammadzadeh, M., Salmanmahiny, A., & Nejad, A. N. (2013). Urban Change Detection Using Multi-temporal Remotely Sensed Imagery (Case Study: Gorgan Area, Northern Iran). *Environment and Urbanization Asia*, *4*(2), 339-348.

10. Guan, D., Li, H., Inohae, T., Su, W., Nagaie, T., & Hokao, K. (2011). Modeling urban land use change by the integration of cellular automaton and Markov model. *Ecological Modelling*, *222*(20), 3761-3772.

11. Gomez, H., Kavzoglu, T. and Mather, P. 2002. Artificial neural network application in landslide hazard zonation in the Venezuelan Andes. *Abstracts of 15th International Conference on Geomorphology*, Tokyo, Japan, 23-28.

12. Huang, H.G., Hwang, R.C. and Hsieh, J.G. (2002). A new artificial intelligent peak power load forecaster based on non-fixed neural networks. *Electrical Power Energy Syst 24*, 245 250.

13. Jalili Ghazi Zade, M., and Noori, R. 2008. Prediction of Municipal Solid Waste Generation by Use of Artificial Neural Network: A Case Study of Mashhad. *Int. J. Environ.* Res 2 (1),13-22.

14. Javadi, y (1387). Modeling land cover changes using Cellular Automata in the environment. GIS Master's thesis, College of Engineering, Tehran University.

15. Junfeng, J. 2003. Transition Rule Elicitation for Urban Cellular Automata models Case Study: Wuhan-China, MSc. Thesis, *International Institute for Geo-Information Science and Earth Observation (ITC*). The Netherlands.

16. Kamyab, Hamid Reza; Salman Mahini, Abdolrasool; Hosseini, Seyyed Mohsen; Gholamali Fard, Mehdi. (1390). Application of Artificial Neural Network in Urban Development Modeling (Case Study: Gorgan City). Human Geography Research, 43 (2), 99-114.

17. Kamal Jain, P. (2011). A review study on urban planning and artificial intelligence. *International journal of soft computing and engineering (IJSCE)*. Volume, 1. No, 5. November. pp: 2231-2307.

18. Kiartzis, S.K., Bakirtzis, A.G. and Petridis, V. 1995. Short-term load forecasting using neural networks. *Electric Power Syst Res33*, 1 -6.

19. Lin, H., Lu, K. S., Espey, M., & Allen, J. (2005). Modeling Urban Sprawl and Land Use Change in a Coastal Area--A Neural Network Approach. In *2005 Annual meeting, July 24-27, Providence, RI* (No. 19364). American Agricultural Economics Association (New Name 2008: Agricultural and Applied Economics Association).

20. Lu, D., & Weng, Q. (2007). A survey of image classification methods and techniques for improving classification performance. *International Journal of Remote sensing*, *28*(5), 823-870.

21. Noori, R., Khakpour, A., Omidvar, B., and Farokhnia, A. (2010). Comparison of ANN and principal component analysis multivariate linear regression models for predicting the river flow based on developed discrepancy ratio statistic, *Expert Systems with Applications*37,5856-5862.

22. Noori, R., Karbassi, A., Mehdizadeh, H., Vasali-Naseh, M. and Sabahi, M.S. (2011). A Framework Development for Predicting the Longitudinal Dispersion Coefficient in Natural Streams using a Neural Network, *Environmental Progress and Sustainable Energy* 3, 439 447.

23. Pijanowski, B. C., Brown, D. G., Shellito, B. A., & Manik, G. A. (2002). Using neural networks and GIS to forecast land use changes: a land transformation model. *Computers, environment, and urban systems*, *26*(6), 553-575.

24. Pilaway, Sajjad; Parsi, Hamid Reza. (1393). Determining the optimal distribution of Kermanshah city using AHP and GIS. Urban and Regional Studies and Research (Stop Publishing), 6 (22), 127-142.

25. Pourahmad, Ahmed (2003), A survey on trend and urban development pattern in Sanandaj using GIS and RS, Tehran, Fine Arts magazine, No. 16.

26. Park, S., Jeon, S., Kim, S., & Choi, C. (2011). Prediction and comparison of urban growth by land suitability index mapping using GIS and RS in South Korea. *Landscape and urban planning*, 99(2), 104-114.

27. Pauchard, A., Aguayo, M., Peña, E., & Urrutia, R. (2006). Multiple effects of urbanization on the biodiversity of developing countries: the case of a fast-growing metropolitan area (Concepción, Chile). *Biological Conservation*, *127*(3), 272-281.

28. Rezaei Moghaddam, Mohammad Hossein, Rezaei Banafsheh, Majid; Feizizadeh, Bakhtiar and Nazarmar, Hossein. (2010), Classification of Land Coverage / Land Use Based on Objective Technique and Satellite Images, Case Study: West Azarbaijan Province, 19-32.

29. Subudhi, B. N., Bovolo, F., Ghosh, A., & Bruzzone, L. (2014). Spatial-contextual fuzzy clustering with Markov random field model for change detection in remotely sensed images. *Optics & Laser Technology*, *57*, 284-292.

30. Subasia A, Erçelebib E (2005). Classification of EEG signals using the neural network and logistic regression, *Computer Methods and Programs in Biomedicine*; 78.

31. Samadi, Amir (1394). Use of Artificial Neural Network and Fuzzy Logic in Urban Development (Case Study: Urban City). Master's Thesis. The University of Tehran.

32. Student News Agency of Iran (ISNA): Kermanshah is one of the first four cities in the country in terms of marginalization, written on December 22, 2012.

33. Safari, Abdolreza, Leo, Hamid Reza, Homayouni, Saeed, Khazaee, Safa. (1393). Estimation of coastal depths by means of distortion distance imagery. Tehran: Scientific Journal - Extension of Surveying and Spatial Information Engineering.

34. Sliuzas, R. V. (2004). Managing informal settlements: A study using geo-information in Dar es Salaam, Tanzania.

35. Tayyebi, A., Pijanowski, B. C., & Tayyebi, A. H. (2011). An urban growth boundary model using neural networks, GIS, and radial parameterization: An application to Tehran, Iran. *Landscape and Urban Planning*, 100(1), 35-44.

36. Tewolde, M. G., & Cabral, P. (2011). Urban sprawl analysis and modeling in Asmara, Eritrea. *Remote Sensing*, 3(10), 2148-2165.

37. Wassenaar, T., Gerber, P., Verburg, P. H., Rosales, M., Ibrahim, M., & Steinfeld, H. (2007). Projecting land use changes in the Neotropics: The geography of pasture expansion into forest. *Global Environmental Change*, *17*(1), 86-104.

38. Yilmaz, I., "Landslide susceptibility mapping using frequency ratio, logistic regression, artificial neural networks and their comparison: A case study from kat landslides (Tokat-Turkey)"Computers *and Geosciences*, 35 (2009) 1125-1138.

39. Yaakup, A. (2007). GIS as new approach and method for preparing and implementing the development plan in Malaysian planning system. Jurnal Alam Bina, (7).

40. Zubairy, Muhammad and Alireza Majd (1380). Familiarize with remote sensing technology and application in natural resources. Tehran: Publishing and Printing Institute of Tehran University.