IRAQI Academic Scientific Journals

Iraqi Journal of Civil Engineering

Available online at https://www.iasj.net/

Journal homepage: https://www.iasj.net/iasj?func=issues&jId=141&uiLanguage=en

The Environmental Dimension and its Impact on the Sustainability of the Road Network in Ramadi City

***Rana Salah Thabit*[1], *Thaer Sh. Mahmood* [*2], *Hamid A. Awad*[3]**

[1] *Heet Education Department of Planning and School buildings, Iraq, ranaheet9@gmail.com*

[2] *Manager of Strategic studies Centre, University of Anbar, Iraq, drthaersh@uoanbar.edu.iq*

[3] *Department of Civil Engineering, University of Anbar, Iraq, hamid.awad@uoanbar.edu.iq*

ARTICLE INFO

Article history:
Received 26 / 06 / 2021
Received in revised form 29 / 07 / 2021
Accepted 01 /08 / 2021
Available online 01 03 / 2022

Keywords:
Environmental dimension,
urban road network,
sustainability

ABSTRACT

Transport is a vital part of urban life and a foundation for society's growth. It is a wonderful indication of the growth and development of cities. It protects the free flow of people, commodities and the economy. . Despite the great advancement in technology, it still has many difficulties in developed and developing nations, particularly in our country, such as environmental issues, where congestion leads to traffic pollution, noise and a rise in cars which is a problem in itself.. So transportation is an issue. And it became a subject of attention, requiring consideration of sustainability in the planning and development of transportation systems. Ramadi has been chosen as a model in this study because of its significant impact on sustainable development and the approach that thins our study. Using the data from the study area, which included 27 neighbourhoods, were analyzed by the SPSS statistical program , the results showed that the indicators of the environmental dimension had a direct and strong relationship. For Ramadi and other Iraqi cities, a sustainable development system may be developed based on based on the two indicators of pollution and green areas (0.794 and 0.776), on which a choice can be made about sustainable urban environmental transport.

DOI: **10.37650/ijce.2021.172878**

1. Introduction

The city is the largest urban system and consists of secondary systems, a complex network that interact and intertwine with each other, such as the urban environment and transportation (Al-Jubouri et al., 2019) which is the focus of my study. The century is urban. Projections indicate that by 2030, more than 60% of the urban population will live and reach 10 billion people by 2050 (UNICEF, 2019). This has led to a noticeable increase

* *Corresponding author*. Tel.: 009647807910485
E-mail address: drthaersh@uoanbar.edu.iq

in population growth, increased movement of goods and transportation, and increased vehicle ownership to keep pace with the age of speed. Many of the problems of traditional transportation and one of the most important of these problems are environmental pollution, which is one of the most important transportation risks. The transportation sector is one of the largest in energy consumption, with an estimated consumption of a quarter of energy consumption(Shanbi, 2017). Despite the huge development in the world of technology, the problems of urban transportation are more complex, especially in developing countries and cities with low economies(Al-Baramly & Al-Sarfi, 2017). Therefore, it is necessary to put an end to these problems because of their impact on the most important pillar of sustainable development, and this is not sufficient in itself to control what threatens the health of society and the environment, but must work with the basic standards to which they are subject, and in this research paper we will limit our study to the study of the environmental dimension and its impact on The urban road network and its sustainability through transportation indicators, like any planning for the basic design of the city, must take into account the development of the road network, as it is one of the most important things that transmit the development of the city and its development through movement and activity, it must be monitored and evaluated (Al-Wahab, 2008).

1.1 Research Aims

The data will be analyzed to find out the impact of the environmental dimension on the urban road network, meaning whether the indicators of the environmental dimension of the urban road network meet the requirements of sustainable development. For the study area to reach the sustainability of urban roads.

2. Previous Studies

2-1 They prepared a group of indicators through a participatory understanding of the local community and the local government, according to conceptual frameworks and a scientific methodology to find a balance between the three main dimensions, by local conditions for each country to achieve the concept of integration and thus can choose and organize a set of final indicators that are considered a turning tool Sustainable thought to practical application to collect the three main dimensions in one to assess urban sustainability of Iraqi cities and the city of Hilla model(Al-Anbari &Abdul Majeed, 2015).

2-2 The study addresses everyone between sustainability and transportation and the use of evaluation methods to reach recent ways of transportation planning for the suffering of Iraqi cities, especially in the holy cities and pressure from the ability and transportation of the capacity of roads and transportation because of the influence of the enormous preparation of visitors were not well thought and was charged traditionally, for this reason, Approved assessment for this purpose to ensure the sustainability of transport plans and enabling sustainable transport systems ***(B. K. Ahmed & Wahab, 2015)*** .

2-3 The research consists of two basic axes of the stimulant city, its indicators and the second sustainability study and its dimensions by applying the principles of sustainable urban format to achieve the mechanism for achieving the research hypothesis which is the tasty city relationship with urban sustainability***(ALBAZZAZ & OMAIRY, 2016).***

2-4 The city of Algeria suffers from unorganized urban growth, so he studied the reality of the traffic problems in the city of Algeria at the level of transportation because it did not keep pace with and its integration with development lines and its analysis. Effective strategies to face urban transport challenges in light of sustainable development controls to evaluate transport performance ***(Al-Obaidi &Dabdoub, 2018).***

2-5 Studying the concept of sustainability as one of the basic concepts for sustainable transport planning and achieving liveable cities and analysing various problems, including traditional problems that neglect the environmental impacts, and the Medina experience is considered one of the integrated experiences to achieve sustainable transport***(Al-Wahab, 2017).***

2-6 The study aimed to identify the importance of sustainable transport and how to benefit from it in the future, and to determine the extent of the urban transport response to intelligent transportation systems and the extent to which it addresses the problems***(Al-Mashhadani, 2019).***

2-7 This study examined British experience in sustainable urban coordination to accomplish the sustainability framework and extract indicators by way and corridors South False Creek Trails - Burnaby Mountain Tracks - Coquitlam Riverwalk - East Clayton Trails & Lanes according to the topography of the region***(Lafah, 2014).***

2-8 The city of Sydney has adopted a long-term strategy (the target year 2031) that developed an integrated action plan for the transportation network by applying the foundations of sustainable development**.** It made the citizen in the first place. It adopted to obtain sustainability, re-changing transportation methods, rely on pedestrians and public Transport and create a clean, healthy environment and development***(Shaheen and Mohsen, 2019)***.

2-9 Germany is a guideline for sustainable mobility solutions and supports the transformation towards sustainability in developing and emerging countries that cannot create reliable Transport. Germany is internationally playing a pioneering role in policy development and innovation. Environmentally friendly technologies. Hence, it offers many comprehensive solutions in the field of sustainable mobility and logistics services. They analysed the data to see how the schematic engineering dimension affects the urban road network, which means whether the urban road network hierarchical index meets the requirements of sustainable development that the study area reaches the sustainability of urban roads ***(Fremer,2015)***.

3. Urban Road Network

The urban road network in any area exceeds the degree of human progress under natural conditions and the road transport network that works to make the urban city an accessible place and the extent of technical progress in it (Al-Sahili 2016).

The network consists of two dimensions of length and width. The road network works to connect the different neighborhoods with urban and urban areas in the main center and areas of urban activities, bypassing the secondary and subsidiary centers, as well as the most important public utility equipment such as referendum centers and stations such as railways, promotions, airports, schools and utility lines, that is, linking the different neighborhoods to each other. There are unnecessary or important lines, but they enable users to navigate through them easily, quickly and comfortably, and facilitate the process of social communication between individuals, and thus strengthen social relationships between individuals and work to strengthen social ties (Godiyah, 2017). Lines can also be arranged based on urban standards that relate to the study of road planning by choosing the means of transportation used, and according to the planning of roads and corridors, and urban lines that constitute and shape the basic urban structure (Mohammed, 2015). And as an engineering network that secures the movement of vehicles and goods according to the design specifications.

4. Research Methodology

The analytical approach was adopted on final, quantitative and qualitative bases, through the use of methods of analyzing the available data using the statistical program according to the area of the urban road network, as it represents the main factor in determining transportation and urban development and a set of measurable indicators by obtaining the highest value of the correlation between indicators Transportation, so it was adopted as an independent index (Y), and the indicators of the environmental dimension represent the variable indicators (X1, X2, X3 ....). For the analysis, the study area will be divided according to the Ramadi city neighbourhoods, as it is the urban city center in the governorate. Data were obtained by relying on government departments' data and some variables obtained through the geographic information systems program. The Ramadi Municipality Directorate provided us with a satellite image of Ramadi for the year 2020.

The research hypothesis assumes that the total area of the urban road network is directly proportional to the indicators of the environmental dimension, as the total area of the urban road network is a form of urban roads, and it is one of the elements of urban areas. Road design. The city, and since the urban transport indicators support the sustainable development thereof, we conclude that the total area of the urban road network, urban roads and related transport factors have an impact on the sustainability that connects them directly, and this will be analyzed and questioned. Use of multiple variables. With what we want to obtain and demonstrate access to urban modelling to understand the interconnectedness between the structure of an urban system and its environment. It is expressed in urban mobility, using the urban road network area model. And provide feedback to correct, improve or update urban models before moving to the construction stage, to apply them now and predict the future.

After collecting and analyzing data using the multiple linear regression method in SPSS statistical analysis software, three indicators were obtained as shown in the correlation table and tested by the ANOVA method,

and the test was confirmed by the T-test method. The calculated T values are less than the probability value of T. Therefore, we accept the null hypothesis of sufficient claim. (Jibril, 2020).

5. Indicators Of The Sustainable Environmental Dimension On The Urban Road Network

To know the impact of the environmental dimension on the urban road network and its sustainability, we must know if there is a relationship between them through indicators, as the indicator is a tool for assessment and decision-making, whether they are adjustments or corrections, through which we can measure an apparent situation in a relatively objective way, and the indicator is either a qualitative or A quantitative indicator describing a situation or response, but it is not possible to make a direct decision and reach the correct indicator means approaching the goal (strategy) indicators have become an essential part of strategic planning, and this development came as a result of the greatly increased reliance on indicators in order to measure the results of achieving goals And assisting decision-makers in making decisions that affect future results (Amran, 2016) There is a huge amount of international reports, studies and research that have been shared that confirm the relationship of sustainable transport with the sustainable environmental dimension. Therefore, cities must be ready to plan for the future and always work to take advantage of the new things that the days bring up. Table No. 1 shows the indicators that were used in the research

6. Environmental Dimension Indicators Standards

6.1 Green spaces Standards

Each city has its criteria for green spaces due to the different nature of the land and its topography, that is, there are no special determinants. There are general equations and standards for green spaces according to planning standards. In the 1970s, the United Nations Environment and the European Union set a standard for green spaces and set the minimum and the highest at (12-16) square meters, and set Simmons plan that green spaces should not be less than 10% of the city area(Bouanaca, 2010). In the 1990s, the United Nations Environment Program set standards that specify the minimum green spaces ranging between (12-18) square meters, per capita share according to the equation below (Badlawy, 2017), and for the Iraqi planning standards it was (6-7)% of the land use and the per capita share is (7) square meters. (Ahmed, 2020)In another source, the average per capita green space in Iraqi cities ranges between (0.5-2) within neighbourhoods according to the estimates of the Parks and Parks Unit in the municipalities of Iraq(Al-Shakraji et al., 2012). We have an average green space in the sectors of the study area equivalent to 344 square meters, which is higher than the required area shows in Figure 1, and the average per capita share is 22.7 square meters(Al-Shakraji et al., 2012).

Table 1 – Determinants of green areas(Ahmed, 2020)

Greenspace	City area	% green space	per capita share	Standards		Evaluation
				% green space	per capita share	
770	7191	10.7	28.4	6-7	7	excess

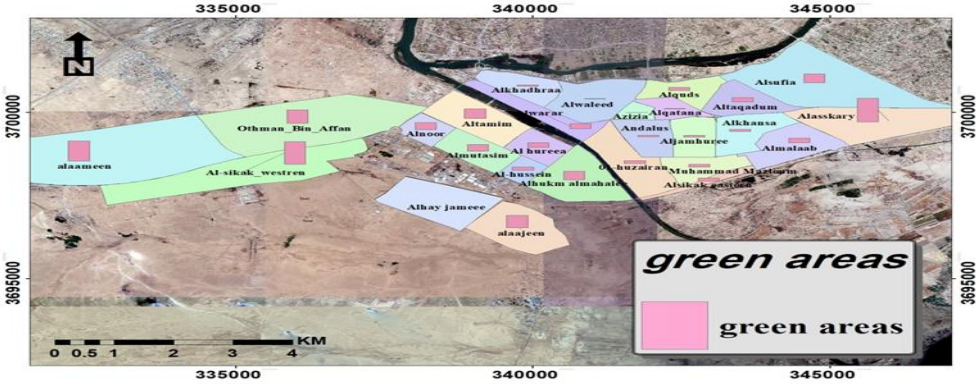


Figure (1) Green area of Ramadi City

6.2 Noise Standards

According to international standards, the sound intensity (Abrahim, 2019)should be about (30 - 35) dB, while we found that the intensity level ranges from (60-70) dB shows in Figure 2, which is higher than usual due to the increase in the number of streets and road spaces, this leads to the emergence of the highest level of noise.

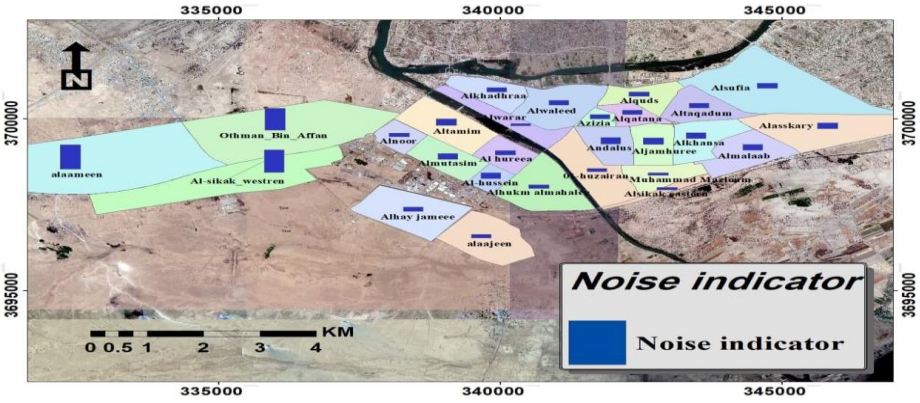
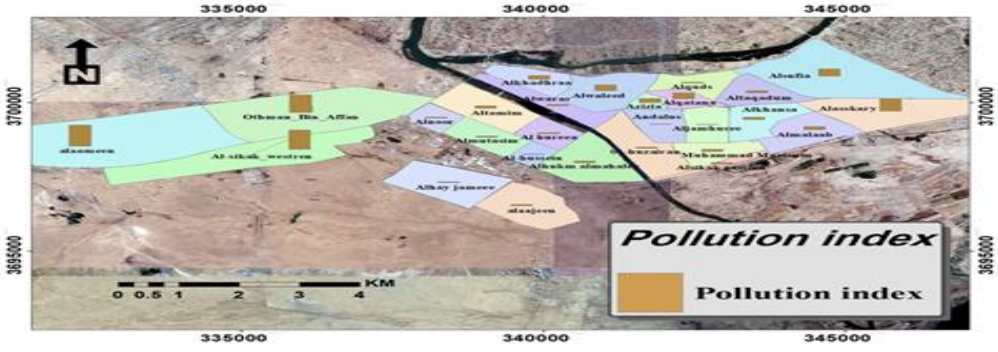


Figure (2) Noise index of Ramadi City

6.3 Pollution Standards

According to national standards, the pollution level should range from (0.5-5) parts per million, while we found that the pollution level ranges between (0.3-3) parts per million(Abrahim, 2019) shows in Figure 3, but it is not reliable due to different parameters, which is an expected result. Streets, road spaces, and a large number of events increase the rate of air pollution.

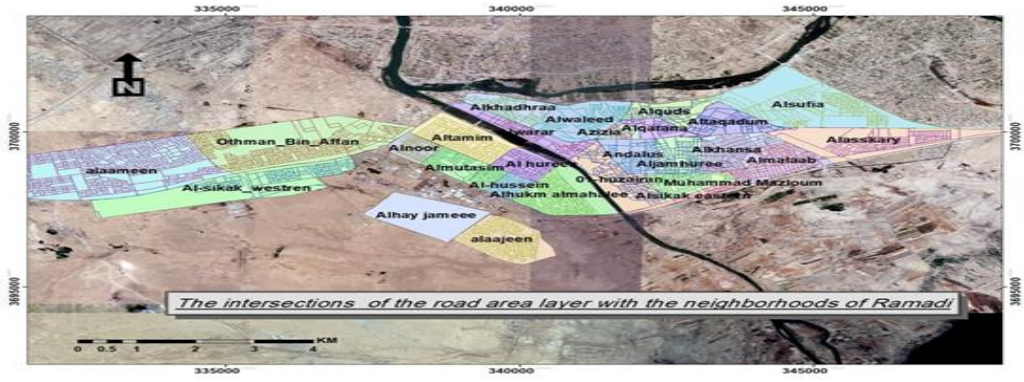


Figure(3) Pollution index of Ramadi City

7. Description of the study area

The location of Ramadi determine in the western part of Iraq at the intersection of longitude (43°-20'), (43°- 12') east and latitude (33°-27'),(33° – 23') north. The area of Ramadi is 318088 km2, while the borders of the urban neighbourhood locat in Ramadi (7375 hectares). The city locations are in the southeastern part of Anbar Governorate, and the Euphrates River passes through it. This city is an important administrative and urban centre for Anbar Governorate. It surround by Jazira in the north (Ramadi Island), Habbaniyah Lac to the south, Hasbah to the east, and Rutba to the west. Baghdad, the capital of Iraq, is around 120 miles distant, Fallujah is 45 km, Heet 60 km, Haditha is about 160 km, and Al-Qaim is about 300 kilometres (Al-Issawi, 2019). The

central and administrative importance of the city has become an important place for the circulation of activities between neighbourhoods and the gathering of many important government agencies. Institutions that gave it local importance directly contributed to the development and urban growth of the city see Figure 4.



Figure(4) Spatial distribution of Ramadi neighbourhoods

8. Stages and steps of quantitative analysis

1.Data extraction by geographic information systems program
2.Obtaining data from government departments such as the satellite image for the year 2020 and the basic design of the port for the year 2019, and field surveys
3.Collecting data and extracting indicators according to scientific references, which numbered four indicators
4.Inserting data into the statistical program SPSS was in 6 stages.

The first stage

Entering the data and inserting it into the statistical program, we analyze and instruct the correlation to show the correlation value that 3 transportation indicators have been linked with the total road area indicator.

The second stage

Please enter the data, insert it into the statistical program, and then analyze, and from there to the curve estimation, a list appears. We put the total path area in the y square and the x square. We start placing the variables one by one to obtain the variables associated with the independent variable y, which appeared in three indicators see table 2.

Table 2 – Correlation coefficient values

indicators	Correlation Coefficient R^2 Adjusted	The degree of correlation
The green spaces index	.794	Good Linear relationship
The Noise Index	.776	Good linear relationship
The pollution indicator	.882	Strong linear relationship

The third stage

After extracting the indicators related to the independent Variable, we make a statistical test for their importance to address the concept of decision-making based on the sample data by examining the T-test. After that, we perform the analysis and then the written instructions.

The fourth stage(t-test)

In this stage, a test of the relevant indicators is doing by statistical analysis of the T-test. As shown in the tables, the values of t computed are less than the value of probability t. Therefore, we accept the null hypothesis of

sufficient claim. Each indicator has a table for the T-test, as described in the indicators section.

The fifth stage(Interpretation of results)

In this stage, the results are interpreting according to what appeared. We explained the details of each indicator in the previous, which indicates the existence of positive relationships and highly significant associations between the urban total area index. Road network and transportation indicators. Which four variables in terms of number.
The results will be interpreting by the measure of dispersion most used in statistics because it has very high precision in the lower the value of the standard deviation. The closer the data is to the expected value, the higher the normal deviation value, the more information is from the expected value. Table (3) below shows the standard deviation of the transport indicators.

Table 3 – descriptive Statistics

indicators	Std. Deviation
The green spaces index	3.88373
The Noise Index	227.3505
The pollution indicator	6.43254

Sixth stage: building the model

After implementing the above five stages, road and transport engineers and urban planners tend to build and implement a spatial network model with high accuracy and conduct an evaluation to give positive results in sustainability to develop and improve the efficiency of the urban road network. The present and prediction of the future after extracting the equations for each of the dimensions related to building the general model using multiple linear regression analysis in the SPSS program

9. Results

9.1 The green spaces index

The linear equation was found between the green spaces index (V1) and the road network density of population (Y), and Table (4)(the summary of the model) shows the correlation coefficient between them.The dependent variable and the independent variable are equal to (R = 0.895) and the square of the correlation coefficient (R2 = 0.802) The adjusted Square R = 0.794 and the analysis of variance to test the significance of the regression and the most significant value Sig.is(0.00) less than 0.05. These indicate that the dependent Variable with the independent Variable has a statistically meaningful connection.

Table 4 – model summary of green area index

R	R Square	AdjustedR Square	F	Sig.	Mean	Std. Deviation	Variance
.895	.802	.794		.000	3.7041	3.88373	15.083

9.2 The noise index

The linear equation is found between the noise index (V2) and the total road area index (Y), and Table (5) (model summary) shows the correlation coefficient between them.The dependent variable and the independent variable are equal to (R = 0.88) and the square of the correlation coefficient (R2 = 0.775) The modified square R

= 0.766 and the analysis of variance to test the significance of the regression and the most important value Sig is (0.00) less than 0.05. These indicate that between the dependent Variable and the independent one, there is a statistically significant link.

Table 5 – model summary of the noise index

R	R Square	AdjustedR Square	F	Sig.	Mean	Std. Deviation	Variance
.880	.775	.766	86.137	.000	251.737	227.3505	227.3505

9.3 The pollution index

The linear equation is found between the pollution index (V3) and the total road area index (Y), and Table (6) (model summary) shows the correlation coefficient between them.The dependent variable and the independent variable are equal to (R = 0.942) and the square of the correlation coefficient (R2 = 0.887) The modified square R = 0.882 and the analysis of variance to test the significance of the regression and the most important value Sig. is (0.00) less than 0.05. These imply that the dependent and independent variables have a statistically significant connection.

Table 6 – model summary of the pollution index

R	R Square	AdjustedR Square	F	Sig.	Mean	Std. Deviation	Variance
.942	.887	.882	196.207	.000	4.8778	6.43254	41.378

10. building the model

After extracting the indicators and performing the five stages of statistical analysis on them, we are now building the environmental dimension model and it appeared as follows

The linear equation is found between the environmental dimension indicators (V1, V2 and V3) and the total road area index (Y), and Table. (7) (model summary) shows the correlation coefficient between them.

The dependent variable and the independent variable equals (R = 0.983) and the square of the correlation coefficient (R2 = 0.967) The modified square R = 0.963 and the analysis of variance to test the significance of the regression and the most important value Sig. is (0.00) less than 0.05. These denote that the dependent and independent variables have such a statistically significant connection.

Table 7– model summary of the indicators

R	R Square	AdjustedR Square	F	Sig.
.983	.967	.963	225.252	.000

Through Table (8) (Coefficients), we note that the effect is proportional between the total road area index and the environmental dimension indicators, as shown in the equation of the regression line No.

Table 8– coefficient of the indicators

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-.337-	.266		-1.264-	.219
V1	.456	.064	.426	7.111	.000
V2	.004	.002	.234	2.780	.011
V3	.261	.064	.403	4.101	.000

Therefore, the equation becomes $$Y = -0.337 + 0.456\,V_1 + 0.004\,V_2 + 0.261\,V_3 \quad (1)$$

These tables(7,8) and Figures (5,6,7) contains the measures that appeared in the multiple linear regression analysis and the estimated model was calculated and through it, the evaluation is performed

1. An equation was found that represents the linear relationship between the environmental dimension indicators that achieved a significant correlation in the first stage, which is three indicators and the total area of the urban road network.
2. The analysis of (multiple linear regression) and Table(8) show that the coefficient of determination is an indicator of the validity and quality of the model and depends on the significant value if it is less than 0.005 and the most important value. Is sig. = 0.000 (less than 0.005). The coefficient of determination for this relationship is equal to (R = 0.983) and in turn, indicates the validity and quality of the model
3. The multiple correlation coefficient indicates the strength of the relationship between the dependent and independent variable, which in turn indicates the quality of the model, the square of the correlation coefficient (R2 = 0.967) and the square of the correlation coefficient for the rate R = (0.963), which in turn indicates the quality of the successful model.
4. The ANOVA shows the analysis of variance for the most important regression test and the most important value is Sig. = 0.000 (less than 0.005), Therefore, we will reject the null hypothesis and accept the alternative hypothesis that the regression is important and therefore there is a significant relationship between the dependent variable and the independent variable.
5. A t-test was performed to confirm the hypothesis, and the calculated value of t appeared to be greater than the tabular value, and the significant significance value was greater than 5. Therefore, the null hypothesis was accepted and that the average mean of the environmental dimension is sufficient for the claim

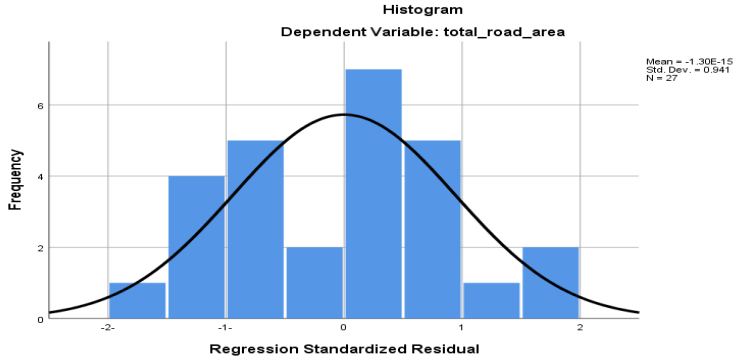


Figure 5. Regression Standardized Residual

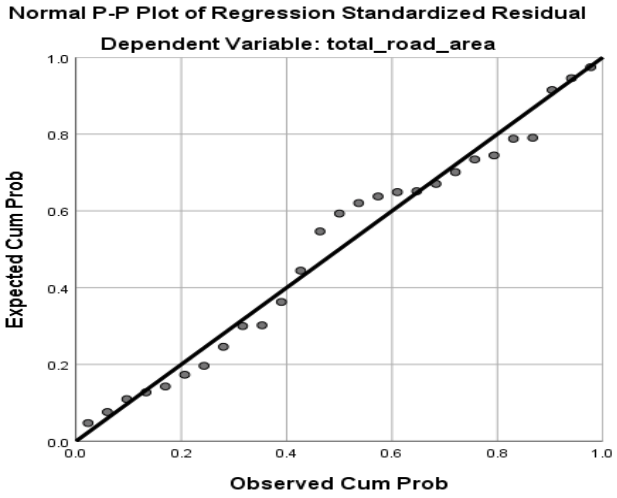


Figure 6. Normal P-P Plot of Regression Standardized Residual

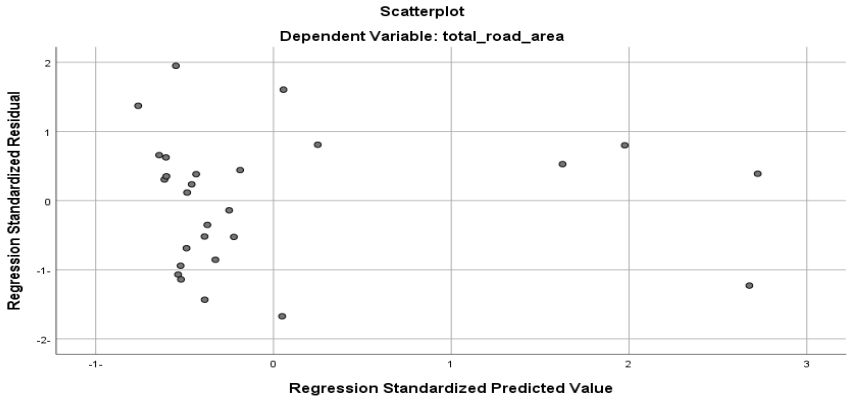


Figure 7. Scatter plot

11. Conclusions

The study conclusions indicate that the environmental dimension has a great impact on the urban road network and contributes to achieving sustainability and that Ramadi is an urban city. And for sustainability to be achieved together. The study also concluded that there is a close correlation between the total urban road network area, green spaces, noise and pollution, and although the green spaces have achieved sustainability for the city by matching design standards, pollution and noise have led to a defect in the transportation system and a loss of sustainability from the urban road network.

12. Recommendations

These recommendations are the solutions and the keys to technical and planning solutions, so the presence of specialists is required to analyze and apply them in a manner that suits each case to reach the most efficient, appropriate and appropriate designs and to reach a sustainable environment and an environmentally sustainable road network, and it must be updated to keep pace with development and social and economic growth and to benefit from the designs of developed countries. , And using similar schemes in it, and using it as a model to address existing or future problems.

- Developing traffic centers by connecting them to mobile networks using the fifth-generation technology and linking them with cameras to facilitate traffic flow, regulate traffic and reduce congestion.

- The necessity of organizing separate pedestrian and cycle paths and the spread of new means of transportation in all countries represented by tuk-tuk or tripe, especially if the streets are wide, redesigning them, and imposing appropriate laws.

- Working with standards of the distance between services to reduce the volume of trips

Integrated planning through mixing uses to encourage walking, availability of services, reduce transportation, and provide a clean environment free from wear and energy

- Developing sustainable transport and energy systems in urban areas, represented by public transport and non-motorized transport

Preferring public transport to reach different regions on a paid system and providing stops on bus lines to encourage citizens to use public transportation

Allocating special means of transportation for employees and workers in state departments

- The competent authorities must impose the existence of car parks when constructing any building, and they must be by the standards

Use of economic standards by managing demand for transportation systems by imposing tolls on roads, parking lots, and vehicles.

References

Abrahim, A. H. (2019). *Strategies of Sustainable Transport of Ramadi City*. 1–177.

Ahmed, Ni. A. (2020). *The Impact of Land Use Change in Ramadi on Sustainable Transport planning*.

Al-Baramly, A., & Al-Sarfi, A. (2017). *Foundations of sustainable urban transport for the new Arab city*. *24*(April).

Bashar Thanoun Al-Shakraji, Muhammad Thanoun Al-Sharabi, F. J. A.-D. (2012). *Green Investment: Analysis study in the City of Mosul*.

Fouad Abdullah Al-Jubouri, H. A.-Q., & Omar, M. K. (2019). *Urban and Social Sustainability: Two sides of one coin*. 1–24.

Jibril, D. R. S. (2020). *data analysis Step-by-step in SPSS*.

Lafah, M., Consulate, G., & Hussein, J. (2014). *(Sustainable Urban Landscaping For Street Corridors in Modern Cities Case Study : British experience)*. *5*(36), 459–479.

Muhammad Ali Al-Anbari, H. H. A. M. (2015). *Evaluate the importance of urban sustainability indicators for a city Hilla city as a model*.

Musab Sami Al-Obaidi , Rawia Marwan Dabdoub, A. J. S. K. (2018). *Test the principles of sustainability in the streets of the city center of Sulaymaniyah towards achieving a sustainable urban city*.

Shanbi, S. (2017). *The use of the smart transport strategy as a tool to support sustainable transport tools - studying the application requirements in road transport in Algeria*.

UNICEF. (2019). Middle East and Africa Generation 2030.