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Research paper

The Role of Carbon Footprint Disclosure in Improving Displacement Tracking Matrix (DTM) Indicators: An Exploratory Study in The Iraqi Environment

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Abstract

The research aims to examine the key mechanisms for disclosing carbon footprints among economic units listed on the Iraq Stock Exchange, as reflected in their financial statements. It also examines the impact of such disclosures on improving the indicators of the Displacement Tracking Matrix (DTM), particularly the return index. Through a content analysis of financial statements and a comparison with the indicators published by the International Organization for Migration for 2024, the study addresses the significant issue of mass displacement occurring in southern Iraq due to environmental changes driven by emissions. These changes have resulted in increased temperatures, drought, and pollution. The research concludes that there is a correlation between the disclosure of carbon footprints by companies in the industrial sector and improvements in DTM indicators. Specifically, when economic units report on climate change and their carbon footprints, it reassures the community that they are taking their environmental responsibilities seriously by working to reduce emissions and protect the environment. This, in turn, positively influences the displacement matrix, particularly the return index.

Keywords: *Carbon Footprint; Displacement Matrix; Carbon Disclosure; Return Index.*

1. Introduction

As we enter the second millennium, the Earth has increasingly suffered from activities that are poorly planned and have harmed the environment. This has led to serious issues like global warming, rising temperatures, the melting of polar ice, desertification, and the degradation of land suitability for life shortly. In response to this significant environmental crisis, political leaders worldwide acted by signing the 2015 Paris Climate Agreement. By reporting their carbon footprints, economic units are effectively working to reduce emissions. It is crucial to emphasize their active role in such disclosure and their efforts to lower greenhouse gas emissions, contributing to the development of a sustainable future (AlLouzi, A.S., & Alomari, K. M., 2023). Given the connection between environmental changes and the displacement of individuals from affected areas—such as those experiencing drought, desertification, and pollution—there is a lack of a legal framework to regulate forced migration. Therefore, mechanisms must be established to minimize its causes, including the disclosure of carbon footprints. This refers to the strategies adopted by economic units to reduce their gas emissions, which can aid in environmental preservation and reduce the number of displaced persons (Albayati, Y.K., Allouzi, A.S., Abdalaziz, M. M.M.O., Al-Ali, M., & Yas, H., 2025). The research is organized into three main sections: the first section covers the research methodology, the second discusses the dis closure of carbon footprints and the indicators related to displacement, and the third presents the practical aspects. Finally, the fourth section outlines key conclusions and recommendations.

1.1. Research problem

As reported by the International Organization for Migration, Iraq is facing increasing climate change and environmental degradation and ranks fifth among the most vulnerable countries to climate collapse. This situation has resulted in a rise in the number of displaced individuals from southern regions. Unfortunately, there is a lack of suitable strategies to mitigate climate change, coupled with the absence of mandatory carbon footprint disclosures by companies. These factors have contributed to increasing greenhouse gas emissions and have

negatively impacted the environment, leading to drought, desertification, rising temperatures, and reduced rainfall. Consequently, the return index within the Displacement Tracking Matrix (DTM) has been declining. Therefore, the research problem is formulated as follows:
Can the disclosure of carbon footprints in financial reports by industrial companies that impact the environment lead to a decrease in the return index within the Displacement Tracking Matrix (DTM)?

1.2. Research objectives

The research aims to achieve the following objectives:
a) Shed light on the concept of carbon footprint and the importance of its disclosure.
b) Examine the dimensions of displacement and the rationale for finding root solutions.
c) Review some of Iraq's environmental efforts to reduce emissions and combat global warming, while also highlighting the indicators of the Displacement Tracking Matrix (DTM).

1.3. Research importance

The research is significant due to the crucial role that the environment plays in determining the suitability of living conditions, particularly given the exceptional circumstances leading to migration, especially in southern Iraq. The research aims to address the causes of displacement and work towards facilitating the return of displaced individuals, ultimately improving the return index in the Displacement Tracking Matrix (DTM).

1.4. Research hypothesis

The researcher formulated the following main hypothesis:
There is a significant relationship between the level of disclosure of carbon footprints and the Displacement Tracking Matrix (DTM). From the main hypothesis, the researcher derived the following:
a) There is a significant relationship between the disclosure guidelines for carbon footprints and the Displacement Tracking Matrix (DTM).
b) There is a significant relationship between the unified accounting system for carbon footprint disclosure practices and the Displacement Tracking Matrix (DTM).
c) There is a significant relationship between the size of the economic unit (industrial sector sample) and the Displacement Tracking Matrix (DTM).

Statistical Methods - To test the research hypothesis, we relied on content analysis, a scientific research method, where financial reports and management comments were analysed. The disclosure ratio was calculated by dividing the number of disclosed items (numerator) by their total (denominator) and multiplying the result by 100%. Using a simple correlation between carbon footprint disclosure and displacement tracking indicators, the relationship between the independent and dependent variables was found.

2. Literature review

2.1. What is the displacement tracking matrix (DTM)?

The Displacement Tracking Matrix (DTM) is a system used by the International Organization for Migration (IOM) to manage information on population displacement and movement during crises (Allouzi, A.S., 2024). The DTM consists of a variety of components and tools and regularly monitors and processes multi-layered data, publishing a wide range of information reports that provide a deep understanding of the key needs of displaced populations, both in the areas of displacement and along the routes leading to these locations. Data is collected through IOM's rapid assessment and response teams, which consist of over 100 staff deployed across Iraq. At the site level, data is gathered through an established network of over 9,500 information sources, including community leaders, elders, local authorities, and security forces (Displacement Tracking Matrix Institute, 2022).

2.2. Components of the displacement tracking matrix (DTM)

The Displacement Tracking Matrix (DTM) includes several key indicators:
a) Primary List of Internally Displaced Persons (IDPs) and Returnees:
The list provides data on the number of internally displaced persons (IDPs) and returnees at the governorate, district, sub-district, and site levels. It includes information on shelter types, displacement periods, origins, and final displacement areas for both IDPs and returnees.
b) Site Assessment
The site assessment offers a comprehensive analysis of displaced populations and returnees in Iraq, focusing on their locations. It includes demographic data, infrastructure status, availability of services, security conditions, social cohesion, and the mobility intentions of IDPs. The International Organization for Migration (IOM) conducts annual data collection through interviews with reliable sources.
c) Return Index
The return index assesses the conditions in return areas using 16 indicators, which include livelihoods, essential services, perceptions of safety, and social cohesion. Each assessed return site is assigned a risk score ranging from 0 (indicating that all essential conditions for return are met) to 100 (indicating that no essential conditions for return are found).
d) Cross-Border Monitoring
The monitoring provides data on the number of individuals and vehicles crossing five selected border points with Turkey, the Syrian Arab Republic, and the Islamic Republic of Iran. It aims to identify the characteristics of travelers and migrants, focusing on demographics, reasons for travel, and vulnerabilities.
e) Emergency Tracking:
The tracking provides data on the number of individuals displaced due to recent crises. When possible, it also includes demographic information, origin areas, and vulnerabilities of those displaced by emergencies.

2.3. Reasons for migration due to climate change in Iraq

Iraq ranks fifth among countries most vulnerable to climate collapse. Without adequate preparation and planning, the scale of environmental changes could be devastating, potentially forcing Iraqis to migrate for survival. Climate migration has already become a reality in Iraq. By the end of 2021, the International Organization for Migration (IOM) recorded nearly 20,000 displaced persons due to water scarcity and climate change. Climate change and environmental degradation have displaced many individuals in areas assessed by the IOM in central and southern Iraq between January 2016 and October 2022. It represents about 10% of the original population residing in these areas. In other words, over the past six years, more than one in ten individuals have been displaced from these regions (AlKhamaiseh, M. A., Allouzi, A., & Karima, K. R. I. M., 2025). The expected worsening situation is reflected in the increased rates of environmental migration observed in 2022, particularly in the absence of appropriate mitigation and adaptation strategies.
The IOM's Displacement Tracking Matrix (DTM) has developed a tool to assess how a site is affected by climate-induced displacement. The tool measures four dimensions: 1) environmental events and water access, 2) services and infrastructure, 3) livelihoods and mitigation measures, and 4) tensions and conflicts. This report summarizes key findings across these dimensions and conflicts. The assessment evaluates conditions in sites that have seen displacement due to climate change, as measured by the DTM's climate emergency tracking tool (Dafri, W., Yas, N., Salem, O., Khalifa, A. A., & AlLouzi, A. S., 2025). The data collection for the evaluation started between August and October 2022 across nine governorates, 29 districts, and 263 sites. The IOM's rapid assessment and response teams collected data through interviews with key community-level information sources. The results from key sources were triangulated with data from the Vegetation Index Standard Difference (NDVI), which measures the density and health of vegetation, and used to highlight anomalies with the help of the U.S. Geological Survey (USGS) and NASA's remote sensing data, analyzed in partnership with the World Food Programme (WFP) vulnerability mapping and analysis team. Families left behind often lack transportation and represent a potential group of vulnerable populations. The chart (Figure 1) illustrates key indicators pointing to a decrease in population due to climate change in Iraq.

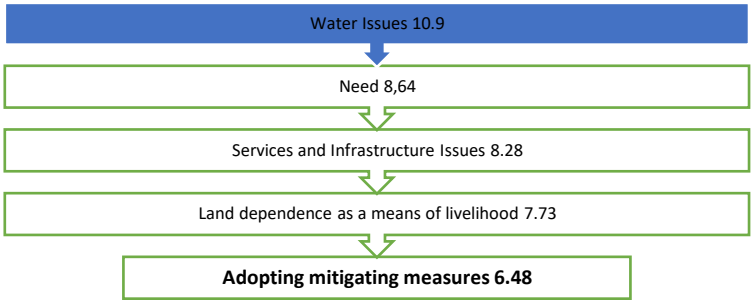

Fig. 1: The Most Important Indicators Indicating Population Decline Due to Climate Change in Iraq.

Source - International Organization for Migration in Iraq, Migration, Environment and Climate Change in Baghdad, 2022

2.4. Root solutions to mitigate the risk of climate migration in Iraq

Iraq has initiated efforts to address climate migration, mainly by developing the "Green Paper" in early 2022. This paper aims to assess and implement measures to mitigate the impact of climate change and support Iraq's transition to net-zero emissions, focusing on the economy (Yas, N., Salem, O., AlLouzi, A. S., Abdalaziz, M. M. O., Marks, A., & Al-Jumaili, A., 2025). During the Second International Water Conference held in Baghdad in March 2022, the United Nations actively participated in the consultative process to draft the Green Paper. They will contribute to addressing climate migration issues. The Green Paper promotes a green economy, emphasizing renewable energy, biodiversity, and nature-based solutions. The Green Paper is one of the government's promising projects. Iraq has also convened a Climate Conference, recognizing climate change as a national development and security issue for current and future generations. This conference led to several recommendations, including:
a) A-Government Action on Climate Integration:
The Iraqi government will implement necessary measures to integrate climate change into all sectors, significant policies, and planning and financing decisions. Additionally, the government will work on developing Iraq's vision for climate and the environment through a Green Paper, along with a comprehensive green growth strategy aimed for completion by 2030 (Allouzi, A.S., & Yas, N., 2024).
b) International Cooperation on Transboundary River Basins:
Iraq urges all signatories of international environmental agreements to strengthen their cooperation in the joint management of transboundary river basins and to preserve the rights of riparian countries. Iraq seeks to raise international awareness regarding the unilateral control over water resources by upstream countries in the Tigris and Euphrates River Basins, which exacerbates Iraq's vulnerability to the impacts of climate change.
c) Financial Support for Green Growth:
The Central Bank will take necessary actions to enhance financing for green growth, which supports Iraq's adaptation and mitigation priorities. International incentives to bridge the business viability gaps until 2030 are critical, and Iraq calls for such strategic support to facilitate the green growth transition. Additionally, the Iraq Private Banks Association will contribute 10% of the funding for the afforestation program (Shwedeh, F., Yas, N., & Abdijabar, Z., 2024).

2.5. The carbon footprint

- A-Understanding the Carbon Footprint

The concept of the carbon footprint emerged from the broader environmental footprint and ecological impact discussions. First gaining significant attention in the 1990s, the carbon footprint is typically measured in tons per year and is a part of the overall environmental footprint, focusing on emissions of gases contributing to climate change. The goal of measuring it is to reduce the negative impacts of these emissions (Elyat, M. N., Al Bayati, N. Y., Al Baloushi, N. A., Sarhan, M. I., Marks, A. A., Khudhair, H. Y., & Allouzi, A. S., 2024). It is

an indicator expressing the amount of carbon dioxide emissions produced by burning fossil fuels, including oil, coal, and natural gas used in energy production (Harris, 2015, p. 11).
The European Commission defines it as the total emissions of carbon dioxide and other greenhouse gases that individuals or institutions produce daily, impacting the surrounding environment (Al-Manshawi, 2024: 190). William A. Reits Romatias developed the term and made it widely known through the British Petroleum Company in 1951. The carbon footprint has gained greater focus than other environmental footprints due to its direct relation to climate change-causing gases.
The carbon footprint consists of two parts:
1) Primary Footprint: Measures direct carbon emissions from burning fuel.
2) Secondary Footprint: This measures indirect carbon emissions throughout a product's life cycle, from raw material extraction to consumption.

According to the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD, 2004), the carbon footprint measures the total emissions of carbon dioxide and other greenhouse gases throughout a product or service's entire life cycle, measured in CO2-equivalent tons (CO2e), based on the methodology specified in the Greenhouse Gas Protocol.

2.6. Disclosure of the carbon footprint

Many people use terms like "energy footprint" and "carbon footprint" interchangeably, as most emissions from individuals, products, or institutions come from fossil fuel-based energy use (Franchetti & Apul, 2012). Environmental information disclosure is paramount for companies to gain support from various stakeholders, legitimize their environmental management actions, and attract investors. Such information links guide investment decisions to positive recommendations from financial analysts for stock investment (Radhouane et al., 2020).
Many organizations now voluntarily disclose the emissions they generate for reasons like risk management, cost savings, brand protection, and social responsibility. Environmental disclosure includes activities aimed at mitigating and adapting to climate change, promoting sustainable resource use, protecting water and marine resources, preserving biodiversity, reducing pollution, recycling waste, and cutting emissions (Becchetti et al., 2022: 6).
Environmental footprint reports have emerged as separate environmental reports. They provide information about a company's performance in maintaining natural resources and responding to climate change, embedding this in its strategy and operations (Devie et al., 2019).

2.7. Benefits of carbon footprint disclosure

Disclosure of financial impacts related to climate risks and opportunities effectively ensures that capital flows are allocated more efficiently, particularly by financial organizations (Ilhan et al., 2021). It helps managers of business units identify and manage climate-related risks and opportunities effectively. Inadequate climate-related risk disclosure can lead to misjudgements of those risks, ineffective capital allocation, and insufficient pressure on executives to manage these risks.
Thus, integrating climate issues into the strategic management of economic units and disclosing environmental information helps investors make informed investment decisions (Muhammad & Aryani, 2021: 6). In line with the 2022 Climate Index (COP27), the European Commission has set a target to reduce emissions by at least 55% by 2030 compared to 1990 levels and aims to cut emissions by 60% in the future.

2.8. Measuring the carbon footprint

The measurement of the carbon footprint involves three key steps (Pandey et al., 2011, p. 140):
a) A-Selecting the greenhouse gases to be measured.
b) B-Defining the boundaries for measurement.
c) C-Gathering data on greenhouse gas emissions for the study area.

2.9. Assurance and verification of carbon footprint disclosure

Assurance of corporate social responsibility (CSR) reports, sustainability reports, and environmental disclosures is crucial for building trust and managing uncertainties regarding social and environmental responsibility information. Professional assurance services on non-financial disclosures offer several benefits to the capital market, primarily reducing the information risk decision-makers face when relying on unverified data (Tsang et al., 2023). This process provides credibility, integrity, transparency, and reliability to the reported emissions data, fostering better governance practices and increasing stakeholder trust (Allouzi, A.S., 2024).

2.10. International standards for climate-related financial reporting (IFRS S2)

The IFRS S2 standard focuses on sustainability and its financial value by providing a structured framework for sustainability disclosures, particularly climate-related risks and opportunities that can impact a company's financial performance (Allouzi, A.S., Alomari, K.M., Maghaydah, S., 2024). The standard aims to guide organizations in reporting climate-related risks, assessing progress, and developing emission reduction strategies. The summary addresses the root solutions to mitigate climate migration risks. It provides an in-depth explanation of the carbon footprint and its disclosure, emphasizing its importance in tackling climate change challenges in Iraq.

3. Methodology

The study tests the research hypothesis, reflects the disclosure of the carbon footprint in improving the indicators of the displacement matrix (DTM)), the content analysis of the financial reports of the companies listed in the Iraq Stock Exchange will be relied upon, according to the presence of branches of companies in populated areas in the governorates suffering from displacement.

3.1. Research community and sample

The research community is represented by all economic units listed in the Iraq Stock Exchange, as shown in Table 1, which includes different sectors. In contrast, the research sample list includes the listed industrial economic units, numbering 20 companies, and five economic units with branches in the southern and central governorates. Table 1 below shows the economic units listed in the Iraq Stock Exchange.

Table 1:

Sector	Number of economic units
Banks	43
Telecommunications	2
Industry	20
Agriculture	7
Tourism	10
Services	10
Financial investment	6

Source: Iraq Stock Exchange website.

Through Content Analysis of the Financial Reports of Industrial Companies Listed on the Iraq Stock Exchange

Table 2:

Sequence	Sample Company	Full	Partial	Did not disclose
1	National Home Furniture Industry			√
2	Fallujah for the Production of Construction Materials and Real Estate Investments			√
3	Baghdad for the Manufacturing of Packaging Materials			√
4	Modern Paints			√
5	Chemical Industries		√	

As shown in Table 2, the research sample consists of five companies with branches in the relevant provinces.

- Disclosure of global warming

From the above table, the disclosure of gas emissions is weak, and it is a very small percentage, despite its importance, barely exceeding 20 %. To measure the level of disclosure of the carbon footprint of industrial companies that have branches in Najaf,
Maysan, Dhi Qar, Muthanna, and Qadisiyah, disclosure indicators of ten paragraphs were developed, including: -:1- Disclosure of direct and indirect emissions for all sources and types of emissions. -2Emissions are disclosed according to the scope (3-2-1). 3- Disclosure of waste causing emissions in terms of volume and number.4- Fines and legal claims for the company are disclosed. 5-The costs incurred by the company to reduce the carbon footprint are disclosed. 6-There is a database in the company that shows the amount of direct and indirect emissions according to their source and for the company. 7-Emissions are disclosed according to international protocols. 8-The company discloses its emission factor according to international protocols.9-- The type of renewable energy used by the company is disclosed. 10 - The fine particulate emissions resulting from the burning of fuel to generate energy in the company are disclosed. The disclosure percentage was calculated by dividing the disclosed items as the numerator by the total of the items as the denominator, and multiplying by 100%.

2.3. Climate change-induced displacement in southern and central Iraq

Figure 2 shows the number of households displaced due to climate and environmental change based on the updated report of the International Organization for Migration (RARTS) in 2024.

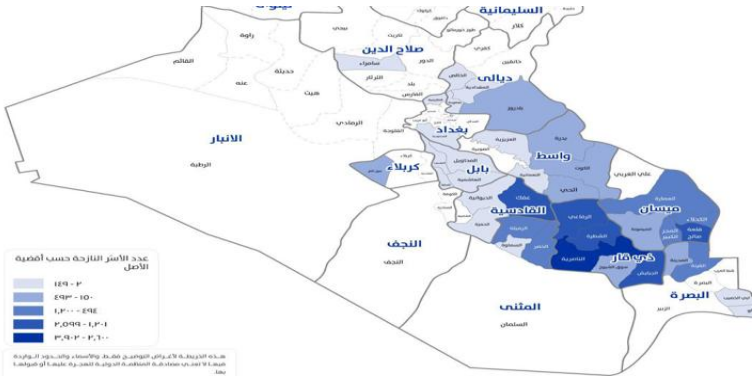

Fig. 2: Number Of Households Displaced Due to Climate and Environmental Change in Southern and Central Iraq.

Source: International Organization for Migration (RARTS) https://migrationsmartpractices.ifrc.org.
Figure 3 shows the number of households displaced due to climate change/drought according to the governorates of displacement

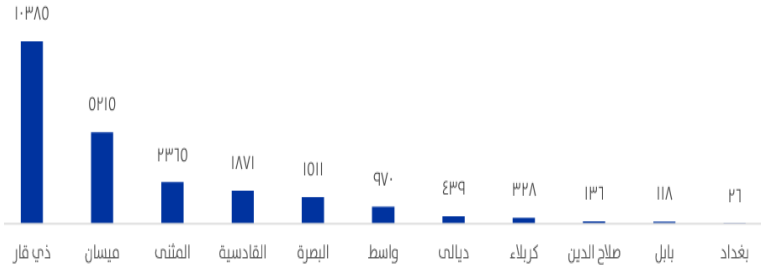

Fig. 3: Number of Families Displaced Due to Climate Change/Drought According to Displacement Governorates Source – International Organization for Migration 2024.

Figure 3 illustrates the increase in the number of families displaced by climate change. The governorates of Amarah (Maysan), Najaf (Najaf), and Nasiriyah (Dhi Qar) are the districts hosting the largest number of displaced families. Most of the displaced families came to Dhi Qar and Maysan. In contrast, all of the displaced families to Najaf came from outside the governorate, particularly from Dhi Qar and Qadisiyah. It is also worth noting that most of the displaced families to Najaf live in rural areas, which contradicts the general trend of rural-urban migration. However, urban pollution may be a cause of displacement.

Table 3: Shows The Number of Displaced Families by Their Respective Provinces, Illustrating the Geographical Distribution of These Families and Where They Have Settled Across Iraq

Numbers	City	Number of displaced families
1	Thi Qar	10385
2	Maysan	5215
3	Muthanna	2365
4	Qadisiyah	1871
5	Basra	1511
6	Wasit	970
7	Diyala	439
8	Karbala	328

To find the correlation between carbon footprint disclosure and the displacement matrix, where the independent variable is the carbon footprint disclosure, and the dependent variable is the displacement matrix, the intermediary variables are as follows:

1) Carbon Footprint Disclosure Guidelines (K): These are the disclosure guidelines within the Iraq Stock Exchange, provided by the disclosure authority in the financial market. These include:

- Instruction No. (8) of 2011 (amended)
- Instruction No. (13), including the contents of the annual and quarterly financial statements for 2010.

Instruction No. (14) of 2011. A value of 1 is assigned to companies that are required to disclose their carbon footprint and 0 to companies that are not required to disclose their carbon footprint. All sample companies received a value of 0 for not complying with the voluntary disclosure instructions.

2) Applied Accounting System (S): This refers to the unified accounting system applied in industrial economic units.
3) Company Size (Z): This represents the size of economic units within the industrial sector. To measure firm size as an intermediate variable, various measures are used to determine firm size. The most common of these measures is total assets.

The formulated research model tests the hypothesis to measure the correlation between disclosure levels and the displacement matrix as follows:

$$Y = a + B1K + B2S + B3Z$$

Where:

- Y represents the dependent variable, the displacement matrix measured in Table 4.
- A represents the constant value, which is the level of carbon footprint disclosure without considering the influencing factors.
- B represents the slope for the independent variables (i) in years (r) and (k).
- The intermediary factors:
- K = Carbon Footprint Disclosure Guidelines
- S = Applied Accounting System
- Z = Company Size

Table 4:

Dependent Variable	B	R2	F	Correlation	The symbol	Independent variable
Displacement Matrix	0.61	0.32	11.8	0.73	K	Disclosure instructions
Displacement Matrix	0.65	0.29	5.8	0.55	S	Adopted accounting system
Displacement Matrix	0.45	0.14	2.1	0.20	Z	Company size in the sector

The above table presents the correlation results between the main variables and the multiple linear regression between the variables and the influencing independent factors.

From the analysis of the above table, the relationship between the disclosure guidelines, which regulate market disclosures, and the displacement matrix is a strong, statistically significant correlation at the 0.05 level, with a correlation coefficient of 0.73. The disclosure guidelines that regulate market disclosure do not mandate companies to disclose their carbon footprint and climate impacts in their financial reports. However, they affect household displacement. On the other hand, there is a positive, statistically significant correlation at the 0.05 significance level, with a correlation coefficient of 0.55, which indicates that the accounting system applied in the industrial sector, which is a unified accounting system, lacks the elements needed to disclose the carbon footprint. Additionally, the correlation between company size and the displacement matrix is weak and statistically insignificant, with a correlation coefficient of 0.20, indicating no relationship between company size and household displacement.

From the analysis of the calculated F-value (11.8), which is greater than the table value of (4.19) at the 0.05 significance level, this means there is a statistically significant effect between carbon footprint disclosure guidelines and the displacement matrix at the 5% significance level, with a confidence level of 95%. The coefficient of determination (R^2=0.32) indicates that the carbon footprint disclosure guidelines can explain 32% of the changes in the displacement matrix. The remaining 78% is due to other factors not included in the regression model. The slope coefficient for the regression angle is (B=0.61). Hence, the secondary hypothesis, which states that there is a significant relationship between carbon footprint disclosure guidelines and the displacement matrix, is accepted. The results obtained can be reinforced through Table 1-3 and Figure 1-4, which show the increase in the number of displaced persons from their governorates according to the emissions and pollution associated with the presence of companies that do not disclose their carbon footprint.

4. Conclusions

The research reached several conclusions, the most important of which are:

1) The Displacement Tracking Matrix (DTM) is a system that the International Organization for Migration (IOM) uses to track and monitor population displacement and movement during crises.
2) The carbon footprint concept, derived from the environmental footprint concept, gained significant attention in the 1990s.
3) Climate change and environmental degradation have displaced many individuals in the regions assessed by the International Organization for Migration (IOM) in central and southern Iraq between January 2016 and October 2022, representing approximately 10% of the original population.
4) The content analysis of the financial reports of industrial companies listed on the Iraq Stock Exchange revealed a weak disclosure of greenhouse gas emissions, with only 20%, a very low percentage.

5. Recommendations

The research came up with several recommendations, the most important of which are:

1) Prioritize carbon footprint disclosure for companies and issue instructions and guidelines regulating carbon footprint disclosure in the Iraq Stock Exchange.
2) Expedite the issuance of the Green Paper, which regulates procedures, policies, and methods for scientifically sound and applicable solutions to address climate-induced migration.
3) Expand the indicators used in the climate change matrix.
4) Increase scientific research on climate degradation and migration, finding effective solutions while promoting the culture of net-zero carbon neutrality and reducing pollution burdens on the environment. Addressing the obstacles that prevent companies from adopting carbon footprint disclosure practices .and addressing the obstacles that prevent companies from adopting carbon footprint disclosure practices.

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Data availability

The datasets used during the current study are available from the corresponding author on reasonable request.

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