Knowledge-based Engineering and Sciences (2025), **6**, (1), 38–63
doi:10.51526/kbes.2025.6.1.38-63

REVIEW PAPER

A Comprehensive Survey on the Natural Resources of Iraq: Insight into Possible Regional Development

Furaha Emmanuel Ndaka[*,1,2]

[1]Civil and Environmental Engineering Department, King Fahd University of Petroleum Minerals, Dhahran, 31261, Saudi Arabia
[2]Civil and Environmental Engineering Department Ardhi University (ARU), Tanzania
[*]Corresponding author. Email: ndakafuraha@gmail.com

(Received 22 March 2025; revised 15 April 2025; accepted 20 April 2025; first published online 30 April 2025)

Abstract

This comprehensive review study explores the diverse range of natural resources available in Iraq, by assessing their occurrence, geographical distribution, economic potential, and the challenges associated with their sustainable development. Drawing on extensive literature, institutional reports, and GIS data, the study systematically analyzes major resources including oil, natural gas, minerals, water, soil, forests, fisheries, and renewable energy sources. The review identifies a strong overdependence on the oil and gas sector, which, despite its substantial contribution to the national GDP, has limited the growth of other potentially valuable sectors such as agriculture, mining, and renewable energy. In addition, the study highlights how climate change, resource mismanagement, geopolitical conflicts, and weak governance frameworks pose significant threats to long term sustainability. The study provides visual mappings of resource locations and offers policy oriented insights into economic diversification, environmental resilience, and integrated development planning. Ultimately, this review emphasizes the urgent need for Iraq to adopt a multi sectoral approach to resource utilization, moving beyond fossil fuels to harness the full potential of its rich natural endowment in alignment with global sustainability goals.

Keywords: Natural Resources; Sustainable Development; Gross Domestic Product; Economic Diversification.

1. Introduction

Natural resources are materials found naturally in the environment that humans can use without needing human intervention for their formation. They play a crucial role in sustaining human life and other organisms on Earth. Examples of natural resources include land, rocks, forests, bodies of water (such as oceans, lakes, rivers, and streams), fossil fuels, various animal species (wild, aquatic, and domesticated), minerals, sunlight, and air [1] [2]. These resources hold significant value, play a crucial role in producing goods designed to meet people's needs, due to this the natural resources are highly sought after, but are limited and scarce in availability [3] [4]. Therefore, it is essential to ensure that resources are managed and utilized sustainably in production, so that future generations will still have access to the resources needed to create goods for their own needs, rather than having them depleted by the present generation [5] [6] [7].

This review is grounded in the theoretical underpinnings of sustainable development and the resource curse hypothesis. The sustainable development framework emphasizes the need to meet present resource demands without compromising the ability of future generations to meet their own needs, particularly in fragile or resource rich states [8] [9]. In parallel, the resource curse

theory explains how countries rich in natural resources, particularly fossil fuels, often experience slow growth, poor governance, and economic instability due to overdependence and mismanagement [10][11]. These concepts guide the assessment of Iraq's current development model and help identify pathways for economic diversification, environmental stewardship, and institutional reform. The political ecology perspective also frames the interaction between natural resource control and socio political conflict, especially in regions like Kurdistan and Basra [12]. Therefore, the study is motivated by the urgent need to reassess Iraq's diverse natural resources beyond the dominant oil and gas sectors, in light of economic, environmental, and geopolitical pressures. By combining a broad literature base with spatial insights, the study presents a novel, multi sectoral synthesis of resource availability, usage patterns, and development potential. This integrated approach provides a strategic foundation for sustainable planning, policy reform, and future research directions across Iraq's key resource sectors.

1.1 Research background

Modern Iraq, which fell under British mandate, was formed from three former Ottoman provinces: Mosul, Baghdad, and Basra. Following British occupation, the Mosul region was subdivided into four governorates. Mosul itself had a predominantly Arab population, while Erbil and Sulaimaniya were primarily Kurdish, and Kirkuk had a Turkmen majority, except for certain northern areas [13]. Politically Iraq is being driven by federal constitution, a common feature of this constitutions is the principle of decentralization and the sharing of power between federal and local governments and one area where the constitution divides power between the federal and local governments is in the management of natural resources. The management of the country's resources is divided between Baghdad and the regional authorities. The constitution seeks to balance power between the federal government and regions, particularly the Kurdistan Region, for sharing natural resources [14] [15].

As per the reported research [16] until the 1950s, Iraq's economy was predominantly agricultural. However, following the 1958 revolution, the country saw significant economic growth. By 1980, Iraq had become the second-largest economy in the Middle East world, after Saudi Arabia, and the third largest in the Middle East. Its economy had evolved into a complex, state-dominated, centrally planned system. While the economy, especially petroleum exports, struggled during the Iran-Iraq War, with the gross domestic product (GDP) even declining in certain years, it was the invasion of Kuwait, Iraq's defeat in the Persian Gulf War, and the UN sanctions imposed in 1990 that caused far more severe damage to the country's financial system.

Nowadays, as reported by [17], Iraq's economy is heavily reliant on the oil industry, which generates approximately 95% of its foreign exchange earnings. Other sectors remain largely underdeveloped, contributing to an unemployment rate of 18–30%. The public sector serves as the primary employer, providing nearly 60% of full-time jobs. While the oil industry is a key driver of Iraq's economy, it creates minimal employment opportunities. Although petroleum is the country's primary natural resource, Iraq also has substantial reserves of sulfur, phosphate, and natural gas. Agriculture plays a role in the economy as well, with farmers heavily relying on irrigation due to the country's dry, desert like and desert climate. Therefore, there is the need for Iraq to turn to other resources which shows the potential to add the revenue for country, and diversify the economy, instead of relying on oils and natural gas [18]. In recent years, the Iraqi government has launched several initiatives to address sectoral gaps and improve resource management. The National Development Plan (2021–2025) outlines goals for diversifying the economy, modernizing infrastructure, and advancing agriculture, energy, and water sustainability [19]. Therefore, this study will help to show the resources and open up the ways they can implement different initiatives.

1.2 Research motivation

Iraq's progress has been hindered by many years of conflict. Currently, it is a resource-rich nation with an upper-middle-income status, but it remains fragile and deeply affected by ongoing instability [20]. So, for the purpose of constructing stability there is the need to diversify Iraq's economy from depending much on oil and gas to find the balance to other natural resources within the country. To succeed in economic diversification as a country it need to know an inventory of all the available resources, their abundance, and how they can be sustainably exploited. As per the Scopus database, there were over 500 research articles were published on the search of natural resources of Iraq. It is clearly indicated as per Figure 1a, the interconnection between the major keywords tends into general wording; however, the mainly observed keywords are how much Iraq important in tern of geopolitical country. On the other hand, Figure 1b presented the keywords index of the published research where more insightful vision can be observed on minerals, energy, oil/gas, water, soil and others. Based on the displayed Figure 1b, the literature review was structured to define the current review elements. Finally, Figure 1c presented the research keywords were used in the published literature review and it is clearly can be understood that the natural resource of Iraq has essential potential on the biodiversity as well as there is huge impact of war conflict on the current status of the country development.

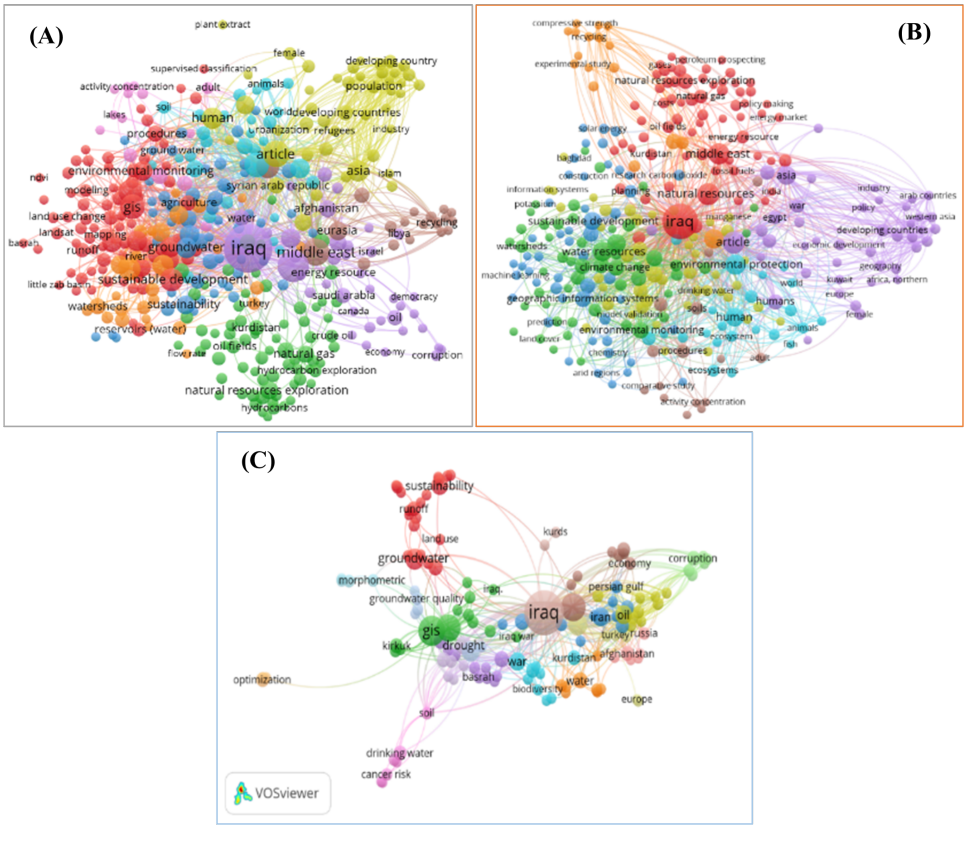

Figure 1: *The collected database of Scopus on the published research of natural resources of Iraq.*

1.3 Novelty of study

This review uniquely integrates Iraq's natural resources into a single, comprehensive framework using both literature and geospatial analysis. Unlike previous works that focus narrowly on specific sectors like oil or water, this study provides a multi sectoral assessment, identifies spatial distributions, economic contributions, and development gaps, and proposes research-based strategies for national resource planning and sustainable development.

1.4 Objective of the study

Natural resources of every nation are the main fundamental components of reliable sustainability and development. Adopting a survey for natural resources of a particular region "country" can contribute essentially to recognizing the available natural resources and proposing a strategic plan for the nation development. In this current review research, a radar survey is adopted to analysis all the available natural resources of Iraq region as this country have a historical heritage history dated based to 7000 years. Hence, providing a comprehensive milestone on the existing natural resources can give a reliable plan on how to optimally utilize them for national development and sustainability. The survey covered multiple types of natural resources including oil, natural gas, water, land, forest and minerals. The analysis of the literature aims to recognize the critical elements of gap in facilitating those natural resources. Further, this review is keen to provide an insightful vision for the utility of those natural resources for Iraq region rehabilitation due to the several crises pass through over the past century.

2. Literature review

The biggest tool of data collection for this work was a literature review, of which different past works that have discussed natural resources or have information corresponding to one of the available natural resources in Iraq were reviewed. The types of documents reviewed include books, journal articles, institutions/organization reports and other online resources. A large number of documents were reviewed just to be sure and get in-depth detailed information to be delivered for the benefit of the country's development and future research. As per the Scopus database, over 500 research articles have been published related to natural resources in Iraq, spanning topics such as oil and gas, minerals, water, land use, biodiversity, and renewable energy. For this review, more than 90 relevant sources were selected and analyzed, including peer reviewed journal articles, institutional reports, and geospatial databases, to ensure comprehensive coverage and balanced assessment across all resource categories.

2.1 Minerals

Iraq is abundant in mineral resources and industrial rocks. Significant deposits have been found on the Western Desert of Iraq with deposits such as phosphorite, kaolinitic claystone, montmorillonite-palygorskite claystone (Bentonite), quartz sand, bauxite, flint clay, porcelanite, uranium, ironstone, heavy mineral sandstone, feldspathic sandstone, limestone, and dolostone. These resources are largely confined to the Western Desert (as presented by Figure 2) and are primarily sedimentary in origin, derived from both marine and continental deposits. Their ages range from the Permocarboniferous to the Pleistocene periods, with most appearing as bedded stratiform deposits, except for certain formations like karst bauxites and flint clays [21][22]. While on the other part of Iraq, The Kurdistan Region is characterized by its abundance of metallic mineral deposits, including zinc, lead, copper, chromium-nickel, and manganese. It is also rich in distinctive non-metallic minerals and industrial rocks like barite, asbestos, and marble [23].

2.1.1 Bentonite

Bentonite deposits were first identified in the Himreen Mountain Range in the early 1970s. Two specific sites within the Mukdadiya Formation (dating to the Upper Miocene – Pliocene) were examined: Zarlukh and Qara Tappa. Evidence of previous mining and excavations can be seen at both locations. The bentonite occurs in lens-shaped formations, often found alongside tuff, sandstone, and siltstone [15].

2.1.2 Phosphate

In his study [24]. As other minerals, the Phosphate deposit is much available on the Western part of Iraq, and particularly in Akashat. The phosphate deposits in Akashat played a key role in the development of Iraq's phosphate industry, particularly to produce phosphoric acid and phosphate fertilizers. In 1976, the State Company for Phosphate was founded to manage the exploitation of these deposits and oversee the production of phosphate fertilizers at the Al-Qaim fertilizer complex. Construction, led by the Belgian company Sybetra-Union Miniere, began in the same year, with production starting in 1983.

As reported by [25] Phosphate-bearing layers in Iraq's Western Desert date back to the Late Cretaceous and Paleogene periods, with the majority of economically significant phosphorite resources being from the Paleocene epoch. These deposits form a crescent shape along the northern and western edges of the Ga'ara depression. Additional phosphorite occurrences have been reported and partially explored in areas like Nukhaib (Paleocene) and Wadi Akash (Eocene).

2.1.3 Ironstone

Iraq has plenty of ironstone formation in different forms, with the most of this formation in the western dessert such as Ga'ara formation and hussainyat formation, also on the north of Iraq such as Benavi ironstone deposit. According to [26], the ironstone deposits in the Ga'ara region are found within the uppermost section of the clastic sequence of the Permocarboniferous Ga'ara Formation. This sequence primarily consists of sandstones (occasionally containing pebbles), siltstones, and kaolinitic claystones. Based on their lithology and texture, the ironstones are categorized into two types: massive ironstone and pisolitic–oolitic ironstone. On the other hand, the Benavi ironstone deposit, located within the Jurassic–Cretaceous sequence of the Imbricate Zone in northern Iraq, represents a stratiform iron mineralization. It consists of a variety of mineral assemblages, including iron oxides and hydroxides (such as hematite, goethite, limonite, and magnetite), sulfides (pyrite and arsenopyrite), carbonates (calcite, siderite, and ankerite), silicates (kaolinite, chamosite, and glauconite), as well as quartz and apatite [27].

2.1.4 Sulphur and Potash

Sulfur deposits are in various regions of Iraq, with the most significant deposits currently found between Al-Fatah and Mosul on both sides of the Tigris River. This area features a landscape characterized by convex anticlines and concave synclines, stretching from the northwest to the southeast. Sulfur occurs in sedimentary rocks from the Lower Miocene "Lower Persia" formations, extending across vast areas of the region. This area has been subjected to intense erosion, which has contributed to the formation of numerous outlets that facilitated the accumulation of sulfur deposits in the middle and upper layers where the erosion took place [28]. Also, in the study of Mineralogy of recent sediments [29] evidenced the availability of potash in sediments of Al-Teeb River Basin in southeastern Iraq.

2.1.5 Uranium

Interest in uranium ore exploration in Iraq dates back to the early 1950s. Initial geological surveys took place in the Iraqi Zagros Suture Zone, where geological formations and lithology showed

conditions favorable for the formation of radioactive minerals. Furthermore, black shale deposits located in various areas of northern Iraq were identified as another potential source of uranium. Early exploration efforts in the Zagros Mountains region were conducted by foreign companies, including Iraq Petroleum Company (IPC). This was followed by investigations led by the Site Investigation Co. (UK) in 1955, Russian experts in the late 1950s and early 1960s and thereafter the Nuclear Geology Department of the Iraqi Atomic Energy Commission in 1966 [30].

Economically point of view, as reported by [31] in 2022, Iraq exported $121 billion worth of mineral products, ranking as the world's 8th largest exporter in this category. Mineral products were Iraq's top export that year. The primary destinations for Iraq's mineral exports were India ($38.6 billion), China ($34 billion), the United States ($10.3 billion), South Korea ($8.2 billion), and Greece ($6.27 billion).

2.2 Coal

Iraq lacks large scale, economically viable coal deposits, and no minable coal seams have been reported to date. Despite over 95% of the country's surface being composed of sedimentary formations that often host coal in other regions, detailed surveys have not confirmed significant reserves [26]. In their 2006 assessment, Al-Bassam and Hak omitted coal from the list of notable non metallic minerals in Iraq, reflecting its limited industrial relevance. Nevertheless, localized occurrences of small coal seams have been documented, particularly in the folded mountainous areas of north northeastern Iraq [32]. These coal seams are mainly found in the upper sections of the Injana Formation (formerly known as the Upper Fars Formation), a geological unit that spans parts of the Kurdistan Region. Historically, these minor coal deposits were used by local communities for domestic heating and cooking, particularly in areas where other energy sources were unavailable or unaffordable.

Although these deposits are not currently considered viable for commercial exploitation, their presence holds geological significance. Studies such as [32] have detailed the lithological and geochemical characteristics of coal seams in the Hemrin South Mountain area, highlighting their organic richness and depositional environment within the Injana Formation. These findings contribute to a better understanding of Iraq's paleogeography and sedimentary basin evolution, even if the seams are not minable at present. Moreover, small coal accumulations in northern Iraq may serve as reference sites for regional stratigraphic correlations and paleoenvironmental reconstructions [33]. With advancements in extraction technologies and interest in off grid energy solutions, such deposits might warrant reassessment, particularly in rural or remote areas where energy access remains limited. However, considering Iraq's broader energy priorities and its untapped renewable energy potential, coal remains a low priority resource in both the national development strategy and environmental policy framework [34].

2.3 Oil and gas

Iraq holds 112 billion barrels of proven crude oil reserves, making it the second largest in the world, representing 11% of the global total. Out of 80 known oil fields, only 17 have been developed, with the largest being Kirkuk in the north and Rumaila in the south. Due to limited exploration in recent years, Iraq's actual oil reserves may exceed current estimates. The country also possesses significant natural gas reserves, most of which remain undeveloped. In comparison, Saudi Arabia has the largest oil reserve, with 260 billion barrels and a production capacity of up to 10.5 million barrels per day [35]. Oil and gas is a major contributor to Iraq's GDP, it represents approximately 45% of the country's yearly production [36].

Iraq's major oil fields are primarily located in the north, within the autonomous Kurdistan region and the Kirkuk governorate, as well as in the southeast, in the Basrah governorate. Apart from Diyala and Karbala, every governorate in the country produces either oil or gas. The management of oil fields and the allocation of oil revenue frequently spark debates among Iraq's ethnic, religious, and

political groups. Provincial governments lack significant authority over oil revenue and rely heavily on financial transfers from the federal government. Even the Kurdistan Regional Government (KRG), despite its semi-autonomous status, remains largely dependent on the Iraq Federal Government (IFG) for its budget [37]. Iraq's heavy dependence on oil is not a sustainable foundation for broad economic development. This is due to two key factors. First, unlike its oil-rich neighbors in the Gulf Cooperation Council (GCC), who also face serious concerns about economic sustainability, Iraq has a much larger and rapidly expanding population, currently estimated at 40 million [38]. Even in the most optimistic projections for oil production, relying solely on oil will not create enough jobs. Second, Iraq's current economic institutions are not capable of generating productive benefits from the growth of the oil sector or government spending. This is especially true as there are no incentives for private sector investment in the economy [20].

Nevertheless, Iraq's economic prospects are clouded by substantial risks that could emerge in the medium term. While positive oil price shocks could enhance economic indicators in the short term, past experience suggests they may undermine an already limited momentum for reforms. The recent recovery is particularly vulnerable to significant fiscal risks. These risks stem from increasing budgetary inflexibilities, delayed arrears clearance, significant exposure of state-owned banks and the central bank to government debt, and limitations in managing public investments, all of which have affected the delivery of public services [39].

2.4 Renewable Energy

The global need for energy, especially clean energy, is rising swiftly. Environmental protection, particularly the reduction of pollution and greenhouse gas emissions, has become a significant global concern. While fossil fuels are still accessible and will be for some time, the era of plentiful, inexpensive energy is nearing its end. Therefore, it is essential to explore alternative energy sources, especially renewables, and to tackle the environmental challenges linked to current energy production [40] [41].'

Despite Iraq's vast potential in energy and infrastructure, including engineering research and scientific centers, the government has been unable to meet the basic energy needs of the population or the demands of the transportation sector since 2003. For the past 50 years, Iraqi governments have not prioritized or invested in diversifying electricity sources through renewable energy. Instead, they concentrated solely on oil production to meet immediate demands and address shortages [34]. Now days, Iraq is gradually shifting towards investment in sustainable renewable energy projects, with the government actively promoting the development of renewable energy sources such as solar, wind, geothermal, and hydropower [42] In addition, its geographical location provides an advantage by allowing it to harness solar radiation one of the renewable energy sources that reaches 1899 kWh/m^2, particularly in central and southern Iraq [43] [44].

2.5 Water

The Middle East is among the most water-scarce regions globally [45] Iraq, in particular, is ranked as the fifth most vulnerable country to shortages of water and food, as well as extreme temperatures. The country, along with its transboundary areas, faces growing vulnerability to water scarcity, due to reduced water availability and heavy reliance on the surface waters of the Tigris and Euphrates rivers [46].

The main and dependent source of water in Iraq, is surface water and the Tigris and Euphrates rivers are Iraq's primary water sources. Originating in Turkey, these rivers converge in southern Iraq to form the Shatt Al-Arab, which flows into the Arabian Gulf. Prior to their confluence, the Euphrates River travels approximately 1,000 km and the Tigris about 1,300 km within Iraq's borders. Together, these rivers provide 98% of Iraq's surface water (this includes their contribution to the

available lakes which are Habbaniya, Thartha, and Zazzazza, with exclusion of lake Sawa which depends on subsurface water) [47].

The combined annual flow of the Euphrates and Tigris is roughly 80 to 84.2 billion cubic meters (BCM), with 65.7 BCM originating from Turkey, 11.2 BCM from Iran, 6.8 BCM from Iraq, and 0.5 BCM from Syria. This distribution highlights Turkey's significant influence over the water resources of both rivers. Groundwater use in Iraq is relatively minimal, accounting for only 2% to 9% of the country's total water. The Ministry of Water Resources has divided Iraq into ten groundwater zones and is conducting hydrogeological surveys for each. In the desert regions, these surveys are mostly complete and indicate potential for additional wells in specific aquifers. Thousands of wells have been drilled across Iraq for various purposes, with a significant number constructed in the 1980s primarily for agricultural use [48].

Threatening condition is that Iraq is experiencing a drastic decline in water resources, largely due to disputes over shared water with neighboring countries like Turkey, Syria, and Iran. These neighborhood countries due to their water management programs they have built many dams upstream river Euphrates and Tigris and reduce the amount of water reaching Iraq, also climate change has led to increase in temperature, evaporation and reduces rainfall, hence reduced amount of water available for agriculture and other water using sectors. Additionally, Iraq's water management policies are unclear, and there is no strategic plan in place to address the significant reduction in available water [49].

2.6 Fish in Iraq

For over 4,000 years, fisheries have played an important role in Iraq, dating back to when the Sumerians established the first known fishing regulations. The Tigris and Euphrates River basin, the largest in Southwest Asia, is central to this. The Euphrates stretches 2,700 km, while the Tigris is 1,900 km long, both originating in Turkey. While the Euphrates has a few small tributaries in Turkey and Syria, Iraq's Tigris receives several significant tributaries, including the Great Zab, Little Zab, and Diyala rivers. In Iraq, the Tigris flows for 1,345 km, and the Fart River spans 1,200 km. The two rivers converge at Qurna, forming the Shatt al-Arab, which stretches approximately 200 km before emptying into the Arabian Gulf [50].

The aquaculture industry, particularly fish farming in Iraq, has faced significant setbacks due to the Iran-Iraq War in the 1980s and the Desert Storm operation following the invasion of Kuwait. Also, the decline in fish farming has been largely influenced by disruptions and environmental impacts caused by oil pollution, and water scarcity in two major rivers (Tigris and Euphrates) which is primarily due to climate change and development of dams upstream. Current prospects for international food aid and advancements in agricultural technology do not present a positive outlook for either short-term or long-term food security at the community or national level in Iraq [51].

In 2017, Iraq's total fish production amounted to just 52,429 tons [52]. Data shows that the total area dedicated to fish farming covers 7,500 hectares, with nearly 1,900 farms, most of which are located close to freshwater sources. The majority of fish farms are small-scale operations, typically owned and managed by private individuals or companies. Productivity in these farms tends to be relatively low, ranging from 1,400 to 2,000 kg per hectare [53] [54]. Despite the existing setbacks, the fisheries and aquaculture sectors currently have greater development potential compared to other meat-producing industries like poultry and ruminants, as they represent only 4% of total investments. As an example, in recent years, fish production has seen improvements in northern Iraq, particularly in Erbil province. However, to achieve greater economic returns at minimal cost, it is essential to adopt scientific and technological advancements [55].

2.7 Soil

Iraq has approximately 8 million hectares of arable land, representing less than 15% of its total area, with only about 3.5 million hectares actively cultivated. The most fertile regions are in the north, northeast, and along the Tigris and Euphrates valleys [56] [57]. Despite Iraq's wealth in oil, agriculture remains critical for poverty alleviation and food security, particularly in rural employment. Sulaimania in the Kurdistan Region is a key agricultural area. Due to conflicts, recent soil studies are lacking, with the last major survey conducted in 1960. Soil properties vary greatly, affecting management and land use practices [58] On their study [59], The agricultural sector in Iraq has been influenced by the political, economic, and legislative changes that occurred following the events of 2003. These shifts have, in turn, affected the sector's contribution to key variables in the Iraqi economy, as outlined in the table 1 with Figure 2.

Table 1: *The Growth rate of GDP from 2004 to 2019 (in million dinars) [59]*

Year	GDP	Growth rate%
2004	101,845,262.40	53
2005	103,551,403.40	92
2006	109,389,941.30	6
2007	111,455,813.40	9
2008	120,626,517.10	8
2009	124,702,847.90	3
2010	132,687,028.60	6
2011	142,700,217.00	8
2012	162,587,533.10	14
2013	174,990,175.00	8
2014	178,951,406.90	2.2
2015	183,676,252.10	3
2016	208,932,709.70	12
2017	205,130,066.90	-9
2018	202,776,268.90	-1.14
2019	211,789,774.10	0.62
Average		13.4175

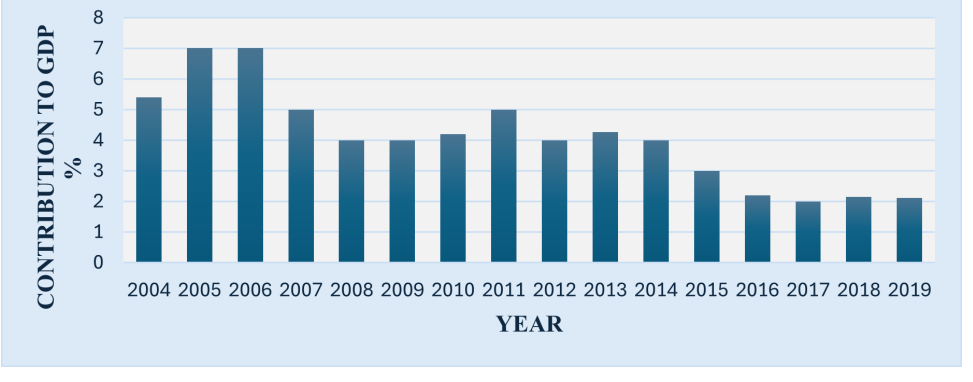

Figure 2: *Agricultural sector contribution to GDP from 2004 to 2019 [59].*

The analysis of the morphological, physical, and chemical properties of the collected soil data revealed variations across the different pedons. Generally, Iraqi soils show limited development, as evidenced by the diagnostic horizons found within the selected pedons. This is likely due to the dry climate and the relatively young calcareous alluvium parent materials. However, soils from the mountainous regions, which receive over 650 mm of annual rainfall and have an average annual temperature of 20°C, exhibit greater soil development. This is reflected in deeper soil profiles, higher organic matter content in the surface horizon, and lower salinity levels. The data from the mountain region pedons align with the criteria for forming diagnostic horizons such as Mollic, Calcic, and, to a lesser extent, Cambic and Argillic horizons. In contrast, soils from other regions show weakly developed diagnostic horizons typical of arid environments, including Ochric, Cambic, Salic, Gypsic, and Calcic horizons [60].

Generally, while the country is widely recognized for its oil, Iraq's soil and agricultural capacity are vital for ensuring food security, supporting rural communities, and preserving cultural heritage. Iraq's soil holds great importance in various aspects, particularly in agriculture in the fertile areas on the northern part and along river Tigris and Euphrates where they cultivate crops such barley, wheat, rice, and vegetables which is essential for food consumption [16]. Economic growth, as most of the country's rural communities depends on agriculture for food and money to buy for other needs, through this and general agricultural business [61], the agricultural sector is one of the key drivers in Iraq's economy. Environmental sustainability, as the soil is the key media to support biodiversity such as different plant species, wetlands, and marshes, also support sustainability by contribution to the reduction of carbon dioxides in the air by carbon sequestration process [62]. On top of this the Iraq soil held some historical and cultural importance, such as development of ancient Mesopotamian civilizations, including the Babylon, Akkad and Sumer, who believed to introduce some earliest agricultural techniques such as irrigation which is the base of modern agriculture [63].

2.8 Forest

Studies as that conducted by [64][65] shows that, the natural forest area of Iraq forms a large crescent along the northern and northeastern borders with Turkey and Iran, located between latitudes 35.0° and 37° 20' N and longitudes 42° 20' and 46° 20' E. The southern and western boundaries can be roughly drawn from Zakho district in the northern plain, passing through Dohuk district, Aqra, the Erbil plain, and reaching where the mountain ranges intersect the Iranian border near Horin Shaikhan. This crescent-shaped forest covers approximately 1.8 million hectares, excluding the Ahrah forest, which lies along the Tigris and Euphrates rivers. Iraq's forests constitute about 4% of the country's total area, which is approximately 438,000 square kilometers [66].

The forests in Iraq are classified into two categories: First, Mountain forests, known as Ghabat, and second, Ahrah, which refers to the scrubby woods that grow sporadically along the banks of the two major rivers, the Tigris and Euphrates, through the plains. Iraq's wealth is largely found in the vast mountainous regions, which are covered by native oak forests that dominate the vegetation in the northern mountains and valleys. These forests play a crucial role in conserving water and soil, in addition to providing wood and other forest products. The area covered by Ahrah forests is approximately 43,851 hectares. In addition to the natural forested regions, around 25,000 hectares of artificial reforestation exist in the mountainous areas. There are also numerous irrigated plantations established along the two major rivers, extending from the north to the south, based on their proximity to factories and the demand for recreational use [65][66].

2.9 Wildlife

The country's geographical characteristics that range from desert, rivers, marshes and mountains, has influenced the presence of variety of wildlife in groups of mammals, birds, reptiles, insects and invertebrates. The most considered wildlife (wild mammals) face global threats, particularly due

to habitat loss and alterations, as well as instances of unregulated, illegal, or commercial hunting [67][68]. In Iraq, 93 wild mammal species have been documented, spread across eight orders, 28 families, and 65 genera. According to the International Union for Conservation of Nature (IUCN), these species are classified as follows: one is Extinct, one Critically Endangered, four Endangered, eight Vulnerable, seven Near Threatened, and three listed as Data Deficient [69].

Wildlife in Iraq faces significant threats, primarily due to human activities such as agriculture, road construction, deforestation, illegal hunting, and the presence of minefields along the northeastern border with Iran. These activities endanger both humans and wildlife, including species like the Persian leopard and wild goat [69]. Protecting wild mammals is crucial and can be supported by gathering data on species diversity and distribution in different forest conditions. However, observing wildlife in tropical forests is challenging because these animals are elusive, inhabit dense vegetation, occur in low populations, avoid humans, and are mostly nocturnal [70] Camera traps, which are widely used by wildlife researchers, offer an effective method for identifying species in specific regions. They also help track patterns of behavior and population abundance [71] [72].

3. Assessment and Evaluation

In assessing and evaluating the exhibited literature on the natural resources of Iraq region and in order to meet the goal of critical reviews in the current survey study, several tools for visual and statistical descriptions used to present clear information on the natural resources' availability, location and contribution to economy. The key areas discussed to portray this information are in three categories, first is existing situations where the availability of resources and their location are well presented, second is resources contribution to country development, where the data on the percentage contribution to country GDP has been shown, and third is the general challenges facing natural resources in Iraq.

3.1 Existing situations

After reviewing numerous literatures which discussed different kind of natural resources, it directly evidenced that Iraq has significant resources, in which some of resources such as oil/gas are well utilized, and some are not yet or not well utilized. There can be many reasons why some of resources are not well utilized, but one of the reasons is the lack of clear inventory of resources and their potential for economic development. Therefore, this survey study highlighted visually the natural resources available and their location.'

3.1.1 Oil, gas and minerals

Oil/gas reserves and refinery plants are found more on the north part of the Iraq (particularly Kurdistan region and Kirkuk) and Rumaila in the south. Oil and gas sector is the back born of the country economy as it contributes to almost half of the yearly GDP. The presence of this crucial resource in Iraq helped the country economic development to step up from scratch to where it's now, and currently with the initiatives to diversify the economy, this sector is believed to play the main rule of generating revenues to invest on other natural resources development. Despite the economic advantages of this sector, also comes with a lot of problems, and the ones who suffer the most are rural residents through resettlements, different pollutants introduced into the environment. With more emphasis on exploration and exploitation these effects are expected to heap up. On the other hand, the country has also a variety of minerals and potential non-oil mining sites, especially in the western desert. These minerals include sulfur, phosphate, limestone, gypsum, salt, sand, clay, dolomite and quartz. The development and expansion of non-oil mining can help to diversify the economy and hence help to reduce the overdependence of oil/gas and reduce the environmental footprint of it, by implementing the well sustainable plant for developing non-oil/gas mining. Figure 3 displayed the oil/gas sites locations and potential minerals (non-oil/gas mining sites. It can be seen

that the major sites of oil and gas is on the north and south, while for minerals reserves are mainly distributed within west of Iraq.

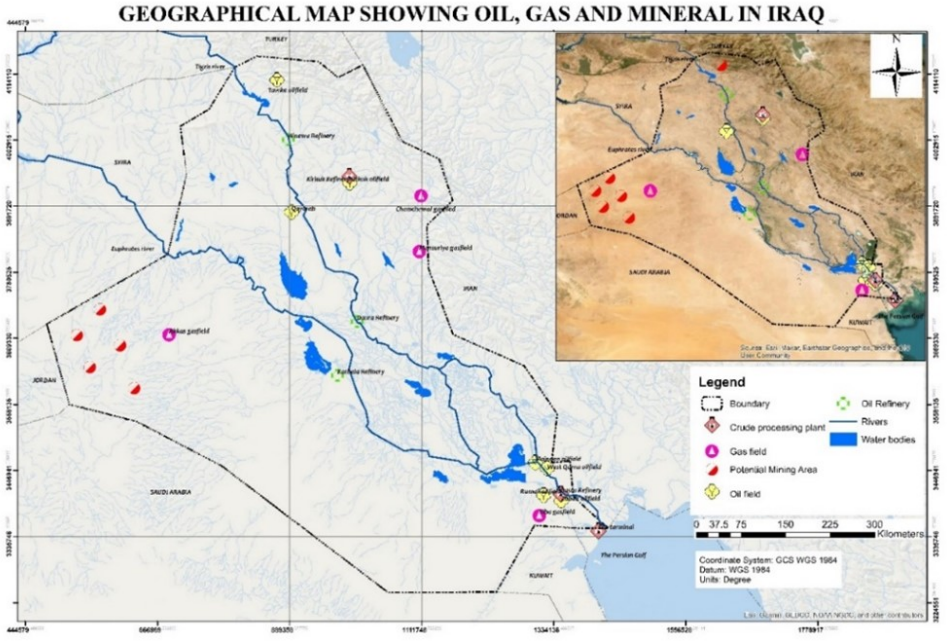

Figure 3: *Oil/gas sites and potential minerals (non-oil/gas mining) sites (GIS output by using GIS user community data updates of October 2024).*

3.1.2 Water bodies

Iraq mainly depends on two major rivers (Euphrates and Tigris), on their nations water demand such as water supplies and irrigation. Several dams have been constructed upstream to reserve water for use in the dry season. One of the major sources of employment and contributor to country GDP is agricultural sector, of which to the large extent depends on water bodies for irrigation, due to the fact that Iraq receives low average rainfall. Generally, the main available surface water bodies in Iraq are Euphrates River, Tigris River, Shatt al-Arab river, lake tharthar, lake habbaniyah, lake lazzaza, Darbandikhan/dokan lakes, marshlands, Mosul dam reservoir (lake Dahuk) and Haditha dam reservoir [73]. These water bodies, rivers, reservoirs and lakes has a biggest potential to contribute to Iraq economy, not only to industrial/domestic supplies and irrigation, but the program can also well develop to further activities such as recreation, fishing, Hydropower production (renewable energy) and afforestation. Figure 4 exhibits the major rivers, lakes, sea and wetlands as the water bodies present in Iraq. This figure clearly shows the coverage of the main source of water in the country, which is the river Tigris and Euphrates.

With the challenge of climate change which influences the reduction of the average annual rainfall, which in turn affected the amount of water in Tigris and Euphrates, the country also uses groundwater to as alternative to surface water. Groundwater recharge primarily comes from three sources: natural precipitation, infiltration of surface water, and, in agricultural settings, artificial recharge from irrigation [74]. Groundwater storage is highly responsive to both surface water availability and usage levels. Variations in well withdrawals can impact river discharge, while changes in streamflow influence the amount of groundwater available. Groundwater plays a great role in

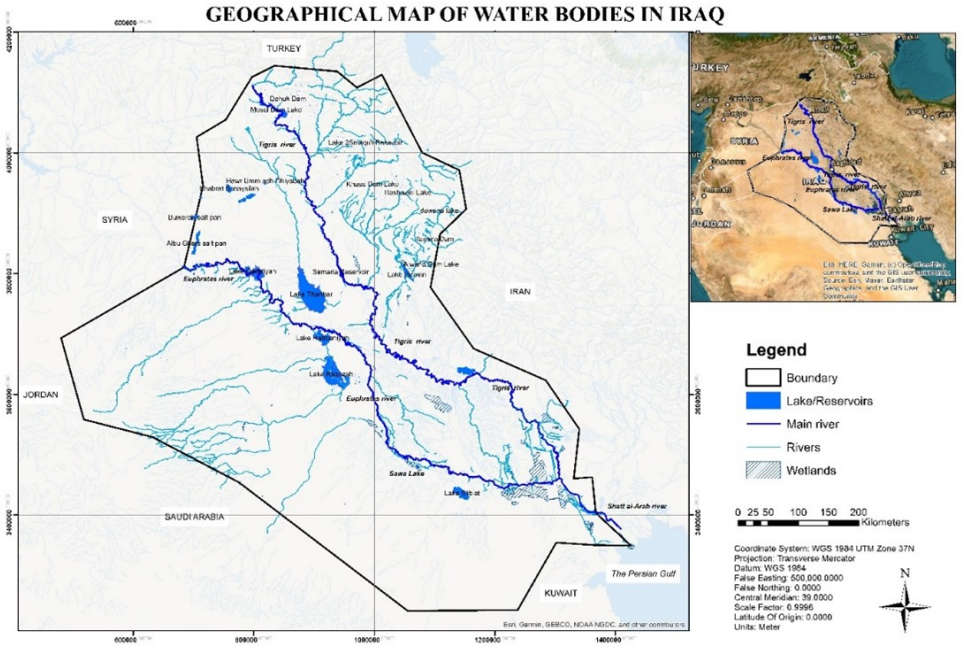

Figure 4: *Water bodies in Iraq (GIS output by using GIS user community data updates of October 2024).*

meeting the water demands especially in the areas with limited surface water such western desert and in mountain areas (northern). In general, the groundwater reserve is distributed and accessible in whole Iraq and mainly used to serve for domestic uses and irrigation. In recent years, groundwater in Iraq is facing a number of challenges, including low groundwater recharge caused by climatic changes, saltwater intrusion, contamination primarily by oil and gas industry, as well as limited infrastructure for monitoring groundwater [75].

3.1.3 Land uses

As Iraq advances in its development, gaining insight into the complex dynamics of land use and land cover becomes ever more essential. This land use and land cover discussion marks an important step in supporting informed decision-making and promoting sustainable development. Iraq's deep history, varied landscapes, economy and cultural heritage are closely connected to its land. Approximately 40% of Iraq land is rock dessert which is not used at all, and about 30% is mountains with hash winter and characterized by forest [76] [77]. The more land use in Iraq is by Agricultural sector, which also uses less than 15% of the arable land. The most fertile land is obtained in the north part of the country and along the course of two major rivers (Euphrates and Tigris) [58]. The rest of the land is used for other activities such as oil and gas processes and settlements (built area) [78]. By looking on the percentages of land uses it shows how much agriculture is potential for the life of Iraq people especially for those living in rural areas. By investing in development of agriculture sector, it will increase the number of employments, improve food security and reduce over dependency on oil and gas.

The unused areas such as that high percent of dessert, the government of Iraq can find a way to utilized it. Those areas receive a significant amount of sun rays per year, which can be used to

produce electricity (solar power) by investing in the solar farms and reducing the dependence on oil/gas for energy production, hence minimizing environmental impacts. As the renewable energy is concerned, in those areas (dessert) solar energy can pe coupled with wind energy to benefit from wind in the wind periods. Figure 5 represents the distribution of the current land uses in Iraq, and it shows that most land uses is on north and along the major rivers (where the most land uses is by agricultural activities) on the other hand on west on dessert area, the land is almost unused.

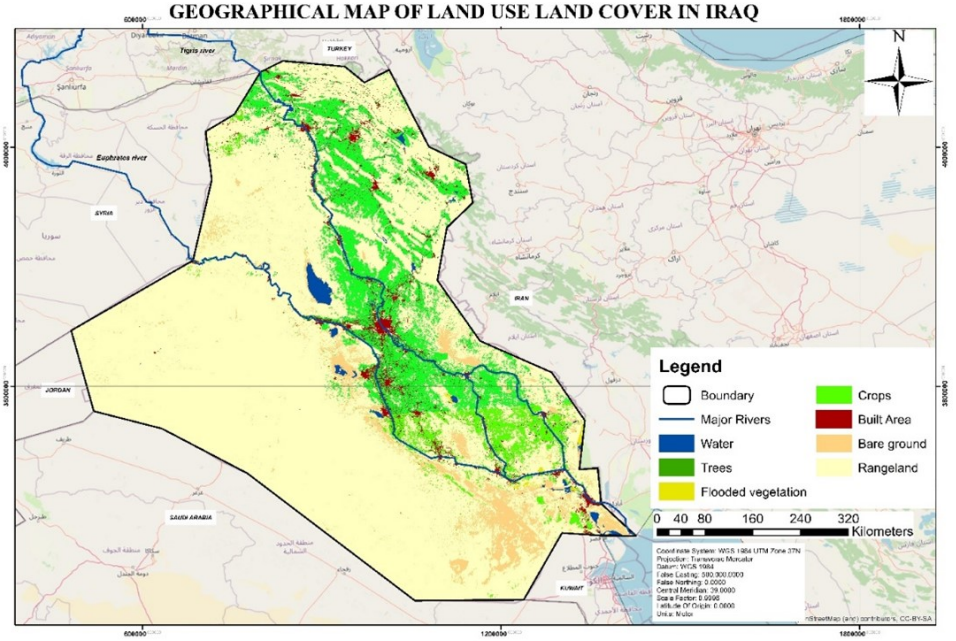

Figure 5: *Iraq's land use (GIS output by using GIS user community data updates of October 2024).*

Geographically, Iraq's position serves as the regional connectivity among Middle East countries, including Saudi Arabia, Iran, Turkey, Syria, Jordan and Kuwait. Using advantage of its land to be central of all those countries, Iraq is the most significant link in the Middle East trade, energy transport as well as politically. The land of Iraq act as the biggest connection of oil rich Persian Gulf, Syria, Lebanon, Jordan, Palestine, Europe and Central Asia [79]. This connection gives Iraq an advantage of using its land for significant routes of oil and gas pipeline, contributing to both country economy, regional economy and global energy supply chain. Also, the country although has the relatively small coastline on the Persian Gulf, it gives the country advantage to directly path to marine routes, which is very important for global business (that is importing and exporting goods through sea, which connect the country to the global market directly). As the country is more depending at large percent on oil and gas, it values this small coastline access particularly for oil/gas exports, as much of the global oil/gas business depending on shipping routes through Persian Gulf, which is very near to Iraq's Basra port [80].

3.1.4 Terrain, Forest and Wildlife

Generally, most of areas in Iraq is low land, except the upper north near Turkey where it has been characterized by mountains and forest, and part of the western desert bordered by Jordan, Syria and Saudi Arabia. The big forest is in the north and along the two major rivers (Tigris and Euphrates).

The well-known forests are such as Zagros mountains forests – located at Kurdistan region near the borders of Turkey and Iran (the largest forest in Iraq), Shirwan Mazin forest – located north Iraq – Kurdistan region, Rawanduz Valley forest – near the Rawanduz city close to Turkey and Iran border, Paramagroon Mountain – in the eastern part of Kurdistan near Sulaymaniyah and Halgurd-Sakran National Park Forest in the Erbil Governorate. These forest areas are where a variety of wildlife such as mammals, birds, reptiles, insects and invertebrates are present. Examples of the mammals include wild goat, Persian leopard, wolf, wild cat, striped hyena and Eurasian otter [81]. Figure 6 presents the terrain of Iraq, in which in the highest terrain especially in the north is where forests and wildlife mostly found.

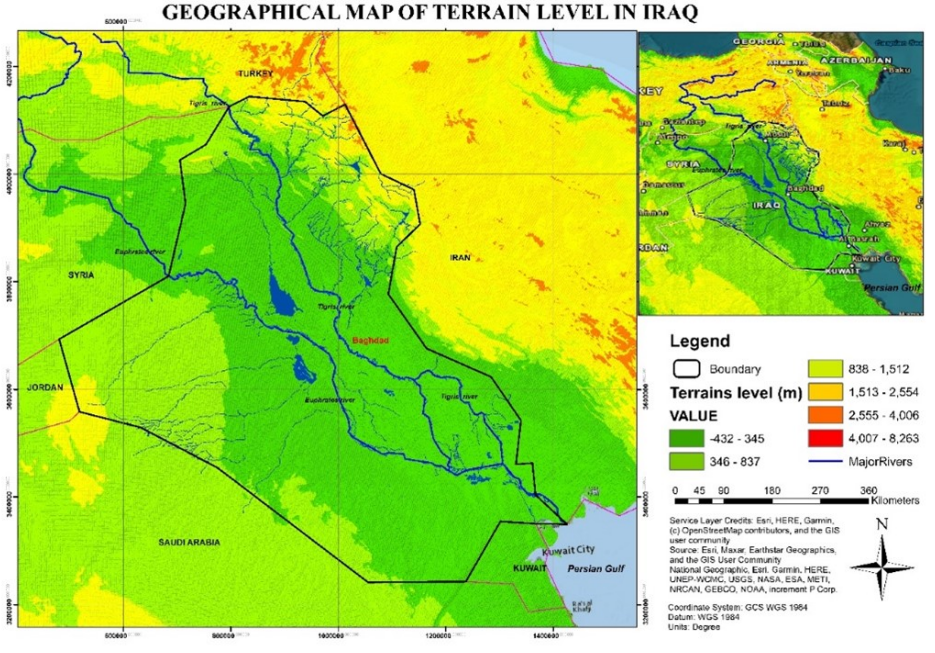

Figure 6: *Terrain levels in Iraq (GIS output by using GIS user community data updates of October 2024).*

3.2 Natural resources contribution to development

Iraq's economy is heavily reliant on the oil industry, which generates approximately 95% of its foreign exchange earnings and is a major contributor to Iraq's GDP, in recent years data it represents approximately 45.67% of the country's yearly production, while the non-oil sectors accounted for 54.33% of this total. Among these, productive sectors like agriculture, non-oil mining, and manufacturing contributed 8.34%, while construction, electricity, and water made up 12.92%. The remaining 78.74% was from various service sectors, with 39% attributed to the public sector and 61% to the private sector [38]. This directly shows that other sectors remain undeveloped or developing at a slow rate as compared to the oil/gas sector. Figure 7a below evidencing how the Iraq economy is much depending to oil/gas industry while Figure 7b represents growth trends for both oil/gas and non-oil/gas GDP. Although in recent years the non-oil GDP has shown some positive trends compared to oil GDP, their general contribution percentage to GDP is still very low.

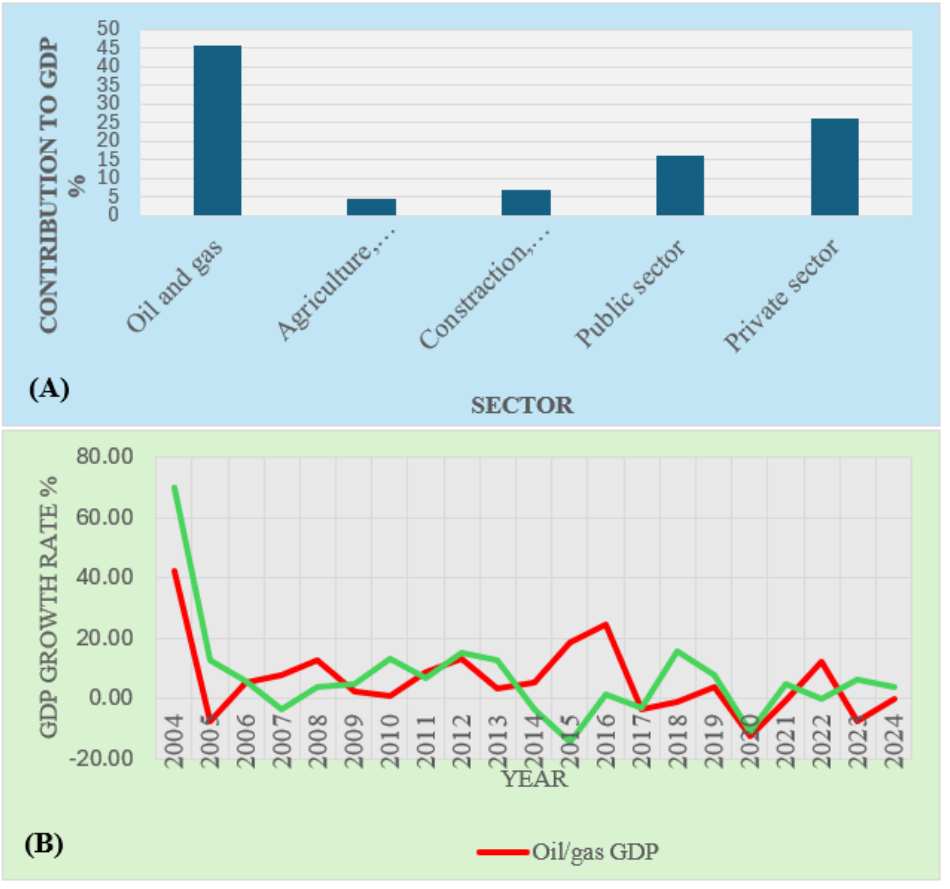

Figure 7: *(A) Sectors contribution by percentage to Iraq's GDP [38]; (B) Comparisons between Oil/gas GDP and non-oil GDP growth trends [82].*

3.3 Challenges facing natural resources in Iraq

3.3.1 Over dependence on oil and gas

The biggest challenge associated on the utilization of natural resources in Iraq is the over dependence on oil and gas sector. The government and political activities all are dictated by how they can maximize the benefit from oil and gas. This challenge has led to many problems including hindering the development of other sectors which have greater potential to generate earnings to the government such as non-oil mining, fishing, and agriculture [83]. This situation puts Iraq in Economic vulnerability as the oil and gas in world market is more volatile, and with the world movement toward sustainability by reducing the use of fossil fuels the price is expected to all at the near future. To avoid this situation reduces the efforts towards transition to renewable energy, the global energy is now shifting in this direction, but Iraq has a low renewable energy capacity, to avoid further subsequences it needs to significantly invest and develop the renewable energy.

3.3.2 Climate change

The region of Mesopotamia has historically been recognized for its predominantly hot climate. Examining the Lower Mesopotamian environment, which includes deserts, foothills, steppes, and marshes, reveals a shared characteristic: minimal summer rainfall. Overall, the area experiences

hot, dry summers and mild, dry winters in the desert and steppe regions, while the foothills are marked by mild winters and warm, dry summers [84]. Climate change is a global issue, as the world is experiencing a rise in the average temperature (global warming) and an increase in adverse weather events such floods, hurricanes and tornados as the result of global warming. This problem is significantly affecting natural resources in Iraq especially in the areas of water, agriculture and biodiversity. Water scarcity, the country much depending on the river Euphrates and Tigris, so due to global fall of average rainfall the upstream of these two rivers (Syria and Turkey), they are developing a lot of dams to reserve water for their demand, the act which reduces amount of water coming to Iraq. The water scarcity is frightening the agricultural sector, and municipal and industrial water supplies. Acting upon this the government should prepare a well water management plan to adjust with the climatic changes. Also, the rise in temperature with less annual average rainfall is extending the desertification, as Iraq now has the highest rate of desertification in the middle east. Due to this the arable land is continuing to be reduced, the forest is dried up, wildlife species are extincted.

Deterioration of other natural resources by oil and gas activities Despite the fact that oil and gas is the key sector to Iraq's economy, but also the development and operation of oil and gas activities has led to significant deterioration of other natural resources such as water, land and biodiversity. In terms of quantity, the oil and gas industries draw significant amounts of water from water sources (billions of gallons per day) for processing and cooling machines, this creates scarcity in other areas like agriculture and fishing. The contaminated water after used, due to improper waste management, and also by normal chance they get back to pollute water bodies by introduction of different hazardous pollutants (heavy metals, VOCs, hydrocarbons, Acids and radioactive materials) to human health and other organisms [85]. Some of the pollutants tends to seep into the soil and deteriorate the ability of the soil to sustain agriculture and also killing microbial life within the soil. The effects extend further to loss of biodiversity not only by pollutants introduced to land and water but also through deforestation to acquire more land for expansion of oil and gas projects.

3.3.3 Over consumption and depletion

Natural resources in Iraq, especially the oil/gas, forest, fisheries and water are under considerable strain, that is their demands is very high to the point that it poses risk to meet the demand of the future (they are not sustainably managed). Iraq is one of the highest producer and exporter of oil and gas globally, also internally it much reliant to oil/gas sector for generating incomes and different services to serve the community. As oil and gas are not renewable energies, the current rates of extraction pose more risk to the country's long-term depletion. Forest areas are reduced from time to time, as the country faces serious deforestation, mainly due to urbanization (settlements and industries), agricultural developments, as well as the use of woods as a source of energy. This issue leads to loss of biodiversity, soil degradation and increased vulnerability to desertification. The fishing industry facing its own crisis, as due to increased demand of fish caused by the increased population, Iraq water bodies are now experiencing overfishing, which pose the risk of fish availability in the near future. The water deficit is also growing in the country, regarding the country is in the dessert region where it receives low rainfall amount. The largest amount of water is used by agriculture activities and industrial activities (particularly oil/gas industry) [85]. These activities are leading to over-extraction of both surface and groundwater, and lead to the depletion of water available for community, acceleration of desertification as well as threatening future agricultural outputs.

3.3.4 Population growth and urbanization

Between 2003, when Iraq was invaded by a US-led coalition, and 2022, Iraq's population saw significant growth, rising from 24 million to 42 million, an increase of 18 million. Projections from Iraq's Ministry of Planning indicate that by 2030, the population could reach 50 million,

with further growth expected to bring the total to 80 million by 2050, marking an increase of 56 million since 2003 [86]. The growth of population comes together with the expansion of urban areas and increased demand from natural resources. The coupled effects of population growth and urbanization lead to several situations including increased demand for natural resources, deterioration of natural resources, increased waste/pollution, and pressure on public services and infrastructures. An increase in natural resources demand (such as water and energy) means the overexploitation of natural resources unsustainably, this poses risk to the availability of these resources in the future. As the population increases the cities also increase which leads to deforestation and loss of biodiversity. The increased population means the increase in anthropogenic activities and increases of the waste and emissions to the environment (such as wastewater, solid waste and greenhouse gas emissions). Finally, the increase in population leads to high pressure in public services as well as infrastructures, which will require a government to overexploit the natural resources to adjust with the number of people.

3.3.5 Weak policies and governance

Policies and governance are the foundation of resources management. Iraq is facing the problems of having in the area of policies and governance, which is mainly caused by various numbers of factors but mainly is due to corruption and political instability [87] [88]. These two biggest reason of weak policies and governance is directly affecting the general management of the natural resources by causing issue like, resources misallocations, lack of resources protection, limited public participation and awareness, and inconsistence policies. Lack of resource protection through policies leads to people being involved in unsustainable exploitation of natural resources, such as illegal fishing and overusing water in non-productive activities. Limited public participation and awareness due to failure of government plans to reach people and share the insightful knowledge on the importance of sustainable use of resources, influences the community to deteriorate or overuse of resources without knowing the negative impact of their actions. Inconsistency in policies is mainly caused by political instability. When each government takes over, they tend to change policies in line with their new vision, lacking the continuity of different resource management and development plans.

3.3.6 Geopolitical conflicts and resource control

Development for natural resources does not go in line with conflicts in the country; whenever there is a country, the damage will end up on resource [89]. In Iraq resources has background of generating conflicts within the country and outside the country, and still believed these conflicts are still passively there. The two main resources that a though to bring conflicts, which in turn hinder the development of the country are Oil/gas and water. The control of oil and gas has often led to both internal and external conflicts. The regions in Iraq like Kirkuk and Basra historically they competed to control oil rich areas, this competition usually led to violence and disruption of resource development [90]. Living scenario is the Kurdish government in north of Iraq, has declared the total operation of several oil fields and their exports, thigs which is not accepted by Iraq's central government [91]. This disagreement on who should have control over resource distribution is causing ongoing disruptions which affect the development of the oil/gas sector. As the oil and gas industry the global commodity, it attracts foreign influence over control of it, which when Iraq don't align with their suggestion it causes political conflicts. In water the main conflict is with neighbor countries particularly Turkey and Syria, where is the origin of the two major sources of water (River Tigris and River Euphrates) [92]. The upstream countries developed several dams which reduces the amount of water coming to Iraq, this situation lead the ongoing political arguments between these countries on the distribution of water resources.

These challenges have direct environmental implications that extend beyond economic concerns. The over exploitation of oil and gas contributes significantly to environmental degradation, including

soil contamination, air and water pollution, and loss of biodiversity. Ineffective land use and water management practices accelerate desertification and reduce ecosystem resilience. In addition to that, the absence of integrated Environmental Impact Assessment (EIA) practices in planning and development exacerbates these issues, particularly in regions where extractive activities overlap with ecologically sensitive zones. The findings emphasize that without stronger environmental governance and mitigation frameworks, the benefits of resource development may be outweighed by long term ecological damage.

4. Future research direction, implementation and implication

4.1 Future research direction and implementation

The study through literatures and evaluation, shows various natural resources found on different locations of Iraq. These resources, when the proper program is established to exploit them, will reduce the overdependence on oil and gas and all the consequences associated with it. To find a way to reach this target, it needs researchers to find insights into different natural resources in areas such as abundance, exact locations, sustainability and economy diversification based on the available resources. The mentioned potential areas for future research can further be categorized to reflect the global movements, such as sustainable resource managements, climate resilience and adaptation, incorporating technology (e.g. the use of AI) on exploitation of resources, social issue with respect to natural resources as well as renewable energies potentials and options.

For a country, depending much on one source of foreign earnings and GDP is a risk which can cause economic downfall whenever there is an overseen event which interrupts the market chain of a particular resource, good example is fall of oil prices and market activities in the period of COVID 19. Due to this the government of Iraq have to prepare the strategic plans and funds to support the research related to natural resources (development and exploitation) and implementation in due time. By investing in many natural resource developments, the government will increase the power of national institutions and add more employment, which in turn will increase the government ability to rely on local earnings.

Resources abundance, this study has shown the geographical location of different natural resources, which is the major first step towards the development of resources in the country. The government has now needed to invest and motivate in performing different research aiming to establish/project the approximate number of resources available and evaluate the chance to economically and sustainably utilize them. In mineral, the research direction like feasibility for economic extraction of copper in Kurdistan region, where specifically a geologist with economist researchers can come up with comprehensive information which can help the country to implement the utilization of a researched mineral. In Agriculture, as the biggest problem is the availability of arable land and enough water, the researchers should look at how organically they can turn a rangeland to suitable for a certain kind of crops, also on incorporation of AI on the modern ways of irrigation to copy with the reduced amount of water available in the country. The same applies to all kinds of natural resources and comes up with thousands of implementable results.

Sustainable development, there are number of existing research in this area, but still there are needs to add more in respectively kind of resource. Sustainability involves creating development that meets today's needs while preserving resources and opportunities for future generations, ensuring they can also meet their own needs [93]. First towards the sustainable development of government should invest in research for more sensitive areas as sources of energy. Exploring the potential of implementing different kinds of renewable energy in different parts of the country. For the geographic nature of Iraq, the research should focus more on solar energy, wind energy, hydropower and biomass energy, to seek for a way to reduce the environmental footprint of oil/gas [94]. In water, due to reduced amount of surface water, now they are turning to the use of groundwater, the researchers should look on sustainable way to use round water which is equivalent to the rates of groundwater

replenishment in a particular region. The same way to be applies to all natural resources in connection with sustainability.

Economic diversification, despite the fact that Iraq has the vast of natural resources, but its economy to the large extent depends on oil and gas sector [95] This put the country in risk in case of any unforeseen disruption of oil and gas market. The research typically from economists is needed to pave the way on how the country will reduce the overdependence on oil and gas by incorporating other resources on the national development plans. Resources like land and water, which are key in agriculture, the sector which is the backbone for most of the country's economy, can be researched on how minimal resources can be used to maximize agricultural production. Non-oil and gas mining has been contributing significant revenue to the country, though there are not much investment in it as compared to oil/gas and its mainly on building material mining, this should attract researchers to find on how this sector can be developed to exploit inherited crust wealth. And it should not only depend on the product market, but the available resources can also be used to generate a service market like tourism which is more sustainable and has the potential for generating foreign currency.

Climate change mitigation, adaptation and resilience, Climate change is the current challenging issue globally, their effects are even worse in the country like Iraq which are dessert in nature [84]. The main contributor to climate change is the anthropogenic activities which emit greenhouse gases, which lead to an increase in the earth's average temperature. The research on how to reduce greenhouse gases is more crucial as its implementation will help the future generation (ensuring sustainability), but there is current generation, how they are adjusting to the current climate change, the answers needed from research on the adaptation to climate change. The finding on how to change the way of our activities on resource utilization with respect to current climate. Currently the effects of climate change are there and expected more effects. How the community prepared to minimize the consequences of the coming effect of these changes, the resilience to climate change answers should be provided by researchers.

Transborder policies, Iraq as the country is not an isolated island, its development it depends on both within and outside the country cooperation. Policies is the map of how the country will handle this cooperation outside the country's border. In water resources the country depends much on River Tigris and River Euphrates, with both rivers originating outside the Iraq's borders, to maintain the availability of this resource there are policies governing these agreements with neighbor countries. On the other hand, as one of the biggest oi/gas producers and exporter, there are policies governing the whole trade outside the boundaries and policies governing the cooperation with other oil producers' countries. The same applies to all other natural resources in the country. The findings are needed from researchers on how the existing policies help the country to benefit from its resources and highlight the area where improvement needs. As of now through the existing transborder policies, the country has launched biggest road project to connect the country from Persian Gulf to all neighbor countries [96]. With the dynamics of the world market for natural resources and climate changes, the research needs to come up with recommendations of new policies to cope with the current situation and the future.

4.2 Implications for Research, Practice, and Society

This study provides a critical foundation for advancing interdisciplinary research in natural resource management, climate adaptation, and economic diversification in Iraq. For researchers, the findings offer a roadmap for priority studies such as quantifying untapped mineral reserves, modeling water stress under climate change, or piloting renewable energy systems in arid regions. For practitioners and policymakers, spatial analysis and sector specific insights can inform integrated planning, decentralized governance strategies, and the design of investment programs targeting underutilized resources. At the societal level, the paper underscores the urgent need for sustainable development practices that not only mitigate environmental degradation but also create inclusive economic op-

portunities particularly for rural and conflict affected communities. In doing so, it supports Iraq's broader goals of post conflict recovery, environmental justice, and long term resilience.

5. Limitations of the Study

Although this review provides a comprehensive overview of Iraq's natural resources, several limitations should be acknowledged. First, the study is based primarily and secondary data from existing literature, reports, and GIS sources. As such, the findings are limited by the accuracy, availability, and publication dates of those sources. Some of the data may not fully reflect the most recent changes in resource distribution or policy developments. Second, there is limited availability of consistent, high resolution, and up to date geospatial data across certain resource sectors, such as groundwater reserves, forest coverage, and biodiversity metrics. Third, the review does not include primary field investigations or stakeholder interviews, which could have added depth to the socio economic and policy related aspects of resource management. Finally, while the review attempts to address regional diversity, some local level nuances may not be fully captured due to a lack of disaggregated data. These limitations suggest the need for continued research involving more recent datasets, multidisciplinary approaches, and on-the-ground validation.

6. Conclusion

The survey for natural resources in Iraq, has found that the country has a vast natural resource comprised of both finite and infinite resources. The resources present are oil/gas, soil, minerals, renewable energy, water, fish, forest, and wildlife. These resources have distributed in different parts of the country, as oil/gas is more available on north and south part, arable soil on the north and along the river Tigris and Euphrates, renewable energy as solar and wind potentially in west desert, water/fish (in the rivers, lakes, reservoirs and sea), forest in north and along two major rivers, and wildlife in forests. Oil/gas is more appreciated than others and most plans and investments have gone in oil/gas way, while some like agriculture and non-oil mining are also trying to grow, and the rest is almost stagnant.

Oil/gas sector is contribution to almost half of the country's GDP, with the rest of natural resources combined with other service sectors (public and private) contributing to approximately half of annual GDP. The biggest challenges with natural resources in connection with the economy in the country are overdependency on oil/gas sector, climate change, deterioration of other resources due to oil/gas activities, overconsumption and depletion, population growth and urbanization, weak policies and governance and geopolitical conflicts and resource control. Overdependency in oil/gas is causing the stagnant development of others, because more funds are allocated in one sector, situation which is risky to country's economy, as an unforeseen challenge that can affect the oil/gas market will lead to dramatical fall of the country's economy. Climate change, especially the rise of average global temperatures, has had significant effect on natural resources, as the amount of water available for agriculture and fishing has reduced, forests are drying up, also leading to extended area of dessert. Due to oil/gas waste released to environment the natural resources as soil and water are suffering from pollution, hence reducing the chance for utilizing them and also destroying biodiversity by killing flora and fauna present in the soil and water. All the challenges at the end are limiting the development of resources in the country.

Therefore, the findings underscore the need for resource diversification, improved planning, and sustainable exploitation. Environmental degradation, especially in water, land, and biodiversity emerged as a recurring consequence of unchecked development and weak regulatory enforcement. Hence, environmental considerations must be central to all future national strategies. Integrating Environmental Impact Assessments (EIAs) into all large scale projects, investing in ecosystem restoration, and adopting climate resilient planning are essential steps toward achieving balanced development.

The review calls for a paradigm shift where economic growth, environmental integrity, and social stability are addressed as interdependent priorities.

Declarations

Ethical Approval: Not applicable.

Consent to Participate: Not applicable.

Consent to Publish: I have not submitted my manuscript to a preprint server before submitting it to Knowledge based Engineering and Science (KBES).

Authors Contributions

Furaha Emmanuel Ndaka: Conceptualization, Analysis, Methodology, Visualization, Validation, Writing- Original Draft Preparation, Writing-—Reviewing and Editing.

Conflicts of Interest: The authors declare no conflict of interest.

References

[1] UNEP, "Global-Resource-Outlook," 2024, Accessed: Apr. 10, 2025. [Online]. Available: https://www.unep.org/resources/Global-Resource-Outlook-2024

[2] K. R. Subramanian, "The Crisis of Consumption of Natural Resources," 2018. [Online]. Available: www.ijriar.com

[3] M. Chêne, "Natural resource management transparency and governance A literature review focusing on extractive industries," 2017. [Online]. Available: www.U4.no

[4] S. N. Nakouwo, D. Ofori-Sasu, and B. A. Kusi, "Natural resources and national productivity in Africa: are there differences in high and low globalized economies?," Critical Perspectives on International Business, vol. 19, no. 2, pp. 299–318, Jan. 2023, doi: 10.1108/cpoib-12-2021-0103.

[5] A. Bebbington, A.-G. Abdulai, D. Humphreys Bebbington, M. Hinfelaar, and C. A. Sanborn, "Governing Extractive Industries OUP CORRECTED PROOF-FINAL, 25/5/2018, SPi," 2018.

[6] S. Steadman, I. Gençsü, S. Mustapha, S. Colenbrander, and J. Tyson, "Indebted: how to support countries heavily reliant on oil and gas revenues to secure long-term prosperity," 2023. [Online]. Available: www.odi.org/publications/indebted-how-to-support-countries-

[7] A. Deka, "The role of natural resources rent, trade openness and technological innovations on environmental sustainability – Evidence from resource-rich african nations," Resources Policy, vol. 98, Nov. 2024, doi: 10.1016/j.resourpol.2024.105364.

[8] WCED, "Report of the World Commission on Environment and Development," 1987.

[9] Dasgupta, The Economics of Biodiversity: The Dasgupta Review Abridged Version. 2021. [Online]. Available: www.gov.uk/official-documents.

[10] R. Auty, Sustaining Development in Mineral Economies, 1st ed. Routledge, 1993. doi: 10.4324/9780203422595.

[11] M. L. Ross, The oil curse: How petroleum wealth shapes the development of nations. Princeton University Press, 2012. doi: 10.1093/afraf/adt051.

[12] S. Odell, "Governing Extractive Industries OUP CORRECTED PROOF-FINAL, 25/5/2018, SPi," 2018. [Online]. Available: https://academic.oup.com/book/34807

[13] S. N. Jawad, "The Kurdish question in Iraq: historical background and future settlement," Contemporary Arab Affairs, vol. 1, no. 1, pp. 25–41, Jan. 2008, doi: 10.1080/17550910701773119.

[14] K. Papagianni, "Political Transitions after Peace Agreements: The Importance of Consultative and Inclusive Political Processes," Journal of Intervention and Statebuilding, vol. 3, no. 1, pp. 47–63, Mar. 2009, doi: 10.1080/17502970802608175.

[15] Q. M. Hasan, "The power of constitution for enacting energy law and managing natural resources: The case of the Kurdistan Regional Government's oil contracts," Energy Policy, vol. 128, pp. 744–751, May 2019, doi: 10.1016/j.enpol.2019.01.012.

[16] Encyclopaedia Britannica, "Iraq," Apr. 2024. [Online].
Available: https://www.britannica.com/print/article/293631

[17] WorldAtlas, "Natural Resources of Iraq A drilling rig in Iraq," Jul. 2019. Accessed: Sep. 27, 2024. [Online]. Available: https://www.worldatlas.com/articles/what-are-the-major-natural-resources-of-iraq.html
[18] UNDP, "United Nations Development Programme (UNDP) Iraq," Jul. 2024.
[19] The Ministry of Planning, "National Development Plan 2024-2028 Republic of Iraq The Ministry of Planning," 2024.
[20] World Bank Group, "World Bank Document," 2017.
[21] K. S. Al-Bassam, "MINERAL RESOURCES," 2007.
[22] F. H. Tobia, Y. A. Kettanah, and M. M. Mustafa, "Petrography and geochemistry of Ga'ara sedimentary ironstones, Western Desert of Iraq," 2014, Elsevier Ltd.
Doi: 10.1016/j.jafrearsci.2014.04.030.
[23] K. S. Al-Bassam, "MINERAL RESOURCES OF KURDISTAN REGION, IRAQ," 2020. [Online]. Available: https://www.researchgate.net/publication/343905717
[24] H. Z. Toama, "PHOSPHATE ROCK PROCESSING AND FERTILIZERS PRODUCTION AT AL-QAIM FERTILIZERS COMPLEX, IRAQ," 2017.
[25] K. S. Al-Bassam, "GEOLOGY OF THE PHOSPHORITE DEPOSITS OF IRAQ," 2017.
[26] Y. A. Kettanah and C. F. Eble, "Petrology, mineralogy and geochemistry of Hemrin Coal Seam, Hemrin South Mountain, Northern Iraq," Int J Coal Geol, vol. 181, pp. 39–59, Aug. 2017, doi: 10.1016/j.coal.2017.08.001.
[27] A. T. M. M. M. Yasin, "Mineralogical and geochemical characteristics of the Benavi ironstone deposit, northern Iraq," 2019.
[28] Ghalib, "Sulfur deposits between Al-Fatah and Al-Mawsel: A study of the geographical factors affecting production," 1977.
[29] Kadhim et al, "View of Mineralogy of Recent Sediments of Al-Teeb River Basin-East Missan Governorate, Southeastern Iraq," 2023.
[30] M. A. Mahdi, "URANIUM DEPOSITS AND OCCURRENCES IN IRAQ," Dec. 2018.
[31] The Observatory of Economic Complexity (OEC), "Mineral Products in Iraq," 2022. [Online]. Available: https://oec.world/en/profile/bilateral-product/mineral-products/reporter/irq
[32] Y. A. Kettanah and C. F. Eble, "Petrology, mineralogy and geochemistry of Hemrin Coal Seam, Hemrin South Mountain, Northern Iraq," Int J Coal Geol, vol. 181, pp. 39–59, Aug. 2017, doi: 10.1016/j.coal.2017.08.001.
[33] Y. A. Kettanah, J. S. Armstrong-Altrin, and F. A. Mohammad, "Petrography and geochemistry of siliciclastic rocks of the Middle Eocene Gercus Formation, northern Iraq: Implications for provenance and tectonic setting," Geological Journal, vol. 56, no. 5, pp. 2528–2549, May 2021, doi: 10.1002/gj.3880.
[34] I. M. Saeed, A. T. Ramli, and M. A. Saleh, "Assessment of sustainability in energy of Iraq, and achievable opportunities in the long run," May 01, 2016, Elsevier Ltd. doi: 10.1016/j.rser.2015.12.302.
[35] L. Kumins, "CRS Report for Congress Iraq Oil: Reserves, Production, and Potential Revenues," 2003.
[36] A. Abd Al-Rahim Al-Abudi, "Al-Bayan Center Studies Series Al-Bayan Center for Planning and Studies Oil and gas sector in Iraq: reality and solutions," 2024. [Online]. Available: www.bayancenter.org
[37] M. L. Aresti, "Oil and Gas Revenue Sharing in Iraq," 2016. [Online].
Available: http://www.iraqoilreport.com/news/basra-pushes-toward-
[38] K. A. Nawfal, "Oil and Economic Performance in Iraq," Regional Studies Journal, vol. 17, no. 56, pp. 9–38, Apr. 2023, doi: 10.33899/regs.2023.178234.
[39] World Bank Group, "IRAQ ECONOMIC MONITOR," 2021.
[40] H. H. Al-Kayiem and S. T. Mohammad, "Potential of renewable energy resources with an emphasis on solar power in Iraq: An outlook," Resources, vol. 8, no. 1, Mar. 2019, doi:

10.3390/resources8010042.
[41] K. A. Khalaf, A. Gamil, B. Attiya, and J. Cuello, "Exploring the potential of concentrating solar power technologies for vertical farming in arid regions: The case of Western Iraq," Energy for Sustainable Development, vol. 77, Dec. 2023, doi: 10.1016/j.esd.2023.101310.
[42] H. J. Mohammed, A. T. Naiyf, T. Al-Jadir, and S. K. Khbalah, "Assessment of sustainable renewable energy technologies using analytic hierarchy process," in IOP Conference Series: Earth and Environmental Science, IOP Publishing Ltd, Jul. 2021. doi: 10.1088/1755-1315/779/1/012038.
[43] Q. Hassan et al., "Evaluating energy, economic, and environmental aspects of solar-wind-biomass systems to identify optimal locations in Iraq: A GIS-based case study," Energy for Sustainable Development, vol. 79, Apr. 2024, doi: 10.1016/j.esd.2024.101386.
[44] J. Al-Naffakh and M. R. Al-Qassab, "Comparing the growth of renewable energy sources in Turkey, Iran and Iraq Comparing the growth of renewable energy sources in Turkey, Iran and Iraq Article History Attribution (CC BY-NC-SA) 4.0 International License (https://creativecommons.org/licenses/by-nc-sa/4.0/)," International Research Journal of Advanced Science E, vol. 2, no. 2, pp. 21–26, 2021, doi: 10.5281/zenodo.5196668.
[45] UNICEF, "UN Iraq aims for 30 percent less water consumption under UNAMI-UNICEF conservation project," 2023.
[46] G. Pavur et al., "Sensitivity of development goals to water scarcity of Iraq and transboundary regions," Sustainable Horizons, vol. 12, Dec. 2024, doi: 10.1016/j.horiz.2024.100121.
[47] W. R. Awad, "The problem of utilization the water resources of the Republic of Iraq under progressive desertification conditions," Geography and Natural Resources, vol. 35, no. 4, pp. 373–379, 2014, doi: 10.1134/S1875372814040106.
[48] M. Abd El Mooty, R. Kansoh, and A. Abdulhadi, "Challenges of Water Resources in Iraq," Journal of Waste Water Treatment Analysis, vol. 07, no. 04, 2016, doi: 10.4172/2157-7587.1000260.
[49] L. M. Zangana, W. B. I. Al-Temimi, and S. A. Aljuhaishi, "ANALYTICAL STUDY OF RATE VOLUME LIQUID WATER CONTENT IN LOW CLOUDS OVER IRAQ," 2021.
[50] R. A. Hashim, "Diversity of fish in Iraqi waters and some factors affecting them," 2023.
[51] M. R. Kitto and M. Tabish, "Aquaculture and Food Security in Iraq," 2004.
[52] FAO, "Iraq 2020," 2020.
[53] L. M. Abbas, A. J. Abu-Elhine, A. G. Radhy, and H. A. Hassan, "Evaluating the Fish Structure Community at Euphrates River near Al-Hindyah Barrier, Babylon Province/ Iraq," 2017.
[54] H. T. MAARUF and C. AKBAY, "Economic Analysis of Fish Farming in the Northern Region of Iraq," Kahramanmaraş Sütçü İmam Üniversitesi Tarım ve Doğa Dergisi, vol. 23, no. 5, pp. 1257–1269, Oct. 2020, doi: 10.18016/ksutarimdoga.vi.692756.
[55] M. HARLIOĞLU, S. OMAR MUSTAFA MUSTAFA, and Z. BATOOL, "The Present Situation of the Fisheries Sector in Iraq: A Critical Review," Çanakkale Onsekiz Mart University Journal of Marine Sciences and Fisheries, vol. 6, no. 1, pp. 70–75, Jul. 2023, doi: 10.46384/jmsf.1216078.
[56] S. H. Hamad et al., "Risk assessment of total and bioavailable potentially toxic elements (PTEs) in urban soils of Baghdad-Iraq," Science of the Total Environment, vol. 494–495, pp. 39–48, 2014, doi: 10.1016/j.scitotenv.2014.06.006.
[57] I. S. Khurshed, Y. T. Mustafa, and M. A. Fayyadh, "Assessing Spatial Patterns of Surface Soil Moisture and Vegetation Cover in Batifa, Kurdistan Region-Iraq: Machine Learning Approach," IEEE Access, vol. 11, pp. 130406–130417, 2023, doi: 10.1109/ACCESS.2023.3334635.
[58] A. Surucu and E. A. Günal, "SPATIAL VARIABILITY OF SOME SOIL PROPERTIES IN AN AGRICULTURAL FIELD OF HALABJA CITY OF SULAIMANIA GOVERNORATE, IRAQ," 2019. [Online]. Available: https://www.researchgate.net/publication/330410861

[59] S. F. Mahmoud and H. Z. Adel Al-Sabbagh, "Tikrit Journal for Agricultural Sciences," Tikrit Journal for Agricultural Sciences, vol. 22, no. 2, pp. 20–35, 2022, [Online]. Available: http://tujas.tu.edu.iq
[60] A. S. Muhaimeed, A. J. Saloom Mowr, K. A. S. Moa, K. A. Alani, and W. M. M. Moa, "Classification and Distribution of Iraqi Soils," 2014.
[61] A. M. Breure, J. P. A. Lijzen, and L. Maring, "Soil and land management in a circular economy," Science of the Total Environment, vol. 624, pp. 1025–1030, May 2018, doi: 10.1016/j.scitotenv.2017.12.137.
[62] Y. Pressler, B. M. McClymonds, and M. M. Balgopal, "Communicating about soil biodiversity: Insights from science editorials and future recommendations," Pedobiologia (Jena), vol. 107, Nov. 2024, doi: 10.1016/j.pedobi.2024.151003.
[63] L. A. Oppenheim, "Letters from Mesopotamia," The university of Chicago press, 1967.
[64] A. F. Hasan, H. K. Eulewi, and A. F. Hasan, "MONITORING OF THE TEMPORAL CHANGES IN THE FORESTS OF NORTHERN IRAQ THROUGH THE DIRECTED CLASSIFICATION AND THE INDEX OF NATURAL VEGETATIVE DIFFERENCE," 2020. [Online]. Available: https://www.researchgate.net/publication/350240799
[65] Yayuz, "FOREST OF IRAQ," 1962.
[66] FAO, "Global Forest Assessment, Iraq report," 2020.
[67] T. R. Bowyer, M. S. Boyce, J. R. Goheen, and J. L. Rachlow, "Conservation of the World's mammals," 2019.
[68] S. Kaboodvandpour, K. Almasieh, and N. Zamani, "Habitat suitability and connectivity implications for the conservation of the Persian leopard along the Iran–Iraq border," Ecol Evol, vol. 11, no. 19, pp. 13464–13474, Oct. 2021, doi: 10.1002/ece3.8069.
[69] Ministry of Environment, "National Report on Biodiversity in Iraq," 2010.
[70] S. Debata and K. K. Swain, "Estimating Mammalian Diversity and Relative Abundance Using Camera Traps in a Tropical Deciduous Forest of Kuldiha Wildlife Sanctuary, Eastern India," Mammal Study, vol. 43, no. 1, pp. 1–9, Mar. 2018, doi: 10.3106/ms2017-0078.
[71] M. Yasuda, "Monitoring diversity and abundance of mammals with camera traps: a case study on Mount Tsukuba, central Japan," 2004.
[72] S. H. Ahmed and S. I. Majeed, "Monitoring of the wild mammal fauna in bamo mountain in northern Iraq (kurdistan) for the first time using camera trap method and raising awareness for its conservation," Bulletin of the Iraq Natural History Museum, vol. 16, no. 2, pp. 161–172, Dec. 2020, doi: 10.26842/BINHM.7.2020.16.2.0161.
[73] V. A. Shirokova and H. K. Al-Nussairi, "Water quality dynamics of alluvial marches Al-Khaweze of southeastern Iraq," in IOP Conference Series: Earth and Environmental Science, IOP Publishing Ltd, Nov. 2020. doi: 10.1088/1755-1315/579/1/012041.
[74] Fanack Water, "Iraq water resources (country report)," 2022, Accessed: Nov. 06, 2024. [Online]. Available: https://water.fanack.com/iraq/water-resources-in-iraq/
[75] W. H. Hassan, H. H. Hussein, and B. K. Nile, "The effect of climate change on groundwater recharge in unconfined aquifers in the western desert of Iraq," Groundw Sustain Dev, vol. 16, Feb. 2022, doi: 10.1016/j.gsd.2021.100700.
[76] A. A. Jaradat, "Agriculture in Iraq: Resources, Potentials, Constraints, and Research Needs and Priorities," 2002.
[77] H. Razvanchy, K. Hakzi, F. Ahmad, and A. Ali, "REMOTE SENSING MACHINE LEARNING BASED HIGH-RESOLUTION LAND Use Land Cover Classification Map for Iraq A Step towards Improved Land and Water Management for Food Security," 2023.
[78] N. T. Ismael and A. M. Abdulwahab, "Analysis of land use in Iraq cities," Wasit Journal of Engineering Sciences, Apr. 2020, doi: DOI:10.31185/ejuow.Vol7.Iss3.134.
[79] Control Risk, "Two competing trade visions in the Middle East united by ambition," Jun.

2024, Accessed: Nov. 07, 2024.
[80] U. Shokri, "Geopolitics and Challenges in Iraq's Quest for Regional Connectivity gulfif.org/geopolitics-and-challenges-in-iraqs-quest-for-regional-connectivity," 2024.
[81] M. K. Haba, "Checklist of the Mammals of Iraq (Chordata: Mammalia)," 2015. [Online]. Available: https://www.researchgate.net/publication/280606885
[82] Federal Reserve Economic Data, "Real GDP Growth in Constant Prices for Iraq," Apr. 2024. [Online]. Available: https://fred.stlouisfed.org/series/IRQNGDPXORPCHPT,
[83] N. K. Ali, "Oil and Economic Performance in Iraq A Blessing or a Curse!," Regional Studies Journal, vol. 17, no. 56, pp. 9–38, Apr. 2023, doi: 10.33899/regs.2023.178234.
[84] KAPITA, "Climate Change Overview: Impacts, Mitigation, and Adaptation in Iraq," 2022.
[85] S. Manisera and D. Sala, "Iraq's oil boom blamed for worsening water crisis in drought-hit south," Jun. 2023, Accessed: Nov. 08, 2024. [Online].
Available: https://www.theguardian.com/environment/2023/jun/03/iraqs-oil-boom-blamed-for-worsening-water-crisis-in-drought-hit-south
[86] A. Bakawan, "Iraq is on the verge of a deep demographic crisis," Aug. 2023, Accessed: Nov. 07, 2024. [Online]. Available: https://cfri-irak.com/en/article/iraq-is-on-the-verge-of-a-demographic-disaster-2023-08-28
[87] A. Mohammed et al., "Corruption in Public Offices: A Way to Reduce Corrupt Practices," Croatian International Relations Review, vol. 28, no. 90, pp. 36–57, Jul. 2022, doi: 10.2478/CIRR-2022-0023.
[88] S. A. Al-Jundi, A. Shuhaiber, and S. S. Al-Emara, "The Effect of Political Instability and Institutional Weakness on Administrative Corruption," Contemporary Economics, vol. 16, no. 2, pp. 168–181, 2022, doi: 10.5709/ce.1897-9254.475.
[89] J. Yu, S. Wang, and W. Yang, "Natural resources governance and geopolitical risks: A literature review and bibliometric analysis," Resources Policy, vol. 86, Oct. 2023,
Doi: 10.1016/j.resourpol.2023.104299.
[90] M. Alkış, "De facto statehood and natural resources: How oil resources affect the foreign relations of the Kurdish Regional Government of Iraq," Extractive Industries and Society, vol. 12, Dec. 2022, doi: 10.1016/j.exis.2022.101146.
[91] I. Rogg and H. Rimscha, "The Kurds as parties to and victims of conflicts in Iraq," 2007. [Online]. Available: www.theotheriraq.org
[92] F. Zagonari and C. Rossi, "A negotiation support system for disputes between Iraq and Turkey over the Tigris-Euphrates basin," J Hydrol (Amst), vol. 514, pp. 65–84, Jun. 2014,
Doi: 10.1016/j.jhydrol.2014.04.003.
[93] UN, "Report of the World Commission on Environment and Development: Our Common Future," 1987.
[94] Q. Hassan, A. K. Al-Jiboory, A. Z. Sameen, M. Barakat, K. Y. M. Abdalrahman, and S. Algburi, "Transitioning to sustainable economic resilience through renewable energy and green hydrogen: The case of Iraq," Unconventional Resources, vol. 5, Jan. 2025.
[95] Aras Abdulkareem Miho, "Economic Diversification In Iraq: A Comprehensive Review," Bhinneka: Jurnal Bintang Pendidikan dan Bahasa, vol. 2, no. 3, pp. 287–301, Jun. 2024, doi: 10.59024/bhinneka.v2i3.867.
[96] H. Hasan and H. H. Summary, "Iraq's Development Road: Geopolitics, Rentierism, and Border Connectivity," 2024.