The Use of Remote Sensing Techniques and Geographic Information Systems As a Tool to Support Smart Planning: A Case Study of Rashid Camp

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Abstract

The twenty-first century is considered the era of technology, information and communication, or what is known as the information revolution, where cities that rely on information and communication technologies and artificial intelligence have appeared, called smart cities, which allow societies to develop their capabilities at various levels.

Iraq's urbanization is expected to increase rapidly over the next several decades, presenting significant challenges related to pollution, inadequate water and energy resources, and waste management infrastructure. The Al-Rashid camp in Baghdad offers potential for smart city development while preserving its historical character and civilization, but has been neglected by the Iraqi state. To promote development in this area, it is essential to prioritize smart technologies and consider their integration with the region's natural features.

This paper describes Smart remote sensing Techniques and Geographic Information Systems in the development of master plans of cities on the example of the Rashid Camp .And this study such as fundamentals of the analysis techniques i.e., satellite imageries, (GIS), (RS), requirements of smart city design, describing the physical and human characteristics of Rashid Camp

Through this, it was concluded that smart cities depend on information and communication technologies and artificial intelligence to transform the lifestyle and work in smart planning ways by using remote sensing and GIS as the most important technical means that contribute to the analysis of satellite visuals for various sensitive areas on the one hand, and that Integration and employment of GIS in the analysis and extraction of thematic maps contribute significantly to smart sustainable planning

Keywords: *GIS, smart cities, Integrating, Remote Sensing, Rashid Camp, Technologies.*

1. Introduction:

The increase in the population and their needs, in addition to the displacement towards the city, and the economic, social and technological developments that the world has known, are all factors that have contributed to encouraging the trend towards devoting the concept of smart cities, especially since cities today accommodate more than half of the world's population, and they are also moving towards housing. More than 80% of the world's population by 2045.

This exodus towards cities would increase energy consumption, double carbon emissions, and increase pressure on transportation and environmental pollution, all of which affect sustainable development. These matters combined made experts and specialists propose the idea of adopting smart cities, using information and communication technology To create cities that achieve an easier and better quality of life for its citizens and visitors, as well as preserving the environment and allowing for sustainable development for present and future generations.

Smart city technologies can make everyday commute faster Tens of millions of people in cities around the world become angry and frustrated with traffic and overcrowding on buses and trains, and improving daily commuting is critical to quality of life (Lee, Jiao, et al , 2021), Interest in the smart city has increased in recent years as an imperative to meet the great challenges faced by various cities of the world, as the transformation to it requires concerted efforts from various disciplines (Silva, khan & Han, 2018) .

Industrialization can give birth to a fast pace of urbanization and by 2050, Iraq's urbanization levels can increase to seventy percent from fifty-two percent in 2011. In an international context, the size of Iraq’s urbanization is going to be vast. Iraq can have eighteen governorates with a population of forty million, two cities with quite three million individuals, and three megacities with populations of one million or a lot, in keeping with the Centre's studies specializing in population statistics.

As urbanization will increase, adverse effects conjointly increase. Swelling populations can solely exacerbate the various issues in urban areas.
Issues embrace slums, pollution, water shortages, energy shortages, hold-up, inadequate capability for treating wastewater and biodegradable pollution, and inadequate capability for casting off urban and industrial waste (Danilina N, Slepnev M, and Chebotarev S 2018) .
Most cities will barely deal with the crush of a steadily increasing population, and lots of area units stretched to snapping points attempting to satisfy the energy, water and transport, and communication demands of their residents.

Al-Rashid Camp in Baghdad is one of the most untapped areas in Iraq. It is the largest investment project in Iraq and the region in the event of plans to develop the camp and convert it into a smart city due to its proximity to the Tigris River. It is one of the main entrances to the capital Baghdad southeast of Baghdad.

The importance of the study lies in the need for cities to develop their infrastructure represented in transportation, housing, water, energy and the Internet through the inclusion of a new method in building them, which is smart cities by relying on information and communication technologies, services and others, in addition to facing environmental challenges and the need to develop sustainable strategies for energy generation and distribution. Transportation, water management, construction of environmentally friendly buildings.

Through this research paper, we aim to show the necessity of including and adopting a new method in building cities, such as the use of modern smart technologies such as remote sensing and geographic information systems, with the aim of facing environmental challenges and meeting the requirements of sustainability as well as supporting smart sustainable urban planning.

2. Smart City: A Contemporary Revolution for Urban Space Management

The term digital or smart city was first used at the European Conference on Digital City in 1994(Al Manhal Platform,2023), and in 1996 Europeans launched the European Digital City in a number of European cities, which met with modest success and then adopted by European authorities (Ben Hadda,2017) Mainly Amsterdam as a digital city followed by Helsinki. The reason why the term intelligence is used to refer to the so-called smart devices such as smartphones, tablets, etc(Renata,2014). This term has been used as a synonym for the digital city, the information city, the city of fibers, the knowledge-based city for electronic societies linked to digital spaces, which is a dominant form of collective spaces, as digital networks and software applications cover and facilitate the various dimensions of the economic and social life of cities (Dey, 2016).

The concept of a smart city is linked to virtual cities, from which the term Digital Cities appeared, and its most important results are the electronic space or the virtual space(Droege,1997), A smart city is also described as a city that possesses information technology infrastructure and the latest communication technology technologies to transform the lifestyle and work within the region, in creative and smart ways, instead of traditional methods. A distinction can be made between a digital city and a smart city, as a smart city has the ability to Learning, technological development, innovation, and in this sense, every digital city is not necessarily a smart city, but every smart city has digital components. The two concepts differ in terms of the link between the real city and the virtual city. The digital city includes the functions of the traditional city such as: work, housing, transportation, entertainment and the environment, while the smart city includes the functions of research, technology transfer, production development, and technological innovation.(Komninos ,2015). It is a data-driven city and in this sense, big data is an indispensable tool to allow the emergence of real smart cities, built with knowledge of the city(Breux & jérémy, 2017).

From the foregoing, it can be said that a smart city is a city that relies on integrating information technology in the management of its various departments (government, health, education, transportation and communications...) to improve the quality of life of individuals.

The goals of the smart city are to develop a new understanding of urban problems, a highly effective and feasible way to coordinate urban technologies; models and methods for using urban data across spatial and temporal scales; development of new communication and dissemination technologies; development of new forms of urban management and organization; Identify critical problems related to cities, transportation, and energy, and identify risks, uncertainties, and dangers in a smart city, and the basic pillars of intelligence in any city are human capital, infrastructure, and information. (Giacomo & Rodolfo, 2015)

The goal of smart city development is to provide quality and innovative services to the public, economic activities as well as to city visitors, as well as to produce a safe and comprehensive urban environment. For this purpose, smart city development assumes the correct integration of three layers. (Stratigea, 2012)

- A physical layer, which includes human capabilities and knowledge-intensive activities;

-An institutional layer that includes appropriate institutional mechanisms for social cooperation for the development of knowledge and innovation. More specifically, it involves institutions and mechanisms for information dissemination, technology transfer and new collaborative product development;

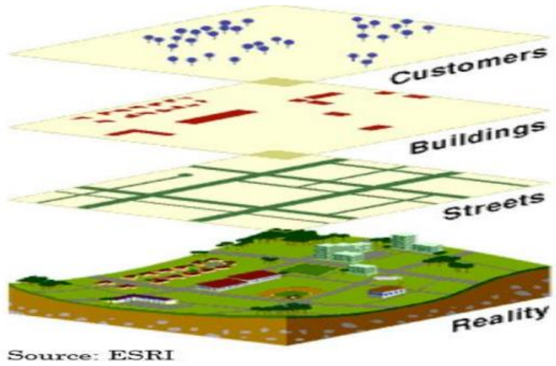
-The digital infrastructure layer that includes a set of ICT infrastructure, tools, applications, and content to support individual and collective action in smart cities. More emphasis is placed on embedded systems, sensors, and interactive media that support knowledge dissemination and interaction. On the other hand, it seems that Smart cities rely more on collective/collaborative intelligence, innovation systems, and web-based collaborative spaces.In both cases, the focus is on integrating the three dimensions of urban space, physical, institutional, and digital.

3. The geographic information system (GI.S) and Remote Sensing (RS): Smart Planning Support Tool

A geographic information system is “a set of data identified in space, structured in such a way as to be able to conveniently extract summaries useful for decision-making” (Pornon, 1993) GIS techniques are crucial tools for improving the efficiency, accuracy, quality, and responsiveness of government and local services. Based on digital maps and database software the GIS records, stores, and analyzes different and multiple layers of spatial data and relates this data to the region of interest. GIS layers contain data in the form of points, lines and polygons and satellite images are the input data of GIS in a form of land use /land cover or other landforms (Laurini & Thompson, 1992). Is a system used for collecting, storing, analyzing and managing geospatial data and associated attributes which are spatially referenced to the Earth (Burrough, and al, 2015). GIS offers to visualize the spatial impacts of situations and migratory patterns and provides urbanization plans (ziad, 2019)

GIS can help in differentiating the environmental impact of planning, development, design and evaluating neighborhood patterns, estimating the “walkability” based on data collected from pedestrian building entrances, routes, streets, bicycle routes, transit accessibility, and a variety of other factors (Shekar & Xiong,2008).

GIS is an ideal technology that has the ability to scale across any expanse, from the individual asset within a building to a virtually global context tying all aspects of a smart city planning and development (Shekar & Xiong,2008)



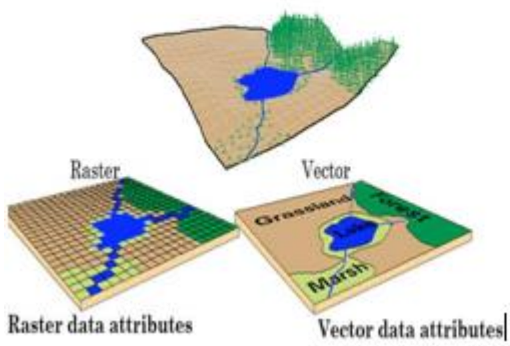


Figure 1. The spatial features of GIS **Figure 2. Types of GIS attributes**
(Burrough, and al, 2015)

Remote sensing refers to obtaining information about objects and/or areas using the electromagnetic spectrum without being in direct contact with the object or area. In remote sensing, different types of devices and tools are used to make electromagnetic spectrum outside this range visible to the human eye, especially the near, middle, thermal, infrared and microwaves (Sivakumar, and Al, 2003). Remote sensing now plays an important role in a wide range of environmental disciplines such as oceanography, botany, geography, zoology, agriculture, geology, forestry, meteorology, and civil engineering (De Jong & van der Meer, 2007).

On the other hand, emits energy in order to scan objects and areas, whereupon a sensor then detects and measures the radiation that is reflected or backscattered from the target. RADAR and LIDER are an example of active remote sensing where the time delay between emission and return is measured, establishing the location, height, speeds and direction of an object. See Figure (3) for illustration.(Makki ,2019)

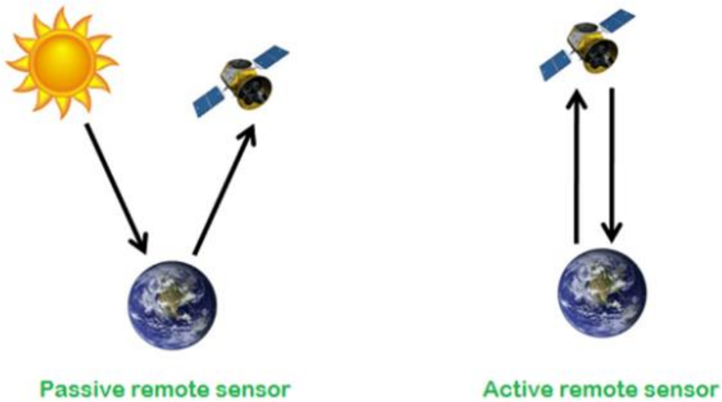


Figure 3. Two types of remote sensors (Sivakumar, and Al, 2003)

GIS in this case is used during all stages of planning and development of a Smart City. The fundamental background is aided by ICT (Information and Communications Technologies), while the emphasis is on the spatial GIS platform which operates through all stages of the life cycle: from modeling, planning, building to managing across the broad spectrum of functionalities see figure (4) (Makki ,2019).

Figure 4. How GIS unlocks the value of a digitized urban ecosystem (Makki ,2019).

The GIS role in its ecosystem is integrating different data obtained by sensors in real time and providing suitable decisions, higher efficacy and, better collaboration. A significantly enriched image which is provided by GIS allows the evolution in the future much smarter cities since geospatial/location data and applications can be considered as an elemental factor of vision (Blaschke ,and Al, 2011)

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4. Description of the Case Study Al-Rashid Camp:

The Al-Rashid Camp, which formerly housed a military hospital, was destroyed after 2003, neglected, and abolished by the Iraqi State, but its vast area remained abandoned without any reconstruction or new projects. Its plans remained under paper, including the establishment of a modern hospital and modern housing complexes, but none were implemented.

High temperatures, lack of vegetation on the one hand, and irregular population migration due to war and the deterioration of the economic situation in some neighboring cities on the other, which called on the Iraqi Government to consider and resolve development using smart technologies so that this development is commensurate with the nature of the region and preserves the city's historical identity and civilization.

Rashid Camp (research study area), coordinates 33 ° 16 40 N, 44 ° 29 41 East is one of the oldest cities in the Middle East, and Rashid Base is the first army camp set up in Baghdad in the Ottoman time. as shown in figure (5 and 6).

The Rashid camp, situated in close proximity to important areas of Baghdad, including Baghdad International Airport, Baghdad University, the University District, and Baghdad New City, is strategically located to take advantage of the benefits of constructing a smart city in the capital.

Figure 5. Iraqi Map with Rashid Camp, (selected part).

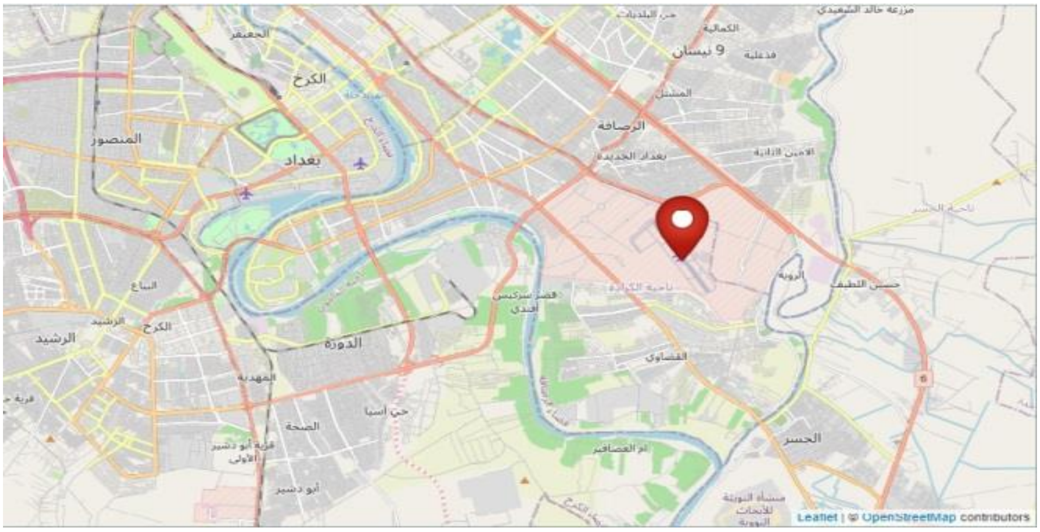

Figure 6. Rashid Camp (source: active research).

Table 1. People living in Rashid Camp.

Year	Inhabitants
2012	131,120
2014	150,000
2017	180,000

Table 2. Population and city-type relationships.

City Type	Population (p)
small town**.**	50,000.
Central city**.**	50,000 – 100,000.
large city**.**	100,000- 250,000.
Very big city**.**	250,000 - ≥.
Metropolitan**.**	1,000,000.

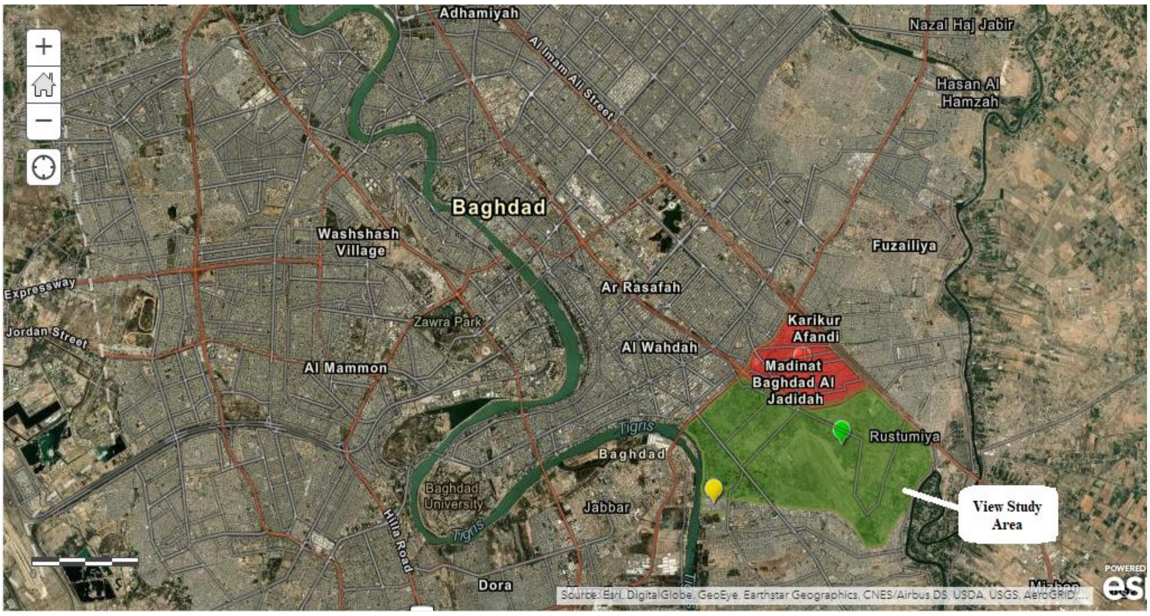

Figure 7. Rashid Camp (source: active research).

The study area, which was misled in green, Sarkis Palace and misled in yellow, is a very distinctive archaeological site, and in red the new city of Baghdad.

5. Methodology and Approche :

In order fully comprehend the potential benefits of implementing smart city technology in Rashid Camp city, it is necessary to explore the fundamental principles and basic components of this technology. Smart city technology primarily involves leveraging digital and technological solutions to enhance the sustainability, efficiency, and quality of life of urban areas. This often necessitates the incorporation of advanced analytics and data-driven insights, the integration of technology into urban infrastructure and systems, and the creation of an interconnected and unified urban environment. If smart city technology is successfully implemented in Rashid Camp city, it has the potential to positively impact the local economy, improve user experiences, and enhance overall livability.

To design a smart city like Rashid Camp, various information and communication technologies (ICT) are used to optimize territorial management and urban development. It is important to establish linkages based on geographic information science and technology (GPS, GIS, and RS). High criteria are set for the planning and design of urban environments and a smart city must be connected to smart economic and commercial systems, smart transportation and people, and a smart government using technology. Additionally, a smart city should provide an environment conducive to a smart lifestyle.
Designing a smart city in an existing or new town or managing a smart city demand enormous spatially referenced database. Hence GIS assumes great importance. Development of models that can be used in conjunction with GIS can be time consuming.

A GIS uses spatial referenced data (say with latitude, longitude and elevation) as well as nonspatial data (most government-collected data such as population census, live stock census, forest surveys, hydro geological surveys, economic census, caste census, climate data, traffic volume count, water supply statistics and so on) and includes operations, which support preliminary spatial analysis in GIS with the common purpose of group strategic and tactical decision making, planning, managing for development of urban land, other natural resources, transportation, and other urban services and utilities systems.
- Remote Sensing technology and Geographic Information System Multi-criteria evaluation method will be employed to perform effective site suitability analysis of the study area.
- Remote sensing technology can give current/spatial data on land-cover patterns that can be used as input data in the task. Geographic Information Systems, on the other hand, are useful in the selection of a smart media city site because of their unique capabilities and tools for performing an integrated analysis of spatial and attribute data to produce maps that can lead to a number of candidate sites after further analysis and field investigations, reducing the cost and time involved in the process.

Their Proposed GIS-Based Methodology for Smart Cities Site Selection:

Preparing Criterion Maps:
The criteria considered are Land Cover, Soil Type, Elevation, Proximity to High Ways, Proximity to Residential Areas and Proximity to Universities and Proximity to Airports.

Data Processing:
The second step is the data processing procedure for generating criterion maps based on the following GIS functions: Buffer and Intersect.

Spatial Analysis:
This third step consists of the MCE and the overlay. The MCE model includes standardization of spatial data from its original format into a general format to be ready for analysis.

Techniques in GIS, Remote sensing:
Satellites or aircrafts capture land data base on different scales.

- Satellite images (Worldview 2 m, Landsat 8)
- RFID Radio Frequency Identification
- ERDAS IMAGINE
- ArcGIS Desktop 10.6
- ArcGIS Pro3.2
- Spatial Data Infrastructure (SDI). SDI is all about coordination and facilitation of the exchange and sharing of spatial data between various stakeholders from various territorial levels.

6. Results and discussion:

The tools employed include EOS data analytics and ArcGIS software, as indicated in Figure (8). To investigate, analyze, and map the research area, ArcCatalog is used to construct a database, Arc Toolbox is used for analysis, and the Table of Contents is used to display and manage study area layers. In this stage, judgments must be made as well as environmental damage caused by oil production and other issues that determine how territories are used.

A powerful framework for displaying and analyzing two-dimensional features with X and Y coordinates is offered by ESRI Production, ArcGIS, and EOS Data Analytics. Geographic Information Systems (GIS) also provide the capacity to work in a three-dimensional space where a point's coordinates along the X and Y axes are linked to the Z value. This feature enables a more thorough and accurate analysis and representation of spatial data.

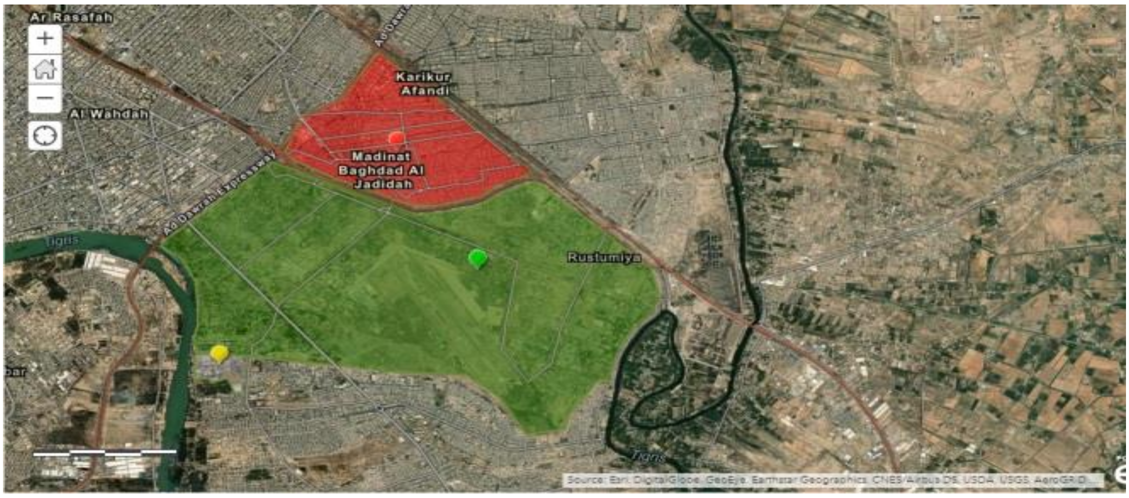

Figure 8. Arc Map's representation of 2D data. (source: the work of the researcher).

To facilitate a better understanding and based on analysis, the study region has been divided into a number of zones using the Arc GIS 10.2 and EOS data analytics software. An online base map was utilized to aid in this process. The zones include water areas, farmlands, residential areas, industrial zones, public utilities, archaeological areas, nearby service areas, and population groupings. These zones are further explained in figure 9.

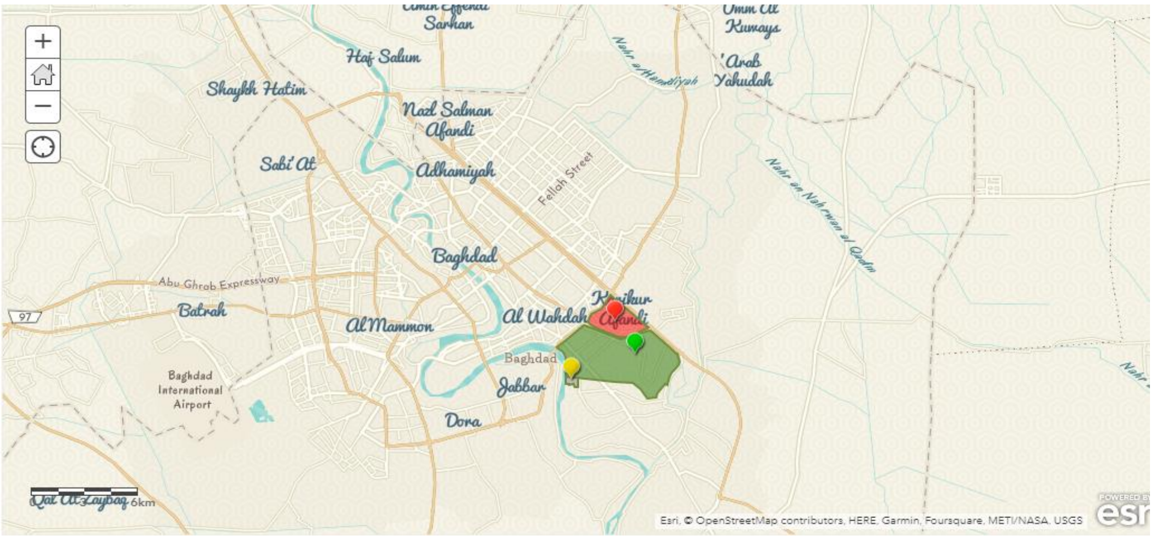

Figure 9. Rashid suburb's strategic location in Baghdad Arc Map (source: researcher's working).

The study area, depicted in green as Sarkis Palace and in yellow as a significant archaeological site, is bordered by the new city of Baghdad, marked in red.

The EOS data analytics program was employed to analyze the study area, revealing its extensive usability due to its size, as illustrated in Figure 6, which indicates that the area spans approximately 21 kilometers.

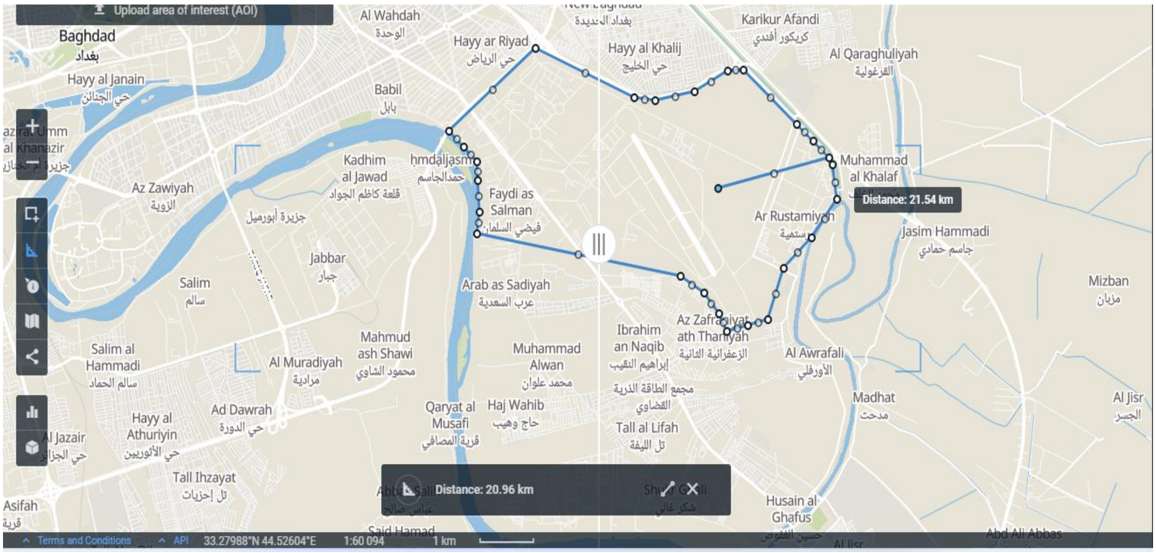

Figure 10. Rashid analyze in EOS data analytics (source: researcher's working).

Functional zoning, a technique for classifying land uses based on their performance, can be classified into two categories according to both their performance and their physical characteristics. A functional zoning strategy might, for instance, designate particular zones according to their use, such as an industrial zone, a leisure zone, and a housing zone. In addition to defining zones based on traits like population density, size, height, elevations, and coverage, physical traits can also be used. Based on its functional zones, Rashid Camp has been categorized in this study, as indicated in Figure 11.

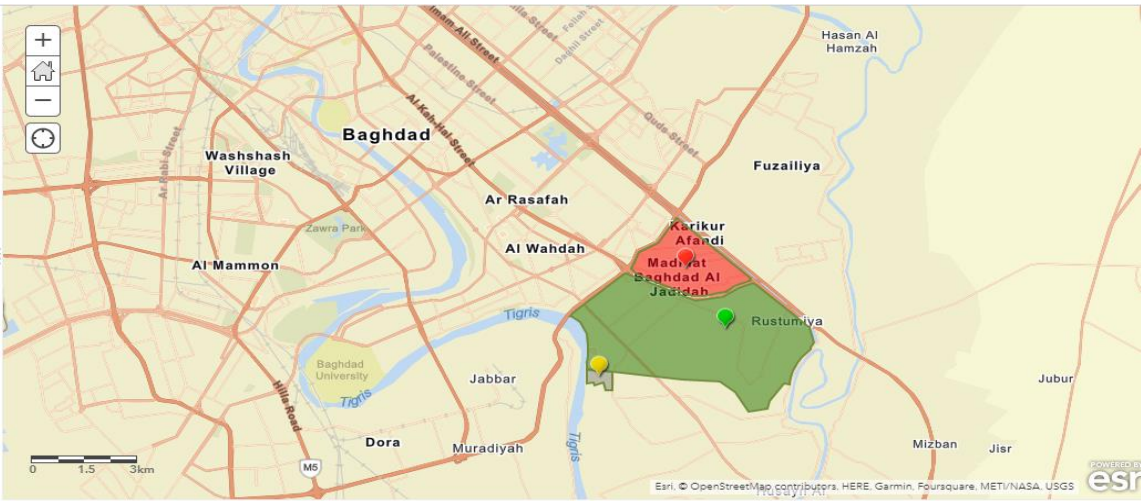

Figure 11. Study Area Analysis for Important Surrounding Locations on an Arc Map (from the work of the researcher).

It is possible to locate the research area by three different zones: green, representing Sarkis Palace; yellow, representing a distinctive archaeological site; and red, representing the new city of Baghdad.

Time series analysis of the study area was conducted using EOS data analytics with a focus on two factors:

- NDVI analysis.
- NDWI analysis.

An integrated approach was used to analyze satellite data, with the shape of the time series graph being influenced by the types of surfaces recorded by the peak readings and the satellite sensor are affected by meteorological factors as temperature, humidity, and cloudiness. The graph, which presents data based on the spectral index values of satellite photos with a minimum amount of cloud cover, was created using interpolation using cubic splices. in the area of interest. Additionally, the graph can be split by year to allow for comparison and evaluation of the time series dynamics using available data for the selected period.

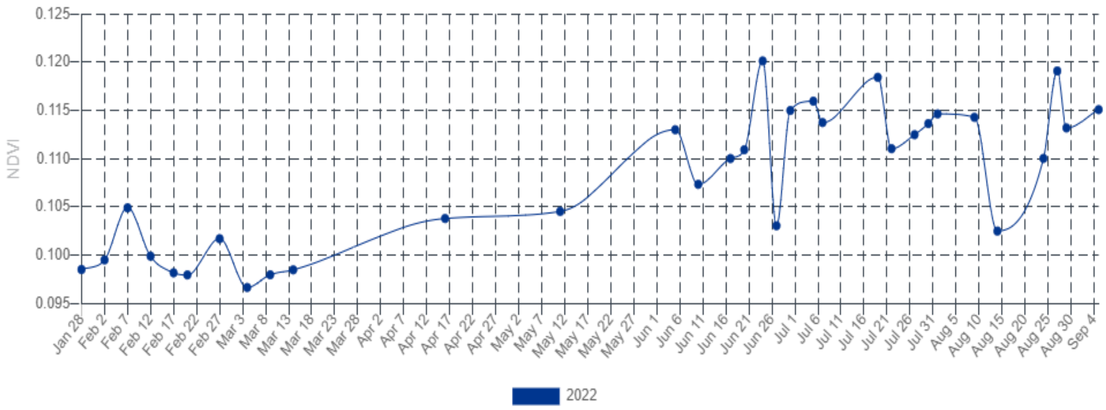

Figure 12. NDVI analysisstudy area 2022 / EOS data analytics (Source: researcher’s working).

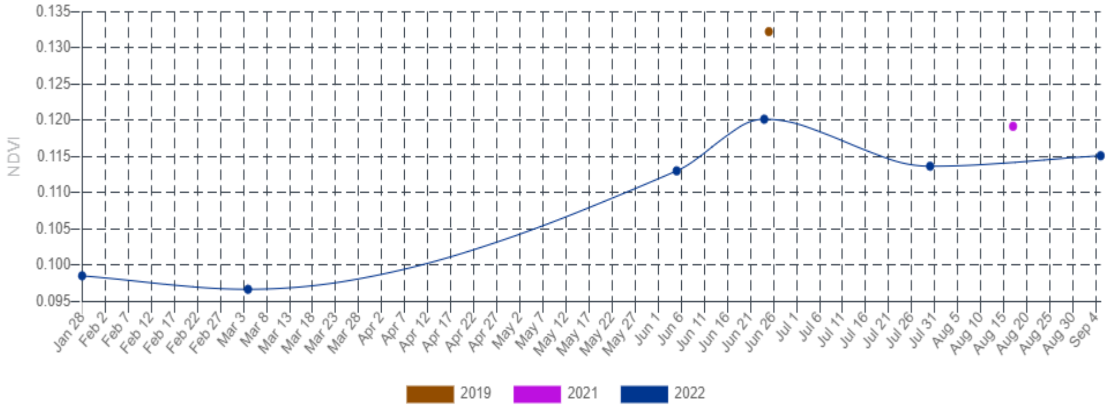

Figure 13. NDVI analysisstudy area 2019-2022 / EOS data analytics (Source: researcher's working).

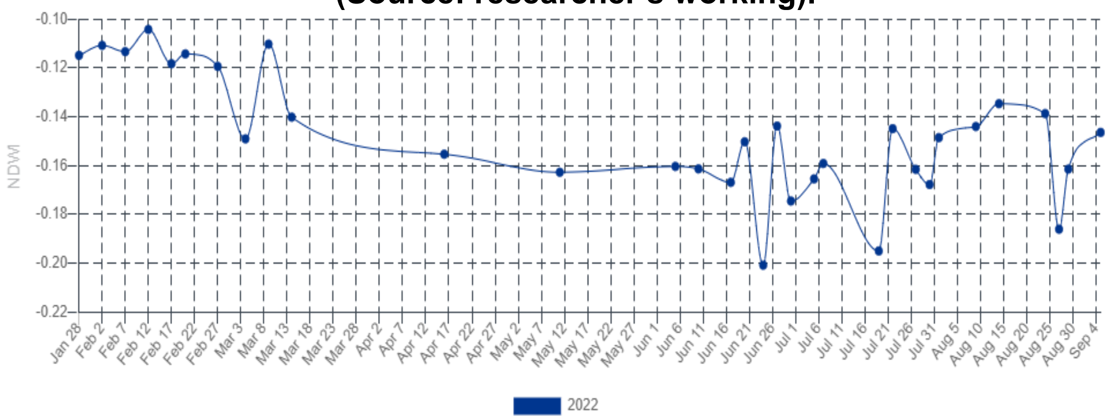

Figure 14. NDWI analysisstudy area 2022 / EOS data analytics (Source: researcher's working).

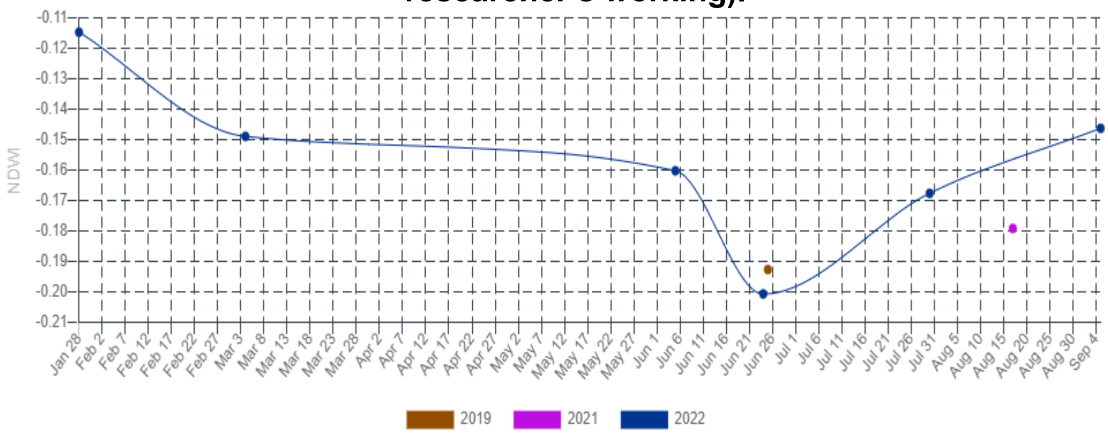

Figure 15. NDWI analysisstudy area 2019-2022 / EOS data analytics (Source: researcher's working).

It is important to note that the establishment of a buffer zone around certain land use areas is a common practice for environmental protection purposes. In this study, a buffer zone of 1000 meters was established around agricultural land, industrial zones, and transport areas based on standard requirements. This buffer zone provides a special area that can be used as a starting point for transportation. To determine the area that can be developed for a new city, the equation (area can be developed) = ∑ (agricultural land - industry zone - transport areas) was used. The analysis was conducted in steps according to standard requirements and guidelines, including land use, public utilities and industrial zones, transport network, and the development of a smart city. EOS data analytics and Arc Map were utilized in the field analysis process to ensure accuracy and consistency of results. The application of the aforementioned equation allows for the identification of appropriate areas for the development of a new city within the Rashid Camp, referred to as the Smart City. Figure 16 depicts the subdivision of the study area and proposed land use development, which includes the addition of green areas, industrial and development zones for industries, and the proposed Smart City.

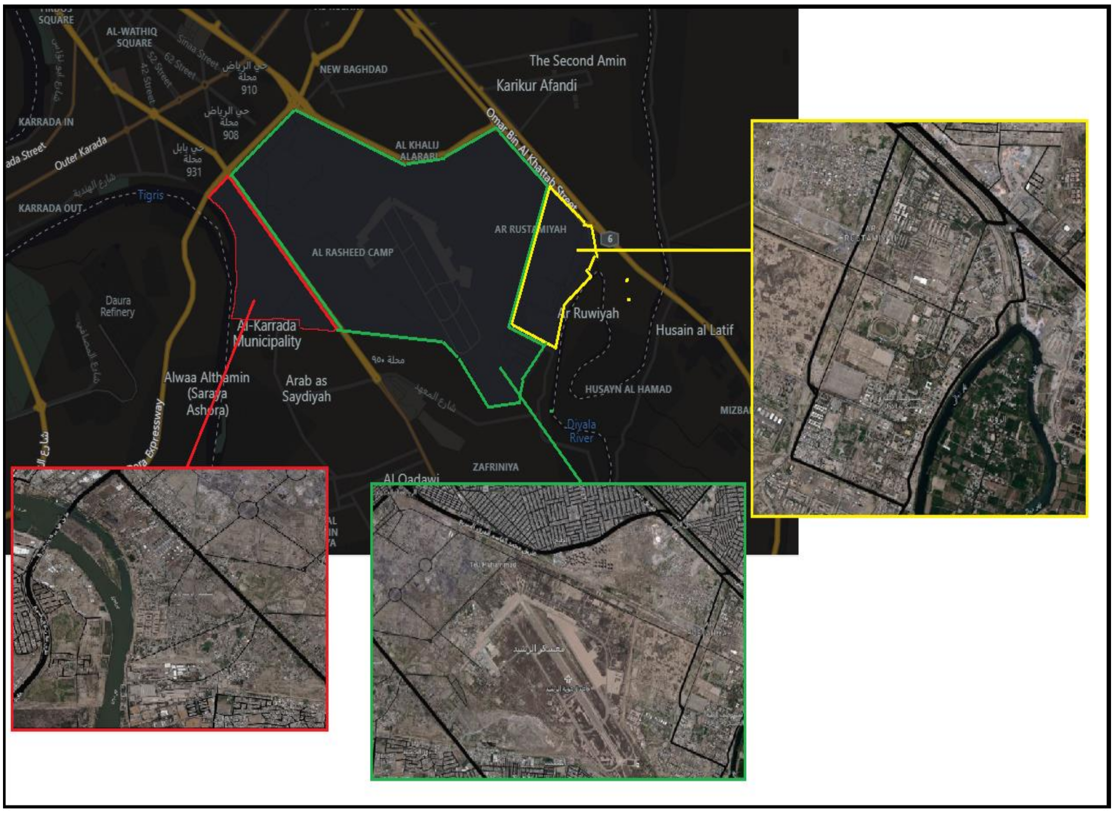

Figure 16. Spatial division of the study area (Source: researcher's working).

The proposed development plan for the Rashid camp area includes the creation of green spaces, recreational areas, hospitals, modern educational facilities, as well as preserving the archaeological and religious sites within the region's borders which are indicated in red. Additionally, industrial zones and smart transport zones associated with several international routes will be established within the limits of the area in yellow. The development plan also includes the construction of a Smart City, specifically a proposed Smart Media City, which will be located within the limits of the region in green.

Additionally, EOS data analytics was utilized to support the analysis. Based on the speed function, the time for commuting between the large city center and other indoor urban centers is expected to be no more than 15 minutes, as per the researcher's working.

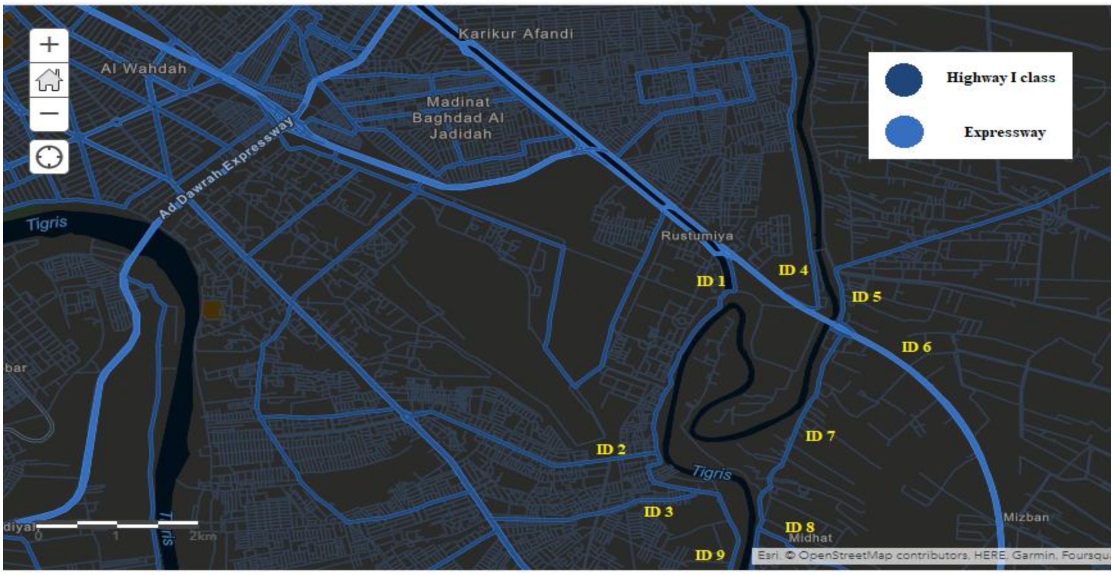

Figure 17. Rashid Camp transport data base Proposed Main Roads (Expressway for example and smart transport). (Source: Researcher's work).

Table 3. Rashid (Source: researcher's work) Travel data base (Expressway, for instance, and smart transportation).

ID	L.(m)	Velocity(km/h)	Length Kilometer	Time(h).	Time(min).
1	4490	120	4.49	0.037	2.22
2	5240	80	5.24	0.066	3.96
3	3550	80	3.55	0.044	2.64
4	3820	80	3.82	0.048	2.88
5	6920	80	6.92	0.087	5.22
6	10690	120	10.69	0.089	5.34
7	4500	80	4.5	0.056	3.36
8	4230	80	4.23	0.053	3.18
9	4320	80	4.32	0.054	3.24

We reached the following results:

1) Land use is often categorized into Industrial Land, Green Land, and Public facilities and services, with a buffer zone of 1000m applied.
2) The transportation network and roads are classified based on allowable speed.
3) The selection of potential urban growth zones is influenced by a number of elements including existing cities.

In the case of the Rashid Camp, using sophisticated remote sensing techniques, such as EOS data analytics and Arc Map, has provided valuable insights and information for the development of a master plan. These technologies were used to analyze land use, public utilities and industrial zones, transportation networks, and the potential for a smart city. By applying buffer zones and classifying roads based on allowable speed, suitable areas for development were identified.

Overall, the use of smart remote sensing technologies has potential to greatly improve the efficiency and accuracy of urban planning processes. However, it is important to note that these technologies should not be seen as a replacement for traditional planning methods and community engagement. Instead, they should be seen as a complementary tool that can enhance the planning process and provide valuable information for decision-making. Ultimately, the success of using these technologies will depend on the ability to integrate them effectively into the planning process and to use the information gained to make informed and sustainable decisions for the future development of cities.

7. Conclusion:

Based on the available information, it is unclear what specific benefits or outcomes have been identified as a result of using smart remote sensing technologies to develop master plans for the Rashid Camp city, or how they have impacted the planning process. However, it is clear that these technologies were used to sectionalize the city into different categories, such as industrial land, green land, and public facilities and services, and to apply a buffer zone of 1000 meters around certain land use areas for environmental protection purposes. The transportation network and road classifications were also based on allowable speeds. Additionally, criteria and factors were used to choose areas for potential city development. It would be helpful to have more information on the specific ways in which smart remote sensing technologies were used to inform the development of master plans and how they contributed to the identification of potential development areas.

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