Environmental assessment of land use in the city of Samawah using spatial techniques

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Abstract. The city of Samawah is one of the most important cities which emerged in the poverty area within the poverty map produced by the Ministry of Planning, despite being an important provincial centre. Although it has great development potentials, it was neglected for more than 50 years,. This dereliction has caused a series of negative accumulations at the urban levels (environmental, social and economic). Therefore, the basic idea of this research is to detect part of these challenges that are preventing growth and development of the city. The methodology of the research is to extrapolate the reality with the analysis of the results, data and environmental impact assessment of the projects using the methods of spatial analysis and modelling provided by different spatial techniques. The environmental side was chosen because it is the most sensitive aspect in terms of its impact and its impact on the development side, also on the stability of the population in any city. All environmental and urban elements that are affected by human activities and natural factors and their spatial distribution in the city and its environs will be identified, and analysis of the mutual influences between the environmental elements and the urban land uses of the city will be done. The main results and conclusions are: preserve the green areas within the city and not expand in its direction, develop the sewage system and develop sewage treatment plant especially for the small part of the city to end the discharge of sewage to the river, transferring the gas station outside the city border as it is adjacent to the residential neighbourhoods and adopting a technology friendly to the environment in its establishment.

1. The concept of environmental pollution

The scientific concept of environmental pollution is primarily related to the ecosystem; the efficiency of this system is greatly reduced and is completely paralyzed when there is a change in the harmonic movement between the different elements [1]. The quantitative or qualitative change in the composition of the elements of this system leads to the imbalance in this system. Environmental pollution works to add an element that does not exist in the ecosystem, or it increases or reduces the presence of one of its elements in such a way that the ecosystem cannot accept this, and then leads to disruption of this system [2].

2. Environmental impact assessment

When the work presented has significant environmental effects, the environmental impact assessment (EIA) will be carried out on the work presented with possible alternatives. The important results of the EIA process are development of new alternatives that can reduce environmental effects.
Environmental impact assessment is the systematic examination of the environmental impacts of a development project or program, with a view to reducing or mitigating adverse effects and maximizing positive effects [3]. The process of assessing the environmental impact of any project depends primarily on the extent of the environmental impact or lack of activity. An environmental assessment process is used to identify environmental impacts (positive or negative) and to analyse these effects in order to reach the most important environmental impacts, with their impact on the work environment and environment.

3. Evaluate the environmental impact of environmentally critical areas in the master plan

Class A: Have significant negative environmental impacts on vulnerable organisms or affect cultural heritage sites or large areas beyond work sites.

Class B: Projects that have negative environmental impacts that are not reversible to living organisms and belong to a particular location. These projects are determined based on the activities, quantity of production and the size of the project; we notice through the study of the food industry impact, in general, within this list.

Class C: Projects with or without adverse environmental impacts. This list includes projects that may be approved without detailed studies [4].

4. Case study location

Geography: The city of Samawah is located within the sedimentary plain on its western edge. The city occupies an intrusive position that is in the middle of the sedimentary plain and the western desert plateau. It is thus an important centre for commercial exchange. The city also has a river located on both sides of the Euphrates River.

Dust storms are the most important natural elements of air pollution in the city of Samawah, which blows throughout the months of the year with varying rates rising in the summer and spring and its output from the desert areas located to the west and southwest of the province as well as neighbouring countries [5].

5. Main city function

Residential land uses: The residential function is one of the basic functions that share with the other urban uses in controlling the area of urban space, see figure (1). This represents more space than the area of the urban area with 30-40% of the total land area in cities. Land use in the city, which was calculated by the Directorate of Urban Planning in Muthanna area, is (5,614) hectares and the area of residential use therein is (1,700) hectares which is equivalent to (30.28%) of the total area of land uses [6].
Figure 1. Residential land use in the city

5.1 Samawah Cement Plant
It is located at (1) km from the city centre and 100 m from the nearest residential neighbourhood adjacent to the plant. Built by TECHNOSTROY EXPORT, a Russian company, the company constructs one oven. This plant works in a wet way, its design capacity is 1500 tons per day and the production capacity reached to (400) thousand tons for the year (2008). It works on 230 ton/day of black oil, table (1) shows air pollution resources.

| source     | Type of pollutions                                                                 |
|------------|------------------------------------------------------------------------------------|
| Natural sources | Dust, dust storms, and desertification resulting from lack of rain and vegetation |
| Human sources | Fixed sources Combustion, used oil, gas and other fuels such as the random combustion of waste and the labs working in black oil |
|            | Producing non-combustible gases, particles and solid pollutants without combustion, thereby escalating news from oil derivatives depots in refineries, gas stations, mills and cement dust. |
|            | Moving sources All means of transport working with liquid and gas fuels within the transport sector |

Source: the researchers

5.2 Gaseous pollutants
Dust breakers from all production stages (primary milling, secondary milling, packing phase) of the product and precipitated clinker minutes with combustion gases, especially since most of the cement plants in Iraq use black oil as fuel as shown in Figure 2. These gases are oxides of nitrogen, sulphur oxides, carbon dioxide, carbon monoxide, unburned hydrocarbons, non-reactivated oxygen and other dangerous combustion products.

5.3 Solid pollutants
Main cause is dust resulting from most operations. The greatest increase in dust was through the
furnace chimney and the most dangerous was through an alkaline dust chimney.

5.4 Environmental Impact of Cement Plant
The Plant lacks the presence of filters which causes the release of large quantities of residues, namely
carbon oxides, sulphur and nitrogen. Secondly, the dust from the plant contains metal residues such as
barium, lead, calcium and sodium and also contains cadmium, zinc and residues of parts of mercury. It
affects the population directly, especially with the direction of the south, eastern, and south-east wind.
This leads to the accumulation of these substances in the atmosphere of the city and its descent to the
ground causes serious health diseases affecting local population especially with respiratory diseases.
Plant and agricultural products that a person deals with are also contaminated by the impact of gases
and dust from the plant and it not only affects the city of Samawah, but also includes villages under
the prevailing winds. From other side, noise caused by the industry to its employees and to the
adjacent residential and urban areas, see figure (3) that clarifies location of industrial services related
to the city.

Also from figure (4) we can notice the rates of respiratory diseases in the city of Samawah and its
concentration in the neighbourhoods near the Plant. The most important diseases that have been
observed are allergic rhinitis, dyspnoea and eye infections.

5.5 The impact of the plant on the agricultural land in the city

The decrease in the productivity of agricultural land is an essential indicator of the economic effects of
pollutants from the plant. These pollutants affect the loss of soil’s fertility of ion exchange and its
ability to permeate thus decreasing its fertility and suitability for agriculture.
The map shows the effect of the Plant on the decline of the fertility of the agricultural land in the city as a result of the cement plant and the low productivity as a result of pollutants and dust. The agricultural land was cultivated with various vegetable crops and palm trees, but it began to decline due to the effects of dust from the Southern Cement Plant, where there are indirect effects of air pollutants on plants by making them more vulnerable to attack by insects. So, in one of the affected villages, the area of agricultural land damaged by pollutants from the factory amounted to more than 25 (hectare). In addition, the Plant has other negative economic effects on nearby lands, where the remnants of the Plant and the rubble are thrown in the lands behind the Plant. These lands are originally agricultural land with an area of more than 45 (hectare), owned by the residents, causing great economic losses.

![Figure 3. Health damage to the plant](image)

![Figure 4. Distribution of respiratory diseases and Spread of pollutants on agricultural land](image)
5.6 Thermal power plant
This station was established in 2005 with capacity of 60 MW with the funding of foreign organizations without obtaining environmental approvals in time, it is occurring polluted activates from class A. It does not comply with rules about environmental conditions which stipulate that these stations should be located outside the border of the Master plan at a calculated distance based on the safe limits of gases and other air pollutants. This distance is estimated at 8 km in the prevailing wind direction and 6 km in other directions.

5.7 Power network and plants
Some of the most important contaminants present in the atmosphere are thermal oxides, sulphur oxides, carbon oxides, nitrogen oxides, hydrogen sulphide gas, hydrocarbons, suspended particles and heavy elements with heat. About 10-15% of the remaining heat is generated by the generation of electricity through gases from chimney. Also noise from the station resulting from the operation of the plant for the purpose of generating electricity, the water left by the cooling process that is disposed of indirectly to sewerage system, the industrial water left from the generation processes that are disposed of to the public sewerage system, and disposal to the public sewerage system. High pressure lines passing adjacent to residential neighbourhoods pose a danger to the health of the inhabitants where the electromagnetic field lines are generated that affect human health, see figure (5).

![Figure 5. Power network](image)

6. Industrial Area in Samawah City
It is located to the south of the city of Samawah and includes more than 350 different Plants ranging from flooring brick, Block and Blacksmith, also to 250 car repair and painting workshops. Located within the boundaries of the Master Plan and only 500 meters from the nearest residential neighbourhood (Al-Aalam neighbourhood - Al-Muthanna district - Prince's neighbourhood). It is a major source of pollutants such as smoke, dust and noise, and the cause of traffic congestion in the city.
and visual pollution of the southern entrance. Solid waste and scrap produced from workshop work and not processed by the right way, pollution of soil with waste oils and chemicals for cars and others.

**7. Industrial activities outside Master Plan that affect the environment of the city of Samawah**

*a. Central refinery south of the city of Samawah*

It is located about 12 km south of the city. It produces large amounts of pollutants estimated at 1000 m³ per day of carbon monoxide and nitrogen oxides and others that affect the city sometimes according to the direction of the wind.

*b. Brick plants*

It is estimated at 42 plants and is situated at a distance of 14-20 km outside the city limits to the south-west and affects by wind direction.

![Industrial location, and air Pollution from Cement Plant](image)

**Figure 6. Industrial location, and air Pollution from Cement Plant**

**8. Industry Indicators**

These indicators are included in Iraqi environmental law; the research classified them by projects found in the city (study area) where they specified the environmental requirements and the location determinants of each project, notice negative effects on the environment due to industrial location form figure (6).

| Industry          | Indicators                                                                 |
|-------------------|--------------------------------------------------------------------------|
| Cement industry   | 1- 8 km outside the municipal boundaries and a distance of not less than 5 km for residential communities. |
|                   | 2- The site is a distance of not less than 1 km to the public highway road. |
|                   | 3- Provide treatment of air pollutants caused by factory exhausts.        |
|                   | 4- Treatment of liquid wastes to ensure their compatibility with water resources. |
|                   | 5- Remove solid residues by moving them to landfill sites.                |
|                   | 6- Surround the plant with at least two belts of evergreen trees.         |
Brick Industry

1- It shall be erected at a distance of not less than 5 km outside the boundaries of the municipality and the residential communities.
2- It is 1 km from public road buffer.
3- The use of suitable fuel and burning systems to pump
4- Ensure complete combustion treatment of liquid waste to ensure their compatibility with water resources.
5- Remove solid residues by moving them to landfill sites.
6- The factory shall be equipped with at least two belts of evergreen trees.

Aluminium Industry

1- It shall be erected at a distance of not less than 5 km outside the boundaries of the municipality and the residential communities.
2- It is 1 km from public road buffers.
3- Means of controlling air pollutants to ensure compliance with national standards for air pollutants.
4- Treatment of backward industrial water to ensure compliance with water resources.
5- Remove solid residues by moving them to landfill sites.
6- Surround the plant with at least two evergreen trees

Cement Block Factory

1- It is located outside the municipal boundaries within places dedicated to the construction of industries in the industrial areas, if any, 250 meters away from road buffers.
2- Submersible drainage ponds for industrial reuse within the plant.
3- Solid waste transported to landfills.

Car maintenance workshops

1- It is located outside the borders of the municipality and the residential communities 500 m or within the boundaries of the municipality and within the industrial zones.
2- It is 100m away from road buffers.
3- Provide containers for solid waste collection and transfer to sanitary landfills.

Asphalt factory

1- It was set up outside the municipal borders, 1 km away, and 500 m road buffers.
2- Means of controlling air pollutants to ensure compliance with national standards for air pollutants.
3- Treatment of backward industrial water to ensure compliance with water resources.
4- Remove solid residues by moving them to landfill sites.
5- Surround the plant with at least two evergreen trees.

Gas power station

1- Set up outside the municipal borders and residential communities with a distance of not less than 1 km and a distance of not less than 500 meters from road.
2- Disposal of transformer oil by transportation to hazardous landfill sites.
3- Treatment of industrial wastewater.
4- Provide methods of treatment of gases and particulates emitted so as to ensure compliance with national standards for air pollutants.

Source: the researchers depend on the environmental Iraqi laws and requirements

Environmental service determinants

9. Solid waste and landfill

The amount of daily waste produced is 300 tons; approximately 80% of the city's area is covered by waste removal services through specialized workers and machinery. The remainder represents the slums, agricultural areas and the new neighbourhoods. The waste is periodically raised by heavy machinery. The landfill is located outside the municipal borders, at a distance of 5 km and with an area of 400 hectare. There are no intermediate stations to collect waste and are transported directly to landfill, this affects on the efficiency of the service directly. This site is affected by methane gas, smoke from burning waste and leakage of liquids to the groundwater at a level of 1.5 m at the site. According to health utilities, Samawah General Hospital and the Children's Hospital in Samawah include a special incinerator, which lacks the necessary means to reduce environmental damage and contributes to contaminating the air of surrounding areas at varying rates.

10. Central Processing Plant for Swage
The station is located within the southern part of the city to the east at a distance of 5 km outside the boundaries of the Master Plan and 11 km from the city centre. The area of the complex is 350 hectare, of which 200 hectare is used, and the remaining areas are allocated for future expansion. The design capacity of the plant is 37000 m³/day, it is currently processing 20000 m³/day.

11. The Plant includes primary and secondary treatment stages
   a. Preliminary stages
   The unit filters screens working on booking large items. Primary Sedimentation; at this stage, high density materials that may be organic or inorganic substances are removed. This phase leads to a reduction in the concentration of suspended substances by up to 55%. It takes about (3-4) hours. Biological Treatment; is the stage in which organic matter in the wastewater is oxidized by air bacteria, and the treatment method is used according to the biological growth system used for microorganisms, it also takes about (14-18) hours, and Final Sedimentation; removal of sand and rocks from the water. At this stage through the process of sedimentation, which helps to increase sediment, some materials float on the surface, which facilitates the extraction process.
   b. Secondary stages
   Add chlorine for sterilization and remove it (outside service), and removal of industrial pollutants (out of service).

12. Evaluation of the sewage network in the city
The network covers 60% of the city large side and only 20% of the remaining city small side depends on the septic tanks that cause significant contamination of soil and groundwater. The treatment plant lacks isolation units for industrial pollutants and is therefore discharged into the river. There is no treatment plant for the city small side and sewage is discharged directly into the river.

13. Transportation and its environmental impact on the city
Transportation is one of the major causes of pollution within cities, where 60% of pollutants within cities are estimated to be caused by transportation. Number of cars of different types within the city of Samawa is estimated at 297940 vehicles, pollutants produced are combustion gases (nitrogen oxides, carbon monoxide (18-36 kg / 100 litres of fuel) and sulphur oxides, and lead compounds are added to oils, fats and volatile substances from brakes.

14. Environmental SWOT analysis for study area

| Strength | weakness |
|----------|----------|
| 1- Provides a productive industrial sector consisting of cement plant and brick factory, which depends on raw materials originally produced in the region. | 1- Lack of employment opportunities and poor exploitation of labour and most businesses can be included in the seasonal work and so-called shadow economy. |
| 2- The existence of fertile agricultural lands. | 2- The decline in infrastructure due to pressure on them as a result of population growth. |
| 3- A city with a large proportion of youth capable of working. | 3- The decline of agricultural land due to pollution and expansion of informal housing. |
| 4- A city that grows in a continuous dynamic manner. | 4- Limited industrial production. |
| 5- A homogeneous city in terms of population habits and traditions. | 5- Lack and poor distribution of services in general. |
| 6- Provides transportation routes between the provinces and Baghdad passing through the city and its border location in relation to Iraq. | 6- Desecration of roads and railways. |
| 7- The railway provides access to the city. | 7- The prevalence of illiteracy and exploitation of some groups of society in the work. |
| 8- The passage of the Euphrates River inside the city. | 8- Lack of development of health services, causing the deaths of children and the elderly. |
| 9- University of Muthanna. | 9- The city of Samawah lies within the natural limits of the desert climate, hot dry within the central and southern region of Iraq and |
10-There are no geographical indications for the expansion of the city and the spread of its land.

| Opportunities                                                                 | Threats                                                                 |
|-------------------------------------------------------------------------------|------------------------------------------------------------------------|
| 1- Development of industry based on agricultural crops.                      | 1- Lack of understanding of future growth in services and jobs because there is no clear development plan. |
| 2- Development of agricultural techniques for continuous production throughout the year. | 2- The future threat of the decline of cultivated land as a result of pollution and disinterest in the development of agriculture. |
| 3- Development of an industry based on raw materials located in the region.   | 3- Emigration to the province by the hands of the worker due to lack of employment and services, knowing that there is migration from the rest of the province to the centre. |
| 4- Development of transport routes and making them a vital area between the provinces and to connect with neighbouring countries. | 4- The deterioration of the health situation of a large segment of the population due to environmental pollution and lack of development of health services. |
| 5- Open the door of commercial, industrial and residential investments, given the availability of working hands and the land that can be exploited. | 5- Increase in the number of age groups less than 15 years (youth of the future) who do not have the level of education and basic knowledge because of the physical condition and the lack of educational services. |
|                                                                                 | 6- The phenomenon of chaotic and chaotic urbanism increases the demand for infrastructure. |

15. Recommendations

1- Use of technological methods to treat the waste resulting from the cement plant because of its environmental damage.
2- Change the path of high pressure lines outside the city limits to exploit the areas occupied by future expansion and damage.
3- Transferring the industrial zone outside the city and the development of industrial zones in the vicinity of the city with specifications conforming to environmental determinants.
4- Preserve the green areas within the city and its integrity and not expand in its direction.
5- To develop the sewage system and develop sewage treatment plant especially for the small part of the city to end the discharge of sewage to the river.
6- Transferring the gas station outside the city border as it is adjacent to the residential neighborhoods and adopting a technology friendly to the environment in its establishment.

References

[1] What is Environmental Impact Assessment? www.uow.edu.au, Retrieved 14-4-2019. Edited
[2] Pollution Sources and Solutions", www.epa.gov, Retrieved 7-5-2019. Edited.
[3] Environmental impact assessment (EIA) www.businessdictionary.com, Retrieved 9-5-2019. Edited
[4] Instructions for environmental determinants for establishing projects and monitoring the safety of their implementation No. 3 of 2011, Iraq
[5] The municipality of Samawah city 12- 12- 2018
[6] Ministry of planning, the Regional Planning Department, Iraq, 2019