Migration Letters

Volume: 21, No: S11 (2024), pp. 197-208

ISSN: 1741-8984 (Print) ISSN: 1741-8992 (Online)

www.migrationletters.com

The Role Of Geographic Artificial Intelligence In Achieving Sustainable Development In Dry Regions Of Algeria

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Received: 01/2024 Published: 07/2024

Abstract

In recent years, the term sustainable development has appeared, which most countries, whether developing or on the path to growth, have adopted to become a necessity that must be achieved, especially after the global pandemic Corona, to achieve their national security. Most countries have taken this approach by developing comprehensive development plans aimed at meeting the needs of the population in the present and the future. It has environmental, economic and social dimensions. These development plans depend on the natural and human resources available in the region. In order to be more accurate and sustainable, it has become necessary to use modern technology, namely information systems and geographical artificial intelligence, which we will attempt to study in this research paper.

***Keywords**: sustainable development, geographic artificial intelligence, geographic information systems, sustainable development goals*

1. Introduction

In recent decades, the concept of sustainable development has been embraced by most countries in response to the catastrophic environmental, economic, and social conditions experienced worldwide. According to the Rio de Janeiro Conference in Brazil in June 1992, sustainable development was defined as fulfilling economic, social, and environmental progress simultaneously while preserving the sustainability of natural and environmental resources and meeting the needs of present and future populations. The conference set 17 goals for sustainable development in the Earth Summit's Agenda 21, highlighting that achieving sustainable development necessitates establishing and employing Geographic Information Systems (GIS).

Governors and decision-makers should employ new information technologies that offer the technical knowledge necessary to sustainably manage the environment and resources. These technologies create an environment that supports spatially based decision-making, especially GIS and artificial intelligence. This framework aids in addressing contemporary issues such as fulfilling food and water security and fighting climate change.

Questions such as "Where are we going?", "What should the situation be like?" and "What do we do when we get there?" are often raised. They are applied in regional specialization for geographic areas to guarantee their sustainability. Therefore, most disciplines and sectors today have begun to employ Geographic Information Systems (GIS) and artificial intelligence (AI).

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2. Problem Statement:

Nowadays, amid climatic and economic changes, the governments of Arab countries are seeking to fulfill national security, which can only be realized through sustainable development. This, in turn, necessitates the use of information technology. The raised question is: **What is the role of using geographic information systems combined with artificial intelligence systems in achieving sustainable development goals in dry desert regions?**

3. Study Importance:

- Identifying the nature of GIS and geographic AI.
- Determining the evolution of the concept of sustainable development, its 17 goals, and its environmental, economic, and social dimensions.
- Identifying the relationship between utilizing GIS combined with AI and sustainable development.
- Highlighting the reality and role of employing GIS in fulfilling sustainable development goals.

4. Study Objectives:

The main objective of the research is to offer a precise scientific definition of GIS and geographic AI. This will be fulfilled through:

- Studying the nature of GIS and its areas of application.
- Studying the nature of AI and defining the concept of geographic AI.
- Exploring the relationship between geospatial AI and GIS.
- Examining the nature, dimensions, and goals of sustainable development and its relationship with utilizing GIS combined with AI.

First: Theoretical Aspect:

1. Geographic Information Systems (GIS):

Geographic Information Systems (GIS) are structured, location-based information systems designed to collect, process, analyze, and display data related to specific locations to derive valuable insights. GIS depends on computers, allowing it to store, organize, and classify vast amounts of spatial data. It has proven its significance in solving different problems associated with daily life and sustainable development. It stores data in the form of interconnected spatial layers, offering a strong method for spatial analysis.

1-1 Evolution of the Geographic Information Systems (GIS) Concept:

The world experienced rapid advancements in computer technology, encompassing applications, starting from the last quarter of the twentieth century. Eventhough the history of Geographic Information Systems (GIS), one of the most well-known computer applications in civil works today, dates back to the 1960s, its development and widespread use in the form we witness currently only started towards the end of the last century as we entered the third millennium.

GIS depends on connecting vast areas of maps with large quantities of data related to these maps. This capability facilitates displaying data with maps in different ways and processing operations to extract results with minimal effort and in the shortest time possible. This technology is employed in conducting studies and research, identifying solutions to various problems, quickly searching for specific locations on maps, and obtaining information about these locations.

Any information system involves collecting data in digital or analog form, representing phenomena from the real world, along with devices, software, and human expertise to employ this data and extract information from it, benefiting various fields. This data can be:

- **Direct data**, like data about the Earth's surface, is collected from surveying activities employing known surveying devices.
- **Derived data**, such as digital data from satellite imagery and aerial photos in remote sensing and photogrammetry activities.
- **Interpreted data** from satellite imagery and aerial photos, including land use and land cover data.
- **Observational data** from rainfall, temperature, wind speed, and relative humidity.
- **Descriptive data**, or tabular data, is organized in tables, including census data.
- **Data about specific locations**, like data about an oil well.

Despite numerous definitions for Geographic Information Systems (GIS), upon closer examination, it is evident that they are all similar and differ only in their formulation to suit several application fields. They are information systems consisting of hardware, software, and data, with highly multifunctional capabilities for decision-making and support. They handle spatial and descriptive data employing computers by qualified individuals who manage this data and information specific to different development domains. These systems collect, store, retrieve, display, and analyze information, determining locations and establishing relationships and correlations between datasets. Thus, G.I.S. hardware and software (a collection of computer equipment and software designed to store, extract, process, and analyze digital spatial data) aid in making appropriate decisions based on this analysis.

1.2. The Importance of Geographic Information Systems (GIS):

Geographic Information Systems (GIS) are significant because they can offer detailed location information on maps, such as villages, cities, streets, and more. For example, within these systems, one can search for a specific street name, and the map will show its location within the city, how to access it, and some information about it.

The extensive use of GIS has made spatial sciences more widespread and employed. It has raised public awareness about the significance of spatial signatures, prompting interest in retrieving various components of the Earth's surface from GIS datasets. Georeferencing information is crucial, as it assigns integrated spatial coordinates to elements on the Earth's surface regardless of when they occurred. This process is fundamental in distinguishing GIS operations, regarding the main purposes across different fields of Earth sciences or technical domains that express the needs of various organizations and institutions.

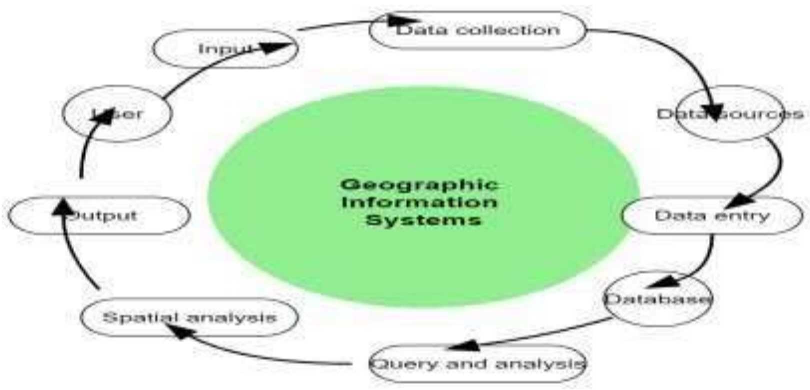
From the above definition, GIS can be seen as an advanced computer technology capable of gathering, storing, processing, analyzing, displaying, and outputting geographic and descriptive information for specific purposes. This involves entering geographic information (maps, aerial photos, satellite imagery, etc.) and descriptive information (geographic names, tables), processing it (error correction), storing, retrieving, and analyzing it (spatially and statistically), and then introducing it on a computer screen or in paper format such as maps, reports, and graphs.

It is possible to determine some of the primary elements that geographic information systems (GIS) must cover for any application as follows:

- **Data Acquisition**: Acquisition includes determining and gathering the data specific to the intended project to be executed. This process involves numerous procedures.
- **Data Preprocessing**: Data preprocessing involves organizing the data suitable for project input.

- **Data Management**: Involves configuring the database, gaining access, and updating it.
- **Data Manipulation and Analysis**: Refers to rearranging and analyzing the data to derive new information.
- **Final Product**: Represents the format in which the results of the preceding operations, which were generated utilizing GIS, are introduced to the user to make informed decisions.

Geographic Information Systems (GIS) diagram



3- Artificial Intelligence (AI)

3-1- What is Artificial Intelligence (AI)?

The Muslim scientist "Abu Ja'far Muhammad ibn Musa al-Khwarizmi" discovered "Algorithms" in the 9th century. They are a set of logical and sequential mathematical procedures and steps to solve any problem, simplifying and facilitating it. This concept led to the initial foundation for computers and programming languages, evolving to involve different branches of artificial intelligence. Algorithms appeared with the advancement of diverse computer programs in fields such as information systems management, geographical information systems, databases, and software. Handling millions of data without advanced algorithms, tools, and mathematical and logical procedures offered by various computer programs was challenging. Scientists have invested these ideas in decision-making, depending on algorithms composed of inputs and outputs. Inputs rely on accurate data; outputs and reliable indicators are as precise as the available data. Mathematical, statistical, and different programming operations, known as "processors and analyses," occur between inputs and outputs. Thus, the outputs serve as indicators for taking the required actions to resolve issues.

Over the past few decades, numerous definitions of Artificial Intelligence (AI) have appeared. The simplest demonstrates that AI is a system or device miming human intelligence to perform tasks and can enhance themselves by relying on the information they collect. Alternatively, AI combines computer science with powerful datasets to enable problem-solving. Furthermore, it can be defined as the ability of machines and digital computers to perform specific tasks that mimic intelligent beings, including the ability to think, learn from previous experiences, or perform other mental processes.

3-2- Geographic Artificial Intelligence:

During the 1960s and 1970s, artificial intelligence (AI) experienced a period known as "AI winter" due to AI methods' failures to address real-world complexities adequately. However, since the beginning of the 21st century, AI has witnessed significant progress, especially in Geographic AI (GeoAI). This marks a new approach based on creating intelligent models that employ computational techniques to solve spatial problems within a geographic framework and introduces a new methodological approach for monitoring, simulating, enhancing, and forecasting geographic realities.
GeoAI appeared around 2010, benefiting greatly from three key factors that facilitated its rapid advancement:

1. **Big Data**: Due to the significant advancements in remote sensing and user-generated content on the web, offering vast amounts of data.
2. **New Algorithms**: Developed by AI communities adopting ideas and theories from diverse fields such as statistics, economics, medical sciences, biology, physics, and cognitive sciences.
3. **Massive Computational Power**: Enabled the handling of big data and the implementation of new computational models, thereby supporting the creation of advanced AI models.

These three factors have substantially fueled the notable evolution of GeoAI in recent years.

4- The Relationship between Geographic Information Systems (GIS) and Artificial Intelligence:

As mentioned, GeoAI appeared as software algorithms designed separately and distant from Geographic Information Systems (GIS) and remote sensing environments. Since the beginning of the 21st century, geographers started integrating Artificial Intelligence (AI) as intelligent algorithms, first with remote sensing environments where some remote sensing programs were installed, and secondly with GIS environments where AI was employed as integrated intelligent algorithms, albeit not built within GIS software.

Research trends in spatial GeoAI have been consistent with research objectives that sought to integrate AI with geography. Some software companies have recently relied on intelligent AI methods to be built within GIS and remote sensing software. Therefore, research trends in spatial GeoAI have evolved along three main axes:

First Axis: Scientific research in GeoAI within Geographic Information Systems (GIS) seeks to fulfill accurate scientific predictions relying on extensive and voluminous datasets. One of the most renowned models in this context is Keith Clarke's Urban Growth Model (UGM), which employs Cellular Automata (CA). Initially implemented locally in the United States, this model was later adapted and improved into another model called SLUETH, suitable for global application across diverse geographical environments on Earth's surface.

Second Axis: Scientific research in Artificial Intelligence within remote sensing is based on improving various remote sensing analyses, notably Land Cover Classification Analyses. Among the critical methodologies used is Artificial Neural Networks (ANN), which have become one of the intelligent algorithms for classification. ANN allows researchers to fulfill the highest level of classification accuracy, surpassing traditional statistical classification methods commonly employed in remote sensing environments. Furthermore, researchers can achieve the highest possible accuracy when implementing advanced analysis techniques, especially in Change Detection Analyses.

Third Axis: This represents the contemporary trend in scientific research in spatial GeoAI by integrating and complementing intelligent methods within remote sensing and GIS environments. The purpose is to enhance analysis and prediction capabilities simultaneously.

5- Applications of Geographic Artificial Intelligence:

Geographic Artificial Intelligence applications are numerous, among the most prominent:

- **Prediction**: This technique employs known data values to derive unknown data values. The most notable example include interpolation methods such as IDW and Kriging.
- **Geo-enrichment**: The process of adding demographic data to a map to query specific location properties within the map.
- **Clustering**: Creating clusters of large datasets relied on shared features.
- **Simulation**: Simulating reality to study phenomena such as floods and inundations.
- **Modelling**: Simplifying reality, a method for introducing spatial data and connecting them to discover relationships and patterns.
- **Automation**: Converting manual processes that are time and effort-intensive into tools that execute these processes automatically.
- **Classification**: Classifying groups relied on common features, illustrated by land cover classification processes based on pixels or phenomena.
- **Object Detection**: Determining phenomena and objects from visuals.
- **Feature Extraction**: Extracting geographic characteristics from visuals.

These applications illustrate how Geographic Artificial Intelligence is utilized across various domains to enhance prediction, analysis, and classification using large datasets and advanced algorithms.

Future applications of Geographic Artificial Intelligence represent an ambitious trend to improve Geographic Information Systems software to accelerate the processing of massive and raising amounts of geographic data. Mentioned among these future applications are:

1- **Intelligent Geographic Assistant**: This intelligent system automatically implements processing and analysis operations without necessitating a user experienced in applying these analyses. Like Google Assistant, the Smart Geographic Assistant may understand the needs of Geographic Information Systems practitioners, automate task formulation and definition, and determine and implement the necessary tools from the Geographic Information Systems toolkit.

2- **Improved Intelligent Geographic Models**: This refers to refined models (or training processes), that allow the transfer of Artificial Intelligence models developed across various geographic regions. These models can be described as intelligent geographic models trained on data capable of determining features of various geographic regions and their impacts. Therefore, they can operate without creating new models and train data separately for each geographic area. The flexibility of Geographic Artificial Intelligence algorithms can address environmental effect features (such as geographic properties), often overlooked in modelling, such as spatial instability of phenomena and variations in features between environments[3].

5-1: Definition of Sustainable Development:

There have been numerous definitions of sustainable development since its emergence to the present day, including the following:

Sustainable development refers to efficient management and use of resources without waste or delay in investing in essential natural resources such as soil and water. It involves continuous maintenance and rehabilitation of investing in and employing these resources, coupled with human development in its different forms, encompassing livelihood, health,

[3] Falah Maarouf Al-Azawi (2016); Sustainable Development and Spatial Planning. Amman, Jordan: Dar Al-Dijla Publishing and Distribution, page 59.

education, recreation, and culture. All of this seeks to meet the population's current and future human needs through a network of responsible institutions and in accordance with modern, socially acceptable economic and technological capabilities.

5-2: Goals of Sustainable Development:

Since September 20, 2010, the United Nations Summit on Sustainable Development adopted a resolution titled "Transforming our World: The 2030 Agenda for Sustainable Development." This historic resolution was passed by 193 world leaders and heads of state in New York as a global and comprehensive vision for transforming the world into a better place. It entails 17 Sustainable Development Goals and 199 targets to decrease poverty and inequality, enhance health and education, fulfill economic growth, offer decent employment opportunities, guarantee clean energy, water, and infrastructure, establish sustainable cities, protect natural environments and biodiversity, and address climate change in peaceful and just societies.

These goals officially came into effect in developing countries in January 2016. They mainly focus on improving social and economic development, enhancing access to education and healthcare, and fostering renewable energy and sustainable agriculture, which is the focus of our study.

5-3- Significance of Sustainable Development:

Sustainable development links the current generation and the next, guaranteeing the continuity of human life and ensuring future generations a decent standard of living and fair distribution of resources within individual countries and nations. Its significance lies in decreasing economic reliance on external sources, distributing production, protecting the environment, fulfilling social justice, and enhancing national income.

A thoughtful and clear strategic vision is essential to narrowing this gap, fulfilling all priorities, and ensuring a legacy for future generations. The development also served as a bridge between the North and the South, integrating their interests and settling the debts of advanced countries that depleted the resources of underdeveloped nations during the colonial era.

5-4: Dimensions of Sustainable Development:

Sustainable development includes three fundamental dimensions:

Economic Dimension: Sustainability means fulfilling continuity through generating high income that enables reinvestment and facilitates replacement, renovation, and maintenance of resources. It encompasses sustainable production of goods and services while maintaining a balance that involves sustainable economic growth, capital efficiency, economic justice, and offering for and meeting basic needs, thereby enhancing individual welfare.

Social Dimension: It focuses on humans as the core and ultimate development goal. It highlights social justice, poverty alleviation, and offering social services to all who need them. It also guarantees democracy through transparent people participation in decision-making processes, sustains institutions, and preserves cultural diversity.

Environmental Dimension: It centers on preserving and protecting environmental safety and handling natural resources for human benefit without disrupting environmental components such as land, water, and air, which sustain human, animal, and plant life. It seeks to maintain and advance these resources, preventing depletion, pollution, or degradation.

Technological Dimension: Some consider it a secondary dimension of sustainable development, including cleaner and more efficient technologies that decrease energy consumption and other natural resources. This goal should be reflected in technological processes or systems that produce minimal waste and pollutants, internally recycle waste, and work with and support natural systems. It encompasses establishing specific laws with penalties and their enforcement. Typically, developing countries utilize less efficient technologies that cause more pollution than industrialized nations. Technological cooperation and cleaner and more efficient technologies can satisfy local needs, bridge the gap between developed and developing countries without further deteriorating environmental quality, and raise economic output. The relationship among the dimensions of sustainable development is one of integration and interdependence.

5- The importance of employing geographic information systems in sustainable development:

The significance of utilizing Geographic Information Systems (GIS) in sustainable development can be summarized as follows:

- GIS aids analyze and explain geographic, statistical, and environmental data, thereby determining relationships between them.
- Provides a large amount of geographic and environmental information that can be employed in managing natural resources and enhancing human quality of life.
- **E**ases the planning and application of environmental management plans, prioritizes actions, and assists in planning awareness campaigns.
- **I**dentifies geographic patterns of environmental issues and evaluates economic activities' positive and negative effects. It also pinpoints geographic locations for disposal of solid, liquid, and gaseous waste.
- **S**trengthens the monitoring and assessment of environmental quality, climate, seismic, inflationary, and maritime changes. It assesses predictions of their future implications.
- **F**acilitates planning and coordination among stakeholders involved in environmental development and supports sustainable development, especially in agriculture, tourism, industry, energy, transportation, and mobility sectors.

6- The use of geographic maps in sustainable development:

Utilizing geographic maps in sustainable development includes numerous critical applications:

- **Evaluation of Natural Resources:** Geographic maps can pinpoint the locations of natural resources including groundwater, forests, agricultural lands, and wildlife. This information helps in identifying sustainable resource utilization methods.
- **Environmental Management:** Geographic maps are valuable in determining areas necessitating environmental protection, such as ecologically sensitive zones or natural reserves that need conservation through eco-tourism or other sustainable uses.
- **Urban Development:** Geographic maps facilitate the development and organization of urban and civic infrastructure by determining appropriate areas for urbanization and assessing the environmental effects of such developments on surrounding areas.
- **Transportation Planning:** Geographic maps help determine optimal transportation routes and plan local and regional transportation networks while evaluating their environmental effect on the surrounding areas.
- **Land Management:** Geographic maps help determine areas suitable for agriculture and biodiversity conservation. They also aid in identifying available areas for mining and preserve wilderness and wetlands.

7- The Significance of Utilizing Geographic Information Systems (GIS) Accompanied by Geospatial Artificial Intelligence (GeoAI) in Sustainable Development:

The use of geographic information systems and artificial intelligence plays a significant role in fulfilling many of the sustainable development goals by offering valuable data, information, and insights that enable better decision-making, from mapping areas impacted by poverty and inequality to monitoring climate change, such as: determining areas where temperatures are abnormally high or irregular compared to the global average, identifying natural atmospheric processes that impact the greenhouse effect, as well as developing models to represent how rising climate temperatures can affect the environment in various regions. Furthermore, geographic information systems can aid in managing, explaining, and analyzing geographic data, as geographic information systems are tools employed to store, manage, and analyze geographic data and predict future trends. Thus, geographic information systems are a valuable tool for measuring progress and guaranteeing the effective fulfillment of many sustainable development goals worldwide.

We will focus on the role of employing Geographic Information Systems (GIS) accompanied by Artificial Intelligence (AI) in fulfilling sustainable development goals, encompassing sustainable agriculture (sustainable food security).

8- The Utilization of Geographic Information Systems (GIS) Accompanied by Artificial Intelligence (AI):

Since 2017, and in line with sustainable development goals, many developing countries have started employing geographic information systems (GIS) and artificial intelligence (AI) in different domains. Our study addresses the Egyptian experience utilizing GIS augmented with AI to evaluate the suitability of wheat cultivation in arid regions to improve food security and fulfill sustainable development in agricultural products.

Following recent global events such as the COVID-19 pandemic and the Russian-Ukrainian war, there has been a rising demand for agricultural products and food. This has accelerated expansion and enhanced agricultural land utilization to satisfy this demand, intensifying pressure on natural resources. Therefore, numerous developed and developing countries have recently altered their agricultural policies to preserve cultivated areas and employ them appropriately.

Recent climate changes threaten food security in dry and semi-arid areas, and greater attention is now being paid to them. Accordingly, guaranteeing the sustainability of agricultural production has become the primary goal of new policies compared to other land uses.

9. Applications of Geographic Information System (GIS) in Land Suitability Evaluation for Products:

Traditional methods previously employed for selecting land for cultivating specific products and evaluating their processing and analytical capabilities were limited to manually assembling paper maps. These methods necessitated considerable effort and time and did not integrate all-natural and productivity determinants. They also needed to offer more planning options and alternatives compared to those easily executable utilizing GIS. This technology allows the mapping of soil properties significant for crop planning and determining soil conditions such as acidity, salinity, and other vital information for crop growth. This aids farmers in identifying the potential success of cultivating a specific crop in the region. Studying the practical application of Geographic Information System (GIS) in choosing appropriate soil for wheat cultivation, which addresses many disadvantages and deficiencies resulting from traditional methods in arid land farming, saves time and effort, and allows for more flexible changes in features and goals. It offers several quick alternatives and options with accurate results. However, it necessitates combining planning thinking, expertise in computer usage, and the ability to utilize artificial intelligence accompanied by GIS software. Furthermore, it requires the availability of physical resources to buy software and equipment and the ability to link descriptive data with spatial data on maps.

Accordingly, researchers indicate that mapping land suitability is of utmost significance. After rice and maize, wheat is the third most significant crop, producing 189 million tons. However, this number needs to meet the rising demands of the growing world population.

The annual wheat production of 642 million tons needs to be raised to 840 million tons. The essential components of soil, such as texture, organic matter, slope (topography of the area), and depth, all contribute to land suitability. Moreover, human mismanagement, such as improper drainage, irrigation, and soil practices, can impact water quality, soil fertility, and crop management, thus affecting land sustainability. In some wheat cultivation areas, excessive nitrogen levels lead to decreased productivity.

Soil variation features over time can be addressed by employing enhancement techniques such as Fuzzy Inference Systems (FIS), which can be regarded as one of the most significant Artificial Intelligence techniques for soil indicator selection. However, these uncertainties impact the final decision. Planning for a specific crop production includes a combination of fuzzy algorithm calculations within GIS techniques, which serve as a suitable strategy for evaluating land suitability for crop cultivation while minimizing negative environmental and agricultural effects. This study utilized the Analytic Hierarchy Process (AHP) to judge the scales and calculate the priority index for each scale. The land suitability map with distinctive features was created by integrating various thematic layers using ArcGIS software (version 9.2), which estimates agricultural land suitability by relying on inference rules and linking land features to suitability classes.

This study adopted the following soil indicators: chemical, physical, and fertility. Using GIS, these indicators were analyzed to identify their diversity and spatial distribution by classifying each attribute based on the following risk levels: high-risk, moderate-risk, and low-risk.

10- Study Area Definition:
The southwestern region of Algeria includes four provinces: Naama, Béchar, Adrar, and Tindouf. It is bordered to the north by the provinces of Saïda and El Bayadh, to the south by Mali, to the east by the provinces of Tamanrasset and Ghardaïa, and to the west by Morocco, Western Sahara, and Mauritania. Although the region experiences some variations, it generally falls within dry and semi-arid climates. The temperature peaks in July and August, reaching up to 45°C, with light rainfall from November to February, averaging 17 mm annually. Evaporation rates reach their maximum, and the main field crops produced extensively in the area are wheat, maize, and alfalfa.

Chemical Suitability Ranking:
The chemical suitability index demonstrates very low, low, medium, and high categories, respectively.

Physical Suitability Ranking:
The physical suitability index indicates that the multi-frequency parameters (A), (B), and (C) belong to very low, low, moderate, and high levels.

Fertility Suitability Ranking:
Regarding the fertility index, soil fertility loss and nutrient depletion are determined as the primary causes of reduced production. Reducing these losses and enhancing usage efficiency is essential for fulfilling sustainable development. The Fertility Suitability Index (FSI) was calculated.

In this study, the suitability of wheat crops was assessed utilizing one of the most beneficial and widely adopted artificial intelligence techniques in this field. Besides, this system can introduce and control uncertain or incomplete agricultural knowledge. The inference system employed in this research is of the field type. The results have indicated the suggested program's quality, effectiveness, and speed in the accuracy of computational processes. By integrating financial and geographic information systems, the program effectively assessed soil suitability for wheat cultivation compared to traditional methods.

Using such innovative programs in evaluating proposed crop suitability offers accurate results that benefit:

1. Decision-makers need to obtain valuable information for short-term and medium-term planning.
2. Determining necessary improvements and taking suitable measures for fulfilling sustainable development.
3. Integrating financial information systems with geographic information systems to map land usage and suitable crops is significant for optimal land use and food security in arid regions like Egypt.
4. Generalizing the suggested technology to other crops.

In conclusion, periodically assessing land suitability has become very significant to maintain high crop yields or productivity, seeking to narrow the gap between production and consumption.

Conclusion :

In conclusion, the world has reached a consensus that sustainable development is the only path to securing the essentials of life both now and in the future, guaranteeing the advancement of societies and meeting the needs of individuals. The Sustainable Development Agenda, initiated in 2015 and continuing until 2030, introduces a comprehensive development plan consisting of 17 goals that sought to eradicate poverty, address climate change, fight gender inequality, and tackle several other issues that countries committed to but failed to fulfill by 2015 under the Millennium Development Goals agenda.

To keep pace with this development, it is necessary to implement indicators and use geographic information systems supplemented with artificial intelligence to accurately diagnose, monitor, and swiftly find solutions to these problems. This approach is essential for decision-makers to continue progressing towards the summit of sustainable development goals.

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