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The Role of Brownfield Development in Sustainable Urban Regeneration

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Abstract. The process of industrial revolution and population growth brought such problems as transport congestion, pollution and environmental degradation which led to rapid immigration of residents and shutting down industrial areas. The outcome was a large number of remained sites with vacant or underused buildings and infrastructures in low-demand markets. Hence, Industrial zones which have been formerly deemed as a vital part of human daily lives turned into a formidable obstacle within the cities. Brownfield lands are, nowadays, recognized as a problematic element in large number of countries, as it is assumed to cause gradual land decline by means of environmental, physical, social and economic negative effects. In spite of all problems these urban sites may make, over the past 30—40 years, Brownfields have been regarded as a precious opportunity for urban developers in order to bring a new value into a poor- quality lands and create new sets of behavior in the declined urban communities.

Keywords: Brownfield, Urban regeneration, Sustainability, Environment, Society, Economy

1. Introduction

The United States Environmental Protection Agency (EPA) first came into use of the term “Brownfield” in 1992 and thereinafter Cuyahoga County designated as the first brownfield project in 1993 which was assisted by State of Ohio Clean Ohio as well as US EPA Clean-up funds (EPA, 2012). The area, before the intervention, used to contain large number of abounded and unused manufacturing facilities and

industrial lands as well as some underused low-quality buildings and utilities which needed to be reused effectively. The project was aimed to bring back the perceived polluted areas to wise land use by physical development and to protect the country's remaining landscape. The Cuyahoga County development project also intended to solve the environmental contaminations by allocating cost-effective cleaning-up plans in order to revitalize the former industrial and commercial areas. Development of Cuyahoga County mainly relied on existing infrastructures instead of building new ones. As a result, the poor-quality and dense industrially and commercially utilized areas were substantially replaced with more productive land uses such as residential areas, public schools and other services.

Therefore, after The Cuyahoga County experience, the countries have found brownfields regeneration as an opportunity to bring back the derelict or detrimental underused sites into the cycle of urban development.

Each country has its own perception of the term brownfield based on its certain geographical, social and economic needs as well as its organizational priorities which eventually results in different sets of definitions. The United States Environmental Protection Agency, U.S. EPA defines Brownfields as: "The lands that have been once used industrially or commercially and are now abandoned and inactive, and the possibility for their redevelopment is very complicated due to environmental pollutions (EPA, 2002)." In fact, according to the interpretation in United States, Brownfield lands are abounded or under-used industrial and commercial facilities considered as practically or potentially contaminated lands.

European countries are also dealing with the confusion as to how the term "Brownfields" can be recognized. There is no single meaning which could be applied throughout the Europe. For example, unlike the definition in the United State, brownfield sites in the UK are more referred to "Previously developed lands" than "Contaminated sites". The main and most dependable data source tracking the extent of brownfield sites in England is the National Land-Use Database (NLUD) which is updated annually. NLUD categorizes the term Brownfield into four different types as: (NLUD, 2006)

- Vacant previously developed land or buildings
- Under-used previously developed land or buildings allocated in local plan or with planning permission
- Under-used previously developed land or buildings with redevelopment potential but no planning allocation or permission
- Derelict land and buildings;

In short, in UK, Brownfields are recognized as all abounded, idled or underused properties with fixed infrastructure and developed surface on site regardless of whether contamination is present or not.

In Germany, "Umweltbundesamt" or "Federal Environmental Agency" has carried out the pilot studies in order to characterize the term brownfield within Germany. Umweltbundesamt in Berlin describes brownfield in two types as: (Umweltbundesamt, 2005).

1. Inner city buildings not under use.
2. Inner city areas for redevelopment and refurbishment.

Therefore, as it could be observed in German and English examples, the contamination factor could be deemed as a "possible" determinant in defining the term brownfield. Indeed, in many European countries the concepts of "brownfield" and "contaminated lands" have been relatively segregated from each other. However, it does not mean that contamination issues have been paid little attention in such countries. But contrariwise development of both contaminated and brownfield lands have been extremely prioritized in urban development programs of all these developed countries.

2. Brownfield Redevelopment and Urban Regeneration

The concepts of "brownfield development" and "urban regeneration" are closely correlated toward accomplishment of sustainable urban development so that both concepts have been respectively structured around environmental, social and economic issues.

The role of brownfield reuse on sustainable urban regeneration could be taken into consideration in three different aspects including: (Doerle, 2112)

- Remediation as a display of environmental issue,
- Revitalization as a display of social issue and
- Reintegration as a display of economic issue

The following discussion will be triggered to survey the substantial effects of each aspect on sustainable urban regeneration subject:

2.1Environmental Benefits of Brownfield Redevelopment

As previously stated, different nations have defined the term brownfield in various ways. Some countries defined it as previously developed land, some as contaminated land and some others as contaminated previously developed land. Therefore, contamination issue is basically an important factor in explanation and development of what is presumed as brownfield land. However it is not commonly considered as a major factor in some countries. Assuming brownfield lands are dealing with presence of hazardous materials, pollutants or contaminants, cleaning-up programs will be extremely required in order to remediate the degraded sites. These contaminants mainly resulted from previous industrial uses which still remained on the site and have detrimental effects on human health and the environment. The contaminants can be due to intrinsic factor – in site contamination like soil, groundwater and surface water pollution- or extrinsic factor- resulted from off- site contamination mainly through nearby sites. So removal and remediation plans should be taken into account not only to recover existing quality of a land, but also to contribute to preserve fertile lands. In other words, by means of reusing existing developed lands we can also reduce the pressure on undeveloped land (Greenfield site) that is currently or could be used for agricultural purposes.

Therefore, apart from the significant and obvious impact of brownfield redevelopment on the revitalization of a declining site, we can also maintain the valuable and productive natural resources through remediation of contaminated lands. Meanwhile, different studies indicate that brownfields projects, in

comparison to alternative Greenfields projects, save between 20 percent and 40 percent of vehicle miles traveled. This translates directly to air emissions reductions (Paull, 2008).

Therefore, remediation of brownfield sites could also significantly result in reduction of greenhouse gas emission which is one of the principal of global warming. Global warming is a phenomenon caused by excessive use of fossil fuels mostly generated by industrial activities. Additionally, as previously mentioned, most of brownfields – but not all- are formerly utilized in industrial purposes and are mainly aimed to take some more sustainable functions afterwards- whether to reuse the abandoned buildings or to use the remained lands as Greenfields or parklands-. Hence, as a result of brownfield remediation we could expect greenhouse gas emission to decline and subsequently the outcome will be the improvement of air quality.

Another environmental benefit of brownfield remediation is its significant influence over improvement of water quality. According to EPA, the higher-density properties generate less stormwater runoff. As briefly noted before, brownfield regeneration basically tends to reduce urban sprawl by means of development in densely developed areas to effectively exploit the existing infrastructures; thereby it could significantly improve the quality and quantity of local water supply. Brownfields redevelopment contributes substantially to reduction of stormwater runoff in two different fashions:

1. Protecting undeveloped and natural lands through reusing abounded or under-utilized buildings and infrastructures.
2. Maximizing pervious and vegetated areas through transforming existing hardscapes into landscapes.

Additionally, increasing the amount of vegetated areas that are pervious also results in reduction of a natural phenomenon called “heat island effect”. Heat Islands are temperature differences between developed and undeveloped areas- mainly rural areas- caused by sunlight absorption of dark colored surfaces (EPA, 2008). Urban heat islands can create elevated temperature up to 10 degrees in

urban areas compared to their outlying rural surroundings (ibid). Accordingly, by means of protecting undeveloped lands as well as creating more green spaces, brownfield redevelopment can considerably reduce urban heat island effects through an integrated and comprehensive remediation plan. Consequently, as it is illustrated on Table1, brownfields redevelopment on the environmental side saves land from the negative externalities associated with sprawl; reduces air emissions and greenhouse gases; improves water quality through reduced runoff; depletes heat island effects and generally accommodates growth in an environmentally responsible fashion (Paull, 2008).

2.2 Socio-Economic Benefits of Brownfield Redevelopment

Declined and damaged urban sites can be redeveloped and redeployed for the good of whole communities. Brownfields redevelopment promotes the social responsibility of areas that are at the risk of land degradation in many ways. Revitalization of brownfields can be considered as a reinforcement of the social aspects of sustainable urban regeneration through improvement of quality of life, promoting human health and also occupant's well-being. In addition a successful development plan could also result in reducing urban sprawl by encouraging different communities to concentrate in a compact mass rather scatter across the metropolitan regions. Therefore, the pattern of a society and respectively the whole involved community members -including occupants, workers, visitors, and all relevant actors- can be profoundly changed through the redevelopment management of brownfield sites especially within metropolitan cities. Table1 shows some important social impacts of brownfield redevelopment process on sustainable urban regeneration.

Meanwhile, the profound effects of brownfields reintegration practice on the economic growth of a declined neighborhood should be extremely taken into consideration. During the last decades, economic issues have been regarded as integral themes in urban planning procedures. By means of exploration into the history of urbanity, we can obviously realize that all the prosperous projects essentially have striven to develop long-term, positive and practical strategies to

take advantage of economic opportunities. In fact, reintegration of brownfields - as degraded lands- into the economic market cycle could significantly contribute to sustainable approaches.

As previously stated, brownfield redevelopment has to be considered as an opportunity rather than a problem. On the economic side, it could attract the attention of investors and developers to enroll in revitalization process of brownfields -as distressed lands- where considerable subsidy levels are required. Meanwhile, brownfield redevelopment can economically benefit both government and population interests. Governments benefit since redevelopment places property back on the tax rolls (Hudak, 2002). The Brownfield development also benefit population since it contributes to generation of new job opportunities. By this means, the average income of the area will be significantly increased which subsequently allows the provision of better amenities and services. Meanwhile, a fast and safe redevelopment process of brownfields could also profit the owners as well as companies which redevelop their degraded real estate property, since brownfields incur costs, whether for maintenance and traffic safety, connection charges, land tax and insurance payments or the obligation to prevent hazards (Umweltbundesamt, 2005).

Table1. The major benefits of brownfield redevelopment.

Remediation (Environmental display)	**Revitalization** (Social display)	**Reintegration** (Economic display)
- Protects biodiversity	- Provides more integrated community involvement	- Increases land value
- Improves air quality	- Cuts down long-term risks to human health	- Reduces energy consumption cost
- Minimizes stormwater runoff	- Increases the quality of life	- Enlarges employment and investment rate
- Reduces greenhouse gas emissions	- Appreciates local culture and heritage	- Increases the average income
- Reduces heat island effects	- Promotes public safety	- Encourages regional industries
- Lessens urban sprawl	- Aesthetically creates more pleasing urban space	

3. Existing barriers of Brownfield Redevelopment

In spite the fact that brownfield sites often offer an excellent infrastructure, these sites do not usually get considered for potential re-use as frequently as undeveloped land (Greenfield) does so that investors still prefer new locations for industries and residential purposes on the lands that are free of many risks associated with brownfields (Siebielec, 2012). While, for all previously noted reasons in this chapter, a successful brownfield regeneration project can be regarded as a win-win project that could yield remarkable environmental, social and economic benefits for the whole involved communities. But recycling brownfields often face a number of barriers that may induce multiple complications into redevelopment process which ultimately constraint the reuse of these sites. Accordingly, the success in reviving brownfield sites significantly relies on overcoming these obstacles to redevelopment. In general, the barriers of brownfields redevelopment could be discussed in two principal perspectives including "physical-environmental" and "socio-economic" barriers which are summarized on Table2.

Table2. Possible barriers of brownfield redevelopment

Physical-environmental barriers	Socio-economic barriers
– Presence of inappropriate and low-quality infrastructures which cannot be easily adopted – Distance to main roads and the lack of accessibility – Poor community connectivity due to the lack of proximity to basic services and amenities – Unknown contamination status which leads to complication in clean-up process (for contaminated sites) – Inflexible clean-up standards which may restrict the redevelopment in some locations	– Insecure community support and cooperation – The risk of development on an area due to the existence of inappropriate conditions – Difficulty in obtaining private and public financial supports – Competing against development on undeveloped lands because they are less costly and much easier to develop – High cost of clean-up and commissioning process (for contaminated sites)

4. Conclusion

The discussion around redevelopment of brownfield sites has recently become an important issue associated with urban regeneration process. In fact, recreation of derelict and underused sites is deemed as a principal way to reduce pressure on undeveloped sites (Greenfields) around cities. The emergence and evolutionary formation of brownfield sites demonstrates that the post-industrial lands (such as contaminated factory sites, derelict railway land, abandoned and disused quarries etc.) are the main areas of concern for urban brownfields. But rather, based on new interpretations, brownfield sites are currently recognized as other land uses besides industrial purposes, whereby the contamination issues have become a minor factor in portraying brownfields in many countries.

The impact of brownfields on urban systems is quite poorly understood so that they are mostly regarded as problems to be solved. While, brownfields are better to be viewed as development opportunity than planning problem; as a chance to make a city more interesting for developers, worth living for inhabitants and also more productive for investors. In order to better understand the role of brownfield revitalization in urban development, this term was comprehensively analyzed in the contexts of society, economy and environment, the criteria which shape the concept of sustainability. Therefore, brownfield land reuse could be translated into three components of sustainability within urbanity, all of which are important for understanding the subject of urban brownfields regeneration.

Following this pattern, this research put effort into simplifying the worldwide comprehension of term brownfields. Hence, the research went through various definitions of brownfield sites to establish a general framework for this concept. In order to do so, a brief study has been carried out about how different countries define the term brownfield in their urban structures. Meanwhile, the possible barriers and benefits of brownfield redevelopment were extensively exposed to discussion with the purpose of portraying the significant role of brownfield sites development in sustainable urban regeneration.

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