

THE IMPACT OF BAZIAN DISTRICT ON THE LOCAL ENVIRONMENT

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Executive Summary

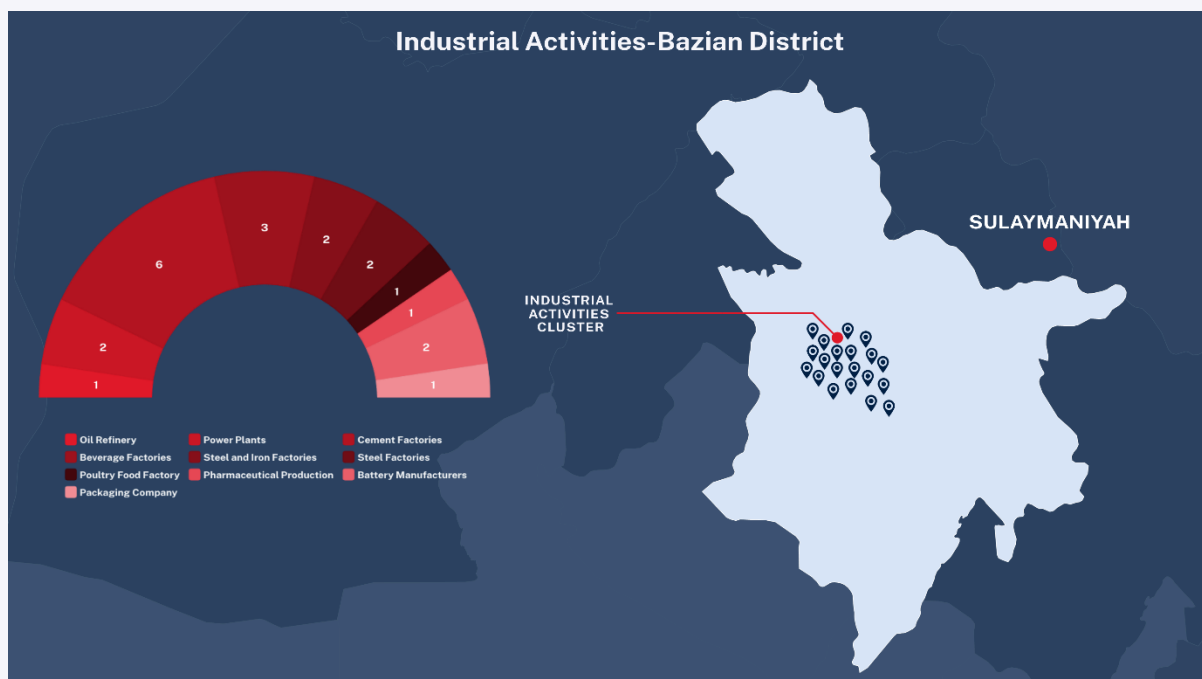
The balance between leveraging renewable and non-renewable resources in Iraq will paint the picture for its future economy and geopolitical scene. Iraq is dependent on river water for agriculture and domestic use, such as providing water for its population. Climate change threatens the future of Iraq's water resources. Rise in temperature, drought, desertification will lead sectors such as agriculture to major shift and reduction. Not to mention the socio-economic shifts that will result from migration and displacement of locals of certain areas to more suitable for living areas. In this paper, Bazian district industrial activities near Sulaymaniyah city are put forward, discussed and analyzed in terms of its effect on Sulaymaniyah Governorate climate change. Therefore, this paper shines the light on one of Iraq's strategic locations for industrial activities, the Bazian district industrial zone, which is in northern Iraq in the Sulaymaniyah governorate. The industrial activities in Bazian district are largely important for the region. However, they contribute to the depletion of water resources in the region besides affecting its air quality index (AQI) and increasing greenhouse gas (GHG) emission.

Key Question

What are the challenges the Bazian district industrial zone imposing on the Sulaymaniyah Governorate climate, and do they outweigh its economic value for the region?

Introduction

Among the prominent Iraqi cities in north, bordering with international borders, Iran from the East, and Kirkuk and Erbil from the West, lies Sulaymaniyah city. Sulaymaniyah governorate consists of Sulaymaniyah city and several districts, such as Bazian, Ranya, Pshdar, Dukan, Sharbazher, Penjwen, Chamchamal, Darbandinkhan, and Kalar.¹



Sulaymaniyah holds nearly 30% of industrial activities of Iraq.^{2,3} A large portion of this industrial sector is present in the Bazian district. In recent years many articles and claims resurfaced from Bazian about residents and locals' complaints on the negative impact of the industrial activities on the environment. There has been noticeable depletion and contamination of surface and underground water resources. Furthermore, Industrial activities such as cement production contribute to the increase of Particular Matter (PM) and dust into the air from the cement production process. Overall, air quality is compromised by such industrial activities which also contribute to climate and environmental changes in Sulaymaniyah.

Industrial Facility Type	Name(s)
Cement factory	Mass Cement, Bazian Cement, Delta Cement, Tasluja Cement, Gasin Cement, Lafarge Iraq Bazian Plant
Oil refinery	Bazian Oil Refinery
Liquefied natural gas	Satyar and Bazian
Canned beverages and water	Royal Can Making Company, Ala Company, Jam Water
Construction material	Bazian Gypsum Factory, Cedrus Industries
Steel and iron	Alkun Iraq for Steel and Iron Factory, Sulaimania Steel Company, Mass Iraq for Iron and Steel, Azady Industries Steel Fabricator, Super Steel
Poultry food	Golden Feed Factory
Pharmaceutical Production	Rasan Pharmaceutical
Packaging company	Mondi Kaso
Battery Manufacturing	Iraq Acid and Maya Battery Factory
Power Plant	Suleimanya Gas Power Station and Bazian Power Plant

Table 1: Example of industrial activities present in Bazian District. (sources: Google Maps)

Bazian Industrial activities are immensely valuable and important for the region. Industrial activities produce cement, fertilizers, iron, steel, electronics, plastics, food, medicine, clothes, poultry food and other essential goods for life. These productions increase life satisfaction of the public. Providing electricity, water, gas, roads, and public service are possible because of industrial sectors. Industries must continue and grow to meet the demand of the population in the present and future. Therefore, this paper reflects on the impacts of Bazian district

industrial activities on the climate change in the district, particularly in terms of water resource (surface and underground) depletion, contamination and its effect on air quality of Sulaymaniyah in general. The intent behind this paper is to also focus on Bazian district industrial sector economic value and importance. This paper is in hopes to generate constructive arguments between policy makers, investors, stakeholders, government officials, residents, locals of Bazian district on how to move forward by striking a balance between allowing this industrial zone to support economy stabilization in the region whilst preventing its processes and by-products to have negative impacts on the local environment and that of Sulaymaniyah region in general.

Why Depletion of Water Resources Affect the Economy?

Iraq's population (44.47 million in 2024) and its expansion (rate: 2.58% annual rise between 2023 and 2024) demand higher Gross Domestic Products (GDP).⁴ GDP per capita is the value of ready-to-use goods and services for each individual produced by the economy. Life satisfaction increases directly with the growth of GDP in countries which have high poverty rates.⁵ Iraq's GDP per capita is \$6,100 and the expansion rate is 2.9% according to most recent data (2024).⁶ Growing GDP demands more production of power using fossil fuels (oil and natural gas) to produce industrial goods. The amount of water necessary for essential industrial products is substantial. For example, crude oil production is in millions of barrels per day in Iraq, which require just as many barrels of water per day. Iraq and Iraqi Kurdistan Region's geolocation makes it dependent on river and underground water, which are originating from Tigris and Euphrates, for domestic use and oil and non-oil industrial productions. Therefore, depletion of water resources by Iraq's industrial sectors threatens the strength of the very economy that the industries are supposed to help grow.

Industrial Product	Unit Production (barrels)	Water Usage (barrels)	Water Usage (liters)
Crude oil production	1 barrel of crude oil	1.3-1.5	206.7-238.5
Crude oil refinement	1 barrel of crude oil refinement	0.34-0.71	54-112.8
Production of steel & iron	1 ton of steel and iron	12.6	2003.3
Production of cement	1 ton of cement	13.4	2130.5

Table 1: Amount of water (in barrels and liters) used for the most common productions in Iraq^{7,8}

Iraq is Dreaming of a Stable Economy: Is a Profitable Oil Industry Enough?

Economically Iraq is heavily dependent on its oil and gas sector. Iraq's revenue from exports to global markets in 2023 constituted of 87.14% (\$90.194 billion) from crude oil and petroleum products and 12.86% (\$13.308 billion) from other exports.⁹ This is because Iraq is the second largest crude oil producer in the Organization of the Petroleum Exporting Countries (OPEC). Largely depending on its oil and gas sectors makes Iraqi economy fluctuate with oil global demand, price and political scene changes. For instance, the Iraqi annual budget in 2023 had a deficit of 32% because of politics involving Ceyhan port exports of crude oil from Kurdistan to Turkey.¹⁰ This large deficit would not be as substantial (\$49.506 billion) if there was diversification in the sources of revenue. Inducing a stable economy would entail Iraq to focus on its non-oil industries as well to decrease the amount of budget deficits and probability of an economic recession. An industrial sector that can support exports to foreign markets will stimulate economic growth by capturing global market shares, generating income, increasing employment rate, opening channels to global networks and knowledge transfer, increasing quality of life and reducing the risk of economic recession.

Concentration of Industrial Activities in Bazian District

Many industrial activities exist in the bigger radius around Bazian district residential area. Manufacturing, generating power, using transportation, powering buildings, production of iron, steel, cement, growing food in greenhouses and refining oil all exist in the Bazian district industrial zone. Greenhouse gas (GHG) emissions, including pollutants such as CH₄, CO₂, N₂O, SF₆ and water vapor are the by-products of these industrial activities.¹¹ Fine Particular matter (PM) pollutants in the air are also caused by emissions of dust from industrial factories and transportation.¹²

Why This Industrial Cluster in Bazian District?

This cluster of factories, power plants and refinery were constructed in this area due to the availability of natural raw materials, water resources, access to workforce, proximity to urban area and availability of roads. Not to mention the rising demand for electricity for Sulaymaniyah population, cement, iron and steel for the expansion of the city and greenhouses to provide produce all year round created the accumulation of these facilities in this area. What is concerning is their underground water usage that affects the integrity of the natural environment surrounding the area and the waste they deposit in the surrounding area. Water usage comes from the abundant underground water available in Bazian district and surrounding area. Underground water is the purer form of water compared to surface water; therefore, it is less costly to use as it does not require much filtration after its validity is confirmed for usage. Naturally, underground water is high in minerals. However, industrial chemical compounds could prove damaging to the environment and health of residents drinking the water.

The Effects Imposed by the Industrial District on Water Quality in the Area

Underground water is a useful and necessary component for industrial facilities besides natural resources occurrence in Bazian district. Therefore, depletion of underground water is a consequence of the existence and expansion of industrial activities in Bazian district.

Industrial Activity in Bazian District	Production (Full Capacity)	Water Usage for Full Capacity	Water Usage for Half of Capacity
Oil refinement	250,000 barrels/day	85,000-177,500 barrels/day	42,500-88,750 barrels/day
Production of steel and iron	4,706,000 ton/year	59,295,600 barrels/year	29,647,800 barrels/year
Production of cement	17,536,000 ton/year	234,982,400 barrels/year	117,491,200 barrels/year
Electrical power generation	2,500 MW/hour	61,500 barrels/hour	30,750 barrels/hour

Table 2: Water Usage full capacity production of industrial facilities in Bazian District ^{13 14}

Chemical Contaminations from Oil Refinement Found in Bazian Underground Water Affecting Water Quality

Oil refinery is very essential industry for Iraq as it is complementary to extracting crude oil as the crude oil needs to be refined to products such as gasoline and diesel. The oil refinery capacity of Iraq is 900,000 barrels per day. ^{15 16} Bazian Oil Refinery operated by Qaiwan Group has a capacity of 90,000 barrels per day and this represents 10% of Iraq's total refinery capacity. ¹⁷ The second most important industry besides crude oil production is the oil refinery industry. Iraq has a potential of exporting refined oil products such as gasoline and diesel and create additional revenue sources for the country.

Besides the large amount of water usage for oil refinement which is 47,250 barrels of water per day in Bazian (for the refinement of 90,000 barrels of oil per day). There's the risk of contamination here which might be spillage from the tankers that transport the refined oil

from the refinery .According to a study, conducted in the area surrounding Bazian Oil Refinery site, chemicals such as hydrocarbon compounds were found in the region's soil and groundwater. ¹⁸

Soil and Groundwater Contamination Hydrocarbon Compounds	
Benzene	
Toluene	
Trimethylbenzene	
Total Petroleum Hydrocarbons C ₁₀ -C ₁₅	

Table 3: Hydrocarbon compounds from petroleum found in the soil and underground water in the area surrounding Bazian Refinery site. ¹⁹

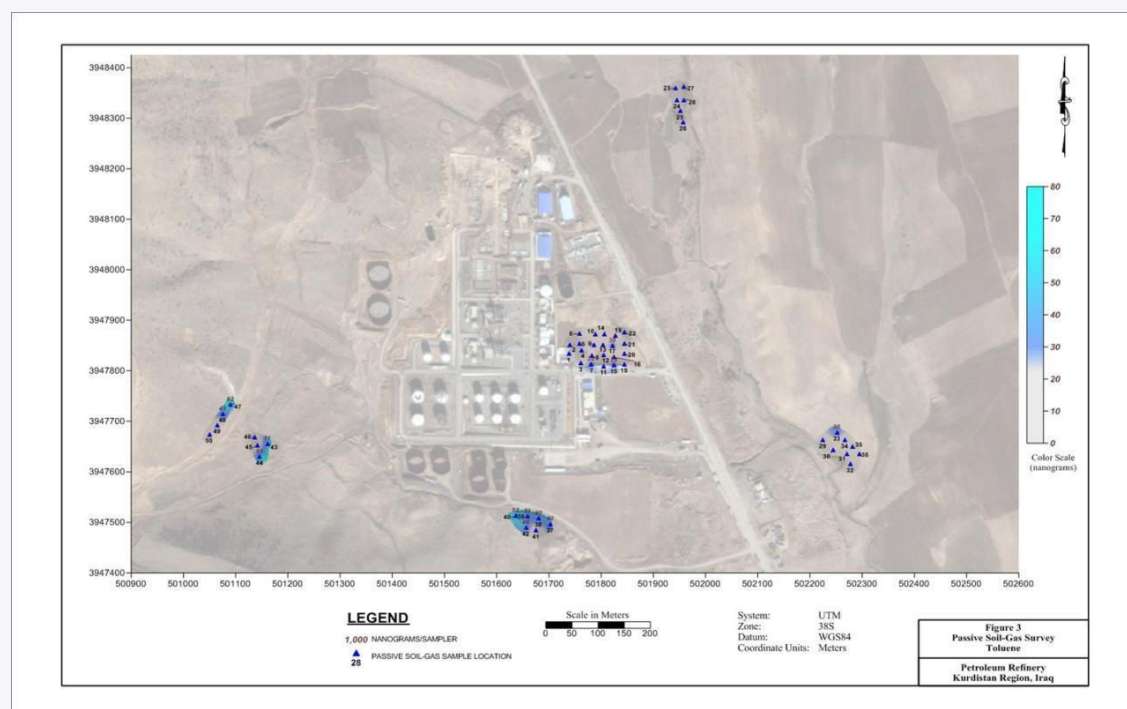


Image 3: Toluene concentration areas in soil and underground water around Bazian Refinery ²⁰

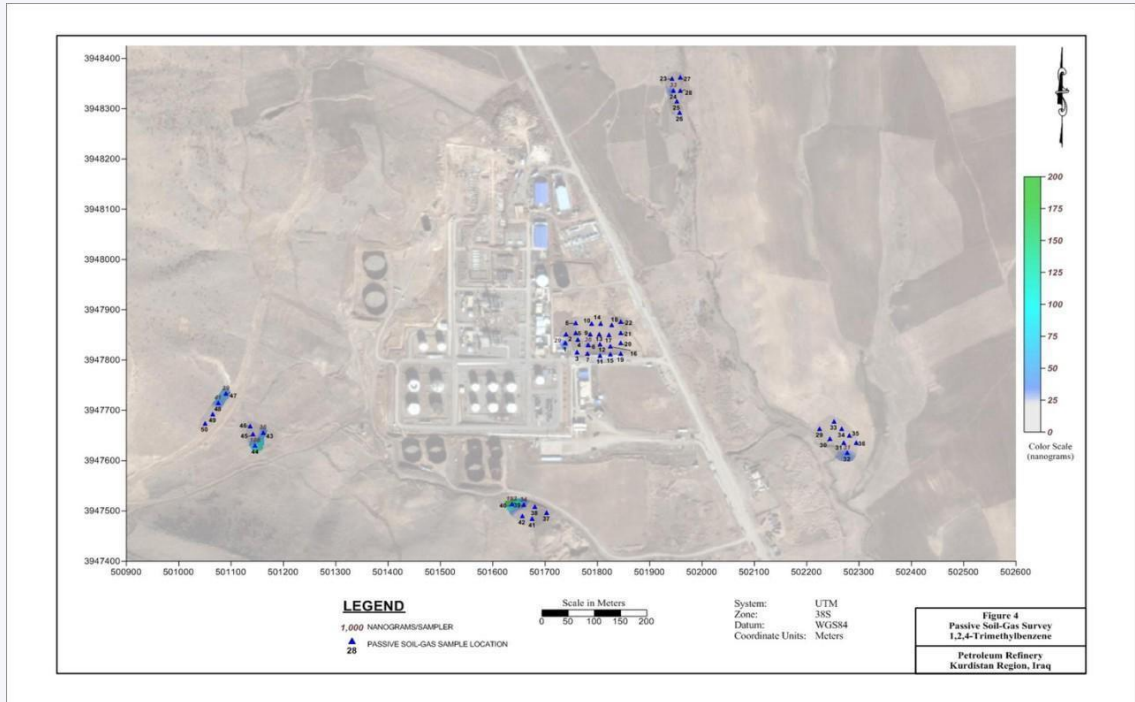


Image 4: Trimethylbenzene concentration areas in soil and underground water around Bazian Refinery ²¹

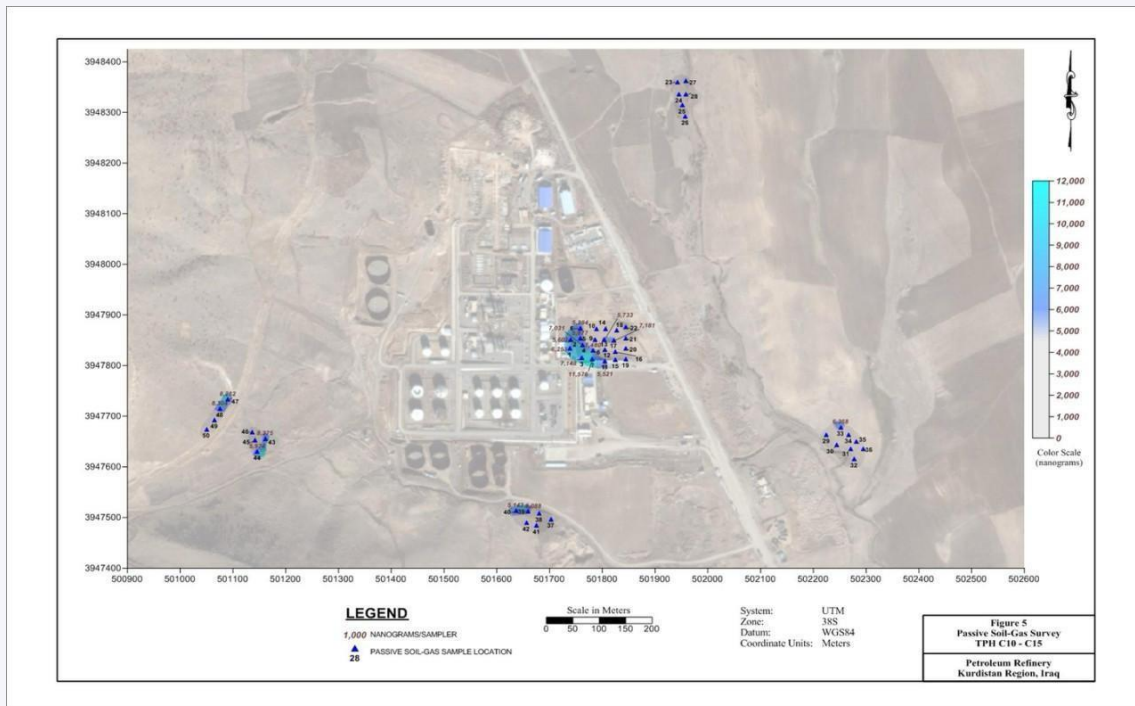


Image 5: TPH C₁₀-C₁₅ concentrations in soil and underground water around Bazian Refinery ²²

Merely the presence of petroleum hydrocarbons in the underground water near the Bazian Refinery site does not impose health risks. It however confirms the presence of foreign chemicals in the underground environment. If not treated or removed, these chemicals will spread over time with the underground water to nearby wells and eventually end up in the water supply sources of residential population and into drinking water. The health risks will begin instantly with exposure, be it for a short or long term. If a person is exposed to soil and contaminated water, duration of the exposure will determine its effects, depending on age, state of health, and the way of exposure (drinking or skin contact). Total Petroleum Hydrocarbon (TPH) compounds that originate from gasoline, particularly benzene and toluene can affect the human central nervous system.²³ In general, all hydrocarbon compounds have been confirmed by multiple studies that they have mutagenic (causes mutations in cells), teratogenic (disturbs normal fetal development and causes cognitive disabilities), and carcinogenic (has potential to cause cancer) characteristics.²⁴

The Effect of Industrial Activities on Air Quality and GHG Emissions in Bazian District:

Oil Refinement Oil refinery like crude oil extraction produces a large amount of GHG emissions. The process demonstrated below shows that crude oil is boiled to different boiling point producing different products starting from lighter products such as butane, gasoline blending components and naphtha and ending with heavy gas oil and residual fuel oil. At every stage GHG emissions are present and it is according to the kind of oil products produced. Most common GHG due to oil industries is Methane CH₄.

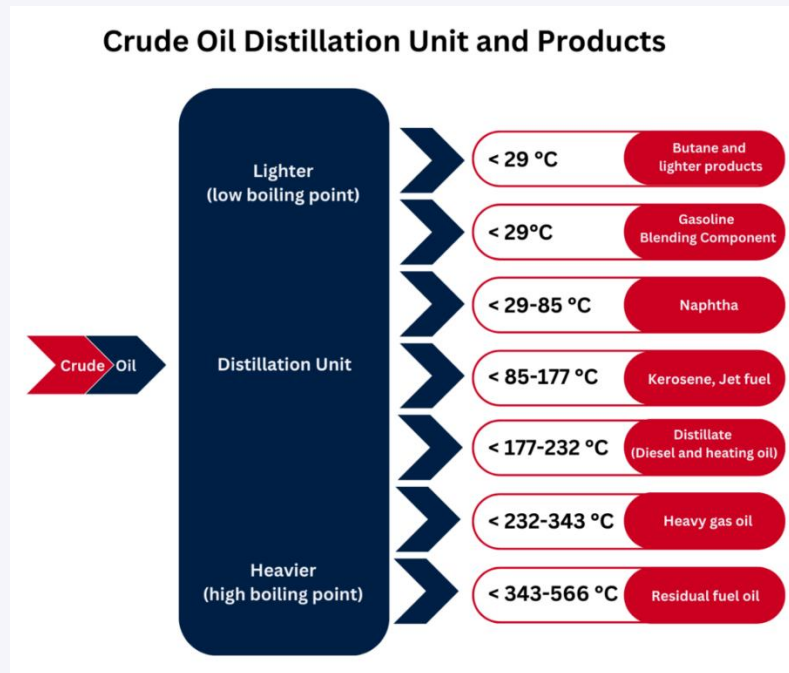


Chart 1: Crude Oil to Refined oil Products Process (Source: U.S. Energy Information Administration)

Cement Production in Bazian District

Cement production amount is high in the Bazian district, and it involves various processes in which dust, PM and precipitation is released into the air. Aside from its implication on the quality of the air around the large facilities, transporting and extracting its raw materials also disturbs the environment surrounding the facilities. The power generated for and used by the cement production facilities also contribute immensely and negatively to air quality.



Cement Production and Air Quality in Bazian District

According to a study conducted in the Sulaymaniyah city area in 2021, the rate of PM₁, PM_{2.5} and PM₁₀ in the atmosphere was measured.²⁵ PM particles have detrimental effects on human health and directly affect lungs and ability to breathe, especially in people with pre-existing lung and heart diseases.²⁶ Air pollutants are generally made up of water, mineral dust, organic materials, inorganic salts, trace elements and floating elemental carbons. Therefore, the World Health Organization (WHO) set limitations and guidelines for emissions from cities and its industrial areas to keep the air quality around us clean and safe to breathe.²⁷ The study conducted in Sulaymaniyah city and its surrounding area that also included Bazian district found that PM_{2.5} and PM₁₀ concentration levels in the air were higher than those standards set by the WHO. Among 12 different locations this study was conducted in, Bazian district proved to be second highest in Carbonate mineral contents and highest in acidity (pH) of atmospheric dust particles.²⁸

Atmospheric Dust Particles	Bazian District rank among 12 sites
PM ₁	9 th highest
PM _{2.5}	5 th highest
PM ₁₀	5 th highest
Electrical Conductivity (EC)	5 th highest
Acidity (pH)	Highest (1 st)
Carbonate mineral content	2 nd highest
Settable dust organic matter (OM) content	11 th highest

Table 4: Quality of Air of Bazian district compared to 11 other tested locations in Sulaymaniyah²⁹

The most prominent item on this table is the acidity (pH) of the dust particles which is associated with toxicity, it is the highest concentration among the 12 sites tested which were, Tanjaro, Wluba, Qrge, Destareke roundabout, Bakrajo, Ibrahimpasha, Salim Street (near Qaiwan Towers), Kilespy, Salim Street (near Hajy Hassan Mosque), Civil Development

Organization (adjacent to Azadi Park), Qanat Street, Sarchnar, Bazian and Hawary Shar park.³⁰

Cement Production and GHG Emission

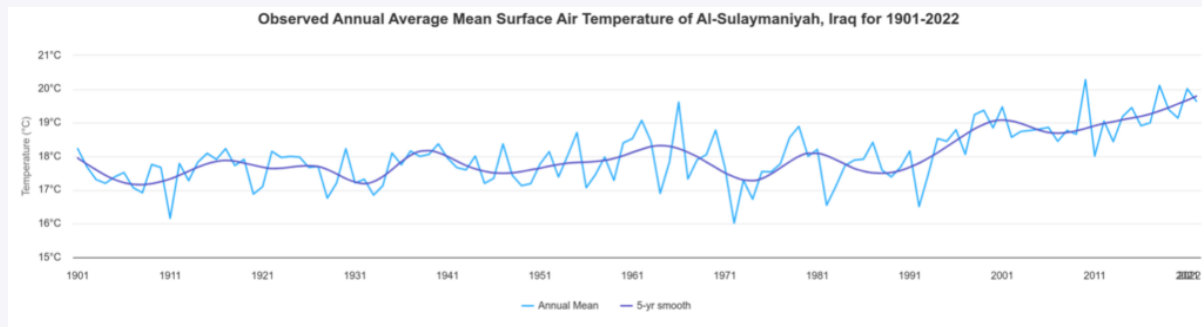
Cement production globally contributes to 9% of global GHG emissions. Carbon Dioxide CO₂ is the by-product produced by chemical reactions involved in the process and for every 1 kilogram of cement, 1 kilogram of CO₂ is released into the atmosphere.³¹

Cement Company	Annual Full Production Capacity (tons)	Annual Water Usage (barrels)
Delta Cement	2,000,000	26,800,000
Tasluja Cement	2,336,000	31,302,400
Gasim Cement	2,150,000	28,810,000
Bazian Cement	2,550,000	34,170,000
Mass Cement	6,000,000	80,400,000
Lafarge Cement	2,500,000	33,500,000
Kar Cement	-	-
Total	17,536,000	234,982,400

Table 5: Water quantity needed for cement production in Bazian district ^{32 33}

Temperature Change Trends in Sulaymaniyah City

Sulaymaniyah climate has been changing since the beginning of last century. A big contributing factor to its climate change is the concentration of industrial activities in the area. As the annual average air temperature continues to rise, it becomes even more difficult to dial back to normal average temperatures.



Graph 1: Temperature Trend in the last 100 years in Sulaymaniyah (Source: World Bank)

Research Limitations

Two main issues arise in terms of availability of data in the Iraqi Kurdistan Region. First, the governmental infrastructures shift to digital platforms is delayed, especially in terms of data collection. Much of the data is in the form of physical copies. Second, the governmental agencies and ministries have a culture of unwillingness to share their data. During the process of writing this paper, there were multiple requests for data related to tracking natural water resources in Sulaymaniyah Governorate, however, all requests were denied. This makes the research about current climate change in the Iraqi Kurdistan region difficult, which makes policy forming in response to these current developments also difficult and untimely. Another example is the tracking of GHG emissions rates. Factories operating in Sulaymaniyah Governorate as far as we know do not submit annual or quarterly reports about their GHG emission rates. This kind of information is important for mapping out the percentage contribution of industries to GHG emission. The lack of such data or reluctance to share them decreases the public's visibility on the pollution rates and the environmental and health issues related to them.

What are greenhouse gases GHGs?

Greenhouse gases have the property of absorbing infrared radiation (net heat energy) emitted from Earth's surface and reradiating it back to Earth's surface thus creating greenhouse gas effect. Among the common GHGs are CH₄, CO₂, N₂O, SF₆, water vapor (precipitations), surface -level O₃ Ozone, fluorinated gases (F-gases).³⁴

What is an Air Quality Index?

The Air Quality Index (AQI) is a simplified index to measure and show the cleanliness of the air we breathe. This index is color coded: (1-50) as "**good**", (51-100) as "**moderate**", (101-150) as "**unhealthy for sensitive groups**", (151-200) as "**unhealthy**", (201-300) as "**very unhealthy**" and (301-500) as "**hazardous**", and it includes pollutants such as fine particles or Particulate Matter (PM), ground-level ozone (O₃), carbon monoxide (CO), sulfur dioxide (SO₂) and nitrogen dioxide (NO₂). Note that PM₁, PM_{2.5} and PM₁₀ References to fine particle of any kind (usually a mixture of aerosols and solids) with a diameter less than 1, 2.5 and 10 micrometers (μm) respectively. These pollutants are measured in volume measurement of micrograms per cubic meter (μg/m³) in air.^{35 36} A high air quality index (AQI) can have a serious effect on the heart, lungs and the overall population's breathing ability on top of many other health and environmental issues they cause. PM particles stay for days to months in the air, but eventually they are forced to land on the surface of the earth.³⁷

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ABOUT

Nestled in the mountains of Sulaymaniyah, the Culture Capital of KRI, iNNOV8 Research Center pioneers cutting-edge research and innovation. We aspire for excellence as an independent research center by providing valid, valuable, and timely products to the public. We deliver impactful solutions and contribute to our industry's vibrant and forward-thinking community. As an affiliate of CHANNEL8 Media Corporation, iNNOV8 also serves as the in-house research and public relations hub for the channel.

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