JOURNAL OF NATURE AND SPATIAL SCIENCES (2023) 3(2), 25–39

Available online at https://jonass.meybod.iau.ir/

Journal of Nature and Spatial Sciences

Journal homepage: https://jonass.meybod.iau.ir/

Research Article

Investigating suitability of land use based on land capability Lake Urmia catchment area

Morteza Eyvazi [a]*, Ali Akbar Nazari Samani [b], Sara Parvizi[c]

[a] *Corresponding Author, M..Sc Student of Watershed Management Engineering, Faculty of Natural Resources, University of Tehran, Karaj, Iran*

[b] *Associate Professor .Department of Arid and Mountainous Region Reclamation, Faculty of Natural Resources, University of Tehran, Karaj, Iran*

[c] *Ph.D Student. Department of Watershed Management, Faculty of Natural Resources, Yazd University, Yazd, Iran*

ARTICLE INFO

Article history:
Received 12 December 2022
Revised 25 May 2023
Accepted 05 June 2023

Keywords:
land use
land capacity
geographic information system
land evaluation.

ABSTRACT

Background and objective: Assessing the suitability and capability of land is a guarantee of sustainable production and preservation of valuable soil and water resources in any country, and paying attention to it is an undeniable necessity for the sustainable management of water and soil resources.

Materials and methods: In this research, the land use map of 1381 and the land capability map of 1360 of Urmia Lake catchment area were used using the INTERSECT tool in the geographic information system environment, and the land capability codes, each of which represents its land, were used with the land use of the studied area Matched.

Results and conclusion: The results of this research showed that about 76.27% of the codes that had the capability of agricultural land on low slopes have been converted to urban land and 10.17% of the codes that were related to pasture use have been converted to agriculture and rain fields and also on slopes of 8 to 40%, the codes that had pasture and grazing capacity, about 3.9% of it became rainfed and agricultural lands, and finally in the slope above 40%, which includes the smallest area of the lake's catchment area, both in terms of the slope and the land capability map, which is specific to the land They are pastures, nearly 1% of it has been converted into wetlands. Although this amount is less, it is very influential on the flooding of the studied area. In a general summary, it can be said that the land suitability of the study area is not well respected and this can be one of the important factors threatening the saline lake of the study area in the coming years.

1. Introduction

Soil, as a non-renewable natural resource, the national capital, and the bed of life, is considered one of the most important underlying factors of the economy of any country (Kelley, 1983) (in recent decades, the increasing human population on the planet has increased the need for agricultural and livestock production and In addition, inappropriate and unprincipled use of natural resources, regardless of its

* *Corresponding author.* Tel.: +989146901850
E-mail address: eyvazi.m@ut.ac.ir , ORCID: 0000-0001-8173-0942

Peer review under responsibility of Meybod Branch, Islamic Azad University

DOI: https://doi.org/10.30495/jonass.2023.1974883.1062

production capacity, has caused its widespread destruction. Any exploitation of land that is beyond its capacity, in the long run, causes destruction and reduction of land fertility, and adopting unreasonable methods and creating unaccountable changes in land exploitation causes irreparable damage to natural resources (Jalalian & Ayubi, 2013).

Therefore, soil and land evaluation is very important in terms of agriculture and natural resources, and land should be exploited according to its potential, which is one of the most essential parts in protecting water and soil in any watershed. One of the most important goals of land evaluation is to predict the result of changes in the type of land use or the method of land management (Moravej et al., 2018). Land suitability assessment can be defined as the process of determining the capability and aptitude of a specific piece of land for the allocation of a specific use. This process states how much a piece of land located in a range meets the requirements of a specific type of use; in a way that has the maximum efficiency (Ghorbani 2015).

After evaluating the suitability of land for different uses, the basic question is, what level of land should be allocated to each type of use, so that the available resources are used efficiently and effectively, and the most satisfactory balance about the resulting sustainable goals to be. Therefore, the researchers in this field tried to find a better understanding of the characteristics of the land and the climatic factors affecting it, including the studies that have been conducted abroad and inside the country. In Turkey, Ozcan (2006) conducted research on the qualitative suitability of lands. The results showed that 40.1% of the studied lands for wheat cultivation have high suitability, as well as 54.1 and 65.8% of the lands for cultivation of other crops, have S3, S2, and S1 suitability. Martin & Saha (2009) investigated the use of geographic information systems and remote sensing in a part of India for the cultivation of corn, wheat, and rice in different physiographic units. They introduced limitations and their research results showed that the level increased the arable land from 47% to 71% after modifying the restrictions. Mesgaran et al (2017) evaluated Iran's agriculture. The research results showed that 0.4% of the country's land is in the very good category, 9.7% is in the middle category, and the rest is in the poor and very poor category. In another study, Abou-Najem et al (2019) evaluated the capability of agricultural land in the Hermel region of Lebanon.

The results of comparing the obtained land capability map with the current conditions of the region showed that the use of land use pattern should be modified according to the land capability class with the aim of land sustainability. Utama et all, (2019) in Batur UNESCO Geopark, evaluated land use with its capability by using satellite images and a geographic information system, their results showed that by overlaying the land use layer with its capability in the Arc GIS software environment, A total of 88.5% of the land use area has been done with compliance with land suitability and 9.92% without compliance with land use suitability according to its potential and 1.59% of the land area could not be investigated due to cloud interference and other studies that In this context, it has been done, including (Fadhilla et al, 2022) in the Kankaringan watershed located in Yogyakarta using LCLP software to analyze the land capability of the studied region, in addition to the land use classes and land capability to identify management limiting factors.

In Australia, Adams and Engert (2023) investigated the capability of agricultural land to choose the best crop with the most appropriate ability to produce it. In the country, there have been several studies related to land capability, such as Rahdari et al. (2020), under the Plasjan watershed for rainfed cultivation, they used a multi-criteria evaluation method of land capability. and climate are the most important factors in the study of land capability assessment, these researchers finally classified the dryland farming capability map into six categories and checked the stability of the land under rainfed cultivation with the current situation. The study is in the category with high and very high capability and 5999 hectares of rainfed lands are in the category with less capability. In the following, Ahmadi et al. (2020) using parametric methods to achieve sustainable development, investigated the suitability and feasibility of land within the limits of Khodaafrin City in East Azarbaijan province. The results showed that the climate of the region is unsuitable for olive and citrus cultivation and completely suitable for peach cultivation. It is suitable and the most important soil restrictions for growth are slope in slopes, flooding in floods, lime, and gravel.

Summary of other studies that were conducted about land capacity, including preparing a land ecological capacity map using GIS and comparing it with the current land use map (Shahbazi et al., 2015).

Suitability and ability of rainfed agricultural lands with the principles of environmental management in the Chehlgezi sub-basin of Kurdistan province (Nainiva and Jalilian, 2022) Assessing the ability of land for agricultural and pasture use (Khalifa et al., 2018; Alikhah Asl et al., 2019).

According to the studies carried out inside and outside the country, it can be seen that several studies have been conducted in different regions and with different methods to evaluate the capability of lands based on their talent and capabilities, which reveals the importance of examining the issue, but with all this research, because researchers are related to a large scale in the discussion of land capability and capacity, so they have many shortcomings to investigate the capability of the land. In this study, two important factors for land use suitability, namely land capability and slope percentage of the study area, were considered simultaneously. The aim of this study was to investigate the impact of slope percentage and land capability of the watershed on land use suitability. Due to the many stresses present in the study area today, this study focused on examining the extent of adherence to or deviation from land use suitability in the region. It is also expected that in this study, in areas with lower slopes that have agricultural land capability, there will be more changes to urban and residential land use, while in areas with higher slopes that have rangeland capability, there will be more changes to agricultural land use. This study stands out from other studies on land use suitability by emphasizing the simultaneous impact of slope percentage and land capability on land use suitability.

2. Material and Methods

Urmia Lake watershed is one of the six main sub-watersheds in Iran and is the only closed main watershed in the country. This catchment area covers a wide area of the country with an area of 51,801 square kilometers, including the provinces of East, West, Kurdistan, and Ardabil province. The western border of the catchment area of Lake Urmia is the border heights of Iran and Turkey, and its highest elevations include Sablan Peak at a height of 4811 and Sahand at a height of 3707 meters, and the lowest point of the catchment area is related to the level of Lake Urmia at an average height of 1280 meters above sea level. Mediterranean currents are one of the main sources of rainfall in the studied catchment area, based on numerous studies in the catchment area of the studied area, an average rainfall of 330 mm has been reported. The catchment area of Lake Urmia has only one sub-basin of the second degree and includes the rivers that lead to Lake Urmia. And the most important of them are Aji Chai, Zarinerud, Siminerud, Mahabadrud, Baranduzchai, Zulachai, and Nazlichai. Figure (1) shows the location of the watershed in the province and the country.

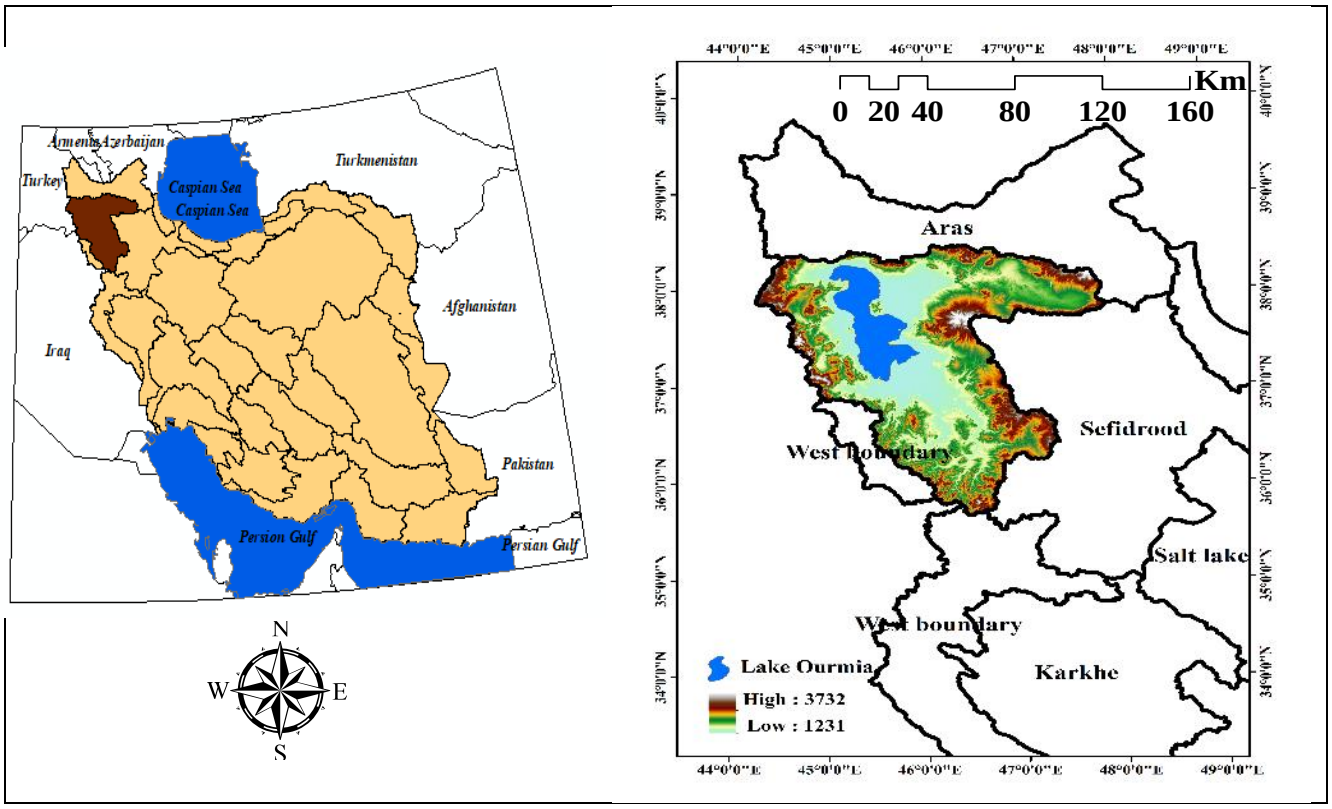


Fig. 1 - The study area

2.1. Data and information

The current research was carried out with the aim of evaluating the land suitability of the catchment area of Lake Urmia in order to investigate the ability and potential of existing land uses for the sustainable development of natural resources and the environment by using the geographic information system. According to the objectives and methods of this research, the required data and information include the land use map of 1381, the land aptitude and capability map of 1361 and the slope map. That the land use map and land capacity and capabilities have been prepared from the country's forest and watershed management system.

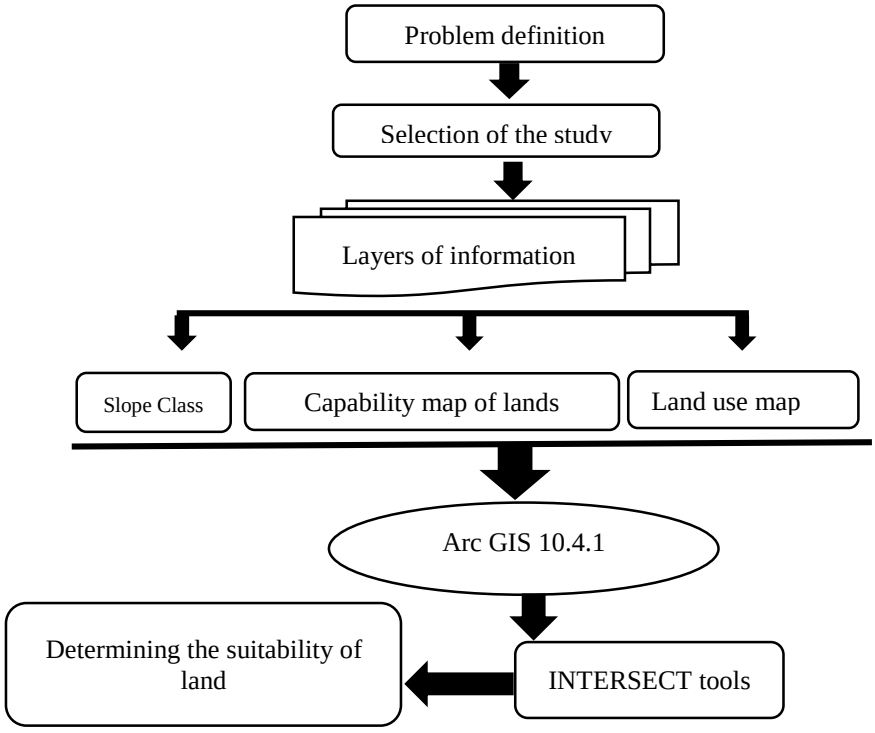
2.2. The general method of conducting research

In short, the purpose of land evaluation is to determine the potential of land in terms of its exploitation, so that by identifying the potential and limitations of land, we can use land appropriately. It is possible to identify the capabilities of the region. For this purpose, the land use map of 1381 and the map of land capacity and capability of 1361 were prepared from the country's watershed forests and pasture organization.

Each of the maps was first referenced in the Arc GIS 10.4.1 software environment, then the digitization operation was done manually with high precision. Finally, the capability codes of each user were determined for the aptitude and land capability map (Figure 5), and for the map, the land use of the polygons of each land use was determined (Figure 4). Further, to extract the slope map of the studied area, the elevation model map with a spatial resolution of 30 meters was used (Figure 8). Finally, by

using the INTERSECT tool in the Arc GIS 10.4.1 software environment, the common face of all three maps was determined to determine the potential land uses in the study catchment area. Figure (2) shows the general process of the current research.

Fig. 2 - The general research process of the studied area



2.3. INTERSECT tool

In the Intersect command, the sharing of layers is taken as shown in the image below. The Intersect tool creates a new layer that has the same properties as all the merged input layers. This tool will be used to overlap one layer with another when the output layer has two properties. First, the output layer has a combination of the descriptive features of both input maps, and second, the output layer includes only the range that is within the range of both input layers. Figure (3) clearly shows the presented content.

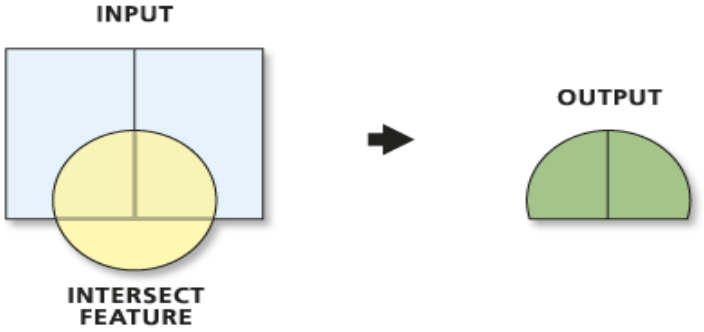


Fig. 3 - Simple form of the Intersect tool

2.4. Purpose of land evaluation

In short, the purpose of the land evaluation is to determine the potential of the land in terms of its exploitation, so that by identifying the potential and limitations of the land, we have the appropriate use of the land.

In general, the basic goals of land resource evaluation studies include the following:

1) Conducting a series of public assessments, studying the land in its current state, and making decisions based on the available information in the coming years, or it could be the conversion of one type of land use to another.

2) Collect all the information about the situation of the studied land resources and use this information for the next work.

3) Investigating the issues that have been raised so far in connection with factors such as climate, elevation and altitude, soil, natural vegetation, conventional agriculture, irrigation, drainage, and land reform has not been done in the region.

4) Determining major drawbacks and limitations of land use and providing necessary suggestions for more correct use of land resources

5) Determining different lands and also determining suitable levels for different uses in the region (Jalalian & Ayubi 2014).

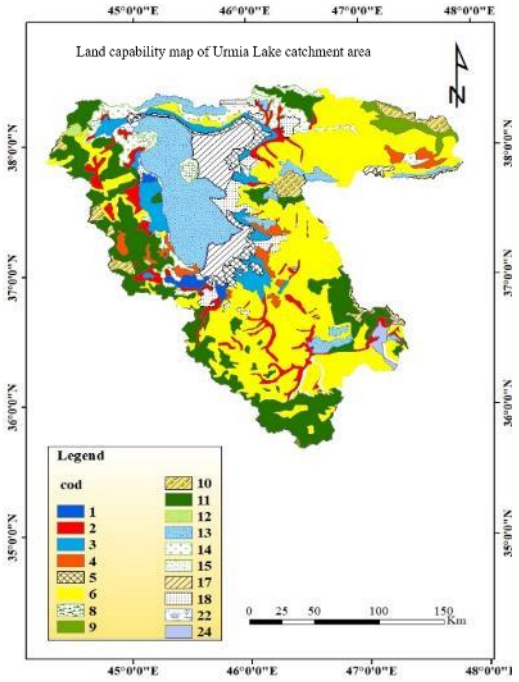


Fig. 5- Land capability map of the studied catchment area (Forests, Rangelands and Watershed Management Organization of Iran, 2019)

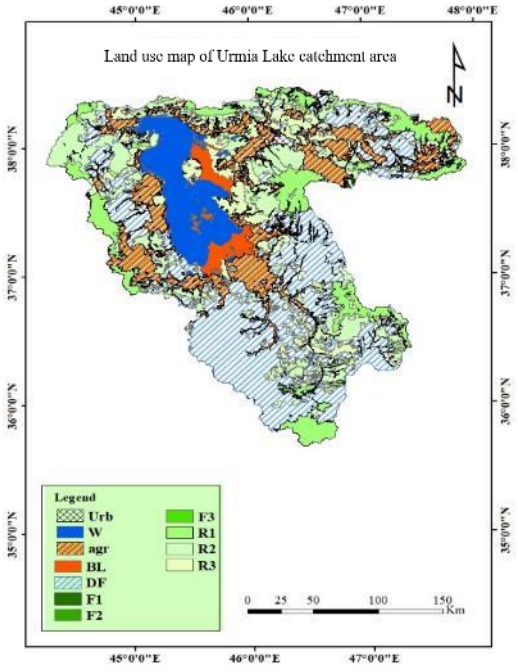


Fig. 4- Land use map of the studied catchment area (Forests, Rangelands and Watershed Management Organization of Iran, 2019)

3. Results and discussion

Evaluation of land is in two ways: capability and talent of land. Land can determine the usability in current conditions, and the ability of land means to determine the ability or class of land in future conditions if the restrictions that can be removed are removed - land ability map. In this research, it has tried to determine the suitability of the lands from the 1363 land capacity map and the 1381 land use map, then the catchment area of Lake Urmia was cut from both land use and capability maps in the geographic information system environment and their descriptive information They were compared to each other in the current research for a better understanding of the land use in the studied catchment area, table (1) has been prepared. In this study, for a better understanding of the issue of the percentage of land use in the study area, Figure 6 was prepared, which shows that the rainfed land with code number six has the highest percentage of the area of the catchment area of Lake Urmia.

Table 1- The most important and common land use in the studied catchment area (Forests, Ranges and Watershed Management Organization of Iran, 1981)

Account Type	agriculture	body of water	First class pastures	Second grade pastures	Grade three pastures	First class forest	Second grade forest	Third grade forest	Rainforests	urban	Abandoned lands
Abbreviation	agr	W	R1	R2	R3	F1	F2	F3	DF	Urb	BL

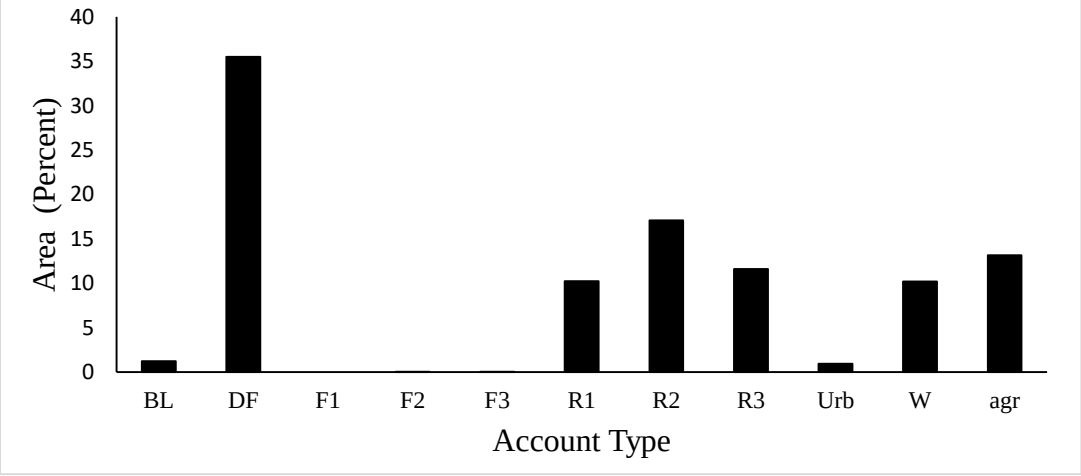


Fig. 6- Percentage of land use in the studied catchment area

It should be noted that for a better understanding of the subject of land capability codes of the studied area, it was prepared according to Figure 7 that each code shows the specific capability of each land, refer to table (2) for a better understanding of the issue.

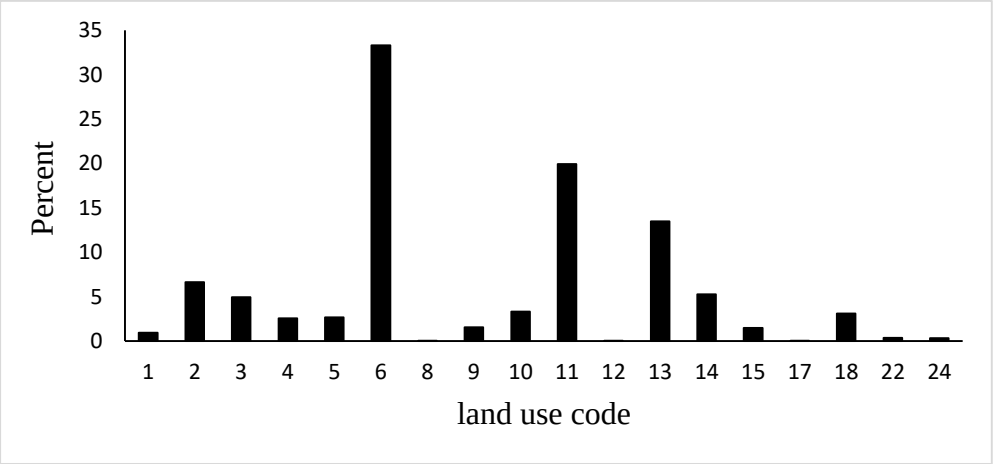


Fig. 7- The percentage of land capability codes of the studied area

Table 2- The most important and common land capability codes in the study area (Forests, Ranges and Watershed Organization of Iran, 1981)

Program	Conditions	characteristic	code
Allocation for a variety of vegetables and fodder plants, by improving local drainage and preventing urban development	The irrigated area is suitable for all plants that can be adapted to the local climate	The type of land is agricultural, rainfed fields with annual rainfall of more than 300 mm, irrigable lands, very susceptible lands, drainage or salinity, without restrictions to low restrictions.	1
Allocation of mountain areas to fruit trees and tourism and allocation of plain areas to vegetables, fruit trees and fodder plants. Prevent urbanization	The irrigated area is suitable for annual plants and fruit trees that match the prevailing conditions of the area	The type of land is agricultural, rainfed fields with annual rainfall of more than 300 mm - irrigable lands - very prone lands - no restrictions to low restrictions - low and variable altitude	2
Winter crops (cereals and fodder plants) along with drainage correction and soil salinity management	More or less irrigated area (wheat, barley, hemp, sugar beet, clover) planting rice locally (Caspian Sea) and palm trees	Characteristic: the type of land is agricultural, rainfed fields with annual rainfall more than 300 mm - irrigable lands - irrigable lands (under special conditions) - drainage or salinity and with medium to high restrictions	3
Development of rain irrigation (cereals, fodder plants) or rainfed crops (rain more than 300 mm)	Partially irrigated (wheat and barley) or rainfed crops of fruit trees on a temporary basis	Characteristic: the type of land is agricultural, rainfed fields with annual rainfall of more than 300 mm - irrigable lands - irrigable lands (under special conditions) - low and high or the movement of water in the soil and with medium to high restrictions	4
Irrigation and drainage on a large scale and soil washing and palm trees in the south (barley, hemp)	Irrigation of crops in a very local way (wheat, barley and cotton) Irrigation and drainage on a large scale and soil washing and palm trees in the south (barley, hemp)	The type of land is agricultural, saline soils or the possibility of irrigation in some parts - saline or drainage and with very limited	5
Restrictions on land plowing and development of erosion control methods. Improvement of pastures using existing potential talent	Rainfed crops (barley and cotton) and fallow land are grazed on hard land from plowing	The type of land is agriculture, rainfed crops and pastures - rainfed crops - lowland and high or soil depth and erosion and with medium to high restrictions.	6
Application: grazing operations, afforestation locally for grazing	Excessive grazing locally around the countryside Operation: spring and summer	The type of land is pasture, cold winter - average annual rainfall is 400 to 600 mm, the topography is mountainous. With the cover of grassy steppes and deer meadows or juniper and oak communities, livestock farming is dominated by migratory and resident herds.	11

Grazing operations	Fodder production: 100 to 300 kg/hectare More or less assumed grazing Operation: spring and summer Fodder production: 100 to 200 kg/hectare	The type of land is pasture, the average annual rainfall is 200 to 400 mm, the topography is mountainous. With the coverage of grassy and grassland communities and locally bushland, livestock farming is dominated by migratory and resident herds.	13
Improvement of pastures	Very intensive grazing competes with rainfed farms Operation: Spring Fodder production: 200 to 300 kg/hectare	The type of land is pasture, the average annual rainfall is 200 to 400 mm, the topography is hilly. With the coverage of grassy and grassland communities and locally bushland, livestock farming is dominated by migratory and resident herds.	14

In the next stage, land suitability assessment between land capacity and land use was investigated by considering the slope classes of the study area, as many as 4 slope classes. In general, based on the results of several studies in this field, slopes of 0 to 15% are suitable for agricultural crops. And slopes higher than 15% are suitable for pasture, forest, and afforestation (Jalilian and Ayubi 2014; Ghorbani, 2015) Figure (8) shows the slope of the studied area.

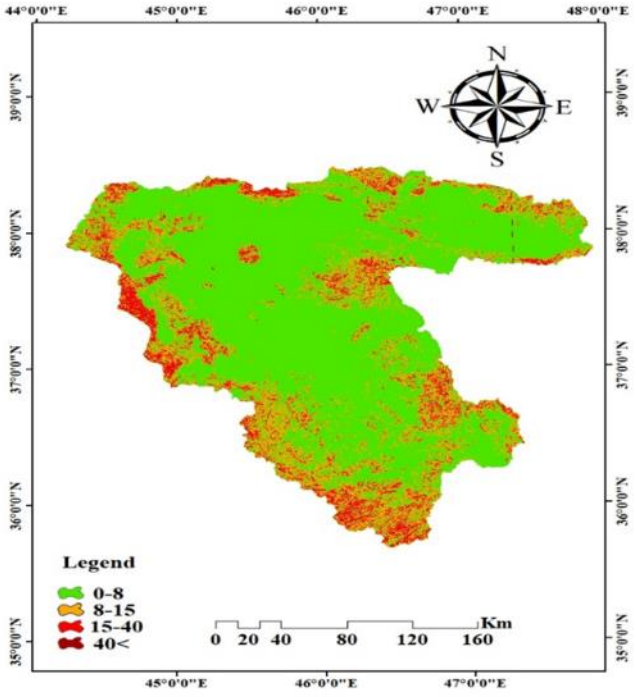


Fig. 8- Slope classes of the studied area in terms of percentage

Based on this, according to Figure 9, the slope of the study area is 0-8%, it shows that codes one to six, which have the ability of agricultural land and have suitable soil depth and low elevations, 26.79% of it is due to migration. Humans have moved from villages to cities, as well as human interventions in the direction of industrial development, have replaced urban use, and as a result, urban marginalization has developed more, and also in codes above 12, which were more capable of pasture lands and pastures, and include vegetation communities.

10.17 percent of these lands may have been converted into irrigated agricultural lands and rain fields due to the increasing human population and the human need for food. In this way, there is a mismatch between the capabilities of the land and the land use in the above-mentioned codes. In the long term, it will have destructive effects on the ecosystem of the studied area.

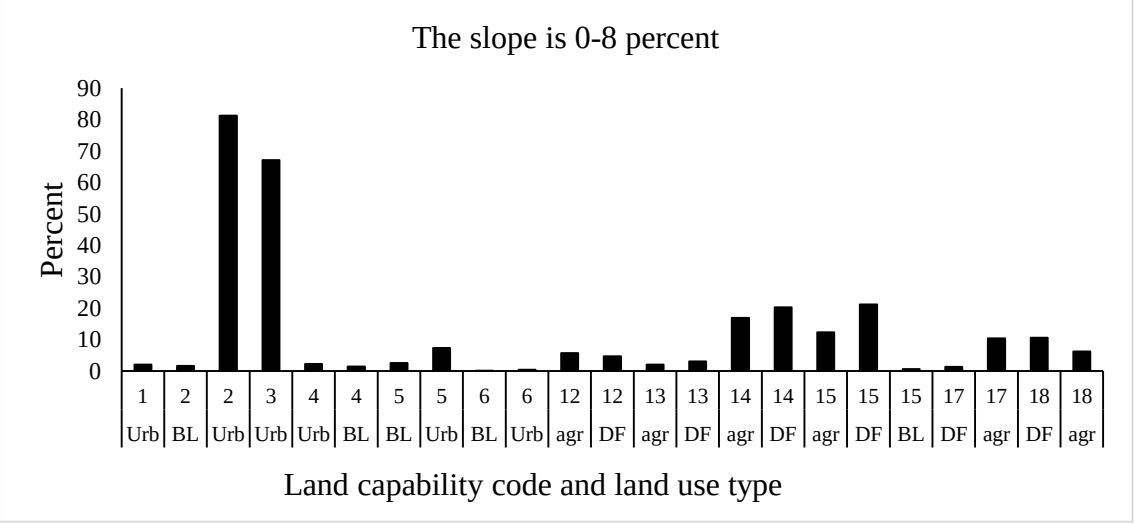


Fig. 9- The percentage of mismatch of land capability with the land use type in the slope of 0 to 8 percent

In the following, the slopes above 8% of the catchment area were examined with their land use, according to figures 10 and 11, which have taken into account the slopes of 8 to 15 and 15 to 40%. it shows that codes 11, 12, and 13, are usually land capability. They show pastures and do not have good potential for cultivation. About 3.9% of the land has been converted to agriculture and dry land. Also, in the slope above 40% of codes 4 and 6, which according to the table (1) are characterized by agricultural and pasture lands, nearly one percent of these lands have been converted into dry land, although the effect of this change seems to be small, but in the long term, its effect on flooding and non-infiltration of runoff is very significant. AbdelRahman et al. (2016) conducted a study in India, taking into account human factors, slope, soil, and precipitation, and ultimately concluded that 0.43% of the study area with steeper slopes is not suitable for agricultural production. However, even in this small percentage, crops such as flax, rice, and other agricultural products are grown without suitability. Therefore, this study confirms that land use compatibility is not well respected in the study area in the catchment of Lake Urmia. In a subsequent study conducted by Nainiva and Jalilian (2022) in the 40-gaz region of Golestan province, it was found that the majority of rain-fed lands (49%) in the study area have an unsuitable status for agriculture, indicating that land use compatibility has not been properly respected. In addition, only a small percentage of agricultural lands have been respected in different slope categories. Moreover, in a study conducted by Roy and Saha (2018) in India on land suitability for rice cultivation, only 10.83% of agricultural lands were found to be suitable for rice cultivation, indicating that land use compatibility has not been respected, as agricultural lands suitable for cultivation have been converted to urban and residential areas, and pasture lands have been converted to dryland

cultivation. Therefore, it can be concluded that land use has not been respected in general. The study's hypothesis was that in lower slopes suitable for agricultural land use, land has been converted to urban and residential areas, and the results of the study showed that 27.76% of the land in the 0-8% slope category has been converted to urban use, which is significant. Finally, the second hypothesis, which stated that in higher slopes suitable for pastoral land use, land has been converted to rain-fed agricultural land, was found to be true only to a small extent, as only a small fraction of pasture lands in higher slopes has been converted to dryland cultivation. However, even with this small area, the potential for flooding, sediment erosion, and vegetation destruction is expected to increase in higher slopes. Therefore, researchers are advised to investigate the effects of slope and land suitability on flood potential.

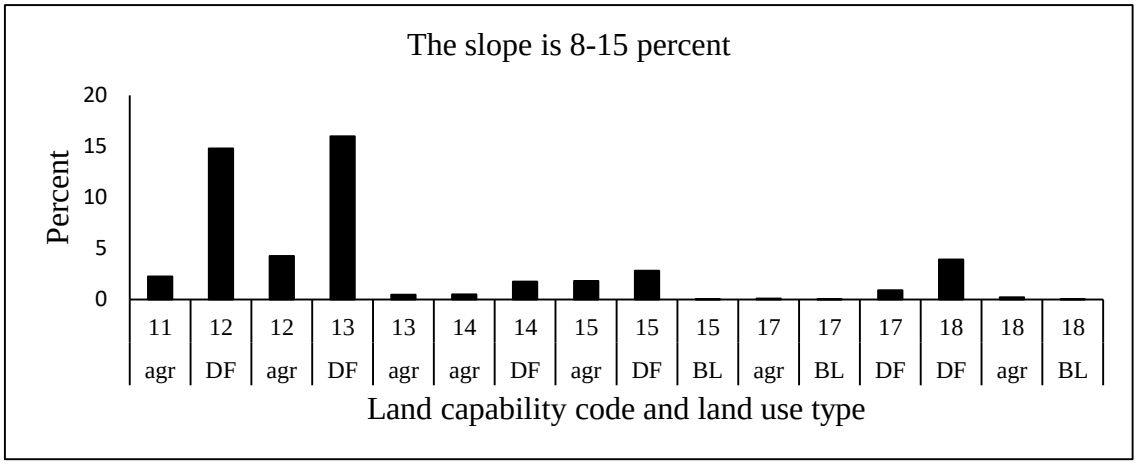


Fig. 10- The percentage of mismatch of land capability with the type of land use in the slope of 8 to 15%

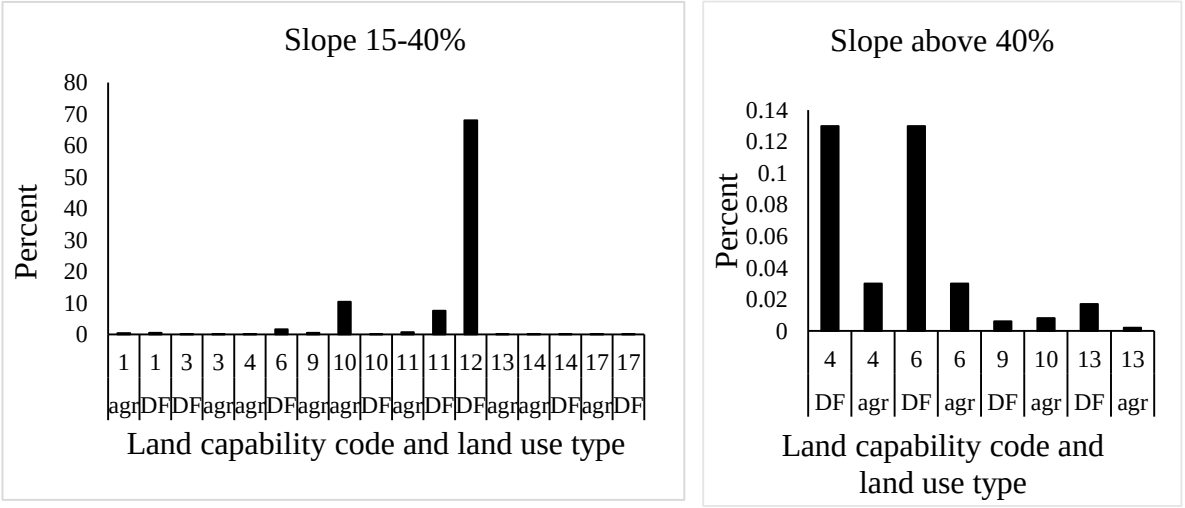


Fig.11- The percentage of mismatch of land capability with the type of land use in specific slopes

In the following, there are several photos of the studied area, whose land suitability has not been properly observed due to changes in land use (Figure 12).

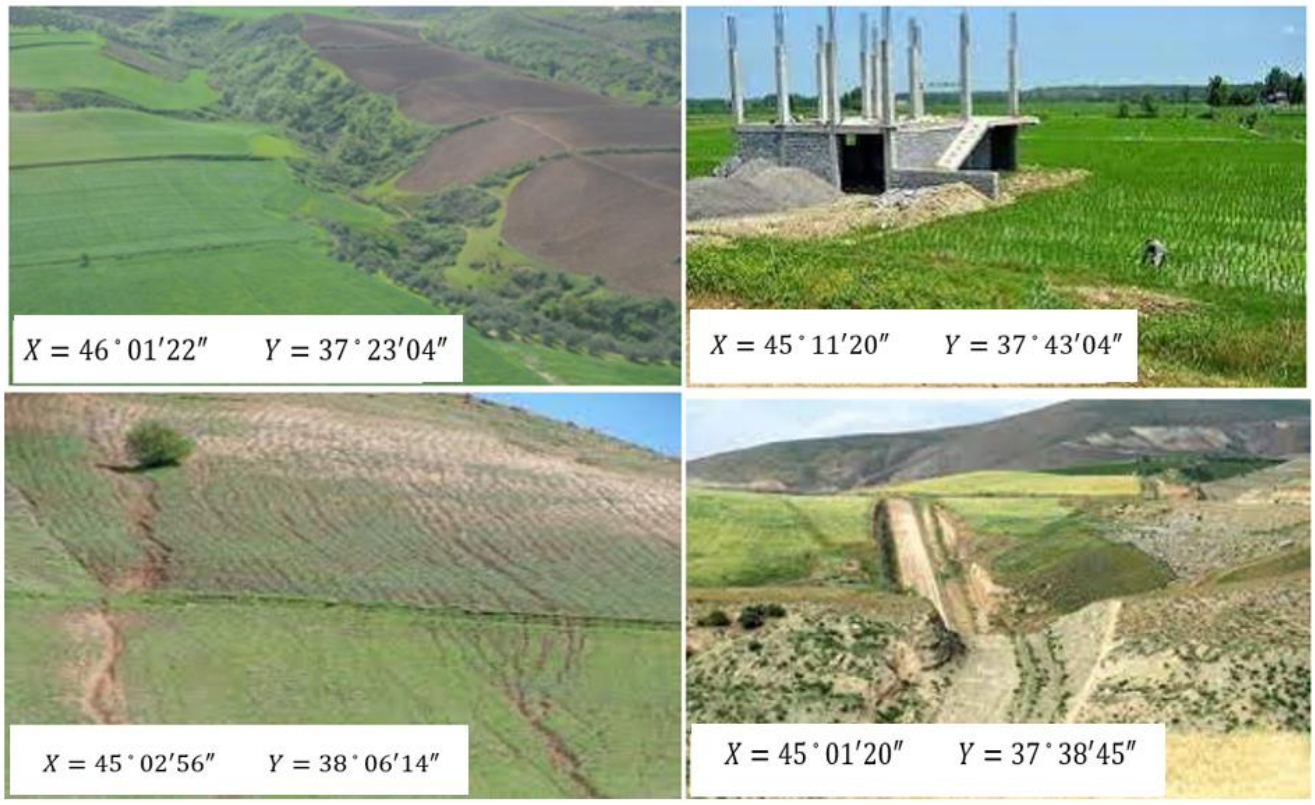


Fig. 12- Land use changes and non-observance of land suitability principles in different areas of Urmia Lake catchment area

4. Conclusion

Coordinating and matching the ability and potential of land with the type of land use is a guarantee of sustainable production and preservation of valuable soil and water resources in any country, and paying attention to it is an undeniable necessity for the sustainable management of water and soil resources. Many studies have been done in this field. Akhvan et al. (2023) investigated land suitability using qualitative and fuzzy models, while in the present study, an attempt was made to quantitatively examine land suitability in the studied catchment area.

Also, Nainiva and Jalilian (2022) during a country-wide research to determine the suitability of agricultural land for the production of crops for the optimal use of soil resources, while in the present study, in addition to the agricultural level, changes in other existing land uses were investigated. In the following, there are many types of research inside and outside the country that did not examine the suitability of land use with slope classes, while in this research, three important factors for assessing the suitability of land include land potential and capability map, land use map and slope map simultaneously in the region.

The study was investigated The results show that by comparing the land use map of 2011 with the land use map of 2011 and also with the slope map of the studied area with different classes in codes 1, 2, 3**,** and 4, respectively, in the lower slopes that are prone to agricultural land use, more Urban has prevailed, and in codes 12 and 13, which are prone to pasture lands, agriculture**,** and wetlands have

prevailed, and also in the high slopes, land uses that have pasture capabilities and relatively shallow soil depth and vegetation and bushes after two decades of wetlands and Agriculture is developed in the region Finally, by examining the map of land capability and land use, it can be seen that a significant part of the existing land uses in the catchment area does not match the capability and talent of the Lake Urmia catchment area, which can be attributed to the droughts and the reduction of rainfall. climate, increase in human population, rooted in economic reasons and as a result migration from villages to cities and expansion of marginalization, lack of systematic policies to support agriculture and villa construction in urban areas, it can be mentioned that in the long term, unpleasant consequences will be studied in the catchment area. It turned out that one of its consequences, which has become a problem now, is the drying up of Lake Urmia, which is one of the main roots of the non-compliance with the land capacity of the studied.

Declarations

Funding Information (Private funding by authors)

Conflict of Interest /Competing interests (None)

Availability of Data and Material (Data are available when requested)

Consent to Publish (Authors consent to publishing)

Authors Contributions (All co-authors contributed to the manuscript)

Code availability (Not applicable)

REFERENCES

AbdelRahman, M. A., Natarajan, A., & Hegde, R. (2016). Assessment of land suitability and capability by integrating remote sensing and GIS for agriculture in Chamarajanagar district, Karnataka, India. *The Egyptian Journal of Remote Sensing and Space Science, 19*(1), 125-141.

Adams, V. M., & Engert, J. E. (2023). Australian agricultural resources: A national scale land capability map. *Data in Brief, 46*, 108852. https://doi.org/10.1016/j.dib.2022.108852, http://dx.doi.org/10.1016/j.ejrs.2016.02.001 1110-9823

Abou-Naiem, S., Palacios-Rodríguez, G., Darwish, T., Faour, G., Kattar, S., Clavero Rumbao, I. & Navarro-Cerrillo, R.M., (2019). Land Capability for Agriculture, Hermel District, Lebanon. *Journal of Maps*, *15*(2), pp.122-130.

Ahmadi, O., Alamdari, P., Servati, M., & Khoshzaman, T. (2020). Investigate the suitability and capability of lands using parametric methods to achieve sustainable development. *Geography and Development, 18*(61), 1-28.

Akhvan, Jalalian, Ahmed, Tomanian, Nurair, Hornajo and Nasser, (2023). The application of multi-criteria decision making model in land suitability assessment. DOI: 10.22067/JSW.2023.78892.1205

Alikhah Asl, Naseri and Doshvarpasand, (2019). Determining the potential of land for the development of agriculture and pasture in the rural areas of the Sari-Qomish watershed in Ardabil province. *Village and Development, 21*(4), pp. 111-89. DOI: 10.30490/RVT.2019.85220

Fadhilla, S., Kusumandari, A., Lubis, Y. S., Siregar, A. W., & Hakim, L. (2022, December). Land capability analysis using LCLP software in cangkringan micro watershed model. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1115, No. 1, p. 012058). IOP Publishing. https://doi.org/10.1088/1755-1315/1115/1/012058

Ghorbani (2015). Preparation of land use map and evaluation of the utilization capacity of Zilbarchai watershed rain fields for conversion to fodder cultivation based on the slope factor using geographic information system.Geographicalspace,14(48),pp.103122.

Jalalian, A. Ayubi, Sh. (2014). Land evaluation (agricultural use and natural resources), *Isfahan University of Technology, 4th edition.* ISBN: 9789648476231

Kelley, H. W. (1983). Keeping the land alive: soil erosion--its causes and cures (No. 50). Food & Agriculture Org..

Khalifa , Alikhah Asl, Rizvani and Mohammad, (2018). Assessment of land potential for agricultural and pasture development using the Hierarchical Analysis Process method (Case study: Gezdraz-Lavar coastal watershed of Bushehr province). *Geographical Research,* 33(1), pp. 109-123'. DOI:10.29252/geores.33.1.109

Martin, D. and Saha, S.K., (2009). Land evaluation by integrating remote sensing and GIS for cropping system analysis inawatershed. *Currentscience*,pp.569575.

Mesgaran, M.B., Madani, K., Hashemi, H. and Azadi, P., (2017). Iran's land suitability for agriculture. *Scientific reports*, *7*(1), pp.1-12. DOI:10.1038/s41598-017-08066-y

Moravej, K., Delavar, M. A., & Najafi, V. (2018). Importance of Using Modern Irrigation Methods in Increase of Employment and Development of Rural Areas. *Geographical Researches*, *33*(2), 175-190. https://doi.org/10.29252/geores.33.2.175

Nainiva, S. P., & Jalilian, S. (2022). Determining the capability of agricultural lands and the degree of compliance with the principles of environmental management (Case study: the Chehelgazi Sub-basin, Kurdistan province). *Integrated Watershed Management*, *1*(2), 83-94.

Ozcan, H. (2006). GIS based land evaluation of the high land in east Mediterranean region, Turkey. *Journal of Agricultural Faculty, Harran University*, *10*(1/2), 17-27.

Rahdari, V., Soffianian, A., Pormanafi, S., Ghayomi Mohammadi, H., Maleki, S., & Pormardan, V. (2020). Multi-Criteria Evaluation for Land Rain-Fed Agriculture Capability (A Case Study: Plasjan Sub-Basin). *JWSS-Isfahan University of Technology*, *23*(4), 285-297. DOI: 10.47176/jwss.23.4.6211

Roy, J., & Saha, S. (2018). Assessment of land suitability for the paddy cultivation using analytical hierarchical process (AHP): A study on Hinglo river basin, Eastern India. *Modeling Earth Systems and Environment*, *4*, 601-618.

Shahbazi, Aghajanlou, Khalil, Ain Lo, Ahmadian and Mamek, (2015). Preparation of land ecological potential map using GIS and comparing it with the current land use map (case study: Goni watershed). *Pasture and Desert Research of Iran, 21(4), pp.718-730.* DOI: https://doi.org/10.22092/ijrdr.2016.13075

Utama, P. W., Adnyana, S., & Wayan, I. (2019). Evaluation of land use with land capability classification using satellite data and GIS in Batur UNESCO Global Geopark. *Ecotrophic*, *13*(1), 61-73. https://doi.org/10.24843/EJES.2019.v13.i01.p07