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Analysis of Urban Development and Land Use Change in Urmia City

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Abstract

The two decades the urban growth has been caused in changing land cover in the urban areas, especially in agricultural lands locating in borders of cities. It is necessary for suitable urban planning to achieve suitable urban growth plans, the past evolution of the physical and spatial development of cities in order to predict the appropriate zones for future development in proportion to the ecological conditions of the region.

The purpose of this research is to identify, describe and predict land use change for the year 2030 by using Land Cover Change Modeling (LCM). For this purpose, Landsat satellite images Landsat 1995 and 2016 have been used to illustrate user changes and classifying the land cover which uses logistic regression model to study the factors affecting land cover variations and then modeling the transmission potential of the artificial neural network multilayer perceptron model (MLP) with five variables. Finally, the allocation of users to each other with the Markov chain has been assess. The results in study indicate that the most changes are related to the lands built with 5600 hectares (more than the conversion of agricultural land into built). The land cover predict map also showed that the most development will be in the north, northeast, and northwest in 2030.

Keywords: Urban development, land use, LCM, MLP, Urmia

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Introduction

The world urban population is increasing rapidly (Marinoni, Higgins, & Coad, 2014).Urban development is increasing due to better conditions economic and social and population growth and build up which solve this problem, cities grow sprawl and compact, which has a negative impact on urban ecosystems at national and regional level(Breuste & Qureshi, 2011; Meng et al., 2008; Wu, 2014). The rapid growth of urbanization, the need for land and use more than its potential for urban land use, the land use changes from the natural environment (such as: agricultural land, forests, rangeland and wetland) to build space (such as: residential, commercial and industrial land) urbanization, urban expansion and increase human activities by eliminating valuable agricultural land, increasing greenhouse gas emissions, air pollution, water pollution The underground has affected about 1.3 to 1/2 of the Earth's surface environment (Angel et al., 2005; Li, Ye, Song, & Wang, 2015; Vitousek, Mooney, Lubchenco, & Melillo, 1997; Zinia & Mcshane, 2018) therefore land use and change it as urban expansion(Ameen, Mourshed, & Li, 2015) Important factor changes environmental scale spatial and time(Mishra, Rai, & Mohan, 2014). In recent decades, urban sustainability as the most important method of city ecology has been to examine the relationship between man and environment, with balance in the urban area in order to achieve conservation nature and biodiversity(Dizdaroglu, Yigitcanlar, & Dawes, 2010; Dzieszko, 2014; Wu & Wu, 2013).Therefore, the ecological approach is applied without the destruction of agricultural land, forests and pastures by preserving the urban environment in the reconstruction of existing urban texture, the new development is being used around cities and new cities(Legras & Cavailhes, 2016) and all city as a ecosystem (economic and social) studied(Barrico, 2015) the agricultural lands to urban and industrial uses and its economic and environment consequences is one of the problems and difficulties of urban planners (Rahmati, Nazmfar &Afshoon, 2024).To manage the land use, environment, and urban development, using land cover maps and GIS &RS tools and methods analysis Modeling(Araya & Cabral, 2010). Model (LCM) is one of important models land cover change for analyzing changes in land cover and predicting land use changes for the future. Is used. The most important assumption of the model is that development and change over time are the same, and past changes can predict future changes based on the historical scenario(Schulz, Cayuela, Echeverria, Salas, & Benayas, 2010; Veldkamp & Verburg, 2004) and useful tools for exploring the various factors: economic, social and environmental (Pijanowski, Brown, Shellito, & Manik, 2002). Growth in the population as well as the increase in urban migration in the past decades have caused population density as well as the level of cities great in Iran. Urmia City is also due to its economic, social and, most importantly, the capital of the province of Azerbaijan West has grown significantly over recent years, and also due to its special geographic location and plain Fertile, which is the physical development of the city, on the one hand, due to the needs of the inhabitants of the urban land and, on the other hand, the maintenance of land and gardens They have faced challenges around the city and preventing their destruction (Abedine, mossayeb zade, & Shokrani, 2013; Mobaraki, Mohammadi, & Zarabi, 2013).

This is reason, it is imperative that urban development and land use change and land cover be identified. (LCM) is one of the most important models used in this field. Using this model, GIS, RS data and methods, and the identification of Urmia city growth changes between 1986 and 2016 will be used to model the future development of the city for 203.

2. Methods

2.1. Study area

Urmia city is the center of West Azerbaijan Province in the political divisions of Iran. The location of the Urmia city is geographically located in the northwest of Iran, near the Lake of Urmia, and is located at the coordinates of Urmia, (37° 4’E, 37°32’ N) (Fig.1) According to the statistics of 1395, the population living in this city is about 736224 thousand people in an area of 8100 hectares. Urmia Urban area is a mountainous region that is lowered from the west to the east, and is located in a flat at a height of 1300 to 3000 meters above sea level.

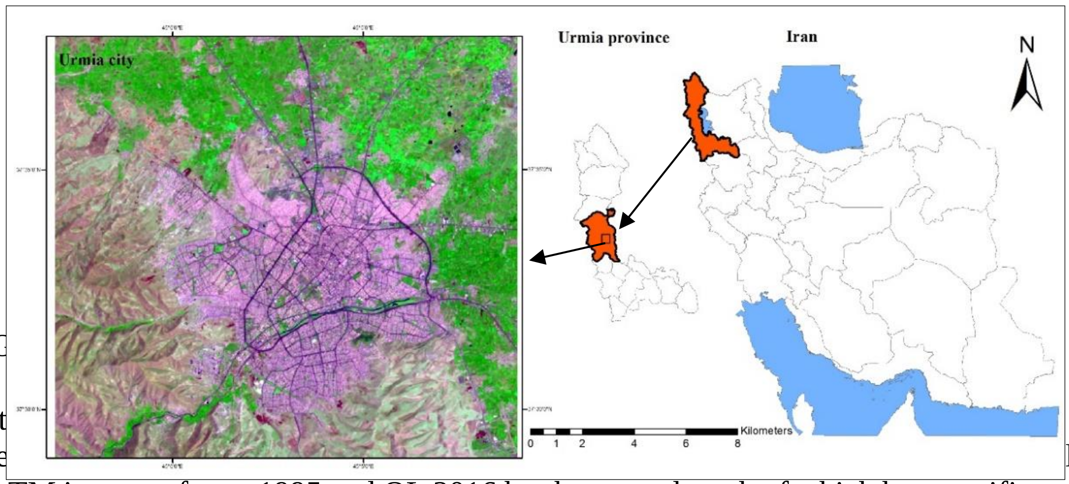

Fig. 1. C

2.2. Mat

In this re luding Landsat TM images of year 1995 and OL 2016 has been used, each of which has specific property satellite images in ENVI software using for reformation in radiometric, atmospheric and The geometry. Then for classified using the supervised maximum likelihood classification method in IDRISI Selva 17.0 software. The maps contained three land use/land cover such as agriculture land, built up area and fallow land. Used filter mood for remove the pixels and small pieces used to enhance the resolution of the images. Land Change Modeler in IDRISI Selva 17.0 was used for analyzing land cover changes and predict the land change map in 2030 Urmia city(Fig.2). Change analysis, transition potential modeling and driving forces determination, change prediction, and model validation procedure: 1) change analysis, 2) transition potential modeling and 3) change prediction.

Chart

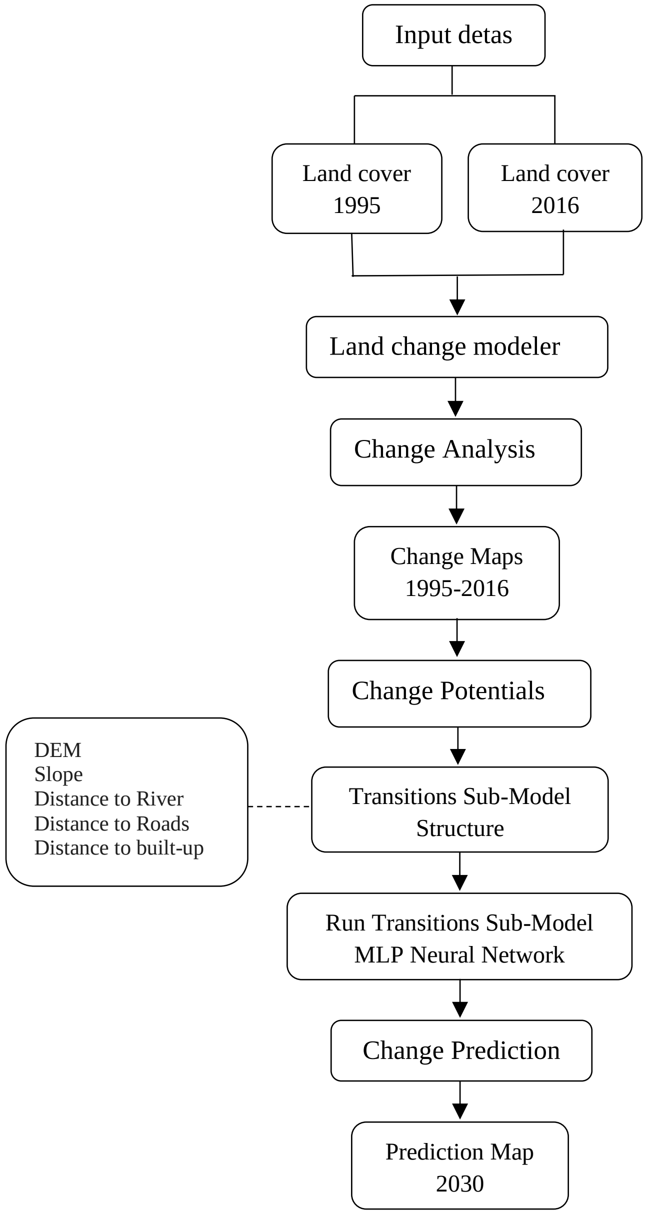

Fig. 2. Methodology Flow

2.3. Change Analysis

At this stage, the land cover evaluation between two different periods from one land use to another(Megahed, Cabral, Silva, & Caetano, 2015). which result showed maps and graphs. Various methods for showing changes are used. In this model, in the change analysis section, the Gain and losses of each class(Hamdy, Zhao, Osman, Salheen, & Eid, 2016), the net changes, a map of changes, the map of areas without change (stable) and the transfer of from each The floor is being prepared and analyzed by different classes of land cover.

2.4. Transmission potential

At this stage, transfer potential each group or sub-model of the transfer separately and in the end, predict the changes with their subset(Dzieszko, 2014). For selecting the independent variables affecting and role that of the possible changes is evaluated between maps by Cramer coefficient. Carmer's V was calculated for every variable between 0.15–0.4 were selected to be taken into account in the final mode(Nor, Corstanje, Harris, & Brewer, 2017). There are several methods for modeling the transmission potential, including: MLP Neural Network, sim weight and logistic regression which previous studies have shown artificial neural network, the strongest method in among other methods.in this research multi-layer perceptron neural network method (The ANN was designed with one input, one hidden, and one output layer(Yang, Zhao, Chen, & Zheng, 2016) has been used.

2.5. Changes Prediction

The third step and final transition matrix dispelled land use changes to each other of future. Simulated land use changes (soft and hard map) based change LC in the tow period between (Islam & Ahmed, 2011; Mas, Kolb, Paegelow, Olmedo, & Houet, 2014; Sayemuzzaman & Jha, 2014).In analyzing the forecast of changes is that, using the past trends of the change and the potential transmission model, the future Scenario for a given date is predicted. The prediction of the Markov chain model is used to calculate the amount of variation for a particular date based on transition potential
mapping maps.

3. Results

3.1. change analysis: 1995–2016

The results of the land cover change between 1995 and 2016 showed that during the course of this period, the most land-based changes were made, which was increased by 6732 hectares, which is due to the loss of agricultural land and fallow land. In the next stage, the largest changes are related to the use of agricultural land, from 17071 hectares in 1995 to 541 hectares in 2016, when the significant amount of agricultural land has been converted to land and has been reduced(Fig.3).

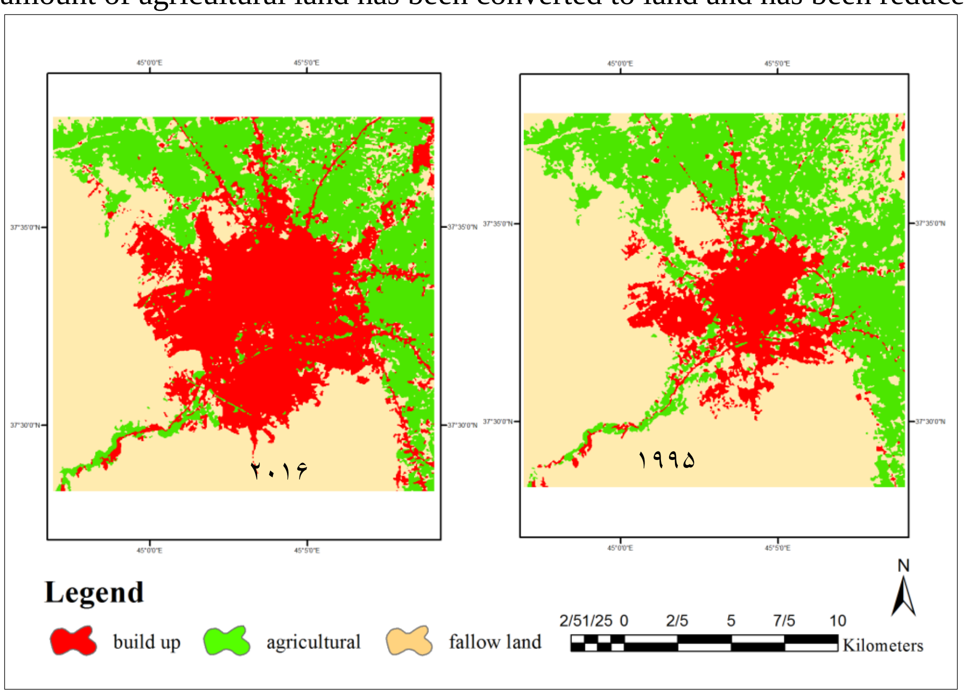

Fig. 3. Land use maps in the study area

3.2. Transmission potential

In the second stage, the modeling of land use change models is modeled by the potential for transfer from one land use to another according to the variables introduced to the land-change modeler. Finally, three sub-models were used to model the transmission potential using multi-layer perceptron artificial neural network, which was selected as follows (1) agricultural land to build up (2) fallow land to build up (3) agricultural land to fallow land.

Five variables (slope, dem, distance from the road, distance from river and distance from built-up) (Mishra, Rai, & Mohan, 2014) were introduced for modeling the transmission potential to the land use change modeler.

In order to investigate the relationship between the variables used in the model (independent variables) and the changes in the land use classes (dependent variable), the Cramer's V correlation was used. The Cramer's V is a number between 0-1, which is near to one, showing a high correlation between variables Independent and dependent. Usually, variables with a correlation coefficient greater than 0.15 are selected to enter modeling (Fig. 4).

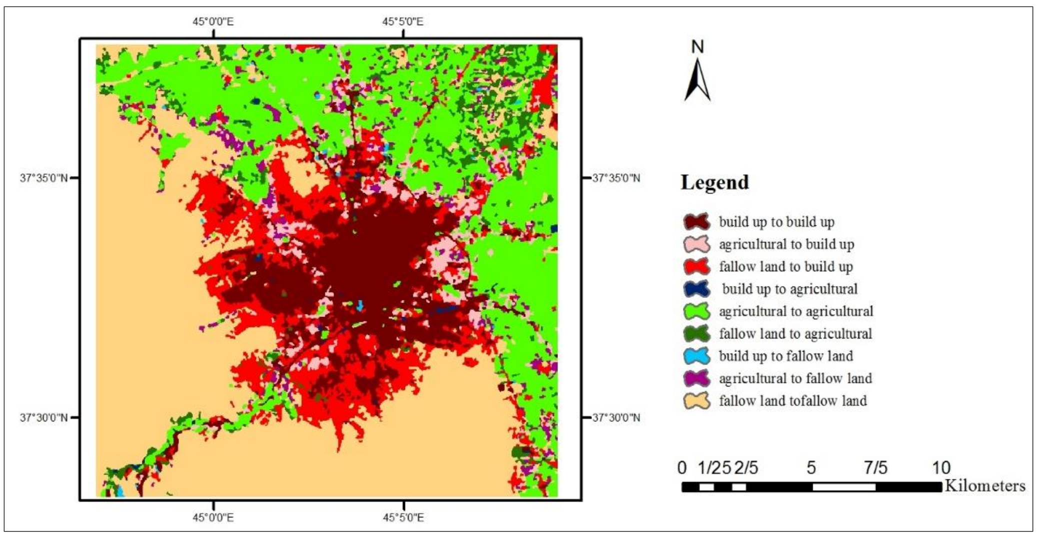

Fig. 4. Combined land use change map of 1995 and 2016.

Table1: Cramer’s V and coefficient values for each variable.

Variables	Overall Cramer’s V
DEM	0/3623
Slope	0/3526
Distance to River	0/2057
Distance to Roads	0/3655
Distance to built-up	0/5299

modeling the transmission potential in this model by modeling the artificial neural network (MLP), which is used to calculate potential transition maps in order to predict land use change for 2030, changes between 1995 and 2016 are considered as the base year for potential The transition between three classes of built-up, fallow and agriculture by independent variables of slope, dem, distance from the river as a variable Static and distance from the road and built-up dynamics. The evaluation of the implementation of the transition potential showed.

Table2: Model essay accuracy

years	Training	Testing	Accuracy rate
1995-2016	0/3661	0/3366	84.66%

3.3. Changes Prediction

Due to changes in occurrences and the possibility of transfer from one user to another, based on user changes from 1995 to 2016, a map for predicting land use changes for the year 2030 was developed using the Markov chain. In this study, the probability matrix of a land cover in a class of built-up areas has the least likelihood of converting to other applications, which has a high degree of sustainability. In contrast, fallow lands with the least degree are most likely to change to other classes, which is also the reason for the large area of the land is landed in relation to the agricultural lands and because of its conversion into lands and built-in dead. As well as the area obtained for land use. The forecast map for 2030 lands is 12244 hectares, 7025 hectares of agricultural land and 11897 hectares of fallow land.

Fig5.Projected land use map for the study area, 2030.

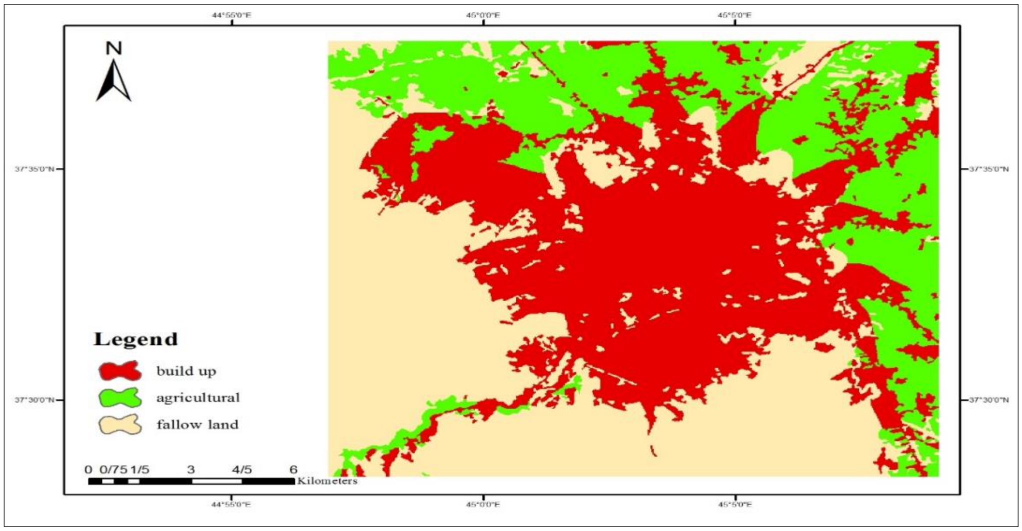

Table3: Markov prediction to 2030 based on land use and land cover maps of 1995 and 2016

Land use class	built-up land	agricultural land	fallow land
built-up land	0/92860	0/0185	0/0528
agricultural land	0/0901	0/8087	0/1012
fallow land	0/1730	0/0678	0/7593

5. Conclusion

By expanding cities in recent years and increasing land use changes in their immediate areas, they need to predict long-term land use, so that proper management and sustainability are applied in the regions. In this regard, urban ecological development is one of the important issues that has been taken into consideration in recent years. Achieving this goal requires knowledge of land use patterns and changes over the years, the use of Remote Sensing techniques and geographic information systems, and the use of models Ecological, to assess land-use spatial variations of land use for planning planners to guide future cities to sustainable development.

In this research, Land Use Change Modeling (LCM) was used to model land use changes and predict ecological growth and development in Urmia. The results of the study indicate significant changes in the developed regions, which built-up from 4231 hectares in 1995 to 9075 hectares has increased in 2016, which has had the greatest impact on agricultural lands and gardens. Land use surveys over the past thirty years show that lands have been built and agriculture has undergone a systematic change, as lands are increasing and agricultural lands are decreasing on the contrary, fallow land has had irregular trends. The most expanding city was also towards the highlands and towards the main road (roads of Mahabad, Salmas and Sea roads).

In model the transition potential from the changes of 1995 to 2016 to predict city development using MLP perceptron model due to non-linearity, lack of attention to normal distribution and also without the need for a single scale, according to Varietal variables were used to survey the land cover for three grounded, built-up and agricultural land classes with a Accuracy rate of over 80. In the next step, in order to predict the future based on past changes from 1995 to 2016, the transition probability matrix of the Markov model was used to explain future changes, which resulted in the two previous maps the nose is hard and soft for 2030.

The results of LCM modeling showed that agricultural and fallow lands were largely lost and turned into built land. This research by reconcile ecological changes with future land use based on the natural capacity of the region can prevent environmental damage and create ecological balance. It should be noted that this model, like other forecasting models, has some limitations, including lack of attention to social and cultural factors and lack of quantification in urban development, and more attention to natural factors that can be considered by considering cultural and social factors in The choice of independent variables and the use of quantitative methods minimize these constraints.

References

4- Abedine, A., mossayeb zade, A., & Shokrani, M. (2013). Study on tne physical Expansion of Urmia City using quantiative models. *Researchs Geograpy Human, 47*, 411-422.

5- Ameen, R. F. M., Mourshed, M., & Li, H. (2015). A critical review of environmental assessment tools for sustainable urban design. *Environmental Impact Assessment Review, 55*, 110-125.

6- Angel, S., Sheppard, S., Civco, D. L., Buckley, R., Chabaeva, A., Gitlin, L., . . . Perlin, M. (2005). *The dynamics of global urban expansion*: Citeseer.

7- Araya, Y. H., & Cabral, P. (2010). Analysis and modeling of urban land cover change in Setúbal and Sesimbra, Portugal. *Remote Sensing, 2*(6), 1549-1563.
8- Barrico, M. d. L. C. S. (2015). *Ecological processes related to urban development and land use change in the municipality of Coimbra.*
9- Breuste, J., & Qureshi, S. (2011). Urban sustainability, urban ecology and the Society for Urban Ecology (SURE). *Urban Ecosystems, 14*(3), 313.
10- Dizdaroglu, D., Yigitcanlar, T., & Dawes, L. (2010). Planning for Sustainable Urban Futures: An Ecological Approach to. *Rethinking Sustainable Development: Urban Management, Engineering, and Design*, 15.
11- Dzieszko, P. (2014). Land-cover modeling using Corine land cover data and multi-layer perceptron. *Quaestiones Geographicae, 33*(1), 5-22.
12- Hamdy, O., Zhao, S., Osman, T., Salheen, M. A., & Eid, Y. Y. (2016). Applying a hybrid model of Markov chain and logistic regression to identify future urban sprawl in abouelreesh, Aswan: A case study. *Geosciences, 6*(4), 43.
13- Islam, M. S., & Ahmed, R. (2011). Land use change prediction in Dhaka city using GIS aided Markov chain modeling. *Journal of Life and Earth Science, 6*, 81-89.
14- Legras, S., & Cavailhes, J. (2016). Environmental performance of the urban form. *Regional science and urban economics, 59*, 1-11.
15- Li, F., Ye, Y., Song, B., & Wang, R. (2015). Evaluation of urban suitable ecological land based on the minimum cumulative resistance model: A case study from Changzhou, China. *Ecological modelling, 318*, 194-203.
16- Marinoni, o., Higgins, a., & Coad, p. G., J. N. (2014). Directing urban development to tne right places: Assessing the impact of urban development on water quality in an estuarine environment. *Landscape and Urban planing, 113*, 62-77.
17- Mas, J.-F., Kolb, M., Paegelow, M., Olmedo, M. C., & Houet, T. (2014). Modeling Land use/cover changes: a comparison of conceptual approaches and software. *Environmental Modelling and Software, 51*, 94-111.
18- Megahed, Y., Cabral, P., Silva, J., & Caetano, M. (2015). Land cover mapping analysis and urban growth modeling using remote sensing techniques in greater Cairo region—Egypt. *ISPRS International Journal of Geo-Information, 4*(3), 1750-1769.
19- Meng, Y., Zhang, F.-R., An, P.-L., Dong, M.-L., Wang, Z.-Y., & Zhao, T. (2008). Industrial land-use efficiency and planning in Shunyi, Beijing. *Landscape and Urban Planning, 85*(1), 40-48.
20- Mishra, V. N., Rai, P. K., & Mohan, K. (2014). Prediction of land use changes based on land change modeler (LCM) using remote sensing: a case study of Muzaffarpur (Bihar), India. *Journal of the Geographical Institute" Jovan Cvijic", SASA, 64*(1), 111-127.
21- Mobaraki, O., Mohammadi, J., & Zarabi, A. (2013). Provide the optimal pattern of physical expansion of Urmia city. *Development Geography, 32*, 75-88.

Mohammad Mohammadnejad, M and Abedini, A (2025), Challenges and Opportunities of the Metaverse in Urban Climate Change, geography and human relationships, Volume 7, Issue 3 - Serial Number 27, Pages 38-52.

22- Nor, A. N. M., Corstanje, R., Harris, J. A., & Brewer, T. (2017). Impact of rapid urban expansion on green space structure. *Ecological Indicators, 81*, 274-284.

23- Rahmati, M., Nazmfar, H., &Afshoon, Y. (2024). Reviewing and evaluating tne physical development process of Astara city and its changes in 2038. Geograaphy and Human Relationships.
24- 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.
25- Sayemuzzaman, M., & Jha, M. (2014). Modeling of future land cover land use change in North Carolina using Markov chain and cellular automata model. *American* Journal *of Engineering and Applied Sciences*, *7*(3), 295.
26- Schulz, J. J., Cayuela, L., Echeverria, C., Salas, J., & Benayas, J. M. R. (2010). Monitoring land cover change of the dryland forest landscape of Central Chile (1975–2008). *Applied Geography, 30*(3), 436-447.
27- Veldkamp, A., & Verburg, P. H. (2004). Modelling land use change and environmental impact: Elsevier.
28- Vitousek, P. M., Mooney, H. A., Lubchenco, J., & Melillo, J. M. (1997). Human domination of Earth's ecosystems. *Science, 277*(5325), 494-499.
29- Wu, J. (2014). Urban ecology and sustainability: The state-of-the-science and future directions. *Landscape and Urban Planning, 125*, 209-221.
30- Wu, J., & Wu, T. (2013). Ecological resilience as a foundation for urban design and sustainability *Resilience in Ecology and Urban Design* (pp. 211-229): Springer.
31- Yang, X., Zhao, Y., Chen, R., & Zheng, X. (2016). Simulating land use change by integrating landscape metrics into ANN-CA in a new way. *Frontiers of Earth Science, 10*(2), 245-252.
32- Zinia, N. J., & Mcshane, p. (2018). Ecosystem serviceces management: An evaluation of green adaptations for urban development in Dhaka, Bangladesh. *Landscape and Urban planing, 173*, 23-32.