

Environmental Issues in Erbil City

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Abstract -- Erbil city is facing environmental problems such as Wastewater treatment, Water supply, Land preservation, Air pollution, Noise pollution, Pollution due to the huge increase of the numbers of vehicles, as well as the big increase of public generators which work in every edge of the city.

Political instability and tension between the Iraqi federal and regional governments due to power sharing and application of the constitution are major contributors to the delay in solving these environmental problems.

This research will deal with these environmental issues. Although these problems are causing serious health concerns for the inhabitants, they can sometimes, in the worst scenarios, lead to death, due to the lack of interest of the authorities to solve these kind of issues. The research sheds light on some of the causes and effects of the environmental problems and also draws conclusions and makes suggestions for reducing their impact on the environment.

Extensive statistics and studies were performed to outline the environmental effects of the following sources of pollution with emphasis on dealing with the issue qualitatively and quantitatively.

I- Pollution due to increasing numbers of vehicles in Erbil city, indicating an increase in the volume of traffic by an amount of 10.87 times over a period of 6 years between (2006 - 2011). This has resulted in the emission of huge quantities of CO₂ in comparison to the other pollutants, whereby the total daily emission of CO₂ reached a staggering figure of 2813 tons in 2011. Our research has also indicated an increase in the amounts of other pollutants by the following multifold rates:

- 10.0 times for CO, whereby the total daily amount reached 163.68 tons in 2011.
- 10.1 times for HC, whereby the total daily amount reached 19.38 tons in 2011.
- 10.4 times for NO_x, whereby the total daily amount reached 12.94 tons in 2011.
- 11.8 times for mass particulates, whereby the total daily amount reached 1.311 tons in 2011.
- 11.0 times for CO₂, whereby the total daily amount reached 2813 tons in 2011.

II- Pollution due to increasing numbers of power generators in Erbil, indicating an increase in the number of used generators by 76.1 % over a period of 10 years between (2003 - 2012), whereby the number of used generators climbed from 1458 in 2003 to 2568 in 2012. This was accompanied by an increase in the amounts of emitted pollutants as in the following percentages:

- 76.3 % for CO₂, whereby the total annual amount reached 1024 tons in 2012.
- 75.7 % for NO_x, whereby the total annual amount reached 181 tons in 2012.
- 78.4 % for SO₂, whereby the total annual amount reached 91 tons in 2012.

Some conclusions were drawn and adequate recommendations were made.

Keywords-- Toxic gases, Water supply, Land preservation, Noise pollution und Air pollution, Pollutants, Environmental issues, Emission.

I. INTRODUCTION

Erbil Governorate is the capital city of Kurdistan region. It has witnessed a big increase in its population. That was accompanied by a huge development in various fields which made it a focus of many international companies and investors which were encouraged to come to Erbil and establish their bases there, something which made Erbil a market and commercial center for the whole of Iraq.

Erbil Governorate and Kurdistan region have never experienced peace and security over a long time. The long lasting conflict between the region and different central governments has never left time for real development and advancement in the region of Kurdistan in general and in Erbil Governorate particularly. This picture has changed after 1991, whereby peace and stability, together with the end of all military operations have given the chance for some development and set pace for progress and advancement, especially after the formation of the KRG (Kurdistan Regional Government). Visits to Erbil and making a comparison with the situation before 1991 left the impression that vast changes have happened, especially in the fields of buildings, transportation, main roads, industry and communication. We also noticed that the number of population has grown dramatically. Some of the developments in certain fields have left negative side effects on the environment which hasn't been given the relevant and necessary attention.

We believe that understanding the impact of environmental issues is still not fully recognized and it needs a lot of work and follow-up.

II. WASTEWATER TREATMENT

Erbil is the capital of the Kurdistan region and the seat of the KRG. The present population of Erbil is around 1.7 million. Although this figure cannot be viewed as accurate as the last census for Kurdistan which took place in 2009¹. Like much of Iraq, currently only a small fraction of Erbil's population is served by wastewater treatment facilities, as the city lacks a functioning sewage and wastewater treatment system, as shown in (Figure 1).

To address these matters, the KRG has launched a comprehensive project, which incorporates the design and the construction of a complete sewage system as well as the design and the construction of a new wastewater treatment plan (WWTP). The total budget for the project is currently planned to be approximately \$750 million, and takes into account the projected growth of the city by the year 2022 (when Erbil is projected to have a population in excess of 2.5 million people). However, given the magnitude of the problem facing Erbil, and the KRG's determination to implement a comprehensive and long-term solution to the problem, actual project costs could increase significantly.

The construction of the (WWTP) to allow an acceptable waste-water quality, to be diluted with surface water, and enable unrestricted irrigation practices in the surrounding areas (adequate treatments will disinfect treated effluents for suitable irrigation purposes under various irrigation schemes).

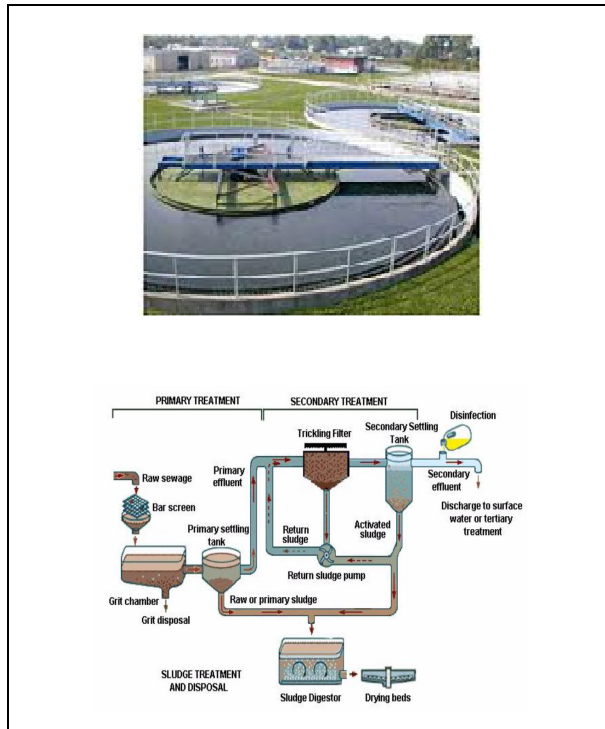


Fig. 1 Sewage primary settling tank and water treatment process.

III. WATER SUPPLY

The water supply in Erbil is currently plagued by problems such as leaks in the municipal distribution network, which means that not all drinking water can be utilised. Sweco², as one of the Swedish companies has been chosen by the authorities to assist preparing a business plan and an operating and maintenance plan to address the issue.

The network includes transmission and distribution lines. About 30% of the network is old and in such a bad state that it has to be replaced. Some pipes are made from asbestos cement and should be replaced due to this reason. The network is partly inadequately designed (too narrow pipes), leading to increasing pressure drop and reduced pressure and flow. Reasons for this "engineering misbehavior" are mainly the lack of proper design and planning. This in turn is caused by lack of management skills. The problems have led to the fact that many consumers and households have installed their own booster pumps, connected to the distribution pipe, for pumping to their storage tanks. This in turn leads to further pressure decrease in the system.

IV. LAND PRESERVATION

Earth is a very important part of our lives. Most of us would not think of polluting our bodies, yet we are polluting our planet by misuse and overuse of our natural resources. As responsible individuals we should at least do what we can to help reduce, reuse, and recycle what we can as a first step. We are not completely to blame, we inherited a polluted Earth, but we can do something to ensure that our children can grow up in a cleaner, safer planet than ourselves. Do not ever let someone get away with saying "what can I do? I am only one person". Each and every person can do a lot, and we can influence others to do something as well.

V. AIR POLLUTION

There is no doubt that air pollution is detrimental to health, especially to the respiratory system. A dramatic example of the health effects of air pollution is London smog of December 1952 when 4000 people were recorded dead in one day. In addition to Asthma, air pollution can result in chronic illness and even premature death. For example Carbon Monoxide as an invisible gas produced by incomplete combustion of carbon-based fuels is a major air pollutant. It damages the oxygen carrying capacity of the blood and affects the nervous system.

The major man made source of nitrogen oxides (NO_x) comes from the combustion of fuels and road vehicles. Nitrogen dioxide (NO₂) is highly toxic and causes throat and eye irritation, it is also found to cause respiratory illness in children. In the presence of sunlight, nitrogen oxides react photo chemically with hydrocarbons from vehicle emissions to produce ozone (O₃). Ozone is an unstable oxygen molecule and a strong oxidising agent. According to the WHO, even

⁽¹⁾ According to KRG statistics in year 2009.

⁽²⁾ www.swecogroup.com

low concentration of ozone in the atmosphere can cause eye, nose and throat irritation, chest discomfort, cough and headache. People who suffer from bronchitis or asthma are particularly at risk.

Volatile organic compounds (VOC) are substances which evaporate easily. They are capable of producing photochemical oxidants as a result of reaction with oxides of nitrogen in the presence of sunlight; some are toxic or carcinogenic. They are present in exhaust fumes, cigarettes, synthetic materials, household chemicals, benzene and polycyclic aromatic hydrocarbons (PAH).

Other pollutants such as sulfur dioxide (SO₂) and particulate matter (PM) are harmful air contaminant, detrimental to human health. A pollutant such as lead is a neurotoxin and it affects the central nervous system. The primary source of lead in air is car exhaust.

The quality of light, air, water and soil is fundamental in determining the health of humans, plants and animals; all these essentials can be seriously affected by air pollution which in turn affects their functions.

VII. NOISE POLLUTION

Noise is a prominent feature of the environmental pollution including noise from transport, industry and neighbours. Exposure to transport noise disturbs sleep. Noise results in complex task performance, affects social behaviour and causes annoyance. Studies of occupational and environmental noise exposure suggest an association with hypertension, whereas community studies show only weak relationships between noise and cardiovascular disease. Aircraft and road traffic noise exposure are associated with psychological symptoms but not with clinically defined psychiatric disorder. In both industrial studies and community studies, noise exposure is related to raised catecholamine secretion. In children, chronic aircraft noise exposure impairs reading comprehension and long-term memory and may be associated with raised blood pressure. Further research is needed examining coping strategies and the possible health consequences of adaptation to noise.

Exposure to continuous noise of 85–90 dB, particularly over a lifetime in industrial settings, can lead to a progressive loss of hearing, with an increase in the threshold of hearing sensitivity³. Hearing impairments due to noise are a direct consequence of the effects of sound energy on the inner ear. However, the levels of environmental noise, as opposed to industrial noise, are much lower and effects on non-auditory health cannot be explained as a consequence of sound energy. If noise does cause ill-health other than hearing impairment, what might be the mechanism? It is generally believed that noise disturbs activities and communication, causing annoyance. In some cases, annoyance may lead to stress responses, then symptoms and possibly illness⁴. Alternatively, noise may influence health directly and not through annoyance. The response to noise may depend on

characteristics of the sound, including intensity, frequency, and complexity of sound, duration and the means of the noise.

VI. POLLUTION DUE TO AUTOMOBILES

Erbil city witnessed a rapid increase in the number of automobiles. Our team has conducted an intensive statistical survey of the automobiles in Erbil. Our data source was the General Directorate of Traffic Police –Erbil. The recorded increase in the traffic volume has resulted in an increased amount of pollution as outlined below:

TABLE 1
ACCUMULATED ERBIL AUTOMOBILE PROFILE.

Types of Cars	2006	2007	2008	2009	2010	2011
Private	29845	62034	98323	132309	183034	241907
Taxi	6464	12163	18056	25739	35135	79036
Trucks	5651	12086	24893	39173	64737	122902
Motorcycles	1	474	4354	6504	8359	9549
Agricultural	26	47	149	647	1097	1675
Construction	164	206	623	1380	2074	3167
Total	42151	87010	146398	205752	294436	458235

TABLE 2
ACCUMULATED ERBIL VEHICLES PROFILE CLASSIFIED ACCORDING TO FUEL TYPE.

Types of Vehicles	2006	2007	2008	2009	2010	2011
Gasoline Vehicles	39136	80714	133180	184139	258897	391943
Gasoil Vehicles	3016	6296	13219	21614	35540	66293

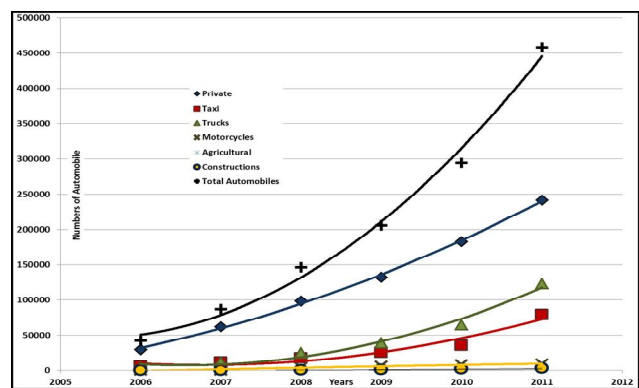


Fig. 2 Rate of increasing numbers of different types of automobiles in Erbil during the period from 2006 – 2011

⁽³⁾ Kryter KD. The Effects of Noise on Man, 2nd edn. Orlando, FL: Academic Press (1985).

⁽⁴⁾ Van Dijk FJH, Souman AM, de Vries FF. Non-auditory effects of noise in industry. VI. A final field study in industry.

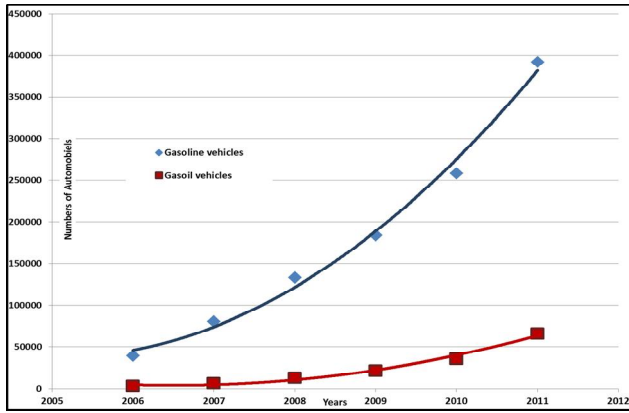


Fig. 3 Rate of increasing numbers of automobiles classified according to fuel type in Erbil during the period from 2006 – 2011

TABLE 3
EMISSION STANDARDS FOR GASOLINE AND GASOIL VEHICLES IN GM/KM.

Types of Cars	CO	HC	NO _x	CO ₂	Mass Particulate (Pm)
Gasoline Cars	27.7	3.24	2.04	399	0
Diesel Passenger Cars	0.83	0.27	0.9	403	2.46
Diesel Light Commercial Vehicles	0.94	0.39	1.01	537	2.46

Note: For diesel cars, assumed average between the two limits.

Assumption: Average Distance traveled for Gasoline and Diesel Cars is 15 Km daily.

This Assumption is based on personal statistics.

To calculate the daily amount of CO pollution for example = ((Number of gasoline automobile × 15 km/day) × (27.7/10⁶)) + ((Number of diesel automobile × 15 Km/day) × (((0.83+0.94)/2)/10⁶)) ton CO pollutants.

So to calculate CO pollution in 2011 = ((391943 × 15) × (27.7/10⁶)) + ((66293 × 15) × (0.885 /10⁶)) = 162.8 + 0.88 = 163.68 ton/day.

Similarly, the calculations for all daily pollutants were done as below:

TABLE 4
DAILY EMISSION OF VARIOUS POLLUTANTS IN ERBIL

Years	CO (ton)	HC (ton)	NO _x (ton)	CO ₂ (ton)	Mass Particulate (Pm) (ton)
2006	16.30	1.92	1.24	255	0.111
2007	33.62	3.95	2.56	527	0.232
2008	55.51	6.54	4.26	890	0.488
2009	76.80	9.06	5.94	1254	0.798
2010	108.04	12.76	8.43	1800	0.798
2011	163.68	19.38	12.94	2813	1.311

These data were represented graphically as shown below to clarify the multifold increase of the rates of pollution. The data for CO₂ emission was graphically represented separately from other pollutants due to its exceedingly high values compared with other pollutants.

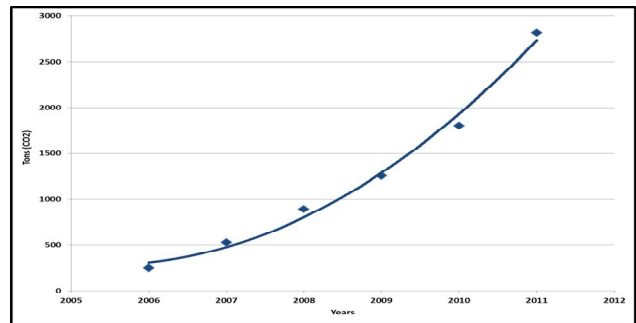


Fig. 4 Rate of increase of CO₂ gases emitted from different Automobile types in Erbil.

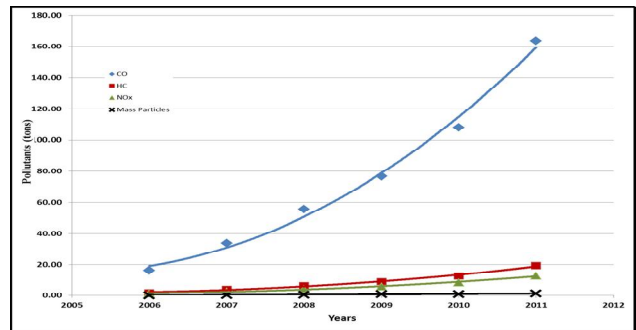


Fig. 5 Rate of increase of pollutants (without CO₂) emitted from different Automobile types in Erbil.

VIII. POLLUTANTS DUE TO POWER GENERATORS

The following table and figure show clearly the increase in the pollutants produced by power generators over the years

from (2003-2012). This was based on a comprehensive statistical survey which was performed by our team in different districts of Erbil city. It is shown from the table the produced power in KVA and Megawatt for different sectors, as well as the amount of emitted pollutants in Kg have been calculated according to the assumptions and conversion factors below.

Assumed average capacity/generator = 500 KVA (one Megawatt = 1000 KVA)

From references: GAO-12-545R Air Emissions and Electricity Generation at U.S. Power Plants, Page 28, standard pollutants emitted from power generators shown in table (5) as follows:

TABLE 5
US STANDARD POLLUTANTS EMITTED FROM ELECTRICITY POWER GENERATORS.

Pollutants	Data for year 2000 (lb/Mwatt.hr)*	Pollutants (kg/Mwatt.hr)
CO ₂	1.016	0.55
NO _x	0.18	0.10
SO ₂	0.09	0.05

*Note: The data of year 2000 were chosen being compatible with the available generators in Erbil.

A detailed survey for electricity power generators in Erbil governorate had been done; table (6) shows the number, locations of these generators.

TABLE 6
NUMBER, LOCATIONS AND POWER PRODUCED FROM GENERATORS IN ERBIL CITY.

Years	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Districts	672	704	725	763	795	840	882	920	1005	1222
Civil	658	740	771	806	842	874	905	946	995	1035
Hotels	26	30	35	42	50	56	62	73	85	100
Government Department	42	44	48	52	58	64	68	71	75	80
Restaurants	30	34	37	41	48	52	57	60	64	70
Hospitals	8	8	8	9	11	13	15	17	20	22
Banks	7	7	8	8	9	11	13	15	18	20
Colleges	13	13	13	13	13	13	13	13	13	15
Malls	2	3	3	4	4	4	5	5	5	6
SUM of No. Generators	1458	1583	1648	1738	1830	1927	2020	2120	2280	2568
Power produced in thousands KVA. Hr	729	792	824	869	915	964	1,010	1,060	1,140	1,284
Power Produced in Mwatt. hr	729	792	824	869	915	964	1,010	1,060	1,140	1,284

Assumption: Number of working hours per day is 4 hrs for 360 days per year.

TABLE 7
CALCULATED POWER GENERATED AND EMITTED POLLUTANTS IN TON PER YEAR.

Year	No of Generator	Power Produced in Mwatt. hr	CO ₂ (ton)	NO _x (ton)	SO ₂ (ton)
2003	1458	729	581	103	51
2004	1583	792	631	112	56
2005	1648	824	657	116	58
2006	1738	869	693	123	61
2007	1830	915	730	129	65
2008	1927	964	768	136	68
2009	2020	1,010	805	143	71
2010	2120	1,060	845	150	75
2011	2280	1,140	909	161	81
2012	2568	1,284	1024	181	91

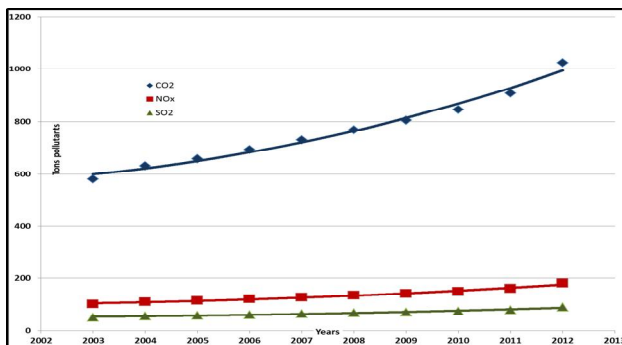


Fig 6 Rate of increase of pollutants emission from public generators in Erbil.

IX. CONCLUSIONS

To Protect Human and Environment, we must take the following matters in consideration:

- 9.1. Due to the improvement of communications and use of satellite in particular, we believe that high percentage of general public in Erbil are aware of environmental issues but unfortunately their opinions are not decisive.
- 9.2. Our main problem is not the lack of knowledge, but rather the lack of or outdated elements of infrastructure. It's also hard for us to attend

international conferences, which is vital for keeping up to date on the latest developments in scientific technology which is related to the environment and environmental protection.

- 9.3. Clean water through proper purification plants for groundwater leads to better health and improved quality of life.
- 9.4. The study has shown a rapid increase in the number of Vehicles by more than 10 times during a period of 6 years (2006-2011). See Tables -1, -2, Figures 2 and 3.
- 9.5. This increase in the numbers of vehicles has resulted in the emission of huge quantities of CO₂ in comparison to the other pollutants, whereby the total daily emission of CO₂ reached a staggering figure of 2813 tons in 2011. Our research has also indicated an increase in the amounts of other pollutants by the following multifold rates:
 - 10.0 times for CO, whereby the total daily amount reached 163.68 tons in 2011.
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See Table (4) and Figures 4 and 5.

- 9.6. Pollution due to increasing numbers of power generators in Erbil, indicating an increase in the number of used generators by 76.1 % over a period of 10 years between (2003 - 2012), whereby the number of used generators climbed from 1458 in 2003 to 2568 in 2012. This was accompanied by an increase in the amounts of emitted pollutants as in the following percentages:
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X. RECOMMENDATIONS

1. The Ministry of Environment in Erbil must establish offices to deal with environmental issues. Their main task

will be to record, collate and analyse data on the environment; drawing up expert and management reports.

2. A further aim, and an important one is to develop ways to harmonize relations with other entities such as ministries, universities, local municipalities, hospitals..., and to increase cooperation and coordination of efforts to combat the environmental problems.
3. On the basis of what was mentioned above, the council of ministers and the parliament have to adopt an action; let us call it (*First Step to better Environment*). This programme has to set out goals and objectives, legislation and regulations and defined principles, such as prevention is better than cure. It must also stress on the need for all the sectors of the community, government, industry and citizens to become involved and to take responsibility for the protection of their environment. Initially three areas require major effort and they have to be targeted. These are transport, agriculture and industry. Within each of these target areas the programme has to identify number of objectives aiming for sustainable development. After objectives and targets are set and programme is proposed, environmental issues have to be highlighted such as air and water quality, urban environment, waste management, climate change, protection of nature and management of water resources.
4. Increasing the green areas around and inside Erbil city in order to improve the environment.

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