Evaluation of Multi- Storey Housing Projects in the Context of Sustainability / The city of Duhok

A Thesis Submitted to the School of Planning, University of Duhok in Partial Fulfillment of the Requirements for the Degree of Master of Science in Planning

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Abstract

The subject of the study is Evaluation of Multi-Storey Housing Project in the Context of Sustainability in the city of Duhok. The housing problem is one of the serious problems in Duhok, due to the rapid increase in population. The Multi-Storey Housing as one of solutions has been adapted by the government to encounter the housing deficit; as yet the housing project has many problems. Therefore, the research problem focused on Multi-Storey Housing project deficits in sustainable dimensions (environmental, social and economic). The aim of the study is to improve the sustainable quality of the neighborhoods. The concept of sustainability and criteria that are related to housing projects are illustrated in this study. The peculiarity of the city of Duhok and the current situation of the housing problem in the city are studied. The research involves a field study of two different neighborhoods, which aims to evaluate the state of the multi-story buildings in Duhok, and the problems related to the housing projects. The study surveys are carried out by the questionnaires and in-depth interview to analyze and assess of the reality of the projects and identify the problems faced by these projects and how they meet the needs of the residents.

The finding of the study approves that housing projects have many economic, social and environmental problems, and the dependence on the sustainability criteria is the best solution for the housing problems in Duhok. Finally the study provides some recommendations for activating the sustainability concept in the future of multi-story family building projects by promoting laws imposed by the government on the investors.
**Abbreviations**

- KRG (Kurdistan Regional Government)
- WCED (World Commission on Environment and Development)
- LEED (Leadership in Energy and Environmental Design)
- USGBC (U.S. Green Building Council).
- R-2000 (Natural Resources Canada Program for the Construction of Energy)
- EMR (Energy, Mines and Resources)
- CHBA (Canadian Home Builders’ Association)
- LEED-ND (LEED neighborhood)
- IHSES (Iraq Households Socio-economic Study)
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Chapter One

1-1- Preface

Urban growth in the last few decades has led to a number of physical and environmental problems especially in the housing sector. Many factors are responsible for this unprecedented growth of urban areas have also contributed to the acute shortage of building spaces and rise in the price of urban land. Also, the cost of infrastructures is increasing continuously (Forsyth, 2003).

In Iraq several estimates of the housing deficit were made. Polservice Study, for example, already identified a need for 1.6 million units in the early 1980s. Current estimates suggest that about two million dwellings will be required in urban Iraq by 2016. This represents 200,000 dwellings per year for the next ten years or about one dwelling every 45 seconds of the working day (Republic of Iraq, Ministry of Construction and Housing 2010). Analysis of the housing sector of Iraq in 2010 reveals a broad set of challenges in the years ahead. The main challenges are listed below in descending order of importance (Republic of Iraq, Ministry of Construction and Housing 2010):

- Substantial unmeet housing demand is constrained by a number of different restrictions, has been unable to produce new housing in sufficient quantities to meet the needs of the growing population.
- Acute shortage of buildable land in urban areas. The land management system does not systematically convert land to residential use or make land sites available to various potential builders and developers.
- Beside the absence of formal housing finance: there is little capital readily accessible today for either home improvement loans or long-term mortgage financing.
- Infrastructure backlogs in many residential areas and declining infrastructure service have levels of inadequate maintenance.

The demand for housing in Kurdistan increased to 1,131,700 housing units in 2010 and will increase to 1,287,500 housing units in 2017 (KRG Regional Statistics Organization, 2009). Kurdistan Regional Government (KRG) helps citizens to obtain decent housing that meets their needs and help low-income people by distributing plots of land and give loans to
help people complete the building. KRG provides services to new residential areas, but this does not cover the current housing problem. In Kurdistan region the Housing Needs Reporter and the Reports on the Existing Conditions in the three governorates (Erbil, Duhok and Sulaimani) have given an indication of the needs and demands of housing that have to be met by appropriate strategies (Mumtaz, 2011). The demand for housing in Duhok as the capital city was 43,032 units in 2012 and will be 50,600 units in 2017; therefore, 1500 units per year are needed to cover the growing wave (KRG Regional Statistics Organization and the IHSES (Iraq Households Socio-economic Study), 2009).

Mid-rise and low rise housing projects are one of the solutions to cover this demand. There were 40 housing projects from (01/01/2007) to (03/16/2012) in Duhok (General Directorate of Investment in Duhok). These projects solve the housing problem for many people, but these projects do not construct according to sustainability qualification and standards of housing projects. Here comes the importance of this research to evaluate these projects and to identify problems and find appropriate solutions to avoid these problems in future. To build Housing projects that have access to habitable environments with adequate infrastructure, economic opportunities and social services, within a housing project are integrated and financially sustainable.

1-2- **Research Problem:**

Multi-Storey Housing projects in Duhok are facing many environment, social, and economic deficits such as lack of efficient infrastructure, public service and open spaces. Which are essential to obtain a sustainable Multi-Storey Housing projects. This research will study the Sustainability of Multi-Storey Housing Projects in the City of Duhok.

1-3- **Research Hypotheses:**

The lack of planning and designing criteria to obtain sustainable housing projects in the City of Duhok has contributed to inefficiency in implementing housing projects.
1-4- **Research Question**

The following is the main research question:-

What is the current situation of Multi-Storey Housing projects and what does it need to be improved to achieve sustainable housing Projects?

To answer the main question, the following points are raised:

- What are the main criteria of sustainable housing projects?
- How do housing projects consider the social, economic and environmental dimensions of the city?
- What are the main challenges concerning sustainability of housing projects?
- What could be done to mitigate the negative impact and meet the housing needs within the City of Duhok?

1-5- **Significance of the Study**

The aim of sustainable housing is to improve the quality of the city by creating sustainable and safer neighborhoods with better social and cultural facilities, as well as serving the economic and environmental dimensions of the city. The outcomes of this study can be used as guidelines for planning institutions to adopt or include sustainability in the housing sector.

1-6- **Aims of the Study**

1- To explore the current situation of the housing sector (Multi-Storey Housing projects).
2- To know the challenges of housing sustainability.
3- To provide possible solutions for promoting sustainability.
4- To increase the efficiency of the sector (production of housing).
5- To improve the social, economic and the environmental quality of the new production of housing.
1-7- **Research Methodology**

Literature and information have been reviewed and studied about sustainability and housing planning criteria. The following methods are used for data collection:

- Analyzing the social, economic and environmental conditions in the City of Duhok.
- Analyzing the current situation of the housing sector in Duhok.
- Analyzing the government role and housing policies.
- Studying and analyzing the existing housing projects.

Since the most important method is the case study, two existing housing projects (Zari Land and Lelav City) are chosen. These will be evaluated to cover the main characteristics of the housing in Duhok and to meet the best criteria for more efficiently housing planning. Data collection was mainly based on:

- Observation
- Analysis of the available data about the projects.
- Interviews with residents (questionnaire and in-depth interview).
- Interviews with architects and stockholder (questionnaire and in-depth interview)

1-8- **Previous Studies**

There are some previous studies of the City of Duhok about sustainability and residential areas such as:

- The rural areas’ potentials for economic, social, cultural progress and sustainability in Kurdistan Region of Iraq. Case study of Amedy Region (Hussein, 2012).
- Measuring urban sustainability: The City of Duhok as a case study (Hassan, 2011).
- Spatial planning of residential area in the City of Duhok in the light of Neighborhood concept (Shihab, 2011).

These studies researched the issue of sustainability and residential area but did not combine them. The first study took the direction of sustainability in rural areas. The second study discussed sustainability of the urban areas as an overall (including services, facilities, etc) and did not focus on the housing issues in the city. The last study was about residential area and did not study the impact of sustainability on the neighborhood.
The importance of the current study (Evaluation of Multi-Storey Housing Project in the Context of Sustainability in the city of Duhok) has not been mentioned.

1-9- **Research Structure**

The structure of the research will be:-

**Chapter One:** -Will clarify the problem of housing in general (Research Problem, Research Hypotheses, Research Question, Significance of the Study, Aims of the Study, Research Methodology and Previous Studies).

**Chapter Two:** - Will clarify the term of sustainability and the three dimensions of sustainability and the Iraqi criteria for Multi-Storey Housing projects.

**Chapter Three:** - Study Property of the City of Dohuk and the housing problems in light of urbanization and population growth. The government's attempts to solve the problem.

**Chapter Four:** - Case study of two housing projects, which aims to clarify the reality of Multi-Storey Housing projects in the City of Duhok.

**Chapter Five:** -Represents the findings of the research (conclusions, recommendations, the prospects for future research and the beneficiaries of the research).
Chapter Two

2- Theoretical Framework

2-1- Sustainability

In 1987 the World Commission on Environment and Development (WCED)*, changed the development concept to sustainable development in order to solve the conflict between environment and development goals by the famous definition, “sustainable development is development which meets the requirements of the present generation without compromising the capability of future generation to meet their own needs” (Harris, 2003).

As the concept of sustainability came after the development process in the world and the consumption of natural resources did not take the needs of the next generations very seriously in the construction process, designers and planners should realize the seriousness of such situation and avoid further negligence. Sustainability is the integration systems with natural patterns that serve human interests. The concept of sustainability is based on three pillars: economic, social and environmental issues (Lapak and Culldnov, 2009).

2-1-1- Dimensions of Sustainability

Economic, environmental, and social perspectives are essential to understand the requirements of sustainability. When we attempt to give equal weight and a well-balanced to all three aspects, sustainable residential community where all concerns are addressed is more likely to emerge. None of the pivotal issues should be marginalized at the expense of others (Friedman, 2007). Three dimensions are integrated so that each one complements the other.

Sustainability has three elements in parallel: economic interest (minimize the cost of building and operating as much as possible, social interest in the welfare of the individual, environmental care and how to minimize the impact on development and construction process.

*(The UN decided to establish the Brundtland Commission In 1987. WCED, the Brundtland Commission’s mission is to unite countries to pursue sustainable development together)
2-1-1-1- **Social Sustainability**

The first factors of sustainability reflect and respond to the social needs of a community’s residents.

A socially sustainable system must achieve fairness in distribution and opportunity and adequate provision of social services including health and education (Harris, 2000). Therefore, to reach the quality of life, there is need for interaction within the community. Such as, pedestrian oriented neighborhoods provide opportunities for people to interact with society. Design is a key to create sustainable development by enhancing or enabling social equity, economic vitality and environmental responsibility (Chan and Lee, 2009). Social sustainability could be achieved through (Design and density). A number of design considerations (address local character, pedestrian friendly, prepare mix and balance of land use, prevision of social infrastructure and recreation of all facility, accessibility, ability to fulfill everyone’s need irrespective of age and maximization of community participation) These considerations have to be taken into account when preparing residential and urban development (figure 2.1).

Figure 2.1: Design Element to make Social Sustainable Neighborhood.

Source: Chan and Lee, 2009
2-1-1-2  **Economic Sustainability**

Second fostering economic sustainability is another objective with ramifications for community planning.

Sustainable economy demands for products and technologies that are environmentally friendly and satisfying human desire (Bader, 1994).

Design element also has an impact on economic sustainability. The low cost of infrastructure, low construction cost of residential buildings, maintenance of infrastructure and buildings and permeable design lead to economically viable development. Designer is interested in orientation, ventilation, micro and macroclimate, and materials, generally has lower maintenance and ongoing cost (Chan and Lee, 2008).

Designer also has to achieve a proper balance between various land uses to maximize the revenue. Economic sustainability of any residential development is the outcome of intensity of gross and net residential densities and various design elements. Some of the design elements are (Chan and Lee, 2009):

- Access to open space and social facilities for all age
- Efficient use of land, space and mixed use development
- Adaptability of development to the changing need
- Provision of housing for different income groups
- Building design in terms of appearance, density, height and mass
- Convenience efficiency and safety for pedestrian and public transport users.

From above we can see that density and design parameters play a very important role for achieving economically sustainable development.

2-1-1-3  **Environmentally Sustainable**

An environmentally sustainable system must maintain a stable resource base through:-Avoiding over-exploitation of resource. Depleting nonrenewable resources only when adequate substitutes not available (Harris, M.2000).

There is a close relationship between development density, design, environmental quality and it is necessary to decide the form of development carefully (Chan and Lee, 2009). Design parameters affect the environment at both macro and micro level. Intensity of density
also plays an important role in making development environmentally sustainable. Increased density and mixed use development mean more buildings, shops, homes and local services in close proximity to encourage walking and cycling. It also enables more efficient use of services, resources and suitable to its citizens. This increase in density means more inhabitants should walk or ride bicycle and thus medium and high density will direct to reduced emissions and pollutions (Chan and Lee, 2009). Design parameters are key components in creating sustainable development. Some of the design parameters that need to take into account are presented in figure (2, 2). Design parameter will vary according to the local context.

Figure 2.2: Design Element to make Environmentally Sustainable Neighborhood

Source: Chan and Lee, 2009

2-1-2- Sustainable Practices

In recent decades, governments, construction associations and non-governmental organizations around the world have set criteria for sustainable building practices. National building codes, which established minimum requirements for energy performance, for example, the new offerings set stricter criteria that raised the bar to a higher efficiency level. These criteria act as accreditation systems that qualify builders
and projects according to the scope of their sustainable pursuits. Two such systems will be elaborated here: LEED (Leadership in Energy and Environmental Design) set by the USGBC (U.S. Green Building Council), and R-2000 (Natural Resources Canada Program for the Construction of Energy), which was founded by the Canadian Department of EMR (Energy, Mines and Resources) in collaboration with CHBA (Canadian Home Builders’ Association).

The importance of sustainability in construction projects is shown in some studies and institutions dealing with this subject.

- **Leadership in Energy and Environmental Design**
  LEED is a rating system that recognizes sustainable building design practice. According to the USGBC website, the system was created to be used as a tool by architects, engineers and builders who want to develop sustainable design strategies. Various LEED standards define requirements for each sector of construction homes and neighborhood development.
  LEED for Homes was developed to enable the Neighborhood industry to move toward sustainable construction. Categories and credits were adapted to the residential sphere and concern, design, and site aspects specific to the house (USGBC, 2007b).

- **R-2000**
  The R-2000 Program provides sustainable technical information for the industry as well as financial and marketing assistance for participating builders.
  One of R-2000 Principles deals with planning principles at the site. The second area deals with the design, detailing and construction of the building envelope.
  Finally, the need to use efficient and mechanical systems with minimal amounts of energy (Friedman, 2007).

2-1-3- **Elements of Sustainability**

The pillars of sustainability are a model that looks at the five key elements of a project from the foundation of sustainable development. The pillars create a formwork for establishing performance metrics and maximizing opportunities for synergies among the five elements:
Several subdivisions have appeared on how to provide sustainability in the projects (Community, Sites, Material and resources, water, Energy and atmosphere) in order to facilitate the designer and planner working on all parts and to measure the extent of the application of sustainability in housing projects.

According to (Bary, 2010) Elements have to be classified into four levels.

Table 2.1: Level of Elements of Sustainability

Source: (Bary, 2010).

<table>
<thead>
<tr>
<th>Community</th>
<th>Sites</th>
<th>Material and Resource</th>
<th>Water Efficiency</th>
<th>Energy and Atmosphere</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEVEL ONE: REDUCE HARM</td>
<td>LEVEL TWO: SUSTAINABILITY (maintaining)</td>
<td>LEVEL THREE: SYSTEMS INTEGRATION</td>
<td>LEVEL FOUR : REGENRATIVE DESIGN</td>
<td></td>
</tr>
<tr>
<td>MINIMIZE IMPACT ON EXISTING COMMUNITIES (Minimize infrastructure and circulation impacts)</td>
<td>NO IMPACT ON EXISTING COMMUNITIES (No impacts on infrastructure and circulation)</td>
<td>Improve/expand infrastructure in surrounding communities</td>
<td>COMMUNITY INTEGRATION (Achieve lasting economic and social benefits)</td>
<td></td>
</tr>
<tr>
<td>MITIGATE DISTURBED AREAS</td>
<td>CONSERVE AND PROTECT NATURAL SYSTEMS</td>
<td>ON-SITE RESTORATION /REGENERATION NATURAL SYSTEMS</td>
<td>OFF-SITE RESTORATION</td>
<td></td>
</tr>
<tr>
<td>NATIONAL MATERIAL SOURCING AND ACTIVE RECYCLING MATERIAL</td>
<td>REGIONAL MATERIAL SOURCING AND ACTIVE RECYCLING (Active reuse of materials On-site composting)</td>
<td>LOCAL MATERIAL SOURCING AND REDUCTION STRATEGIES</td>
<td>CRADLE-TO-CRADLE PROGRAM (promote responsible recycling and reuse)</td>
<td></td>
</tr>
<tr>
<td>WATER EFFICIENCY (Water conservation)</td>
<td>WATER RECLAMATION (Gray water waste water recycling On-Site)</td>
<td>WATER REUSE (On-site rain water harvesting)</td>
<td>WATER BALANCE (Effective demand management)</td>
<td></td>
</tr>
<tr>
<td>EFFICIENCY ENERGY (Reduce carbon emissions appliances)</td>
<td>ACTIVE HIGH-PERFORMANCE SYSTEMS (Promote passive energy design)</td>
<td>RENWABLE ENERGY GENERATION (Zero-emissions)</td>
<td>CARBON ZERO (Carbon dioxide Sequestration)</td>
<td></td>
</tr>
</tbody>
</table>
2-1-3-1- **Community**

Community represents the social networks within the built environment and the physical places that foster the cultural interactions that sustain our social system. Community includes all people in and related to the site, with a special emphasis on adjacent populations and place-making within the project (Bary, 2010). The Location and Linkages category recommends that the home be sited in a community that fulfills requirements similar to those of a LEED neighborhood. As in LEED-ND the Community should be served by existing or adjacent infrastructure; developments should be compact and efficient, and the community should be equipped with services such as, post offices and schools to encourage walking. At designing the housing project these point must be available; (rental housing, for-sale housing, Open Community and Outreach, involvement and diversity of uses, apply regional precedents in urbanism and architecture) (Friedman, 2007). Density of population and distance from the site and methods of getting there determine the ratio of yard requirements, parking and community services (Schools, Shopping, Religious buildings, Recreation, Medical centers, clinics and Cultural services) (De Chirar, 1987).

2-1-3-2- **Sustainable Sites**

As with the Sustainable Sites category for new construction, the goal is responsible site development that reduces the site’s ecological impacts which include all natural and geophysical systems related to a site and the ecosystem services they provide as well as its effects on the environment as a whole (Bary, 2010).

Paved areas such as sidewalks, driveways, and patios should be shaded with trees and shrubs to reduce the effect of urban heat islands (Friedman, 2007).

Selecting the site must take in consideration number of points such as (Redevelop urban areas and brown field, protection or restore open spaces, parkland preservation and farmland preservation, minimizing site disturbance during construction and through site design, Steep Slope Preservation, erosion and sedimentation Control , reducing automobile dependence). Suitable design to reduce the cost of site preparation and infrastructure construction. Easy access to public transportation and the provision of alternative means of transport such as bicycles. Reduce the heat island effect through the colors used in the termination and add shading elements and increasing the green areas (Khalil, 2011). When selecting the place of project must take into consideration
location of main arteries (parkways, freeways, and highways) and existing street layout and around the project. Also transportation available other than automobile (Bus and taxis and other vehicles) and time of travel to center of the city and to job and other location should be consider at site selecting (De Chirar, 1987).

2-1-3-3- **Materials and Resources**

Efficiency materials use include all the physical components involved in the functioning of the built environment and range from soil nutrients to building materials to solid waste management (Bary, 2010). The Materials and Resources section of LEED specifies minimization of construction materials and the use of materials and environmentally preferable products. However, it goes a step further by providing guidelines for appropriate sizing for homes. Based on the number of bedrooms, usually a good indicator of the number of residents in a home, square footage recommendations are provided for the home’s floor area (Friedman, 2007). Use of recycled, local materials, having a place for storage and collect recyclables (Khalil, 2011).

2-1-3-4- **Water Efficiency**

Water Efficiency, including rainfall and aquifers encompasses the water resources piped into a project, water treatment and reuse methods, as well as storm water, gray water and black water treatment (Bary, 2010). To reduce unnecessary consumption of potable water, rainwater collection and gray water reuse are recommended, and where the need for irrigation is necessary, highly efficient systems are required. In terms of indoor water use, low-flow faucets, showerheads and dual-flush toilets are recommended (Friedman, 2007). Local landscape features that reduce the need for irrigation and synthetic chemicals should be used (Khalil, 2011).

2-1-3-5- **Energy and Atmosphere**

Energy efficiency flow to, from, and within the site. It includes transportation and other activities that use energy; it also encompasses the impacts that power production and energy flows have on humanity, atmosphere, and other elements of the environment (Bary, 2010).
The house should be well isolated, with efficient windows, minimal air leakage from ducts, highly efficient space heating and cooling, and an efficient water heating and distribution system. Outdoor lighting fixtures should have motion sensors to minimize use; indoor lighting as well as appliances should be very efficient. Installation of renewable energy sources such as wind generators and photovoltaic panels is encouraged (Friedman, 2007). Optimum operation of energy and use of renewable energy, with a few changes relatively design approach can improve the energy performance of buildings reduces operating costs, and reduce pollution from power plants and other equipment producing energy. Could generate renewable energy on-site, such as photoelectric solar panels (Khalil, 2011).

2-2- **Housing Planning**

There is a set of definitions for planning; all emphasize the process or access to specific targets over a period of time. It can be summarized in a specific and clear definition: Planning is a way to think of the future (Aqeel, 1999).

Housing Planning is a set of principles which has a policy based on it; it is related to the stages of housing planning, goal and elements, so housing provides requirements for their owners (Sheikh Dora, 1988).

**Housing Standards:** - Are references which determine the qualitative and quantitative levels for achieving the housing needs on the social, economic and physical levels according to the perspective of the environment (Al-Issawi, 1996). The concept of housing standards is not just about housing, but it includes the technical infrastructure and public infrastructure of residential areas.

The aim of Housing Standards is to determine housing needs within urban and semi-urban areas. The respective standards and recommendations determine technical program, functional, spatial and technical requirements in order to be used as a tool while designing the development plans of residential areas (Polservices, 1982).

2-2-1- **Comprehensive Housing Planning Standards**

Housing comprehensive planning means an integrated system consisting of residential units, land and infrastructure (socially and technically) (Al-Issawi, 1996).

The most comprehensive system for housing includes social infrastructure (education, entertainment, health, etc.) as well as technical infrastructure (water, electricity,
communication, street, etc). It is necessary to deal with a range of variables that have
great impact on the economics of housing planning projects which identify the living
situation of the housing. The most important variables are:

- Housing standards.
- Social services infrastructure and technical standards.
- Housing densities.
- Climate and social standards determinants.

It should be clarified that the basis for the standard residential planning has the
ability to implement it. The best criterion and the most convenient way of living may not
be the appropriate standard for the present stage, and may require the adoption of a
standard and residential alternative which may seem to be logically inappropriate in
future (Adhami, 1986).

2-2-2- **Housing Planning Standards in Iraq**

Housing Standards Scheme for the year (1982) is one of the standards that made
the regulation of residential areas and the developed studies for the scheme in (1977) in
collaboration with the Consultative Group Poland (Pol Service). Iraqi housing planning
standards aim to link between the housing as an environment of internal and external
housing. Taking into consideration integrity, social services and technical services basis
which are expressed by the type and size of public buildings that commensurate with the
number of population. Another important study on housing standard in Iraq is Urban
Housing Standard (1986) by General Organization for Housing in Iraq, which has an
extension from 1982 study. Iraqi standards did not develop in detail after these studies.

2-2-3- **Neighborhoods**

Neighborhood may be defined as an area, whose population can satisfy its
everyday needs within walking access distance from houses and/or dwellings to services
securing the children and youth education, shopping, certain social and cultural activities,
religious worship, medical care, recreation, sport, leisure and entertainment. The local
administration, security services as well as convenient access to public transportation
should also be provided (Pol services, 1982). The degree of satisfaction of population needs,
expressed by the services available, depends on size of the neighborhood ranging from
2400 up to 12000 inhabitants. Neighborhood is the residential area with social and
technical infrastructure services, which vary according to the population of neighborhood (12000, 9600, 7200, 4800 and 2400).

The neighborhood area consists of (General Organization for Housing in Iraq):

- Residential area.
- Neighborhood services.
- Neighborhood open spaces.
- Circulation and car parks
- dwellings (Apartment)

2-2-3-1- **Residential Area**

Residential area is a set of dwelling with services to serve that zone only. The residential area consists of a group of residential buildings. It includes also common open spaces, car parks and pedestrian and vehicular accesses (General Organization for Housing in Iraq).

A **residential building** is a physical mass resulting from a group of apartments according to the specific design system (Macsia, 1981).

Multi-story low – rise residential building should not be more than 4 storeys.

Multi-story mid-rise residential buildings should be more than 4 storeys and lees than 8 storeys (Polservices, 1982).

**Planning and Land Use Intensity Indicators for Residential area**

Standards should be applied when determining the number of population, houses and/or dwelling in the community. Standards are variable and are widely dependent on the types of buildings applied. Standards constitute a tool for a proper environment and economic planning. Table (2.2) shows standards for residential area according to Iraqi standards.
Table 2.2: Criteria for Residential Area
Source: (General Organization for Housing in Iraq, 1986.)

<table>
<thead>
<tr>
<th>Type of Residential Buildings</th>
<th>Floor area ratio (Total Floor Area / Residential Area)</th>
<th>Accommodation Density (Apartment /Hectares)</th>
<th>Population Net Density (Inhabitants / Hectare)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Building (Low-rise)</td>
<td>0.60 – 1.0</td>
<td>40 – 80</td>
<td>200 – 400</td>
</tr>
<tr>
<td>Residential Building (Mid-rise)</td>
<td>1.00 – 1.5</td>
<td>60 – 120</td>
<td>250 – 500</td>
</tr>
</tbody>
</table>

2-2-3-2- Neighborhood Services

According to Iraqi Housing planning standard, the neighborhood should be provided with:

• Technical Services

Technical infrastructure networks should provide the residential area with the following services:

- Potable water, sanitary sewerage and storm drainage, electrical network, local telephone network and (gas supply network is not mandatory).

The scope and range of the technical infrastructure networks depend on the number of population in the community, number of users of community services, the area to be developed and physical features of the project (Polservices, 1982).

• Public Services and Infrastructure in Residential Neighborhoods

Public Services should be provided outside the apartments to serve the neighborhood (2400 - 12000 people) comprehensive all social services (General Organization for Housing in Iraq). (Mosque or church, cultural center, youth center, corner shop, local market (bazaar) or small shops, shopping center, tea-house, refreshment shop, restaurants and casino, local administration, post office, police station, fire brigade, filling station and car service station) (Polservices, 1982).

The numbers given below in the table (Table 2.3) should be applied for assessing the community services according to the number of population. However, the services may either be limited, depending on the services located in the neighborhood zones within permissible access for distance or extension (Polservices, 1982).
Table 2.3: Community Services Plots in Hectares Related to the Neighborhood.

Source: General Organization for Housing in Iraq, 1986.

<table>
<thead>
<tr>
<th>Services</th>
<th>2400 inh.</th>
<th>4800 inh.</th>
<th>7200 inh.</th>
<th>9600 inh.</th>
<th>12000 inh.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursery</td>
<td>0.12</td>
<td>0.24</td>
<td>0.36</td>
<td>0.48</td>
<td>0.60</td>
</tr>
<tr>
<td>Kindergarten</td>
<td>0.24</td>
<td>0.48</td>
<td>0.72</td>
<td>0.96</td>
<td>1.2</td>
</tr>
<tr>
<td>Primary school</td>
<td>0.77</td>
<td>1.54</td>
<td>2.31</td>
<td>3.08</td>
<td>3.85</td>
</tr>
<tr>
<td>Intermediate school</td>
<td>0.48</td>
<td>2 x 0.48 = 0.96</td>
<td>0.58 x 2 = 1.16</td>
<td>0.77 x 2 = 1.54</td>
<td>0.96 x 2 = 1.92</td>
</tr>
<tr>
<td>Secondary school</td>
<td>-</td>
<td>2 x 0.45 = 1.08</td>
<td>2 x 0.62 = 1.2</td>
<td>2 x 0.84 = 1.68</td>
<td>2 x 1.02 = 2.04</td>
</tr>
<tr>
<td>Health center</td>
<td>-</td>
<td>0.25</td>
<td>0.25</td>
<td>0.34</td>
<td>0.42</td>
</tr>
<tr>
<td>Mosque (church)</td>
<td>-</td>
<td>0.06</td>
<td>0.09</td>
<td>0.12</td>
<td>0.15</td>
</tr>
<tr>
<td>Cultural center</td>
<td>-</td>
<td>0.325</td>
<td>0.49</td>
<td>2 x 0.325 = 0.65</td>
<td>3 x 0.325 = 0.975</td>
</tr>
<tr>
<td>Youth center</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.2</td>
</tr>
<tr>
<td>Corner shop</td>
<td>0.042</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Local market or small shops</td>
<td>0.2</td>
<td>2 x 0.2 = 0.4</td>
<td>3 x 0.2 = 0.6</td>
<td>4 x 0.2 = 0.8</td>
<td>5 x 0.2 = 1.0</td>
</tr>
<tr>
<td>Shopping center</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tea-house, Refreshment shop</td>
<td>0.072</td>
<td>0.145</td>
<td>0.216</td>
<td>0.290</td>
<td>0.36</td>
</tr>
<tr>
<td>Restaurants and casinos</td>
<td>-</td>
<td>0.145</td>
<td>0.216</td>
<td>0.290</td>
<td>0.36</td>
</tr>
<tr>
<td>Local administration</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.072</td>
</tr>
<tr>
<td>Post office</td>
<td>-</td>
<td>0.035</td>
<td>0.05</td>
<td>2 x 0.035 = 0.07</td>
<td>0.085</td>
</tr>
<tr>
<td>Police station</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.12</td>
</tr>
<tr>
<td>Fire brigade</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.05</td>
</tr>
<tr>
<td>Filling station</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.084</td>
</tr>
<tr>
<td>Car service station</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.24</td>
</tr>
</tbody>
</table>
Garbage:- The domestic garbage is to be removed either from the garbage collection points or from pick up points depending on the system use. The required area of a garbage collection point should be 16-24 m$^2$ and a pickup point should be 20-30 m$^2$. Both should be situated not less than 10m away from the windows of dwellings and not more than 50m away from the building entrances (General Organization for Housing in Iraq).

2-2-3-3- **Community Open Spaces**

Community open spaces (include public spaces for adults, children’s play areas and green areas). Open spaces should constitute not less than 50% of the total residential area. Open spaces should be characterized by coefficient greater than 6-8 sq m/inhabitant. The area of playgrounds for small children should not be less than 0.75 sq m/inhabitants. The community open spaces should be planned as complementary to the open spaces within facility plots and residential precincts (Pol services, 1982). They encompass:

- Play fields for children.
- Sport fields for youth.
Community squares and park for all inhabitants including resting places and sport courts.

Table 2.4: The Planning Indicators of Community Open Spaces
Source: General Organization for Housing in Iraq, 1986.

<table>
<thead>
<tr>
<th>Services</th>
<th>Age group of users</th>
<th>Area in m² per one inhabitant</th>
<th>Recommended plots size in m²</th>
<th>Max distance of access from dwellings in m</th>
<th>Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Play field</td>
<td>Children from 6 up to 11</td>
<td>0.75</td>
<td>600-900</td>
<td>200-300</td>
<td>Crossing with access streets allowed</td>
</tr>
<tr>
<td>Sport field</td>
<td>Youth from 12 up to 18</td>
<td>0.50</td>
<td>900-1500</td>
<td>500-800</td>
<td>Crossing with collector street allowed</td>
</tr>
<tr>
<td>Community parks and squares including sport courts</td>
<td>For all inhabitants</td>
<td>5.00</td>
<td>-</td>
<td>800</td>
<td>Crossing with collector street allowed</td>
</tr>
</tbody>
</table>

2-2-3-4- **Circulation and Car Parks**

**A-Street**

The community vehicular network constitutes a complement system related to the basic urban system of express ways and major as well as minor arterial ways. The community vehicular circulation network conveys traffic between city center, industrial areas, residential districts, urban and suburban areas, particular community apartments, services and car parks. The system consists of the following elements: Community Collector Street connecting the community minor and/or access Street within main streets. Community minor street conveying local traffic between residential precincts and community services (Polservices, 1982). The traffic of vehicles takes place in access streets (6 m wide) and/or in-service -occasional streets (4 m wide). The through traffic within the residential precinct should be avoided, thus the cul-de-sac streets are recommended. Vehicles stops at all entrances of the staircases as well as garbage collection and pickup points should be ensured.
B- **Sidewalks**

The separate sidewalks and walkways as well as those running along streets within the residential precinct should be applied according to population density. See Table (2.5). That provision has no regard to occasional street service (General Organization for Housing in Iraq, 1986).

<table>
<thead>
<tr>
<th>Population density of community area (inhabitants per hectares)</th>
<th>Minimal width of sidewalk in (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 300</td>
<td>1.50</td>
</tr>
<tr>
<td>301 – 500</td>
<td>2.25</td>
</tr>
<tr>
<td>501 – 700</td>
<td>3.00</td>
</tr>
</tbody>
</table>

**C- Car Parks**

Residential buildings and community services should have their own parking places. For Multi-story buildings and for community services, the car places should be planned as common car parks. They may be located along the community streets and/or be separated. It is recommended to locate the common car parks in direct connection with minor and Access Street. According to Polservices (1982), the common car parks should not have more than 80 car parking. The maximum access distance between common car parks should not exceed:

- Entrances of residential buildings 80m
- Entrances of service buildings 40m

2-2-3-5- **Apartment**

It is a set of spaces with architectural specifications and is affected by the nature and number of the living family and their behavior. The apartment is the basic unit of any housing project, which is the main indicator for many planning parameters and values in the housing project (Aledany, 2004). The apartment spaces and their activities vary according to the number of family members. Table (2.6) shows apartment and floor area and its main categories.
Table 2.6: Apartment Categories and Floor Area
Source: Polservices, 1982

<table>
<thead>
<tr>
<th>CATEGORY OF APARTMENT</th>
<th>S1</th>
<th>S2</th>
<th>M1</th>
<th>M2</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCCUPANCY RATE (number of persons per dwelling)</td>
<td>1</td>
<td>1-3</td>
<td>3-5</td>
<td>5-7</td>
<td>7-9</td>
</tr>
<tr>
<td>MINIMUM NUMBER OF ROOMS</td>
<td>BEDROOMS</td>
<td>1</td>
<td>1-2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>LIVING ROOMS</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>HABITABLE ROOMS</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>REQUIRED SPACE</td>
<td>CHARACTER OF DIRECTIVE</td>
<td>FLOOR AREA IN SQUARE METERS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1st Master bedroom</td>
<td>r.min.</td>
<td>12</td>
<td>21</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>2nd bedroom</td>
<td>ob.min.</td>
<td>-</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>3rd bedroom</td>
<td>ob.min.</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>4th bedroom</td>
<td>ob.min.</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>5th bedroom</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>6th bedroom</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Total of sleeping and personal activities space 1+2+3+4+5+6+7</td>
<td>r.min.</td>
<td>12</td>
<td>21</td>
<td>27</td>
</tr>
<tr>
<td>8</td>
<td>Multi-purpose living room</td>
<td>r.min.</td>
<td>21</td>
<td>21</td>
<td>24</td>
</tr>
<tr>
<td>9</td>
<td>2-living room</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>Total living space  8</td>
<td>r.min.</td>
<td>21</td>
<td>21</td>
<td>24</td>
</tr>
<tr>
<td>11</td>
<td>Total habitable space 7+10</td>
<td>ob.min.</td>
<td>33</td>
<td>42</td>
<td>57</td>
</tr>
<tr>
<td>12</td>
<td>Kitchen</td>
<td>ob.min.</td>
<td>9</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>Bathroom</td>
<td>ob.min.</td>
<td>4.5</td>
<td>4.5</td>
<td>3.5</td>
</tr>
<tr>
<td>14</td>
<td>2nd bathroom</td>
<td>ob.min.</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>Toilet</td>
<td>ob.min.</td>
<td>-</td>
<td>-</td>
<td>1.5</td>
</tr>
<tr>
<td>16</td>
<td>Storage</td>
<td>ob.min.</td>
<td>3</td>
<td>4.5</td>
<td>6</td>
</tr>
<tr>
<td>17</td>
<td>Total of service space 12+13+14+15+16</td>
<td>r.min.</td>
<td>16.5</td>
<td>18</td>
<td>23</td>
</tr>
<tr>
<td>18</td>
<td>Circulation space</td>
<td>r.max.</td>
<td>6</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>19</td>
<td>Useful in-door space 11+17+18</td>
<td>ob.</td>
<td>57-63</td>
<td>69-75</td>
<td>93-99</td>
</tr>
<tr>
<td>20</td>
<td>Out-door space for summer night rest</td>
<td>r.min.</td>
<td>3</td>
<td>6</td>
<td>9-12</td>
</tr>
<tr>
<td>21</td>
<td>Total in-door and out-door useful space 19+20</td>
<td>r.</td>
<td>60-66</td>
<td>75-81</td>
<td>102-111</td>
</tr>
</tbody>
</table>

r.min - recommend minimum. ob. – obligatory .ob.min-obligatory minimum r.max - recommend maximum. S – small family .M-Medium family .L –Large family.
2-3- **Conclusions**

The current study was carried out to study sustainability in order to extend the availability of natural resources. Achieve resident's pleasure and its importance in improving the quality of residential sector in term of environmental, economic and social facilities. Furthermore, to provide a clear perspective on the criteria that should be applied in order to achieve sustainability and the housing criteria which exist in Iraq. Designers need to think of the neighborhood as a space occupied by human being and is used to meet the needs of individuals psychologically, socially, economically and physically. The neighborhood should not be just an area of land includes a number of events of human work or as suit of mechanical functions.
Chapter Three

3- The City of Duhok

3-1- Location

The City of Duhok is the center of the governorate. It is about (107) Km² in area. The city is located in the north part of Iraq, about 585m above the sea level and 470Km north of Baghdad between the latitude (36°51'43.56"N) and longitude (42°59'51.47"E) in the city center. The City is somehow in the shape of an irregular long triangular strip. The old city was established near the narrow passage of Duhok valley. The city occupies the valley between the two mountains from north and south, namely Bekhair and Zaiwa. See figure (3.1).

Figure 3.1: Iraq Map and Duhok Governorate Map
Source: http://www.duhok-badinan/.
3-2- Climate of the City of Duhok

The climate of Duhok area is cold and snowy in the winter, warm and dry in the summer. Typical semi-arid climate conditions are generally prevailed.

3-2-1- Temperatures

The lowest temperature in the City of Duhok is found in winter in January. The degree of temperature reaches 7.5 °C (average) and this temperature increases gradually from one month to another to the highest degree up to 38.75 °C (average) in July. The rapid increase of temperature is usually noticeable from winter to summer then decreases rapidly from summer to winter. Sometimes temperatures reach below the (0 °C) (The Directorate of Weather Forecasting in Duhok, 2011). July and January represent the maximum and minimum limits and boundaries of average monthly temperatures. The large difference between the temperatures in summer and in winter is due to the geographical location of the city of Dohuk, which needs special environmental treatment.

3-2-2- Wind

The predominant wind in the City of Duhok is the northern wind, North West, but this changes its direction towards the south east, North West and south west in general. The city is surrounded by a series of mountains from the north, the south and the east direction with some paths that allow the movement of the winds through them (AL-Faqeeh, 1999). The west and east components may be related to the general direction of the valley, the maximum wind direction is towards the west about 20% annually. There is no south wind in the area (Kurdistan Regional Government Ministry of Municipalities, 2008). When designing the project the designer can take advantage of wind direction to generate natural ventilation for the housing project. The designer should take into his/her consideration the location of mountains as it is greatly affected by the wind direction.

3-2-3- Precipitation (Rainfall, Snow and Hailstone)

All kinds of falling appear in the City of Duhok (rain, snow and hailstone), but rain is the chief manifestation in this city.

- A huge quantity of rainfall occurs during the winter months (December, January and February). Rainfall is totally absent especially in summer during the months (June, July, and August). Rainfall in the City of Duhok varies from one year to
another. The average of rainfall is (535.4mm) in the City of Duhok from (2000 – 2010) (The Directorate of Weather Forecasting in Duhok, 2011).

- Snow fall varies in the City of Duhok from one year to another; in some years the snow fall is less than 25cm while in other years the snow fall is extremely rare or there is no falling at all (The Directorate of Weather Forecasting in Duhok, 2011). Snow falls heavily during winter which results in a decrease in temperature to the freezing degree or less.

- It is necessary to take into account the course of rain water that rate from (535.4mm) average annually. Rainfall water provides a natural source of water. The usage of rain before entering the water systems in the urban regions will ensure less contaminated water source than other water sources inside the town. This water has multi-purpose usages like irrigation of general parks, gardens, agriculture and also supplying the underground water reserve and some other various urban usages.

3-3- Population

The City of Duhok is a multi-cultural and multi-religious city. Ethnically, the majority of the population is Kurds, with minority groups of Assyrians, Keldans, Arabs and Armenians. The population of the City of Duhok is approximately (295800) inhabitants in 2010 (Directorate of Statistics in Duhok). The City of Duhok has witnessed rapid growth of population during the last decades (From 122,469 in 1998 to 295,800 in 2010 in the City of Duhok), due to several reasons such as immigration, rising of economic and social level, as shown in table (3.1). Population growth has been a big challenge facing housing sector in the city.

Table 3.1: Population Growth in Duhok.

Source: (AL-Faqeeh, 1999), (Herrory, 2008) and (Directorate of Statistics in Duhok, 2011).

<table>
<thead>
<tr>
<th>Year</th>
<th>Population of the City of Duhok</th>
<th>Population of the Governorate of Duhok</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>18284</td>
<td>243113</td>
</tr>
<tr>
<td>1977</td>
<td>40191</td>
<td>240575</td>
</tr>
<tr>
<td>1987</td>
<td>114322</td>
<td>293304</td>
</tr>
<tr>
<td>1998</td>
<td>122469</td>
<td>714034</td>
</tr>
<tr>
<td>2006</td>
<td>263898</td>
<td>919431</td>
</tr>
<tr>
<td>2010</td>
<td>295800</td>
<td>1257098</td>
</tr>
</tbody>
</table>
The average growth rate taken from different statistics and sources of information conducted by the government is around 3%.

**Economic Situation of the Population**

The income of most householders in the City of Duhok according to (Kurdistan Regional Government Ministry of Municipalities, 2008) was 36% people, between 300,000 and 500,000 Iraqi Dinars (ID) per month. 28% people have up to 800,000, 17.75% more than 800,000. A lot of people have income which is insufficient to own a house.

3-4- **Urban Development of City of Duhok**

The City of Duhok has witnessed rapid expansion in the urban areas. The expansion was random in the last years. A large increase in urban areas may have occurred during the last decades because of multiple socio-economic and political reasons such as rapid population growth and immigration from rural areas, etc.

The process and pattern of urban growth and development have a significant effect on the form and function of cities (Peak, 2008).

Residential areas are considered to be the main content of the city structure. They usually occupy the highest percentage of the urban area. This percentage varies according to several factors, like the history of the city, economic tendencies, potential and natural features. On average, residential areas constitute 50% to 60% of the urban area (Othman, 2008).

The development of the City of Duhok took a radial shape starting near Duhok valley and proceeded both to the east and west, mainly with urban features to the eastern part and rural features to the west. Therefore, the density toward the eastern part was much more than the density in the western part. The intensity of development (the speed of development process) in the eastern part was also faster than the western part due to the fact that the former Iraqi army prohibited and limited against urban expansion, particularly near its garrisons in the western area. This situation lasted long till 1992 (Othman, 2008).

The urban growth in the last decades towards the west gave priority to the west of Dohuk for the construction of residential projects.
Figure 3.2: Development of City of Duhok
3-5- **Land Use in the City of Duhok**

Residential areas accounted for more than sixty percent of the City of Duhok total area and its percentage has decreased to (52.61%) during the 1989-2010 period. See Table (3.2). Transportation area land held the second largest portion and its percentage also decreased from (22.28) percent in 1989 to (9.46) percent in 2010. On the other hand, industrial, cemetery, green, and tourist facility lands continued to increase. This pattern resulted from the continued industrial factories, tourist projects and green area development in the City of Duhok during 2003. As a result, residential and transportation lands have faced a variety of development pressure. The continued industrial, commercial, tourist facilities, residential, and green open space lands development have contributed to a loss of arable and agricultural lands as well as forested areas in the City of Duhok. In Dohuk municipality A lot of land have been converted from agricultural land to urban land .This conversion increased significantly in 2012 (Agricultural Directorate, 2013). Although preserve farmland is one of important points in sustainability.

Table 3.2: Overall Land Use Development in City of Duhok, 1989-2010

Source: Hirory, Al-janabi and Hassan, 2011

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>380.74</td>
<td>512.83</td>
<td>1126.03</td>
<td>2452.6</td>
<td></td>
<td>61.87</td>
<td>57.36</td>
<td>56.75</td>
<td>52.61</td>
</tr>
<tr>
<td>Commercial</td>
<td></td>
<td>8.52</td>
<td>22.94</td>
<td>70.42</td>
<td>120.27</td>
<td></td>
<td>1.38</td>
<td>2.57</td>
<td>3.55</td>
<td>2.58</td>
</tr>
<tr>
<td>Public Services</td>
<td></td>
<td>59.05</td>
<td>172.1</td>
<td>263.48</td>
<td>353.4</td>
<td></td>
<td>9.6</td>
<td>19.25</td>
<td>13.28</td>
<td>7.58</td>
</tr>
<tr>
<td>Industrial</td>
<td></td>
<td>9.95</td>
<td>14.22</td>
<td>101.48</td>
<td>194.54</td>
<td></td>
<td>1.62</td>
<td>1.6</td>
<td>5.11</td>
<td>4.17</td>
</tr>
<tr>
<td>Tourist Facility</td>
<td></td>
<td>8.12</td>
<td>28.49</td>
<td>59.35</td>
<td>478.64</td>
<td></td>
<td>1.32</td>
<td>3.19</td>
<td>2.99</td>
<td>10.27</td>
</tr>
<tr>
<td>Transportation</td>
<td></td>
<td>137.14</td>
<td>127.83</td>
<td>254.26</td>
<td>441.02</td>
<td></td>
<td>22.28</td>
<td>14.3</td>
<td>12.81</td>
<td>9.46</td>
</tr>
<tr>
<td>Green Open Space</td>
<td></td>
<td>11.91</td>
<td>15.62</td>
<td>109.31</td>
<td>621.47</td>
<td></td>
<td>1.94</td>
<td>1.75</td>
<td>5.51</td>
<td>13.33</td>
</tr>
<tr>
<td>Total Area</td>
<td></td>
<td>615.43</td>
<td>894.03</td>
<td>1984.33</td>
<td>4661.94</td>
<td></td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

The agricultural sector was mainly affected by the development of the City of Duhok when huge areas of the agricultural lands were lost. The distribution of new expansions, in particular the early wave, was random and the houses were built casually and the municipality did not control the process of dwellings construction.
Figure 3.3: Land use of City of Duhok.

Source: (Herrory, 2008).
3-6- **Housing Demand in Dohuk**

A house is one of the durable and expensive essentials in our life. The demand for housing units is linked with the total income of an individual. There is an imbalance between the level of salary and the prices of housing unit (Mohammed, 2004).

3-6-1- **Residential Density in the Dwellings**

The household size amounts to 8.9 persons. Accounting for the fact that in some households more than one family live together, the “family size” is 6.2 persons (Kurdistan regional government ministry of municipalities, 2008). The living conditions in Dohuk show that householders are living in crowded conditions (more than three persons per room in a dwelling) is almost 19%. That situation increases with lower income and higher number of small children (Kurdistan regional government ministry of municipalities, 2008). It is seen from table (3.3) that 71% of the population of Duhok live separately in units (unit for each family), while 21% live as two families in one unit, and this ratio decrease to 6% as three families in one unit. The four families per unit represent 2% (Kurdistan Region, the Ministry of Planning, the Regional Statistics Organization and Statistical 2007), See table (3.3).

Table 3.3: Distribution of Households on Housing Units in Duhok city.

Source: Kurdistan Region, the Ministry of Planning, the Statistics region organization, Statistical 2007.

<table>
<thead>
<tr>
<th>Families</th>
<th>Governorate of Dohuk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of families</td>
<td>Ratios</td>
</tr>
<tr>
<td>One family</td>
<td>98532</td>
</tr>
<tr>
<td>Two families</td>
<td>28704</td>
</tr>
<tr>
<td>Three families</td>
<td>8142</td>
</tr>
<tr>
<td>Four and more</td>
<td>2622</td>
</tr>
<tr>
<td>Total</td>
<td>138000</td>
</tr>
</tbody>
</table>
In the three governorates (Erbil, Dohuk and Sulaimani) there is an indication of the needs and demands of housing that have to be met by appropriate strategies. The table below shows housing needs in Kurdistan Region

City of Duhok needs 43,032 in 2012 and 50,600 in 2017 therefore 1500 unit annual is needed to cover the growing rate.
Table 3.4: KRG Housing Needs


<table>
<thead>
<tr>
<th></th>
<th>ERBIL</th>
<th>DUHOK</th>
<th>SULEIMANIYE</th>
<th>KRG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Households 2012</td>
<td>478,600</td>
<td>179,300</td>
<td>473,800</td>
<td>1,131,700</td>
</tr>
<tr>
<td>Urban Households</td>
<td>153,000</td>
<td>86,000</td>
<td>189,500</td>
<td>920,600</td>
</tr>
<tr>
<td>Capital Households</td>
<td>244,000</td>
<td>43,032</td>
<td>203,700</td>
<td></td>
</tr>
<tr>
<td>Rural Households</td>
<td>82,400</td>
<td>50,200</td>
<td>80,500</td>
<td>211,100</td>
</tr>
<tr>
<td>Households 2017</td>
<td>540,500</td>
<td>211,000</td>
<td>536,000</td>
<td>1,287,500</td>
</tr>
<tr>
<td>Urban Households</td>
<td>167,500</td>
<td>101,300</td>
<td>214,400</td>
<td>1,044,500</td>
</tr>
<tr>
<td>Capital Households</td>
<td>281,000</td>
<td>50,600</td>
<td>230,500</td>
<td></td>
</tr>
<tr>
<td>Rural Households</td>
<td>91,900</td>
<td>60,000</td>
<td>91,100</td>
<td>243,000</td>
</tr>
<tr>
<td>Annual Housing Needs</td>
<td>12,380</td>
<td>6,340</td>
<td>12,440</td>
<td>31,160</td>
</tr>
<tr>
<td>Total Urban Areas</td>
<td>3,800</td>
<td>3,000</td>
<td>5,000</td>
<td>25,160</td>
</tr>
<tr>
<td>Capital City</td>
<td>6,400</td>
<td>1,500</td>
<td>5,300</td>
<td></td>
</tr>
<tr>
<td>Total Rural Areas</td>
<td>2,100</td>
<td>1,800</td>
<td>2,100</td>
<td>6,000</td>
</tr>
</tbody>
</table>

It is also observed in Kurdistan Region generally and in Duhok specially, that the illegal units are increasing. These units are built on Municipality lands. They are not built according to law of residence in the area regarding ventilation design and stimulation. This has led to presence of random zones without the necessary infrastructure such as electricity, sewage system, etc. Some of these illegal units are in a bad condition because they are either old or poorly built (Mohammed, 2005).

Informal settlements in City of Duhok refer to illegal or semi-legal urbanization which occupy 5% of the total area of City of Duhok (Mohammed, 2011).
3-7- **The Housing Policy**

Kurdistan Regional Government tries to help the citizens to obtain decent housing that meets their needs through the housing policy but this does not cover the current housing problem. The housing policy adopts several directions.

3-7-1 **Investment in the Housing Sector**

The housing and construction sector have witnessed widespread growth in the region. Foreign and local housing companies operate in the region taking advantage of the facilities provided by the government, which has been able to create a positive atmosphere and environment to attract local and foreign investment in housing and contracting for the establishment and developments of construction projects in the region by relying on private sector’s activity (Shama, 2009). The Investment Law for the year 2006 (No.13) is the basic foundation for the portal of investment. Forty housing projects have been built from 11-8-2008 to 16-4-2012 on (2292225 hectare) including 33024 apartments and 4716 houses with a total cost of 2674609169$ (Directory of Investment Duhok office 2012).

However, these housing projects contained expensive apartments so that only high-income earners could buy them. As a result, these projects have not solved the problem of housing (Shama, 2009).

3-7-2 **Providing Housing Law**

The Presidency of the Kurdistan region issued a special decision in 2004 (No.11) in order to secure housing for the citizens of low-income in the Kurdistan Region through the government investment in the housing sector. It aimed through the Ministry of Construction and Housing, to build apartments and houses and sell them to the citizens of the region who wish to own property and who do not have apartments or houses and who have not taken advantage of any residential project in the region or those who do not have real estate.

3-7-3 **Housing Fund**

Housing Fund is one of the financial institutions that help citizens for building or owning housing units. The Regional Government issued a law in 6/5/2008 providing the Fund to be responsible for lending citizens to get a house, and therefore helps to promote
the housing sector through the provision of financing to own housing units. In spite of the serious government attempts to solve the housing problem, the housing problem in the region in general and in Duhok in special has not been solved.

3-7-4 Distribution of Residential Land

Residential lands are distributed to citizens according to the special requirements set by the KRG. Plots of lands are given to citizens who have not been given any residential land before, employees who have long years of service. However, the distribution system of residential lands has not solved the housing problem because the civil servants to whom the state distributed plots of lands have used these plots of land in a commercial way by trading in the real estate sector (Mohammed, 2005). As a result of the movement of construction reconstruction and relying on the traditional method of construction and not introducing modern technology, the cost of construction has risen. This is reflected in the sharp rise of the price of the housing units, which in turn has a negative effect on the housing sector (Mohammed, 2005).

3-8- Conclusion

This chapter discussed the rapid expansion especially in Duhok for the last decades. Many of the agriculture lands were converted to residential and service lands. A clear problem appeared in the residential sector due to many reasons, like the population growth inside the governorate. The Kurdistan Region government tried to solve these problems through the housing policy. In spite of the increasing number of residential buildings, the housing problem has not been solved and there is still a great need for more housing units. One of the solutions to these problems is the mid-rise and low-rise housing projects. Thus the government provided opportunity for the investors to build housing projects. In the last decade many multi-story projects have been built. However these building have not been built according to the planning and sustainability specifications also housing projects contained expensive apartments. These are some of the reasons for choosing this topic for this research subject. The next chapter will discuss this problem by field study.
Chapter Four

4- Case study

This research will study the new housing projects in City of Duhok from 2004-2012. Since there is lack of statistics about residents and housing needs, two housing projects have been chosen for field study in order to identify the current situation of the infrastructure, the economic situation of the residents and sustainability situation in the project. The projects are Zeri land and Lelave city. They have been chosen because of the following condition:

**Size of the Project:** Area and population of Lelav City Project is larger than Zari Land. The services type and area depend on the project size and the population density. The larger the project size and intensity, the larger the area and the variety of the services. This leads to increase the sustainability of the project because of the availability of the various services to the Neighborhood.

**Date of Building:** Zeryland was one of the first projects implemented in Duhok in 2007 and Lelav City was one of the last projects implemented in Duhok in 2012. One can take advantage from this point to know the differences between the two projects and find out whether they are for better or worse.

**Location:** In terms of distance from the city center, Zeryland is near to the city center and Lelav City is far from city center. The sustainability is directly affected by the project position. Closeness to the city center means closeness to the services and infrastructure of the city in addition to its closeness to the technical infrastructure. This matter affects the construction and the operational cost of the project.

4-1- Information Collection

Information and statistics of data were collected from (Articles, researches, books, Department of Investments, Directorate of Urban Planning, Directorate of Municipality, Directorate of Agricultural, and Directorate of Statistics). The most important method for data collection was from the survey and field study. According to the residence needs in the project, all information was collected from the neighborhood and divided into five main axes which are considered the important points serving the people (residents) comfort and they were compared to the Iraqi standards to
know to what degree these axes agree with the standards and what the reasons behind the deviations to the standard for Neighborhood.

The five axes are:

- Residential Area
- Neighborhood Services
- Circulation and Car Parks.
- Community Open Spaces
- Apartments

This information helps to know the reality of the housing projects and strength and weakness points to develop the positive points and find solutions for the negative points.

4-1-1- Questionnaire and In-depth Interview with the Residents

Questionnaire and in-depth interview (open and closed question) were used with the residents to collect more information on the project and residents who live in the project (services, the economic situation of the residents, population, etc.). For this purpose 125 sampling housing units were chosen for questionnaire and in-depth interview with (12) families where made (they are used in the research for the expression of the opinion of residents). Families where chosen for questionnaire randomly and it took about (15) Minute for each interview, but 12 families that are living in the housing projects where chosen for in-depth interview because of the time needed for the interview, to give them more time to talk in detail about the issues. The questions for the in-depth interview were the same questions in questionnaire but without options to choose. The survey took two months from 15-10-2012 to 15-12-2012 for the residents in Lelav City and Zari Land. The questions focused on the following information.

- **Socioeconomic Situation of the Family**
  
  **Family Income and Apartment Price and Rental:** it is important to know the residents income and if the income is reasonably proportional to the apartment price
  
  **Size of the Family:** Knowing the number of persons who live in the apartment helps to reach population density which is one of the most important points that determine the type of services and if the space of the apartment fits the number of persons living in.
Residents desire to leave the Neighborhood: Knowing the main reasons, which lead the residents to leave that resident.

Reasons to Choose the Apartment: What are the reasons behind choosing the project to live in by the residents and if the residents had the ability to choose place inside the project and their satisfaction about the project.

Social Relationship: Knowing if the project design helps in improving the social relationship among the residents inside the building or in neighboring buildings.

Privacy:- Evaluating the personal privacy inside the project or in the apartment itself.

- Neighborhood
  - Infrastructure and Service: Evaluating the services and the level of implementation and whether they meet the needs of residents.
  - Circulation: Knowing the movement efficiency for the pedestrians or vehicles or the public transportation

- Building quality: Knowing the apartment quality in relation to the construction and if the apartment had been fixed or improved and if those improvements are proportional to the residence period.

4-1-2- Questionnaire and In-depth Interview with the Experts

Questionnaire and In-depth Interviews were made with the persons who work in related governmental offices in Kurdistan Region – Duhok governorate (Department of Investments, Department of Urban Planning, Department of Municipality, Department of Agricultural, Department of Statistics, Other Stockholders, Engineer’s with experience work out of the projects owners of PhD, Master degrees and experienced for more than five years) and with the engineers of the booth projects to collect information that cannot be collected by the interviewing the residents or be found in printed sources. The interviewees according to their experiences had evaluated the points below of both projects (Zari Land and Lelav City). The answers were collected and analyzed statistically to get the result. The questions for in-depth interview were the same questions in questionnaire but without options to choose.

The questions are divided into five main axes which are related to sustainability, each one of those axes is divided into secondary axes in order to approach or understand the current state of the projects, relating to the major elements of the sustainability.
The main axes are:-

- Community (the community information has been collected from the residents and available data collected from related governmental offices and in depth interview with the experts).
- Sustainable Site.
- Materials and Resources.
- Efficiency of Water Use.
- Energy and Atmosphere.

4-2- **Field study**

4-2-1- **Lelav City**

4-2-1-1- **General Observation of Lelav City Neighborhood**

Lelav city is located to the east of the city of Duhok in Nizarke area with more than (5500) residents and a total area of (21.32 hectares) approximately.

![Figure 4.1: Location of Lelav City](image)

Source: (Herrory, 2008).
The project was built in two phases. There is a big difference between the first phase site plan and the second site plan of the project. A lot of green land and service were changed to residential building. This matter reduced green spaces, resulted in problems in services, increased population density and affected the buildings bordering zone. Instead the residential building being next to green spaces and services, they become next to buildings of six or eight floors. There are (1292) apartments in Lelav city. There are four types of apartment height eight floors (two types), six floors and three floors. The Project apartments were also built in two phases. The first one is low-rise building whose apartment area is (120m²). Table (4.1) shows the number, and type of apartment. See Figure (4.2) which represents first phase site plan.

Table 4.1 Low-rise Building (First Phase Building in Lelav City)

Source: (Researcher).

<table>
<thead>
<tr>
<th>Type of Residential Building</th>
<th>No. of Floor</th>
<th>Area of Apartment</th>
<th>Number of Apartments per Building</th>
<th>No. of Residential Buildings</th>
<th>Total Number of Apartments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-G</td>
<td>3</td>
<td>120</td>
<td>12</td>
<td>65</td>
<td>780</td>
</tr>
</tbody>
</table>

Figure 4.2: Lelav City First Site Plan

Source Lelav City administer office
The second phase is Mid-rise building with three types of apartment whose area is different. The first type area is (150 m²), the second type is (256 m²) and the third type is (138 m²). Table (4.2) shows the number and type of apartment's. See Figure (4.3) which represents second phase site plan.

Table 4.2: Mid-rise Building (Second Phase Building in Lelav City)

Source: (Researcher).

<table>
<thead>
<tr>
<th>Type of Residential Building</th>
<th>No. of floors</th>
<th>Area of Apartment</th>
<th>Number of Apartments per Building</th>
<th>No. of Residential Buildings</th>
<th>Total Number of Apartments</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1,2,3</td>
<td>8</td>
<td>150</td>
<td>32</td>
<td>3</td>
<td>96</td>
</tr>
<tr>
<td>R4,5,6,7</td>
<td>8</td>
<td>256</td>
<td>32</td>
<td>4</td>
<td>128</td>
</tr>
<tr>
<td>H</td>
<td>6</td>
<td>138</td>
<td>24</td>
<td>12</td>
<td>288</td>
</tr>
</tbody>
</table>
Figure 4.3: Lelav City Second Site Plan

Source: Lelav city administer office
4-2-1-2- Analyzing the Site Plan of the Project (Lelav City)

4-2-1-2-1- Neighborhood

4-2-1-2-1-1- Residential Area

After the comparison of existing residential areas with the Iraqi standards of residential areas, it was found that many differences exist between the standards and the actual residential areas as shown in table (4.3) below. The floor area ratio (total floor area / residential area) for residential building (Med-rise) is found to be 3.97 in some area and in other is less than the values as the below table show, and for (Low-rise) it is found to be between 0.71 – 1.17. Also, accommodation density (dwellings / hectares) for (Med-rise) residential building in one hectare is about (156.1) or less in other places. Residential building (Low-rise) Accommodation density for one hectare is between (60 – 97.5) apartments. The population density (inhabitants / hectare) for (Med-rise) residential building is nearly (415 – 660.04) people in hectare. Population net density for residential (Low-rise) is nearly (215.63 – 417.3) people in hectare.

From the comparison with the standards, there are problems in the residential area because of the increasing number of residential buildings with regard to residential area. This leads to increase the number of apartments and population density per hectare, which leads to increased load and problems in services.

Table 4.3: Comparing the existing residential area with the standards of residential area (Lelav City)

<table>
<thead>
<tr>
<th>Type of Residential Buildings</th>
<th>Standard</th>
<th>Lelav City</th>
<th>Standard</th>
<th>Lelav City</th>
<th>Standard</th>
<th>Lelav City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Residential Buildings</td>
<td>Floor Area Ration (Total Floor Area / Residential Area)</td>
<td>Floor Area Ration (Total Floor Area / Residential Area)</td>
<td>Accommodation Density (Dwellings /Hectares)</td>
<td>Accommodation Density (Dwellings /Hectares)</td>
<td>Population Net Density (Inhabitants / Hectare)</td>
<td>Population Net Density (Inhabitants / Hectare)</td>
</tr>
<tr>
<td>Residential building (Med-rise)</td>
<td>1 – 1.5</td>
<td>1.34 – 3.97</td>
<td>60 – 120</td>
<td>96.96 – 156.1</td>
<td>250 - 500</td>
<td>415 – 660.04</td>
</tr>
<tr>
<td>Residential building (Low rise)</td>
<td>0.60 – 1.0</td>
<td>0.71 – 1.17</td>
<td>40 – 80</td>
<td>60 – 97.5</td>
<td>200 – 400</td>
<td>215.63 – 417.3</td>
</tr>
</tbody>
</table>
Figure (4.4) shows the closeness of buildings to each other and the effect of street-level rise on the privacy of residents in the buildings and it also shows the impact of the second phase buildings.

1- The buildings are near to each other

2- The effect of second phase buildings

3- Lack of privacy inside the apartment

4- Level of apartment height to the garden

Figure 4.4: Residential Area Situation in Lelav City

4-2-1-2-1-2- Neighborhood Services

By analyzing the neighborhood of Lelav City, there was lack of the needed services. Table (4.4) shows the difference between the existing services in Lelav City and the needed services according to the Iraqi standards. There is lack of secondary school, cultural centre and post office.

Most of the services (Primary school, Intermediate school, health center, mosque, local market, tea-house, refreshment shop, restaurants and casino) exist in the plan of the project but they have not been built until now. Secondary school is available out of the project area but the distance is more than 800m.
Table 4.4: Comparing the existing Services with the standards of Neighborhood (Lelav City).

Source: (General Organization for Housing in Iraq and Researcher).

<table>
<thead>
<tr>
<th>Services</th>
<th>Services area in hectare (standers)</th>
<th>Services area in hectare (Lelav City)</th>
<th>Maximum access distance from dwellings to services (in m) standards</th>
<th>Maximum access distance from dwellings to services (in m) Lelav City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursery</td>
<td>0.36</td>
<td>0.0934</td>
<td>300</td>
<td>390</td>
</tr>
<tr>
<td>Kindergarten</td>
<td>0.72</td>
<td>Available (due to standards)</td>
<td>300</td>
<td>470</td>
</tr>
<tr>
<td>Primary school</td>
<td>2.31</td>
<td>0.52</td>
<td>500</td>
<td>612</td>
</tr>
<tr>
<td>Intermediate school</td>
<td>0.58x2 = 1.16</td>
<td>Available (due to standards)</td>
<td>500</td>
<td>612</td>
</tr>
<tr>
<td>Secondary school</td>
<td>2x0.62 = 1.12</td>
<td>Not available</td>
<td>800</td>
<td>Out of project (distance is more than 800m)</td>
</tr>
<tr>
<td>Health center</td>
<td>0.25</td>
<td>0.1000</td>
<td>800</td>
<td>390</td>
</tr>
<tr>
<td>Mosque (church)</td>
<td>0.09</td>
<td>0.0890</td>
<td>800</td>
<td>500</td>
</tr>
<tr>
<td>Cultural center</td>
<td>0.49</td>
<td>Not available</td>
<td>800</td>
<td></td>
</tr>
<tr>
<td>Local market</td>
<td>3x0.2 = 0.6</td>
<td>Available (due to standards)</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>small shops</td>
<td>0.6</td>
<td>Available (due to standards)</td>
<td>200</td>
<td>500</td>
</tr>
<tr>
<td>Tea-house, refreshment shop</td>
<td>0.216</td>
<td>Available (due to standards)</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Restaurants</td>
<td>0.216</td>
<td>Available (due to standards)</td>
<td>800</td>
<td>500</td>
</tr>
<tr>
<td>Post office</td>
<td>0.05</td>
<td>Not available</td>
<td>800</td>
<td></td>
</tr>
</tbody>
</table>

46
Figure (4.5) shows the delay in the implementation of services and located the services on the edge the project because of financial interests. This has affected the life of the residents and caused many problems to them.

Source: (Researcher), 2013.
4-2-1-2-1-3- **Community open spaces**

By comparing community open spaces in Lelav City with the standards of community open spaces, one can observe that the green areas are close to the standards; play fields for children are available in site plan but have not been constructed until now. Green field and play areas for youth are available and close to the standard but they have not been built until now. Community Park and squares (including sport courts) are not available.

Table 4.5: Comparing the existing community open spaces with the standards of Neighborhood (Lelav City).

Source: (General Organization for Housing in Iraq and Researcher).

<table>
<thead>
<tr>
<th>Services</th>
<th>Age group of users</th>
<th>Area in m² per one inhabitant</th>
<th>plots size in m² (Stander)</th>
<th>plots size in m² (Lelav City)</th>
<th>Max distance of access from dwellings /m² (Stand)</th>
<th>Max distance of access from dwellings /m² (Lelav City)</th>
<th>Access (Standard)</th>
<th>Access (Lelav City)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Play field</td>
<td>Children from 6 up to 11</td>
<td>0.75</td>
<td>600-900</td>
<td>400-600</td>
<td>Available (due to standards)</td>
<td>Available (due to standards)</td>
<td>200-300</td>
<td>70-122</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total</td>
<td>Field</td>
<td></td>
<td></td>
<td></td>
<td>Crossing access streets allowed</td>
</tr>
<tr>
<td>Sport field</td>
<td>Youth from 12 up to 18</td>
<td>0.50</td>
<td>900-1500</td>
<td>600-1000</td>
<td>Available (due to standards)</td>
<td>Available (due to standards)</td>
<td>500-800</td>
<td>175-330</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total</td>
<td>Field</td>
<td></td>
<td></td>
<td></td>
<td>Crossing collector street allowed</td>
</tr>
<tr>
<td>Community park and squares /including sport courts/</td>
<td>For all inhabitants</td>
<td>5.00</td>
<td>-</td>
<td>-</td>
<td>not available</td>
<td>not available</td>
<td>800</td>
<td>not available</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total</td>
<td>Field</td>
<td></td>
<td></td>
<td></td>
<td>Crossing collector street allowed</td>
</tr>
</tbody>
</table>
Figure (4.6) shows the negligence of gardens. Instead of providing beautiful Yards and play areas for children, they became car parks and dust source within the project.

1- Play field for children are available in site plan but have not been constructed.

2- Open space are not suitable for play because of the slope.

3-The green areas have been not constructed until now.

4- Some green areas are constructed by resident.

5-The green areas are used for parking.

6- Children are playing in the dirt

Figure 4.6: Community Open Spaces Situation in Lelav City

Source: (Researcher), 2013.
4-2-1-2-1-4- **Circulation and car parks**

Service /occasional/ Street is available in some areas but the width is less than 4 m. Walkways are close to the standards but in some areas they are found to be below the standards (See table 2.5).

The common car park has more than 80 cars parking in same area. The maximum access distance between common car parking and Entrances of residential buildings exceed (80m) in some area.
Figure (4.7) shows the bad state of the streets surrounding the project and this affects the internal streets of the project. Walkways are incomplete in some areas causing problems for the occupants, especially in winter.
There is a problem in the design of high sidewalks in the project, which leads to encourage residents to use it as a car park and affects on the movement of residents.
4-2-1-2-1-5- **Apartment spaces**

The apartment spaces and their activities vary according to the number of family members. The project contains four types of apartments:

<table>
<thead>
<tr>
<th>Figure 4.7: Circulation and Car parks in Lelav City</th>
<th>Source: (Researcher), 2013.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Streets surrounding the project are Incomplete.</td>
<td>2-Streets surrounding the project is incomplete which effect on the internal streets.</td>
</tr>
<tr>
<td>3-Walkways are below the standards.</td>
<td>4-Walkways are Incomplete</td>
</tr>
<tr>
<td>5-Cars are parking in Walkways.</td>
<td>6-Car parking has more than 80 cars parking.</td>
</tr>
</tbody>
</table>
A- First type of apartment (A-G): A building consists of three floors and each floor consists of four apartments. Apartment area is (120m²)

Components of the apartment:

The apartment consists of two bedrooms, kitchen, a reception room, one bathroom, WC, as well as two balconies and an external store, but it does not have a dining and living room, so most of residents are using the internal hall instead of the missed spaces. See Table (4.6) and (4.7) in Appendix.

Figure 4.8: Apartment Type A-G

Source: (Lelav City administers office).
Figure (4.9) shows the changes which are made on apartments combining space or changing its function.

Figure 4.9: Apartments Situation in Lelav City

Source: (Researcher), 2013.

**B- Second type of apartments (H):** Each building consists of six floors and each floor consists of four apartments. Total apartment area is (138m²). The apartment consists of two bedrooms, kitchen, a reception room, bathroom, WC, suite bathroom, as well as one balcony. It does not have dining and living room, so most of residents are
using the internal hall instead of missed spaces. See table (4.8) and (4.9) in Appendix.

C- **Third type of apartments R4, 5, 6, 7:** Each building consists of eight floors and each floor consists of four apartments. Apartment Area is (256m$^2$). The apartment consists of three bedrooms, a reception room, bathroom, WC, Suite bathroom, as well as one balcony. It does not have dining and living room, so most of residents are using the internal hall instead of missed spaces. See table (4.10) and (4.11) in Appendix.
D- **Fourth type of apartments (R1, 2, 3):** Each building consists of eight floors; each floor consists of four apartments. Apartment Area is (150m²). The apartment consists of three bedrooms, a reception room, bathroom, WC, suite bathroom, as well as one balcony. It does not have dining and living room, so most of residents are using the internal hall instead of missed spaces. See table (4.12) and (4.13) in Appendix.
Figure 4.12: Apartment type R1, 2, 3

Source: (Lelav City administers office).
4-2-1-3- Results of the Questionnaire and in-depth Interviews in Lelav City

4-2-1-3-1- Socioeconomic Situation of the Family

4-2-1-3-1-1- family income

In general the income of 59.5% of the residence is less than 1,000,000 Iraqi dinars and 25.1% of the residence income ranges from 1,000,000 to 1,500,000 Iraqi dinars. 15.4% of the residences’ income is more than 1,500,000 Iraqi dinars.

4-2-1-3-1-2- Apartment Price and Rental

The price of the apartment is 60,000,000 Iraqi dinars. It is paid in installments. At apartment registration, the buyer pays three million dinars then another three million dinars after three months, followed by six million dinars after six months and finally a payment of 180,000 Iraqi dinars for the company and 250,000 Iraqi dinars to the investment bank, so 430,000 dinars each month will be paid till the amount paid becomes 60,000,000. The rental depends on the status of the apartment, if it’s furnished the rent is around (500$) per month. If the apartment is empty the rent is around (300$) per month. Most of the apartments are occupied by their owners (97.96%) and (2.04%) are rented. (This price, the payment method and rent for cheaper apartments and even the price of these apartments vary depending on the payment method. So method payments that sell the majority of apartment's type was chosen (A-G).

4-2-1-3-1-3- Size of the family

From the diagram below we found that (4.04%) of apartments were empty. (13.64%) of families consist of husband and wife. (16.67%) of families consist of husband, wife and one child. (33.33%) of families consist of husband and wife and two children. (16.67%) of families consist of husband, wife and three children. (6.06%) of families consist of husband and wife and four children. (5.56%) of families consist of seven persons. (1.52%) of families consist eight persons. (1.01%) of families consist eleven persons. (1.52%) of families consist twelve persons.
Figure 4.13: Family Size in Lelav City

Source: (Researcher).

4-2-1-3-1-4- **Educational level**

The following percentages show the distribution of the student according to the stages of education for residents.
1- Kindergarten 25.93%.
2- Primary school 25.93%.
3- Intermediate school 25.93%.
4- Secondary school 11.11%.
5- University 11.11%.
4-2-1-3-1-5- Residents desire to leave the Neighborhood

After interviewing the residents, it was found that the residents who like to move in the future are 86.79% and those who do not think of moving are 13.21%.

Reasons of moving to new residence: -
1 – Increase in the number of family members (16%).
2 – Owning a piece of land (10%).
3 - Inefficient services and social infrastructure in the neighborhood (50%).
4 – Getting a house in other area (23%).
5 - Problems with the neighbors(1%).
6 - Others (0%).

As we see from figure below the main reason for changing the residence is inefficient services, although the apartments were built only two years ago.
Most of the residents feel the project did not meet their desires and expectations: (Bad 65.96%, Fair 29.79% and Good 4.26%). Before living in to the project everyone has an idea about life in the project and their answers depended on the extent to which the reality of the project matched their expectations.

Figure 4.15: Residents Desire to Leave the Neighborhood (Lelav City)
Source: (Researcher).

Figure 4.16: Project Meeting the Desires of Residents (Lelav City)
Source: (Researcher).
Most of the residents feel living in the neighborhood is Fair 77.55%. Bad 12.24%. Good 10.20%.

4-2-1-3-1-6- **Choosing apartment**

Reasons for buying apartment

1- Apartment design (5%).
2- Design of the neighborhoods (3%).
3- Safety availability (11%).
4- Services provision (0%).
5- Accessibility (4%).
6- Appropriate price (77%).
7- Other (0%).

![Pie chart showing the reasons for choosing apartments.](image)

Figure 4.17: Reasons for Buying Apartments in Lelav City

Source: (Researcher).

**Choice of residence in the project of Lelav City**

The way of paying for this project was the best among the projects established at that time, so the financial reason was the main reason for choosing this project. Choosing the apartment was according to the sequence or order of registry numbers. There was no option to choose floor or the orientation of the apartment or closeness to any type of service. So the registry number was the number of the apartment in the neighborhood.
Half of residents (54.35%) did not want to live in the upper floors of the building and 30.43% preferred living in the upper floors and 15.22% said there was no difference.

4-2-1-3-1-7- **Social relationship**

Relationships with the residents of apartments within the same building are Fair 56.86%, no relation 3.92%, Good 39.22%. Residents' evaluation is based on existence or absence of problems with neighbors and the nature of the relationship between residents in the same building. Half of the families say relationships with the residents of other building are Fair 52.17%, No relation 40.58%, Good 7.25%. Residents' evaluation is based on existence or absence of problems with neighbors and the nature of the relationship between residents in the different building.

4-2-1-3-1-8- **Privacy**

Half of families think privacy within the neighborhood is Good 49.02%, Bad 17.65% and Fair 33.33%. Residents' evaluation is based on the possibility of families in mobility within the neighborhood public parks without being annoyed by other residents. Half of families say privacy in the apartment is bad 46.15%, Fair 25%, Good 28.85%. The assessment of residents is based on what the residents in cross buildings or pedestrians can see inside the apartments. Half of the residents (49.02%) sometimes hear a voice from the neighboring apartment, 39.22% always hear and 11.76% say they do not hear. Residents' evaluation is based on sound insulation between apartments on the same floor and apartments on the other floor.

4-2-1-3-2- **Neighborhood**

4-2-1-3-2-1- **infrastructure and service**

Most of the resident 80.85 % agreed that public gardens are bad, 10.64% fair and 8.51% good. Residents' evaluation is based on the level of public parks in terms of (beauty, providing games and accessibility). Only 15.38% of residents take care of the gardens surrounding building 64.10% do not, 20.51% of residents sometimes do. Note that most of the gardens are left incomplete. Those residents who take care of the garden
surrounding their building use these green areas as private garden specialty on the ground floor. Residents see car parking location design bad 37.25%, fair 31.37% and Good 31.37%. Residents' evaluation is based on the availability of parking spaces and its closeness to the entrance of the building.

Figure 4.18: Car place Efficiency in Lelav City
Source: (Researcher)

Most of the residents think garbage collection Location is Bad 70.83%, Fair 14.48% and Good 14.68%. Residents' evaluation is based on the view of garbage and the spread of the smell near the location of the building entrance.
Most of the residents consider cleaning services like cleaning up gardens, streets and entrances of buildings bad 54.90%, Fair 31.37% and Good 13.73%.

Health services are bad because the health center has not been built till now. Only 1.96% of residents considers efficient provision of electricity bad, Fair 37.25% and Good 60.78%. Residents' evaluation is based on the efficiency of electricity and electrical problems in every apartment, but when power breaks there is no generators in the area to provide residents with electricity. Only 12.50% of residents think water provision is bad, Fair 25% and Good 62.50%. Residents' evaluation is based on the efficiency of water provision and water problems in every apartment.

21.05% of primary school pupils walk to school, 26.32% go by car and 52.63% by bus. 55.77% of residents sometimes shop from the nearby neighborhood shops, 34.62% always do shopping there and 9.62% do not shop there. Only 18.37% of residents shop from the nearby neighborhood shop monthly, 42.86% shop every day and 38.78% weekly.

The executive company claims that it has provided everything in the advertisement of the project, however, 2.08% of residents agree but 97.92% do not agree. According to the advertisement of the project by the company there was a school building, a health center, a mosque and a kindergarten, but they were not built even after the delivery of the apartment to residents. As for the green spaces, the company built residential buildings in same of the green areas. There has been a delay in the delivery date of apartments and the company did not compensate the residents for the delay.
**Circulation efficiency**

Many questions were asked about the efficiency of movement inside the neighborhood and movement from and to the neighborhood.

As for distance from the neighborhood to work, 16% of residents consider it is near, 29% OK and 55% far. So as we see 55% of the residents are far from their work place because the project is built far from the city center.

![Pie chart showing distance preferences](image)

**Figure 4.20: Residents Work Place Destines (Lelav City)**

Source: (Researcher).

As for moving to and from the neighborhood to city's main services or other activities that are outside of the neighborhood, 11.54% think it is good, 26.92% think it is suitable and 61.54% think it is bad. Residents' evaluation is based on how near or far the project is from the city center and the city's main services (such as government departments, the main market, etc.).

As for how to reach the apartment from the entrance of the neighborhood, 13.21% consider it is good, 32.08% suitable and 54.72% bad. Residents' evaluation is based on efficient roads and walk-ways from the entrance to the apartment and vice versa (distance, width and quality of finishing).

Concerning transportation availability in the neighborhood (not taking personal cars into account), sometime it is available 30.77% and available all the time 21.15% and 48.08%
is not available. Most of the residents (96.08%) see the efficiency of public transport such as buses and mini buses is bad, 1.96% think it is fair and1.96% consider it is good. Residents' evaluations are based on the availability of public transport in the project. Most of the residents (96%) see access to public transport is bad, 2% fair and 2% is good. Residents’ evaluations are based on the time consumed on reaching and waiting time for the public transportation. Residents rating of the connection and links of the neighborhood with the surrounding projects as bad 28.57%, fair 57.14% and good 14.29%. Residents' evaluation is based on the efficiency of project connection to nearby neighboring projects by the streets and walkways.

Half of the residents (46.94%) consider the design of pedestrian movement is bad, 28.57% Fair and 24.49% good. Residents' evaluation is based on the efficiency of pedestrians' movement and access to project services and the intersection of pedestrian movement with car traffic.

Regarding building location for pedestrian movement in terms of closeness to services, 25% of the residents consider it far, 35% fair and 40% near. 30.61% of the residents think buildings location affects the movement of pedestrians, 26.53% think it does not affect and 42.86% think it affects somehow. Residents' evaluations are based on the amount of interception to walkways and the need to get around the building to reach services. Only16.33% of residents consider safety availability for the movement of the children at the entrance of the residential buildings good, 42.86% consider it is bad and 40.82% fair. Residents' evaluation is based on children's access to the gardens near the building entrance without risk.

4-2-1-3-3- Building condition and construction

This project has been handed to the owners in 2011 and other groups of the apartments were handed in 2012.

58.14% of residents consider the building condition for the apartment in Lelav City bad, 39.53% fair and 2.33% good. Residents evaluate their apartments according to the amount of changes and repairs they have made in the (sewage, water, electricity, doors, windows, etc.). After receiving the apartment they had to change the main entrance door of the apartment and also change a lot of electrical parts, make some changes in the
sewage and had made other small changes in the apartment. All these changes because the company had used poor materials.

![Figure 4.21: Status of Apartment (Lelav City)](image)

Figure 4.21: Status of Apartment (Lelav City)

Source: (Researcher).

**The functional space of the Apartment**

After living in the apartments residences had made changes in the apartment such as expanding the size of the kitchen by combining it with the balcony, or converting the balcony to store and other changes. The changes had been made by 63.04% of the residents but 36.96% did not make any changes. Many changes were not made because the apartments were rented or the owners were thinking to sell them.
4-2-1-4- **Results of (Questionnaire and in-depth interview with expert)Lelav City project**

- **Community**

  In this project rental housing and for-sale housing are not affordable. Open community and compact development, community outreach and diversity of uses were all observed to be unreasonably applicable. However, in this project no plan for adaptive reuse of historic buildings forms was witnessed. Moreover, applying regional patterns precedents in urbanism and architecture were not observed.

- **Sustainable site**

  With regard to site selection, some measurements were not taken into account including the redevelopment of urban areas, redevelopment of brown field and the protection or restoration of open spaces. Moreover, there were some criteria observed to be unreasonably convenient such as reducing the impact of the heat island effect, Farmland preservation, erosion and sedimentation. Light pollution is convenient because of the insufficient use of the light. Parkland preservation, minimizing site disturbance during construction and minimizing the site disturbance through site design were...
reasonably proper. However the project designs do not help to reduce automobile dependence. Furthermore, in Lelav City the steep slope preservation is reasonable.

- **Materials and resources**
  The management of construction waste, recycled content and identification in the post-construction are not available in this project. The use of local materials and use of local materials extracted regionally are medium. The use of renewable resources, reuse of materials and comprehensive waste management are not available. Did not have a place for storage and collect recyclable wastes. Generally, the efficiency of materials and resources in the project are not convenient compared with sustainability criteria.

- **Efficiency of water use**
  One of the problems that exist in the project is the use of drinking water for irrigation purposes, lack of technology in sewage treatment to use it for irrigation. There is no technology to reduce water use in buildings. There are no techniques for reuse of rain water or its management. There is no technology to reduce the impact of rainwater. Taking into account the use of gray water from the project for irrigation purposes is limited. Generally, the efficiency of water use in the project is bad.

- **Energy and atmosphere**
  The project does not use renewable energy or green energy. Efficient use of electrical energy in buildings and infrastructure is little. Power generation and using renewable energy sources are not available within the site. In general energy efficiency is low.

4-2-2- **Zari Land**

4-2-2-1- **General Observation of Zari Land Neighborhood**
  Zari Land is located in the North of City of Duhok between Shakhke and Maseki area with more than (4000) residence which cover approximately a total area of (17.77) hectare.
The project was built in two phases. There is a big difference between the first phase site plan and the second site plane of project. A lot of green land and service were changed to residential building and commercial projects serving people outside the project more than the residents of the project. This reduced green spaces, caused problems in services, increased population density and affected the buildings bordering zone. Instead of being next to green spaces and services, they became next to residential buildings. Project apartment were also built in two phases. The first one is mid-rise building with two types of apartment of different areas: the first is (150 m²); the second apartment is (150 + 120 m²). Table (4.14) shows the number and type of apartments. See figure (4.24) which represents the first phase site plan.
Table 4.14: Type of Mid-rise building (First Phase Building in Zari Land)

Source: (Researcher).

<table>
<thead>
<tr>
<th>Type of residential building</th>
<th>No. of floor</th>
<th>Area of Apartment</th>
<th>Number of Apartment per Building</th>
<th>No. of residential building</th>
<th>Total Number of apartments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>8</td>
<td>150</td>
<td>16</td>
<td>17</td>
<td>272</td>
</tr>
<tr>
<td>A+B</td>
<td>8</td>
<td>150+120</td>
<td>8+8</td>
<td>8</td>
<td>64 for each type</td>
</tr>
</tbody>
</table>

Figure 4.24: Zari Land First Phase Site Plan

Source: (Zari Land administers office).

The second phase is Low-rise building whose apartment area is (95m²) and it is classified in to 5 Types. Table (4.15) shows the number type of apartment. See figure (4.25) which represents the second phase site plan.

The total number of apartments for both phases is (416+580=996) apartments. There are two types of building heights: eight floors and four floors.
Table 4.15: Type of Low-Rise Building (Second Phase Building in Zari Land).

Source: (Researcher).

<table>
<thead>
<tr>
<th>Type of residential building</th>
<th>No. of Building</th>
<th>No. of Apartment</th>
<th>No. of Basement-Apartment*</th>
<th>Total Number of Apartments</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(A)</td>
<td>11</td>
<td>88</td>
<td>6</td>
<td>94</td>
</tr>
<tr>
<td>C (B)</td>
<td>11</td>
<td>88</td>
<td>14</td>
<td>102</td>
</tr>
<tr>
<td>C( C)</td>
<td>12</td>
<td>96</td>
<td>8</td>
<td>104</td>
</tr>
<tr>
<td>C( D+E)</td>
<td>28</td>
<td>224</td>
<td>56</td>
<td>280</td>
</tr>
</tbody>
</table>

*Number of floor is 4 but some Building also contain basement-apartment (5 floor)
Figure 4.25: Zari Land Second Phase Site Plan

Source: (Zari Land administers office).
Analyzing the site plan of the Zari Land project

Neighborhood

Residential Area

After the comparison of existing residential areas with the Iraqi Housing standards of residential areas, it was found that many differences exist between the standards and the actual residential Areas as shown in the table below. The floor area ratio (total floor area / residential area) for residential building (Med-rise) is found to be 2.12 in some areas and in others is less than this value as the table below shows. Floor area ratio for (Low-rise) is within the standards. Accommodation density (dwellings / hectares) for (Med-rise) residential building in one hectare is about (136) apartments or less in other places. Residential building (Low-rise) accommodation density for one hectare is about (85-89) apartments or less in other places. The population density (inhabitants / hectare) for (Med-rise) residential building is nearly (478 – 544) people in hectare. Population net density for residential (Low-rise) is nearly (341 - 355) people in hectare.

From the comparison with the standards, there are problems in the areas that have high Accommodation density in (gardens, car parks, Services Street, walkways and the open space between the buildings.) and these problems respectively increase with increasing dwellings / hectares ratio.

Table 4.16: Comparing the existing residential area with the standards of residential area (Zari Land)

<table>
<thead>
<tr>
<th>Type of residential buildings</th>
<th>Standard</th>
<th>Zari Land</th>
<th>Standard</th>
<th>Zari Land</th>
<th>Standard</th>
<th>Zari Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor area ration (total floor area / Residential Area)</td>
<td>1 – 1,5</td>
<td>1.86 – 2.12</td>
<td>60 – 120</td>
<td>120 - 136</td>
<td>250 - 500</td>
<td>478 - 544</td>
</tr>
<tr>
<td>Floor area ration (total floor area / Residential Area)</td>
<td>0.60 – 1.0</td>
<td>0.86 - 0.90</td>
<td>40 - 80</td>
<td>85 - 89</td>
<td>200 – 400</td>
<td>341 - 355</td>
</tr>
</tbody>
</table>
Figure (4.26) shows the closeness of buildings to each other and the effect of street-level rise in comparison with the buildings on the privacy of residents and the impact of waste place on the entrance of the building.

![Images showing different aspects of residential area in Zari Land](image)

1. The buildings are near to each other
2. Waste place at the entrance of building
3. Level of apartment height to the garden
4. The amusement park is near to the building

Figure 4.26: Residential Area Situation in Zari Land

Source: (Researcher), 2013.

4-2-2-2-1-2- Neighborhood Services

By analyzing the neighborhood of Zari Land city, there was lack of the needed services. Table (4.17) shows the difference between the existing services in Zari Land and the needed service according to the Iraqi standards. There is lack of (Nursery, Cultural center, Post office and Health center).
Most of the services (Mosque, Local market or small shops, Tea-house, refreshment shop and restaurants casino) exist, but the problem is that the people out of the project are using them. Therefore, the size of services should be larger. The Primary school, Intermediate school and Kindergarten are found in one building, with two working shifts. The secondary school is available out of the project area but the distance is more than 800 m.

Table 4.17: Comparing the existing Services with the standards of Neighborhood (Zari Land)

Source: (General Organization for Housing in Iraq and Researcher).

<table>
<thead>
<tr>
<th>Services</th>
<th>Services area in standard in hectare</th>
<th>Services area in Zari Land in hectare</th>
<th>Maximum access distance from dwellings to services (in m) standards</th>
<th>Maximum access distance from dwellings to services (in m) Zari Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursery</td>
<td>0.24</td>
<td>Not available</td>
<td>300</td>
<td>Not available</td>
</tr>
<tr>
<td>Kindergarten</td>
<td>0.48</td>
<td>Using the same building and it’s below the standards</td>
<td>300</td>
<td>400</td>
</tr>
<tr>
<td>Primary school</td>
<td>1.54</td>
<td></td>
<td>500</td>
<td>400</td>
</tr>
<tr>
<td>Intermediate school</td>
<td>2 X 0.48 = 0.96</td>
<td></td>
<td>500</td>
<td>400</td>
</tr>
<tr>
<td>Secondary school</td>
<td>2 X 0.45 = 0.9 1 X 0.84</td>
<td>Out of the project</td>
<td>800</td>
<td>Out of the project(distance more than 800 m)</td>
</tr>
<tr>
<td>Health center</td>
<td>0.25</td>
<td>Out of the project</td>
<td>800</td>
<td>Out of the project(distance more than 800 m)</td>
</tr>
<tr>
<td>Mosque (church)</td>
<td>0.06</td>
<td>Available</td>
<td>800</td>
<td>660</td>
</tr>
<tr>
<td>Cultural center</td>
<td>0.325</td>
<td>Not available</td>
<td>800</td>
<td>Not available</td>
</tr>
<tr>
<td>Local market small shops</td>
<td>2 X 0.2 = 0.4</td>
<td>Available</td>
<td>500</td>
<td>Available</td>
</tr>
<tr>
<td>Tea-house, refreshment shop</td>
<td>0.145</td>
<td>Available</td>
<td>500</td>
<td>Available</td>
</tr>
<tr>
<td>Restaurants casino</td>
<td>0.145</td>
<td>Available</td>
<td>800</td>
<td>Available</td>
</tr>
<tr>
<td>Post office</td>
<td>0.035</td>
<td>Not available</td>
<td>800</td>
<td>Not available</td>
</tr>
</tbody>
</table>
Figure (4.27) shows services in the site of the project according to financial interest for example shops had been built in the edge of the project and delay in the implementation of services.

![Figure 4.27: Services Building situation in Zari Land](image)

Source: (Researcher), 2013.

4-2-2-1-3- **Community open spaces**

From comparison of community open spaces in Zari Land with the community open spaces standards one can observe that the green areas are close to the standards, play fields for children are available in site plan but have not been constructed until now. Green fields and play areas for youth are available and close to the standard but are used by people from out of the project. Community parks and squares (including sport courts) are not available.
Table 4.18: Comparing the existing community open spaces with the standards of Neighborhood (Zari Land)

Source: (General Organization for Housing in Iraq and Researcher).

<table>
<thead>
<tr>
<th>Services</th>
<th>Age group of users</th>
<th>Area in m² per one inhabitant</th>
<th>plots size in m² (Stander)</th>
<th>plots size in m² (Zari Land)</th>
<th>Max distance of access from dwellings /in m/ (Stander)</th>
<th>Max distance of access from dwellings /in m/ (Zari Land)</th>
<th>Access (Stander)</th>
<th>Access (Zari Land)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Play field</td>
<td>Children from 6 up to 11</td>
<td>0.75</td>
<td>600-900</td>
<td>400-600</td>
<td>Available</td>
<td>Not Available</td>
<td>200-300</td>
<td>Available</td>
</tr>
<tr>
<td>Sport field</td>
<td>Youth from 12 up to 18</td>
<td>0.50</td>
<td>900-1500</td>
<td>600-1000</td>
<td>Available</td>
<td>Available</td>
<td>500-800</td>
<td>370</td>
</tr>
<tr>
<td>Community park and squares /including sport courts/</td>
<td>For all inhabitants</td>
<td>5.00</td>
<td>-</td>
<td>-</td>
<td>not available</td>
<td>not available</td>
<td>800</td>
<td>not available</td>
</tr>
</tbody>
</table>

Figure (4.28) shows the negligence of some gardens, green areas with games for children are not provided. Some green areas located in the streets surrounding the project cannot be used by the inhabitants in the project and sometimes they are used by people from outside the project.
Figure 4.28: Community Open Spaces Situation in Zari Land

Source: (Researcher), 2013.

4-2-2-2-1-4- **Circulation and car parking**

Service (occasional) Street is available in some areas within the standards. Walkways are close to the standards but in some areas that walkways are close to the street walkways on-street less than standards. The streets are designed to parking cars on the side of the street but the car parks are less than need of families. In some areas like the medical complex and local market people from out of the project come to these places so they make extra load on the area which makes problems to the residents. Figure
(4.29): streets surrounding the project are crowded and car parking design on streets side effects resident's children safety. Walk ways are incomplete in some areas causing problems for the occupants, especially in winter.

Figure 4.29: Circulation and Car Parks Situation in Zari Land

Source: (Researcher), 2013.
4-2-2-1-5- **Apartment spaces**

The apartment spaces and their activities vary according to the number of family members. The project contains three types of apartments.

A- **First apartment type (A):** The building consists of eight floors; each floor consists of two apartments. Apartment Area is (150m²). The apartment consists of three bedrooms, kitchen, reception opened on living room, one bathroom, WC, as well as two balconies and an entrance. It does not have a dining room, so the kitchen is used for this purpose, although it is small. See table (4.19) and (4.20) in appendix.
B- **Second apartment type (B):** The building consists of eight floors; each floor consists of two types of apartments. First type (B) area is (120m$^2$). The apartment consists of two bedrooms, kitchen, living room, one bathroom, WC, as well as two balconies and an entrance. It does not have a dining room, so the kitchen is used for this purpose, although it is small. See table (4.21) and (4.22) in appendix. The second is apartment Type (A).
C- **Third apartment type (C):** The building consists of four floors; each floor consists of two apartments. Apartment area is \(95\text{m}^2\). The apartment consists of two bedroom rooms, living room, one bathroom, WC, as well as two balconies and an entrance. It does not have a dining room, so the kitchen is used for this purpose, although it is small. See table (4.23) and (4.24) in appendix.
Figure 4.32: Apartment type C

Source: Zari Land administers office.

Figure (4.33) shows the changes which are made to apartments merging space or changing its function. Low height level of some apartment to the entrance causes lack of privacy inside the apartment.
Figure 4.33: Apartment Situation in Zari Land

Source: (Researcher), 2013.
4-2-2-3- **Results of the questionnaire and In-depth interviews in Zari Land**

4-2-2-3-1- **Socioeconomic situation of the family**

4-2-2-3-1-1- **Family income**

In general the income of 45.7% of the residents are less than 1,000,000 Iraqi dinars, 40.1% of the residents income ranges from 1,000,000 to 1,500,000 Iraqi dinars and 14.2% of the residents income are more than 1,500,000 Iraqi dinars.

4-2-2-3-1-2- **Apartment Price and Rental**

The price of the apartment is 45000$. The payment was in phases. At apartment registration, the buyer pays 22500$ out of 45000$, and the rest of the money will paid in ten years. The rental depends on the status of the apartment, if it’s furnished the rent is around (800$) per month. If the apartment is empty the rent is around (400$) per month. Most of the apartments are occupied by their owners (66.67%) and (33.33%) are rented. This price, payment method and rent for cheaper apartments and even the price of these apartments vary depending on the payment method so I chose a payment method that suits the majority of apartments type (C).

4-2-2-3-1-3- **Size of the family**

From the diagram below we found that (2.34%) of apartments were empty. (3.91%) of apartments had one person living in. (11.72%) of families consist of husband and wife. (22.66%) of families consist of parents and one child. (32.03%) of families consist of parents and two children. (13.28%) of families consist of parents and three children. (7.03%) of families consist of parents and four children. (3.91%) of families consist of seven persons. (1.56%) of families consist of eight persons. (0.78%) families consist of nine persons. (0.78%) families consist of twelve persons.
Figure 4.34: Family Size in Zari Land

Source: (Researcher).

4-2-2-3-1-4- **Educational level**

The following percentages show the distribution of the Student according to the stages of education for residents.

1- Kindergarten 23.88%.
2- Primary school 37.31%.
3- Intermediate school 14.92%.
4- Secondary school 16.41%.
5- University 7.46%.
4-2-2-3-1-5- **Residents desire to leave the Neighborhood**

After interviewing the residents, the percent of residents who like to move in the future is 65.91\% and those who do not think of moving is 34.09\%.

Reasons of moving to new residence: -
1 – Increase in the number of family members.
2 – Owning a piece of land.
3 - Inefficient services and social infrastructure in the Neighborhood.
4 – Getting a house in other area.
5 - Problems with the neighbors.
6 - Others.

As we see from figure below the main reason for changing the residence is inefficient services although the apartments were built six years ago.
Figure 4.36: Residents Desire to Leave the Neighborhood (Zari Land)
Source: Researcher

Only 4.49% of residents feel the project did not meet their desires and expectations, Fair 65.96% and Good 29.55%. Before living in the project everyone has an idea about life in the project and their answers depended on the extent to which the reality of the project matched their expectations.

Figure 4.37: Project Meeting the Desires of Residents (Zari Land)
Source: Researcher
Most of the residents (62.79%) feel living in the neighborhood is Fair, 2% Bad and 35.21% good.

4-2-2-3-1-6- **Choosing apartment**

Reasons for buying an apartment

1. Apartment design
2. Design of the neighborhood
3. Safety availability
4. Services provision
5. Accessibility
6. Appropriate price
7. Others

![Figure 4.38: Reasons to Choose the Apartments in Zari Land](source)

Source: Researcher

**Choice of residence in the project of Zari Land**

The way of paying payments for this project was the best among the projects established at that time and project location was in the city center. So the financial reason and project location were the main reasons for choosing this project. Half of residents (48.84%) did not want to live in the upper floors of the building and 25.58% preferred living in the upper floors and 25.58% said it did not make any difference. The reason for
choosing the ground floors by some is the lack of elevators, and some have chosen the middle floors because they are better in terms of isolation and away from walkways. Others have chosen the upper floors to be far from the noise and inconvenience. But some did not have the right to choose so they just took what was available.

4-2-2-3-1-7- Social relationship

Only 54.55% of families consider relationships with the residents of apartments within the same building fair, 29.55% consider relations good and 15.91% of families have no relations. Residents' evaluation is based on existence or absence of problems with neighbors and the nature of the relationship between residents in same building. 9.09% of families consider relationships with the residents of other building apartments good, 59.09% bad and 31.82% fair. Residents evaluation based on existence or absence of problems with neighbors and the nature of the relationship between residents in neighboring building.

4-2-2-3-1-8- Privacy

Only 13.64% of families consider privacy within the neighborhood bad, 40.91% good and 45.45% fair. Residents' evaluation is based on the possibility of mobility of families in within the neighborhood public parks without being annoyed by other residents. Half residents (45.45%) think privacy in the apartment is bad, 22.73% fair and 31.82% good. The assessment of residents is based on what the residents in cross buildings or pedestrians can see inside the apartments. Most of the residents (65.91%) sometimes hear a voice from the neighboring apartment. 20.45% of residents say they always hear noise and 13.64% say they do not. Residents' evaluation is based on sound insulation between apartments on the same floor and apartments on the other floors.

4-2-2-3-2- Neighborhood

4-2-2-3-2-1- infrastructural and service

28.57% of residents evaluate public gardens as bad, 38.10% as fair and 33.33% as good. Residents' evaluation is based on level of public parks in terms of (beauty,
providing games and accessibility). Only 28.21% of residents are gardening the surrounding of building, 56.41% do not gardening and 15.38% same time do. Those residents who take care of the garden surrounding their building use these green areas as private garden specialty on the ground floor. Most of residents (60.47%) consider car parking location is not enough, 16.28% consider it is fair and 23.26% consider it is good. Residents' evaluation is based on availability of parking spaces and how close it is to the entrance of the building.

![Figure 4.39: Car place Efficiency in Zari Land](image)

Source: Researcher

Half of residents (52.27%) think waste collection location is fair, 20.50% think it is bad and 27.23% think it is good. Residents' evaluation is based on how bad the view of waste collection is and the spread of the smell near the location of the entrance of the building.
Half of residents (50%) consider cleaning services like cleaning up gardens, streets and entrances of buildings fair, 26.09% bad and 23.91% good. Health services are bad because the health center is not available in the project but there is a privet one.

Half of residents (50%) think the provision of electricity is good, 31.67% consider it bad and 18.33% consider it fair. Residents' evaluation is based on the efficiency of electricity and electrical problems in every apartment. Half of residents (50%) consider the efficiency of water provision good, 31.67% bad, 18.33% fair. Residents' evaluation is based on the efficiency of water provision and water problems in every apartment. One of the problems in neighborhood is that the water project works by electricity so when power is cut off, water is also cut off. There are many failures in the elevators and most of the buildings have one elevator that works. When any malfunction occurs within the building in the project, technical department does not respond quickly to solve problems.

Method used by primary school students to reach their school 52.94% walk to school, 26.47% go by personal car and 20.59% go by bus. Only 2.27% of residents do not shop from the neighborhood shops 63.64%, shop from there and 34.09% sometimes shop from there. 60.47% of residents shop from the neighborhood every day, but 37.21% shop weekly and 3.33% shop monthly.
34.15% of residents said the executive company provided everything in the announcement of the project, but 65.85% said it did not. The locations of service were changed. People from outside the compound use the services as well. There has been a delay in service buildings.

4-2-2-3-2-2- **Circulation efficiency**

Many Questions were asked about the efficiency of movement in the neighborhood and movements from and to the neighborhood.

33.56% of residents consider distance from the neighborhood to the work area near, 33.33% consider it OK and 33.11% consider it far. So as we see only 33.11% of the residents are far from their work place because the project is built close to the city center.

![Circulation efficiency chart]

Figure 4.41: Residents Work place Destines (Zari Land)

Source: (Researcher).

About moving to and from the neighborhood to city's main services or other activities that are outside of the neighborhood, 67.44% of residents consider it is good, 20.93% suitable and 11.63% bad. Residents' evaluation is based on the distance from the project to the city center and the city's main services (such as government departments, the main market and others). 76.19% of residents think reaching the apartment from the entrance
of the neighborhood good, 16.67% think it is suitable and 7.14% bad. Residents' evaluation is based on efficient roads and walkways from the entrance to the apartment and vice versa (distance, width and quality of finishing).

As for transportation availability in the neighborhoods (not taking in account personal cars) 11.90% of residents think it is sometimes available, 85.71% think it is always available and 2.38% think it is not available. Most of residents (65%) consider the efficiency of public transport such as buses and mini buses bad, 17.50% fair and 17.50% good. Residents' evaluation is based on availability of public transport in the project. Half of residents (52.78%) think access to public transport is bad, 25% fair and 22.22% good. Residents' evaluation is based on the time consumed on reaching and waiting for public transport. Only 2.22% of residents think connection and links between the neighborhood and the surround project is bad, 48.89% think it is fair and 48.89% think it is good. Residents' evaluation is based on efficiency of project connection to nearby neighboring projects by the streets and walkways. 29.41% of residents consider design of pedestrian movement bad, 41.18% consider it fair and 29.41% consider it good. Residents' evaluation is based on efficiency of pedestrians' movement and access to project services and intersection of pedestrian movement with car traffic. Only 22.50% of residents consider safety availability for the movement of the children at the entrance of the residential buildings bad, 35% consider it fair and 42.50% consider it good. Residents' evaluation is based on children's access to the gardens near the building entrance without risk.

4-2-2-3-3- Building condition and construction

This project has been handed to the owners in 2007-2008. The building condition of apartments in Zari Land according to 3.03% of residents is bad, according to 48.5% it is fair and according to 48.42% of residents it is good. Residents evaluate their apartments according to the amount of changes and repairs they have made in the (sewage, water, electricity, doors, windows, etc.).
Figure 4.42: Status of Apartment in Zari Land

Source: Researcher

The functional space of the Apartment

After living in the apartments they made changes in the apartment such as expanding the size of the kitchen by combining it with balcony, or converting the balcony to store and other changes. 41.86% of the residents made changes and 58.14% did not make any changes. Many changes were not made because the apartments were rented or the owners were thinking to sell the apartment.
4-2-2-4- Results of (Questionnaire and In-Depth Interview with experts) Zari Land

- **Community**
  In this project for-sale housing are not affordable but rental housing are affordable. Community outreach observed to be reasonably applicable but open community and compact development and diversity of uses were all observed to be unreasonably applicable. However, in this project the plan for adaptive reuse of historic buildings form was not observed. Moreover, applying regional pattern precedents in urbanism and architecture was not observed.

- **Sustainable site**
  With regards to the site selection, some measurements were not taken into account including the redevelopment of urban areas, redevelopment of brown field and the protection or restoration of open spaces. Moreover, there were some criteria which were observed to be reasonably convenient such as; minimizing site disturbance during construction, the erosion and sedimentation. Light pollution is also convenient because of
the insufficient use of the light. However, the project designs help to reduce automobile dependence. Furthermore, in Zari Land the steep slope preservation is reasonable. Farmland preservation, parkland preservation and the reducing impact of the heat island effect are bad.

- **Materials and resources**
  Management of construction waste, recycled content and identification in the post-construction are not available in this project. Use of materials manufactured locally and use of local materials extracted regionally are medium. Use of renewable resources, reuse of materials and comprehensive waste management are not available. Did not have a place for storage and collect recyclable wastes. Generally if we look at the efficiency of materials and resources in the project, it is not convenient compared with sustainability criteria.

- **Efficiency of water use**
  One of the problems that exist in the project is the use of drinking water for irrigation purposes, lack of the use of technology in sewage treatment for irrigation. There is no technology to reduce water use in buildings. There are no techniques for reuse of rain water or its management. Technologies to reduce the impact of rainwater do not exist. Taking into account the use of gray water from the project for an irrigation purposes is rare. Generally, the efficiency of water use in the project is bad.

- **Energy and atmosphere**
  The project does not make use of renewable energy or green energy. Efficient use of electrical energy in buildings and infrastructure is medium. Power generation and renewable energy sources are not available within the site. In general, energy efficiency is low.
Chapter Five

5- Conclusions and Recommendations

5-1- General Conclusions

The city of Duhok suffers from a housing crisis because of a multiple of socio-economic and political reasons such as rapid population growth and immigration from rural area etc.

The housing needs reporter and the reports on the existing conditions in Duhok have given an indication of the needs and demands on housing. Duhok city needs 1500 unit annually to cover the growing need for housing.

Multi-Storey Housing projects are one of the solutions to solve the growing problem of the housing crisis in the city of Duhok but the housing projects in Duhok face many deficits such as lack of efficient infrastructure services and environment in addition to social and economic problems.

The city of Duhok needs housing projects that have access to habitable environments with adequate infrastructure, economic opportunities and social services. It needs a housing project that is integrated and financially sustainable that promote the delivery of housing opportunities on a progressive basis.

Therefore, the housing project must provide basic services and open spaces, and calculate the spaces needed to meet the needs of the population according to housing standards and should take into account the environmental, social and economic criteria of sustainability.

5-2- Field Study Conclusions

5-2-1- Neighborhood

5-2-1-1- Residential Area

Increasing the number of housing buildings in relation to residential area leads to increasing the number of apartments and population density per hectare, which in turn increases the load and cause problems in services. The buildings are near to each other and ground floor apartments are close to the street. This causes problem of losing privacy
in apartments. No places are designed for waste collection and therefore people put it close to building’s entrances and cause nasty smells and improper view at building's entrance.

Recycling process and reuse materials in projects are not taken into account. Local extracted manufactured materials and materials locally manufactured are limited.

5-2-1-2 Neighborhood Services

Services Such as (Primary school, Intermediate school, health center, mosque, local market Tea-house, refreshment shop and restaurants casino) are inefficient in neighborhood projects.

- Some of the services are not available (health center, restaurants and casino) and some are out of the project and farther than standard maximum distance (secondary school). Other services are available in the plan but have not been built until now (mosque).

Neighborhood services (kindergarten, primary and intermediate school) work two shifts in one building, therefore the size of these services should be larger and they were not built according to the standards or there was delay in the implementation of these services, therefor students have to go to neighboring schools. This creates two problems: first, it increases the number of students in these schools and second, schools buildings are far for most of primary school students, so they use (Buses or personal cars) to reach schools.

Other services are available but are used by people from outside the project (local market, Tea-house and refreshment shop). Delay in markets construction force residents to shopping from neighboring markets outside the project. Sometimes, markets are placed on the sides of neighborhood in order to increase the financial interest. Because these markets are not close to all apartments in the project, many residents do not shop every day from neighboring markets.

- There are big problems in services. Because of the lack of supervision by government departments. The investor looks only to financial profit when building the apartments in the project without giving enough space or taking into account the services buildings and providing comfortable environment for the residents in the neighborhood. These are the main reasons for the dissatisfaction of residents with the neighborhood and their desire to change the place of residence.
• Lack of interest in choosing neighborhood close to city infrastructure and services. On the contrary, agricultural areas are converted to neighborhood. Technical infrastructure (water and electricity) is inefficient. There are some problems in water and electricity. There is water treatment stations, but they are inefficient and potable water is used for irrigation. Energy and Atmosphere are almost neglected in the project design and the designer has not thought about this point.
• Most residents think that the project and the apartments are not up to their personal expectations. Although there are problems, most residents are satisfied with their new lives in the neighborhood, because of the problems in previous poor housing conditions (rental housing or living in a house that contains more than one family .etc.).

5-2-1-3- **Community Open Spaces**

Relationship between the inhabitants of the same building is good, social relations between residents in neighboring building are weak because of lack or incomplete open spaces and playgrounds to gather families. There is also lack of green areas and play fields for children. There are also lack of public gardens and play fields for youth. Some community open spaces have been abandoned or converted to residential building. Community Park and squares (including sport playgrounds) are not available. Also all internal gardens in the project have not been completed leading to scattering of dust in the project; therefore some of the gardens are planted by the residents. The main reason for the inefficiency of community open spaces is that the investor does not benefit financially by building community open spaces and providing comfortable environment for the residents and the lack of supervision by government departments.

5-2-1-4- **Circulation and Car Parks**

**Circulation:** - There is lack of interest in vehicles and pedestrians movement and delay in the implementation operation. Narrow service streets as well as long streets within the project cause a threat to children safety. There is no safety for children at the entrance of the building and in the nearby gardens because of the closeness of the building to the streets. Delay in paving streets surrounding the project leads to traffic problems and scattering dust into the project. Inefficient walkways are because of the intersection with
a street and some sidewalks are narrow in some places. Design of car parking affects vehicles and pedestrian movement negatively. The location of buildings helps to ease movement for pedestrian. Public transport (buses) is generally inefficient in Duhok, but the other problem is that some housing projects are far from public transport line.

**Car parking:** Inefficient parking places led to car parking in unallocated places. Some car parking accommodates more than 80 vehicles contrary to the Iraqi standards but there are shortages of car parking in other areas because of apartment's number. There is another problem because of the services that used by inside and outside the neighborhood people, leading to insufficient parking for those services forcing some of the customers to use parking that belongs to the residents. Also there are some services building in the project without parking areas. Using service streets or internal streets for parking affects the movement efficiency for cars, pedestrians and children safety.

5-2-1-5- **Apartment**

Construction and quality of the building:-

There is a problem in the design of the apartments, so some places are larger than standards and others are smaller than standards or less spaces (often bedrooms). The kitchen area must be larger to be suitable for dining. The apartments should include a special room for guests as a reception and living room because of the nature of social life in Duhok.

The quality of the apartment in Zari Land is better than Lelav City: residents have been living the Zari Land project for more than five years and residents have not exceeded two years in Lelav City project.

Design of balcony, windows is inefficient and voice transmission affects residents' privacy in apartments.

5-2-1-6- **Affordability of the Project**

The amount of advance payment and monthly installments is relatively high compared with the quality of the apartment and project. The Price and installments are the main reason for residents to buy apartment. Most residents pay more than half their salary for installment plus the first advance payment. It is clear that the payments are not good as residents first thought because they have to pay most of their salaries to installments. However, these projects are the best solution for people who do not have
ability to buy a house. Most of the residents are the owners of apartments and few of them have rented apartments.

Choice of apartment and its location within the neighborhood depends on the sequence of registration and it is not according to the desire of residents. More than half of the residents do not want to live in the upper floors, but they have no choice.

Most families were medium (around 4 members). This is appropriate to the size of the apartments and diversity in sizes of apartments serve diversity in sizes of families, although buying the apartment is based on the financial condition and the sequence of registry and does not depend on the size of the family.

5-2-1-7- Comparison of the Projects (Lelav City and Zari Land)

After comparing the projects (Zariland and Lelav City), can be seen the big difference between them: Zariland is better than Lelav City, although Zariland was built before Lelav City by years this indication is serious. Housing projects are getting worse instead of getting better. The reason goes back to the laws imposed by the government on investors and because of the investor himself and also the ignorance of the residents, especially when they buy apartments in the project without thinking of what the project will provide to them in the future. See table 5.1, table 5.2 and table 5.3.

Table 5.1: Comparison of Site Plan Indicator

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Table 5.2: Comparison of results for (in-depth interview and questionnaire) with residents

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Table 5.3: Comparison of Results for (in-depth interview and Questionnaire) with expert

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5-3- **Final Recommendations**

This research has come up with some recommendations, which can be taken into consideration by the architects, planner and decision-makers and implementing agencies, in order to reach the desired results for housing projects:

5-3-1- **General Recommendation for housing project in City of Dohuk**

- Living within environmental limits – Respecting the limit of Duhok's environment, resources and biodiversity – to improve our environment and ensure that the natural resources needed for life are unimpaired and remain so for future generations.
• Ensuring a strong, healthy and social housing project – Meeting the diverse needs of all people existing and future communities, promoting personal well-being, social cohesion, inclusion, and creating equal opportunity for all inhabitants.
• Economical housing projects must be within the resident financial ability and the costs of (electricity, heating, cooling, water, transportation, etc.) should be reduced.
• Living in housing projects built according to the planning standards to meet the needs and desires of users to live a welfare life.

5-3-2  Recommendation to Achieve Sustainability

The local administration has to help and encourage the contractors for the transition of housing project from traditional buildings into sustainable buildings. Construction of housing project in Duhok should be according to level one of pillars sustainability and this is a first step. It is also necessary to ask the contractors to abide by level one of pillars sustainability. Implementation of the recommendations and features, to get to level one of pillars sustainability is feasible in the light of the proposed budgets for projects.

• Community efficiency should be maintained (the location should be served by existing or adjacent infrastructure, developments should be compact and efficient, and the community should be equipped with services, shops and schools and other services to encourage walking. It is preferable that neighborhood relatively close to the city's public services. It is important to strengthen social relations between residents through the design of buildings and open spaces).

• Sustainable Site should be considered through (site development that reduces the site’s ecological impacts which include all natural and geophysical systems related to the site and the ecosystem services that neighborhood provide, as well as site effects on the environment as a whole. Site selection plays a more effective role in achieving sustainability; therefore the government must take interest in the selection process for housing project sites).

• Materials and resources efficiency through (minimization of construction materials, use of recycled and native materials and environmentally preferable products. Strategies should be adopted in the choice of materials and the extent of its negative effects on the environment and energy consumption during the design process of construction or after the operation of the building. There should be adoption of
natural materials such as wood, stone and recycled material, recycled plastic and recycled aluminum as structural materials used in sustainable buildings and adoption of local materials in preliminary design decisions).

- Efficiency of water use through (gray water treatment and reuse, as well as storm water reuse should be taken into account). This water can be used to irrigate green areas within the project and in W.C. Use of taps that restrict the flow of water or equipped with sensors to automatically close.

- Energy and atmosphere efficiency should be taken into account (The apartment should be well insulated, with efficient windows. Outdoor lighting fixtures should have motion sensors to minimize use of electricity).

- There is needed to keep up with future developments for the City of Duhok and their impact on residential systems. Continuity focuses on developing the concept of sustainable housing project depending on the circumstance of economic and society changing as a government strategy.

5-3-3. Recommendation for Planning Criteria

Designer should investigate human behavior and the factors that affect it with respect to compatibility with the space, especially if we realize that the neighborhood is an area involving several services designed to meet basic human needs in a civilized style.

- The investors have to apply the criteria for residential area because they often increase the proportion of residential buildings. The government departments' should confirm on this point at the design stage.

- Services and green spaces in the neighborhood should be various according to the number of residents (based on Iraqi criteria). They also must be implemented before delivering the apartments to occupants'. The government departments should confirm at this point.

- Circulation should be considered when choosing a project location in order not to be away from city services. Movement within the project must be efficient by separating traffic for walkways. Services should be close to the apartments so that residents use walking to reach it. Walkways and streets should be designed according to residential density.
• The distribution of spaces in apartments must be according to the nature of the people of Duhok. Apartments should be designed in a way that keeps the privacy of residents.

• Giving the opportunity to residents in the participation in the design process leading to meet the needs of residents in creating a comfortable environment and harmonious with the desire of residents.

• The government needs to decrease the adoption of single housing patterns. These patterns represent economic loss for government and the family. The government should motivate such as paying part of the apartment cost in Multi-Storey Housing project.

5-4-  The Implications for Future Research

At the end of research some research proposals are put forward to complement and extend the subject to support the scientific knowledge regarding sustainable housing projects, as follows:

• The government's policy to provide sustainability in housing projects
• Effect of sustainable housing projects on the interior spaces
• The impact of new technology on sustainable housing projects
• Energy efficiency in housing building

5-5-  The Beneficiaries of the Research

• Architecture departments in all universities.
• Institutions of consultancy and design.
• Graduate students in the departments of engineering.
• Architects.
• Specialists in the field of environmental and energy.
• Department of planning and designs in the province of Duhok.
• Ministry of Housing.
References


**Official Sources**

38. Agricultural Directorate in City of Duhok.


40. Duhok government from Department of Statistics.

41. Directory of Investment Duhok office.

42. KRG Regional Statistics Organization and IHSES 2009.


44. Lelav City administers office.

45. Weather forecasting directory of Duhok.

46. Zari Land administers office.
## Appendix

### A- Table

Table (4.6): Distribution of Apartment's Spaces Type A-G
Source: (Researcher and Lelav city administer office).

<table>
<thead>
<tr>
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<th>area</th>
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<td>1</td>
<td>Master bedroom</td>
<td>(4.5m * 3.60m)</td>
<td>(16.2 m²)</td>
</tr>
<tr>
<td>2</td>
<td>Kids Bedroom</td>
<td>(4m * 3.40m)</td>
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</tr>
<tr>
<td>3</td>
<td>Kitchen</td>
<td>(3.6m * 3m)</td>
<td>(10.8 m²)</td>
</tr>
<tr>
<td>4</td>
<td>Reception</td>
<td>(4.5m * 4m)</td>
<td>(18 m²)</td>
</tr>
<tr>
<td>5</td>
<td>Internal Hall</td>
<td>(3.4m * 4.20m)</td>
<td>(13.6 m²)</td>
</tr>
<tr>
<td>6</td>
<td>Balcony 1</td>
<td>(1.3m * 3.65m)</td>
<td>(4.75 m²)</td>
</tr>
<tr>
<td>7</td>
<td>Balcony 2</td>
<td>(3m * 1m)</td>
<td>(3 m²)</td>
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<tr>
<td>8</td>
<td>Bathroom</td>
<td>(1.8m * 2m)</td>
<td>(3.6 m²)</td>
</tr>
<tr>
<td>9</td>
<td>WC</td>
<td>(1.4m * 1.1m)</td>
<td>(1.54 m²)</td>
</tr>
<tr>
<td>10</td>
<td>Store</td>
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<td>(3.24 m²)</td>
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Table (4.7): Apartment Type A-G
Source: (Polservices, 1982 and Researcher).

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<th>DWELLING CATEGORIES AND FLOOR AREAS</th>
<th>URBAN MULTI-STOREY HOUSING</th>
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<tr>
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<td>Lilav city</td>
</tr>
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</tr>
<tr>
<td>BEDROOMS</td>
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</tr>
<tr>
<td>LIVING ROOMS</td>
<td>1</td>
</tr>
<tr>
<td>HABITABLE ROOMS</td>
<td>4</td>
</tr>
<tr>
<td>REQUIRED SPACE</td>
<td></td>
</tr>
<tr>
<td>CHARACTER OF DIRECTIVE</td>
<td></td>
</tr>
<tr>
<td>FLOOR AREA IN SQUARE METERS</td>
<td></td>
</tr>
<tr>
<td>1 Master bedroom</td>
<td>r.min.</td>
</tr>
<tr>
<td>2 2nd bedroom</td>
<td>ob.min.</td>
</tr>
<tr>
<td>3 3rd bedroom</td>
<td>ob.min.</td>
</tr>
<tr>
<td>4 4th bedroom</td>
<td>ob.min.</td>
</tr>
<tr>
<td>5 5th bedroom</td>
<td>ob.min.</td>
</tr>
<tr>
<td>6 6th bedroom</td>
<td>ob.min.</td>
</tr>
<tr>
<td>7 7th bedroom</td>
<td>ob.min.</td>
</tr>
<tr>
<td>8 8th bedroom</td>
<td>ob.min.</td>
</tr>
<tr>
<td>9 9th bedroom</td>
<td>ob.min.</td>
</tr>
<tr>
<td>10 10th bedroom</td>
<td>ob.min.</td>
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<th>area</th>
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<tr>
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<td>Master bedroom</td>
<td>(4.5m * 3.60m)</td>
<td>(16.2 m²)</td>
</tr>
<tr>
<td>2</td>
<td>Kids Bedroom</td>
<td>(4m * 3.40m)</td>
<td>(13.6 m²)</td>
</tr>
<tr>
<td>3</td>
<td>Kitchen</td>
<td>(3.6m * 3m)</td>
<td>(10.8 m²)</td>
</tr>
<tr>
<td>4</td>
<td>Reception</td>
<td>(4.5m * 4m)</td>
<td>(18 m²)</td>
</tr>
<tr>
<td>5</td>
<td>Internal Hall</td>
<td>(3.4m * 4.20m)</td>
<td>(13.6 m²)</td>
</tr>
<tr>
<td>6</td>
<td>Balcony 1</td>
<td>(1.3m * 3.65m)</td>
<td>(4.75 m²)</td>
</tr>
<tr>
<td>7</td>
<td>Balcony 2</td>
<td>(3m * 1m)</td>
<td>(3 m²)</td>
</tr>
<tr>
<td>8</td>
<td>Bathroom</td>
<td>(1.8m * 2m)</td>
<td>(3.6 m²)</td>
</tr>
<tr>
<td>9</td>
<td>WC</td>
<td>(1.4m * 1.1m)</td>
<td>(1.54 m²)</td>
</tr>
<tr>
<td>10</td>
<td>Store</td>
<td>(2.7m * 1.2m)</td>
<td>(3.24 m²)</td>
</tr>
<tr>
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<td>Space</td>
<td>Distance</td>
<td>Area</td>
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<tr>
<td>----</td>
<td>--------------------------------------------</td>
<td>------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>1</td>
<td>Master bedroom</td>
<td>(4.m * 4.60m)</td>
<td>(18.4²m).</td>
</tr>
<tr>
<td>2</td>
<td>Bedroom kids</td>
<td>(4m * 3.45m)</td>
<td>(13.8²m)</td>
</tr>
<tr>
<td>3</td>
<td>Kitchen</td>
<td>(3.2m * 4m)</td>
<td>(12.8²m)</td>
</tr>
<tr>
<td>4</td>
<td>Reception</td>
<td>(4m * 4.8m)</td>
<td>(19.2²m)</td>
</tr>
<tr>
<td>5</td>
<td>Internal Hall</td>
<td>(4m * 3m)</td>
<td>(12²m)</td>
</tr>
<tr>
<td>6</td>
<td>Balcony 1</td>
<td>(1.45m * 4.05m)</td>
<td>(5.87²m).</td>
</tr>
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<td>7</td>
<td>Bathroom</td>
<td>(2.35m * 1.6m)</td>
<td>(3.76²m)</td>
</tr>
<tr>
<td>8</td>
<td>WC</td>
<td>(1.2m * 1.1m)</td>
<td>(1.32²m)</td>
</tr>
</tbody>
</table>

Table (4.8): Distribution of Apartment's Spaces Type H
Source: (Researcher and Lelav city administer office).
Table (4.9): Apartment Type H
Source: (Polservices, 1982 and Researcher).

<table>
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<tr>
<th>CATEGORY OF DWELLING</th>
<th>DWELLING CATEGORIES AND FLOOR AREAS</th>
<th>URBAN MULTI-STOREY HOUSING</th>
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<tbody>
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<td>MINIMUM NUMBER OF ROOMS</td>
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<td>REQUIRED SPACE</td>
<td>CHARACTER OF DIRECTIVE</td>
<td></td>
</tr>
<tr>
<td>FLOOR AREA IN SQUARE METERS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 1 | Master bedroom | r.min. | 15 | 18.4 |
| 2 | 2nd bedroom | ob.min. | 12 | 13.8 |
| 3 | 3rd bedroom | ob.min. | 12 |
| 4 | 4th bedroom | ob.min. | - |
| 7 | Total sleeping and personal activities space | r.min. | 39 | 32.2 |
| 8 | Multi-purpose living room | r.min. | 24 | 12 |
| 9 | 2nd living room | - | 19.2 |
| 10 | Total living space | 8 | r.min. | 24 | 31.2 |
| 11 | Total habitable space | 7+10 | ob.min. | 69 | 63.4 |
| 12 | Kitchen | ob.min. | 12 | 12.8 |
| 13 | Bathroom | ob.min. | 3.5 | 3.76 |
| 14 | 2nd bathroom | ob.min. | - | 2.76 |
| 15 | Toilet | ob.min. | 1.5 | 1.32 |
| 16 | Storage | ob.min. | 6 | 3.24 |
| 17 | Total service space | 12+13+14+15+16 | r.min. | 23 | 23.88 |
| 18 | Circulation space | r.max | 15 | 44.85 |
| 19 | Useful in-door space | ob | 108-114 | 132.13 |
| 20 | Out-door space for summer night rest | r.min. | 12-18 | 5.87 |
| 21 | Total in-door and out-door useful | r | 120-138 |
Table (4.10): Distribution of Apartment’s Spaces Type R4, 5, 6, 7
Source: (Researcher and Lelav city administer office).

<table>
<thead>
<tr>
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<th>Distance</th>
<th>area</th>
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<td>(4.m * 5.5m)</td>
<td>(22.2m)</td>
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<td>2</td>
<td>Kids Bedroom</td>
<td>(4m * 4.7m)</td>
<td>(18.82m)</td>
</tr>
<tr>
<td>3</td>
<td>Kids Bedroom</td>
<td>(4m * 4.2m)</td>
<td>(16.82m)</td>
</tr>
<tr>
<td>4</td>
<td>Kitchen</td>
<td>(3.5m * 4.25m)</td>
<td>(14.882m)</td>
</tr>
<tr>
<td>5</td>
<td>Reception</td>
<td>(6.55m * 4.2m)</td>
<td>(27.512m)</td>
</tr>
<tr>
<td>6</td>
<td>Internal Hall</td>
<td>(5.4m * 5.3m)</td>
<td>(28.622m)</td>
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<tr>
<td>7</td>
<td>Balcony 1</td>
<td>(4.35m * 7.2m)</td>
<td>(31.322m)</td>
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<td>8</td>
<td>Bathroom</td>
<td>(2.25m * 2.45m)</td>
<td>(2.72m)</td>
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<tr>
<td>9</td>
<td>WC</td>
<td>(1.6m * 1.2m)</td>
<td>(1.922m)</td>
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<tr>
<td>10</td>
<td>Suite</td>
<td>(2.6m * 1.6m)</td>
<td>(4.162m)</td>
</tr>
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<td>11</td>
<td>Store</td>
<td>(2.15m * 1.35m)</td>
<td>(2.902m)</td>
</tr>
<tr>
<td>12</td>
<td>Entrance</td>
<td>(1.5m * 3.5m)</td>
<td>(5.252m)</td>
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Table (4.11): Apartment Type R4, 5, 6, 7
Source: (Polservices, 1982 and Researcher).

<table>
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<td>CATEGORY OF DWELLING</td>
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</tr>
<tr>
<td>MINIMUM NUMBER OF ROOMS</td>
</tr>
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</tr>
<tr>
<td>REQUIRED SPACE</td>
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<tr>
<td>1</td>
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<td>3</td>
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</tr>
<tr>
<td>19</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>21</td>
</tr>
</tbody>
</table>

r.mim - recommend minimum. ob. – obligatory. ob.min-obligatory minimum. r.max – recommend maximum. L – Large family.

Table (4.12): Distribution of Apartment's Spaces Type R1, 2, 3.

Source: (Researcher and Lelav city administer office).
Table (4.13): Apartment Type R1, 2, 3,

Source: (Polservices, 1982 and Researcher).

<p>| | | | |</p>
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<tbody>
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<tr>
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<td>Bathroom</td>
<td>(1.75m * 2.45m)</td>
<td>(4.29 m²)</td>
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<tr>
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<td>WC</td>
<td>(1.1m * 1.2m)</td>
<td>(1.32 m²)</td>
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<tr>
<td>12</td>
<td>Entrance</td>
<td>(1.45m * 2.2m)</td>
<td>(3.19 2 m²)</td>
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</table>

**URBAN HOUSING STANDARDS**

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<th>CATEGORY OF DWELLING</th>
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<th>MINIMUM NUMBER OF ROOMS</th>
<th>REQUIRED SPACE</th>
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</tr>
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<td>L2</td>
<td>Lilav city</td>
<td></td>
<td>FLOOR AREA IN SQUARE METERS</td>
</tr>
<tr>
<td></td>
<td>7-9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BEDROOMS</td>
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</tr>
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<td></td>
<td></td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>HABITABLE ROOMS</td>
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</tr>
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<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
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<tr>
<td>19</td>
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Table (4.19): Distribution of Apartment's Spaces Type A
Source: (Researcher and Zari Land administer office).

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<tr>
<td>1</td>
<td>Master bedroom</td>
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<td>2</td>
<td>Kids Bedroom</td>
<td>(10m²).</td>
</tr>
<tr>
<td>3</td>
<td>Kids Bedroom</td>
<td>(15m²).</td>
</tr>
<tr>
<td>4</td>
<td>Kitchen</td>
<td>(14.8m²).</td>
</tr>
<tr>
<td>5</td>
<td>Reception opened on living room</td>
<td>(40m²).</td>
</tr>
<tr>
<td>6</td>
<td>Corridor</td>
<td>(11.2m²).</td>
</tr>
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<td>Balcony 1</td>
<td>(7.2m²).</td>
</tr>
<tr>
<td>8</td>
<td>Balcony 2</td>
<td>(4.2m²).</td>
</tr>
<tr>
<td>9</td>
<td>Bathroom</td>
<td>(5m²).</td>
</tr>
<tr>
<td>10</td>
<td>WC</td>
<td>(2.5m²).</td>
</tr>
<tr>
<td>11</td>
<td>Entrance</td>
<td>(5.8m²)</td>
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</table>

Table (4.20): Apartment type A
Source: (Polservices, 1982 and Researcher).

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</tr>
<tr>
<td>MINIMUM NUMBER OF ROOMS</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>REQUIRED SPACE</td>
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</tr>
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</tr>
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</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
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Table (4.21): Distribution of Apartment's Spaces Type B
Source: (Researcher and Zari Land administer office).
### Table (4.22): Apartment type B

Source: (Polservices, 1982 and Researcher).

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<th>Minimum Number of Rooms</th>
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<tr>
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<td>5m²</td>
<td></td>
</tr>
<tr>
<td>WC</td>
<td>3m²</td>
<td></td>
</tr>
<tr>
<td>Entrance</td>
<td>6.3m²</td>
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<th>Required Space</th>
<th>Character of Directive</th>
<th>Minimum Size (m²)</th>
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<tr>
<td>2nd bedroom</td>
<td>ob.min.</td>
<td>12</td>
</tr>
<tr>
<td>3rd bedroom</td>
<td>ob.min.</td>
<td>12</td>
</tr>
<tr>
<td>4th bedroom</td>
<td>ob.min.</td>
<td>-</td>
</tr>
<tr>
<td>Total sleeping and personal activities space</td>
<td>r.min.</td>
<td>39</td>
</tr>
<tr>
<td>Multi-purpose living room</td>
<td>r.min.</td>
<td>24</td>
</tr>
<tr>
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<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Total living space</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>Total habitable space</td>
<td>7+10</td>
<td>ob.min.</td>
</tr>
<tr>
<td>Kitchen</td>
<td>ob.min.</td>
<td>12</td>
</tr>
<tr>
<td>Bathroom</td>
<td>ob.min.</td>
<td>3.5</td>
</tr>
<tr>
<td>2nd bathroom</td>
<td>ob.min.</td>
<td>-</td>
</tr>
<tr>
<td>Toilet</td>
<td>ob.min.</td>
<td>1.5</td>
</tr>
<tr>
<td>Storage</td>
<td>ob.min.</td>
<td>6</td>
</tr>
<tr>
<td>Total service space</td>
<td>12+13+14+15+16</td>
<td>r.min.</td>
</tr>
<tr>
<td>Circulation space</td>
<td>r.max</td>
<td>15</td>
</tr>
<tr>
<td>Useful in-door space</td>
<td>11+17+18</td>
<td>ob.</td>
</tr>
</tbody>
</table>
Table (4.23): Distribution of Apartment’s Spaces Type C
Source: (Researcher and Zari Land administer office).

<table>
<thead>
<tr>
<th>NO</th>
<th>Space</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Master bedroom</td>
<td>(14.62m²)</td>
</tr>
<tr>
<td>2</td>
<td>Kids Bedroom</td>
<td>(10.2m²)</td>
</tr>
<tr>
<td>3</td>
<td>Kitchen</td>
<td>(10.5m²)</td>
</tr>
<tr>
<td>4</td>
<td>Living room</td>
<td>(17.2m²)</td>
</tr>
<tr>
<td>5</td>
<td>Corridor</td>
<td>(5.6m²)</td>
</tr>
<tr>
<td>6</td>
<td>Balcony 1</td>
<td>(4.8m²)</td>
</tr>
<tr>
<td>7</td>
<td>Balcony 2</td>
<td>(3.9m²)</td>
</tr>
<tr>
<td>8</td>
<td>Bathroom</td>
<td>(2.8m²)</td>
</tr>
<tr>
<td>9</td>
<td>WC</td>
<td>(1.7m²)</td>
</tr>
<tr>
<td>10</td>
<td>Entrance</td>
<td>(2.52m²)</td>
</tr>
</tbody>
</table>

Table (4.24): Apartment Type C
Source: (Polservices, 1982 and Researcher).

<table>
<thead>
<tr>
<th>DWELLING CATEGORIES AND FLOOR AREAS</th>
<th>URBAN HOUSING STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATEGORY OF DWELLING</td>
<td>M1</td>
</tr>
<tr>
<td>NUMBER OF FAMILY MEMBER</td>
<td>3-5</td>
</tr>
<tr>
<td>MINIMUM NUMBER OF ROOMS</td>
<td>BEDROOMS</td>
</tr>
<tr>
<td></td>
<td>LIVING ROOMS</td>
</tr>
<tr>
<td></td>
<td>HABITABLE ROOMS</td>
</tr>
<tr>
<td>REQUIRED SPACE</td>
<td>CHARACTER OF DIRECTIVE</td>
</tr>
<tr>
<td>FLOOR AREA IN SQUARE METERS</td>
<td></td>
</tr>
<tr>
<td>1 Master bedroom</td>
<td>r.min.</td>
</tr>
<tr>
<td>2 2nd bedroom</td>
<td>ob.min.</td>
</tr>
</tbody>
</table>

M1 Zari Land
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>ob.min.</th>
<th>r.min.</th>
<th>ob.max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3rd bedroom</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4th bedroom</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Total sleeping and personal activities space 1+2+3+4</td>
<td>ob.min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Multi-purpose living room</td>
<td></td>
<td>24</td>
<td>17.2</td>
</tr>
<tr>
<td>9</td>
<td>2nd living room</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>Total living space 8</td>
<td></td>
<td>24</td>
<td>17.2</td>
</tr>
<tr>
<td>11</td>
<td>Total habitable space 7+10</td>
<td></td>
<td>57</td>
<td>42.02</td>
</tr>
<tr>
<td>12</td>
<td>Kitchen</td>
<td>ob.min.</td>
<td>12</td>
<td>10.5</td>
</tr>
<tr>
<td>13</td>
<td>Bathroom</td>
<td>ob.min.</td>
<td>3.5</td>
<td>2.8</td>
</tr>
<tr>
<td>14</td>
<td>2nd bathroom</td>
<td>ob.min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Toilet</td>
<td>ob.min.</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>16</td>
<td>Storage</td>
<td>ob.min.</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>17</td>
<td>Total service space 12+13+14+15+16</td>
<td>ob.min.</td>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>18</td>
<td>Circulation space</td>
<td>r.max.</td>
<td>12</td>
<td>29.28</td>
</tr>
<tr>
<td>19</td>
<td>Useful in-door space 11+17+18</td>
<td>ob.</td>
<td>93-99</td>
<td>86.3</td>
</tr>
<tr>
<td>20</td>
<td>Out-door space for summer night rest</td>
<td>r.min.</td>
<td>9-12</td>
<td>8.7</td>
</tr>
<tr>
<td>21</td>
<td>Total in-door and out-door useful space 19+20</td>
<td>r.</td>
<td>102-111</td>
<td>95</td>
</tr>
</tbody>
</table>

r.min - recommend minimum. ob. – obligatory. ob.min-obligatory minimum. r.max - recommend maximum. M-Medium family.
B- **Survey questionnaire**

1- **Survey (Questionnaire with the residents)**

**University of Duhok**

Form Number: (   )

Date

Survey form (Research: *Evaluation of Multi-Storey Housing Project in the Context of Sustainability in the City of Duhok Projects in the City of Duhok*) for master’s student Aram Omer Mohammed.

Neighborhood / building ...... floor ....... No. apartment (apartment) ....... Number of floors of the building...... Number of apartments in each floor........

1- Area of the apartment (M²): -
   - Less than 50 (    ) Less than 100 (    ) Less than 150(    )
   - Less than 200 (    ) Less than 250 (    ) Less than 300(    )

2- Components of the apartment (number):
   - Bedroom (    ) living room (    ) Kitchen (    )
   - Dining room (    ) reception room (    ) Bathroom (    ) W.C (    )
   - Store (    ) Balcony (    )
   - Other ....................................................................................................................
The information in the form is only for the purposes of the study. It is unnecessary to mention the name, only answer the questions.

First: - The Number of Family Members, the job and level of education

<table>
<thead>
<tr>
<th>Family members according to their relationship to household</th>
<th>Level of Education</th>
<th>Job</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Second: Economic Information

1 - What is the total monthly household income?  Less than 1000000 (   )  
between 1000000 and 1500000 ( )  more than 1500000 (   ).

2 - What is the total external help....................

3 - Ownership of the apartment. Owner (   )  Rent (    ).

4 - If the ownership is rented, what is the amount of the monthly rent (    ) ID. per month.

5 – Date of residence in apartment (   \   \   ).

Third: - The opinion of residents about living in the neighborhood

1 - Do you think you will change the current apartment? Yes (   ) No (   )

If the answer is (yes), reasons:

Expansion of family size (   )  Got a plot of land (   )

Inefficiency of public community services (   )  Get a house (   )

Problems with neighbors (   )  Other reason...........................................

2 - What is the extent to which the place meet the desires and expectations of residents?

Bad (   ) Fair (   ) Good (   ).

3 - What is your feeling about living in the neighborhood?

Bad (   ) Fair (   ) Good (   ).
Fourth: - Resident opinion about apartment

1 - Status of the building materials for the apartment

Bad ( )  Fair ( )  Good ( ).

2 - Did you make changes in the apartment? Yes ( )  No ( ).

If the answer is yes, what are the changes
..............................................................................................................................
..............................................................................................................................
..............................................................................................................................
..............................................................................................................................

Fifth: - Circulation efficiency

1 - Is the workplace close to the neighborhood?

Near ( )  Suitable ( )  Far away ( ).

2 - The moving to and from the neighborhood to city's main services or other activities that are outside of the neighborhood is: Near ( )  Suitable ( )  Far away ( ).

Because of..............................................................................................................................
..............................................................................................................................

3 - How to reach the apartment from the entrance of the neighborhood, and vice versa:

Difficult ( )  Normal ( )  Easy ( ).

4 - Transportation availability in the neighborhood (not taking in account personal cars):

Not available ( )  Sometime it is available ( )  Available all the time ( ).

5 - Efficiency of public transport such as buses and mini buses

Bad ( )  Fair ( )  Good ( ).

6 - Access to public transport:   Bad ( )  Fair ( )  Good ( ).
7 - Connection and links of the neighborhood with the surrounding projects
Bad ( )  Suitable ( )  Good ( ).

8 - Design of pedestrian movement is:  Bad ( )  Fair ( )  Good ( ).

9 - Building location for pedestrian movement in terms of closeness to services in the project
Far ( )  Suitable ( )  Near ( ).

10 - Buildings location affects the movement of pedestrians in the project
Affects ( )  Somehow affects ( )  Do not affects ( ).

11 - Safety availability for the movement of the children at the entrance of the buildings
Bad ( )  Fair ( )  Good ( ).

Sixth: Infrastructure and Services

1 - Public gardens are:  Bad ( )  Fair ( )  Good ( ).

2 – Are residents gardening the surrounding residential building green area?
Yes ( )  Sometimes ( )  No ( )

Reasons....................................................................................................................
.................................................................................................................................
.................................................................................................................................

3 - Car parking location design is:  Bad ( )  Fair ( )  Good ( ).

4 - Waste collection locations are:  Bad ( )  Fair ( )  Good ( ).

5 - Cleaning services like Cleanup gardens, streets and entrances of buildings are
Bad ( )  Fair ( )  Good ( ).

6 - Health services are:  Bad ( )  Fair ( )  Good ( ).

Because of....................................................................................................................

7 - Efficient provision of electricity is:  Bad ( )  Fair ( )  Good ( ).

8 - Efficient provision of water is:  Bad ( )  Fair ( )  Good ( ).

9 - Way used by primary school students to reach the school:
Walking ( )  By personal car ( )  Bus ( ).
10 - Shopping from the nearby neighborhood shops:

1- Do not shop ( )  Sometimes( )  Always ( )

2- Monthly shopping ( )  weekly ( )  Every day ( )

Seventh: Social Relations

1 - Relationships with the residents of apartments within the same building
Bad ( )  Fair ( )  Good ( ).

2 - Relationships with the residents of surrounding building apartments
Bad ( )  Fair ( )  Good ( ).

Eighth: Privacy

1 - Privacy within the neighborhood:  Bad ( )  Fair ( )  Good ( ).

2 - Privacy in the apartment:  Bad ( )  Fair ( )  Good ( ).

3 - Hearing noise from the neighboring apartment:
Hear noise Always ( )  Sometimes ( )  Do not hear noise ( ).

Ninth: Information on the reasons of living in the neighborhood

1 - Reasons for choosing residence in the project apartment:  Apartment design ( )
Design of the neighborhood ( )  Safety ( )  Services ( )
Accessibility ( )  Appropriate price ( )  Other ( )

2 - The reason of choosing this project rather than other?
...........................................................................................................................
...........................................................................................................................
...........................................................................................................................

3 - Do you prefer to live in the upper floors of the building?
No ( )  No different ( )  Yes ( ).
4 - Executive company provides everything in the announcement of the project?
No they did not (  ) Yes they did (  ).
If the answer is (did not) what are deficiencies?....................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

5 - Are there other negative or positive points in the project
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
2- Survey (Questionnaire for the Experts)

University of Duhok

Form Number: (   )

Date

Neighborhood

Survey form (Research: Evaluation of Multi-Storey Housing Project in the Context of Sustainability in the city of Duhok Projects in the City of Duhok) for master's student Aram Omer Mohammed.

Criteria for sustainable Housing project

1- Sustainable site

- Redevelopment of Urban Areas
  Not available (   ) little (   ) fair (   ) good (   ) very good (   )

- Redevelopment of Brownfield
  Not available (   ) little (   ) fair (   ) good (   ) very good (   )

- Farmland Preservation
  Not available (   ) little (   ) fair (   ) good (   ) very good (   )

- Erosion and Sedimentation Control
  Not available (   ) little (   ) fair (   ) good (   ) very good (   )

- Protect or Restore Open Spaces
  Not available (   ) little (   ) fair (   ) good (   ) very good (   )

- Reduce Heat Island Effect
  Not available (   ) little (   ) fair (   ) good (   ) very good (   )

- Reduction of Light Pollution
  Not available (   ) little (   ) fair (   ) good (   ) very good (   )

- Reduced Automobile Dependence
  Not available (   ) little (   ) fair (   ) good (   ) very good (   )

- Parkland Preservation
  Not available (   ) little (   ) fair (   ) good (   ) very good (   )

- Steep Slope Preservation
  Not available (   ) little (   ) fair (   ) good (   ) very good (   )
• Minimize Site Disturbance During Construction
  Not available (       )      little (       )   fair (     )   good (     ) very good (     )
• Minimize Site Disturbance Through Site Design
  Not available (       )      little (       )   fair (     )   good (     ) very good (     )

2- Materials and Resources
• Management of Construction waste
  Not available (       )      little (       )   fair (     )   good (     ) very good (     )
• Recycled content, and identification of 5% to 10% in the post-construction
  Not available (       )      little (       )   fair (     )   good (     ) very good (     )
• Use of local materials manufactured locally
  Not available (       )      little (       )   fair (     )   good (     ) very good (     )
• Use of local materials extracted regionally
  Not available (       )      little (       )   fair (     )   good (     ) very good (     )
• Use of renewable resources
  Not available (       )      little (       )   fair (     )   good (     ) very good (     )
• Reuse of Materials
  Not available (       )      little (       )   fair (     )   good (     ) very good (     )
• Comprehensive Waste Management
  Not available (       )      little (       )   fair (     )   good (     ) very good (     )

3- Efficiency of Water Use
• Efficiency of water use in landscaping (not to use drinking water)
  Not available (       )      little (       )   fair (     )   good (     ) very good (     )
• Innovative technologies for wastewater treatment
  Not available (       )      little (       )   fair (     )   good (     ) very good (     )
• Reduce water using reduced technologies
  Not available (       )      little (       )   fair (     )   good (     ) very good (     )
• Water Efficiency in Buildings
  Not available (       )      little (       )   fair (     )   good (     ) very good (     )
• Reuse Gray water
  Not available (       )      little (       )   fair (     )   good (     ) very good (     )
- Storm water management, processing and refining
  Not available (    ) little (    ) fair (    ) good (    ) very good (    )

- Maintain Storm water Runoff Rates
  Not available (    ) little (    ) fair (    ) good (    ) very good (    )

- Reduce Storm water Runoff Rates
  Not available (    ) little (    ) fair (    ) good (    ) very good (    )

- Efficient Irrigation
  Not available (    ) little (    ) fair (    ) good (    ) very good (    )

4- **Energy and Atmosphere**

- Renewable energy proportion of the total energy used
  Not available (    ) little (    ) fair (    ) good (    ) very good (    )

- Green Energy
  Not available (    ) little (    ) fair (    ) good (    ) very good (    )

- Energy Efficiency in Buildings
  Not available (    ) little (    ) fair (    ) good (    ) very good (    )

- Infrastructure Energy Efficiency
  Not available (    ) little (    ) fair (    ) good (    ) very good (    )

- On-site Power Generation
  Not available (    ) little (    ) fair (    ) good (    ) very good (    )

- On-site Renewable Energy Sources
  Not available (    ) little (    ) fair (    ) good (    ) very good (    )

- Optimal Performance of Energy
  Not available (    ) little (    ) fair (    ) good (    ) very good (    )
همه‌سمنگاندنا پروری‌تین ناکنجبونا فردهاتی
د چارچوبی دوام حریثی‌ن دا ل پاری‌رکه‌ها دهوکشی

نامه‌نامه
پیش‌کی‌شه بو سکولا پلان دانان لزانکوییا دهوک
ومک به‌شتهک هم‌پیمان‌ن بدوستقه‌نیانا
پلمیا مسترین پیراندانانی

ثلاسمی
نام: سلام عمر محمد
(به‌کالایزوست بنه‌دانزایاری یا تعلیم‌زریاری - زانکوها تکنولوژی - 2008)

بسم‌به‌ره‌بتی
د. لیلی م. رسول

۱۴۳۴ (کوچی) ۲۷۱۳ (کوچی)
۲۰۱۳ (زاینی)
نوف فوكوليني نا كيف (هادس نا كا نا كا ثوت يجيس قاتي د چارچوغي دو دلتيني دا لرزيكو ها دوكر)

نچيک د ناريشي مزرل د بايرهئ دوكر. ناريشا نا كايجيوبيني يه كوه ناريشه د نه نجاسم زيدونيا رييا نا كايجي يا پيدادیت
نافتهيني قرتشي (شوقه)، دينه هرمزنت وک پاشتنا ناريشا نا كايجيوبيني بور سينکرنت فن كيماتيا نافتهيني
نا كايجيوبيني لهون د نامجي ون بهرغمها بدنز يا پايزر بهره ف قه دگردي. بهن پرويي دو نا كايجيوبيني بهره نگاري چندني ناريشا
dين. و ژمير في چيندي دو كايجيوبيني روحي كریه نسدر كیم خميا پرويي نا كايجيوبيني دارچوغي دو مزريل (ژينگه. چفاک.

نابوری)

نارماي ناجن فوكوليني نوه نا پيشنه برا دومدريي د پرويي نا كايجيوبيني بکیت. تیکه هي دومدریز و ستاندر در پروي
نا كايجيوبيني دا هانيه دیاركرن. دیسان دو فوكوليني نايمي مئندی باييئر دوكر و ناريشا نا كايجيوبيني هانه دیاركرن. ژو
موکرکن وهم فسکن چهار نا كايجيوبيني پيشوييکي پراکتیکي فوكوليني چی تسو ف تساكرن. نارماي ژو چوکرکن بار د پرويي نا كايجيوبيني بین قرتشي ل باييئر دوكر و دیاركرنا دارشین و ناستگنی گرديئي ب پرويي
نا كايجيوبيني قه. و فوكوليني پراکتیکي يا هانيه له نجاسم بريكا راپسين و چاپکيکه قرنگ دگل كماسی تيان ب شرورکین
بارودخون پرويي نا كايجيوبيني و همفسنگان دنا و ژو دیاركرنا ناريشان بین دکفته درنيا قن پروزان دا و همروس دیاركرنا
چاواني دابنکرنا پهکفین نا كايجيوبين

فوكوليني دیاركرنه كوه که لادك ناريشين (نابوری، چفاکی. ژينگه)، دپرويي نا كايجيوبيني بین قرتشي همته و کارکن ب
سانکاری و دو مزريل د پااشتري قرتشي روپایه يو ناريشا نا كايجيوبيني ل باييئر دوكر.

نامگاریب كارپرکرنا نیکه هی دومدریز د پرويي نا كايجيوبيني بین پاپ redoئیدا بي ریکا هاکن و داچنای پاساین ل سمر
وب هرهينه ران.
تقييم المشاريع السكنية المتعددة الطوابق

ضمن سياق الاستدامة

في مدينة دهوك

رسالة قدمت إلى سكول التخطيط جامعة دهوك

كجزء من متطلبات نيل درجة الماجستير في التخطيط

من قبل
تارام عمر محمد
(بكالوريوس الهندسة المعمارية - الجامعة التكنولوجية-2008)

بإشراف
د. ليلي م. رسول

2713 ك
1434 هـ
2013 م
الخلاصة

موضوع البحث هو نحو المشاريع السكنية المتعددة الطوابق المستدامة في مدينة دهوك.

تعد مشكلة إسكان الأطفال من المشاكل الكبيرة في مدينة دهوك الناتجة عن النمو السكاني. البنية المتعددة الطوابق هو أحد الحلول التي تبنتها الحكومة لمواجهة العجز السكني الحاصل نتيجة التوسع السريع للمدينة. لكن مشاريع إسكان تواجه العديد من المشاكل، وذلك تركز مشكلة البحث في موضوع عجز مشاريع الإسكان المتعددة الطوابق في تطبيق أبعاد الاستدامة (البيئية والاجتماعية والاقتصادية).

الهدف من هذا البحث هو تحسين الاستدامة في المشاريع السكنية. تم توضيح مفهوم الاستدامة والمعايير المتعلقة بالمشاريع السكنية. دراسة خصوصية مدينة دهوك وواقع حال المشكلة السكنية فيها.

ويدعم البحث بدراسة ميدانية لمجمعين سكنيين مختلفين والتي تهدف إلى توضيح واقع حال المشاريع السكنية المتعددة الطوابق في مدينة دهوك والمشاكل والمعوقات المتعلقة بالمشاريع السكنية، وقد أجرى المسح الميداني عن طريق الاستبيان والمقابلات الشخصية لتحليل وتقسيم واقع حال المشاريع السكنية والتعريف على المشاكل التي تواجهها هذه المشاريع ومدى تلبيتها لاحتياجات السكانين.

وأثبت البحث أن وجود مشاكل (اقتصادية واجتماعية وبيئية) كثيرة في المشاريع السكنية المتعددة الطوابق وان اعتماد مواصفات الاستدامة هو الحل الأمثل لمشكلة الإسكان في مدينة دهوك.

وتمت التوصية بتعزيز مفهوم الاستدامة في المشاريع السكنية المتعددة الطوابق للمشاريع السكنية المستقبلية من خلال تشجيع وفرض القوانين من قبل الحكومة على المستثمرين.