

## Redevelopment of Brownfields, an Approach toward Sustainable Local Development

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**Article History:** Received: 5 April 2021; Accepted: 14 May 2021; Published online: 22 June 2021

**Abstract:** Urban development is an inevitable process evolving constantly. However, concerns over direction of these developments and physical expansion of cities so that they fulfil today's needs and meet the requirements of the future are always growing. The reason for this distress is the impact urbanization policies have on socioeconomic and environmental issues in urban areas. In this regard, considering the limitations the planet earth has for development of cities along with the problems caused by uncontrolled and irregular growth of cities, smart growth has become a prominent alternative. In fact, smart growth provides a healthy habitat for life and incurs the least damage to the environment. One of the novel approaches toward smart growth of cities, is brownfields. In this regard, the emphasis is put on reusing urban lands deteriorating due to pollution and aridness. Abandoning these lands, induce numerous environmental, social and economic problems and gradually cause huge losses in cities. Not only does redevelopment of brownfields increase spatial and physical quality of cities, but also it plays a key role in the evolution of cities into sustainable societies. The present paper uses descriptive, formative and case study methods to investigate the goals and advantages of redevelopment of brownfields and elaborate on the measures that should be taken about these fields. Later on, to make the findings further objective, a case of redevelopment of brownfields is introduced in London, England and the transformation of a brownfield into a sports complex with several criteria of sustainability is discussed. Finally, findings of the study and its results are utilized to offer solutions so that these lands could be redeveloped and used optimally.

**Keywords:** Smart growth, redevelopment, endogenous development, brownfield, sustainability

### 1. Introduction

Physical quality of cities deteriorates over time as they are used constantly and are transformed due to the changes in the lifestyle of the people. Limitations on land and problems induced by wasteful and scattered growth of cities have drawn attention to redevelopment of brownfields and sustainable development. Significance of brownfields intensifies as their abandonment cause irreparable damage to local communities since they have self-contaminating characteristics, pollute the environment and greatly threaten the health in their communities (Heberle and Kackar, 2006a). On the other hand, properties adjacent to these fields devaluate as a result of their threat. Controlling and redeveloping these fields reduce pollutions, problems and environmental threats of brownfields create new job opportunities, improve quality and increase attraction of these neighborhoods and eventually raise socioeconomic indices along with environmental ones (Garcia, 2012).

The present paper intends to offer policies using which proper solutions are introduced to gradually relieve the problem of brownfields in urban areas so that redevelopment of these fields is conducted both sustainably and optimally. Initially, the subject of brownfields was elaborated through descriptive method and discussions on issues like smart growth and its links to brownfields. Then, formative method and case study were utilized to investigate a case in London, England. Finally, research findings were represented to create a clear framework for redevelopment of brownfields (Heberle and Kackar, 2006b).

Since the introduction of redevelopment of brownfields as an integral part of discussions on urban development, the concept has evolved over time. In 1980, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) was passed on redevelopment of brownfields. This act was a response to the pollutions created and their removal and attempted to compensate the role of negligence of big factories and forming these fields and take them responsible for emergence of phenomenon. In coming years, other laws attempting to facilitate redevelopment of brownfields and removal of pollution were passed (Bendor and Metcalf, 2005).

Numerous studies have been conducted on redevelopment of brownfields both in the UK and the USA; however, studies in Turkey are limited to concepts of smart growth and sustainability and not many studies have worked on the issue of brownfields.

#### Smart Growth

Only in recent decades has the concept of smartness been introduced to the theoretical framework of sustainable urban development and supporting compact urban development patterns. The focus now has turned toward compactness and endogenous development of cities as a result of unpleasant and even destructive outcomes of scattered development patterns in political and environmental arenas (Zarrabi et al., 2010). Turning focus to sustainability has augmented the movement of "smart growth" even more and has gained attention of scholars in the field (Brown et al., 2010).

Smart growth is a planning method through which social, economic and environmental indices, direct development toward arid lands with necessary infrastructures or regions capable of being equipped to these facilities (Walmesely, 2006). For supporters of this view, cities have to develop endogenously so that scattered and marginal development is prevented. The basis for this view was laid in the US and Canada in the 1970s and 1980s in response to scattered development of cities based on sustainability principles and was finally developed into a theory. The emphasis of smart growth is on more compact development and this ends in reaching better environmental advantages, less fuel consumption, bigger underground water reservoirs and more successful measures to protect the environment.

The theory of smart growth is based on theories and movements like sustainable development and urbanization and uses a novel approach to planning so that its principles become general and flexible yet lacking details (Abaszadegan and Yazdi, 2008). In general, this theory covers a set of older solutions and policies offered in a single package: Compact growth, sustainable development, expansion of public transport, suitable design for cyclists and pedestrians, mixed use, protection of farmland and environment and revival of historical works and sites.

**Criteria for Smart Growth**

Smart growth is in fact a tool-oriented concept whose supporters believe in the decuple principles of United States Environmental Protection Agency (EPA) (Cowan, 2005; Yeang and Woo, 2010). These principles are as follows:

- Mix land uses
- Take advantage of compact building design
- Create a range of housing opportunities and choices
- Create walkable neighborhoods
- Foster distinctive, attractive communities with a strong sense of place
- Preserve open space, farmland, natural beauty and critical environmental areas
- Strengthen and direct development towards existing communities
- Provide a variety of transportation choices
- Make development decisions predictable, fair and cost effective
- Encourage community and stakeholder collaboration in development decisions

**Redevelopment of Brownfields and Smart Growth**

Development of local communities is an essential principle of smart growth. This principle encourages reutilizing infrastructures and existing structures along with endogenous development. The policy of reusing existing lands moves us toward redevelopment of brownfields (Adibi, 2012). Redevelopment of these lands not only has socioeconomic benefits, but it can also improve environmental climate quality. Some of the rules and principles of smart growth that could be used in brownfields are as follows:

- Directing development toward existing local regions
- Taking predictable, fair and economically-efficient measures
- Encouraging public and private sectors to collaborate in development plans

**Different Types of Urban Lands**

Urban lands could be divided into various categories according to their usage in different eras. The following table represents a brief description of types of lands in countries with a list of their indices (Table 1.)

**Table 1.** Classification of urban lands in countries

Class	Index
Gray fields	A land with some history of development (business or office etc.) but abandoned
Brownfields	Developed industrially but abandoned and polluted currently
Greenfields	Land formed naturally but undeveloped

**Grayfields**

These lands have no economic value . However, unlike brownfields whose main characteristics is the environmental pollution, they could be invested on in order to increase their value and renovate. Their hidden

values including infrastructures let investors optimize the site through small or big investments and raise rents or value of the property (Mccann, 2010a; Barr and Cary, 2008).

**Brownfields**

Brownfields are lands that had been developed earlier, yet, reusing them is limited due to physical, environmental or even legal obstacles. Brownfields were generally used for industrial or service uses. Although these lands are generally polluted to some degree, there is a potential to remove the contamination and redevelop them. In fact, these fields could mostly be redeveloped and reused in spite of the presence of waste, pollution or the source for the pollution (Wurtzler and Diluigi, 2013a).

**Greenfields**

Greenfields are literally the undeveloped lands in an urban or rural region formed naturally and used for agriculture or landscape. These mostly agricultural lands are excellent for urban developments. Greenfields have agricultural functions influenced by several factors; yet, these farmlands are extremely similar to developed regions. Nonetheless, generally speaking, brownfields is an industrial and developed term used for polluted areas of the city. However, Greenfields is the term for undeveloped lands. Finally, gray fields are the developed pieces of land that have the capacity for redevelopment (Mccann, 2010b; Wurtzler and Diluigi, 2013b).

**Goals of Redevelopment**

The main goal of this policy is redeveloping and renovating along with increasing adaptability and improving spatial quality in arid and polluted lands (Piccioni, 2002). The general goals behind this idea is as follows:

- Promoting smart growth so that it covers both reduction of uncontrolled physical growth of cities and raising economic efficiency
- Promoting visual and physical qualities of polluted and arid sites and urban spaces
- General promotion of public safety and environmental health
- Improving and reviving job opportunities
- Increasing level of public awareness in a society on improved economic, social and environmental levels in case of redevelopment of these sites
- Utilizing capitals of public sector to motivate capitals of private sector in case of redevelopment, renovation and promotion of spatial quality in arid and polluted lands

**Advantages of Redevelopment of Brownfields**

Development of brownfields return life to cities, strengthen them and revive communities. clearing these fields and redeveloping them induce socioeconomic growth and improve public and environmental health in cities. Another important advantage of this redevelopment is increasing job opportunities and tax payment along with new residences, advanced industries, proper retail and business facilities, public open spaces and etc (Won Seo and Lim Lee, 2019). The following demonstrates competitive advantages of redeveloping brownfields and the interaction among them (Table 2.).

**Table 2.** Advantages of reviving Brownfields

<b>Redevelopment of Brownfields</b>		
<b>Environmental Benefits</b>	<b>Social Benefits</b>	<b>Economic Benefits</b>
Reducing or removing risks safety and health	Quality of life	Creating jobs
Reviving the quality of environment	Renovation of adjacent constructions	Revenue
Reducing expansion of cities	Selection of residence	Tax
Ecological health		Business opportunities

**Various Classes of Brownfields based on ABC Model**

Brownfield projects are divided into various categories according to their economic efficiency. These classifications are generally influenced by factors like renovation cost, land price and the site itself. Thus, brownfields are classified into A, B and C classes.

Class A: Development projects in this class are executed totally depending on private sector due to definitive increase in the value of the site.

Class B: Investment in these projects is not without economic risks; thus, their execution necessitates collaboration between public and private sectors.

Class C: These projects are not economically efficient, therefore, investments have to be done by public sector only.

A clear advantage of this model of classification is the fact that experts in the field have to focus their efforts on Class B redevelopments. These sites could use a little investment and effort to turn into Class A redevelopment sites (Figure 1.). On the other hand, this model reveals that revival and redevelopment of some sites are too costly and economically inefficient. These sites have to turn from construction sites into farmlands and Greenfields after they are revived (Martinat, 2014a).

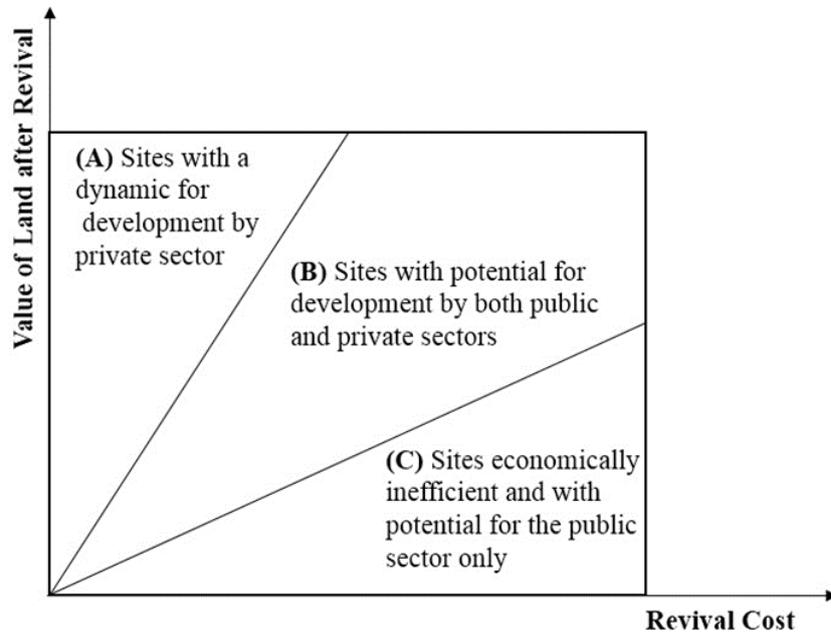


Figure 1. Brownfield redevelopment types the A-B-C Model (Martinat, 2014b)

**Procedure and Stages of Executing Brownfield Projects**

Since European cities have worked a lot on brownfields, in this part, novel approaches to brownfields, namely the Fuzzy Approach, is discussed here. the Fuzzy Approach toward redevelopment of brownfields include four main and 11 phases listed in (Table3.)

Table 3. Overall procedure of executing project

Preparation	Options	Design	Delivery
Phase 1: Commencement	Phase 4: Option Evaluation	Phase 6: Designing Details	Phase 9: Financial Evaluation
Phase 2: Feasibility	Phase 5: Practical Design of Selected Option	Phase 7: Planning and Setting Rules	Phase 10: Preparation and Execution
Phase 3: Site Evaluation		Phase 8: Rights, Assets and Investment	Phase 11: Sale and Evaluation

**Queen Elizabeth Olympic Park (Introduction to Case Study Site Plan)**

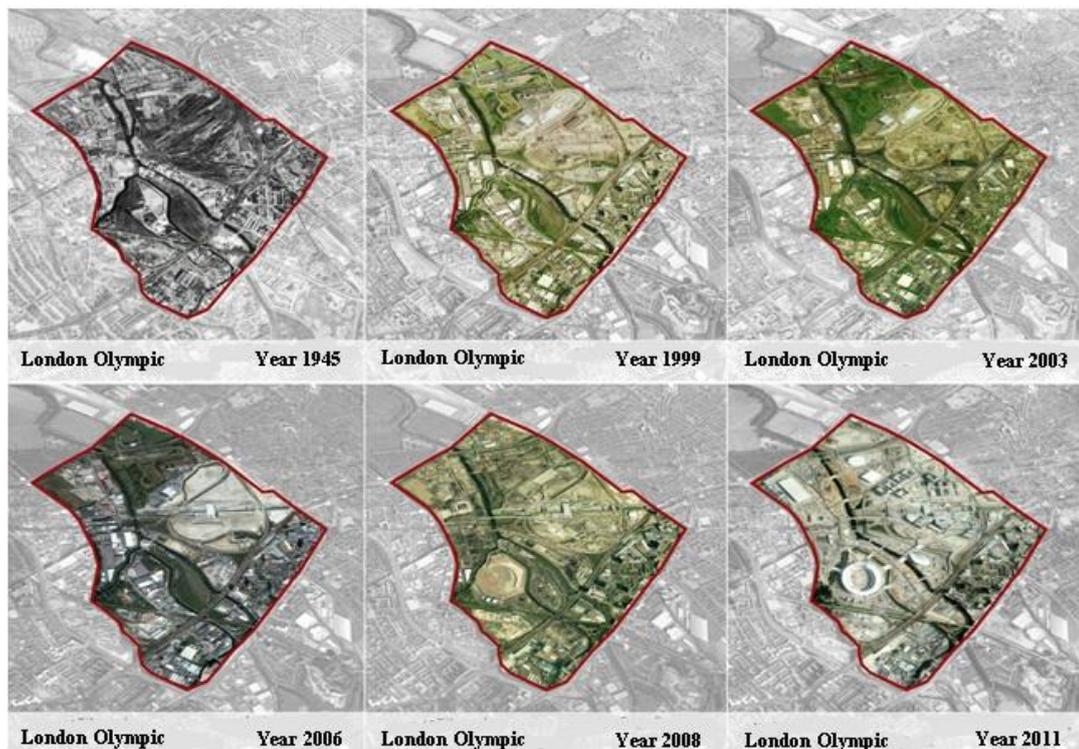
The Queen Elizabeth Olympic Park in Stratford in East London was the central site for 2012 London Olympics and Paralympics. The park is located below the Lee Valley and is 2.5 km<sup>2</sup> or covers an area equal to 357 football pitches (Figure 2.).



**Figure 2.** Location of the Queen Elizabeth Olympic Park (Anonim 2011a)

**History of the Queen Elizabeth Olympic Park**

This site was dedicated to industrial activities like textile industries in the 17<sup>th</sup> and gasoline production plants in the 18<sup>th</sup> centuries. Several other factories like soap and tallow (whale tallow was used in candle making) factories along with breweries and chemical plants were all located on the site as well. In the late 19<sup>th</sup> century, more than half of the site was turned into a landfill. Almost 75% of the area of the site and its water canals were contaminated due to the presence of substances like gasoline, petroleum, tar and heavy metals like Arsenic. The water canal in the site was neglected for several years and this has caused great contamination (Anonymous 2013a). The power lines in the site had distorted the skyline as well. All of these factors had helped form a polluted brownfield in this part of the city (Figure 3.). In 2008, authorities began a project to clear and revive the land, tear down numerous buildings all over the site and turn air power lines into underground tunnels (Anonymous 2014).



**Figure 3.** Redevelopment of the park from 1945 to 2011 (Transformation of industrial and polluted lands into a land with a sustainable development) (Anonymous 2013b)

Meanwhile, sports centers were being designed for the 2012 London Olympics. The authorities executed the project in three demolition and digging stages. A major part of the site in which redevelopment was seriously in progress was cleared out of pollution (Anonim 2014a). Novel developments including stadiums, new infrastructures, parkways and pavements inside and outside the park and water canals were constructed and numerous islands were created with lush green cover in order to improve environmental quality of the site (Figure 4.).



**Figure 4.** Comprehensive Plan of Queen Elizabeth Olympic Park (Anonim 2014b)

The stadiums in this park were designed so that they become some of the most modern ones around the world. At the same time, they were to be based on sustainability principles. Therefore, in its design process, key principles of quality of design, sustainable development and accessibility were of utmost significance (Greenland, 2003).

According to primary plans for the 2012 London Olympics, three goals were set on the path to sustainable development:

- Minimizing damages: Preventing accidents and illnesses along with promoting welfare for all those involved in London 2012 Olympics and Paralympics
- Not leaving any negative trace: Preventing permanent side effects on environment through proper designs and promoting quality of the environment
- Minimizing trash in landfills: Reducing waste through proper design and performance coupled with maximum recycling and reusing in the process of executing the project

Since sustainable development is a key index in development plans for London in 2012, five criteria of Climate Change, Waste Management, Biodiversity, Healthy Life and Capacity in Design and Planning were taken into account (Table 4.).

**Table 4.** Key criteria in development plans of London

Components of the plan	Climate Change	Waste	Biodiversity	Capacity	Healthy Life
Design and Planning	Functional building and design according to climate		Building new residences around constructions	Using architects and urban designers to create all-inclusive places for further correlation and regeneration	
	Using polluted and arid land			Maximizing communications	Creating facilities to supervise environment

	Managing natural resources in proper use of them (energy, water, material, waste management, controlling water and soil pollution)		Standards of access to the site of symbols' site	Health and safety
<b>Material</b>	Using material with the least carbon	Minimizing waste material and promoting reusing them	Using native material	Using healthy construction material to create safety and health on site
<b>Transportation</b>	Accessible transportation and creating mobile services			Active planning on trips and less use of vehicles

**Conclusion**

Redevelopment of brownfields bring livelihood to neighborhoods and adjacent residences, stimulate local economy, accelerate development in neighboring regions, creating and promoting job opportunities, reducing environmental risks, increasing health and safety in collective spaces and reducing social problems and crimes. A very important issue about redevelopment of brownfields is the type of interference measures that have to be taken. The action taken in each of these fields depends greatly on its potentials so that the level of realization of the model is higher. In this regard, after identifying these fields in urban regions the type of brownfield and the interference has to be determined. In the next stage, type of cooperation from public or private sectors is of the greatest significance (Table 5.).

**Table 5.** Recommended process of redevelopment for Turkey

Starting the Project	Evaluation	Investors	Execution
Official and unofficial structures Identifying investors View of local community	Evaluating local and cultural assets Evaluating cultural resources	Role and influence of public and private sectors	Informing and loading educational plans in neighborhoods

Olympic stadium of London is an example of successful attempts to redevelop these fields and the processes in it to transform them into a lively center are models to guide revival of brownfields in other regions around the world. Considering the above diagram, experiences from this project could be utilized to redevelop urban and regional sites or urban decays and even historical sites and attempt to redevelop these sites through introducing investment packages to start collaborative projects for them. In conclusion the following diagram could be drawn as the recommended redevelopment plan for some similar urban sites in Turkey so that they could be used to promote urban spaces qualitatively and quantitatively route to urban and environmental sustainability (Table 6).

**Table 6.** Recommended process of redevelopment for Turkey

<b>Recognition and Identification</b>	Recognition of urban sites Feasibility
<b>Analysis and Evaluation</b>	Analyzing site Evaluating proposed options
<b>Design</b>	Planning and setting rules Urban design and compiling framework Designing details of architecture
<b>Costs and Execution</b>	Financial and legal issues Determining investment packages Executing planned projects
<b>Delivery and Sale</b>	Delivery Sale and valuation

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