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STUDYING THE EXTENT OF COMPATIBILITY OF AREAL CHANGES BETWEEN VEGETATION COVER AND URBAN SPRAWL IN THE CITY OF M'SILA USE OF REMOTE SENSING TECHNIQUES AND GEOGRAPHIC INFORMATION SYSTEMS

Mohamed Soufiane DOGHA*
University of M'sila, Institute of Urban Techniques Management, Laboratory of City, Environment, Hydraulics and Sustainable Development, PO Box 166 Ichebilia, 28000 M'sila, Algeria; e-mail: mohamedsoufiane.dogha@univ-msila.dz

Bachir FAID
University of M'sila, Institute of Urban Techniques Management, Laboratory of City, Environment, Hydraulics and Sustainable Development, PO Box 166 Ichebilia, 28000 M'sila, Algeria; e-mail: bachir.faid@univ-msila.dz

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Abstract: This study analyzed changes in vegetation cover and their relationship to urban sprawl in the city of M'sila by conducting a controlled Supervised classification of satellite images of vegetation and urban sprawl during the periods (1990 -2000 -2010 -2023), Using geographic information systems and remote sensing, then detecting areas of change and urban sprawl and clarifying and demonstrating the factors affecting them, The study classified land cover into three main types (Vegetation, built-up, barren land), It was also shown that there was a change in land cover areas, as the percentage of change in vegetation reached about 6.87%, and its percentage in built-up reached about 113.12%, while the barren lands recorded a percentage of (– 50.12%), during the period (2010 – 2023), The results showed that there is an increase in the rates of changes in vegetation and built-up, but in inconsistent proportions, which may lead to the deterioration of vegetation, while barren lands recorded a significant decline in their areas, The study recommended the necessity of monitoring urban sprawl and its relationship with vegetation, and drawing maps of changes during specific time periods to determine urban sprawl in order to control it and ensure efficiency and harmonious development in the city.

Key words: Vegetation, Built-up, Remote sensing, Indicators of changes, M'sila city

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* Corresponding Author

INTRODUCTION

Urban sprawl is an ongoing dynamic phenomenon for various cities in the world, both poor and rich (Yasin, Yousoff, Abdullah, & Noor, 2020). As most of them grow and expand, influenced by several factors that control their dynamism and urban structure. This expansion is accompanied by several changes and transformations of the city, whether spatial, human or functional (Dadashpoor, Azizi, & Moghadasi, 2019). It has been threatening the environment and development in many cities of the world for years, and its causes and effects vary from one city to another, depending on the factors leading to it natural, human (Hardov, Mitlin, & Satterthwaite, 2013). After becoming saturated, the city begins to search for other spaces for expansion, with the aim of meeting the needs of its population, whose number is constantly increasing at high rates, such as housing, equipment, and other jobs and spaces (Taiwo & Adeboye, 2013). It leads to the emergence of new residential areas as a result of rapid demographic growth and the migration of the countryside towards the city, and considering the latter a refuge for stability, rest, and practicing various activities, which leads to over-consumption of urban real estate and an irrational and unbalanced doubling of its area (Garcia, 2010).

The current uncontrolled urban expansion poses a major challenge to urban planners (Cobbinah & Amoako, 2012). Given the great threats and impacts on the natural environment in various cities, which was part of this expansion at the expense of vegetation and green spaces in the city and its surroundings (Haaland & Van Den Bosch, 2015), this common phenomenon has posed a challenge to most countries of the world, due to the population increasing at high rates, the expansion of urban activity, and the consumption of environmental resources far from the principles of sustainable development (Tarawneh, 2014). One study indicated that the United States of America lost the equivalent of 400 hectares of land annually as a result of its exposure to urban expansion during the period 1972-2000 (Angel, Parent, Civco, Blei, & Potere, 2011). It would increase its urban and environmental problems, which in turn would lead to a decline in the standard of living in it, This phenomenon requires the necessity of studying it and reducing its negative effects on the environment and vital systems surrounding cities.

Studies monitoring and tracking the urban expansion of cities and environmental dangers resulting from changes in ecosystems and patterns of misuse of land and natural resources are important vital studies (Mugiraneza, Ban, & Haas, 1019). These studies provide accurate and comprehensive data on the patterns of urban expansion and its quantitative and qualitative characteristics, and determine the changes that have occurred over time, and the trends and rates of its development (Xu, Zheng, & Zhang, 2018). It helps planners and decision makers in developing policies for optimal land use and creating investment plans that serve the economy and development, Analysis and interpretation of land cover, its transformation and dynamism are among the most important factors taken into consideration when developing planning policies and strategies at different levels (Minale, 2013). The study of land cover is considered one of the most important methods used to study methods of managing and developing various natural resources in light of the increasing population of the world's cities and the overexploitation of natural resources through various human activities at accelerating rates (Dhinwa, et al., 1992). It contributes to strengthening planning decision-making processes and updating databases, using remote sensing techniques and geographic information systems as they are modern and effective means of studying various natural resources (Merem & Twumasi, 2008), by identifying their characteristics and locations, then monitoring them and developing optimal plans to exploit them, according to results and indicators that inform future prediction and change in different types of land cover and land uses (Anand & Oinam, 2020). Therefore, every country seeks to regulate the use of its natural resources by preparing maps of land cover and land use, which are prepared using cadastral methods, whether ground or using remote sensing methods.

Algerian cities, including the city of M'sila, are witnessing, at the current stage of their history, broad and multi-directional social, economic, political and urban transformations at the local and regional levels, which has had a significant impact on its large and unbalanced urban

expansion, as a result of the high rate of population growth and poor urban planning, which has It directly contributed to the exposure of the study area to many problems that contributed to the deterioration of the environment and its resources, which would lead to a decline in the standard of living there, For this reason, this study monitored and tracked urban sprawl in the city of M'sila and its compatibility with vegetation and the environmental risks resulting from these changes during specific time periods (1990, 2000, 2010, 2023), This study provides accurate and comprehensive data on urban sprawl patterns and its quantitative and qualitative characteristics, and identifies the changes that have occurred over time (Awoniran, Ougbamila, & Omisore, 2020). And the trends and rates of its development, in a way that supports decision-making processes for planning, development, management and monitoring of the natural and environmental resources of the study area, in addition to its importance in creating digital maps and managing and updating databases on land cover patterns and linking it to the reasons that led to its change, which contributes to achieving the greatest amount of sustainable development for the community.

This study also uses applications of geographic information systems and remote sensing techniques, as modern technologies that contribute to the development of analytical and applied geographical studies (Thakur, Singh, & Ekanthalu, 2017). These techniques are characterized by their accuracy, comprehensiveness, compatibility and suitability for studying natural and human dynamic changes in the Earth's surface (de Paul Obade & Lal, 2013). In addition to its importance in identifying, evaluating and analyzing problems resulting from changes in urban sprawl patterns and their compatibility with the vegetation of the study area.

STUDY AREA

The city of M'sila is one of the inner Algerian cities located within the following geographical coordinates: Between two viewing circles: '35.48°, '35.67° north of the equator Between linear length: '4.57°, '4.48° east of Greenwich line the north-south link is the seat of the state (Kadri & Atmani, 2023). Thus, it occupies a distinguished astronomical position, given the natural, geographical and astronomical extension of the Algerian state (Figure 1).

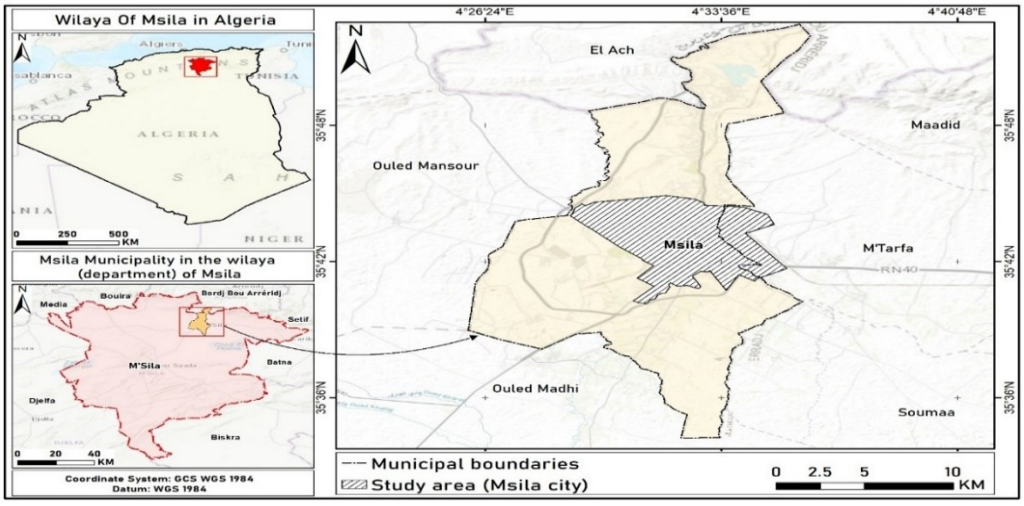

Figure 1. Location of the field of study City of Msila
(Source: Treatment of the researchers by Arc Map 10.2.2, 2023)

The city of Messila has emerged as an urban center in its current location as a result of the abundance of natural resources and its distinctive geographical characteristics, The Valley Al-Qasab passes through it longitudinally from north to south, dividing it into two parts, the eastern

part and the western part, The city represents the capital of the Al-Hudna region and its urban base, far from the Mediterranean Sea. Its height is 100 km, and it rises 470 m above sea level (The Directive Plan for The Planning and Reconstruction of The Municipality of M'sila, 2015). The city includes a group of residential neighborhoods distributed around the central area, and these neighborhoods are connected to each other by a number of main and arterial roads and other local and subsidiary roads, The city is also characterized by economic diversity, Municipality of M'sila, Its area is estimated at 252 km2, it is inhabited by (214,661) people, and the population density is (925) people, according to the Department of Municipal Statistics 2014 (Dehimi & Hadjab, 2019).

MATERIALS AND METHODS

This study used the analytical approach in order to analyze patterns of land cover and the changes that occurred in its uses, and to analyze indicators of environmental deterioration in the study area, to determine the factors responsible for the occurrence of these changes, as well as an approach to Change Detection Through Time in a comparative manner To reveal changes in land cover patterns, uses and areas as a geographical phenomenon, and also to reveal the factors that led to this change over a period of thirty-three years (33 years), where classification indicators were used to achieve the purpose of the study, The most important indicators used in the study are:

- Natural Difference Vegetative Index (NDVI): This index is based on the fact that plants show higher reflectivity in the near infrared wavelength range than in the red wavelength range, and it is calculated by the following equation (Vaughn, 2019):

  $$NDVI = Band\ (NIR) - Band\ (RED) / Band\ (NIR) + Band\ (RED)$$

  The values of (NDVI) range from (1+ to 1-). In general, if the result is positive, this is an indication that the cell has vegetation, and the higher the value indicates greenness, and vice versa if the values are negative (Meera Gandhi, Parthiban, Thummalu, & Christy, 2015).
- Urban Difference Index (NDBI): It is an index used to distinguish urban or densely built areas, and it is the difference between the spectral reflectances at the near infrared wavelength according to the following equation:

  $$NDBI = Band\ (MIR) - Band\ (NIR) / Band\ (MIR) + Band\ (NIR)$$

  NDBI values depend on the distinct spectral response of built-up land, which has high reflectivity at mid-infrared wavelengths and lower reflectivity at near-infrared wavelengths, Therefore, in the study, built-up or urban areas appear white or bright, with negative or zero numerical values (As-syakur, Adnyana, Arthana, & Nuarsa, 2012).

In this study, satellite visualizations were classified as follows: The general goal of visual classification is to automatically classify image elements into land cover categories, Multispectral data are usually used to accomplish this classification, as digital classification is important in studying land cover. The process of classifying visuals by values is done based on numerical fields and has two types of classification:

- Supervised Classification.
- Un Supervised Classification.

Each type has a method of analysis through the computer according to the criteria used with each classification (Ali, 2013).

This study relied on a classification approach directed at researchers' knowledge of the region through field visits to it. This method is used when training samples are available, and its basis is that any type of object in the scene consists of image units with similar value to each other. Land cover patterns and uses in the study area were divided into three classifications (vegetative, built-up lands, barren lands), where the observer's work was classified according to the (Arc GIS) system in correcting the reflectance values for LandSat-05 and LandSat-08 satellite visuals by applying special mathematical equations to calculate spectral reflectivity (Chander, Markham, & Helder, 2009). Using the same program, indicator values were calculated using a tool (Raster Calculator), Located within tools (Spatial Analyses Tools), This tool calculates the spectral

reflectivity between selected wavelengths from within the set of positive wavelengths available in satellite visuals using a mathematical relationship specific to each indicator.

In this study, satellite visuals from the LandSat satellite were used for the years 1990, 2000, 2010, and 2023. It was taken into account that the visuals were taken in the month of August for the different years in order to take into account the favorable weather conditions such as the absence of clouds, the ease of distinguishing land cover in this period compared to the spring season (Table 1).

Table 1. Characteristics of space visuals
(Source: The work of the two researchers based on usgs)

/	1990	2000	2010	2023
Satellite	LandSat-05	LandSat-05	LandSat-05	LandSat-08
Capture date	25-08-1990	20-08-2000	31-07-2010	20-08-2023
WRS Path	195	195	195	195
WRS Row	035	035	035	035
Sensor Identifier	TM	TM	TM	OLI_TIRS

RESULTS AND DISCUSSION

It became clear to us through the study that the city of M'sila witnessed clear changes during the years 1990, 2000, 2010, 2023, and the study revealed changes in all classification categories. This is due to the development that the city of M'sila witnessed in the urban aspect (built-up lands), in addition to the increase in population density that the study area witnessed during the past thirty-three years. Four maps were also created as a result of the classification (Figure 2).

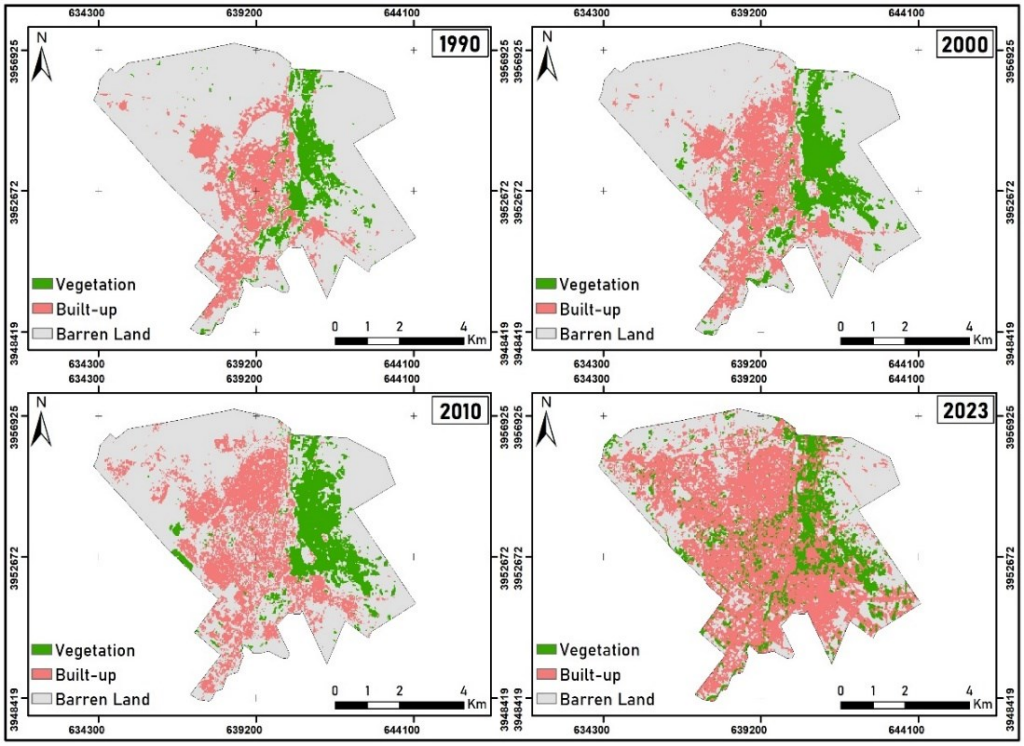

Figure 2. Classification of land cover in the city of M'sila
(Source: Authors' GIS data procesessing 2023)

It is clear to us from the previous figure that the relationship of vegetation to the built-up land in the city of M'sila is distributed inconsistently through density, area and diversity, as it is governed by a group of factors (natural and human), as its distribution takes different ranges in its concentration, which are:

- Vegetative in the valley areas outside the city: represented by Valley al-Qasab, which extends longitudinally from north to south on the eastern side of the city. It has first-class fertile soil, and fruits and vegetables are grown in it (Nawara, Boukhmisa, Ouled Badira, Ouled Salama, Mazarir).
- Vegetation in the valley areas and within the city: The city extends around the Valley Al-Qasab, which is in the middle of the city, and enjoys first-class fertile soil in which fruit and vegetable trees are grown (Al-Kush District, Al-Jaafra, La Rocade, Al-Jinan Al-Kabir, and others) represented by vegetation, prepared green spaces, road trees, and spaces distributed within the city.
- Vegetative around the city: It is found in low plain lands that extend scatteredly and in small areas on the city borders from the northwestern and southwestern sides, It has fertile, second-class soil depending on its location, and its most important crops are wheat, barley, and fruit trees.

Table 2. Changes in land cover area in the city of M'sila in the period 1990-2023
(Source: Author's image analysis, 2023)

/	1990		2000		2010		2023	
	km^2	%	km^2	%	km^2	%	km^2	%
Vegetation	4.11	8.70	6	12.70	6.4	13.55	6.84	14.48
Built up	8.24	17.44	11.27	23.86	12.27	25.97	26.15	55.35
Barren land	34.89	73.86	29.97	63.44	28.57	60.48	14.25	30.17
Total	47.24	100	47.24	100	47.24	100	47.24	100

It became clear to us from the previous table that:

- The area of vegetation in 1990 amounted to 4.11 km^2, representing 8.70% of the total area of the study area, while an area of 6 km^2 was recorded, representing 12.70%, in the year 2000. Then it increased to 6.4 km^2, representing 13.55% in 2010, until an area was recorded of 6.84 km^2, or 14.84% in 2023.
- The built-up land area in 1990 was 8.24 km^2, representing 17.44% of the total area of the study area, while in 2000, the area was 11.27 km^2, representing 23.86%. Then, an area of 12.27 km^2, at a rate of 25.97%, was recorded in 2010, and the largest area of 26.15 km^2, at a rate of 55.35%, was recorded in 2023.
- The area of barren land in 1990 amounted to 34.89 km^2, representing 73.86% of the total area of the study area, while it recorded a decrease in its area, which was estimated at 29.97 km^2, representing 63.44%, in the year 2000. Then, an area of 28.57 km^2, representing 60.48%, was recorded in 2010, to It recorded the largest decrease in 2023, recording an area of 14.25 km^2, or 30.17%.

Table 3. Percentage of change in the land cover area of the city of M'sila from 1990 - 2023
(Source: Author's image analysis, 2023)

Percentage of change	1990 - 2000		2000 - 2010		2010 – 2023	
	km^2	%	km^2	%	km^2	%
Vegetation	1.89	45.98	0.4	6.66	0.44	6.87
Built up	3.03	36.77	1	8.87	13.88	113.12
Barren land	- 4.92	- 14.10	- 1.4	- 4.67	- 14.32	- 50.12

The results of using the approach to detect change in land cover patterns by comparison between maps of land cover patterns for the period 1990 to 2023 also showed that there is a clear change visible through the classification maps in the area of each type of land cover and the spatial distribution of each type (Table 3; Figure 3).

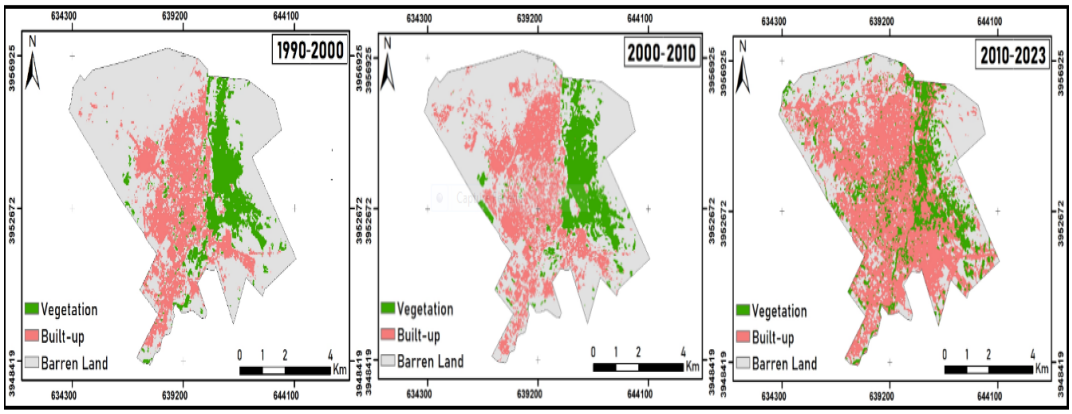

Figure 3. Classification of land cover in the city of M'sila across various periods
(Source: Authors' GIS data procesessing 2023)

It became clear to us through (Table 3 and Figure 3) in which the approach was used to detect change in land cover patterns by comparing maps of land cover patterns for different periods (1990, 2000) (2000, 2010) (2010, 2023) that there is a clear change that can be seen from Through maps Classification according to the area of each type of land cover and the spatial distribution of each type according to:

Vegetation monitoring: The process of monitoring changes that occur in the vegetation of the study area is considered one of the important matters, as the previous table and map show us the most important changes that occurred in the vegetation in the study area for the different periods from 1990 to 2023, which gives us a clear picture of the extent of the exposure of the vegetation during this period:

- **Period 1990 - 2000:** The area covered with plants in 1990 was 4.11 km^2, representing 8.70% of the total area, We note that in the year 2000, the area of vegetation cover, which was estimated at 6 km^2, increased by 12.70% of the total area, and thus the percentage of change in this period from 1990 to 2000 with regard to vegetation cover was 45.98% (Figure 3 and Table 3), During this period, the vegetation in the area increased as a result of the decrease in drought rates in the region and the prevailing climatic conditions of low temperatures and high rainfall rates, Which led to the conversion of large areas to vegetation, in addition to human factors, through the creation of a group of green spaces that were equipped during this period, numbering 67 green spaces distributed over a group of residential neighborhoods in the city, as well as planting roads and empty spaces, Attention was also paid to the agricultural areas adjacent to Wadi al-Qasab on the eastern side by reclaiming some lands and planting them with various types of fruit trees (plums, olives, apples, oranges, wheat, barley...) due to the availability of water during this period.
- **Period 2000 - 2010:** During this period, the vegetation area in 2010 amounted to 6.4 km^2, representing 13.55% of the total area estimated at 47.24 km^2, We noticed that it increased by a very small amount of 0.4 km^2 compared to what was recorded in 2000, The percentage of change reached 6.66%, which is a small percentage compared to the previous period, This weak increase is represented by the continued reclamation of some

lands and their conversion to agricultural lands on the eastern side of valley Al-Qasab, Some streets, roads, and spaces within residential neighborhoods were also planted by residents, as well as the municipality, while the vegetation cover decreased in the northwestern side due to neglect and lack of awareness on the part of residents, and this is what we notice in (Figure 3).

- **Period 2010 - 2023:** The vegetation area reached 6.84 km^2 in 2023, representing 14.48% of the total area, a very slight increase of 0.44 km^2, The percentage of change in this period was 6.87%, which is a very small percentage and close to the previous percentage in the period (2000-2010), where two important observations were recorded:
  - A very large imbalance in the agricultural areas on the eastern side of Valley Al-Qasab, as can be seen in (Figure 3), This is due to the decrease in the area of vegetation in agricultural areas due to their being seized and converted into built-up lands, This is due to the legal nature of ownership of agricultural lands in the eastern side, in which ownership is divided into private ownership, which represents 81% of the lands, while public sector ownership represents 19%, Which facilitated the seizure of these agricultural lands, especially orchard lands, as after they were converted into barren lands due to lack of water and rain (drought period), they ended up, under the temptation of land speculation, in random urban areas, as we observed during field visits:
    - Widespread and unjust cutting of trees and plants to use for heating and fuel.
    - Agricultural activity depends on the water of the Qasab Dam, the water of which continues to decrease due to lack of rain and high temperatures.
    - Due to the uncertainty about the future of agriculture due to water shortages, most farmers have abandoned their agriculture, which is no longer sufficient to earn a living, while job opportunities exist in other activities that offer better living conditions.
    - Although the owners held on to their lands, which had become barren lands, the living conditions and the temptations of land speculation led them to sell their properties, so that it became an area for illegal and chaotic construction (Figure 3).
    - Expansion of the vegetation area in the northwestern side of the study area (Figure 3), By planting some empty spaces, prepared areas, streets and roads, and also exploiting some lands for agriculture (olives, trees, apple trees, wheat, barley) on the borders of the study area.

Built-up land: Monitoring the changes that occurred in the built-up land in the study area for a group of periods, through which a clear picture of the area for each period can be given, is as follows:

- **Period 1990 - 2000:** The built-up land area of the study area in 1990 was 8.24 km^2, or 17.44% of the total area, Then the area increased in 2000, It reached 11.27 km^2, or 23.86% of the total area, While the percentage of change for the period (1990-2000) reached 36.77%, and thus the area of change was positive, As a result of the lack of clarity and instability of the situation through the availability of unbuilt lands that can be developed and the absence of legal, regulatory and legislative texts that control the growth of the city of M'sila and its urban area in general and urban lands in particular, which led to the emergence of new urban forms and uses of public spaces, It facilitated its exploitation and produced an expanded city, New neighborhoods appeared in this period, and varying rates of changes and areas were recorded due to the urban crises that the city of M'sila experienced as a result of the large population growth resulting from rural migration and the large natural increase estimated at 3.24, The Algerian legislator has thought about finding new mechanisms and means that are compatible with the aspirations and requirements of the population to live in an appropriate urban environment, Law No (90/29) from 12/01/1990 related to development and reconstruction

was to organize and manage the urban space through two important tools: The directive Plan for The Planning and Reconstruction, Land occupation plan, In 1992, he began preparing more than 20 land occupation plans distributed over the city of M'sila as a whole, Especially in the northwestern side, This was translated on the ground in the distribution of many land plots in the form of real estate cooperatives (Al-Nasr Cooperative, Al-Amal Cooperative, Boumediene Cooperative... etc.), Kharkhash subdivision, Jinan Boudiaa etc.

- **Period 2000 - 2010:** The built-up land area witnessed a slight increase in 2010, reaching 12.27 km^2, a rate of 25.97% compared to the year 2000, while the percentage of change during this period (2000-2010) decreased to 8.87% as a result of the financial crisis that Algeria went through, which affected land consumption, Its result was limited to the creation of some new neighborhoods in the northwestern side (Figure 3), with a re-densification of the existing urban fabric at the city level and the exploitation of urban enclaves, Where did a group of public facilities appear (the Judicial Council, the Finance House, banks, the Agriculture Directorate...etc.) and this after the rapid consumption of all the lands identified by development and reconstruction tools as areas for future expansion on the one hand and increased need on the other hand, This period was characterized by population growth, which was matched by an increase in demand for land suitable for development in light of its scarcity, which prompted local authorities to resort to densification processes in the existing urban fabric, which was one of the reasons that contributed to changing the image of the city, as follows:
  - Reducing unbuilt areas through densification processes, which changed the face of the city.
  - The nature of the real estate land for these spaces was owned by the state and local communities, which facilitated the densification processes, which changed part of the city's features.
- **Period 2010 - 2023:** The built-up land area witnessed a significant increase in the year 2023, as the area doubled and reached 26.15 km^2, or 55.35% of the total area of the city, The percentage of change was also recorded in the period (2010-2023), which was estimated at 113.12% and therefore it is high and clear (Figure 3), This period witnessed a comfortable financial situation for the Algerian state, which accelerated the pace of urban growth in the study area due to the large demands for housing and services, Accordingly, the city of M'sila benefited from various residential, administrative, service, and industrial projects and thus affected the exploitation of lands in various regions (northern, southern, eastern, and western) for various projects, as well as the consumption of real estate reserves, New collective residential neighborhoods were created (1600 dwellings, 600 dwellings, 300 dwellings, 525 dwellings...etc.), as well as the construction of land parcels in various areas and places, which consumed large real estate areas, In addition, random buildings appeared on the southeastern and western sides of the study area.

  The growth of the built-up area of the study area was also recorded at the expense of the vegetation cover on the eastern side of Valley Al-Qasab, where a large portion of the vegetation cover was seized and converted into built-up lands due to the legal nature of agricultural land ownership, which facilitated the seizure of these agricultural lands illegally.

  Also, the urban planning of the study area in this period was not according to a comprehensive and thoughtful development plan, but rather was distinguished by its circumstantial and functional nature that meets the various needs of the population, by seeking to change the real estate nature of the area of the city of M'sila with various legal and financial mechanisms and means, to affect the increase of the built-up land to reach To the form of the urban fabric that it is now.

Barren land: It includes barren rocky lands, unsuitable for agriculture, sand, soil, etc., where the changes that occurred on the barren land were monitored for a group of periods, and through it a clear picture of the region can be given for each period, as follows:

- **Period 1990 - 2000:** Barren lands constituted the largest area of the study area in the period (1990-2000), as its area in 1990 amounted to about 34.89 km^2, or 73.86% of the total area, During this period, it also witnessed a decrease in its area, recording a decrease of 4.92 km^2, with a change rate of 14.10%, As a result of urban sprawl in various places of the study area, as well as the reclamation of some lands for agricultural purposes.
- **Period 2000 - 2010:** During this period, the barren land continued to lose their area through their transformation into urban and agricultural areas, as they recorded a decline in their area, recording a change rate of 4.67% as a result of the various urban projects established by the city of M'sila.
- **Period 2010 - 2023:** During this period, the barren land recorded a significant change in their area, as their area continued to shrink, as they recorded a loss of area estimated at 14.32 km^2, with a large change rate of about 50.12%. This is due to their exploitation and conversion to built-up lands (urban sprawl), as well as the cultivation of part of them.

CONCLUSIONS AND RECOMMENDATIONS

The subject of studying changes in vegetation and urban sprawl and their compatibility has recently received great attention through administrative and political initiatives from local and international bodies and organizations to control and monitor them, As they are among the most important negative phenomena resulting from unbalanced relationships while, They have resulted in many problems, such as environmental, economic and social damage to the city and its development plans, Therefore, experts and urban planners must initially describe changes in vegetation and the extent to which it is affected by urban sprawl in cities, noting its causes and characteristics, and determining whether the local administration in the city must control and monitor it to ensure compatibility between them.

This study showed the importance of using remote sensing methods and techniques and geographic information systems, which saved a lot of effort, time and cost in determining the changes that occurred in the land cover of the study area in past periods of time, As well as calculating land cover ratios, estimating its area, and calculating its increase and decrease, We also concluded, through analyzing and discussing the results obtained, that there are significant changes that have occurred over time, that is during the specified periods, in the areas of vegetation and built-up land and their incompatibility, and the main reason is the human factor (population increase, high growth rate 3.24, rural migration) and the natural factor (drought, high temperatures, and lack of water from the Reed Dam), which greatly affects it, which led to multiple forms and forms of urban sprawl in the study area, To preserve and protect vegetation, we recommend that:

- The necessity of monitoring vegetation and its compatibility with urban sprawl, and drawing maps of changes during specific time periods to know, identify and control urban sprawl to ensure effective and harmonious development in the city.
- Vegetation cover must be preserved from deterioration and destruction by limiting urban sprawl in accordance with the application of environmental conservation policies, establishing protected areas, and directing urban sprawl in areas suitable for development.
- It is necessary to combine measures to control urban sprawl and conduct appropriate studies of its effects and apply them continuously to preserve vegetation in cities and prevent encroachment on it.
- Planting roads, streets, areas and spaces that suffer from a lack of vegetation, which enhances and contributes to biodiversity, improving soil quality and carbon retention.
- Enacting strict laws and legislation with specific implementation mechanisms and activating them in the event of any construction or agricultural violations or illegal land exploitation.

Aknowlegments

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