International Journal of Research in Engineering and Innovation (IJREI)
journal home page: http://www.ijrei.com
ISSN (Online): 2456-6934

ORIGINAL ARTICLE

The role of studying the environmental footprint in measuring pollution in Iraq

Ali AbdulSamea Hameed

Governmental Contracts Division. Presidency of the University of Baghdad-Iraq

Article Information

Received: 03 August 2021
Revised: 20 September 2021
Accepted: 01 October 2021
Available online: 28 October 2021

Keywords:

Ecological Footprint
Environmental Pollution
Environmental Sustainability.

Abstract

Environmental studies have become widespread in this era, not because they are an interesting subject and are subject to diligence, but because of the exacerbation of environmental problems and the accumulation of harmful effects of uncontrolled economic activity, represented by the phenomenon of global warming, acid rain and the wear of the ozone layer, as well as the neglect of next generation future rights.
In addition to investigating the most appropriate and cost-effective way to address, or adapt to, the consequences of the deviant relationship between man and his environmental incubators, in particular urban construction, despite the division of those interested in this, the researchers had to investigate the causes of this phenomenon and the prospects for its development. This research deals with an important theme of these intellectual concerns, which is the close relationship between environmental footprint and environmental pollution and its relationship to urban and regional planning. Since the beginning of the Industrial Revolution, the usual direction of cities and villages has changed, and human activity has diversified after being exclusively rentier in agriculture, and all of this has led to serious problems, particularly environmental pollution.

1. Introduction

Measuring the relationship between the balance of the environment and sustainable development is one of the many aspects of contemporary environmental studies recently referred to as the 'Ecological Footprint [1]. This type of study seeks to determine the scale of the balance between natural resource consumption and the size of real reserves, whether realised or likely, by analysing the economic and social problems associated with the volume of resource consumption [2].
The spread of diseases, for example, is the result of an increase in the pollution cycle, the accumulation of pollutants and a change in the chemical composition of the vital elements of the environment [3]. In addition, the depletion of resources before the discovery or invention of equivalent alternatives is one of the dangers facing the human race and its impact on the economic and cultural development of the human race [4].
Iraq is a developing country that has been plagued by wars and disasters that have not stopped for more than half a century. These are the countries whose pollution problems cast their shadow over their environment, their economic plans and the future of their children. Ecological Footprint (EF) is really an accounting scheme focused on biomass aimed at controlling human demand and the supply of nature, basic facilities and a critical environmental resource [5]. The primary aim of this accounting system is the calculation of

Corresponding author: Ali AbdulSamea Hameed
Email Address: ali84_baghdad@uobaghdad.edu.iq
https://doi.org/10.36037/IJREI.2021.5614.

citizens' pressure on environments and the applicability of single products in sizes worldwide [6].
In turn, it helps consumers to consider and analyse the local resource sector as a contributor to the global sustainability crisis. Sustainable development requires the creation of a way of life that suits all the resources of the earth [7].
If urban ecosystems are our primary climate, it is necessary to investigate whether a sustainable relationship can be formed between cities and the planet [8]. Nearly all cities have continued to succeed, but at the same time have deteriorated their survival atmosphere. This was only made feasible by the historic expansion of the environmental footprint, the hinterland from which cities generate energy and collect their toxins and waste [9].
In view of the constraints of our planetary resources, it is probably time that we broaden the environmental sphere from environmental protection speeches to take into consideration the whole region that nowadays is centred on urban populations [10].
With global change now before us the concept of environmental footprint becomes more relevant. Sustainability may be done through a straightforward and ecologically sound definition of the components. In this case, ecological impact figures can enable policymakers calculate a community's environmental influence and compare this with nature's potential to regenerate [11].

2. Problem Statement

Development has become a basic goal for all economic plans and policies in all countries whose success and failure rates may vary, and building successful strategies to replenish the resources available has become an inevitable matter of urgency [12]. Where countries have begun to lay down rules for increasing gross domestic production and at the same time, to take all necessary measures to make human activity environmentally friendly, by reducing the levels of pollution caused by man in the environment by increasing production and paying attention to his or her life needs [13]. Research centres and governments have therefore begun to build a clear database that shows the relationship between the volume of consumption and the size of the resources available for consumption, or what is known as the environmental footprint [1]. At the global level, pollution is a common environmental problem. All countries have the same problems, even if the causes of pollution are different [14]. Growing rates of resource consumption are the main cause of pollution in developed countries. In Iraq, the phenomenon of environmental pollution is a source of resource mismanagement. Cultural factors are the primary reason for a low level of environmental interest in the use of resources.

3. Aim of the Study

The aim of the research is to study the positive and negative aspects of economic activity in Iraq, so that the use of these resources is consistent with scientific principles and references and theoretical foundations based on the experience of developed countries. In addition to studying the extent to which government, non-governmental and semi-official data are used to measure the environmental footprint. The research also aims to study the economic reasons that led to an increase in environmental footprint indicators.
The author adopted an inductive approach and a descriptive analytical method to test the validity of the hypothesis and to evaluate realistic data for the phenomenon. The time period that the research will cover is between 2003 and 2108.

4. The Ecological Footprint in Iraq

The environmental footprint is described as an accounting tool through which it can be inferred the size of the available natural resources, in land, water, minerals, wildlife, marine, animal, and plant life, and their reserves compared to consumption rates [15].
It is a balance between the biological potential of the biosphere, which represents the supply side, and its uses, which are made up of aggregate demand. In addition, the ecological footprint expresses the biosphere's capacity to regenerate and replenish [16].
The International Committee for Development and Environment measured the absorption potential of the cosmic space of hydrocarbon compounds at one billion tons per year while the real emission from them is one billion tons, or six times the capacity of the cosmic space, and this has led to many issues, most of which are emissions and its visible and invisible reflection, such as acid rain [17].
Therefore, the importance of the environmental footprint indicates the rate of fulfilment of human needs relative to that found in nature, or some scientists describe it as a measure of the size of the geological space created and available for human use [18]. Consequently, the countries of the world are divided into two groups. The first is the so-called (environmentally creditor) whose biological capacity exceeds its environmental footprint, which means that its consumption rate exceeds its natural resources [19]. As for the second group, it is called (environmentally debtor) whose average propensity to consume exceeds the rate of its counterbalancing effectiveness.

5. Ecological footprint and biological capacity

William Rees first published the academic paper on environmental footprints in 1992. The concept and method of calculation of ecological footprint has been developed as a PhD thesis of Mathis Wackernagel, under the supervision of Rees in 1990-1994 at the University of British Columbia in Vancouver, Canada [20]. Originally the concept was called "appropriate carriage capacity" by Wackernagel and Rees. In order to make the idea more accessible, Rees developed the term "ecological foot prince" based on an informational technician who praised the "small sprint" of his New

Computer on the desk. The easiest way to determine the environmental footprint is to provide the goods and services needed to support a particular life style [21].

This design is a model to compare and control consumption and life style. It can notify the policy by examining the extent to which a nation uses more (or less) than it does in its territory or the extent to which the lifestyle of the country is internationally replicable [22].

The environmental footprints can also serve as a useful tool for educating people in overuse in order to change their personal conduct. The Ecological footprints can be applied to argue that many lifestyles today cannot be sustained. A global comparison of this kind also shows clearly the resource inequalities in the world [23].

Ecological footprint includes the GHG footprint, or the narrower carbon footprint. It is often expressed as CO_2 weight (or CO_2e which represents a GHG Warming Potenzial (GWP)) only when a carbon footprint is reported, but can also be expressed in soil areas such as ecological footprints. Both products, persons or entire societies can be used [24].

6. The relationship of urban planning to environmental pollution

For humans, the urban environment may be harmful and unnatural. There might be a shortage or low allocation of urban green spaces in certain areas. The urban planning ought to consider the pollution emissions from vehicles and home heating systems into account [25].

The impact of heat island in urban and urban environments must also be taken into consideration. Socio-spatial disparities in urban environmental sustainability and human well-being are not modern problems, they are a well-defined aspect of urban existence. Cities have long been a mixed box of blessings and casualties for their residents [26].

Additional main factors may lead to quality of life in urban environments such as proximity to green areas and the prospect of accessing such destinations in ways outside the normal transport means, namely by bike or on foot. Smaller cities that are well built can lead to well-being [27]. Air is a key element to the relationship between environmental quality in inhabited areas and the health and wellbeing of the community. Air is one of the most significant environmental factors.

Open areas lead to air quality that requires pollution protection. Air and green space management legislation must be taken into consideration. Climate change impacts towns that consider more and more the need to plan for its people and assets [28]. Some towns have noticeable increases in the frequency and severity of weather conditions; other towns have major climate shifts, while some also struggle from coastal erosions, the destruction of wetlands or storm surges [29]. It is crucial that stakeholders know what to expect so that in the planning and organizing process the appropriate processes can be established. Most cities focus on plans for adjustment and planning strategies. There are a variety of mitigation roles in ecosystem resources [30].

While a technique and understanding of various types of landscapes or a philosophy needs to be shared, a popular reference structure that is sufficiently compatible with the broad variety of approaches to the interpretation and value of disciplines and societies is important [31]. The latest study indicates a multi-disciplinary solution to a systemic view of urban quality of the atmosphere and human well-being. Urban development started steadily a few thousand years ago and within the last 300 years it has increased significantly. The population of half the planet will remain in urban centers in next century [32]. The characteristic ecosystem of the species is urban if current patterns continue. Over too few generations, the shift from non-urban to urban existence offered plenty of possibilities for adjusting to the urban difficulties [33]. In reaction to the social and physical demands of the Paleolithic, Homo Sapiens developed in the paleolithic and previous times. Many of these requirements are missing from the urban landscape today, and there are lots of new problems, including shifts in urban behavior and nutritional energy allocations, psychosocial tension, steep socioeconomic gradients, greater interaction between social classes, contributing to the enhanced spread and evolution of infectious diseases, and growing emissions, primarily related to transport [34]. In the light of the innovation of so many urban issues and the ancient ages of our answers, a fair question is: " are we appropriate for urban living? Because urban types are collective objects, the study of a dynamic bio cultural relationship requires the interpretation of urbanism and human biology. A socio-cultural factors and biological adaptation and health interventions are well tailored to the challenge [35]. To grasp the impact of industrial pollution on people, though, experiments need different designs than those used to analyze small-scale populations [36]. Two basic principles were used to research the impact of urbanism on human health: the study of urban communities and the study of individuals who might find themselves vulnerable to characteristics of urban environments pollution [37].

In the urban rural contrast, the former method is exceptional. Rural urban comparisons are subject to the usual deficiencies which lead to the reduction of multidimensional distinctions into a simple dichotomy. We recognize today that urban rural health disparities vary due to the specifics of and region and countryside [38]. Results, the cornerstone of research, cannot be repeated as personalities are compared with environment changes. Undoubtedly, while significant inequalities occur in factors that affect the wellbeing, urban rural variations might not be evident, as some positive and some negative factors may amount to nothing [39].

The most noticeable disparities in urban rural regions, as in those during an unchecked industrialization, in various countries have now been limited to differing degrees. However, certain urban characteristics are also very harmful to health and well-being [40].

7. The problem of pollution in the Iraqi environment

The Iraqi environment is considered one of the unsafe environments of pollution, due to the nature of poorly planned economic activities, endless wars, and the lack of environmental awareness. Pollution factors can be classified by the following sources:

7.1 The extractive sector

The crude oil extractive sector is at the forefront of the formation of the gross domestic product in Iraq, as it is the main driver of economic growth. Iraq has proven its oil reserves of 134.7 billion barrels. As a result of the obsolescence of the oil refining units and their lack of hydrocarbon processing systems, the formation of gas emissions and leaks, suspended particles, volatile organic compounds and the combustion gases released by thermal burners as a result of the production processes are the most important sources of pollution.

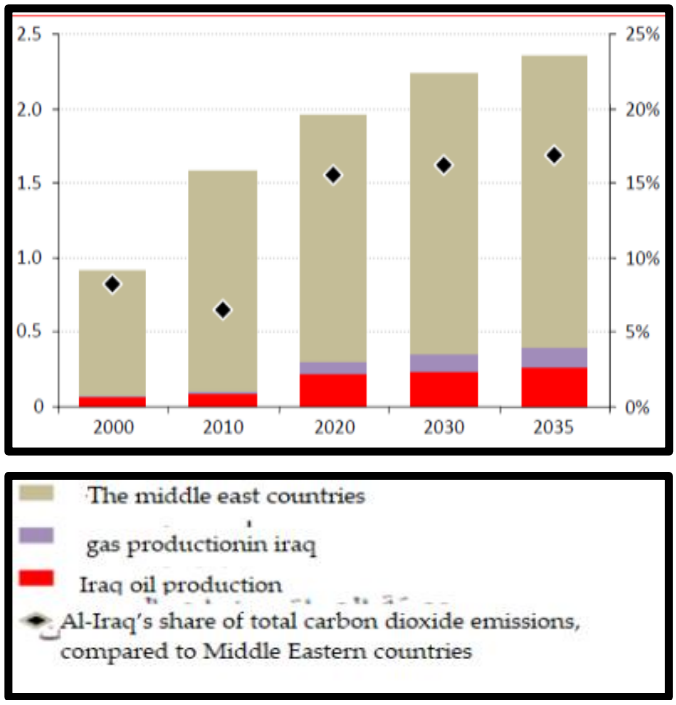

Figure 1: The figure shows carbon dioxide emissions in Iraq, according to fuel quality and its share of the Middle East emissions

Many experts have indicated that, based on the central energy scenario in Iraq, carbon dioxide emissions are expected to increase from 100 million tons in 2010 to 400 million tonnes in 2030. The figure below shows the percentage of carbon dioxide emissions in Iraq and the Middle East that is high compared to Iraq's share of global economies. Iraq's dependence on fossil fuels, as well as the aging of machinery and machines, the lack of efficient energy use standards, have led to the transformation of the Iraqi economy into one of the largest carbon-intensity economies.

The oil industry in Iraq, which involves exploration, extractive and industrial operations, may have serious implications for the topography and geology of the region and its strategic storage of mineral resources. The environmental aspect must therefore be taken into account when planning exploration and extraction operations.

7.2 Sector of Manufacturing industry

Manufacturing industries are processes that depend on human capacity and on machines. In order to achieve the implementation of production on a large scale.

according to the United Nations, the manufacturing industries are mechanical transformations of inorganic or organic materials; with the aim of obtaining new materials by means of manual or automatic means, whether they are used in homes or in factories. Therefore, it can be argued that the manufacturing industries generally have new materials. And by providing consumer goods or secondary goods that are used as raw materials in the manufacturing sector. It can be classified into the following:

- Engineering industries
- Chemical and petrochemical industries
- food and pharmaceutical industries
- Textile and leather industries
- Construction industries and industrial services

The following figure shows the relative distribution of the factories belong to the Ministry of Industry and Minerals and the mixed sector companies, as the sum of the companies reached (56) and the sum of them belong factories was (88), and the percentage of the discontinued laboratories was formed.

Waste from the production processes of these companies and factories can be classified as follows:

7.2.1 Solid waste, both hazardous and non-hazardous

According to the data of the Ministry of Environment, the highest amount of solid waste disposed in the construction sector and industrial services was 664.8 tons per month, with a rate of 97.9%. The reason for the increase in solid waste so quickly is due to the urban progress and urban expansion that began after 2003, and the lowest amount left by the mixed sector companies was 1.3 tons per month in 2018.

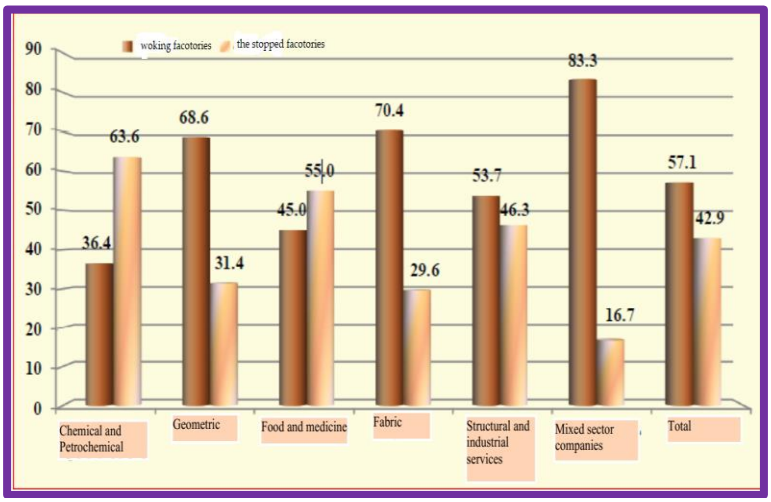

Figure 2: It shows the relative distribution of the factories of the Ministry of Industry and Minerals and the mixed sector companies according to their work or stoppage of 2018 feature (Central Bureau of Statistics Report for the year 2018.

7.2.2 Liquid waste

As shown in the figure below, studies have shown that the highest amount of liquid waste is concentrated in the textile sector, with the total discharge amounting to 22,000 cubic meters per day, with a rate of 51.9%, and the construction sector companies and industrial services at the next level come in the amount of (752.3) cubic meters per day, or 18%.

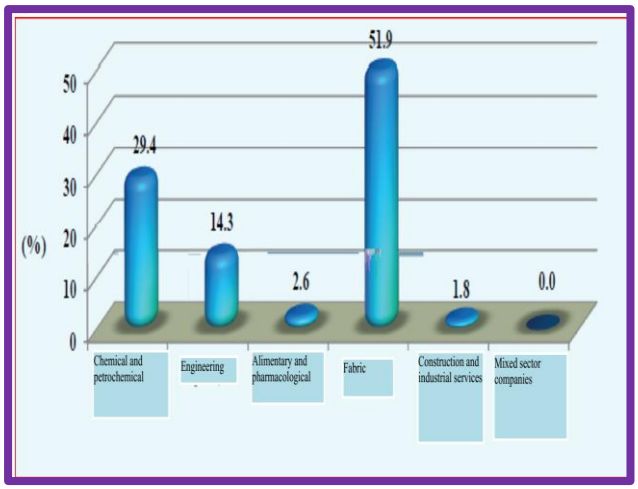

Figure 3: The figure shows the relative distribution of the quantity of water discharged from the laboratories of the Ministry of Industry and Minerals, and the mixed sector companies by sector for the year 2018.

Waste is usually dumped in rivers, drains, sewage networks and lands adjacent to these plants, which constitutes a dangerous source of contamination and spoilage of their validity for use.

7.3 Transport and communications sector

Air pollution is caused by various types of transportation, including vehicles, trains, and its exhausts. The number of cars owned by state agencies, the public and mixed sectors, in 2003 reached about (145,780) cars, and this number increased significantly, reaching in 2016 about (5,775,789). In addition, all substances released by car exhaust are classified in the environmental definitions as (greenhouse gases).

They are carbon dioxide, carbon monoxide, nitrogen oxide, sulphur dioxide, hydrocarbons that are unburned or partially combusted, lead, coarse sandy materials, and these materials, are toxic. The problem here is that the combination of these gases with water vapor causes the formation of acid rain that negatively affects the soil and plant life in it.

7.4 Health services sector

The number of hospitals in Iraq reached 372 hospitals in 2019, of which 253 were government hospitals, while the popular clinics reached 356, while the number of health centres reached 183, and the number of primary health care centres reached 2,680. There are also 733 health institutions that include health insurance clinics and health homes, while training health centres 26, family medicine centres 128, family planning centres 557, central health laboratories 20, Forensic medicine 23, Blood banks 19. As for the materials used for these hospitals and health centres, they are both polluted products and medical waste that contribute to environmental contamination. In addition, the following materials are used in hospital wastewater and items.

- Different types of bacteria that cause many dangerous diseases for humans and animals.
- Pharmaceutical waste that is usually disposed of by throwing it into rivers, causing contamination.
- Liquid radioactive waste, such as beta rays and kama rays, which are very harmful to human health, and are used in radiological examinations.

Heavy metal remnants are mercury, silver, and lead. In addition to the materials which are discarded and disposed of in dental departments and dental departments, in addition to the quantities of solvents and materials used in detergents which are used daily for the maintenance and cleaning of medical devices used in medical departments.

The volume of medical materials, waste and health industrial waste in Iraq is estimated to be approximately 5 million cubic meters per day, and this waste is treated only in a small percentage. For example, the volume of water used in government hospitals reached 4.28 thousand cubic meters in 2010, and the percentage of untreated materials used in the sewage system was approximately 78.35 %. Approximately 22.3% of waist is stored in concrete pits without treatment.

7.5 Electricity sector

Emissions from power plants impact natural elements such as air, water and land, and these emissions comprise of gaseous, liquid or solid elements and compounds. The above table shows Iraq's total production of electrical energy, which is (68,687,453) megawatts / hour, except for the Kurdistan region in 2019, which is distributed among the types of stations mentioned in the table, and it is striking that all these stations lack the means to control gaseous emissions due to the lack of advanced technologies It helps to improve the efficiency of internal combustion and thus increases the achieved environmental pollution rates.

Table 1: Explain the Number of Power Plant in Iraq except Kurdistan

Production Stations	Number of Stations	Amount of Production (Mica / Hour)	Participation Rate
Steam stations	8	26,297,781	32,16
Gas stations	31	34,869,269	42,64
Hydroelectric stations	8	2,546,142	3,12
Total number of stations	47	63,713,178	77,89
Diesel stations	11	4,955,456	6,16
Diesel stations for the Ministry of Oil	.....	19,721	0.03
Diesel stations beauty	11	4,975,142	6,09
Total production of energy in Iraq	58	68,687,453	83,89

7.6 The municipal services sector

In 2019, the total number of municipalities in Iraq reached about 371 municipalities, which generate vast amounts of waste that is disposed in different ways, and the problem of solid waste in all its forms is one of the most serious problems, because solid and liquid waste contains toxic and hazardous elements, so disposal has become an issue. Those who seek to ensure a sound environmental framework are concerned about the problem in Iraq under the following aspects:

- The multiplicity of sources of pollutants (industry, oil, electricity, agriculture) in addition to hazardous waste generated by service institutions and the residential sector, such as batteries, dyes, pesticides and others.
- Failure to deal with such waste and not to keep up with global developments in this field, in addition to the lack of clear plans and policies to deal with it as a resource that can be used.
- The scarcity of sanitary landfill sites, as the number of sanitary landfill sites was only 77, while sanitary landfill sites, which did not obtain an environmental permit, reached 165 sites, and the random waste disposal sites reached 236 sites, as shown in the table below:

Table 2: Number of sanitary landfill sites and random dumping sites, according to the distribution of governorates for the year 2019.

Province	Sites approved	Sites that have not been approved	Random sanitary landfill sites
Kirkuk	1	7	3
Diyala	1	15	2
Baghdad	5	4	1
The outskirts of Baghdad	4	6	72
Babylon	9	5	3
Karbala	1	1	1
Wasit	9	6	0
Salahuddin	1	10	16
Najaf	3	3	2
Qadisiyah	5	5	3
Muthanna	7	2	0
Dhi Qar	3	12	18
Maysan	2	12	25
Basra	1	16	1
Total	42	101	143

Kurdistan region			
Dohuk	10	16	31
Sulaymaniyah	13	28	5
Erbil	10	18	54
The total of the Kurdistan region	33	62	91
Total Iraq	75	156	237

7.7 The Sewage Sector (Wastewater)

Since the middle of the twentieth century, global interest in treatment of wastewater studies has increased due to contaminants that are harmful to environmental incubators, as they are characterized by high concentrations of organic matter represented by bio-oxygens (BOD5).

As a result, wastewater is collected from residential homes by a network of large pipes, which are pumped to the main stations to be treated before it is released to water resources. The wastewater stations in Iraq are characterized by the Obsolescence, failure to keep pace with environmentally friendly technological developments, inefficiency of treatment units within them, and lack of chemical processing units.

In addition to the limited capacity of these stations and the irregular connection of the water networks to them. Liquid waste is also discharged from hospitals, industrial waste or slaughterhouses to the water resources.

The number of central processing plants in Iraq reached around 27 station in 2019, with a design capacity of 1288.6 thousand cubic meters per day, while it is now operating at a rate of 1678.5 cubic meters per day. The figure below shows that the percentage of wastewater that has been treated has reached 70.2% which means that more than a quarter of the wastewater in Iraq is pumped into untreated water or the environment, and therefore the volume of pollutants that are pumped constitutes a large proportion of the environmental impacts caused by many factors in Iraq.

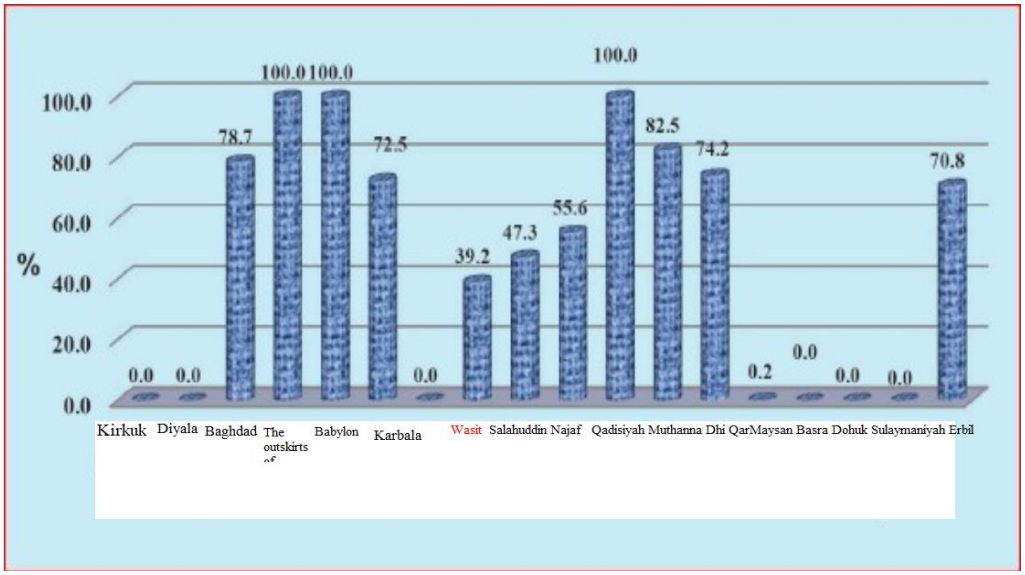

Figure 4: It shows the percentage of the quantity of treated wastewater by governorates in 2019.

7.8 The economic impact of environmental pollution

The environmental situation is reflected in all aspects of nature, as well as the health status of human beings and their activities. In a 2009 study conducted by the United Nations Program in Iraq, the cost of environmental pollution impacts was estimated at $18 billion per year. While the Central Bank of Iraq has estimated the cost of wastewater treatment at $14 billion. Other studies indicate higher numbers.

Experts explain the increasing environmental cost curve in Iraq due to environmental pollution and poor drinking water quality. In addition to the increase in respiratory diseases and cancers caused by air pollution. Moreover, the weakness of waste and waste management systems in factories, hospitals and other facilities causes the accumulation of waste in such a way that specialized equipment cannot solve the problem.

Protection measures are also inadequate for natural resources, low efficiency in fossil energy production and use, and non-use of renewable energy. Insufficient allocations by the competent authorities to deal with environmental impacts.

8. Conclusions

The researcher concludes the following points:

- The Iraqi economy is a quarterly economy par excellence, and despite the multiplicity of rent sources, it

has remained almost entirely dependent on one of them, namely oil, as the source of income generation and the main component of Iraqi exports. It is therefore no longer possible to link the rate of increase in production to the environmental indicators as agreed human society.

- The agricultural sector is characterized by a weak technological level, particularly in the areas of irrigation and mechanization techniques.
- As regards the industrial sector, which is considered to be one of the most vital sectors in the development process, it suffers from the obsolescence of production equipment and the obsolescence of much of it, while neglecting the environmental impacts, as well as the clear waste of energy and water use.
- Total biological capacity in Iraq amounted to (12,276,426) global hectares in the year (2019), divided by the following proportions: agricultural land (65 %), pastoral land (5 %), fishing areas (3%) and forests (15%), land-building (16%) and the global environmental footprint of consumption (72,897,749.00) million h.
- The temporal trend towards the development of the per capita ecological footprint in Iraq is on the upward trend if the exploited biological capacity in Iraq has increased from (1.66) in 1985 to (2.00) years (2019) with a global average of (1.76) hectares, which is higher than the global average (1.12).
- Most of the environmental problems in Iraq are due to a lack of awareness of the environment in society and a lack of firmness in the implementation of environmental legislation, as well as a lack of financial allocations in the general budget to address environmental challenges and their negative and expected effects.

Recommendations

- To commit to international treaties and resolutions of the United Nations and to take dissuasive action in the field of environmental protection.
- To pay attention to the process of recycling waste as an important element in extending the life of environmental resources through post-screening recycling and wastewater treatment (e.g. wastewater and industrial wastewater) in order to maintain the quality of water in rivers and not to pollute it with polluted waste.
- The use of financial instruments, taxes, fees and fines with a view to rationalizing the management of natural resources and ensuring that they are not wasted and that their lifespan is extended.
- Develop plans to reduce the destructive effects of drought and the degradation of plant life, pastures and agricultural production, and expand the vegetation cover area by increasing afforestation around oases and agricultural land on the outskirts of the desert to reduce sand and desertification.
- Determining and adhering to grazing loads, stopping overgrazing and overcrowding of trees and perennials, and taking the necessary precautions to prevent forest fires.
- The conservation of biological diversity, the development of plant species inherent in valleys and mountains, the adoption of sustainable mining methods and the preservation of the natural environment of deserts.

References

[1] Hoekstra, A. (2009). Human appropriation of natural capital: A comparison of ecological footprint and water footprint analysis. *Ecological Economics*, *68*(7), 1963-1974. https://doi.org/10.1016/j.ecolecon.2008.06.021

[2] Kratena, K. (2008). From ecological footprint to ecological rent: An economic indicator for resource constraints. *Ecological Economics*, *64*(3), 507-516. https://doi.org/10.1016/j.ecolecon.2007.09.019

[3] Wackernagel, M. (2009). Methodological advancements in footprint analysis. *Ecological Economics*, *68*(7), 1925-1927. https://doi.org/10.1016/j.ecolecon.2009.03.012

[4] Wang, Y., Wang, L., & Shao, H. (2013). Ecological Footprint Analysis Applied to a Coal-Consumption County in China. *CLEAN - Soil, Air, Water*, *42*(7), 1004-1013. https://doi.org/10.1002/clen.201300508

[5] Franz, J., & Papyrakis, E. (2010). Online calculators of ecological footprint: do they promote or dissuade sustainable behaviour?. *Sustainable Development*, *19*(6), 391-401. https://doi.org/10.1002/sd.446

[6] Zakari, R., Zolfagharian, S., Nourbakhsh, M., Mohammad Zin, R., & Gheisari, M. (2012). Ecological Footprint of Different Nations. *International Journal Of Engineering And Technology*, *4*(4), 464-467. https://doi.org/10.7763/ijet.2012.v4.411

[7] Jiao, W., Min, Q., Cheng, S., & Li, W. (2013). The Waste Absorption Footprint (WAF): A methodological note on footprint calculations. *Ecological Indicators*, *34*, 356-360. https://doi.org/10.1016/j.ecolind.2013.05.024

[8] Vačkář, D. (2012). Ecological Footprint, environmental performance and biodiversity: A cross-national comparison. *Ecological Indicators*, *16*, 40-46. https://doi.org/10.1016/j.ecolind.2011.08.008

[9] Teixidó-Figueras, J., & Duro, J. (2014). Spatial Polarization of the Ecological Footprint Distribution. *Ecological Economics*, *104*, 93-106. https://doi.org/10.1016/j.ecolecon.2014.04.022

[10] Kissinger, M. (2013). Approaches for calculating a nation's food ecological footprint—The case of Canada. *Ecological Indicators*, *24*, 366-374. https://doi.org/10.1016/j.ecolind.2012.06.023

[11] Shao, L., Wu, Z., & Chen, G. (2013). Exergy based ecological footprint accounting for China. *Ecological Modelling*, *252*, 83-96. https://doi.org/10.1016/j.ecolmodel.2012.09.001

[12] Kissinger, M., & Gottlieb, D. (2010). Place oriented ecological footprint analysis, the case of Israel's grain supply. *Ecological Economics*, *69*(8), 1639-1645. https://doi.org/10.1016/j.ecolecon.2010.03.008

[13] Shindo, J., & Yanagawa, A. (2017). Top-down approach to estimating the nitrogen footprint of food in Japan. *Ecological Indicators*, *78*, 502-511. https://doi.org/10.1016/j.ecolind.2017.03.020

[14] Albarracin, G. (2017). Urban form and ecological footprint: Urban form and ecological footprint: A morphological analysis for harnessing solar energy in the suburbs of Cuenca, Ecuador. *Energy Procedia*, *115*, 332-343. https://doi.org/10.1016/j.egypro.2017.05.030

[15] Khazal, A. (2020). Environmental education and its role in reducing environmental problems in Iraq. Iraqi Journal For Economic Sciences, 2019 (63), 29-55. https://doi.org/10.31272/ijes.2019.63.3

[16] Judeh, N., & Jafar, H. (2018). Environmental effects of the oil industry in Iraq. Economic Sciences, 23. https://doi.org/10.33762/0672-013-051-002

[17] Al-Rakbi, N., & Al-Hussaini, H. (2018). Ecological footprint and

planning to crystallize the environmental picture of the Iraqi city: Najaf as a model. Journal of Geographical Research, 233. https://doi.org/10.36328/0833-000-028-010
[18] Al-Yasiri, W. (2015). Development of ecotourism in Iraq. The Literature of Kufa, 11. https://doi.org/10.36317/0826-008-023-001
[19] Jamil, S. (2019). The economic dimension of the environmental investment policy in Iraq. Academic Journal Of Nawroz University, 8 (2), 169. https://doi.org/10.25007/ajnu.v8n2a368.
[20] Sun, Y., & Liu, C. (2009). Analysis of ecological footprint and capacity ofHebei Province for the year 2006. *Chinese Journal of Eco-Agriculture*, *17*(3),588-592.
[21] Nakajima, E., & Ortega, E. (2016). Carrying capacity using emergy and a new calculation of the ecological footprint. *Ecological Indicators*, *60*, 1200-1207. https://doi.org/10.1016/j.ecolind.2015.08.054
[22] Galli, A., Wackernagel, M., Iha, K., & Lazarus, E. (2014). Ecological Footprint: Implications for biodiversity. *Biological Conservation*, *173*, 121-132. https://doi.org/10.1016/j.biocon.2013.10.019
[23] Yue, D., Xu, X., Li, Z., Hui, C., Li, W., Yang, H., & Ge, J. (2006). Spatiotemporal analysis of ecological footprint and biological capacity of Gansu, China 1991–2015: Down from the environmental cliff. *Ecological Economics*, *58*(2), 393-406. https://doi.org/10.1016/j.ecolecon.2005.07.029
[24] Zheng, D., Lin, Z., & Wu, F. (2020). Measurement method of regional water resources carrying capacity based on ecological footprint. *DESALINATION AND WATER TREATMENT*, *187*, 114-122. https://doi.org/10.5004/dwt.2020.25308
[25] Kennedy, C., Pincetl, S., & Bunje, P. (2012). Reply to "Comment on "The study of urban metabolism and its applications to urban planning and design" by Kennedy et al. (2011)". *Environmental Pollution*, *167*, 186. https://doi.org/10.1016/j.envpol.2012.04.012
[26] Kennedy, C., Pincetl, S., & Bunje, P. (2011). The study of urban metabolism and its applications to urban planning and design. Environmental Pollution, 159(8-9), 1965-1973. https://doi.org/10.1016/j.envpol.2010.10.022
[27] Chang, N. (2012). The empirical relationship between openness and environmental pollution in China. Journal Of Environmental Planning And Management, 55(6), 783-796. https://doi.org/10.1080/09640568.2011.628087
[28] Gratani, L., Crescente, M., & Petruzzi, M. (2000). Relationship between leaf life-span and photosynthetic activity of Quercus ilex in polluted urban areas (Rome). Environmental Pollution, 110(1), 19-28. https://doi.org/10.1016/s0269-7491(99)00285-7
[29] Milillo, T., Sinha, G., & Gardella, J. (2012). Use of geostatistics for remediation planning to transcend urban political boundaries. Environmental Pollution, 170, 52-62. https://doi.org/10.1016/j.envpol.2012.06.006
[30] Mitchell, G. (2005). Mapping hazard from urban non-point pollution: a screening model to support sustainable urban drainage planning. *Journal Of Environmental Management*, *74*(1), 1-9. https://doi.org/10.1016/j.jenvman.2004.08.002
[31] Pargal, S., & Heil, M. (2000). Reducing Air Pollution from Urban Passenger Transport: A Framework for Policy Analysis. Journal Of Environmental Planning And Management, 43(5), 665-688. https://doi.org/10.1080/713676583
[32] Ozcan, N., & Cubukcu, K. (2016). Examination of the Relationship between Urban Air Pollution and Urban Planning Decisions in Cigli Case, Izmir (Turkey). Environment-Behaviour Proceedings Journal, 1(2), 178. https://doi.org/10.21834/e-bpj.v1i2.267
[33] Ozcan, N., & Cubukcu, K. (2018). The Relationship between Urban Air Pollution and Urban Planning Decisions. Asian Journal Of Quality Of Life, 3(11), 181. https://doi.org/10.21834/ajqol.v3i11.134
[34] Gross, M. (1981). Computer Simulation in Urban Planning and Air Pollution Control. Journal Of Environmental Systems, 11(3), 257-269. https://doi.org/10.2190/k9jw-7ydk-dad1-8nmu
[35] Lanni, T. (2003). Fine urban and precursor emissions control for diesel urban transit buses. Environmental Pollution, 123(3), 427-437. https://doi.org/10.1016/s0269-7491(03)00024-1
[36] Bergström, L. (1994). Pesticides in urban environments. Environmental Pollution, 85(1), 118-119. https://doi.org/10.1016/0269-7491(94)90246-1
[37] Manning, W. (2016). Urban health & wellbeing. Environmental Pollution, 208, 1. https://doi.org/10.1016/j.envpol.2015.10.017.
[38] Şahin, S. (2018). Dissociation of the Relationship between Urban Planning and Urban Infrastructure and Climate Change. Journal Of Planning. https://doi.org/10.14744/planlama.2018.75547
[39] Şahin, S. (2018). Dissociation of the Relationship between Urban Planning and Urban Infrastructure and Climate Change. Journal Of Planning. https://doi.org/10.14744/planlama.2018.75547
[40] Amegah, A., & Agyei-Mensah, S. (2017). Urban air pollution in Sub-Saharan Africa: Time for action. Environmental Pollution, 220, 738-743. https://doi.org/10.1016/j.envpol.2016.09.042.

Cite this article as: Ali AbdulSamea Hameed, the role of studying the environmental footprint in measuring pollution in Iraq, International journal of research in engineering and innovation (IJREI), vol 5, issue 6 (2021), 446-454. *https://doi.org/10.36037/IJREI.2021.5614*.