

Developing Green Infrastructure for Baghdad City (Iraq)¹

Assist. Prof. Dr. Najeel Kamal Abdul Razzaq
Center of Urban and regional planning for post graduate studies
MayasaFarkad Abdul Raheem

Abstract

The public green spaces in Baghdad city have an obvious shortage and doesn't fulfill and meet the needs of the population and the required open space criteria, moreover these green spaces are disjointed, disconnected and does not function as a unified system, that is why it suffers from neglect which contributes to deterioration of the city's environment and increasing air pollution.

Human beings depended on nature into providing clean air and good health, with the growth of the population and the urban areas, there has been negative influence on the natural environmental system. A new term lately appeared "Green Infrastructure" especially in the developed countries (USA, UK and other countries in Europe), as one form of solutions to conserve the natural environmental system of green and open spaces. Consequently this thesis depended on this new green space approach to solve the green spaces problem in Baghdad city and suggested new sites in different locations in the city to be a new green spaces connected to the existing green spaces in Baghdad. This will increase the public green space areas, accessibility to these areas and social cohesion, it will also contribute to the improvement of the city's environment by reducing air pollution and reducing air temperature especially during the long summer season. Other economic benefits could be achieved by planning for a connected network of green spaces in Baghdad city as well.

ملخص البحث:

ت تعاني المناطق الخضراء في مدينة بغداد من نقص واضح و لا تلبي احتياجات السكان فيها أو المعايير المطلوبة, إضافة الى ان هذه المناطق مجزئة و غير مترابطة ولا تعمل كنظام موحد, لذلك فإنها مهمة الأمر الذي يؤدي الى تدهور بيئة المدينة و زيادة تلوث الهواء.

لقد إعتد الإنسان على الطبيعة في توفير الهواء النقي و الصحة الجيدة, مع النمو السكاني والتوسع العمراني في المناطق الحضرية أصبح هناك تأثير سلبي على النظام البيئي الطبيعي. وظهر في الآونة الأخيرة مصطلح "البنية التحتية الخضراء" خاصة في الدول المتقدمة (الولايات المتحدة الأمريكية و المملكة المتحدة و دول اوروبية أخرى) كشكل من أشكال الحلول للحفاظ على النظام البيئي الطبيعي من المناطق الخضراء و المفتوحة. نتيجة لذلك إعتدت هذه الدراسة على هذا التوجه الجديد في التخطيط لحل مشكلة المناطق الخضراء في مدينة بغداد . جرى إقتراح مناطق جديدة في مواقع مختلفة من المدينة لتكون مناطق خضراء جديدة مرتبطة مع المناطق الخضراء الموجودة أصلا في مدينة بغداد, الأمر الذي سيؤدي الى زيادة مساحات المناطق الخضراء المفتوحة و زيادة إمكانية الوصول اليها و زيادة التماسك الإجتماعي. إضافة الى ان هذا الترابط سيساهم في تحسين بيئة المدينة من خلال تقليل تلوث الهواء و خفض درجات الحرارة العالية خلال موسم الصيف الطويل. كما يمكن أن يحقق هذا التوجه منافع إقتصادية اخرى عند التخطيط لشبكة مترابطة من المناطق الخضراء في مدينة بغداد.

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1- Introduction:

Human beings depended on nature in providing clean air and good health, with the growth of the population and the urban areas there has been negative influence on the natural environmental system. Considering that a new term lately appeared “*Green Infrastructure*” (GI) especially in the developed countries (e.g. USA, UK and other countries in Europe), as one form of solutions to conserve the natural environmental system of green and open spaces.

GI means different things to different people depending on the context in which it is used. For example, some people refer to trees in urban area as GI because of the green benefits they provide, while others use it to refer to

engineered structures (such as water treatment facilities or green roofs) that are designed to be environmentally friendly. The term GI first appeared in 1990 about finding regional GI through the comprehensive use of greenways system and finding simple links between the parks and the surrounding neighborhoods.

GI is different and newer than previous strategies of environmental planning, it represent a newer approach to city planning that aims to minimize the impact of human development on functioning natural systems in urban areas. As the world population increases and the size of the urban centers grow, a new line of thinking in city planning becomes increasingly obvious.

1.1-Study Problem:

The green spaces in Baghdad is disjointed, disconnected and does not function as a unified

system, that is why it suffers from neglect which contributes to increase air pollution.

1.2-Purpose of the Study:

This study aims to develop the existed green spaces in Baghdad and plan for a sustainable GI which will be difficult to encroach on

1.3-Study Hypothesis:

This study assumes that there will be conservation and development to the green spaces in Baghdad if it considered, planed and

dealt with as an interconnected network of green spaces GI.

1.4-GI Definition:

There are currently as many definitions of GI as there are authors working on the concept. GI has been proposed as meaning many things to many people (Davies *et al.*, 2006, p. 2). As in most academic and practitioner research, the definitions used by an organization or an author relate directly to the focus of their own GI research. In this study GI could be defined as: a connected network of natural and human-made green spaces private and publicly owned at the local, urban, regional and national scale which delivers numerous environmental, social and economic benefits.

1.5-Study Methodology:

This study is divided into two main parts theoretical and practical parts. The theoretical part is an assemblage of information concerning the GI concept, historic evolution, network components and principles. While the practical part depends on a descriptive analytical method by collecting information and maps concerning the green spaces in Baghdad as well as field

2- GI System Components:

In the same way that the grey infrastructure are made up of a networks such as roads, parking, and airport for the transportation system, GI has its own physical components. Components of

2.1-Hubs

Hubs are large, ecologically significant natural areas that provide habitat for animal and plant species that cannot thrive in small patches of forest or meadow (Gardner et al. , 2010, p.

2.3-Links/Corridors

Links are the connections that tie the system together and enable GI networks to work (Benedict and McMahon, 2002, p. 8) . They are linear area of landscape or habitat type which connects one hub to another, they often follow

2.2-GI Benefits:

GI provides numerous benefits, functions, and values that address environmental, social, and economic needs – the three foundations of a sustainable community (Fig: 2). A GI system helps to protect, enhance, and restore the naturally functioning ecosystem and provide a framework for future development (Benedict & McMahon, 2002, p.13). These benefits include providing access to green spaces for health, promoting environmental education or developing links between social and environmental histories (Mell, 2008, p. 70). With careful planning and funding it (GI) can help our cities adapt to climate change and improve resilience to extreme weather events,

surveys of some of the existing and under development green spaces projects. These data were analyzed to specify the shortage of the green spaces in Baghdad. Moreover, number of new green spaces was suggested in different locations in the city to be connected to the existed green spaces and compose Baghdad GI network.

GI can be natural, semi-natural and designed spaces (North West GI Guide, 2008, p.4).

A GI network is composed of two types of components (Fig.1) that aid in the mapping of the network:

03-4), hubs anchor GI networks and provide an origin or destination for wildlife and ecological processes moving to or through it. Hubs come in all shapes and sizes.

water courses such as a river or stream (Saratoga County Farmland and Open Space Preservation Committee., 2006, p.40). They range in size, function and ownership

enhance biodiversity and ecosystem services, and improve public health and well-being (Grant, 2010,p.5).

3- GI Planning (GIP):

Just like the built infrastructure, GI should be carefully planned, designed, and invested far in advance of development (Benedict & McMahon, 2002, p.15). Consequently, the role of planning policy is to provide a framework where knowledge and experts can be communicated and used by planners, practitioners and developers. Therefore, it is important for the GI to be viewed as an essential component of GI development by providing criteria for its integration into planning and policy (Mell, 2010, p.79). GI

planning (GIP) should also be coordinated with planning for gray infrastructure like roads, water, electric, telecommunication and other essential infrastructure systems in the community. GI should use approaches similar to those used for the planning, designing and financing of the built infrastructure (gray infrastructure), therefore number of principles are represented to help and guide to put forward a GIP process.

3.1-GIP Principles:GIP principles are:

3.1.1-Comprehensive Planning

GI should ideally be planned in advance of, or concurrently with, the built environment. Long-term maintenance should also be considered (Kambiteset *al.*, 2006, p. 8). Like the electric power and telecommunication systems, the green space systems need to be planned comprehensively to provide ecological,

social and economic benefits, functions, and values (Benedict & McMahon, 2002, p.16). GI should be considered as an essential part of any integrated planning framework (Mell, 2008, p.6).

3.1.2-Information Collection

Extensive information collection relating to ecological, historical, social, and visual matters should be undertaken to guide GI development (Kambiteset *al.*, 2006, p. 8). Identify available information, including maps, regional and

national guidance, datasets relevant policy frameworks, regional and national strategies generate a map of the physical area showing GI types and locations (North West Green Infrastructure, 2008, p. 6).

3.1.3-Holistic Approach

Like the transportation system, GI should be designed to link diverse green space elements into a system that functions as a whole, rather

than as separate, unrelated parts. (Benedict & McMahon, 2002, p.16).

3.1.4- Linkage

Links between natural areas and features, and between people and these natural areas should be created (Kambiteset *al.*, 2006, p. 8). GIP should support the creation and maintenance of networks of connected and accessible spaces. (Mell, 2008, p. 6).

3.1.5-Community Involvement

Interest groups, stakeholders and others such as minority and disadvantaged groups should be involved as this will ensure that development has a degree of ownership for those living within the surrounding area (Kambiteset *al.*, 2006, p. 8). GIP respects the needs and desires of landowners and other stakeholders (who

3.1.6-Recreational Needs

The development should meet residents' needs for recreational opportunities and green corridors (Kambiteset *al.*, 2006, p. 8).

3.1.7-Preservation& Conservation

Where possible the development should protect, restore and create habitats and ensure that all designated sites (ecological, landscape, historical etc.) are conserved (Kambiteset

3.1.8-Funding

Financial support for the development of GI should be sourced at an early stage and particular attention should be paid to longer-term issues such as maintenance and improvement (Kambiteset *al.*, 2006, p. 8). Like other infrastructure systems, the green space system need to be funded as a primary public

3.2-National Open Space Standards

National standards for open space planning were developed at various times throughout the twentieth century, notably in Britain and the United States. In Britain the National Playing Fields Association (NPFA) standard of 6 acres (2.43 ha.) of open space per 1000 population (**24.3 m² per 1 person**) has been in existence since the 1920 while, in the USA, the National Recreation Association (now National Recreation and Parks Association, NRPA) standard of 10 acres (4 ha.) of open space per 1000 population (**40 m²per 1 person**) dates from 'early in the nineteenth century. The standard of 2.83 hectares (7 acres) hectares of open space per 1000 population, which has been widely used in Australia dates back at many practitioners. Table (1) shows national open space standards various eras'.

benefit from the GI) (Mell, 2010, p. 129). Like the built infrastructure systems, the GI systems should be planned and implemented with input from and involvement of the public, including community organizations and private landowners (Benedict &McMahon, 2002, p.16).

Therefore it should be planned to ensure that green spaces are placed where most needed and most appropriated.

al.,2006, p. 8). GI should be the framework for conservation and development (Benedict &McMahon, 2002, p.17).

investment. In other words, GI should be given priority in funding with other essential services, rather than with money that is left over after all other services have been provided (Benedict &McMahon, 2002, p.16). The GIP process is illustrated in Fig. 3

least to the 1940 (Veal, 2008 p.3). However efforts were made by the United Nations (UN) organizations to put an open spaces criteria and it was concluded to be (**20 m² per person**) as the best criteria and the minimum accepted area is (**10 m² per person**) (<http://www.artivist.gr> accessed 15/11/2011).

Consequently, over the last two or three decades efforts have been made to convince recreation planners not to use standards and to encourage the adoption of 'needs-based' approaches to recreation planning. In Britain, United States & Australia efforts were made as early as to move away from standards, but they are still referred to in local planning, and environment and recreation planning among

After reviewing open space standards in North America, UK and Australia it's necessary to view more similar environmental, social and economic circumstances. Table (2) shows a

By counting the average standards from the table above, a comparative analysis between the

3.3-Green space accessibility (GSA) standards:

Another standard based on the accessibility of the green spaces and their distance from home. This standard aims to secure access to green space close to where people live (Fig. 3). These standards recommend that people living in towns and cities should have an accessible natural green space:

3.3.1- Of at least 2 hectares in size, no more than 300 meters (5minutes walk) from home.

An extensive study on the use of woodland for recreation in Redditch, UK, shows the strong correlation between distance and frequency of site visits (Fig.4). A walking distance of no more than 5 minutes foot walk, corresponding p.32).

After reviewing various open space standards, accessibility in particular is critical for the recreational use of public open space. Environmental and landscape ecological studies stress on the importance of holistic approaches to the planning and management of all green spaces in urban

4-Baghdad City

Baghdad is the capital and the largest city in Iraq (840 km²) with a population of 5,842,318*. In the year 2009. Baghdad is located on latitude 33 and longitude 44 on Tigris River (Map 1). It's located in the middle of the country divided by Tigris River into two parts

comparative analysis of the green space standards in the Arabic and National cities experiments

develop countries, Far East Asian countries and Arabic countries is shown in table (3).

3.3.2- At least one accessible 20 hectare site within two kilometers of home.

3.3.3- One accessible 100 hectare site within five kilometers of home.

3.3.4- One accessible 500 hectare site within ten kilometers of home (Natural England, 2009, p. 51).

to distances of 100-400 m, were considered as ideal home range location. (Handley *et al.*, 2003,

areas. Green space planning and management require an understanding of the ecological and environmental functions of green space and their interaction with the surrounding matrix of built and other open spaces on the different levels of a green space hierarchy.

eastern (Rasafa) and western (Karkh). The city was rapidly developed during the last 50 years with the expansion of the physical fabric by the emerging of many new neighborhoods. This massive physical expansion took place on the expense of the city's open spaces. Moreover

*Depending on the Higher Commission for Buildings and Population Census 2009.

open space areas were further decreased by the wrong implementation of the city's master plans and the situation became worsen by the irrational land use changing decisions.

4.1- Baghdad's Parks Historic Evolution

Iraq has a long rich history in land investment, gardening and parks whether it was planting to provide shading or in the form of leisure gardens and parks since 7000 years ago in Mesopotamia. However the modern parks in Baghdad can be distinguished in three stages: **The first stage (1920-1958)** which is considered as the modern founding of the parks in Baghdad. The first public park with modern characters and features was in Bab Al-Muadham and called Al-Maarath Garden. After a brief time The Mayoralty of Baghdad constructed an ideal park in its design and called Al-Saadoon Park. In the 30's Ghazy's Garden was constructed. The garden area was estimated in 50,000 m² (5 hectares) which included all the modern gardens characters. Moreover, in 1945 The Moyoralty of Baghdad started in building few new parks: Al-Numan Garden in Al-Aadhamya and Queen Aalia Garden (now called Al-Umma Garden). (Ismaeel, 2011, p.113). **The second stage (1958-1968)** in this period of time Baghdad faced numerous problems such as the decrease of the city's green patch as a result of the

horizontal expansion and the rising of many new neighborhoods. Therefore, in order to protect Baghdad's residents from heat during summer and to protect the city's green spaces there was a special interest in constructing parks and greening neighborhoods and streets. The Mayoralty of Baghdad started in constructing new parks such as: 14 Tammuz Park in Al-Kadhumya, Al-Kindy Park in Al-Hharthya and Al-Wihhda park east Karrada. **The third stage (1968-2000)** this period of time witnessed real changes in the planning, designing and constructing parks in Baghdad. Three large parks were established Al-Shula, Al-Zaafaranya and Al-Sadr. In 1973 Al-Zawraa Park project (formerly known as Al-Washash Camp) were constructed in the center of Baghdad, after that Abu-Nuwas Street along the Tigris River bank was developed with an estimated area of 1,000,000 m² (100 hectares). In 1981 Al-Aaras Island south of Baghdad was established it's area 6,000,000 m² (600 hectares). Then in 1983 Baghdad Island was constructed in Al-Rashdya on the Tigris River (Mohessen, 2011, p.125).

Since that time no other parks or gardens ever established despite of the population increase and the city's physical expansion except a single project which was constructed in 2003 (Al-Jadrya Lake) with an estimated area of 675,000m² (67.5 hectares) which consist of a lake surrounded with paved streets and concrete yards with no green areas or trees.

4.2-The Existing Green Spaces in Baghdad City:

Although the green spaces in Baghdad are rather lacking in areas and occupy only 4% of the city's area, it has wide variety (parks, river banks and orchards) and they have different

kind of benefits and functions (recreational, environmental and economic benefits such as agriculture).

These green spaces can be categorized as:

Agriculture is the most dominated use among Baghdad city land use (Map 2) it occupies an

estimated area of **237 km²**(23678 hectares) which represent **28.19%**of Baghdad Total area

(840 km²). (Baghdad Comprehensive Development Plan, 2008, p.32).

Although the agricultural land use are planned to occupy the area shown in (Fig. 4.1) the real situation is so far from what are planned for. These areas are almost vacant and are threatened by the city's physical

expansion. These lands should be considered as insignificant areas and to the important environmental system and could be linked to the public green spaces in Baghdad city.

4.2.2-Existing Public Open Spaces:

Recreational open and green spaces in Baghdad are rather poor in quality as well as in quantity, these open spaces are neglected and needs continues maintenance and more heavily planting and greening the existing surfaces with trees, shrubs, flowers, lawn and what so ever. These spaces are:

- 4.2.2.1- Al-Zawraa Park **2,676,542 m²** (267.6542 hectares) (Maps 3).
- 4.2.2.2- Al-Sindibad Land (Al-Resafa Recreational Complex) **1,641,240.7 m²** (164.12407 hectares) (Fig. 4.3).
- 4.2.2.3- Al-Aaras Island **2,464,656.4 m²** (246.46564 hectares) (Fig. 4.4).
- 4.2.2.4- Baghdad Island **12,500,000 m²** (1250 hectares) (Fig. 4.5).
- 4.2.2.5- Abu-Nuwas Park on Tigris river bank **1,011,712 m²** (101.1712 hectares) (Map 4).
- 4.2.2.6- Smaller parks in different neighborhoods in Baghdad which includes:
 - 1. Al-Kadhumya : (14 Tammooz **4856.22 m²**, Al-Hurrya Park **2428.3 m²**, Al-Muheet Park **7082 m²**, Al-Ressala Park **7081.998 m²**).
 - 2. Al-Atifiya Park **3237.5 m²**.
 - 3. Al-Mansour Park **5058.25 m²**. (Mohessen, 2010, p.126).

Combining all the previously mentioned recreational areas the resulting number is **20,324,894 m²** (2032.4894 hectares) which represents 2.42% of Baghdad's city area. Comparing this results with the minimum open spaces criteria (10 m² per person), the total open space areas should be provided in Baghdad city in 2009 depending on the city's population in the same year (5,842,318)* is **58,423,180 m²**.

This means that there is a **38,099,286 m²** (3809.9286 hectares) shortfall in the open space area in 2009 which represents 4.53% of the city's area. This shortfall is continually increasing with the population growth and the city's physical expansion at the expense of the open spaces.

4.3-Under Development Projects:

There are few under development green spaces projects in Baghdad city which will hopefully increase the city's green areas credit. These projects are Baghdad International Airport (BIAP) Road Development, Al-Jaish Canal Development Project and Mohamed Al-Qasim Expressway. Maps 5

*Depending on the Higher Commission for Buildings and Population Census 2009.

4.4- The Suggested (Potential) Green Spaces:

Considering the lack of the open spaces in Baghdad, a new alternative spaces should be found to at least reduce this gap depending on existing lands which might be neglected and could be changed or use some of their areas to be green spaces and take full advantage of the site. Therefore this study suggests some of the

A network of existing green spaces, underdevelopment greenways and suggested network of greenways is the future vision of this study (Maps 6) which may reach the

After suggesting new green areas in different locations in the city and linking them the total areas increased from 20,324,894 m² (the existing areas) to 49,584,039m²(the existing combining with the suggested areas) which means that the area almost multiplied two times which could be considered a good achievement, however, these new suggested area doesn't fulfill all the needs of these green areas if we took in consider the minimum accepted criterion. (Map 7)

This means that more efforts should be done in the future for establishing more green areas especially on the local scale and neighborhoods to at least ensure the minimum accepted criterion.

5- Conclusions

After presenting the theoretical and the practical sides of this study, a number of conclusions have been reached which can be summarized in the following points:

5.1- GI: is a connected network of natural and human-made green spaces private and publicly owned at the local, urban, regional and national scale which delivers numerous environmental, social and economic benefits.

5.2- GI is considered one of the new green spaces conservations approaches in the world.

5.6- The green spaces bad conditions in Baghdad are resulted from the wrong implementations and decisions as well as the land uses changes legislations and laws not

neglected areas such as brownfields, railways, some abandon sites, yet occupy a strategic location in the city. These sites are: Baghdad Railways, Al-Daura Refinery, [Former Directorate of Military Intelligence](#) in Al-Kadhimiya, Al-Rasheed Camp Former Site and Al-Sadr City.

minimum required green spaces criterion and could improve the environmental, social and economic condition of Baghdad city in the future.

With the population growth and the city's rapid expansion serious attention should be drawn to the importance of the green spaces in the city as well as to the conservation of the existing green spaces and the necessity of maintaining these spaces that has several environmental, social and economic benefits to the city.

The new researches and studies shows that linking the green areas in a network would benefits the environmental process also it's considered as a new conservation method which will be beneficial if implemented in Baghdad city.

5.3- There is an obvious lack of green spaces in Baghdad as well as the existing green spaces are neglected and are in a bad condition.

5.4- GI approach could be the proper solution of the shortage and improve the quality of the green spaces in Baghdad.

5.5- In spite of the hot climate, the open spaces standards are insufficient and studies should be made to reach an environmentally, socially suitable standards

because of the insufficient or un practical master plans.

5.7- New residential projects that are taking place in the present will add more pressure on the infrastructure in general and on the green spaces specifically.

5.8- At last green buildings or green architecture as well as street trees should be considered in Baghdad future development projects to reduce the shortage in the green lands.

6-Recommendations

6.1- GI provides green spaces which fulfill the city's population required and the adapted criteria.

6.2- The natural orchards and public open spaces should be maintained and preserved. Moreover, it should be considered as a national heritage.

6.3- There are many vacant lands in Baghdad city which could be developed to be public green spaces.

6.4- New laws and legislations should be set to prevent the physical extends at the expense of the green spaces.

6.5- A network of pedestrian greenways should be planned which connect the small neighborhood parks with the city's larger parks, which may increase its accessibility.

6.6- GIP should be considered in the future city planning strategies.

6.7- Encourage the establishment of community organizations that concerns about green spaces maintenance, conservation and constructions.

6.8- Increase the public awareness about the importance of the green spaces and the benefits they provides on the environmental, social and economic level.

7- References:

- 7.1- Al-Zubaidy, Najwa A. (2005) **Planning Criteria for the Green and Open Space in Baghdad City/Aadhamya case Study**. Urban & Regional Planning Institut, University of Baghdad.
- 7.2- **Baghdad Comprehensive Development Plan (2008)** First Stage Primary Report A,B.
- 7.3- Benedict, M.A. and McMahon, E.T. (2002). **Green Infrastructure: Smart Conservation for the 21st Century**. Sprawlwatch Clearinghouse Monograph Series. The Conservation Fund, Washington DC.
- 7.4- Davies, C, McGloin, C, MacFarlane, R & Roe, M (2006) **Green Infrastructure Planning Guide Project: Final Report**. NECF, Annfield Plain.
- 7.5- Gardner, Jan H. , Gray, David P., Hagen, Kai J., Thompson, John. L., Jenkins, Charles A. & Young, Blaine R (2010) **Fredrik County Future: A Comprehensive Plan for Fredrik County/ Maryland**, Frederick County Division of Planning, Maryland.
- 7.6- Grant, Laura (2010) **Multi-Functional Urban Green Infrastructure**, A CIWEM Briefing Report.
- 7.7- Handley, John, Pauleit, Stephan, Slinn, Paul, Barber, Alan, Baker, Mark, Jones, Carys and Lindley, Sarah (2003) **Accessible Natural Green Space Standards in Towns and Cities: A Review and Toolkit for their Implementation**, English Nature Research Reports, Northminster House, Peterborough, UK.
<http://naturalengland.etraderstores.com/NaturalEnglandShop/product.aspx?ProductID=9d028d4b-eb27-4545-a1fe-3064f70c2f7a>
- 7.8- Higher Commission for Buildings and Population Census 2009.

- 7.9- Ismaeel, Zeyad Ali (2011) **The Public Parks in Baghdad Kinds , Properties and Requisites**, Architecture Department, College of Engineering, University of Baghdad.
- 7.10- Kambites, Carol, Johnson, Phil, Lewis, Nick, Owen, Stephen, Short, Christopher (2006) **Green Infrastructure Planning in the Swindon Urban-Rural Fringe, Final report to the Great Western Community Forest**, Countryside & Community Research Unit, University of Gloucestershire, UK.
- 7.11- Mell, Ian (2008) **Integrated and sustainable planning: can Green Infrastructure meet the needs of a changing urban environment?** UK-Ireland Planning Research Conference: Sustainability, Space and Social Justice, Queen's University, Belfast.
- 7.12- Mell, Ian (2010) **Green infrastructure: concepts, perceptions and its use in spatial planning**, School of Architecture, Planning and Landscape, Newcastle University, Newcastle.
- 7.13- Mohessen, Mohammed Kariem (2011) **Effect Of Green AreasInDecisionsConfigure The Urban EnvironmentIn Hot Dry Areas**,Architecture Department, College of Engineering, University of Baghdad.
- 7.14- Natural England &Landuse Consultants (2009) **Green Infrastructure Guidance**. Natural England, NE176.
- 7.15- North West Green Infrastructure Think Tank (2008) **North West Green Infrastructure Guide Version: 1.1**, UK.
- 7.16- Saratoga County Farmland and Open Space Preservation Committee (2006) **Green Infrastructure Plan for Saratoga County**, Behan Planning Associates, LLC, Saratoga.
- 7.17- Veal, A. J. (2008) **Open Space Planning Standards in Australia: in Search of Origins**, School of Leisure, Sport and Tourism, University of Technology, Sydney, Australia.

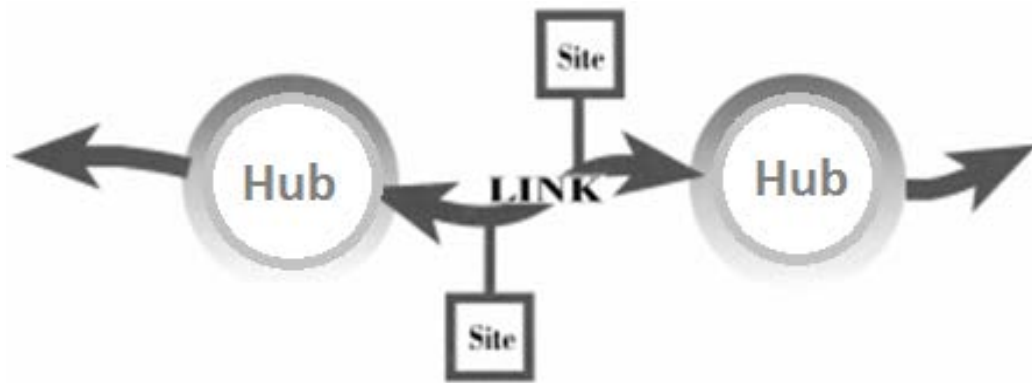


Fig.1: GI System Components

Reference: Benedict, M.A. and McMahon, E.T. (2002). Green Infrastructure: Smart Conservation for the 21st Century. Sprawlwatch Clearinghouse Monograph Series. The Conservation Fund, Washington DC, p. 7.

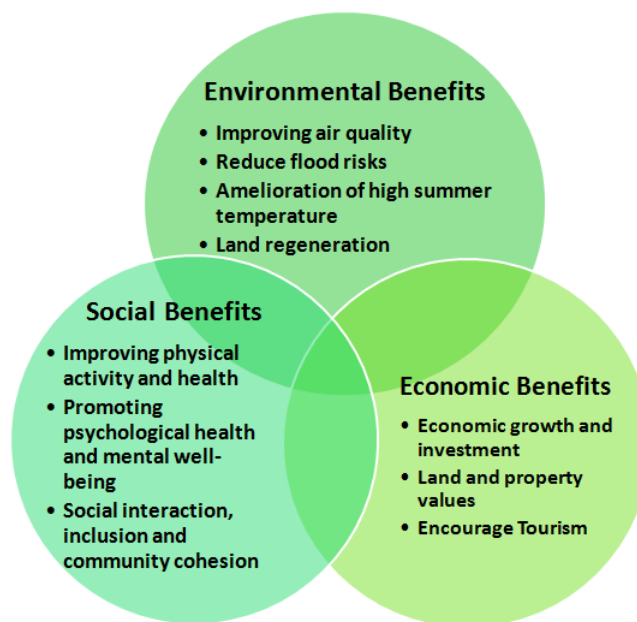


Fig. 2 : GI Benefits

Reference: The Researchers



Fig. 3 : **GIP Principles**
Reference: The researchers

Table 1 : National open space planning standards

Year	Country	Authority	Acres/1000 popn.	Hectares/1000 popn.	Square meters / 1 person
Early 19 th century	USA	NRA (now NRPA ⁽¹⁾)	10	4.05	40.5
1901		APOA ⁽²⁾	5	2.02	20.2
1906-1971- 1983-1996		NRPA	10	4.05	40.5
1920	UK	NPFA ⁽³⁾	6	2.43	24.3
1925			5	2.02	20.2
1934			7	2.83	28.3
1938-1955 1971-1977 1986-1989 1992-2001			6	2.43	24.3
2007	UK (Liverpool)	Liverpool City Council	7	2.83	28.3
1965-1976	Canada	OMCR ⁽⁴⁾	20	8.09	80.9
1954	Australia	MMBW ⁽⁵⁾	7.5	3	30
1969		NFCSA ⁽⁶⁾	12.5	5	50
1981		NCDC ⁽⁷⁾	10.0	4	40
1988		SAULT ⁽⁸⁾	17.3	7	70

Prepared by the researchers depending on: (Veal, A. J. (2008) **Open Space Planning Standards in Australia: in Search of Origins**, School of Leisure, Sport and Tourism, University of Technology, Sydney, Australia.)

1) National Recreation & Parks Association.(USA)

2) American Park and Outdoor Association.(USA)

3) National Playing Fields Association. (UK)

4)Ontario Ministry of Culture and Recreation.(Canada)

5) Melbourne and Metropolitan Board of Works

6) National Fitness Council of South Australia.

7) National Capital Develop Commission. (Australia)

8) South Australian Urban Land Trust.

Table 2: Comparative analysis of the green space standards in the Arabic and National cities experiments

USA	Shanghai/China m ² /person			Singapore City/Singapore m ² /person		Arabic Cities	
	Average	1984	1988	2000	1973	1992	Tripoli Cairo
40	0.47	2	4	4	70	20	3

Reference: Al-Zubaidy, Najwa A. (2005) **Planning Criteria for the Green and Open Space in Baghdad City/Aadhamya case Study**. Urban & Regional Planning Institut, University of Baghdad, p.122.

Table 3: Comparative analysis between the develop countries, Far East Asian countries and Arabic countries

Country	Average Standards Square meters / 1 person
Canada	80.9
Australia	47.5
Singapore	37
USA	33.7
UK	25
Tripoli, Libya	20
Cairo	3
Shanghai, China	2.2

Reference: Researchers

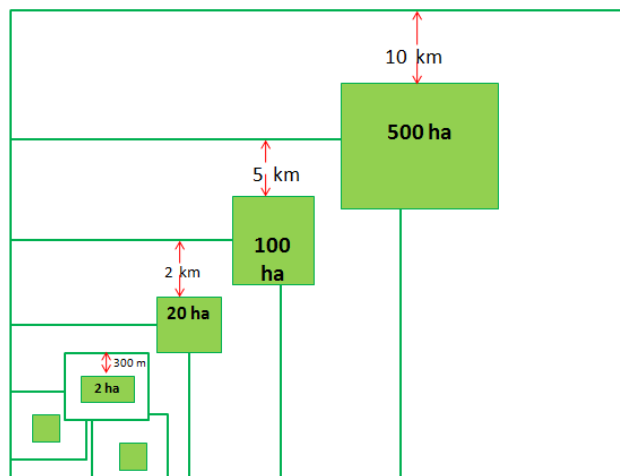


Fig. 3: GSA standards Hierarchy Diagram

Reference: Prepared by the researchers depending on: Natural England & Landuse Consultants (2009) Green Infrastructure Guidance, Natural England, p.51.

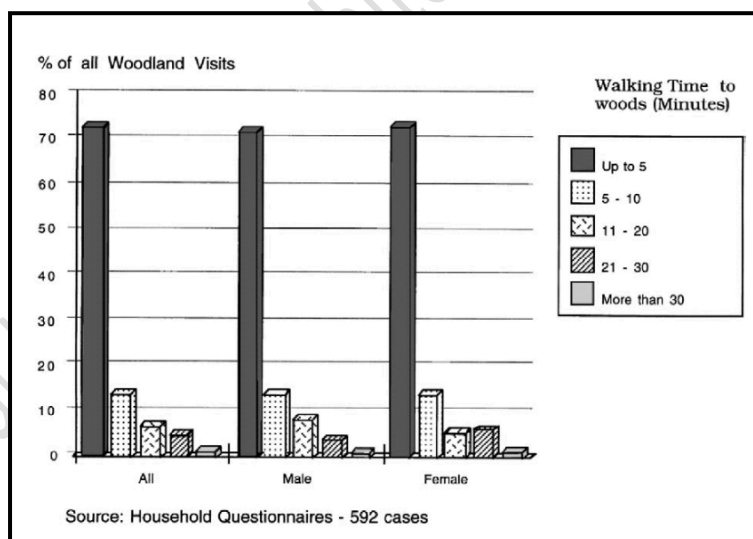
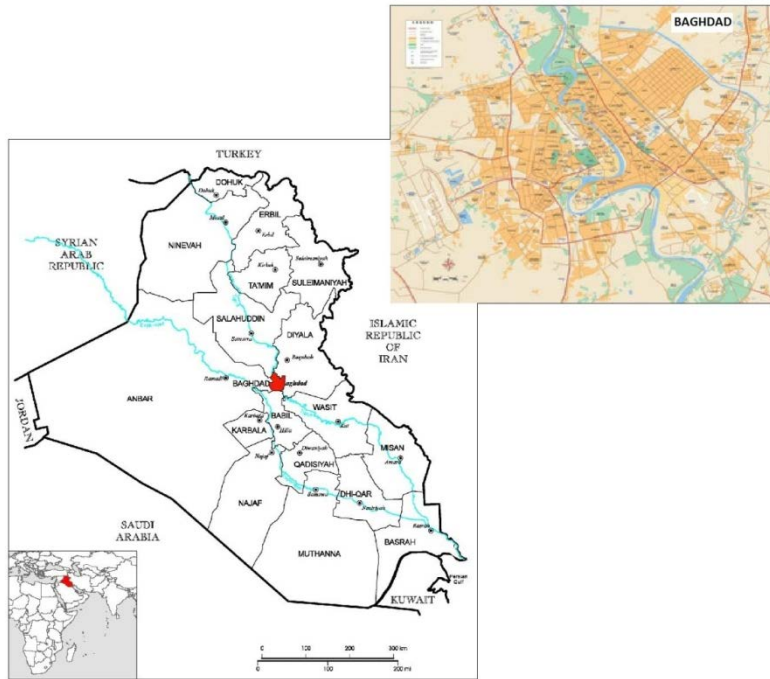


Fig. 4: The effect of urban woodland location on usage patterns

Reference: Handley, John, Pauleit, Stephan, Slinn, Paul, Barber, Alan, Baker, Mark, Jones, Carys and Lindley, Sarah (2003) Accessible Natural Green Space Standards in Towns and Cities: A Review and Toolkit for their Implementation, English Nature Research Reports, Northminster House, Peterborough, UK, p.32.



Map 1: Iraq's Location in the World & Baghdad's Location in Iraq

Reference: Researchers depending on Google Images



Map 2: Agricultural Land Use

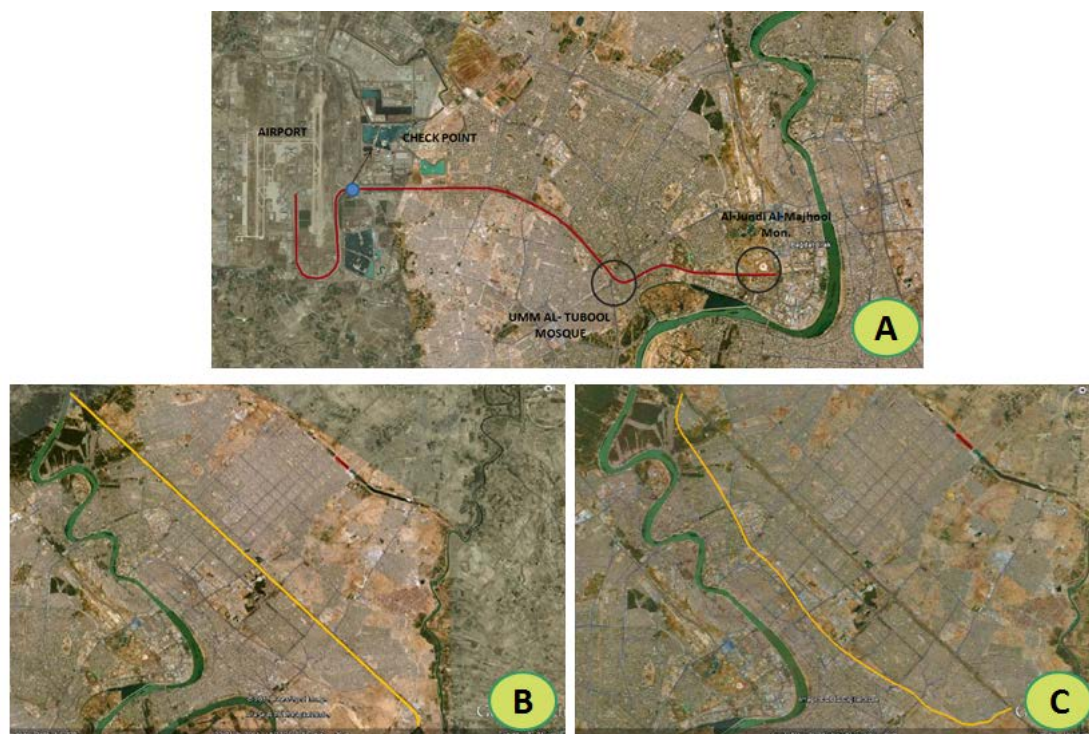
Reference: Researchers depending on: Baghdad Comprehensive Development Plan, 2008, p.33.



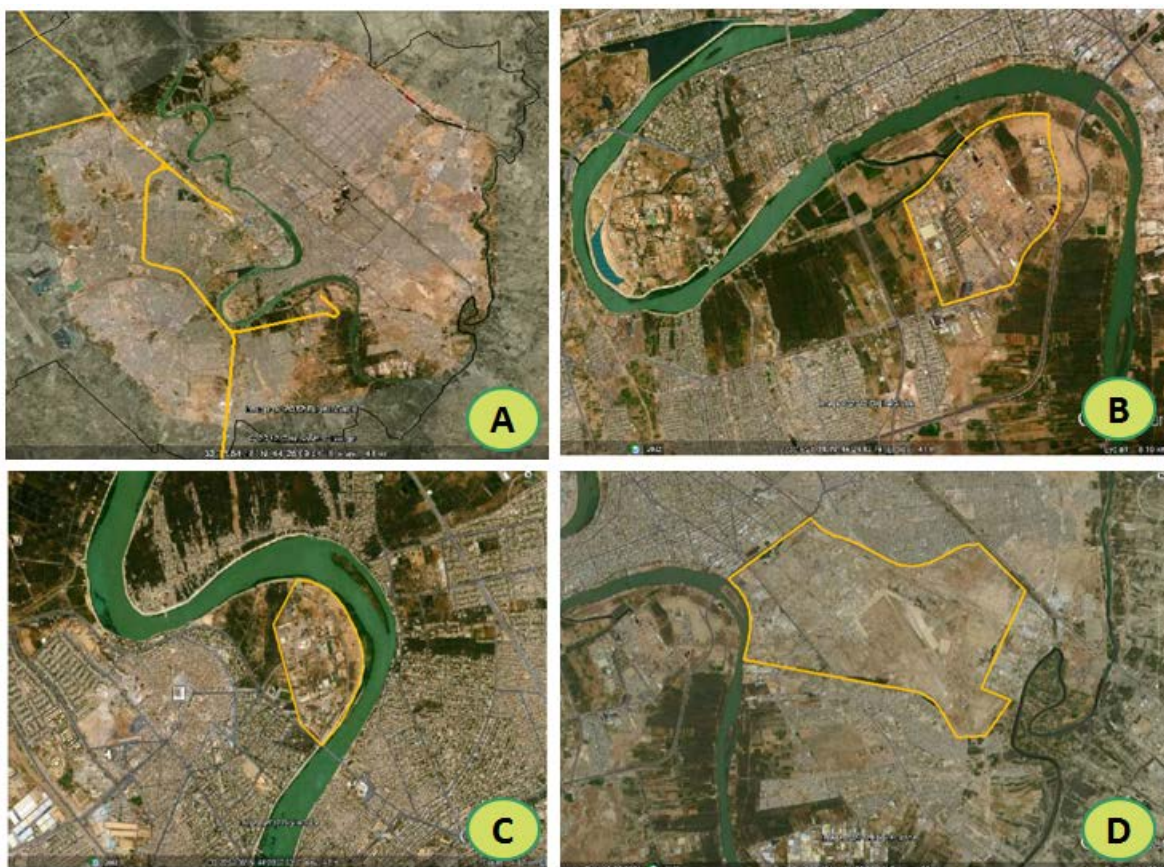
**Maps 3 : A: Al-Zawraa Park, B: Al-Resafa Recreational Complex,
C: Al-Aaras Island, D: Baghdad Island**
Reference: Researcher depending on Google earth.



Map 4: Abu-Nuwas Park-Baghdad
Reference: Researcher depending on Google earth.



Maps 5 : **A:** BIAP Road Development,
B: Al-Jaish Canal Development Project, **C:** Mohamed Al-Qasim Expressway

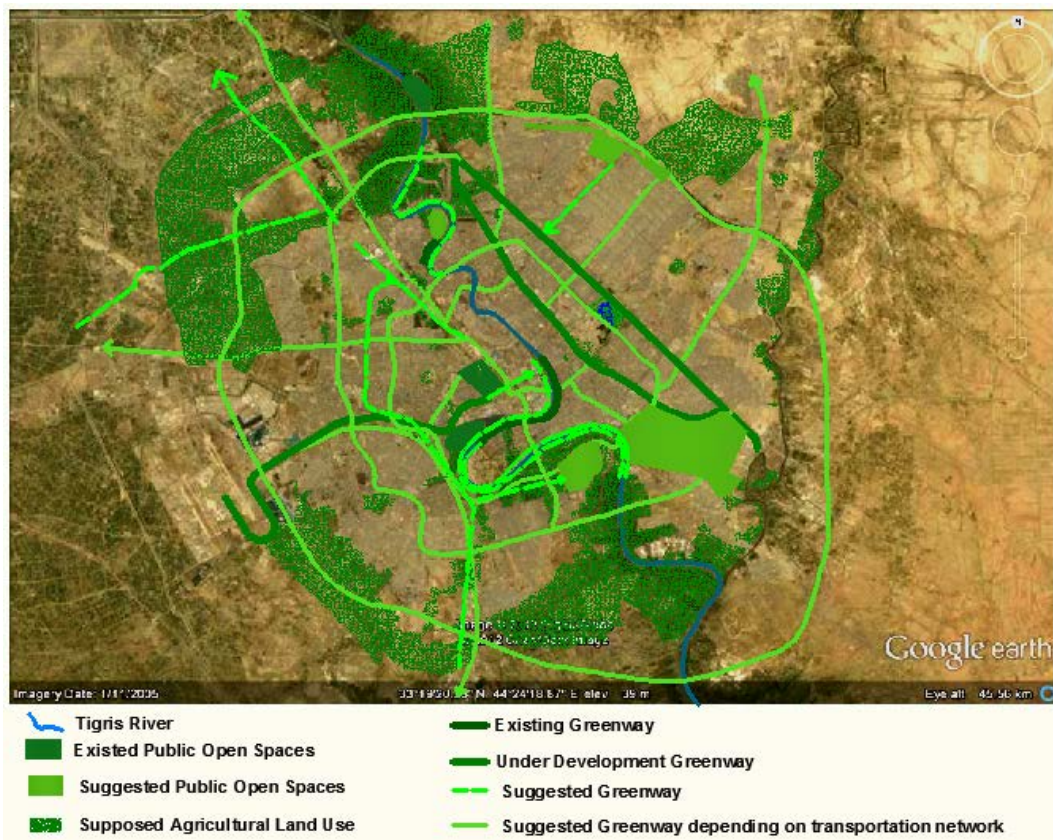


Maps 6 : A: Baghdad Railways, B: Al-Daura Refinery, C: [Former Directorate of Military Intelligence](#) in Al-Kadhimiya, D: Al-Rasheed Camp Former Site and Al-Sadr City

Table 4: **Baghdad City GI**

	Location	Area m²	Classification
Existed	The agricultural land around Baghdad city	237,000	Hub
	Tigris River	—	Corridor
	Al-Zawraa Park	2,676,542.8	Core
	Al-Sindibad Land /Al-Resafa Recreational Complex	1,641,240.7	Core
	Al-Aaras Island	2,464,656.4	Core
	Baghdad Island	12,500,000	Core
	Abu-Nuwas Park on Tigris river bank	1,011,712	Greenway (Link)
	Baghdad International Airport (B.I.A.P.) Road	1,379,000	Greenway (Link)
Under Development	Al-Jaish Canal	4,011,375.2	Greenway (Link)
	Mohamed Al-Qasim Expressway	200,000	Greenway (Link)
	Baghdad Railways	900,000	Greenway (Link)
Suggested	Daura Refinery	6,019,715	Core
	Former Directorate of Military Intelligence in Al-Kadhimiya	913,796.5	Core
	Al-Rasheed Camp Former Site	12,500,000	Core
	Al-Sader City	1,750,000	Core
	Total Area	49,584,039	

Reference: Researchers



Map 7 : Future Vision of Baghdad's GI

Reference: Researchers depending on Google earth.