

# Tracking Tigris River Recession via Island Surface Area Analysis Using GIS

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## Abstract

*This study tracks the Tigris River's decline from 1985 to 2025 using GIS methods, with an emphasis on the island's size within the river. The study focuses on the effects of sedimentation processes and river course alterations, which might be difficult to depict and replicate using modern techniques. Analytical processes, spatial processes, three-dimensional analysis, and operations analysis are crucial in determining changes in the river's morphology. Most of the existing river islands are new or derived from older ones, and their stability is attributed to dense plants preventing sediment erosion. The study also explores the potential for tourism investments in these islands. The results showed that, despite the increasing severity of the drought, the number of islands has occasionally decreased in some years of assessment. The reason for this is that they integrate with the neighboring bank and hence are considered as dry areas rather than falling within the course of the river, as are the areas of the islands, which may shrink for the same reason. Most of the islands are built of sand or a combination, which makes it difficult to drift and strip, allowing them to remain stable for lengthy periods of time. The study concluded that trying to invest the river islands in different ventures, particularly in agriculture, is a smart idea because they have good soil quality, and their central location in the water supplies enough for crop development.*

**Keywords:** Island; Tigris River; GIS; Period.

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## 1 INTRODUCTION

Tigris River suffers from the obvious effects of the activity of sedimentation processes and changes in its course and its riverine manifestations [1, 2, and 3]. With geographical techniques, it constitutes an obstacle in the representation and simulation of the reality that was witnessed with modern techniques of treatment and representation of change in the geographical area. The change in Tigris River and its cartographic representation were presented in the form of accurate and clear models, which include access to the geographical information represented on these models easily and conveniently for the reader and user of the map [4, 5].

The Tigris River flow regime was studied during a decade from 1975 to 1984. Consider the annual water charts of the Tigris River to determine the groundwater elements by knowing the general shape concerning the river system as well as the minimal flow during stagnation. The main slump curve was analyzed from the water flow of the river archives for the area of catchment studied by collecting the features of diverse stagnation records. Used stagnation records to be able to separate the components that contribute to the Tigris River's course and to know the number of aquifers contributing to the river [2, 3 and 6].

The study analysis showed that four main underground reservoirs inside Turkish territory and outside the study area, and groundwater contributed 58% to 75% of the total flow during this decade. From the beginning of the decade, the amount that was specified for storing water volume varied from  $(1 \times 10^9)$  to  $(6 \times 10^9)$  m<sup>3</sup>/year [7]. Another study by Ali et al. [2] deals with the influence of increasing islands' capacity to flood Baghdad's Tigris River. The formation of islands has been observed within the city of Baghdad through the Tigris River's channel during recent years, because of the accumulation of rubble from the destroyed bridges in both the 1991 and 2003 wars. This led to a large volume of sediment deposited in the reservoirs Among the tributaries of the Tigris River, and this led to a rise in the number of islands over time. As a result, the river's ability to pass flood waves is reduced. This led to the flooding of parts of

large cities such as Baghdad. In the years 1976, 1991, and 2008, Surveys of the Tigris River's cross sections were conducted.

A survey was conducted by Geo-hydraulique in 1977 [8] and then researched by the University of Technology-Baghdad in 1991. Finally, a survey was carried out by the Ministry of Water Resources along a 49-kilometer stretch straight from the Muthanna Bridge to the meeting point of the Diyala River, with an average horizontal distance of 250 meters in 2008. Performing a one-dimensional fixed-flow hydraulic model using data to forecast The highest flood level that can occur of a river using HEC-RAS. The last ten years of comments at the Sarai Baghdad station and field observations of water levels along the final 15 km of reach were used to calibrate the model. Model calibration was taking outdoor observations of water levels during the previous ten years and the past fifteen kilometers of reach of comments at the Sarai Baghdad station [5].

One dimensional steady flow model was created for the data resulted from the Water Resources survey in 2008, using the HEC-RAS program. Then varied scenarios were implemented by mounting the discharge with a view to detecting the critical evacuation that can cause immersion of Tigris River Island. The submerged regions were identified, and the water level were recorded. When comparing the current river capacity to what it held during the 1971 and 1988 floods, the model's main runs seemed to indicate a significant decline. According to the results of the three assessments carried out on the same stretch of the Tigris River, the river's ability to carry water had diminished. Furthermore, the morphological alterations in the river cross sections were clearly visible [6].

GIS and remote sensing are examples of contemporary geographic approaches that are integrated, has significantly improved the representation and simulation of these changes. Digital mapping and the use of informational layers provide more precise visualizations, enabling researchers to track riverine transformations and identify critical areas of morphological variation. Furthermore, advancements in satellite imagery have allowed for multi-temporal analyses, making it possible to monitor changes across different periods and compare their effects on river behavior [4]. Studies have also highlighted the value of applying specialized symbology and visualization methods to represent these changes in a way that enhances user comprehension and supports decision-making processes in river management. These approaches not only facilitate the communication of complex geographical information but also strengthen the reliability of analyses conducted over time. As a result, geographical data has become an essential tool in understanding morphological and morphometric changes, providing a comprehensive framework for interpreting natural events and riverine features [6,9]. Since GIS techniques are precise and updated regarding the various patterns and socio-economic and environmental problems, it's useful for gathering information. For this reason, the Geographic Information System (GIS) technique is employed to investigate the morpho-logical conditions of the four islands (Nijhum, Hatiya, Sawndip, and Kutubdia) and to obtain other descriptive information necessary for proper land use planning of those areas [10]. This research aims to identify an important natural geographical phenomenon, which is the river islands, as an important and striking phenomenon, especially in recent years based on GIS technique. In addition, this study state of the relationship between the different geomorphological processes carried out by the river to form river islands.

## **1) METHODOLOGY AND TOOLS**

The nature of the study required the use of descriptive approach through collecting data, sources, maps, and aerial photographs of the study area at different scales and in different years from the General Authority for Survey and the Ministry of Science and Technology Space Research Center Remote Sensing Department in the city of Baghdad and the College of Engineering at the University of Baghdad. It was determined the structure of that data would cover the subject of the study mainly and quantitative analysis to reach the purpose of the research. GIS image technology was used in measuring and representing the median islands.

### **1.1 Study area description**

The Tigris River is located on the continent of Asia. It originates from the Taurus Mountains, southeast Anatolia in Turkey, crosses the Syrian Turkish border, and enters Iraq near the town of Fish Khabur after traveling about 50 km inside Syria. Within the city of Kut, the Tigris River splits into two branches: the

Al-Dujaila and the Al-Gharraf, to form the Shatt al-Arab, which empties into the Arabian Gulf. The Tigris River once met the Euphrates River in Qurna in southern Iraq after passing through Iraqi land with a basin area of 375,000 km<sup>2</sup> and a drainage rate of 1500 m<sup>3</sup>/s. The Khabur, Great Zab, Little Zab, Great, and Diyala are its five tributaries that flow into it after entering Iraqi territory. It starts in Turkey and travels through Iraq for most of its 1400 km length. Two-thirds of the river's water comes from these tributaries and the remaining third from Turkey [11], as shown in Figure 1. Most Iraqis live in Baghdad, which is situated on the Tigris River (Figure 2). The Mosul Dam is the most significant of the dams constructed along the river in Iraq that use hydropower to store the water needed to produce electricity. Large ships cannot navigate the Tigris because most of the river is too shallow for small ships [7]. The study area extends between points (443917.39 and 446951.25) m east of the Greenwich meridian and points (3683948.35 and 3687935.39) m north of the equator, in Iraq, Baghdad, Al-Jadriya area. The sediment in the Tigris River in the Jadriya area consists of a mixture of materials that vary depending on the flow rate and the nature of the channel. The sediment includes sand sediments which are found near the banks and areas of relatively rapid flow. Silt sediments that are most prevalent in the Jadriya area consist of fine particles deposited in calm water. Clay sediments are deposited on the riverbed and in areas near bridges and bends. Also, organic components such as fine plant material and remains of human activity. These types reflect a river environment with medium to low sedimentation energy, influenced by water discharge and changes in the river's course.

There are many reasons for the presence of sediments in Al-Jadriya such as: slow flow at the major bend of Al-Jadriya, leading to the sedimentation of fine particles (clay and silt), low water discharge from the headwaters due to dams, reducing the river's ability to carry heavy materials (coarse sand), leaving only clay and silt, interference with local discharges and secondary streams, such as sewage or debris, which increases fine suspended matter and the lack of regular dredging of the river, allowing successive layers of silt and clay to accumulate on the riverbed.

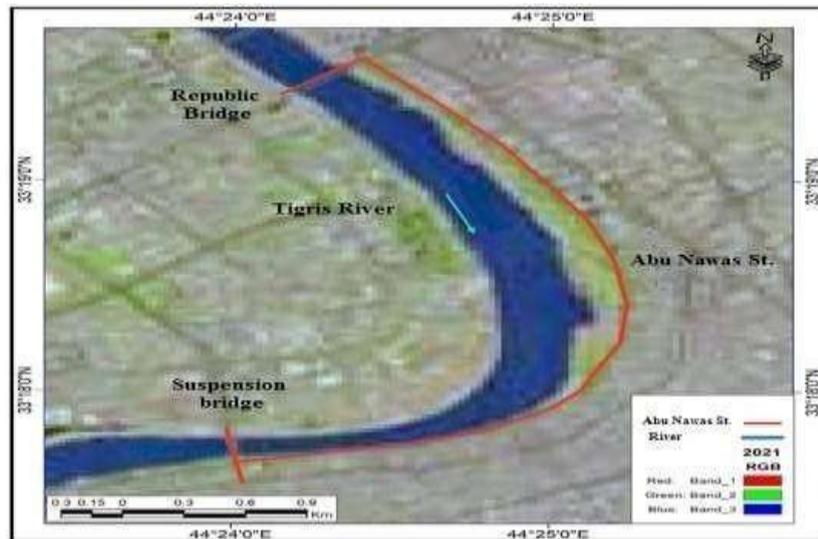


Fig. 1: Tigris River within Baghdad city (by Authors)

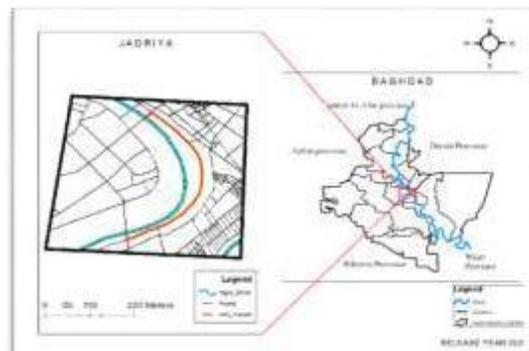


Fig. 2: Location of Baghdad city on Tigris River (by Authors)

### 1.2 River Island

An island is a piece of land surrounded by water on all sides, whether it is in an ocean, sea or river, and it is formed in several ways, the most important of which is sedimentation. One of the phenomena that began to appear clearly is the median river islands, which represent a clear negative development in the river course and an environmental influence. It poses a threat to the river. The formation of river islands gives a geological indication that the rivers have entered the dormant stage, and the sedimentation of materials and sediments that were carried by the river have begun within a state of lack of speed and the increase in the narrowness lack of depth and the courses due to the accumulation of river sediments. This negatively affects human life, directly or indirectly, consumption of water for daily purposes, agriculture, industry, navigation as well as the natural plant and animal life related to that.

Such a phenomenon has become noticeably clear in recent decades due to a number of causes such as the phenomenon that is most significant of drought and the lack of rain and snow in the river sources and the increase in global temperature (global warming), as well as the lack of coordination with the neighboring countries whose river sources are formed in their lands to divid water quotas that are released to enter the Iraqi lands, and the irrigation projects and dams that are built in their lands are multiplied. All these reasons have resulted in the water level dropping in the supply of rivers, and this has led to the emergence of negative riverine phenomena [7].

In order to match and identify the detrimental developments occurring, this study examines the mechanisms of island emergence, their locations, and potential future growth. It also identifies the area most likely to be in danger by analyzing and comparing a number of old maps, aerial photos, and contemporary satellite records. At the lowest possible depth of the riverbed, the river achieves its lowest stages of activity and expends all of its potential energy on the erosion of its sides, the incursion of its channel, and the formation of torsions and zigzags, as shown in Figure 3.

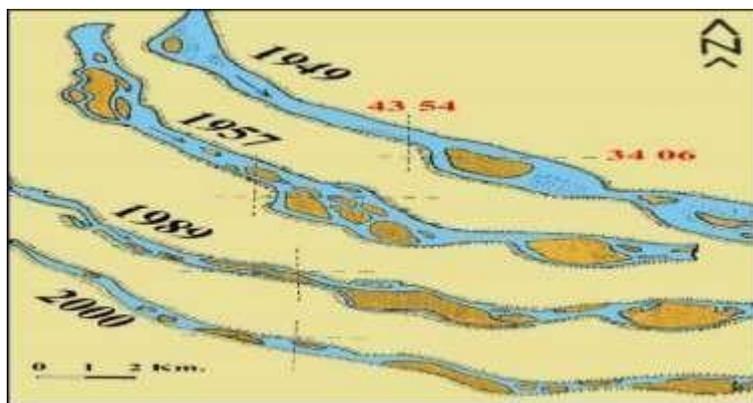


Fig. 3: The development of the river islands [12]

### 1.3 GIS Program

A computer based system that enters, collects, analyzes processes, maintains, stores, displays, and outputs information and distributes spatial data. for specific purposes, for example, help in planning, urban planning, housing expansion [13, 14], decision-making regarding agriculture, this technology allows us to input geographic data (aerial pictures, maps, satellite images) and descriptive data (tables, names) in addition to reading any town's infrastructure by creating so-called layers (LAYERS). Processing (editing them from error) [Error! Reference source not found.,13], storing, inquiry, spatial retrieval, and statistical process and analysis, and displaying them on paper in the form of maps or on a computer screen, graphs, reports, or through the website.

GIS supports the analysis of specific aspects such as spatial distribution patterns, including the relationship between water areas and population distribution, as well as hydrological scenarios, such as the effects of increased irrigation water flow in pipelines [11]. It facilitates rapid, effortless, and precise information access [15, 16], and to identify locations on the map, its possible to produce maps of natural resources (mineral ores, oil, water, etc.) and maps of road networks or maps of potable water or water

drainage [17,18]. The GIS program has the best ability to organize these maps and information and enable efficient decision making, attract users, and then display these results in a way that is easy for the innovator to access [19,20].

The process of building the database begins, then digitizing the reading of the available knowledge, then updating it using existing satellite images, then the method of data with its geographical locations, then the final product of the maps is ready for display, and the information is identified with specific symbols on the map to clarify specific characteristics [10].

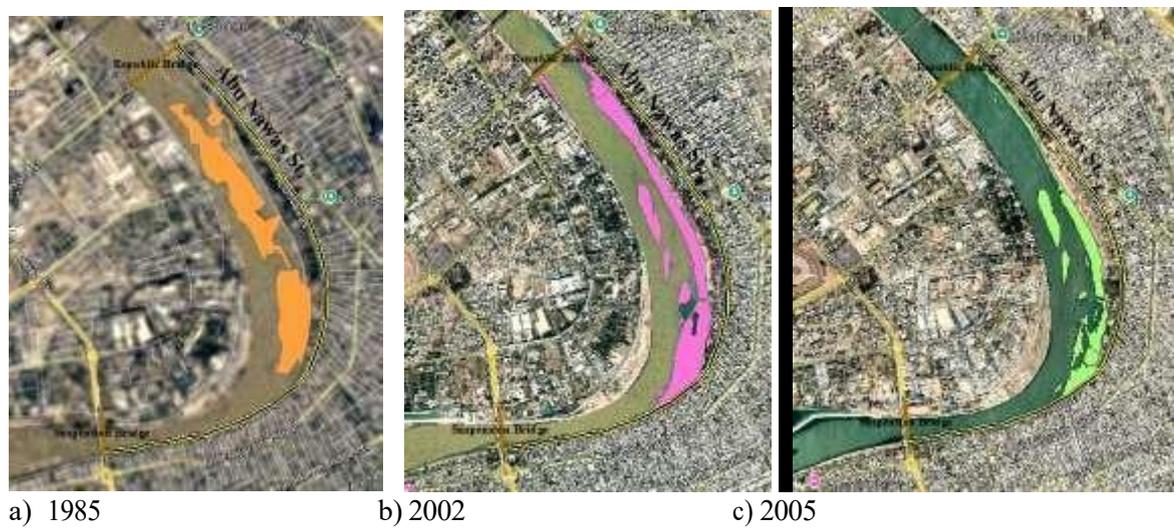
#### 1.4 Island monitoring from 1985 to 2025

The ArcMap 10.5 program was used to collect and process data, images, and maps for this study. Additional information was obtained from previous research on the Tigris River conducted at the University of Baghdad (College of Engineering, Department of Civil Engineering) and the Ministry of Science and Technology in Baghdad. ArcGIS is a widely used Geographic Information System (GIS) for spatial analysis, mapping, and georeferencing. To achieve the study objectives, several years between 1985 and 2025 were selected at 5-year intervals, apart from 1985-2002 due to missing historical imagery in Google Earth. As shown in Figure 4, high-resolution, georeferenced images from Google Earth were used as the base layer, over which island shapefiles were digitized in GIS for each study year. **The islands that formed in the river within the study area were observed, and the area of the islands formed each year was calculated using GIS software, as shown in Figure 5. This figure shows images taken from Google Earth with a shapefile layer prepared using GIS.** These layers were then compared to identify changes in the extent and distribution of sediment islands. Island monitoring through remote sensing enables the detection of geomorphological changes across multiple time periods, based on the principle that satellite imagery captures spatial and temporal variability in surface processes. High-resolution imagery is therefore necessary for tracking the growth and accumulation of sediment islands, assessing morphological change, and understanding the depletion of natural resources associated with increased water usage and population growth in the study area. **Images of the shapefiles were then added to facilitate comparison of island formation from year to year and to easily determine the area of islands formed each year, as shown in Figure 6.**





Fig.4. Georeferenced images with high resolution (Google Earth).



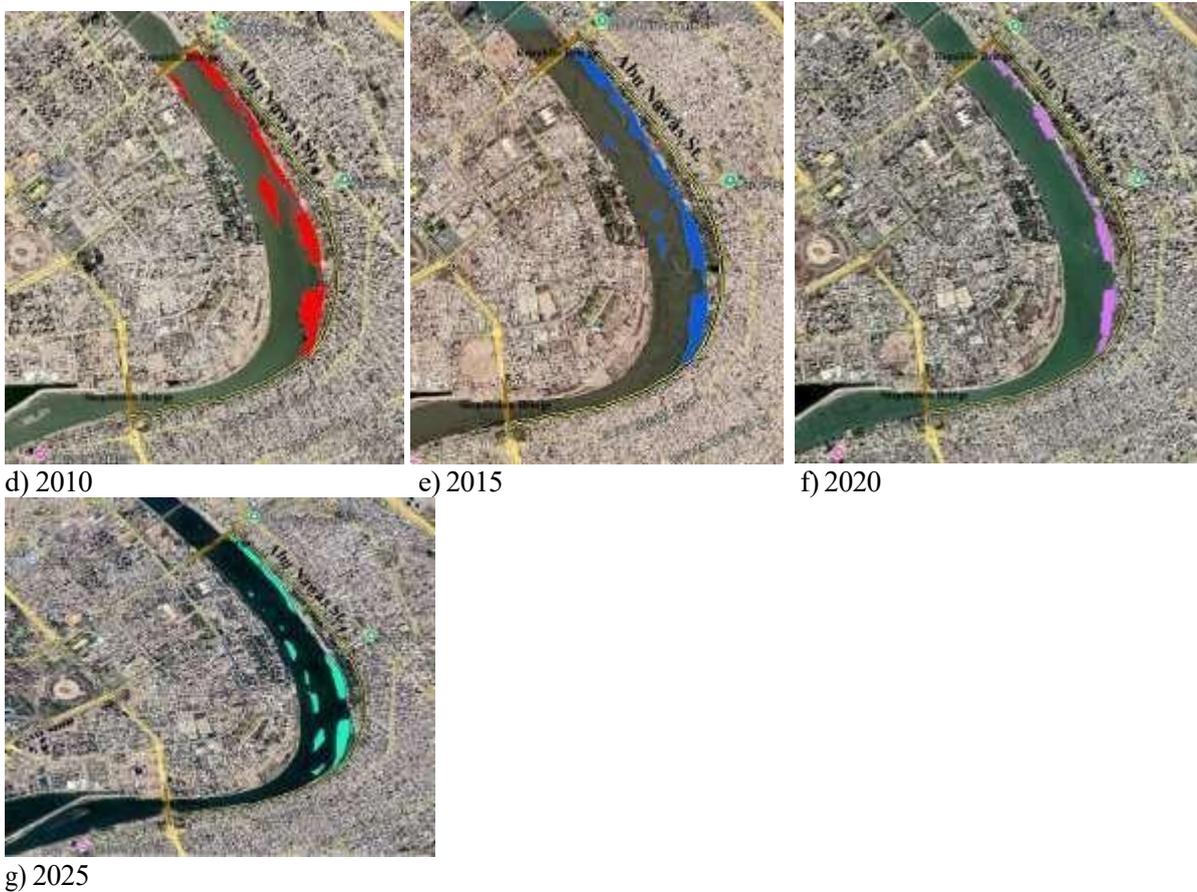


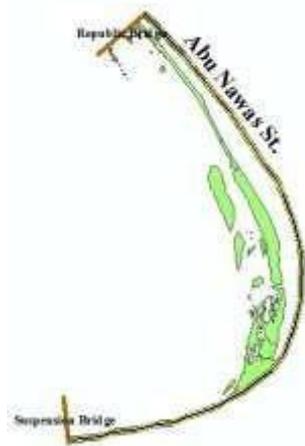
Fig.5 Georeferenced images with high resolution (Google Earth) with a shapefile layer prepared using GIS software.



a) 1985



b) 2002



c) 2005



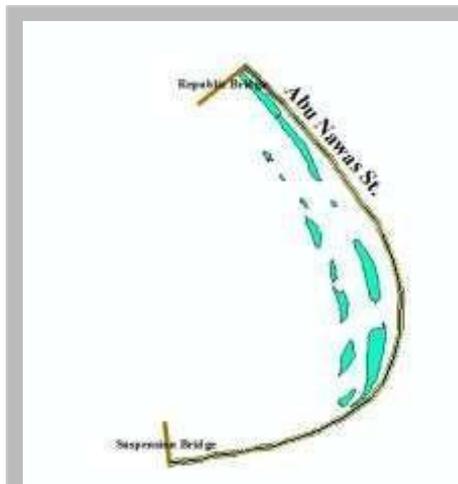
d) 2010



e) 2015



f) 2020



g) 2025

Fig.6 a shapefile layer prepared using GIS software.

#### 4. DISCUSSIONS

Figures 4, 5, and 6 illustrate the amount of accumulation and sedimentation that led to the formation of islands in the Tigris River in the study area. The total area of the islands in 1985 was 556,016.55 square meters. It is worth noting that during the period from 1985 to 2002, it was impossible to take images with Google Earth. This was due to Google Earth not being as accessible and available as it is today, and due to political reasons related to the former regime.

##### 1) In 2002

The sedimentation characteristics of the Tigris River have shifted markedly due to combined hydrological, geological, and human influences. Since the early 2000s, water discharge at Baghdad declined to about 430–450 m<sup>3</sup>/s following the expansion of upstream Turkish dams under the GAP project and reduced rainfall in northern Iraq, particularly during the 2001-2002 drought in Dohuk and Nineveh. This weakened the river's sediment-transport capacity, leading to higher deposition, while suspended solids rose to roughly 470 mg/L, compared with 350–380 mg/L in the late 1990s [21]. Sediment also became finer about 55-60% silt, 30-35% clay, and 5-10% fine sand promoting accumulation in inner river bends such as Jadriya and Karrada where current velocity naturally decreases [22]. Human pressures intensified these changes through increased dumping of rubble and waste during urban expansion, limited dredging and maintenance due to political and economic constraints, and inefficient sewage systems that introduced clay- and silt-rich effluents into the river [23]. Together, these shifts marked 2002 as the onset of a new sedimentation phase, characterized by sustained riverbed buildup and the formation of persistent depositional zones in Baghdad.

##### 2) In 2005

The total island area reached 361,999.02 km<sup>2</sup>, but sedimentation declined primarily due to natural and hydrological factors, especially increased water discharge during 2002-2005. When northern Iraq and southern Turkey experienced above-average rainfall that raised river levels and accelerated flow, enhancing the Tigris River's ability to transport sediments instead of depositing them (24). As a result, sedimentation decreased in the Baghdad reach, including Al-Jadriya, and the absence of severe drought maintained near-normal flow conditions that limited bottom accumulation. Human and engineering factors also contributed, as the Ministry of Water Resources resumed maintenance and dredging operations after 2003, removing accumulated sediments near Al-Jadriya and Karada Maryam as part of early post-war riverbank rehabilitation projects (25). Additionally, reduced urbanization and construction activity during the post-2003 security period led to lower dumping of rubble and temporarily reduced solid pollution loads as many industrial facilities halted or slowed operations [26]. Geomorphologically, the increased discharge between 2002 and 2005 caused erosion along curved sections particularly at Al-Jadriya

redistributing older deposits and increasing channel depth, making the riverbed appear less sedimented in subsequent surveys.

### 3) Period 2005-2010

In 2010, the total area of the islands reached 371,839.56 square kilometers, and the increase in sedimentation in the Tigris River compared to 2005 resulted from combined hydrological, environmental, and human factors that weakened river flow and increased the sediment load. Hydrologically, water flow declined sharply after 2007 as Turkey and Syria began operating additional dams on the upper Tigris such as the Ilisu Dam and other tributary structures reducing the volume of water reaching Iraq, especially during the dry season; with slower flow, the river lost its capacity to transport sediment, causing deposits to accumulate in calmer zones like Jadriya and Karrada [27]. This was compounded by severe droughts between 2008 and 2010, among the driest years in Iraq's history, which lowered water levels and allowed greater buildup of silt and mud on the riverbed. Human and engineering factors further intensified the problem: dredging and maintenance activities declined significantly after 2006 due to security and economic challenges, enabling sediment to accumulate without removal, while expansion of buildings, landfills, restaurants, and tourist facilities along the river particularly in Jadriya and Karrada resulted in increased dumping of rubble, construction waste, and sewage, adding large quantities of suspended and settled solids [28]. Geomorphological changes also played a role, as reduced discharge weakened hydraulic energy and promoted deposition in curved sections such as the Jadriya Canal, where old sediments accumulated and modified channel geometry in ways that accelerated further deposition [29]. Between 2005 and 2010, the thickness of the silt and alluvial layer in the Baghdad reach of the Tigris increased by an estimated 20-35%, with some areas near Jadriya experiencing a river depth reduction of 0.5 to 1 meter due to sediment buildup [30].

### 4) Period 2010-2015

The decline in sedimentation rates in the Tigris River in 2015 compared to 2010 resulted from combined hydrological, engineering, and environmental improvements. Between 2013 and 2015, northern Iraq and southeastern Turkey experienced improved rainfall and snowmelt, increasing the Tigris discharge by an estimated 10-15%, which enhanced flow velocity and sediment transport, reducing silt accumulation in Baghdad, especially near Jadriya. During this period, the Ministry of Water Resources resumed limited dredging at key locations such as bridge crossings and curved reaches helping remove deposits formed during the 2010 drought years. Improved discharge management from Mosul and Samarra dams further redistributed suspended sediments downstream, while stricter municipal controls reduced the dumping of rubble and wastewater into the river, decreasing the solid load entering the channel [31]. These hydrological improvements, combined with dredging and increased runoff, caused slight riverbed erosion and morphological adjustment, restoring a more balanced sediment transport regime and reducing bottom sediment accumulation by 2015.

Table 1: reported field data of Tigris River from 2010 to 2015 [32]

Year	Water discharge rate (m <sup>3</sup> /s)	Bottom sediment thickness (average in Baghdad)	Observations
2010	250–300	0.8–1.0 m	High sedimentation, low flow
2015	350–420	0.4–0.5 m	Improved flow and decreased sedimentation

### 5) Period 2015-2020

The decline in sedimentation in the Tigris River in 2020 compared with 2010 - 2015 resulted from the combined influence of hydrological recovery, engineering interventions, and reduced human impact. Increased water releases from Turkey during certain periods of 2020 linked to operational stages of the Ilisu Dam temporarily raised discharge and flow velocity, enhancing sediment transport and reducing deposition in Baghdad [32]. Heavy rainfall and strong snowpack accumulation in northern Iraq produced higher spring flows and partial floods that naturally flushed older sediments from the riverbed, aided by a 15-20% improvement in rainfall relative to the dry years of 2017-2018. Engineering measures also played a key role: the Ministry of Water Resources resumed targeted dredging in 2019-2020 in areas such as

Jadriya, Karrada, and Adhamiya, helping restore channel capacity and flow continuity. Concurrently, Baghdad Municipality implemented stricter environmental controls, closing unregulated sewage outlets and limiting debris dumping leading to a substantial reduction in solid inputs [33]. Furthermore, the COVID-19 pandemic reduced industrial, construction, and agricultural activity, lowering anthropogenic sediment loads. These factors, combined with increased seasonal flows that re-eroded portions of the riverbed, produced a temporary geomorphological equilibrium in which sediment transport and deposition became more balanced.

Table 2: Reported field data of Tigris River from 2015 to 2020 [32]

Year	Water discharge rate (m <sup>3</sup> /s)	Bottom sediment thickness (average in Baghdad)	Observations
2015	350–420	0.4–0.5 m	Relative stability
2020	420–480	0.25–0.3	Significant decrease in sedimentation

### 6) Period 2020-2025

The rise in sedimentation in the Tigris River in 2025 compared to 2020 resulted from the combined effects of declining water inflow, renewed human pressures, and geomorphological adjustments. After 2021, Turkey reduced releases from the Ilisu Dam to support reservoir filling and irrigation projects, lowering the Tigris discharge and slowing current velocity, which increased deposition in calmer reaches such as Jadriya and Karrada. This was compounded by renewed drought conditions from 2022 to 2024, when rainfall dropped 25–40% below normal levels and high temperatures accelerated evaporation, and increasing water salinity in the downstream of the Tigris river toward the south of Baghdad further weakening sediment transport capacity [34, 35]. On the human side, dredging and maintenance operations in Baghdad declined sharply after 2021 due to budget constraints, while unregulated urban expansion along the riverbanks increased the dumping of construction waste and debris, adding large volumes of coarse and fine solids to the channel. The post-pandemic rebound in industrial and agricultural activities also elevated the discharge of sediment-rich effluents and drainage water into the river. Geomorphologically, reduced discharge encouraged the formation of new sedimentary islands near Al-Jadriya and Bab Al-Sharqi, which disrupted flow patterns, created low-velocity zones, and promoted additional deposition, further limiting the river's ability to transport suspended materials [36]. The projected increase in sedimentation in the Tigris River in 2025 is a result of decreased water discharge, the cessation of maintenance work, and the resumption of human activities, compounded by the effects of climate change, which has reduced natural flow.

Table 3: Reported field data of Tigris River from 2020 to 2025 [36]

Year	Water discharge rate (m <sup>3</sup> /s)	Bottom sediment thickness (average in Baghdad)	Observations
2020	420–480	0.25–0.3	Lowest Sedimentation Rate
2025	300–360	0.45–0.55	Significant Increase in Sedimentation

### The Result

As a result, after calculating the island areas for each year of the study using GIS software, and calculating the total area for each year, these areas and their corresponding year of formation were arranged as shown in Table 4. A diagram was also drawn illustrating the relationship between each year and its total island area, as shown in Figure 7.

Table 4: the total island areas for each year by (GIS).

Area of Islands (m <sup>2</sup> )	556016.55	518970.82	361999.02	371839.56	285899.18	171884.36	249796.69
Years	1985	2002	2005	2010	2015	2020	2025

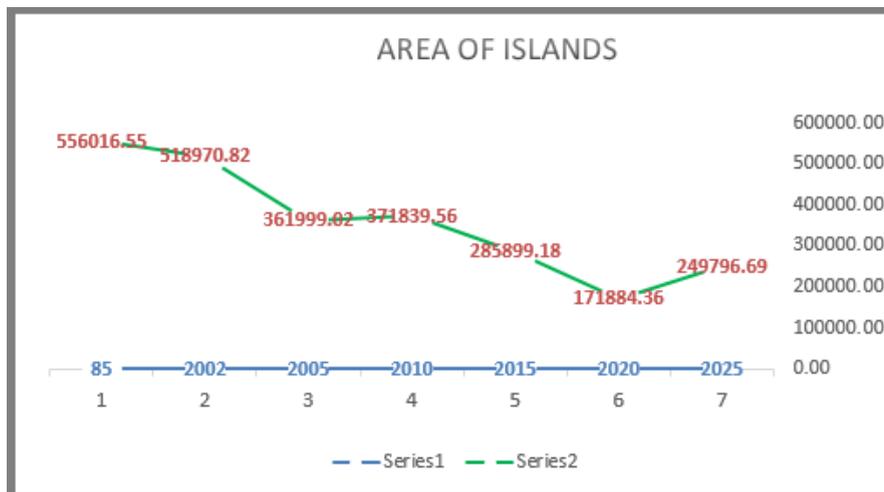


Fig. 7. The relationship between islands areas and the year of formation.

### 5. Sedimentation Causes and Management in the Tigris River at Jadriya

Sedimentation in the Jadriya reach of the Tigris River arises from reduced flow velocity at the river bend, seasonal low-flow periods, and diminished discharge caused by upstream dams that lower sediment-transport capacity, all of which promote silt and sand deposition [36]. Effective mitigation requires integrated engineering and environmental actions such as periodic dredging, channel widening at the inner bend, stabilization of riverbanks, regulating debris disposal, enforcing a protection zone along the banks, and applying GIS- remote-sensing monitoring to track morphological changes [37].

### 6. CONCLUSIONS

The concluded results through this research are explained as follows:

1. The Tigris River is currently in dangerous cases of drought, lack of drainage, and slow current. All of this contributed to the aggravation and increase of the phenomenon of river islands, the decrease in the depth of the waterway, and the narrowness of the course in general.
2. Most of the existing river islands are newly formed or derived from older islands, and they are generally fixed in the stream because the river lacks the ability to push sediments and the nucleus of the islands, and what has contributed to the increase in their stability is the growth of dense plants above them that contribute to preventing sediment erosion and also trapping new sediments if the water level crosses it.
3. It was noted that the number of islands sometimes decreases in some years of measurement despite the aggravation of the drought phenomenon. The reason for this is that they merge with the nearby bank and thus are counted within the dry areas and do not fall within the course of the river, as is also the case with the areas of the islands, which sometimes decrease for the same reason. Most of the islands are made up of sand or a mixture, and this means that they are difficult to drift and strip and therefore stable for long periods.
4. The river islands were the reason for a small increase in the width of the stream, which averaged 221.6 m, and the first part took a high course of 245.9 m, as the river twists and river islands combined to increase the width of this part.

### 7 Recommendation

If applicable, it may contribute to restoring even part of the river activity and removing some islands.

1. Attempting to invest in the islands for tourism purposes through the establishment of tourist resorts, nature reserves, restaurants, etc., due to their beautiful landscapes and pleasant atmosphere that constitute tourist attractions if the appropriate services are available.
2. Attempting to invest the river islands in various investments, especially agricultural, because they are characterized by a good quality of soil, and their location in the middle of the water provides sufficient quantities for the cultivation of crops, especially the crops that need a long growth season, and the disposal

of small river islands and some barriers that appear in the course of the river to avoid the accumulation of sediment and the growth of aquatic plants that impede the flow of water.

3. Conducting continuous refining and dredging of the sediments of the Tigris River, especially the sediments that collect on the sides of the stream.

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