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PREDICTING CHANGES IN THE LAND USE IN MIDSIZE CITIES (CASE STUDY: URMIA CITY OF IRAN IN 2025)

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ABSTRACT

The Urmia is the capital city of the Western Azerbaijan province that is an urban area and in the northwest of Iran. In recent years, the rapid increase in urban lands and areas in this city has resulted in inconsistent and extensive urban growth. The purpose of the present study is to predict the changes in the land use in midsize cities and apply this prediction on the case study of the Urmia city in Western Azerbaijan. Satellite images and IDRISI Andes have investigated the changes land use in the lands of Urmia city and were used GIS to examine the land use and changes from 1984 to 2011. Then, Markov Chain model and Cellular automate have been used in IDRISI Andes to document and propose a prospect of land use changes in the Urmia city in 2025. With respect to the land use changes, the results of the present study will indicate that the built up area in this city in 1984 was about 2706.57hectares; however, in 2011, the area of built urban zones in the same city has reached 9811.26 hectares. Hence, in 2025, it can be speculated that in the future, the area of built up will reach 12970.53 and the agricultural lands will inevitably be allocated for urban constructions; that is, in 2025, all agricultural lands will undergo a change of land use from farming into urbanization. It should be pointed out that due to the population growth in this area and the available lands, a 3000-hectare increase in the area will be needed to accommodate the increased population.

Keywords: Land use, Urban sprawl, Markov chains, Cellular automate, Urmia-Iran.

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Contribution/ Originality

- This study explores the sprawl characteristics of land use/cover changes with rapid population growth and accelerating urban growth in Western of Iran.
- There were changes in land use area in midsize city.
- We have used Markov chain-CA analysis to see direction of change in land use pattern.

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1. INTRODUCTION

The modern world deals with many new challenges and problems, which are the results of industrialization, centralization of productions and services in cities, mechanization of agriculture, urban development and extension. All the above-mentioned urban development gradually lead to the exploitation and destruction of non-renewable resources, global warming. These days, such environmental and urban threats have motivated and attracted the researchers towards the concept of stability. Due to the population growth, which is predicted, to continue until 2030, urban stability has been regarded as an important concept in urban planning in the country of the USA. Based on the report of the United Nations, the population and urban density will reach 4.9 billion people in 2030 (Bhatta, 2009). With respect to the fact that more than half of the world population lives in cities, urbanization processes are now pervasive. This proportion will increase to over 72% by 2050 (Shafizadeh and Marco, 2013). Moreover, in the industrialization and urbanization process, unlimited and excessive consumption and use of resources threaten the environmental resources. In addition, the existence of economic and social gaps among different people who live in cities has resulted in bigger problems such as urban poverty, urban or civil security and low standards of living, which have had negative impacts on the lives of civilians and citizens (Baldemir *et al.*, 2013). The urbanization is a major concern in many world regions where the cities have started to spread outwards and where the urban planning is poor (Deep and Akansha, 2014).

The concept of urban stability has been proposed as a solution to these problems, which has been used for analyzing the challenges of urban living. It can be mentioned that urban researchers and planners have always wondered about how to analyze and examine the issue of urban growth, which is a significant concern for them. Since the policies of stable development were considered in the management of cities, the range and scope of research studies focusing on urban stability has remarkably increased. That is to say, the rapid growth in housing constructions and urban infrastructures has resulted in a kind of unstable and uncontrollable development (Christiansen and Loftsgarden, 2011). Furthermore, the increase in the pace and number of migration from rural areas to urban areas and the increasing problems caused by urbanism have critically necessitated attention towards urban planning and management which should be regarded as a dynamic system (Fisher, 1965; Farina, 1999; Igegnoli, 2002; Vicari, 2007; Yavari *et al.*, 2007). The remarkably fast growth in the urbanization, in particular in developing countries, is the major reason and cause for the creation of many urban problems such as uncontrollable and excessive growth and enlargement of cities. Urban planners and managers failed to predict and foresee such drastic urban developments and population growth; hence, unpredictable growth and change in urban areas have caused numerous problems and issues for cities (Sudhira and Ramachandra, 2007). Urban growth and development or horizontal extension is achieved when the rate of using non-agricultural lands or unnatural lands exceeds the rate of population growth (Bhatta, 2009). Urban sprawl has several social, economic and environmental impacts, which lead to changes and transformations in land and population density and changes in public transportation systems and use of personal vehicles (Couch and Karech, 2007). Sprawl is one of the significant issues in developing countries since this issue has resulted in rapid and incidental development and sprawl of urban lands and areas that previously had low population densities. Uncontrollable growth has enhanced the amount and level urban traffic and transportation; consequently, energy consumption and urban services have increased; hence, the cost of urban infrastructures and their maintenance has risen for the respective municipalities (Couch and Karech, 2007). Land function is considered as an important effect for the human's impact on the environment; hence, for adopting appropriate and proper urban plans and policies and controlling lands and areas, researchers and urban planners should identify and evaluate the effective factors (Longley and Victor, 2000). Land coverage, dynamic and changes in land use are some of the important variables, which have critical impacts on the environment and environmental processes (Foody, 2000). In the modern world, new and sophisticated technologies such as remote sensing and measurement devices and GIS can be used to efficiently plan and manage resources and urban areas. The land use layer and coverage are believed some of the critical layers in urban planning; users and urban planners in identifying and examining the quantity and quality of natural and urban areas can use these layers. The detection and revelation of changes in the lands and predicting changes in land coverage can give the urban planners and managers an insight and vision so that they can efficiently manage the natural resources and protect the lands in urban areas. Knowing the changes in land cover helps planners and managers adopt more effective and useful long-term policies. Detecting such changes is a process, which facilitates the recognition and understanding of differences and patterns in the realization time of the phenomena (Lu *et al.*, 2004). There are various methods for modelling and detecting changes of land use. For instance, C.A (Cellular Automate) model and Markov Chains can be considered as typical methods. Over recent decades, Land-Use and Land-Cover Change (LUCC) has become a core component of research into environmental change and it has become a discipline in its own right integrating the classical theories of geography with more recently developed technologies of remote sensing (RS) and geographic information systems (GIS) in both temporal and spatial dimensions (Gong *et al.*, 2015).

The city of Urmia which is the case study of the present paper is located in the province of western Azerbaijan in northwest of Iran. In the past a few decades, rapid changes have occurred in the land use of this city. Moreover, changes in the population of this city have not been concurrent and simultaneous with land use changes. In this urban area, the local people's tendency to have a garden house or a second house in the suburbs of the city have made some changes in the land use and led to the destruction of some gardens and green areas. The sprawl of these problems and challenges have necessitated and forced managers and planners to find suitable solutions for the urban planning and management of Urmia city.

In this paper, researchers used data obtained from satellite pictures between the years 1984 to 2011 and Markov Chain model and cellular automate to answer three main questions in relation to the prediction and management of urban growth in the city of Urmia. Indeed, an attempt was made in this study to consider the prospect of the year 2025 for the city of Urmia. It should be mentioned that the rationale for the choice of Urmia as the case study is that there have been frequent changes and manipulations in the lands of this city in the past 27 years.

The following questions were examined and studied in the present study:

1: What changes have been made in the land use of the areas in Urmia and how the land areas have been distributed from 1984 to 2011?

2: With respect to the changes made in the lands of Urmia city, what predictions and prospects can be proposed for the land use in the Urmia in the year 2025?

3: Can urban stability in consistency with urban management respond to and accommodate for the reduction in using urban lands?

2. THEORETICAL BACKGROUND AND REVIEW OF PREVIOUS WORKS

Based on a biological perspective, it might be argued that cities function like a fungus in using and exploiting the vital resources such as air, water and food. As a city becomes larger, it demands more lands from the surrounding areas; hence, the risk of destroying the environment increases (Bahraini, 2007). In the 21st century, the sprawl phenomenon is regarded as a critical issue in relation to stable urban development (Anderson *et al.*, 1976). Indeed, stable development is considered to be one type of urban development (Ewing, 1997; Downs, 1999; Galster *et al.*, 2000; Malpezzi and Guo, 2001). In many cities of Iran such as Urmia, Western Azerbaijan province, urban development has resulted in disorder in urban land marketing and business; in particular, large areas of lands within the set urban boundaries have remained unused; consequently, negative horizontal sprawl has been created (Athari, 2000). Furthermore, urban sprawl often leads to rapid extension and incidental development of lands and a change in the land use of low-density residential areas (Olujimi, 2009). In the past twenty years, the use of urban lands by people has been doubled (Hortas- Rico, 2014). Since these developments and changes have had several negative impacts, they have attracted the attention of researchers and urban managers. Fulton *et al.* (2001) investigated the use of urban lands in relation to variations in the American population. He contends that if the rate of using the land is higher than that of population growth, sprawl and dissipation of land will increase.

Change in land use is one of the main research subjects of global environmental change and sustainable development (Guan *et al.*, 2011). Using geographical information systems (GIS), remote measurement, and the hybrid model of cellular automation and Markov chains (Gong *et al.*, 2015) conducted a study in which they predicted future changes in China. In a similar manner simulated the changes, variations in land use in Chang Ping based on the prospect pattern, and criteria using a Markov model and cellular automate (Yang *et al.*, 2014). Ayodeji (2006) detected and investigated the changes in the coverage and land use in the area of the Ilorin *region* in Kwara *state* by using the technology of geographic information systems (GIS) and remote measurement for a time from 1972 to 2001. They made use of MSS, ETM and TM data and Markov model and cellular automate to predict changes in land coverage and land use for the next 14 years. The result of the above-mentioned study revealed that there has been a fast development in the constructed lands for the period between 1972 and 1986; moreover, the comparison of the development of the former period with that of the period (1986-2001) indicated that the development in the earlier period was more than the latter period. In addition, it is predicted that this trend will continue until 2015 (Mirbageri *et al.*, 2005).

Many studies have sought to quantify the spatial-temporal distribution and arrangement of land cover changes on the basis of classified remotely sensed data and they attempt to estimate the environmental impact of these changes using landscape metrics (Franklin *et al.*, 2000; Hansen *et al.*, 2001; Gergel *et al.*, 2002; Betts *et al.*, 2003; Narumalani *et al.*, 2004; Kamusoko and Aniya, 2007). Urban sprawl may be regarded not simply as a pattern of urbanization but as the process of urban change through which the urban area is extended and density gradients reduced (Couch *et al.*, 2005).

The approaches and trends of functional changes have been examined and predicted by some other researchers such as Ahadnejad (2000). He tried to check and predict land use changes in Zanjan. The results of his study revealed that such changes in land coverage and land use can be predictable and proper ways and policies should be adopted to optimally manage land use changes in different cities. Also, in evaluating land use changes in Maragha, a city in Eastern Azerbaijan province in northwest of Iran, Ahadnejad (2010) mentioned some of the methods for predicting changes in land use.

Almeida *et al.* (2002) proposed a C.A model, known as DINAMICA, to simulate different land use changes in the city of Bauru in the Sao Paulo state; this model was based on Weight of Evidence model. Chang and Chang (2006) used SPOT data related to four periods (March 1999, October 1999, November 2002 and 2005) to investigate plant coverage of mount Jiu jitsu. At the end, they also used Markov chain analysis and Cellular automate to predict temporal and spatial variations of plant coverage. Their results revealed that the CA-Markov is an appropriate method for simulating the process of changes in plant coverage.

The significance of this kind of studies can be explained by the fact that in modern times, fast urban growth is the main cause of problems and challenges in cities. Related evidences indicate that although many studies have been done to provide different urban plans (comprehensive plans, detailed plans, strategic plans, structural plans, etc.), due to the presence of a wide variety of extensions in modern societies, there are still many urban and civil problems, which are untouched and unaddressed. Hence, it can be argued that, nowadays, urban management and prediction of changes and optimization of changes with respect to temporal and spatial conditions are indispensable and crucial. Therefore, smart methods based on the needs of the society should be used to adopt appropriate measures to minimize the negative impacts of such changes.

For one thing, the rapid growth and the horizontal extension of cities have significantly affected urban policies. The consequences of these developments have escalated and intensified economic, social, political, managerial and environmental issues of urban societies.

3. PURPOSE AND SIGNIFICANCE OF THE STUDY

As mentioned above, a variety of problems result from urban developments. These problems highlight the necessity of conducting research on urban developments and shifts in the land use. A descriptive-analytical research method was used in this study. In addition, researchers used the reliable and valid theoretical background knowledge and previous studies to better understand the state-of-art in research into urban changes and sprawl.

In this paper, the main research data were obtained through the satellite images for the period from 1984 to 2011. Then, these obtained data were used to classify land use and predict the probable future changes and shifts in the land use in the context of study, i.e. Urmia, the capital of western Azerbaijan province in northwest of Iran. Next, using the data from the satellite images, the researchers detected and investigated the land use changes relating to different time spans and years. In this study, the software of GIS and IDRISI were used and the models C.A and MARKOV were used for predicting the changes and shifts in land use.

Indeed, it should be noted that a Markov–CA model incorporated with geographic information system (GIS) is considered to be an appropriate approach for modelling the temporal and spatial changes in land use (Guan *et al.*, 2011). Due to the characteristics of the Markov model, it could be utilized to control the total quantity within the land use change CA model.

The purpose of conducting the Markov process is to analyze the probability in land use change and obtain the trend implied within the land use change in the context and area of study (Urmia city) through the probability transition matrix.

As a matter of fact, C.A is a modelling technique which is defined in Raster space. Cell status usually indicates the coverage type and land use for that cell. A transformation and change in the form of a cell depend on the status of that cell and its neighboring cells (Batty *et al.*, 1997; Cuclelis, 1997). Then, using the exact area of the constructed lands, which is regarded as a significant prediction parameter and orthogonal tables, the researchers, will predict and analyze land use in the context of study (Urmia City and Western Azerbaijan) for the year 2025.

Indeed, the haphazard urban development, sprawl, and changes in land use have been noted in Urmia city and numerous surrounding and suburban gardens have been manipulated and changed into urban areas, researchers in this study intend to identify and analyze the manner and nature of land use changes based on the hybrid model of Markov chains and cellular automate. The researchers attempt to use the current trend of changes to predict the range of changes for the year 2025. By doing so, researchers aim to propose practical procedures and plans for resolving the urban problems and challenges. The solution proposed in this study can suggest the proportion of absolute value for an assigned urban land use and determine the distribution, physical and spatial form of urban functions. Hence, the study aims to predict and propose an ideal and optimal urban environment with minimum changes and manipulations.

4. THE SETTING OF THE STUDY

The context and focus of study in this paper was the city of Urmia. This city is the capital city of the province of West Azerbaijan. It is located at 45 degrees, 45-minute eastern longitude, 37 degrees, and 33 minutes northern latitude. The local language of the citizens in this city is Azerbaijani Turkish. It is one of the midsized cities of Iran. In 2006, Urmia city was extended in an area of 8577.3 hectares. The population of Urmia city was 583.3 thousand people in 2006 that has reached 963738 people (Census Iran Statistical Center, 2005, 2011). The particular position of the Urmia city in Western Azerbaijan Province will reveal the significance of predicting land coverage in Urmia in the future and the prospect of 2025. Figure 1 illustrates the position of the related province and city.

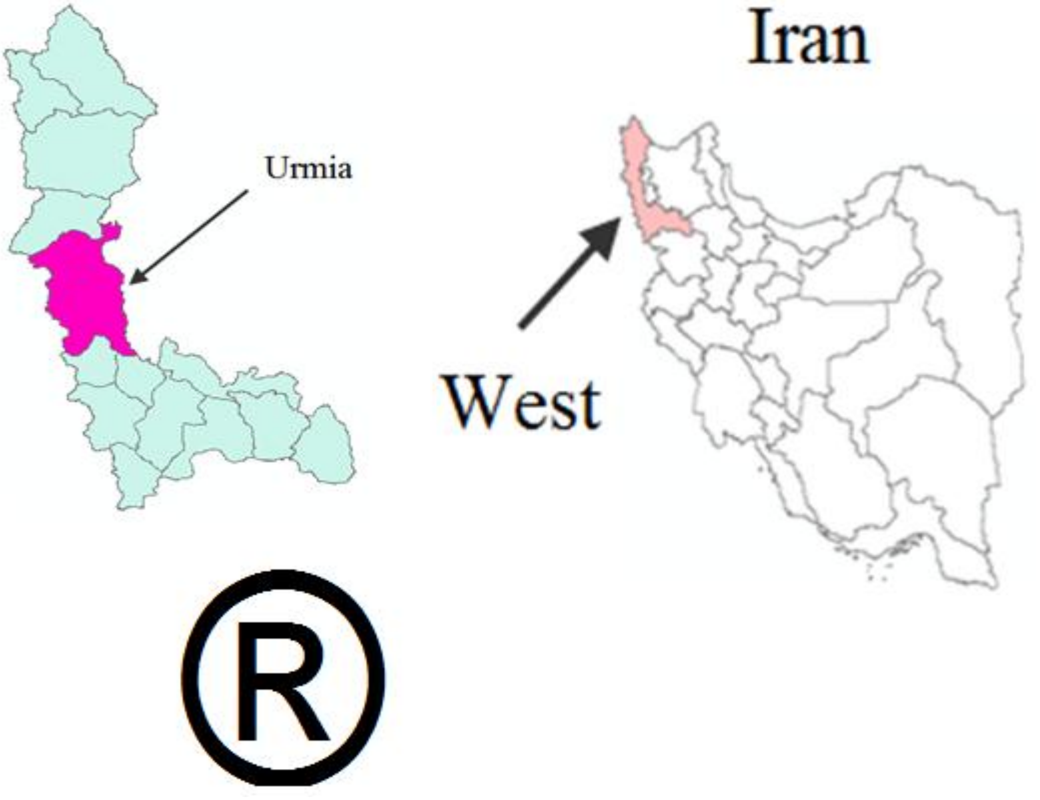

Figure-1. A view of the position of Western Azerbaijan Province and the focused area of the study
Source: Authors

5. RESULTS OF THE STUDY

5.1. Analyzing the Distribution of the Urban Areas in Urmia

The term "sprawl" has entered the literature of urban research in the 21st century (Hess, 2001). According to the report of the European environment agency, extension and lack of appropriate management is regarded as a serious threat for rural and natural environments (Foran, 2009). Indeed, one of the major factors related to time and space that incorporates shifts and changes in land use is the area. As more and more areas of urban lands are constructed, the range and scope of urban sprawl increases and this leads to the destruction of surrounding agricultural lands and gardens.

Based on the results obtained from the satellite images in the area under study, the area of constructing lands in the Urmia in 1984 was 2076.57 hectares and the urban density in the same year was 148 people per hectare. However, for the year 2011, the area of constructing lands was 10024.06 hectares and the amount of density was 98 people per hectare (Table 1 and Figure 2). The results indicate that an urban extension in the Urmia from 1984 to 2011 was based on the fact that area increase had a faster pace than the pace of population increase. In other words, this demonstrates the extension of urban space for the 27-year time period with respect to the relation between population and area in the setting of the study. It can be argued that the urban area in the city of Urmia had a 3.72 percent increase for the period from 1984 to 2011.

Table-1. Evolutions and changes in the built-up lands from 1984 to 2011

Years	Built up area	Built-up area increase percentage (%)	Density	Population
1984	2076.57	-------	148	306789
2011	9811.26	3.72	98	963738

Source: Authors

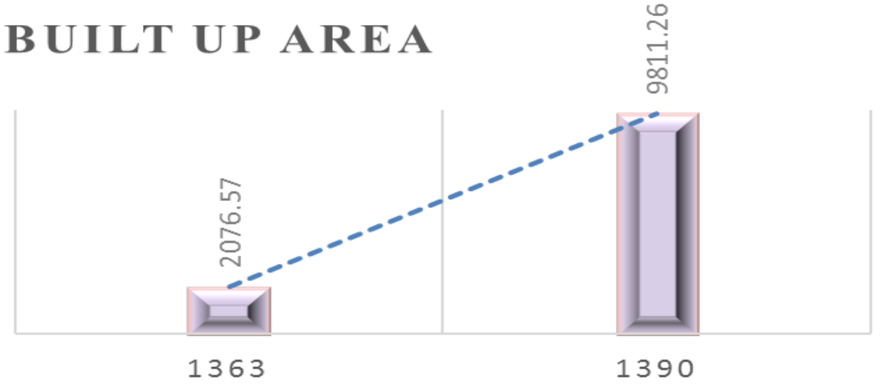

Figure-2. Land use area distribution of in Urmia city in the year 1984 and 2011

Source: Authors

Moreover, table 2 below indicates the functional area distribution of the constructed lands in 1984 and 2011. This table reveals the ascending tendency and trend and the fulfilled changes in the area of the study.

Table-2. Land use area distributed in the setting of the study from 1984 to 2011

years	Built-up area(ha)	Built-up area increase percentage (%)
1984	2076.57	-------
1990	3266.55	57.3
2006	8376.84	156.4
2011	9811.26	17.2

Source: Authors

5.2. Predicting Land Use Changes

One chief purpose of the study was to predict the land use changes in the setting of the study. There are several methods for predicting the future of the land use changes. However, in this paper, Markov chains and cellular automate were used to predict the land use changes for the year 2025. It should be noted that satellite images for the year 1984 and 2011 were used to predict such land use changes. Table 3 indicates the available land distribution for the years 1984 and 2011. The method used for predicting land use changes was selected by considering the conditions and land use for the year 2011. In the prediction method of Markov chains, the process and direction of realizing changes from 1984 to 2011 was taken into consideration and in this way, the nature of changes for year 2025 is predicted. Markov chain is, indeed, a probabilistic prediction method; the result of this method in the software IDRISI Andes is a matrix; table 4 shows the Markov chain probabilistic matrix. The values in this table are less than one and the value of one is equal to the hundred percent probability of prediction. This table indicates that in the next 14 years, namely the year 2025, the probability of land use changes in the constructed lands is hundred percent. In addition, figure 3 demonstrates the prediction map for the land use in Urmia for the year 2025 based on Markov chains.

Table-3. Distribution of the area of constructing lands in the setting of the study Urmia from 1984 to 2011

Class	Land use Type	1984	2011
1	Built- Up Area	2076.57	9811.26
2	Agriculture land	15245	12826.53
3	Dry farming	4565	3380.31
4	Orchards	8913.96	10839.51
5	Water	1.71	8.46
6	Irrigated Agriculture	9493.38	3430.62

Source: Authors

Table-4. The probability percentage of land use change in the studied area until 2025 via Markov chains

Land use Type	Built- Up Area	Agriculture land	Dry farming	Orchards	Water	Irrigated Agriculture
Built- Up Area	100	0	0	0	0	0
Agriculture land	5.6	82.5	7	0.7	0	3.9
Dry farming	16.3	19.3	57.2	0	0	7.1
Orchards	1.04	0.6	0.1	81.9	0	6.8
Water	17.3	0	13.8	0	68.8	0
Irrigated Agriculture	21.9	6.1	1.4	41.3	0	29.1

In table 4, the columns are related to year 2025 and the rows are related to year 2011.

Source: Authors

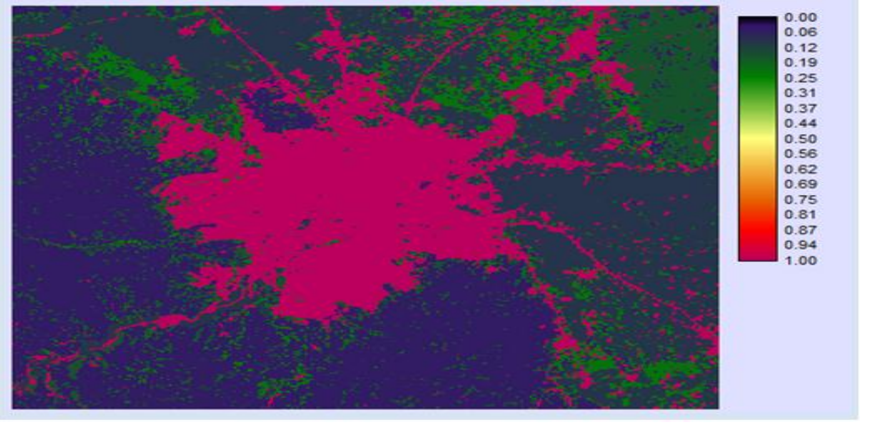

Figure-3. Prediction map for land use in the setting of the study Urmia, by Markov chains for 2025
Source: Authors

5.3. Markov Chains and Cellular Automate

This method is a combination of Markov chains and cellular automate which was used to predict the trend of land use changes and land coverage. In this paper, at first, the researchers analyzed the land use maps for the time period from 1984 to 2011 based on Markov chains so that they can identify land use changes in this period. Then, the researchers used the hybrid method of Markov and cellular automate to predict the trend of land use changes that might occur until 2025. Figure 4. and table 5 shows the prediction of land use changes and land coverage in Urmia for the year 2025. The results indicate that the highest probability of changes in the setting of study in 2025 is related to land use. Based on the fulfilled predictions, the amount of constructing area in 2011 was 9811.26, which is predicted to reach 12970.53 in 2025.

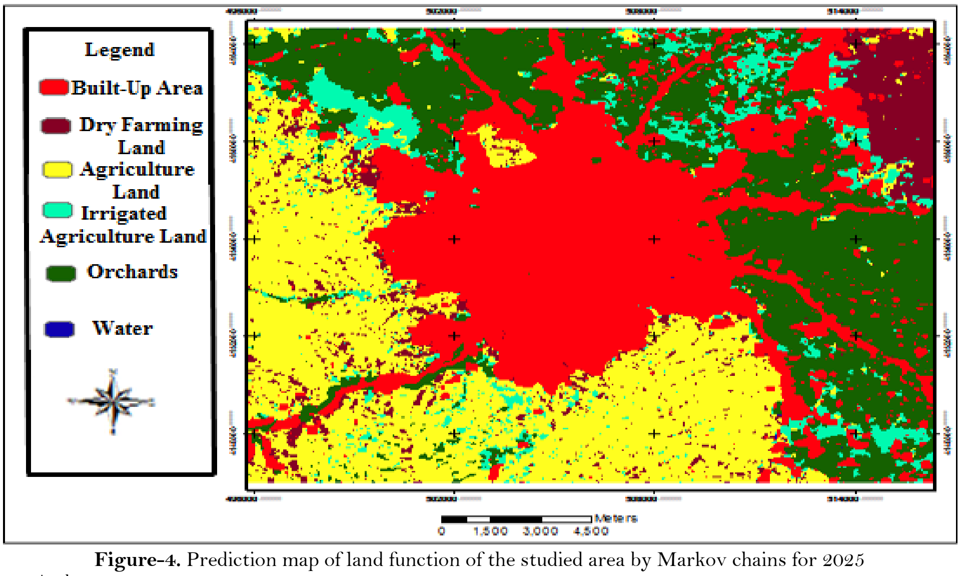

Figure-4. Prediction map of land function of the studied area by Markov chains for 2025
Source: Authors

Table-5. The results of predicting land function in 2025 by means of Markov chains and automate cellular

Land use Type	Built- Up Area	Agriculture land	Dry farming	Orchards	Water	Irrigated Agriculture	Total
Built- Up Area	9811.26	0	0	0	0	0	9811.26
Agriculture land	724.32	11522.88	267.48	9.63	1.26	300.96	12826.53
Dry farming	561.24	0	2635.2	0	0.09	183.78	3380.31
Orchards	990.18	0	0.99	9821.61	1.35	25.38	10839.51
Water	1.53	0	0.27	0	6.66	0	8.46
Irrigated Agriculture	882	1.89	3.06	571.77	0.72	1971.18	3430.62
Total	2970.53	11524.77	2907	10403.01	10.08	2481.3	40296.69

In this table, the rows stand for the functions in 2011 and the columns stand for the functions in 2025

Source: Authors

Table-6. Distribution of the area of functions in setting of the study from 1984 to 2025 (area was measured in hectare unit)

	Land use Type	1984	1990	2006	2011	2025
1	Built- Up Area	2076.57	3266.55	8376.84	9811.26	12970.53
2	Agriculture land	15245	14692.23	14090.58	12826.53	11524.77
3	Dry farming	4565	4808.34	3829.32	3380.31	2907
4	Orchards	8913.96	11893.59	10442.25	10839.51	10403.01
5	Water	1.71	7.02	3.78	8.46	10.08
6	Irrigated Agriculture	9493.38	5628.96	3553.92	3430.62	2481.3

Source: Authors

Table 6 shows the land areas from 1984 to 2025. Based on the results obtained from this table, the lands, which will be constructed in 2025, will increase in size from 3159.27 hectares; it should be noted that this increase in the size and area of constructing lands is attributed to the realized changes in land use in the setting of the study. With respect to the developmental limitations and restrictions and the current trend of development in Urmia, it is predicted that the increase in the size and area of construction is more likely to lead to the sprawl phenomenon. Moreover, the local citizens' passion and interest in having a second house can further accelerate the process of sprawl.

5.4. Results of Predicting Changes in Land Functions from 2011 to 2025

In this paper, the prediction of land use changes was realized based on Markov chains and cellular automate. With respect to number 1 and 2 maps and tables 4 and 6, the results of the prediction indicate that, within the 10-year period, about 88 percent of the changes in the setting of the study will occur in the year 2025. Based on these tables, the probability of maximum changes in terms of size and area will be related to a 2251-hectare change of agricultural lands to the construction lands. It is predicted that about 475 hectares of irrigated agricultural lands will be changed into gardens in the year 2025. In addition, about 253 hectares of home-bred agricultural lands will be changed into irrigated agricultural lands. Furthermore, 248 hectares of home-bred agricultural lands will be changed into antiseptic lands in 2025. Table 7 shows the predictions for the distribution of the land use in the Urmia in 2025 and the area and percentage of land use change to the year 2011.

Table-7. Predicting the distribution of land use areas in the Urmia in 2025 and its comparison with the amount of area and percentage of land use change in 2011

Years / Land use Type	2011 Area(Ha)	2025 Area(Ha)	2011 - 2025 Area(Ha)	2011 - 2025 %
Built- Up Area	9811.26	12970.53	3159	%32
Agriculture land	12826.53	11524.77	-1302	%-10
Dry farming	3380.31	2907	-473	%-14
Orchards	10839.51	10403.01	-437	%-4
Water	8.46	10.08	1.62	%19
Irrigated Agriculture	3430.62	2481.3	-949	%-28

Source: Authors

This table indicates the area of constructing lands from 1984 to 2025. Based on the results obtained from table 6 for the year 2025, it is predicted that the area of constructing areas will increase as much as 3159 hectares that is attributed to the realized changes in the land use of agricultural lands and gardens in the setting of the study (Fig. 5).

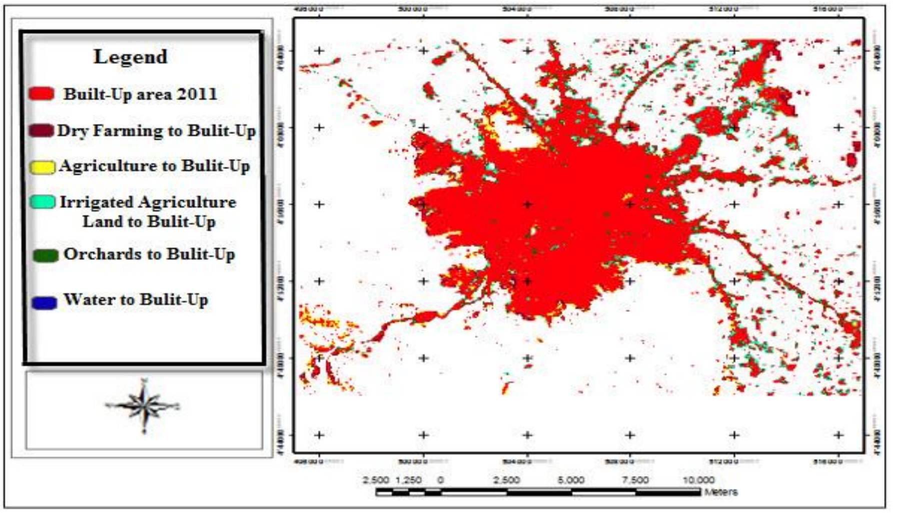

Figure-5. Changes in land functions in the setting of the study, Urmia, from 2011 to 2025

Source: Authors

6. CONCLUSION

In this paper, the Markov Chain and Cellular Automate were implemented and the results were obtained. The researchers used this model to predict the future changes and land use in the structure of Urmia which is a midsized city and the capital of Western Azerbaijan in northwest of Iran. Indeed, the current conditions and characteristics were used as the basis for predicting land use changes for the year 2025. In other words, the probability percentage of land use is predicted for the future. It should be reiterated that sprawl phenomenon has occurred in Urmia city and there is an urgent need to increase the urban area and change the land use in this city. The results of the study indicated that urbanization and population density and the area of constructing lands could be used to understand and discover the manner of urban development and sprawl. Satellite images were used as the data for making predictions about the prospect of the Urmia city in 2025. The findings of the study revealed that within the time span (1984 to 2011), the population of the Urmia has increased while the population density has decreased. More precisely, whereas the area of the city was 2076.57 hectares in 1984, it has reached 9811.26 hectares in 2011. In contrast, with respect to the population density, it was found that while the population density was 148 people per hectare in 1984, it has been reduced to 98 people per hectare in 2011. These current conditions have put urban planners and managers in difficult situations. Hence, researchers noted that area increase and population density reduction should be regarded as land use changes in this area. As mentioned in the study, this issue should be critically addressed and investigated in order to reduce the negative impacts of land use changes and sprawl phenomenon. It was mentioned that for maintaining urban stability and protecting the environment, urban planners and managers should predict such land use changes. For predicting the land area of the Urmia city in 2025 and hence optimal urban management, Markov chains and Cellular automate were used and implemented in the IDRISI Andes and GIS software. The results of the predictions revealed that the area of the constructed lands in 2025 would be about 12970.53 hectares. According to the results of the satellite images in 2011, it is estimated that the area of Urmia city will increase about 3000 hectares and it should be pointed out that the enlargement of the area of Urmia city will cause agricultural lands to change their land use into constructing urban areas that were given in table 5. The maximum changes with high probability will be made in the constructing areas. Consequently, these changes will result in the horizontal extension of Urmia city.

The urban issue which was addressed and highlighted in this paper necessitates the smart management of urban development and internal density of the city. Thus, the land use of urban lands should be systematically planned, urban spaces and locations should be organized and the spaces required for urban operations should be accommodated based on the needs of the citizens and the respective society. With respect to the rapid growth of populations in cities, especially in developing countries, smart and smart procedures should be employed to prevent critical situations and the sprawl of cities, which will threaten human communities and urban lands. Hence, ineffective utilization of non-renewable resources should be minimized.

It is concluded that policies of smart management should be implemented and models and patterns of dense and compact city should be employed. In this way, it will be possible to reduce urban sprawl. Otherwise, the ideal of compact and smart may not be realized and achieved and urban planners and managers will face the challenge of suburban development and urban over extension.

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