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Natural and Human Urban Form Insdicators: Decision-Making and the Natural Environment Dialectic in Sustainability

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Abstract: ***The study consists of both the patterns of land use composition, spreading and distribution of "Khalidya city" in Anbar Province, Iraq. Regarding the generation of slums with endemic mismanagement of in the city of Al Khalidya, the pattern of landuse needs urgently to be studied and then problems which arise from improper planning can be identified in order that the development of a strategic optimum application can take place. The objective of the study is to identify natural and administrative contexts in shaping the urban form of City of Al Khalidyah indicators that influence property use, such as natural, human variables and spatial interactions and to provide combinations and reasons for land use, economic social and utilities feedback in the area under the study Indicator influence in context of natural growth and planning decision-making was calculated using the SPSS software. The model's input was focused on information sources: field studies, immediate interviews with individual's municipal decision makers and the Governorate's Directorate for Urban Planning. The development of Khalidiyah has largely been focused on natural contexts (economic and social), with a view to only addressing the residential crisis, whilst all facilities and utilities have been overlooked with no concept of sustainability, together with the usage of natural and human capital The city plan highlights the failure to utilize agricultural areas, prospective tourism, and renewable sources as well as environmental and economic tasks.***

Index Terms**:** ***Natural context, Urban form, Administrative decision, System***

I. INTRODUCTION

The growth rates in urban areas of Iraq do not give any signs of retard. Rapid urbanization has led to an increased rapidity of residential and commercial development that replaces green areas and other undeveloped surrounding lands [1]. Although the rapid urbanization process has led to considerable development in the economy, industrialization, migration, it has significantly increased land use. The problems of urban sprawl are loss of vegetation cover and a general decline in environmental quality and can be attributed to an increase in population as the total land allocated to urbanization expands [2].

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Land use and land cover are so important as they determine the nature and future performance of infrastructures [3]. Thus, urbanization has become synonymous with periodic changes in land use, which often impacts negatively on the environment. Moreover, land mismanagement results in illogical urban development that antagonizes land suitability and expansion capacities, which leads to complex challenges faced by planners and policymakers. It may also lead to external factors as decision makers have often neglected the enabling resources and absorptive capacity to develop more growth strategies for the future[4].

Al-Khalidya is one of the Iraqi cities that have long suffered from the acquisition of small tracts of land that had structures arbitrarily built on them (irregularities). Hence, an imprint of randomness can be observed within or outside the municipal boundaries. This randomness is due to the competition for land, increasing population and immigrants without a concomitant increase in land area, and misuse of available land projected for specific purposes. Moreover, successive schemes have failed to draw up an effectual land development policy. The political factors that have rolled over the city in previous years have also influenced its planning process. Nonetheless, the municipality is now striving, in cooperation with the local council, to mitigate and reduce this randomness.

Although the given the proliferation of slums and endemic mismanagement of land use are common, there is an urgent need to study the patterns of land use, and then identify existing problems arising from improper planning and the subsequent development of an optimum use strategy. The study of land uses and their sites on the master plan are valuable and beneficial to all aspects of development and the achievement of desired and realistic objectives. Resolving this quagmire of land use constitutes an important and fundamental stage in the development and planning of the study area. Therefore, the objectives of this study are to determine the role of both natural context and administrative decision in shaping the urban form of Al Khalidya City, and provide knowledge of the factors influencing land uses, such as natural and human factors and spatial relationships, as well as compilation and clarification of information on land uses, economic and social characteristics and services in the study area for decision makers. Al Khalidya City was selected because of its important geographic location and expected future role as a vital hub and growth pool for agricultural, industrial and tourism activities, which has the greatest impact in enhancing its attraction of investment and employment.

II. URBAN FORM

A. *The concept*

Cities are, in morphological terms, extremely complex objects. In other words, cities are objects composed of different objects or parts. It is possible to identify several relationships between these objects 'from the part to the whole' and to recognize a hierarchy in these relations. To deal with the complexity of cities, urban morphology uses this hierarchical view of the city, structured according to a set of fundamental physical elements.

At a general level, a city is composed of urban tissues. Karl Kropf defines urban tissue as an organic whole that can be seen according to different levels of resolution. These different levels correspond to different elements of urban form. The higher the level of resolution, the greater the detail of what is shown and the greater the specificity of morphological description. At a very low level, the urban tissue includes only the streets and street blocks. At a high level of resolution, the tissue might include several details such as the construction materials of an open space or building [5].

In general, all cities and their tissues are constituted by a set of elements of urban form—streets, 1 street blocks, plots and buildings. Yet, in each city these streets, street blocks, plots and buildings are combined in a specific way, originating different types of tissues. Some of these tissues are clearly identifiable and can offer their cities unique characters. Each of these urban phenomena is deepened by the 'time' factor, as many our cities are indeed the result of a long process of construction, developed over centuries, and where different layers are continuously overlapping without erasing the previous layer.

B. *The Natural Context*

The natural context is the first condition for the establishment and organization of the different elements of urban form [6]. The land relief, the quality and suitability of soil and subsoil, the climate, the solar and wind exposure, the type of natural landscape— all these factors influence how a settlement is established, from its foundation, from the first paths and streets (and, subsequently, from all the infrastructures that will be built in the streets) to the way land is subdivided into a number of different parts, to the various buildings that are built in these plots, and even to the materials that will give expression and surface to all these forms. In each initial intention of human settlement, in different historical periods, the land relief has its own configuration as well as a geometry that influences the location and the form of that settlement [5].

In different human settlements, the definition of the first paths follows this natural structure of the territory strengthening its own configuration and geometry. Indeed, these lines that structure the territory represent the lines where the effort to overcome the slope is smaller. As such, for centuries, these were the lines of movement. The place where these lines of movement get together became the central places.

C. *The Street System*

The streets system provides a way to systematically move around a given location and to gain knowledge about a city. Streets define the different street blocks that constitute a city and differentiate what is public, and is thus accessible to all citizens, from what is private or semi-public. In general terms, streets are the public and democratic spaces of the city, where everyone with their differences meet and socially interact.

D. *The Plot System*

The plots system of a city is an important element of urban form that separates the public domain from the private domain. Nevertheless, the role of this fundamental system is often ignored by key agents and stakeholders in the process of city building, mainly due to the apparent reduced urban visibility of plots. The definition of the plots system in a specified territory is an essential element of its urbanization process and ensures considerable stability over time. The decision on setting up a new structure of private ownership in a specific territory might involve the subdivision of a set of large plots or the proposal of a new land division. This urbanization process usually involves the precise definition of the different plots based on the following factors: (i) relationship between plot with the street, and the orientation of the plot in relation to the orientation of the street, (ii) the position of each plot within the plots system (in the middle or in the edge of the street block, (iii) the shape of the plot, and its dimensions and proportions.

E. *The Building System*

Although buildings do not have the stability in time that streets and plots have, they are one of the most significant elements of urban form and, possibly, the most visible of these elements. Generally, the city comprises two different kinds of buildings: ordinary buildings and exceptional buildings. The main characteristics that distinguish these two types are related to building form and building utilization. The ordinary building type includes most of the buildings that make up the city. The similarities between buildings, within this type, are stronger than their differences. This type includes mostly buildings of residential utilization but also commerce and services buildings. The exceptional building type comprises only a few buildings of the city that are clearly distinguishable in the urban landscape by their shape. Within this second building type, there is a smaller and very distinct set of unique buildings whose form becomes indistinct from the form of the city they are part of.

The height of buildings is another important feature, particularly the relationship between the height of a building and the width of street they are located. Any variation in these two measures can initiate considerable changes in the urban landscape. If the height of a building is significantly less than the street width, little sense can be made of the enclosure. On the other hand, if the height exceeds the street width, the sense of enclosure will increase.

F. *Factors that affect the elements of urban form*

- Political factors: These factors play a major and influential role in shaping the dimensions of realistic development. Given the circumstances of the country, people have been led to coexist with the randomness and chaos of land use with disregard for the law and controls initially in place [7].
- Economic factors: These are factors that affect the form of land use. The factors or conditions have led to dominance of land issue in important and vibrant locations in the city. Thus, land has become a trading commodity affecting the process of trade within the city (supply and demand) [8]
- Social factors: These are the outcomes of external and internal pressures that are related to human survival, and important to evaluating the social economic development and peoples' livelihood. They determine the extent to which a family and extended families can coexist in an independent dwelling unit. The factors include family structure, household life and social customs.

- These factors affect the design of dwelling house, thereby controlling the urban residential development plan [9].
- General factors: These factors include conditions of the city and the nature of available services in it, and their importance compared to adjoining cities in terms of location, availability of jobs, road network, etc. These factors are important for Khalidya as it lies between two poles of attraction.
- Cultural factors: These play a significant role in the form of land use and the distribution of activities, and the actions of individuals in the city that reflect their inherited culture.
- Administrative and planning factors: These are factors responsible or authorized to plan and manage the city, which are the municipality and Directorate of Physical Planning under the supervision and support of the local government. Given the inability and failure of the local government to provide support for the municipality's decision, municipal officials are constantly confronted by violators in their attempts to remove irregularities [10]

III. THE STUDY AREA

The general characteristics of the study area are analysed from two levels: regional and urban, because of their strong relations and interactions, particularly in the suburbs.Al-Khalidya City in Anbar Governorate is located between two latitudes 33° 22 –33° 26 North and linear length of 43° 48- 43° 49 East, about 80 km away from Baghdad. Al-Khalidya City occupies 714 km^{2}Figure 1. The surface of Khalidya area is generally flat and ranges from 35 to 103 m above sea level. The dominant features in the study area consists of four types, namely the plateau, the sedimentary plain, the Euphrates River and the Lake of Habbaniyah. The major natural resources inKhalidya area are the Euphrates River and Habbaniyah Lake in the south-east side, natural plants and mineral resources that include limestone (49%), gypsum (24%) and river sand (15%). The disparity in the numbers and proportions of the population is due to natural increase in population (natality rate), improvement in the level of social services and amenities, and availability of employment which has encouraged stability. The average population density in the city is 53 persons per/ha. The number of inhabitants in 2018 is 58702 with 11309 households occupying 6367 housing units and a family size rate of 5.9 (Table 1&2).

Figure 1: Khalidya: (a) regional, (b) land use/cover
Ref. (Quik Bird satellite images (2016, R.0.6m)).

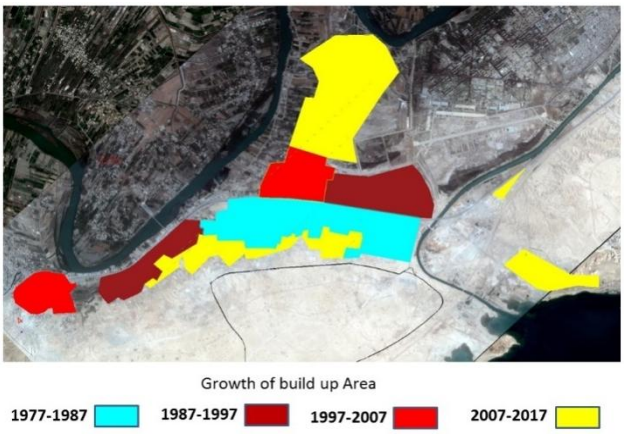

Figure 2 Map of urban sprawl of Al-Khalidya city from 1977 to 2017.
Ref. the researchers

Year	Area		Population		Density Per/ha
	Ha.	% Growth/year	1000	% Growth/year	
1977	198	-	20360	-	103
1987	245	2.13	24148	1.7	99
1997	451	6.1	29486	2	65
2007	602	2.8	46051	4.4	76
2018	1124	6.24	58702	2.2	53

Table 1 Urban sprawl and population growth in Al-Khalidya city starting from 1977 (Ref.: Figs 2&4)

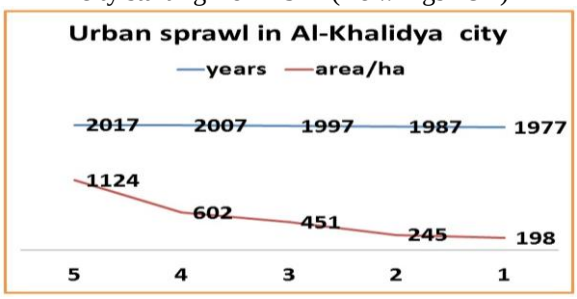

Figure 3: Urban sprawl of Al-Khalidya city from 1977 to 2017 (Ref: the researchers from Table 1).

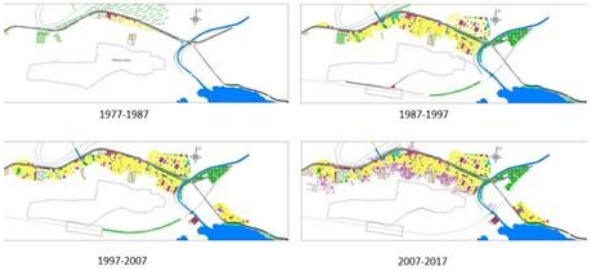

Figure 4Evolution of master plan of Al-Khalidya City over 40 years (4 stages).
Ref.: AutoCad software by the researchers)

A. *Patterns of Urban form*

- Linear distribution: The settlements according to this pattern shows a line along the General road (Baghdad--Ramadi) and a railway (Baghdad -Syria).
- Clustered distribution: The settlement centers in this pattern of urban form comprise regular and irregular gatherings that are characterized by small size area and large population growth.

- Scatter distribution: Here, the centers of settlements are distributed indiscriminately over a wide area of land. The prevalence of this pattern of settlement is widely observed. The appearance of this pattern is due to several causes that include scarcity of water resources and high incidence of individual ownership [2].

B. Economic activities

Agriculture: The total area occupied by rural expanses is 14895 ha, but the suitable agriculture area is only 5059 ha (34%). The area under cultivation did not exceed 68.7% of the total arable land in the area. Agricultural crops in the area include seeds, vegetables, tuber crops, fodder crops and palm groves. Animal production is carried out in 4.8 ha of the area under exploitation with 57 poultry fields covering an area of 10.25 ha.

Industry and Tourism: The city's administration does not currently have a practical plan for exploiting natural resources to revive its industrial potential. Moreover, there is no appropriate design plan for the development of the city and its territory. Tourism depends only on natural elements, and is not related to the human aspects of archaeological and historical sites [11].

C. Urban land use

The area of Khalidya city is 235.5 ha. There are no archaeological or cultural monuments in the city, as it is a modern city. It is also devoid of civilizational monuments being a small city. It should be noted that there are disparities in the levels of construction in the city, as there are many luxury mansions and large villas, as well as simple old-style houses. Two major trends in land use/coverage can be identified between 1997 and 2017: the intensification of urbanization in central areas where a few open areas and hills have been occupied to accommodate residential use, and urbanization in the semi-urban/suburban areas, where urbanization is increasingly being expanded at the expense of permanent crops and palm groves. However, the distribution of services did not consider the needs of residents and is not based on a specific criterion. Due to uncontrolled growth, the land on which the services were constructed is only spaces within the crowded fabric [12]. Table 2 shows the rates of land use.

Land use	Area /ha	%
Residential	199.36	33.66
Educational	7.42	1.25
Health	1.19	0.20
Commercial	2.73	0.46
Government offices	3.35	0.57
Public Services	2.4	0.40
Religious	2.81	0.47
Industrial	0.63	0.11
Warehouses	0.56	0.09
Green area	7.19	1.22
Sport	1.48	0.25
Cemeteries	7.55	1.28
Irregularities (slums)	236.67	39.96
Vacancy	153.66	25.97
Roads and squares	201.64	34.07
Total area / ha	591.97	100

Table 2: Land Use and Coverage Rates in Khalidiya
Ref.: Urban Planning Directorate of Anbar

IV. METHODOLOGY

A. Data sources

The data analyzed in this study was obtained from central departments and institutions in Baghdad and Anbar province. Regional field reconnaissance of the city and its suburban was also embarked on with accompanying recording of phenomena and observations. This study also relied on direct meetings with community personalities responsible for technically managing the city and personalities that have archived knowledge of the city. Other sources of data include topographic maps issued by the General Surveying Institute, spot satellite images (2008, R.14m) and Quik Bird satellite images (2008, R.0.6m). Large and medium-sized enterprises as well as industrial and commercial activities were also surveyed for data on economic activities and employment.

B. Statistical analysis

The SPSS program was used to calculate the effect of indicators on the context of natural expansion and planning decision making. The inputs of the model were based on data sources, field surveys and direct interviews with citizens and decision-makers in the city council and the directorate of urban planning in the governorate.

Table 3 shows the concept of indicators and their expected impacts by program outputs.

No.	Indicators	Natural context	Exp. sign	Administrative decision	Exp. sign
1	Streetssystem	Irregular, non-paved, variable dimensions and organic shapes	+	Regularly, Straight, Grid and paved by 65% with afforestation by 45%	+
2	Plots system	Random in distribution, varying in shape, area and direction. Not specified block	-	Geometric shape, Specific dimensions, static orientation and specified block	+
3	Buildingssystem	Similarity in building materials, design elements, style and height	-	Diversity in building materials, design elements, finishing materials and height	+
4	Political factors	There is no direct or obvious effect	-	Dominates all other factors significantly	+
5	Economic factors	Is important in the supply and demand of land and the lack of employment opportunities	-	The housing market depends on the system of land distribution by the municipality and the impact of supply and demand is weak	+
6	Social factors	Old customs and traditions lead society with a concentration of poverty, deprivation and ignorance by a large percentage	+	government organization that relies on providing some community services, but it does not meet all requirements	+
7	General factors	Far from the city's potential (especially transport routes and water bodies)	+	Is representing the economic base of the city and its suburbs by the shape of the strip adjacent to the regional streets and railway	+
8	Cultural factors	Fading Local Inherited with one nationality and religion	-	Diversity of heritage and culture with more than nationality and religion	+
9	Administrative andplanning factors	Population divides land by mutual consent and without planning or documentation	+	Adopting an objective approach within appropriate planning stages but for long periods (25 years)	+
10	Borders	There are no administrative boundaries, but natural borders such as the river	+	Clear administrative boundaries that define local powers	+
11	Topography	Construction and expansion followmainly topography	+	A secondary factor in decision making	+
12	Natural Resources	Complete neglect of natural resources with crawling on their sources, although they are widely available	+	Complete neglect of natural resources with crawling on their sources, although they are widely available	+
13	Population distribution	Scattered and agglomeration distribution	-	Geometric Grid with blocks	+
14	Agriculture	The abundance of agricultural land, but the crawl on them continues	+	There is no urban vegetated	+

Coefficients (a)								
		Unstandardized Coefficients		ndardized efficients			95.0% Confidence Interval for B	
	Model	B	d. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	99.593	.287		696.093	.000	199.009	200.178
	Streets system	1.001	.024	.211	42.030	.000	.952	1.049
	Plots system	.997	.019	.264	51.260	.000	.957	1.036
	Buildings system	.990	.016	.293	63.175	.000	.958	1.022
	Political factors	1.020	.023	.216	44.431	.000	.973	1.067
	Economic factors	1.000	.021	.262	48.541	.000	.958	1.042
	Social factors	.987	.029	.186	34.609	.000	.928	1.045
	General factors	1.024	.018	.285	56.136	.000	.987	1.061
	Cultural factors	1.080	.034	.172	31.581	.000	1.010	1.149
	Administrative and planning factors	1.008	.027	.208	37.959	.000	.954	1.062
	Borders	1.018	.032	.173	31.722	.000	.952	1.083
	Topography	.982	.045	.123	21.694	.000	.890	1.075
	Natural Resources	1.054	.043	.137	24.247	.000	.966	1.143
	population distribution	.969	.039	.138	24.617	.000	.889	1.049
	Agriculture	1.016	.020	.261	51.460	.000	.976	1.056
	Industry and Tourism	1.003	.019	.282	52.634	.000	.964	1.042
	Urban Land use	.971	.019	.267	51.519	.000	.932	1.009
	Population characteristics	1.001	.023	.222	43.152	.000	.954	1.048
	Infrastructure	1.024	.025	.269	41.415	.000	.974	1.074
(a) Dependent Variable: Administrative decision								

Coefficients (a)								
		Unstandardized Coefficients		ndardized efficients			95.0% Confidence Interval for B	
	Model	B	d. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	99.593	.287		696.093	.000	199.009	200.178
	Streets system	1.001	.024	.211	42.030	.000	.952	1.049
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	Population characteristics	1.001	.023	.222	43.152	.000	.954	1.048
	Infrastructure	1.024	.025	.269	41.415	.000	.974	1.074
(a) Dependent Variable: Administrative decision								

15	Industry andTourism	Not to exploit the potential to establish them economically, environmentally and culturally	+	Not to exploit the potential to establish them economically, environmentally and culturally	+
16	Urban Land use	Residential use by 98%	+	Distribution of uses and their percentages according to Iraqi building standards	+

$$Y_{na} = 91.016+2.602X1-5.551X2-2.585X3-0.207X4-3.485X5+1.946X6+3.666X7-1.82X8+4.187X9+1.369X10+6.949X11+9.45X12-3.294X13+3.636X14+8.895X15+4.975X16+3.25X17-2.069X18$$

R=0.662 , R SQUARE=0.439

17	Populationcharacteristics	Low density due to random distribution with waste in the ground	+	A decreasing population density with an interest in increasing it through the introduction of vertical housing but very little	+
18	Infrastructure	There is no infrastructure planning and reality, and the population has no rights to do so	-	Integrated in planning but weak in implementation and inefficient and provide only the minimum	+

Table 3:**Increasing and decreasing effects (respectively) of indicators on the natural context andAdminis-trative decision**

Ref. the researcher

Table 4: SPSS program outputs about Natural context

Ref: SPSS output

*Table 5*SPSS program outputs about Administrative decision

Ref: SPSS output

Thus, the formula of the model is as follows:

$$Yad=199.009+1.001X1+0.997X2+0.99X3+1.020X4+1X5+0.987X6+1.024X7+1.08X8+1.008X9+1.018X10+0.982X11+1.054X12+0.969X13+1.016X14+1.003X15+0.971X16+1.001X17+1.024X18$$

R=0.811, R SQUARE=0.657

V. RESULTS AND DISCUSSION

From*Table 4*&

representing the output of the SPSS program, the following points were deduced:

Coefficients (a)								
	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	91.016	21.045		4.325	.000	48.094	133.937
	Streets system	2.602	2.350	.184	1.107	.277	-2.192-	7.396
	Plots system	-5.551-	2.475	-.372-	-2.243-	.032	-10.598-	-.504-
	Buildings system	-2.585-	2.164	-.212-	-1.195-	.241	-6.998-	1.828
	Political factors	-.207-	3.118	-.012-	-.066-	.947	-6.566-	6.152
	Economic factors	-3.485-	4.012	-.151-	-.869-	.392	-11.668-	4.698
	Social factors	1.946	3.055	.099	.637	.529	-4.284-	8.177
	General factors	3.666	4.731	.159	.775	.444	-5.983-	13.315
	Cultural factors	-1.820-	3.324	-.117-	-.548-	.588	-8.599-	4.959
	Administrative and planning factors	4.187	2.974	.241	1.408	.169	-1.879-	10.254
	Borders	1.396	3.105	.096	.450	.656	-4.937-	7.728
	Topography	6.949	2.503	.552	2.776	.009	1.844	12.054
	Natural Resources	9.450	4.686	.403	2.017	.052	-.107-	19.008
	population distribution	-3.294-	3.175	-.215-	-1.038-	.308	-9.770-	3.182
	Agriculture	3.636	2.613	.265	1.392	.174	-1.693-	8.964
	Industry and Tourism	8.895	5.944	.274	1.496	.145	-3.229-	21.018
	Urban Land use	4.975	6.117	.148	.813	.422	-7.500-	17.451
	Population characteristics	3.250	2.435	.220	1.335	.192	-1.716-	8.217
	Infrastructure	-2.069-	4.001	-.092-	-.517-	.609	-10.230-	6.091
(a) Dependent Variable: Natural context								

The expansion of Khalidiyah was mainly based on natural contexts (social and economic) with the intent of only filling the housing deficit, while all utilities and services as well as the consumption of natural and human resources were neglected with no thought given to sustainability.

- The planning of the city reflects the lack of any exploitation of agricultural areas, potential sites of tourism and renewable energy resources, specifically solar and wind. Possible areas of expansion were not identified. Moreover, the planning lacks environmental and economic acuities.

- The planning and design decisions were based on traditional standards that are inconsistent with ICT or Eco-cities, although there are possibilities for their application. This is evident from the imbalance in land use and distribution ratios in the master plan prepared by the decision makers Figure 5

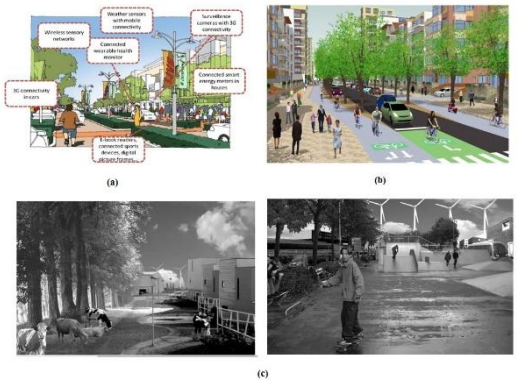

Figure 5 Concepts of: (a) ICT city, (b) Green street, and (c) Eco-cities.

Ref: [13]–[15]

- There is a large gap between the city's stakeholders, which has led to conflicts in design decisions, thus urban form and all stakeholders involved have completely moved away from the elements of sustainability in their entirety.
- A level of planning criteria should be developed in the re-planning of the city, starting from the regional level and its natural and human potentials and it can positively impact on the local level. At the local level, the city of Khalidya needs to plan, redevelop and activate the role of urban design in identifying elements of sustainable urban form, especially conservation of natural resources. The principles of green architecture need to be introduced to increase the percentage of green areas and open spaces.

1 RECOMMENDATIONS

The research team prepared a design proposal for the year 2025 that includes solutions, planning and design treatments that do not conflict with the natural context of the existing expansion and do not violate the legislative and planning laws of the Iraqi cities while emphasizing the introduction of the principles of sustainable cities in the proposed master planFigure 6&Figure 7.

Figure 6 Proposal master plan 2025 by research team.
Ref: the research team

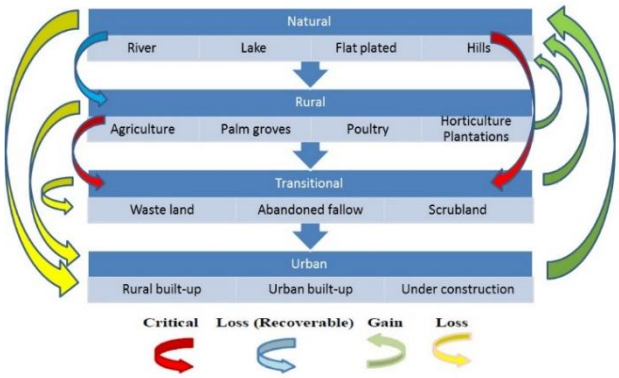

Figure 7Major land use/land cover transformation classes.
Ref: simulated with [16]

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