Industrial Clusters as a Strategy for Achieving Sustainable Industrial Development: An Exploratory Study of the Opinions of a Sample of Employees at the General Company for Food Products in Iraq

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Abstract

The research aims to analyze the role of industrial clusters in realizing sustainable industrial development by reviewing the fundamental concepts, challenges, and available opportunities associated with this model of industrialization. Industrial clusters, also known as industrial agglomerations, are considered a vital entry point for industrial advancement and a crucial step towards implementing a sustainable industrial development strategy and transitioning to integrated industrial societies. The study addresses a central research problem: How can the strategy of industrial clusters contribute to supporting and realizing sustainable industrial development, through analyzing the challenges it faces and how industrial clusters can serve as a solution to those challenges? It seeks to answer this by analyzing the challenges facing sustainable industrial development and exploring how clusters may serve as a solution. The research adopted a descriptive-analytical methodology to analyze its results, using a questionnaire as the primary data collection tool and a key component of the empirical section. The questionnaire was distributed to a sample of employees from companies affiliated with the General Company for Food Products in Iraq, with 60 valid responses for analysis. The data were analyzed using statistical tools with the help of SPSS V26 software to achieve the research objectives and test its hypotheses. The study concluded, based on the practical findings, that there is a statistically significant correlation between industrial clusters and sustainable industrial development—both collectively and individually—within the companies under study. Several benefits were realized in various dimensions of sustainable industrial development **Economic** (increased productivity, cost reduction, enhanced exports), **Environmental** (reduced emissions, adoption of renewable energy, waste management), **Social** (job creation, improved living standards and skill development), **Technological** (accelerated knowledge transfer, innovation, and technical solutions), **Institutional and Governance** (enhanced institutional coordination, improved planning and decision-making at the local and national industrial levels, effective regulatory frameworks, transparency, and accountability). The research also provided a set of actionable recommendations based on its findings.

Keywords: *Industrial Clusters; Industrial Agglomerations; Sustainable Industrial Development.*

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1. Introduction

Industrial clusters are considered one of the key strategic tools and mechanisms for promoting sustainable industrial development and enhancing the industrial sector to improve productivity. They contribute to increasing production efficiency, stimulating innovation, and strengthening the competitiveness of industrial enterprises. Industrial clusters, also referred to as industrial agglomerations, are groups of interconnected industries that collaborate in the production of a specific good or service. These clusters vary by economic sector—such as industry, agriculture, or services—and can be local, regional, or global in scope, depending on their reach and distribution.

Industrial clusters are composed of industries linked through input-output relationships, aiming to achieve integration and mutual benefit across sectors to enhance manufacturing efficiency and deliver goods and services more effectively and economically. This ultimately supports sustainable industrial development and reinforces its multiple dimensions.

Accordingly, the present research is structured around four main axes: The first axis addresses the research methodology, The second presents the theoretical framework, covering both industrial clusters and sustainable industrial development, The third axis explores the empirical (field) aspect of the study, The fourth and final axis outlines the key findings and recommendations proposed for the companies under study.

2. Section One: Research Methodology

2.1 Research Problem:

Sustainable industrial development is considered one of the fundamental pillars for achieving a balance between economic growth, environmental protection, and social equity, in addition to fostering innovation and technology. It is also closely linked to policies and legislation through the institutional and governance dimension, which ensures the effective and organized implementation of development plans. However, this form of development faces numerous challenges that hinder the achievement of its goals, particularly in developing countries.

Industrial clusters represent a strategic model for supporting the various dimensions of sustainable industrial development. By analyzing successful international experiences and identifying the key challenges faced, developing countries can be better positioned to adopt an industrial cluster strategy that contributes to achieving integrated and sustainable industrial development.

From this perspective, the research problem emerges and can be summarized in the following question: **How can the strategy of industrial clusters contribute to supporting and realizing sustainable industrial development, through analyzing the challenges it faces and how industrial clusters can serve as a solution to those challenges?**

2.2 Significance of the Study:

The significance of this research lies in its focus on one of the contemporary and critical topics—**industrial clusters**—particularly given the limited number of Arabic and Iraqi studies addressing this subject. In addition, the study explores the concept of **sustainable industrial development** and examines how its dimensions can be embodied through the strategy of industrial clusters within the companies under investigation.

This research contributes to enhancing **economic and social efficiency** by improving working conditions and supporting local communities, as well as fostering **technological innovation**. Furthermore, it promotes

environmental sustainability through the adoption of environmentally friendly practices, while also creating an enabling environment for small and medium-sized enterprises (SMEs), thereby improving their **competitiveness**.

2.3 Objectives of the Study:

The primary objective of this research is to determine whether industrial clusters can serve as a strategic approach to support sustainable industrial development in its various dimensions. In addition, the study seeks to achieve the following specific objectives:

1. To provide a theoretical framework that clarifies the key concepts of industrial clusters and sustainable industrial development, based on a review of relevant literature and previous research contributions.
2. To identify the extent of the relationship and impact between industrial clusters and sustainable industrial development within the companies under study.
3. To offer a set of recommendations based on the findings drawn from the empirical realities of the companies under investigation.

2.4 Research Framework and Hypotheses:

Based on the research problem and its objectives, the research framework has been developed as illustrated in **Figure (1)**.

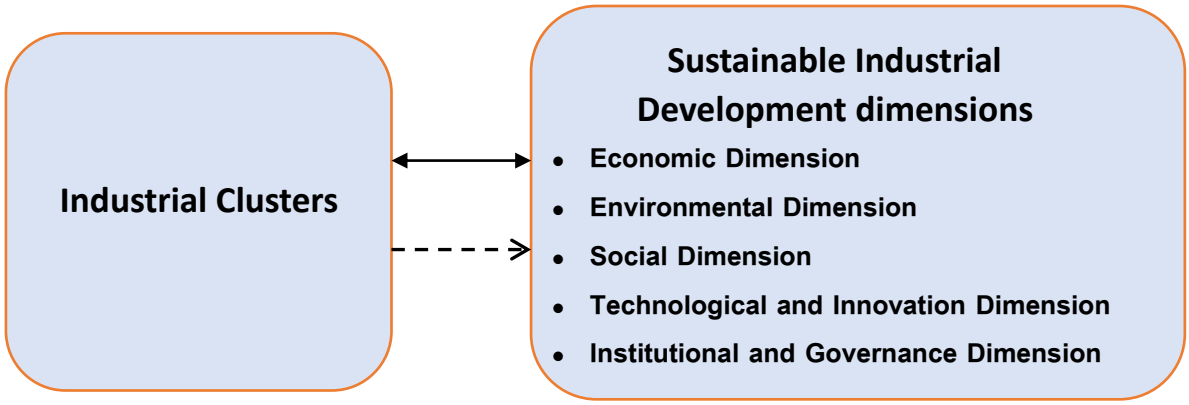

Figure (1): The Hypothetical Research Framework

Source: Prepared by the researcher

2.5 Research Hypotheses:

- **Hypothesis 1:** There is no statistically significant correlation between industrial clusters and sustainable industrial development (both collectively and individually) within the companies under study.
- **Hypothesis 2:** There is no statistically significant impact of industrial clusters on sustainable industrial development (both collectively and individually) within the companies under study.

2.6 Research Methodology:

The researcher adopted the descriptive-analytical approach to describe the research population and sample, as well as to test the proposed model and its derived hypotheses.

2.7 Data and Information Collection Methods:

The researcher relied on reputable **Arabic and international sources** relevant to the research topic to support the theoretical framework. In addition, a **questionnaire** was employed as the primary tool for collecting data and information related to the empirical aspect of the study, with the aim of reaching the research findings and conclusions.

2.8 Statistical Analysis Methods:

The current research utilized a set of statistical analysis tools in line with its objectives and to validate and measure the proposed research hypotheses. The statistical software package **SPSS V26** was employed to derive **percentages, frequencies, means, and standard deviations**, in addition to analyzing **correlation and impact relationships** and testing statistical hypotheses between variables.

It is worth noting that a total of **65 questionnaires** were distributed, of which **60 were valid for analysis**, representing a **92% response rate** for conducting the required statistical analyses.

2.9 Description of the Research Community and Its Sample:

In alignment with the research methodology, the General Company for Food Products, one of the companies affiliated with the Ministry of Industry and Minerals in Iraq, was selected. This company was established in 2016 as a result of merging a group of diverse companies located across various Iraqi provinces, as illustrated in Figure (2), as follows:

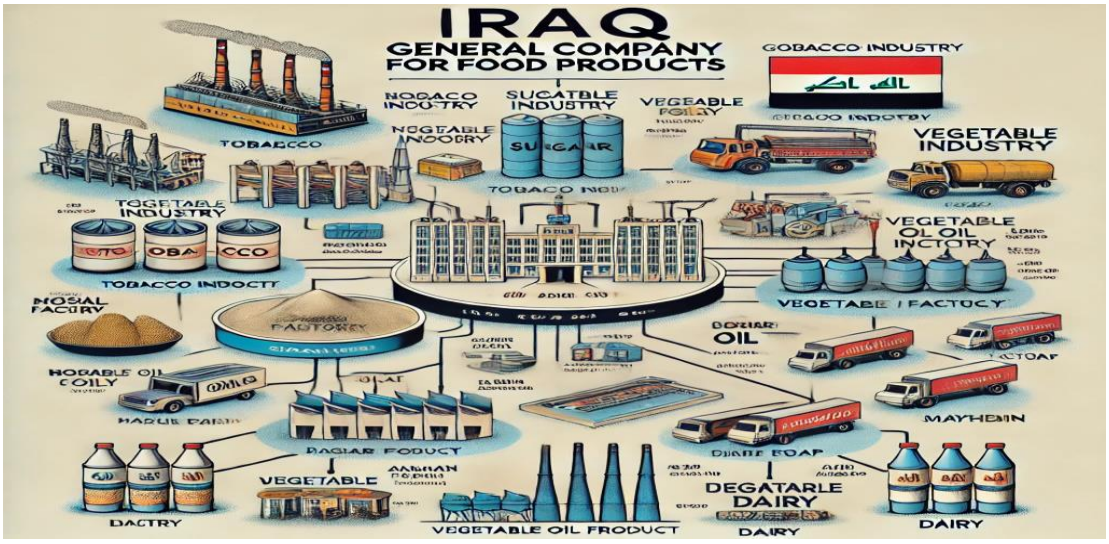

Figure (2): The General Company for Food Products in Iraq

Source: Prepared by the researcher based on AI design software

- **The General Company for Vegetable Oil Industry:**

This is one of the largest companies in Iraq, specializing in the production of liquid oils, solid fats, soaps, cosmetics, and detergents. It was established in 1970 following the merger of the Vegetable Oil Extraction Company, the Cottonseed Company, Al-Rafidain Detergents Company, the Industrial Printing Company, and Abu Al-Hail Soap Company during the years 1968–1970. The company owns several factories distributed throughout Iraq, such as Al-Rasheed, Al-Ameen, Al-Ma'moun, Al-Farabi, Imam Ali Al-Hadi, and Baiji. Notably, it was among the first companies to obtain ISO 9001:2008 certification.

- **The General Company for Dairy Products:**

The dairy factory in Iraq was established in 1956 as a government-owned company under the Ministry of Industry and Minerals, initially named the General Company for Dairy Products. In early 2016, it merged with three other state companies under the same ministry, forming the General Company for Food Industries, which was later renamed the General Company for Food Products. The dairy factory comprises five production plants, including the Mosul plant, the infant milk factory (which ceased operations due to destruction during the 2003 war), and the Abu Ghraib plant consisting of two factories (Dijlah and Euphrates). Additionally, the Diwaniyah plant and several milk collection and cooling centers continue to operate to this day.

- **The General Company for Sugar Industry:**

The sugar refining factory is one of the largest sugar refineries in Iraq and the Middle East. It was designed and constructed to the highest global standards by German, Czech, and other European companies. The factory's initial production capacity was 3,000 tons per day, which increased to 3,600 tons per day in 2017, then to 4,000 tons per day in 2018. In 2024, a new expansion was inaugurated, raising the capacity to 6,000 tons per day. This expansion enhances the factory's ability to export sugar to international markets, fully meet local market demand, and export surpluses to neighboring countries. The factory's operations have reduced sugar prices by 25-30% and ensured regular market supply, supporting the local economy. Moreover, it has created over 1,100 direct jobs and many more indirect jobs, contributing to regional economic and social development**.**

- The General Company for Vegetable Oils was formed in its current structure on May 6, 1970, following the merger of the following companies during the years 1968–1970, all of which began production in their founding year:
  - Vegetable Oil Extraction Company, established in 1940.
  - Cottonseed Products Company, established in 1952.
  - Al-Rafidain Detergents Manufacturing Company, established in 1967.
  - Industrial Printing Company, established in 1969.
  - Abu Al-Hail Soap Company (Gar), established in 1969.

The company operates six factories located in different provinces:

- Al-Rasheed Factory, Baghdad Governorate
- Al-Ma'moun Factory, Baghdad Governorate
- Al-Ameen Factory, Baghdad Governorate
- Al-Farabi Factory, Baghdad Governorate
- Imam Ali Al-Hadi Factory, Maysan Governorate
- Al-Mansour Factory, Salahuddin Governorate – Baiji

- The General Company for Tobacco and Cigarettes, part of the General Company for Food Products, has obtained trademark licenses from reputable international companies in the tobacco and cigarette industry, including the Mazaya and LD brands, as well as the Elikans brand. Modern production lines have also been added. A contract

was signed for the qualification and operation of the Baghdad Tobacco and Cigarette Factory, under which advanced and modern production lines were supplied and installed. The local Iraqi tobacco and cigarette products are considered to be of high quality because they are inspected by the officially accredited authority in Iraq, the Central Quality Control Organization, and have obtained product conformity certificates according to Iraqi Standard Specifications (546) and (1652). This contrasts with imported products in the market, which often have unknown brands and inferior quality.

Regarding the research sample, it consisted of individuals surveyed from several factories belonging to the companies under study. Questionnaires were distributed among them, targeting various administrative levels within the mentioned companies.

3. The second axis: the theoretical aspect

This section aims to provide a comprehensive theoretical overview of the research topics aligned with its objectives and content.

3.1 First: Industrial Clusters

The theoretical framework analyzes the concept of industrial clusters, their emergence, and the most prominent models, such as Michael Porter's model, which demonstrates how competitiveness can be enhanced through the integration of industrial enterprises within a cluster structure. Industrial clusters are defined as geographic concentrations of interconnected companies operating in the same or related sectors, which fosters both cooperation and competition among them.

- **Concept of Industrial Clusters**

The actual emergence of the industrial cluster strategy dates back to the late 19th century, However, it was in 1990 that Professor Michael Porter provided the first clear definition of the concept of industrial clusters after conducting extensive research and studies on the subject. (Porter, 1990 : 77-78). He identified clusters as a fundamental factor for addressing the challenges and risks faced by industrial enterprises, aiming to achieve global competitive performance within the international economic system, Porter found that the most effective approach to achieving this goal is to focus on microeconomic policies and create an attractive investment climate for small and medium-sized enterprises. (Hamoody & Gajo, 2023 : 7) He emphasized that this approach contributes to increasing productivity and innovation by enhancing interaction among companies within the industrial cluster. Porter concluded that the best environment for these enterprises is the cluster environment. (Morosini, 2004 : 306-307)

According to Porter, industrial clusters are geographic concentrations of interconnected institutions, including specialized suppliers of critical inputs such as production components, equipment used in the manufacturing process, and providers of industry-specific services, The concept also extends to include a range of financial bodies and governmental and non-governmental organizations that support the cluster ecosystem. (Manuel et al., 2012 : 72)

The modern concept of industrial clusters is based on the same foundational principles that have governed industrial agglomerations for a long time and shares with them many economic benefits for the state and the companies operating within them. However, the key difference lies in the clusters' focus on the value-added chain of the product. Industrial clusters are geographic concentrations of a group of companies and institutions interconnected within a specific industrial field, where their production and commercial processes integrate to enhance economic efficiency and increase competitiveness. (Devine, 2022 : 1022) As illustrated in Figure (3), industrial clusters represent a geographic concentration of industries that generate various advantages through shared locations.

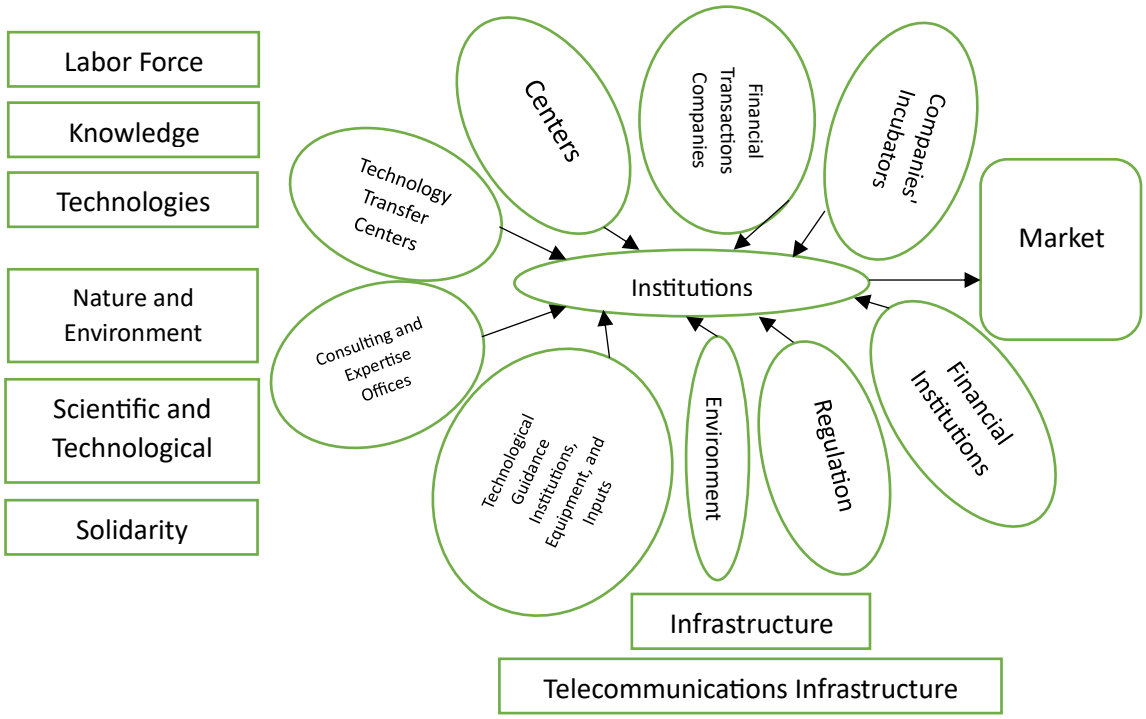

Figure (3) Cluster system effectiveness

Azroul Mohammed, 2006" Diagnostic territoirial etindentiication de projects de SPLzcasdu Mohammedia",memoire pour l'acc 'es au grade d' ingenieur en chef, ministere de l'industrie marocain , ,p:198.

Based on the above, industrial clusters can be defined as a concentration of companies-whether local, regional, or global-that share common factors such as the use of similar technologies, participation in the same marketing channels, reliance on a shared labor pool, or having forward and backward linkages among them, This cluster also includes a set of related and supporting institutions whose presence is essential to enhance the competitiveness of the cluster members, These institutions may include financial bodies, government agencies, research centers, and other organizations that provide the necessary support to sustain and develop the cluster's competitive advantage.

■ Characteristics and benefits of industrial clusters

Industrial clusters possess several distinctive characteristics that set them apart from other forms of business organization, including: (Duranton & Puga, 2001 : 3), (Brown et al., 2007 : 3), (Mohammed & Saadoon, 2022 : 120), (Devine, 2022 : 1022), (Liu & Zhu, 2024 : 570-571)

1. **Geographic Proximity:** Industrial clusters are characterized by the presence of industrial agglomerations within a specific geographic area, which facilitates transportation and communication among companies. The concentration and linkages of the industrial cluster-whether horizontal or vertical-are determined by the geographic location of the cluster's constituent institutions.
2. **Integration Among Companies:** Industrial clusters provide opportunities for small and medium-sized enterprises to benefit from shared resources, such as skilled labor and specialized infrastructure. Active and efficient channels for transactions and communications exist among cluster institutions within a robust participatory and specialized framework, whether in labor markets or services. This collaboration involves

sharing opportunities and risks faced by the cluster, thereby enhancing exports. Industrial clusters can strengthen the competitiveness of national products in global markets.

3. **Enhancing Competitiveness and Innovation:** Industrial agglomerations create a competitive environment that drives companies to develop their products and improve production processes. They enable access to local suppliers of production inputs at relatively lower costs compared to imports. Companies within the cluster exchange resources and expertise, positively impacting the industry's competitiveness in both local and international markets. The specialization of related industries in producing specific components of production inputs further increases opportunities for cooperation among companies, contributing to the development of new products and the improvement of production processes.
4. **Support for Research and Development:** Industrial clusters encourage collaboration in scientific and technological research, accelerating the pace of innovation. Proximity to research and development institutions and suppliers facilitates such cooperation, which can lead to the development of innovative products or the enhancement of manufacturing processes.
5. **Presence of a Supportive Regulatory Environment:** The success of industrial clusters depends on the existence of government policies that support and encourage investments, such as tax incentives, logistical support, and financing for institutions operating within these clusters.
6. **Creation of New Employment Opportunities:** Industrial clusters expand the scope of economic activities, thereby creating jobs and contributing to the reduction of unemployment rates.
7. **Flexibility and Dynamism:** Clusters are characterized by their ability to adapt to market and technological changes, which enhances the sustainability of their competitiveness.
8. **Knowledge Exchange:** Clusters facilitate the exchange of knowledge and expertise among companies and institutions within the region. This leads to technological improvements and increased efficiency in manufacturing processes, adding value to the product.
9. **Improvement of the Supply Chain:** Geographic proximity within clusters contributes to better supply chain management. Companies can obtain materials and components more efficiently, reducing logistics costs and delivery times, which in turn enhances product competitiveness.
10. **Economies of Scale:** Clusters benefit from economies of scale, where large production volumes lead to cost savings. This enables companies to invest in advanced technologies or high-quality inputs.

■ Challenges Facing Industrial Clusters

Despite the numerous benefits provided by industrial clusters, several challenges may hinder the achievement of their objectives, including: (Park et al., 2008: 4-5), (Wijaya & Kurniawati, 2021 : 155), (Awid & Shareef, 2023 : 6) (Huang & Hsueh, 2024 : 3609-3610),

1. **Weak Infrastructure:** Some countries suffer from insufficient facilities and logistical services necessary to support industrial clusters.
2. **Lack of Integration Among Companies:** The absence of effective coordination between companies within the cluster can lead to reduced production efficiency.
3. **Limited Government Support:** Industrial clusters require supportive policies, such as tax incentives and investment in research and development, to thrive.
4. **Unfair Competition:** Small enterprises within clusters may face challenges competing against larger companies.
5. **Rapid Technological Changes:** Industrial clusters must continuously adapt to technological advancements to maintain their competitiveness.

- **Types of Industrial Clusters**

Industrial clusters can be classified into several types according to key criteria, including: (Gordon & McCann, 2000 : 514-515), (McDonald & Huang, 2006 : 526), (Manuel et al., 2012 : 72), (Grumadaitė & Staniulienė, 2022 : 478)

1. **Clusters by Origin:**
    - Natural Clusters: These form spontaneously as a result of the availability of production factors such as raw materials or skilled labor in a specific region.
    - Demand-Driven Clusters: These arise due to increased local demand for certain products, which stimulates the concentration of related industries.
    - Policy-Driven Clusters: These are established as a result of government interventions or policies aimed at supporting and developing specific industrial agglomerations.
2. **Clusters by Product Type:**

    These are clusters specialized in particular products or sectors, such as mechanical industries, tourism, media, or information technology-for example, Silicon Valley in the United States or Hollywood in the film industry.
3. **Clusters by Degree of Linkage:**
    - Vertically Linked Clusters: Comprised of large enterprises supported by a number of smaller firms that supply necessary production inputs.
    - Horizontally Linked Clusters: Consist of a large number of small and medium-sized enterprises producing similar or related products and sharing technologies and resources

Some scholars have classified industrial clusters according to the nature of relationships between companies and other sectors. The most prominent types include: (Zeng, 2008 : 3), (Rachel, 2009 : 2) (Lund & Pillay, 2012 : 569-570), (Yi & Harish, 2022 : 78)

1. **Specialized Clusters:** These consist of industrial agglomerations focused on a specific sector, such as the automotive industry in Germany or electronics in Japan.
2. **Innovative Clusters:** These rely on technology and research and development, exemplified by Silicon Valley in the United States.
3. **Traditional Clusters:** These include artisanal industries and local production communities, such as the textile industry in India.
4. **Emerging Clusters:** These form around rapidly growing new technologies and industries, such as renewable energy technologies.

3.2 Second: Sustainable Industrial Development

Sustainable industrial development forms the cornerstone of long-term economic growth, as it contributes to enhancing productivity, creating job opportunities, and achieving economic sustainability. However, the success of such development depends on the presence of supportive policies, sufficient investments, and the provision of robust infrastructure. This is achieved by studying global experiences and benefiting from successful strategies to develop the industrial sector and realize sustainable development.

■ Concept of Sustainable Industrial Development

Sustainable industrial development refers to the process of transforming the economy from reliance on primary sectors such as agriculture and extraction to an economy based on advanced industry and manufacturing. The objective is to achieve sustainable economic growth by increasing productivity, fostering innovation, and expanding the economic base. Sustainable industrial development is considered one of the most important goals pursued by modern societies, (Fang et al., 2007 : 320), It aims to achieve a balance between economic growth and the preservation of environmental resources for future generations. This type of development seeks to minimize the negative environmental impacts of industries by adopting environmentally friendly technologies and production processes. Achieving sustainable industrial development requires collaboration among governments, the private sector, and civil society, with each stakeholder playing a pivotal role in supporting initiatives aimed at realizing a green and sustainable economy. Through joint efforts, we can secure a better and more sustainable future for generations to come. (Hossain et al., 2021 : 675-676)

Sustainable industrial development has been defined (Ghobakhloo et al., 2021 : 4238-4239) as an integrated framework aimed at developing the industrial sector in a balanced manner that ensures economic growth while protecting the environment and promoting social justice, without compromising the ability of future generations to meet their own needs. From an economic perspective, it involves transforming the industrial structure toward more efficient and sustainable production patterns by utilizing modern technology and clean energy to enhance competitiveness, while ensuring continuous growth without depleting resources. From an environmental standpoint, it represents an industrial approach focused on reducing the environmental footprint by minimizing carbon emissions and hazardous waste, adopting circular economy principles (such as recycling, reuse, and sustainable design), and integrating environmental standards throughout the product life cycle-from raw materials to final disposal. From a social perspective, sustainable industrial development entails providing fair employment opportunities while respecting workers' rights, improving the quality of life for communities surrounding industrial facilities, and achieving equitable distribution of development benefits among different social groups. Thus, it combines the practical dimension (sustainable technologies + economic efficiency), the ethical dimension (responsibility toward the environment and society), and the strategic dimension (adaptation to climate change and resource crises). Consequently, sustainable industrial development transcends the concept of the "green factory" to establish an integrated industrial system that balances human needs, economic growth, and nature.(Shi et al., 2024 : 88)

Based on the foregoing, it can be stated that sustainable industrial development is a long-term industrial strategy that integrates environmental and social requirements at the core of industrial planning. This is achieved through legislation that incentivizes green investment and criminalizes harmful practices. It is a process of developing the industrial sector in a manner that simultaneously achieves economic growth, social efficiency, and environmental protection, without depleting natural resources or compromising the needs of future generations.

■ Importance and Benefits of Industrial Development

Industrial development is a fundamental element in achieving sustainable economic growth, as it provides numerous benefits: (Yülek, 2018 : 3-4), (Tseng et al., 2021 : 582-583), (Hossain et al., 2021 : 675-676), (Mohammed & Al Murad, 2023 : 4), (Shi et al., 2024 : 88)

1. **Enhancing Economic Growth:** Industry contributes to increasing the Gross Domestic Product (GDP) by producing goods with high added value.
2. **Job Creation:** Manufacturing industries provide employment opportunities for various groups, thereby reducing unemployment and improving living standards.
3. **Achieving Economic Sustainability:** Industries that rely on modern technology reduce dependence on natural resources, thereby promoting environmental sustainability.

4. **Strengthening Competitiveness:** Industrial development improves product quality, which enhances the country's competitiveness in global markets.
5. **Encouraging Innovation and Technology:** An advanced industrial environment fosters research and development, contributing to product improvement and increased productivity. Investment in scientific research supports the development of new technologies that reduce the environmental impact of industries, such as the use of solar and wind energy in production processes.
6. **Resource Use Efficiency:** Aims to reduce the consumption of raw materials and energy while relying on renewable resources whenever possible, contributing to lowering the carbon footprint.
7. **Recycling and Waste Management:** Encourages industries to recycle materials and utilize by-products to minimize industrial waste and improve the surrounding environmental quality.
8. **Corporate Social Responsibility:** Promotes transparency and accountability in industrial operations, ensuring that companies are socially and environmentally responsible, which helps create a healthy and safe work environment.
9. **Education and Awareness:** Raises awareness among workers and local communities about the importance of environmental preservation and ways to achieve sustainable industrial development.

■ Challenges and Influencing Factors in Sustainable Industrial Development

Despite the numerous benefits of sustainable industrial development, it faces several challenges and factors that affect its success, including: (Murty & Kumar, 2002 : 469-471), (Baldwin et al., 2005 : 890-891), (Fang et al., 2007 : 320)

1. **Infrastructure Deficiency:** Some countries suffer from weak transportation, communication, and electricity networks, which hinder the manufacturing process.
2. **Environmental Challenges:** Unplanned industrial expansion leads to increased environmental pollution and depletion of natural resources.
3. **Global Competition:** Local industries struggle to compete with global companies due to disparities in technology levels and production efficiency.
4. **Policy Instability:** Frequent changes in government policies affect the stability of the business environment and limit industrial investments.
5. **Education and Training:** The success of industrial development depends on the availability of a skilled workforce capable of handling modern technologies.
6. **Weak Financing and Investment:** Industries require substantial investments from both the public and private sectors to ensure sustainable growth, which may be limited in some developing countries.
7. **Industrial Integration:** The integration of supply chains and the linkage between different industries help increase efficiency and achieve sustainable growth.

(Lokko et al., 2018 : 7-8)و (Zodape et al., 2015 : 112-113)و (Yuan et al., 2020 : 270)و (Fang et al., 2007 : 320)و (Ghobakhloo et al., 2021 : 4238-4239)

■ Dimensions of Sustainable Industrial Development

Sustainable industrial development is a vital component of comprehensive development and is grounded in a set of core dimensions that ensure economic growth without harming the environment or societies. The main dimensions include:

1. **Economic Dimension:** This dimension focuses on achieving economic growth by developing industries in ways that enhance efficiency and productivity, create sustainable employment opportunities, and support the local economy, Key elements include: (Zodape et al., 2015 : 112-113)

- Increasing productivity through the use of technology and workforce training.
- Creating job opportunities, especially in emerging industrial sectors.
- Enhancing local value chains and generating sustainable employment.
- Promoting innovation and improving productivity to drive economic growth and industrial competitiveness.
- Supporting small and medium-sized enterprises (SMEs) to foster a resilient industrial system.
- Diversifying the economy by expanding the economic base and relying on clean, value-added industries, thus reducing dependence on a single sector (such as oil in some Arab countries).

2. **Environmental Dimension:** This dimension focuses on preserving the environment and minimizing the damages caused by industrial processes through a transition to cleaner and more sustainable production systems. Key elements include: (Lokko et al., 2018 : 7-8)

- Transitioning to renewable energy sources such as solar and wind power.
- Managing natural resources efficiently, including water and raw materials.
- Reducing emissions, which involves lowering carbon emissions, optimizing resource use, and adopting clean production technologies, particularly those targeting greenhouse gases.
- Promoting recycling as part of the circular economy, encouraging the safe management of industrial waste.
- Aiming to mitigate the environmental impacts of industrial activities by shifting towards a circular economy model.

3. **Social Dimension:** This dimension focuses on the social impact of industry, encompassing the improvement of working conditions, equality in employment opportunities, and the enhancement of the role of local communities. Key elements include: (Yuan et al., 2020 : 270)

- Employment equity: Supporting equality and social justice in access to job opportunities and training, particularly empowering women, youth, and persons with disabilities.
- Workers' rights: Ensuring fair wages and safe working conditions.
- Industry's impact on local communities: Addressing aspects such as health, education, and social development.
- Poverty reduction: Through the provision of sustainable employment.
- Improving the quality of life for workers and communities surrounding industrial facilities.
- Promoting community empowerment and ensuring safe and healthy working environments.

4. **Technological and Innovation Dimension:** Innovation and technology are fundamental drivers of sustainable industry, contributing to enhanced production efficiency, cost reduction, and minimized environmental impact. Key elements include: (Baldwin et al., 2005 : 890-891), (Alkhaffaf, 2024 : 158)

- Research and Development: Promoting R&D to generate new and sustainable solutions.
- Industry 4.0: Technologies such as artificial intelligence, the Internet of Things (IoT), and 3D printing.
- Technology Transfer: Especially from developed countries to developing countries.
- Support for Technical and Vocational Education: To equip the workforce with the skills required for modern technologies.
- Development of Clean Technologies.
- Digitization of Industrial Processes: Enhancing efficiency through digital transformation.

5. Institutional and Governance Dimension: This dimension relates to the policies, legislation, and administrative structures that ensure the effective and organized implementation of sustainable industrial development plans. Key elements include: (Fang et al., 2007 : 320)

- Establishing clear legislation: Developing policies and laws that support industrial sustainability, protect the environment, and guarantee workers' rights.
- Transparency and accountability: Ensuring openness and responsibility in the management of industrial resources.
- Coordination among entities: Requiring cooperation between the public and private sectors, as well as with international organizations.
- Empowering regulatory bodies: Enabling oversight agencies to monitor the application of environmental and social standards.
- Promoting transparency and accountability in the management of industrial resources.

4. Axis Three: Field Aspect

This section addresses the field aspect of the current research in light of the theoretical frameworks presented and in alignment with its objectives, with the aim of presenting, analyzing, and discussing the results as follows:

A. Testing the Correlation Coefficient Between Research Variables

Table (1) indicates a statistically significant positive correlation between industrial clusters, as the independent variable, and sustainable industrial development, as the dependent variable, with an overall correlation coefficient of (0.882). This result suggests that the focus of public food product companies on forming clusters-characterized by shared factors such as the use of similar technologies or participation in common marketing channels-reflects the alignment between industrial cluster strategies and sustainable industrial development. This alignment leads to commercial and integrative relationships, fostering collaboration with experts and skilled workers within the industrial clusters, thereby enhancing production efficiency and local industrial competitiveness.

Table (1): Analysis of the Overall Correlation Between Industrial Clusters and Sustainable

independent variable / dependent variable	industrial clusters
sustainable industrial development	0.882*

The table was prepared by the researcher based on the results of the calculator n=60 * P ≤ 0.05

Table (2) also shows the correlation between industrial clusters and sustainable industrial development at the individual level:

Table (2) Analysis of the correlation between industrial clusters and sustainable industrial development at the level of the companies under study

independent variable / dependent variable		industrial clusters
sustainable industrial development	Economic Dimension	*0.832
	Environmental Dimension	*0.755
	Social Dimension	*0.788
	Technological and Innovation Dimension	*0.810
	Institutional and Governance Dimension	*0.773

The table was prepared by the researcher based on the results of the calculator n=60 * P ≤ 0.05

1. The Relationship Between Industrial Clusters and the Economic Dimension:

Table (2) indicates a statistically significant positive correlation between industrial clusters, as the independent variable, and the economic dimension, as one of the dependent variables in the study, with a correlation coefficient value of (*0.832) at a significance level of (0.05). This result aligns with the actual situation of the companies under study, as increased production efficiency and reduced costs are achieved through the geographic concentration of specialized companies. Such clustering enables resource sharing, improved access to raw materials and specialized labor, as well as logistics and infrastructure services. This, in turn, supports enhanced communication and integration among companies, whether horizontally or vertically, thereby strengthening the economic dimension of sustainable industrial development and addressing related challenges within these companies.

2. The Relationship Between Industrial Clusters and the Environmental Dimension:

The data in Table (2) indicate a statistically significant correlation between industrial clusters, as the independent variable, and the environmental dimension, as one of the adopted sub-variables. This is confirmed by the correlation coefficient value of (0.755) at a significance level of (0.05). The interpretation of this relationship suggests that the adoption of the industrial cluster concept by the companies under study can significantly contribute to the adoption of collective environmentally friendly practices, enhance resource use efficiency, and reduce the environmental impact of industrial activities, while also raising environmental awareness. Thus, industrial clusters represent a solution to the challenges facing the environmental dimension of sustainable industrial development.

3. The Relationship Between Industrial Clusters and the Social Dimension:

The data in Table (2) show a statistically significant correlation between industrial clusters, as the independent variable, and the social dimension, as part of the dependent variable, with a correlation coefficient value of (0.788) at a significance level of (0.05). This demonstrates that industrial clusters are an effective tool for supporting the social dimension and addressing its key challenges by promoting social justice, improving quality of life through the creation of local and sustainable job opportunities, and building more stable and inclusive communities. Additionally, they contribute to raising levels of education and training, empowering women and marginalized groups, and thereby strengthening social solidarity and corporate social responsibility.

4 .The Relationship Between Industrial Clusters and the Technological and Innovation Dimension:

Table (2) indicates a statistically significant positive correlation between industrial clusters, as one of the independent variables, and the technological and innovation dimension, as the dependent variable, with a correlation coefficient of (0.810) at a significance level of (0.05). This suggests that industrial clusters provide an ideal environment for enhancing technological advancement and innovation, addressing related challenges by accelerating knowledge transfer and the pace of technological innovation. The geographic proximity of companies within clusters facilitates faster exchange of expertise and knowledge, the development of technical solutions, and drives collective innovation among organizations. Furthermore, it promotes collaboration between industry and research centers, thereby improving the competitiveness of the companies under study.

5 .The Relationship Between Industrial Clusters and the Institutional and Governance Dimension:

The correlation analysis results presented in Table (2) reveal a statistically significant positive relationship between industrial clusters, as the independent variable, and the institutional and governance dimension, as one of the sub-variables of the dependent variable, with a correlation coefficient of (0.773) at a significance level of (0.05). This reflects the effective contribution of industrial clusters in supporting institutional development and governance by enhancing institutional coordination. Clusters create an organized mechanism for interaction

among various stakeholders-such as industrial companies, government agencies, civil society organizations, and research and educational centers. Such coordination contributes to improved planning and decision-making at both the local and national industrial levels, the establishment of effective regulatory frameworks, and the achievement of transparency and accountability, resulting in a more stable and sustainable industrial environment.

In line with the above, the null hypothesis was rejected and the alternative hypothesis accepted, which states: **"There is a statistically significant correlation between industrial clusters and sustainable industrial development (collectively and individually) in the companies under study".**

B. Testing the Impact Coefficient Between Research Variables

The results of the impact coefficient analysis indicate a statistically significant effect of industrial clusters-as the independent variable-on the combined dimensions of sustainable industrial development, which represent the dependent variable, at the level of the companies under study. This is detailed in Table (3) as follows:

Table (3): Analysis of the Impact Coefficient of Industrial Clusters on Sustainable Industrial Development Overall at the Level of the Companies Under Study

independent variable / dependent variable	industrial clusters		R^2	F	
	B_0	B_1		The calculated	Tabular
sustainable industrial development	0.807	0.854 (12.123)	0.704	145.2	4.001

Table: Prepared by the researcher based on the results of the electronic calculator (SPSS).
( )indicates the calculated t value. N = 60. P < 0.05 df.(1.58)

The data presented in Table (3), which summarizes the results of the regression analysis, indicate a statistically significant effect of industrial clusters on sustainable industrial development. The calculated F-test value for significance was (145.2), which is higher than the tabulated value of (4.001) at degrees of freedom (1, 58) and a significance level of (0.05).

Regarding the coefficient of determination (R^2), which measures the strength of the effect of the independent variable on the dependent variable, its value was (0.704). This means that 70.4% of the variance explained in the dimensions of sustainable industrial development is attributable to the activation of the industrial cluster concept among the companies under study, while the remaining 29.6% is due to other random variables or dimensions that are either uncontrollable or not included in the regression model.

Furthermore, an examination of the (B) coefficients and their T-test values shows that the calculated T value was (12.123), which is significant and greater than its tabulated value of (1.648) at a significance level of (0.05) and degrees of freedom (1, 58). The analysis of the partial impact coefficient is detailed in Table (4):

Table (4): Analysis of the Partial Impact Coefficient of Industrial Clusters on Sustainable Industrial Development at the Level of the Companies Under Study

independent variable / dependent variable		industrial clusters		R2	F	
		Bo	B1		The calculated	Tabular
industrial sustainable development	Economic Dimension	0.810	0.799 (9.784)	0.691	142.6	2.268
	Environmental Dimension	0.644	0.730 (7,210)	0.536	112.7	
	Social Dimension	0.795	0.799 (7.029)	0.662	131.9	
	Technological and Innovation Dimension	0.746	0.788 (9.05)	0.605	127.8	
	Institutional and Governance Dimension	0.687	0.744 (7.221)	0.627	130.7	

Table: Prepared by the researcher based on the results of the electronic calculator (SPSS).
( )indicates the calculated t value. N = 60. P < 0.05 df.(1.58)

Regression analysis results indicate the extent of the impact of industrial clusters on each dimension of sustainable industrial development, as shown in Table (4). The findings reveal a significant effect of industrial clusters-as the independent variable-on each dimension of sustainable development at the partial level, as follows:

- In terms of the significance of the effect, the highest calculated F-test value was observed for the economic dimension, where the calculated F value was (142.6), exceeding its tabulated value of (2.268) at degrees of freedom (1, 58). The lowest F-test value among the dimensions of sustainable industrial development was for the environmental dimension, with a calculated F value of (112.7), which is also significant and higher than its tabulated value (2.268) at a significance level of (0.05) and degrees of freedom (1, 58).

- Regarding the coefficient of determination (R^2), which indicates the strength of the independent variable's effect on the dependent variable, the values were as follows:

    - Economic dimension: The coefficient of determination was (0.691), meaning that 69.1% of the variance explained by this dimension is attributable to industrial clusters, while the remainder is due to random variables not included in the regression model.

    - Environmental dimension: The statistical value of the coefficient of determination was (0.536), indicating that 53.6% of the changes affecting this dimension are due to the impact of industrial clusters, with the rest attributable to other dimensions or variables not included in the regression model.

    - Social dimension: The coefficient of determination was (0.662), confirming that 66.2% of the effects in this dimension are due to the industrial clusters variable, with the remainder resulting from random variables outside the regression model.

    - Technological and innovation dimension: The coefficient of determination was (0.605), indicating that 60.5% of the variance in this dimension is explained by industrial clusters, with the rest due to random dimensions not included in the model.

- Institutional and governance dimension: The coefficient of determination for this dimension was (0.627), indicating that 62.7% of the variance explained by this dimension is due to the industrial clusters variable, with the remainder attributable to random variables or dimensions outside the regression model.

- Furthermore, an examination of the (B) coefficients and their T-test values shows that, for all dimensions, the calculated T values were higher than their tabulated values at degrees of freedom (1, 58) and a significance level of (0.05).

In line with the above, the null hypothesis is rejected and the alternative hypothesis is accepted, which states: **"There is a statistically significant impact relationship between industrial clusters and sustainable industrial development (both collectively and individually) in the companies under study."**

5. Axis Four: Conclusions and Recommendations

This section presents the conclusions and recommendations derived from the research findings, offered by the researcher for the companies under study, as follows:

5.1 First: Conclusions

1- Industrial clusters facilitate the restructuring of industry and the innovation of new solutions aligned with specific and global specializations, thereby supporting the sustainability of industrial growth across various economic sectors. They contribute to the development of emerging small enterprises by providing supportive infrastructure and reducing production costs, enabling small-scale savings that enhance the ability to adopt technology and improve product quality.

2- Industrial clusters fully support new industrial development by creating employment opportunities, which reduce unemployment and attract foreign investments. Consequently, emerging industries positively impact economic growth and achieve an optimal balance.

3- The results of the correlation analysis between industrial clusters and sustainable industrial development indicate that the companies under study show interest in forming clusters characterized by shared factors such as the use of similar technologies or participation in common marketing channels, which contributes to achieving high levels of sustainable industrial development.

4- The correlation analysis revealed a significant positive relationship between industrial clusters, as the independent variable, and the dimensions of sustainable industrial development, as the dependent variable, within the companies studied. The clusters have yielded various benefits related to the economic dimension (increased productivity, cost reduction, and export enhancement), environmental dimension (emission reduction, renewable energy use, waste management), social dimension (job creation, improved living standards for workers, enhanced skills and expertise), technological dimension (accelerated knowledge transfer, increased pace of technological innovation, development of technical solutions, and promotion of collective innovation among institutions), and institutional and governance dimension (enhanced institutional coordination through organized mechanisms facilitating interaction among relevant stakeholders) through the adoption of the industrial cluster strategy.

5- The impact analysis results demonstrated a statistically significant effect of industrial clusters on sustainable industrial development (both collectively and individually, with varying effect strengths) within the companies studied. The strongest impact of industrial clusters was observed in the economic dimension, while the environmental dimension exhibited the weakest impact compared to other dimensions of sustainable industrial development.

5.2 Second: Recommendations

1. Conduct a comparative study between traditional and virtual industrial clusters in supporting sustainable industrial development, examining the differences in performance and impact between geographical industrial clusters and virtual clusters, especially in light of recent technological advancements within the companies under study.
2. Evaluate the role of government policies and legislation in supporting industrial clusters to achieve sustainable industrial development, analyzing the effectiveness of legal frameworks and industrial policies in enhancing the role of industrial clusters, with recommendations for improvement in the companies under study.
3. Focus on studying how industrial clusters adopt environmentally friendly practices, such as the use of renewable energy and waste management, and assess the impact of these practices on sustainable industrial development within the companies under study.
4. Analyze the economic, administrative, and infrastructural obstacles that limit the capacity of industrial clusters to support sustainable development, providing recommendations to address these challenges in the companies under study.
5. Organize workshops and seminars to raise awareness about industrial clusters and sustainable industrial development for employees within the companies under study.

6. Conflict of Interest

The authors declare that they have no conflict of interest.

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