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Bnaslawa Environmental Parameters Planning Modelling

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ABSTRACT

Global warming, climate change, greenhouse gasses, floods, drought years, and desertification have an impact on the environment. Naturally, the environment of Bnaslawa district (Dashti Hawler) in Erbil City-Iraqi Kurdistan region is affected by the global environmental changes. This research focused on the assessment of environmental parameters, planning, and environmental modelling in Bnaslawa district. A series of site visits, interviews, collection of documented data from directories and literature were conducted for data collection. Environmental factors such as wind direction, topography, water sources, soil type, distance, archeology, esthetics, air pollution, noise pollution, and disease spread were selected. The selected points for environmental planning were landfill, gas factory, slaughterhouse, quarry, cemetery, wastewater treatment plant, green area, animal shelters, industrial area, commercial area, institutional area, and service area. The points for the environmental factors were changed from zero (low impact) to 10 (strong/high impact). The ratio of points and twelve mathematical models for the elements were determined. Based on the scoring and mathematical models, wind direction, topography, water sources, archeology, esthetics, air pollution, noise pollution, and disease spread had an excessive impact on the planning and management of environmental parameters. In contrast, soil type and distance had less influence.

1. Introduction

Erbil is the capital of the Kurdistan Region of Iraq. The population of Erbil province was 2,254,420 in 2022. Erbil province consists of ten districts such as Erbil City Center, Bnaslawa (Dashti Hawler), Khabat, Makhmour, Koya, Shaqlawa, Soran, Ruwuz, Mergsour and Choman (Erbil Governorate, 2021). Each district has a number of sub-districts and villages. Figure 1 shows the Kurdistan Region and the districts in Erbil Province. The increase in population, climate change, refugees, internally displaced persons, economic and political problems have impacted the administration of Erbil province and districts. Water and wastewater management, solid waste, green areas, air pollution and dust storm, landscape and land use change, flooding, foul odors and smoke are common environmental problems related to the planning of Bnaslawa and other districts in Erbil province. In Bnaslawa district and other districts and sub-districts of Erbil province, there is generally no scientific and studied master plan and environmental planning. To date, there is no systematic and recognized study on the environmental problems and planning of Bnaslawa District in the literature. Accordingly, the aim of this study was to investigate the environmental parameters, planning and environmental modeling in Bnaslawa

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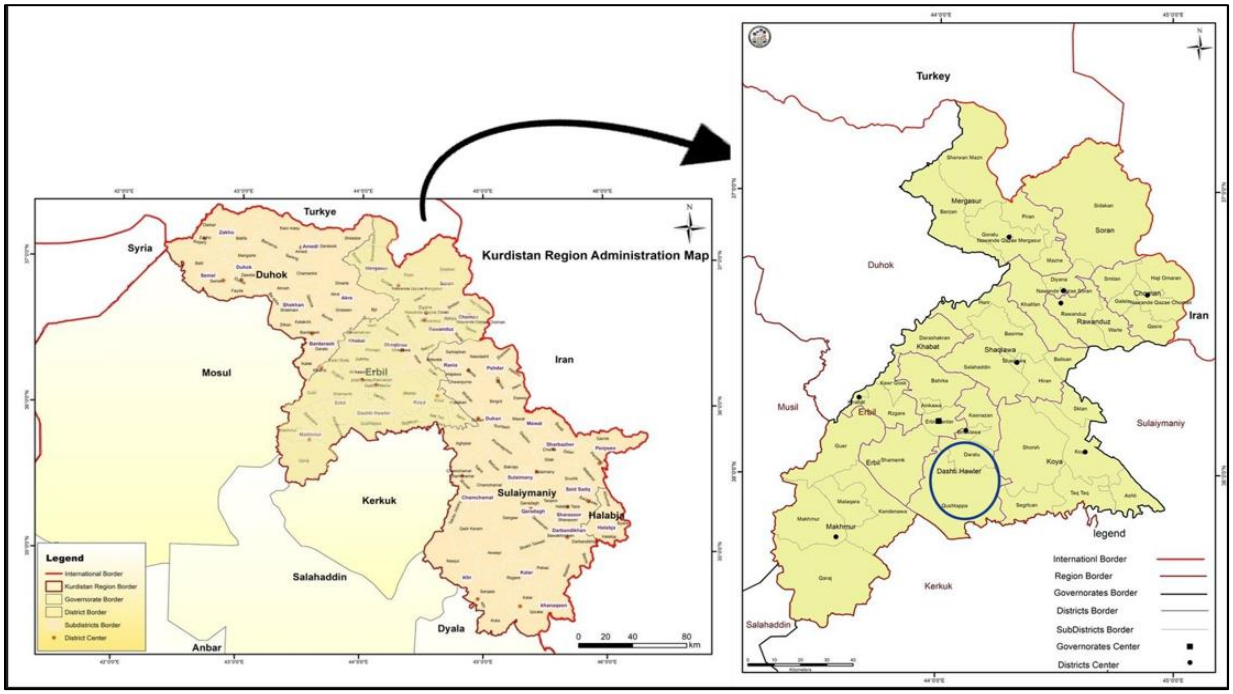


Figure 1. Map of Kurdistan Region and Districts of Erbil Province (KRSO, 2022)

District. So far, this type of study has not been conducted for Bnaslawa District and other districts in Erbil province.

2. Material and Methods

The satellite images of the city of Erbil and the district of Bnaslawa are shown in Figure 2. Bnalawa district is located in the southeast of Erbil city center, Figures 1 and 2, about 10 km from Erbil city. Before 1987, Bnaslawa was a village and was called Great or Big Bnasalawa. Before 1987, the village of Great Bnaslawa was destroyed/burned several times. In 1987, however, the village was completely destroyed and replaced by Bnaslawa Camp. In 1997, Bnaslawa became a sub-district.

In 2002, Bnaslawa was converted into a district and given the name Dashti Hawler (Erbil Plain) or Bnaslwa District. Currently, Bnaslawa District has three sub-districts (Kasnazan, Daratoo and Qushtapa) with 112 villages. The coordinates are 44° 0’ 0" E to 44° 15’ 0" and 35° 45’ 0" to 36° 15’ 0", respectively (Figure 1).

a)

b)

Figure 2. Satellite image of Bnaslawa (Dashti Hawler) District (a,b)

Both qualitative and quantitative research methods were used. Several site visits were made to the Bnaslawa district on March 2, 2021, October 19, 2021, November 3, 2021, January 13, 2022, January 16, 2022, May 3, 2022, April 22, 2023 and February 15, 2024. Direct visits were made to the Bnaslawa district office, the area surrounding the Bnaslawa district, the slaughterhouse, the water shed, the gas factory, the city administration, the water authority and the agricultural authority.

Environmental parameters such as weather, precipitation and flooding, water supply and wastewater, solid waste, green areas, air pollution, land cover and land use were examined. Environmental planning was also examined. The assessment of environmental parameters and planning was based on published documents and standards (Singh and Singh, 2004; Davis and Cornwell, 2008; Aziz 2020).

3. Results and Discussions

3.1. Characteristics of the Bnaslawa District

The characteristics of the district of Bnaslawa are listed in Table 1. The data were obtained through several site visits, interviews and published documents. Residential houses are usually built of concrete blocks with cement plaster outside and gypsum plaster inside. Sometimes other finishing materials such as ceramic tiles, marble and false ceilings are also used.

Sand and gravel pits are available inside the water sheds. Paving and simple concrete are used for the roads. The Bnaslawa district has a health center, a youth center, schools, the police department, a bank, the city administration, the water authority, the agricultural authority, local markets and supermarkets, the land registry and sports fields. The lifestyle of the families ranges from middle to poor. A large proportion of the inhabitants of Bnaslawa travel to the city of Erbil during the day to work, shop and deal with official business. The district of Bnaslawa is surrounded by newly built neighborhoods and agricultural areas. Modern supermarkets, parks and stores are available in Bnaslawa.

3.2. Environmental Parameters

The information in this section was obtained through site visits, interviews and data collection. This section covers watersheds, waste management, water supply, wastewater, air pollution, land cover and land use.

3.2.1. Watershed

The main water reservoir is located in the northern part of Bnaslawa district, Figures 3 and 4. The watershed of Bnaslawa, locally called Basti Mzoran. This watershed carries runoff during the rainy season (i.e. from October to April). On the other hand, the watershed remains dry during the non-rainy seasons (i.e. May to September). A number of quarries observed during the site visits utilize the watershed for aggregate (sand and gravel) extraction. Some areas for sheep, goats and cows were identified within the catchment. Indiscriminate dumping of waste in the watershed has been observed. Climate change, drought years, projects and the expansion of residential areas around the district have had an impact on the reduction of runoff compared to the 1980s and 1990s.

Table 1
Characteristics of Bnaslawa District (Bnaslawa (Dashti Hawler) District (2021), site visit and Interview)

No.	Item	Unit	Value	Notes
1	Area	km^2	29	Area of district centre
2	Sub-districts	No.	3	Kasnazan, Daratwoo, and Qushtapa
3	Villages	No.	112	Bnaslawa District (4 Villages), Kasnazan Sub-District (32 Villages), Daratoo Sub-District (19 Villages), and Qushtapa Sub-District (57 Villages)
4	Population	No.	130,548	47,571 Men (36.44 %), 47804 Women (36.62 %), and 35173 (26.94 %) Children
5	Constructed houses	No.	33,000	14,000 normal house (each 200 m^2) +19,000 houses (each 100 m^2) for district centre
6	Green area	Donum	23	Namran and Hawar Parks at district centre
7	Sheep	No.	43,743	
8	Goat	No.	18,788	
9	Cow	No.	900	
19	Calf	No.	1,344	
11	Agriculture	-	-	Wheat, barley, corn, vegetables, and fruits.
12	Dairy products	-	-	Yogurt, cheese, butter, cream, and milk

Figure 3. Water shed of Bnaslawa District (Site visit on March 2, 2021)

a)

b)

c)

Figure 4. Watershed and flood of Bnaslawa District (Visted on: a) January 13, 2022, b) January 16, 2022 and c) February 15, 2024

3.2.2. Solid Waste Management

Solid waste consists of food, plastic, cardboard, metals, glass, trees and leaves, garden waste and clothing. All types of waste are mixed at the collection points and collected by the municipality's vehicles. Some of the recyclable waste, such as cardboard, plastic and metals, is collected by citizens and sold at the designated points. Later, the recyclable materials are used as raw materials (Aziz et al., 2023b). The population of the Bnaslawa district is estimated at 100,000 people (Bnaslawa (Dashti Hawler) District, 2021). Based on the published work, the average solid waste generation rate is 1 kg/capita/day (Aziz, 2023). Consequently, the amount of solid waste produced is 100,000 kg (100 tons). The collected solid waste is disposed in Erbil landfill near Kani Qrzhala sub-district. It is proposed to separate organic and non-organic waste for the production of composite materials (Aziz et al., 2018). On the other hand, separating recyclable materials from others leads to a reduction in waste and becomes an income for the community (Aziz et al., 2023b).

3.2.3 Water Supply

Groundwater is the main source of water supply in the Bnaslawa district. A number of artesian wells supply the municipality with drinking water. The water is pumped directly into the water distribution system. There is no central water reservoir or elevated tank in the water supply system. The information was collected through direct interviews with the Directorate of Water in the Bnaslawa district. Figure 5 shows the Bnaslawa District Water Directorate. The water provided is used for domestic use, irrigation of green areas and washing. Based on the research published by Hawez et al. (2020), the quality of groundwater can be utilized for drinking water and other purposes. It is proposed to apply a sustainable water supply system using treated surface water from the Greater Zab River or Gomaspan Dam instead of groundwater.

Figure 5. Directorate of Water in Bnaslawa District (Visited on October 19, 2021)

3.2.4. Wastewater

After consumers have used the water provided, it becomes wastewater. In some areas, gray wastewater is channeled through the sewage system or transported through unlined canals outside the Bnaslawa district in the south, Figure 6. Later, the channeled wastewater

spreads in the environment or enters the Kornish valley, which is outside the 120 m road in the city of Erbil. In the rainy season, gray wastewater mixes with surface runoff and the mixed wastewater enters the Kornish Valley (Aziz et al., 2023c).

To date, there is no wastewater treatment plant (WWTP) in the Bnaslawa district. The produced wastewater from Bnaslawa district can be considered as weak wastewater and can be treated in wetlands and aerated lagoons (Aziz, 2020; Aziz et al., 2023a).

In some areas, there are sewer systems with different lengths and different concrete sewer sizes of 0.75 m, 0.9 m, 1.0 m and 1.2 m. In addition, in other zones, box sewers with dimensions of 1.0 m x 1.2 m, 1.5 m x 1.5 m, 2 m x 2 m and 2 m x 2.5 m are available in different lengths. Black wastewater is normally treated in cesspools. About 2 % of black wastewater is illegally connected to the sewage system.

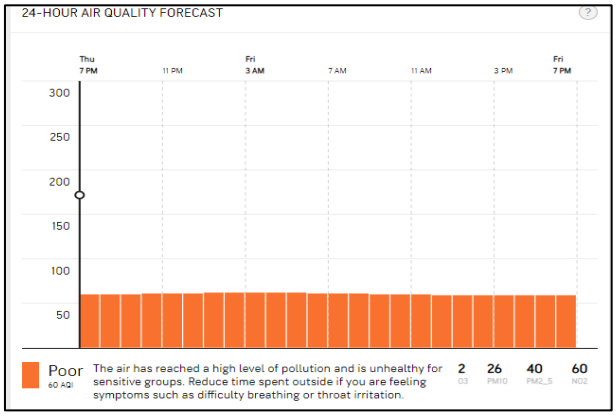
a)

b)

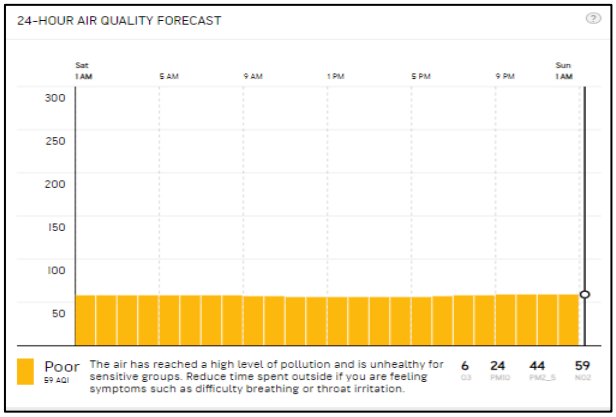
Figure 6. Wastewater conveying by sewerage system and unlined channel (Visited on November 3, 2021)

3.2.5. Air Pollution

The district of Bnaslawa is located far from the city center of Erbil. It is surrounded by a plain to the east and south. Figure 7 illustrates the air quality index (AQI) in the Bnaslawa district. The reported AQI was 60, which is considered a poor level. The expansion of the residential area, the increase in the number of cars and population, and the decrease in green spaces and plains have affected the AQI in the Bnaslawa district. The values for ozone, particulate matter (PM)10, PM2.5 and NO_2 were 2-6, 24-26, 40-44 and 59-60 mg/L, respectively. In general, the air is polluted, unhealthy and impairs breathing. It is proposed to reduce air pollution by increasing green spaces.



a)



b)

Figure 7. AQI for Bnaslwana District a) Date: April 4, 2022 and b) Date: October 6, 2023 (https://www.accuweather.com/en/iq/bnaslawa/506220/air-quality-index/506220)

3.2.6. Land Cover and Land Use (Green area)

The wheat and barley planted in the Bnaslawa district are a hundred years old, Figure 8, as are tomatoes, cucumbers, melons, watermelons, onions, fruit and vegetables. Before 1958 there was a very nice orchard in the village of Bnaslawa. There was a spring and a water channel at that time. Geologically, the soil layers consist of earth and sandy gravel. Nowadays, due to investment projects and the expansion of residential areas, some of the soil is being converted into concrete, tiles and pavement, resulting in a decrease in agricultural land and an increase in surface runoff (Aziz et al., 2023c). From a sustainability perspective, agricultural land should be preserved and protected for future generations (Aziz and Mustafa, 2022). Figure 9 shows the Nice Land Park in the district of Bnaslawa.

Table 2
Bnaslawa Environmental Planning Modelling

No.	Items	Environmental Factors Weight (0 to 10)										Total
		Wind direction (WD)	Topography (T)	Water Source (WS)	Soil Type (ST)	Distance (D)	Archeology (Ar)	Aesthetic (Ae)	Air pollution (AP)	Noise Pollution (NP)	Disease propagation (DP)	
	Dump site (DS) Points	9	7	8	9	6	9	8	9	8	9	82
1	DS Ratio of points	0.11	0.09	0.10	0.11	0.07	0.11	0.10	0.11	0.10	0.11	1.00
	Equation: DS=	0.11 WD + 0.09T+0.1 WS + 0.11 ST + 0.07 D+ 0.09 Ar + 0.1 As +0.11AP+ 0.1 NP + 0.11DP										
	Domestic Gas Factory (DGF) points	10	4	5	1	9	9	8	10	10	9	75
2	DGF ratio of points	0.13	0.05	0.07	0.01	0.12	0.12	0.11	0.13	0.13	0.12	1.00
	Equation: DGF=	0.13 WD + 0.05T+0.07 WS + 0.01 ST + 0.12 D+ 0.12 Ar + 0.11 Ae +0.13AP+ 0.13 NP + 0.12DP										
	Slaughter House (SH) Points	10	2	9	0	9	8	10	10	9	10	77
3	SH Ratio of points	0.13	0.03	0.12	0	0.12	0.10	0.13	0.13	0.12	0.13	1.00
	Equation: SH=	0.11 WD + 0.03T+0.12 WS + 0.0 ST + 0.12 D+ 0.1 Ar + 0.13 Ae +0.13AP+ 0.12 NP + 0.13DP										
	Quarry (Qu) Points	5	9	8	9	7	10	5	8	10	0	71
4	Qu Ratio of points	0.07	0.13	0.11	0.13	0.10	0.14	0.07	0.11	0.14	0	1.00
	Equation: Qu=	0.07 WD + 0.13T+0.11 WS + 0.13ST + 0.10 D+ 0.14Ar + 0.07 Ae +0.11AP+ 0.14 NP + 0 DP										
	Cemetery (Ce) Points	2	8	8	10	9	10	8	3	8	5	71
5	Ce Ratio of points	0.03	0.11	0.11	0.14	0.13	0.14	0.11	0.04	0.11	0.07	1.00
	Equation: Ce=	0.03 WD + 0.11T+0.11 WS + 0.14ST + 0.13 D+ 0.14Ar + 0.11 Ae +0.04AP+ 0.11 NP + 0.07 DP										
	WWTP Points	10	9	9	3	7	8	9	9	8	9	81
6	WWTP Ratio of points	0.12	0.11	0.11	0.04	0.09	0.10	0.11	0.11	0.10	0.11	1.00
	Equation: WWTP=	0.12 WD + 0.11T+0.11 WS + 0.04ST + 0.09 D+ 0.1Ar + 0.11 Ae +0.11AP+ 0.10 NP + 0.11 DP										
	Green Area (GA) Points	8	7	9	9	8	7	10	2	5	0	65
7	GA Ratio of points	0.12	0.11	0.14	0.14	0.12	0.11	0.15	0.03	0.08	0	1.00
	Equation: GA=	0.12 WD + 0.11T+0.14 WS + 0.14ST + 0.12 D+ 0.11Ar + 0.15 Ae +0.03AP+ 0.08 NP + 0.0 DP										
	Animal Shelters (AS) Points	10	5	8	6	7	9	10	8	8	9	80
8	AS Ratio of points	0.13	0.06	0.10	0.08	0.09	0.11	0.13	0.10	0.10	0.11	1.00
	Equation: AS=	0.13 WD + 0.06T+0.10 WS + 0.08ST + 0.09 D+ 0.11Ar + 0.13 Ae +0.10AP+ 0.10 NP + 0.11 DP										
	Industrial Area (IA) Points	10	5	8	6	7	9	10	8	8	9	80
9	IA Ratio of points	0.13	0.06	0.10	0.08	0.09	0.11	0.13	0.10	0.10	0.11	1.00
	Equation: IA=	0.13 WD + 0.06T+0.10 WS + 0.08ST + 0.09 D+ 0.11Ar + 0.13 Ae +0.10AP+ 0.10 NP + 0.11 DP										
	Commercial Area (CA) Points	5	5	6	2	9	8	5	8	10	6	64
10	CA Ratio of points	0.08	0.08	0.09	0.03	0.14	0.13	0.08	0.13	0.16	0.09	1.00
	Equation: CA=	0.08 WD + 0.08T+0.09 WS + 0.03ST + 0.14 D+ 0.13Ar + 0.08 Ae +0.13AP+ 0.16 NP + 0.09 DP										
	Institutional Area (InA) Points	4	7	5	3	9	8	3	4	9	4	56
11	InA Ratio of points	0.07	0.13	0.09	0.05	0.16	0.14	0.05	0.07	0.16	0.07	1.00
	Equation: InA=	0.07 WD + 0.13T+0.09 WS + 0.05ST + 0.16 D+ 0.14Ar + 0.05 Ae +0.07AP+ 0.16 NP + 0.07 DP										
	Services Area (SA) Points	6	7	8	5	8	9	2	5	8	5	63
12	SA Ratio of points	0.10	0.11	0.13	0.08	0.13	0.14	0.03	0.08	0.13	0.08	1.00
	Equation: SA=	0.10 WD + 0.11T+0.13 WS + 0.08ST + 0.13 D+ 0.14Ar + 0.03 Ae +0.08AP+ 0.13 NP + 0.08 DP										

Figure 8. Natural Environment- Small Bnaslwa Village (Site Visit on April 22, 2023)

Figure 9. Nice Land Park- Bnaslawa District

3.3. Environmental Planning and Modelling

Normally, environmental planning consists of current evaluation, vision and implementation. Present assessment of the environmental factors in Bnaslawa District described in the previous section. The vision is to enhance the environmental conditions in the studied area according to the standards. Implementation of the suggested ideas is related to decision maker's policy, political and financial issues. The author presented a table for suggestion of a new location for any item which effect the environment, Table 2. The weight for each item is given in the table as well. The weights for the environmental factors were selected according to the impact on the environment and based on the background. Twelve items for environmental planning were chosen as given in Table 2. The selected items were solid waste dumpsite, domestic gas factory, slaughterhouse, quarry, cemetery, WWTP, green area, animal shelters, industrial area, commercial area, institutional area, and services area. For each item, environmental factors such as wind direction, topography, water sources, soil type, distance, archeology, aesthetic, air pollution, noise pollution, and disease propagation were studied. Environmental points varied from zero (low impact) to 10 (strong/high impact). Ratio of points and equation for each item were found. Twelve mathematical models for the items were derived, Table 2. It can be noticed that wind direction, topography, water sources, archeology, aesthetic, air pollution, noise pollution, and disease spread had great impact on the environmental planning and management items. While, soil type and distance had less influence.

4. Conclusions

Deficiency was identified in environmental planning and management in Bnaslwa District. Proper waste management and treatment is recommended for Bnaslawa District. Main storage water tanks are lacking in the water supply system and a sustainable solution for water supply is essential. Adequate collection, transportation and treatment of the generated wastewater is not possible. Therefore, economical and practical/simple treatment methods such as aerated lagoons and wetlands are recommended for wastewater treatment. AQI levels were poor which is an indicator of air pollution in the district. Land cover and land use were changed resulting in reduction of agricultural land and increase in surface runoff. It is recommended that some areas such as cemeteries, slaughterhouses, gas factories, industrial areas, quarries, tile and marble exhibitions and animal shelters be re-planned and allocated. According to the assessment and mathematical models, wind direction, topography, water sources, archeology, esthetics, air pollution, noise pollution and disease spread had a huge impact on the planning and management of environmental parameters. Soil type and distance had less impact.

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Modeliranje planiranja ekoloških parametara za distrikt Bnaslava

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INFORMACIJE O RADU

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Naučni rad

Ključne reči:
Distrikt Bnaslava
Životna sredina
Erbil
Upravljanje
Matematički modeli
Planiranje

I Z V O D

Globalno zagrevanje, klimatske promene, gasovi staklene bašte, poplave, suša i dezertifikacija imaju uticaj na životnu sredinu. Prirodno, okruženje distrikta Bnaslawa (Dashti Hawler) u gradu Erbil, region iračkog Kurdistana, pogođeno je globalnim ekološkim promenama. Ovo istraživanje je fokusirano na procenu ekoloških parametara, planiranje i modeliranje okruženja u ovom distriktu. Za prikupljanje podataka sproveden je niz terenskih poseta, intervjua, te prikupljanje dokumentovanih podataka iz direktorija i literature. Izabrani su ekološki faktori kao što su pravac vetra, topografija, izvori vode, tip zemljišta, udaljenost, arheologija, estetika, zagađenje vazduha, buka i širenje bolesti. Izabrane tačke za ekološko planiranje bile su deponija, fabrika, klaonica, kamenolom, groblje, postrojenje za preradu otpadnih voda, zelena površina, azil za životinje, industrijska zona, komercijalna zona, institucionalna zona i uslužna zona. Vrednosti za ekološke faktore su varirale od nule (nizak uticaj) do 10 (jak/visok uticaj). Odnos bodova i dvanaest matematičkih modela za elemente su utvrđeni. Na osnovu bodovanja i matematičkih modela, pravac vetra, topografija, izvori vode, arheologija, estetika, zagađenje vazduha, buka i širenje bolesti imali su izrazit uticaj na planiranje i upravljanje ekološkim parametrima. Nasuprot tome, tip zemljišta i udaljenost su imali manji uticaj.