Journal of Energy Technologies and Policy
ISSN 2224-3232 (Paper) ISSN 2225-0573 (Online)
Vol.12, No.4, 2022

Towards An Achieving A Smart Environmental City: A Case Study from Aqaba- Jordan

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Abstract
There is a global trend towards transforming cities into a "smart city" where many countries and governments have begun to implement smart city strategies in their cities due to the many urban challenges and problems facing cities these days, and traditional methods are no longer able to address these problems, so the need arose a new comprehensive system capable of making the city flexible and resilient to challenges through the use of a comprehensive "smart city curriculum" curriculum. In this context, the city of Aqaba was chosen as a study area and we noticed that it obviously suffers from the effects of climate change on it. We then tried to concentrate on developing a methodology aimed at achieving an environmentally smart city and making it more capable of making the city of high quality with a best use of natural resources. The paper also aims to identify the indicators of smart city in the urban environment of Aqaba city that have an impact on smart city factors through a qualitative questionnaire and interviews with specialists working in urban planning sectors in Aqaba. Therefore, the paper comes out with the applications and programs for the environment dimension that must be achieved in Aqaba in order to become a smart city environmentally. The paper presents a set of strategies that come out from the problems which are inferenced from the below study to be used by planners, urban designers and architects in the planning process in Aqaba in order to achieve the environmental dimension, therefore promote the smartness and quality of life for citizens.
Keywords: Smart City, Sustainable, Smart Environment, Aqaba City.
DOI: 10.7176/JETP/12-4-04
Publication date: October 31st 2022

1. The term of smart city

This paper aims to investigate the smart city principles in Aqaba-Jordan through comparing it with the international smart city standards. Where some focus on socio-economic issues highlighting the importance of social and human factor (E. Giffinger,2007). Other on institutional aspects (J. Coe, A., Paquet, G., Roy,2001). While other conceptualise the 'smart city' with the icon of a 'sustainable', 'green' and 'livable' city and indicate its emergency as a response to the rapid urban population worldwide (H. Chourabi,2011). A limited number of studies systematically consider research questions related to this phenomenon called smart cities environmental issues, energy consumption and scarcity of natural resources (G. Karnouskos, S. Da Silva,2012). The second aim is studying the difficult situations and examine the challenges that stand in the face of the trends towards the 'smart' concept focusing on the Aqaba city and its environmental problems and the urban planning process. To achieve a better life for citizens through convert Aqaba to smart city environmentally, it would have clean energy, assured power supply efficient public transport and would not be polluted or congested".

1.1 The concept of Smart City

The concept of "Smart City" is about creating a sustainable and efficient city. Also, the smart city terminology becomes more popular in recent years. Whereas the concept of 'smart' is gaining a worldwide attention as a response to the challenges of urban sustainability (Bibri, Simon Elias, and John Krogstie/2017). In the Eighties of the last century, the Scientifics were focused on the concept of smartness in self-governed cities and were highlighted in the form of technology-based in its integration and increasing importance in planning and management of modern cities, for instance to the deployment of the smart mobility solutions, reduction of CO2 emissions, etc (Battarra, R., Gargiulo, C., Pappalardo, G., Boiano, D. A., & Oliva, J. S. ,2016). The information revolution and the spread of new information technologies in the 1970s had so greatly influenced the expectations of the evolution of the town and society. Beginning in the 1980s and in the 1990s, the complete development of information technology led many individuals to believe that the city's centralizing function was over and that new techniques could generate new types of manufacturing, markets and organisation of culture, by overcoming the boundaries of spatial closeness and by putting sectors, company districts, workplaces, residential districts, And so on, indiscriminately throughout the globe, thanks to an easy click to cancel the distance (Papa, R., Gargiulo, C., & Galderisi, A. ,2013).

The notion of smart cities has been strongly associated in recent years with the role of human, social and relationship capital by the use of ICTs. In other words, the function of customers and how communications

infrastructure are used are becoming more important. One of the most important citations is that the city effectively "using the network infrastructure to improve economic and political efficiency Enabling social, cultural and urban development "(Hollands, 2008). In other words, what makes a smart city different from "viable cities" or "eco-cities" is the use of data (ICT).

1.2 Dimensions of smart city

Assessment of smart cities ' performance is an effective tool for future development. Through this assessment, strengths and weaknesses could be defined and development goals and plans can also be formulated. It is also possible to compare cities and benefit from the best experience. Also, it can identify the dynamics of smart cities, identify the weaknesses and know the effort needed to overcome them.

In order to describe the smart city, the researchers of Giffinger, Kalasek, Fertner and Milanović in 2007 on their study of smart European medium sized, they performed a smart city into six characteristics based on smart combination of self-decisive and aware citizens (smart mobility, smart government, smart economy, smart environment, smart people, smart living). The six characteristics developed by researchers into an easily hierarchic structure where the results of each level are described by the next level. Therefore, every characteristic is defined by a number of factors. In addition, a number of indicators are described each factor.

Finally, the 6 characteristics are identified by 33 factors. In order to analyze the performance, 1-4 indicators were selected in each factor as considered in the figure below (1).

The figure (1) shows the six characteristics and the factors attributed to them.

Considering the dimensions of smart urban development are equally important, none of the indicators, factors or characteristics are weighed upon the final assessment, and through this assessment each city is given a smart value. Indicators defining that factor are added to the total value of that factor, therefore the total of value is added to each dimension of the city and then to the city as a whole. Not all indicators are collected but, due to the difficulty of accessing certain data the average is taken by collecting and dividing the values by their number (Giffinger, R., Fertner, C., Kramar, H., & Meijers, E., 2007). While in this study, we took the dimension of smart environment to study it in the Aqaba city.

SMART ECONOMY (Competitiveness)	**SMART PEOPLE (Social and Human Capital)**
• **Innovative spirit** • **Entrepreneurship** • **Economic image & trademarks** • **Productivity** • **Flexibility of labour market** • **International embeddedness** • **Ability to transform**	• **Level of qualification** • **Affinity to lifelong learning** • **Social and ethnic plurality** • **Flexibility** • **Creativity** • **Cosmopolitanism/Openmindedness** • **Participation in public life**
SMART GOVERNANCE (Participation)	**SMART MOBILITY (Transport and ICT)**
• **Participation in decision-making** • **Public and social services** • **Transparent governance** • **Political strategies &** • **perspectives**	• **Local accessibility** • **(Inter-)national accessibility** • **Availability of ICT-infrastructure** • **Sustainable, innovative and safe** • **transport systems**
SMART ENVIRONMENT (Natural resources)	**SMART LIVING (Quality of life)**
• **Attractivity of natural conditions** • **Pollution** • **Environmental protection** • **Sustainable resource management**	• **Cultural facilities** • **Health conditions** • **Individual safety** • **Housing quality** • **Education facilities** • **Touristic attractivity** • **Social cohesion**

Figure 1. Characteristics and factors of a smart city. Source: (Giffinger, Kalasek, Fertner and Milanović , 2007).Edited by (Author, 2022).

2. The Study Area

The study included the Aqaba region and its affiliated municipalities (Al-Quwaira Municipality, Al-Disah Basin

Municipality, Wadi Araba Municipality, Qatar and Rahma Municipality, Qurayqrah Municipality and Feynan). Aqaba is Jordan's only coastal city, and the most populous city on the Aqaba gulf. It situated in the southernmost part of Jordan. Also, it plays a major role in the Jordanian growth through the vibrant sectors of trade and tourism. Also, the port of Aqaba serves the neighborhood countries (https://en.wikipedia.org/wiki/Aqaba). Aqaba is distinguished by its historical significance, which is due to the confirmation of human existence since more than 4000 BC and had its commercial transactions since ancient times and was characterized by copper trade and extraction from its lands. Also, Aqaba reached its importance and the height of its prosperity after the First World War and its accession under the Hashemite rule. Also, it has a great importance on the economic and tourism levels, due to the presence of the port, which promotes commercial and tourism movement between countries (https://en.wikipedia.org/wiki/Aqaba).

2.1 Climate characteristics of Aqaba

Aqaba has a warm winter desert climate, and a hot dry summer. There is virtually no rainfall throughout the year, with June becoming the driest month with 0 mm of precipitation. Its average rainfall here is 32 mm. August is the warmest month and the lowest average temperature in the year is in January. In Aqaba the average temperature is 24.6 ° C and the maximum wind speed is 13.57 km / h (https://en.climatedata.org/asia/jordan/aqaba/aqaba-5591/).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min Temp. (°C)	10.3	11.1	14.1	17.6	20.6	24	25.4	25.6	24.1	20.7	16.4	11.8
Max Temp. (°C)	21	22.6	26.3	30.1	35.1	38	38.9	39.3	35.7	32.6	27.8	22.6
Average Temp. (°C)	15.6	16.8	20.2	23.8	27.8	31	32.1	32.4	29.9	26.6	22.1	17.2
Precipitation / Rainfall (mm)	5	6	5	4	1	0	0	0	0	1	4	6

Figure 2. Monthly temperatures and precipitation in Aqaba. Sources: (climate data.org/asia/jordan/aqaba). Modified by the Author

We notice from the table that the precipitation varies 6 mm between the driest month and the wettest month. During the year, the average temperatures vary by 16.8 °C. It was clear from the previous table that the weather is sunny in most days of the year in the city of Aqaba, which allows the use of renewable energy as a type of energy reduction and the use of solar energy. Also, we noticed that the humidity is slight in compared with other coastal areas which is good. and the average desired temperature for internal conditions to be 21 °C, the heating degree days (HDD) for the area are calculated to be approximately 422 HDD, meaning that the needs for heating during the winter period are very low (https://en.climate-data.org/asia/jordan/aqaba/aqaba-5591/).

3. Methodology

The method that used in the paper is a mixed method of both quantitative and qualitative. The adopted methodology in collecting data is the questionnaire survey and in-depth interviews with the key actors involved in the city of Aqaba's sustainable urban development for smart trends. The data or information gathered using questionnaires focus on select a large spectrum of residents and visitors of the city of Aqaba, also the architects and planners in it. The research approach that used to accomplish the objectives of study includes: (1) using review of literature to recognize the prime aspects related to smart city of Aqaba ,(2) developing the questionnaire, (3) selecting Architects, planners , Engineers, the visitors and residents of Aqaba , who involved in the development of the urban design of Aqaba in Jordan toward smartness with a focus in environmental smartness , (4) validating the content of survey, (5) checking reliability and validity check of the data, (6) distributing the questionnaire and (7) statistical data analysis.

In this paper, the preliminary data is obtained from the respondents of local community by the questionnaire and the respondents of urban planners and engineers working in main development departments of Aqaba's public sector who they participated in the semi structured interview and give specific answers about the city of Aqaba. Secondary data have been obtained from: articles, websites, textbooks and journals, and across previous chapters these data were compiled and explained.

3.1 The environmental problems facing the Aqaba's urban situation are as follows

Problems related to Environment according to semi structure interview

The interview was conducted with three of the most important officials in charge of planning the city of Aqaba. This gave us an opportunity to provide us with important information about the current situation of Aqaba's master plan for the city, and the importance of developing the strategies of the scheme to suit the requirements of the future time.

- Confinement of urban environment in south industrial zone (Industrial complex).
- The need for adaptation of climate change due to its immediate changing.
- The need for emission reduction from the gypsum mountains in Aqaba.
- Lack of open spaces and green Areas which is represent as a tool for environmental resources

Problems related to Environment from literature review

The total amount of energy consumed in the Aqaba Authority is 684.45 GWh, and the following table provides a general description of the total energy consumption.

Table 1. Total Energy consumption per sector in Aqaba. Sources: (SECAP for Aqaba special zone authority,2012)

MWh Sector	Electricity	LPG	Heating Oil	Diesel	Gasoline	Kerosene	Solar thermal
Municipal Buildings, Equipment, Facilities	12,804						
Public Lighting	12,630						
Residential Buildings	143,634	21,811	3,883			803	22481
Tertiary Buildings, Equipment, Facilities	217,555	14,541	5876				
Municipal fleet				9300	2153		
Public Transport				531	73,784		
Private & Commercial Transport				143,764	54,742		

Buildings Consumption

We notice from figure (3) that the tertiary buildings and equipment facilities includes a number of buildings such as hotels, offices, restaurants, stores, public buildings, banks, hospitals etc. which provide services in Aqaba's citizens are the most consumers of electricity, followed by residential buildings which come at the second level. Whereas municipal buildings, equipment and facilities includes 80 buildings managed by ASEZA, such as the municipal hall which consumes a 25% of the whole energy consumption in the municipal buildings, the library and cultural buildings with consumption of 12,804 MWh of electricity. As far as the municipal public lighting is concerned, this sector is related to the street lighting and public areas' lighting the electricity consumption for this sector is the least compared to the previous sectors with 12,630 MWh of electricity and it is based on bills (Electricity Distribution Company, EDCO). Liquefied petroleum gas (LPG) is used primarily for cooking and heating up space. In water heating, a smaller amount is consumed too. The available data for this fuel includes both the residential and tertiary sectors, since separating the bills was unfeasible. According to the expert opinion of ASEZA Technical Service, Aqaba City consumes 450 LPG cylinders daily (12.5 kg / cylinder) from March through September and consumes the double amount daily from December through February. While the tertiary buildings and equipment facilities having small consumptions in LPG and diesel energy (SECAP of Aqaba,2012). Most ASEZA households use kerosene to heat out room. Because data collection at the municipal level was not feasible, the consultants used data that had been collected for the same purpose in Karak municipality. Estimates for these consumptions were made based on data obtained directly from the Karak Municipality gas stations (350,000 litres). An adjustment at the Authority level was made using the ratio of population and the ratio of days of heating degree, since Aqaba has higher average temperatures than Karak in order to identify how much less fuel is needed for space heating (SECAP of Aqaba,2012). ASEZA also uses an amount of diesel for the room and water heating requirements. The solution here was based on the use of diesel in the residential sector by the municipality of Karak (16,309 MWh), accompanied by changes with the ratios of population and heating degree days (SECAP of Aqaba,2012). Additionally, a significant number of households own solar water heaters (SWH), thereby using solar power to heat water. Since, according to official statistics, 9.32 % of the population of Aqaba Governorate own solar heaters, the percentage in ASEZA was assumed to be approximately the same, hence the population with SWH at the Authority level is 10,999. Based on the aforementioned assumptions and results, in the baseline year solar thermal consumption at municipal level was estimated to be 22,480.87 MWh.

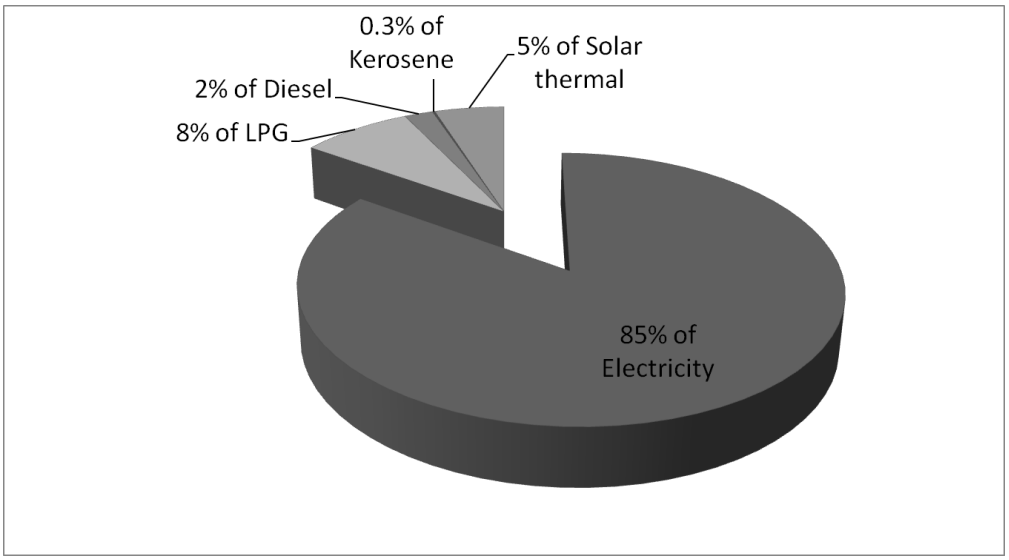

Figure 3. Consumption in buildings and facilities per fuel. Source :(SECAP,2012). Modified by Author,2022.

Transport

"An advanced city is not a place where the poor move about in cars, rather it's where even the rich use public transportation" Enrique Penalosa. In municipal fleet have different types of vehicles with the greatest number of pick-up vehicles followed with passenger vehicles and at the third level is construction vehicles and the least amount number of vehicles is buses. These vehicles are consumed diesel energy more than the gasoline. Whereas public transport refers to the buses and taxes that serve the citizens of Aqaba. The most amount of vehicles types is taxes using only gasoline fuel followed with small buses and coach buses which they use both diesel fuel. Therefore, private and commercial transport according to the registered private and commercial vehicles are 20,541 number. The most amount number of small passenger cars which uses only gasoline fuel followed with (small buses (van), cargo vehicles, trailer (trucks), construction vehicle and medium passenger cars) arranging according to their numbers which uses only diesel fuel (SECAP of Aqaba,2012). In the next figure the proportion between Diesel and Gasoline in the Private and Commercial vehicles and public vehicles. Also, in municipal fleet different types of vehicles as presented, with gasoline being the dominating fuel.

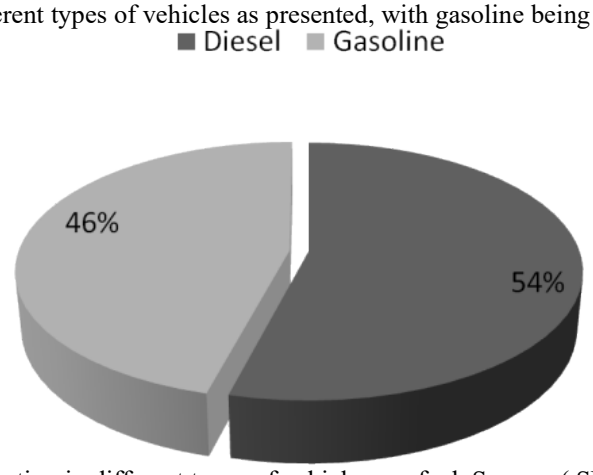

Figure 4. Energy Consumption in different types of vehicles per fuel. Source :(SECAP,2012). Modified by Author, 2022.

Co2 emissions

The local emission factor for electricity is 0.58 MWH which is the most emission resource compared to other energy types. Whereas the solar thermal power hasn't emissions thus its emission factor is zero according to the SECAP guidelines.

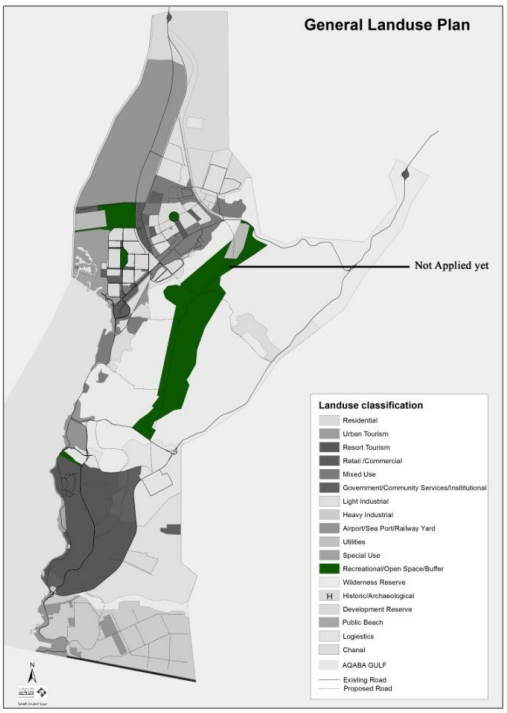

Figure 5. Aqaba Land Use plan represented green areas, (Sources: ASEZA,2022). Modified by the Author.

In the figure 5. we noticed that the green areas which were implemented have the smallest land due to other land use types and the big green land area are not applied yet.

3.2 The Questionnaire Results

Reliability test

Cronbachs' Alpha Coefficient is a measure that was used to estimate the reliability. Cronbachs' Alpha Coefficient value ranges between 0 and 1. If there are no variance among study instruments (i.e. are internally independent) then α =0 but if all study items have a high covariance then α will be close to 1. However, there is a consistence among researchers that the instrument considers reliable and stable if α value are more than 0.7.

Table (2) shows that Cronbachs' Alpha Coefficient is ranged to 0.793 which is more than 0.7, then the instruments of questionnaire are reliable and consistent.

Table 2. Reliability test. Source:(Authur,2022)

Variable	Cronbach Alpha Coefficient
Smart Environment	0.793

Validity (Exploratory Factor Analysis)

Exploratory factor analysis is a statistical mechanism that was conducted to reduce factors or study items to a smaller set of factors. Based on EFA results we can decide which items are appropriate and can be used on further analysis and which one caused cross loading and should be eliminated. To ensure that the data are suited to factor analysis Kaiser-Meyer-Olkin (KMO) was conducted. KMO is a measure of sampling sufficiency for each variable in the instrument. The sampling considers adequate if KMO values ranged between 0.5 and 1. As shown in the table (3), the value of KMO is .93, which means that the factor analysis is relevant for this study.

Table 3. KMO and Bartlett's Test. Source :(Authur,2022)

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.671
Bartlett's Test of Sphericity Approx. Chi-Square	3914.413
Sig	0.000

Demographic Description

Demographic information section of the questionnaire in this study was designed to get the following information from respondents:

1. Gender. 2. Their experience. 3. Age. 4. Occupational Level. 5. Level of education. 6. Resistance status.

Frequencies and percentages are shown in the following Table (4) to describe the profile information of the respondents.

Table4. Demographic description. Source:(Authur,2022)

Variables	Categories	Frequency	Percent
Gender	Female	164	60.2941176
	Male	108	39.7058824
Age	18-29	179	65.8088235
	30-39	64	23.5294118
	+40	29	10.6617647
Are you a resident of Aqaba?	No	69	25.3676471
	Yes	203	74.6323529
Educational Level	High School	8	2.94117647
	Diploma	3	1.10294118
	Bachelor's degree	203	74.6323529
	Postgraduate	58	21.3235294
Experience Level	Less than 5 yrs	122	44.8529412
	5-10 yrs	95	34.9264706
	More than 10 yrs	55	20.2205882
If you are a resident of Aqaba, how many years have you lived in it?	Less than 5 yrs	60	22.0588235
	5-10 yrs	20	7.35294118
	More than 10 yrs	137	50.3676471
If you are a tourist or visitor to Aqaba, then what is your country?	Aqaba	137	50.3676471
	France	1	0.36764706
	Italy	2	0.73529412
	Jordan	10	3.67647059
	Jordan-Ajloun	1	0.36764706
	Jordan-Amman	56	20.5882353
	Jordan-Irbid	13	4.77941176
	Jordan-Karak	28	10.2941176
	Jordan-Maan	15	5.51470588
	Jordan-Mafraq	2	0.73529412
	Jordan-Salt	1	0.36764706
	Jordan-Zarqa	2	0.73529412
	Poland	2	0.73529412
	Russia	2	0.73529412
Job Title	Accountant	4	1.47058824
	Engineer	69	25.3676471
	Environmental field	9	3.30882353
	Education sector	8	2.94117647
	Health sector	10	3.67647059

The results show that the most respondents ranged in age between 18 and 29 years (66%), followed by respondents who aged between 30 and 39 years (23.5%). On other hand, 44.8% of respondents have an experience less than 5 years followed by respondents who have experience ranged between 5 and 10 years (34.9%).

Furthermore, 74% of respondents have bachelor's degree followed by 21.3% of respondents have Postgraduate's degree.

4. Analysis

Table 5. Evaluation of Aqaba city as being a smart city in environment dimension. Source:(Authur,2022)

Smart Environment			
Factor	**Indicator**	**Mean**	**Compatible to smart city dimensions**
A. Availability of natural elements	1. Do you notice that there is an availability of green areas in your area (or the area that you visited in Aqaba)?	2.40	**Not compatible**
B. Pollution	2. I think that the proportion of Aqaba residents who suffer from chronic diseases of the respiratory tract is large.	3.30	**compatible**
9	3. To what extent does the area you live in (or the area you visited in Aqaba) suffer from a specific environmental problem?	3.34	compatible
		3.32	compatible
C. Environmental protection	4. I think there are individual efforts by the residents of Aqaba to protect the environment.	3.04	compatible
D. Natural Resources Management	5. Do you think that there is an effective rational consumption of electricity by the residents of Aqaba?	2.67	Not compatible
	6. Do you think that there is an effective rational consumption of electricity by the residents of Aqaba?	2.72	Not compatible
		2.69	Not compatible

-Aqaba is not smart in environment.

(1) According to the table (5), the estimated indicator of the (A) factor mean are less than the satisfaction mean (3), this is an indicator that all of the respondents have a negative opinion about the first factor which is availability of natural elements from (sarcastic of green areas in Aqaba regions) and the p-values of this indicator is less than 0.05, which means there is statically significant difference in respondents' responses towards this indicator regarding different respondent's age. Where the group who is (+40) see that there is a green area around them but the younger groups don't. On the other hand the mean of Indicator (9+10) of the (B) factor is more than the satisfaction mean (3), this is an indicator that all of the respondents have a positive opinion about the (B) factor which is the existence of pollution from (the proportion of Aqaba residents who suffer from chronic diseases of the respiratory tract and Aqaba region suffer from a specific environmental problem) and the p-values of this indicator is less than 0.05, which means there is statically significant difference in respondents' responses towards this indicator regarding different respondent's age, job title, education level and years of experience. The group age of (18-29) and (+40) see that Aqaba residents suffer from chronic diseases of the respiratory tract where the group age (30-39) doesn't. The engineers and employees in the environmental sector agreed, while their opinions differed from others and from receptionists. While in (3) indicator the old residents of Aqaba and who holds bachelor's degree see that Aqaba have an environment problem. The estimated indicator (4) of the (A) factor mean is more than the satisfaction mean (3) this is an indicator that all of the respondents have a positive opinion about the (C) factor which means that (residents of Aqaba have an individual effort to protect the environment) and the p-values of this indicator is less than 0.05, which means there is statically significant difference in respondents' responses towards this indicator regarding different respondent's job title. Where employees in health sector see that there are no efforts toward environment protection in contrast with the opinions of employees in educational sector and environmental sector. The estimated indicators (5+6) of the (D) factor means are less than the satisfaction mean (3) this is an indicator that all of the respondents have a negative opinion about the (D) factor of natural resources management from (residents of Aqaba have an effective rational consumption of electricity and water) and the

p-values of this indicator is less than 0.05, which means there is statically significant difference in respondents' responses towards these indicators regarding different respondent's job title and residents. Where accountants see that there is rationalization in water consumption whereas urban planners don't. The residents of Aqaba who lived less than 5 years see that there is no rationalization in electrical consumption while the old residents don't. We notice that the factor A+D are not compatible to smart city dimensions and the factor B+C are compatible to smart city dimensions that leads to conclude that Aqaba have efforts toward environmental protection and does not suffer from pollution at its lands but it suffers from lack of green areas and have a bad management for natural resources.

5. Discussion

Demographic data gives information describing the study population and describes the personal characteristics of respondents in terms of their gender, job position, experience, age and the period of living in Aqaba. These qualities may affect the respondent's attitude toward any of the variables the study investigates. The result of this study shows that:

Respondents' job position directly affects respondents' attitudes toward their choice of the smart environment indicators that affect the factors of smart city evaluation of Aqaba. The result reveals that engineers, urban planners and employees that work environmental sector have a more negative attitude toward these factors more than other respondents. This outcome may be the result of their knowledge of the design and planning of the environmental development toward Aqaba city and their knowledge of the strategies of Urban Design unlike the other job positions.

6. Conclusion

The author analyzed the study area of Aqaba city by questionnaire the findings indicate that the urban design indicators that related to the dimensions of smart city of Aqaba city did not accomplish the urban design factors related to smart city dimensions in the section of environment. This paper explored that many of Aqaba city problems are about the lack of cooperation between public and private sectors which is lead to traffic problems especially in public transportation system and in the aspect of the uses of energy. This paper examined also the real problems related to the residents of Aqaba from suffering from poverty due to the rate of unemployment and difficulty to find a job which is somehow affected the individual consumption of natural resources. In addition to the lack of green areas and public spaces for people to interact naturally with the local environment.

6.1 Conclusions of the survey

According to respondents, the results of this research reveal that:

1. According to most participants of the survey, Aqaba is not being yet a smart city.
2. Participants agreed that Aqaba suffer from lack of green areas, as well as the experts agreed too.
3. According to the results, the city of Aqaba has a wide availability of technical infrastructure, but it needs a safe and sustainable transportation system.
4. According to the results, more than half of the City of Aqaba residents, that think that a large proportion of residents suffer from chronic disease of the respiratory tract, while the majority of them think that Aqaba pollution-free, and around half of them believe that there is a huge effort to protect the environment especially from the employees in environmental sector and students.
5. According to the survey participants, the inhabitants of the city of Aqaba think there is electrical consumption, and the urban planners think there is a water consumption while the accountants see there is not.
6. Participants agreed that there is a wide contribution in decision making from the inhabitants, while urban planners and residents of Aqaba complained from lack of public and social services.
7. According to most residents of Aqaba, they are sick from the bad quality of health system. The same happened to educational system, most of the residents especially from students are complained from the difficult access to schools and universities.
8. Inhabitants of Aqaba from students and engineers see that Aqaba suffer from poverty, while the majority see the opposite. Also, more than half of the respondents don't have satisfaction about their quality of their housing.

6.2 Conclusions of Interviews

1. The difficulty of using smart applications by citizens
2. Lack of local expertise in smart city implementation
3. Lack of collaboration between participating governmental agencies
4. Community opposition
5. Legal issues
6. Insufficient regulation of traffic

7. Lack of funding resources for improvement
8. Lack of awareness from the people
9. The need to strengthen international relations by facilitating services for transport companies.
10. Lack of open spaces and green Areas which is represent as a tool for environmental resources.
11. The need for adaptation of climate change due to its immediate changing.
12. The lack efforts in recycling and waste disposal
13. Existing infrastructure for energy, water and transportation systems
14. Lack of collaboration between public and private sectors.

6.3 Recommendations

Based on the study provided before, the author recommends the followings:

Table 6. Proposed strategies for planners in smart environment in Aqaba city. Source: (Authur,2022)

Smart environment		
Problem	Applications	Proposed strategies
Energy consumption	Energy management	• use environmental monitoring to achieve energy conservation and emission reduction
		• optimisation of the distribution network through intelligent adjustments by means of data transmission, computation and analysis.
	Engage the public in energy conservation and emission reduction.	• promote the Energy Saving by formulating the Energy Saving Charters on Indoor Temperature • promote sustainable green buildings to make efficient use of energy by implementing construction within green building standards • An intelligent infrastructure for energy-sharing. Renewable energy sources are stored and distributed on the basis of demand.
Lack of green areas	Implementation of green urban planning	• use of web-based and remote monitoring technologies to fully understand and analyse the distribution of public spaces, grassland and green belts with a view to promoting a green environment
	Implementation of water features	Revitalizing water bodies in large-scale drainage improvement works and planning drainage networks for New Development Areas so as to build a better environment for the public.
The need of resource management	promote a "Use Less, Waste Less" mode of living	Implementing measures such as plastic bag charging, recyclable collection of food waste and yard waste
	Renewable energy	• promoted the use of renewable energy such as solar power, wind power, landfill gas • An energy producing grid using CO2, increasing the use of fossil-based raw materials.

References

J. Coe, A., Paquet, G., Roy, "E-Governance and Smart Communities: A Social Learning Challenge," Soc. Sci. Comput. Rev., vol. 19, no. 80, 2001

Nam, T., Aldama, F. A., Chourabi, H., Mellouli, S., Pardo, T. A., Gil-Garcia, J. R., ... & Zheng, L. (2011, June). Smart cities and service integration. In Proceedings of the 12th Annual International Digital Government

Research Conference: Digital Government Innovation in Challenging Times (pp. 333-334).
Ilic, D., Da Silva, P. G., Karnouskos, S., & Griesemer, M. (2012, June). An energy market for trading electricity in smart grid neighbourhoods. In 2012 6th IEEE international conference on digital ecosystems and technologies (DEST) (pp. 1-6). IEEE.
Bibri, S. E., & Krogstie, J. (2017). Smart sustainable cities of the future: An extensive interdisciplinary literature review. Sustainable cities and society, 31, 183- 212
Battarra, R., Gargiulo, C., Pappalardo, G., Boiano, D. A., & Oliva, J. S. (2016). Planning in the era of information and communication technologies. Discussing the "label: Smart" in South-European cities with environmental and socio-economic challenges. Cities, 59, 1-7.
Papa, R., Gargiulo, C., & Galderisi, A. (2013). Towards an urban planners' perspective on Smart City. TeMA Journal of Land Use, Mobility and Environment, 6(01), 5-17.
Hollands, R. G. (2008). Will the real smart city please stand up? Intelligent, progressive or entrepreneurial? City, 12(3), 303-320.
Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanović, N., & Meijers, E. (2007). Smart cities: Ranking of european medium-sized cities. vienna, austria: Centre of regional science (srf), vienna university of technology. www. smart-cities. eu/download/smart cities final report. pdf.
Aqaba city history, https://en.wikipedia.org/wiki/Aqaba
CLIMATE-DATA.ORG, https://en.climate-data.org/asia/jordan/aqaba/aqaba-5591/
Kardoosh, M. (2005). The aqaba special economic zone, Jordan: A case study of governance. ASEZ Project.
Electricity Distribution Company, EDCO, http://www.edco.jo/index.php/ar/
Authority, A. S. E. Z. (2010). Disaster Risk Management Profile for the Aqaba. Special Economic Zone, Amman