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TOWARDS A SUSTAINABLE CITY: BROWNFIELDS AS A POTENTIAL FOR URBAN DEVELOPMENT

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ABSTRACT

A brownfield site refers to an abandoned and contaminated industrial land that has different levels of dangerous wastes and pollutants. That is why these sites may have many negative impacts on communities and human health, and their development presents a potential for local communities to upgrade. This paper develops a theoretical model for brownfield's sustainable urban development. It uses both theoretical findings and already developed examples to extract this theoretical framework. It highlights the success of redevelopment interventions as a result of balanced achievements on all of the sustainability three main axes (environmental, economical, and social). The developed theoretical model is used to analyze the International Park project, a new urban development in Alexandria, Egypt that replaced a brownfield, which was a garbage dump. The analytical study findings assure the close linkage between the three aspects of sustainable development and the necessity of their fulfillment as a guarantee to the success of brownfields redevelopment process. It shows that the absence of one of these aspects during the development process could break the sustainability circle.

KEYWORDS: Brownfields, Regeneration, Urban development, Sustainability, Healthy community, Industrial lands.

1. INTRODUCTION

Due to fast expanding of cities, old industrial sites are now located on the heart of these cities rather than being on their peripheries [1]. In addition, many changes in production techniques and processes have led these former industrial sites –known as brownfields-to be neglected and abundant [2]. Seen as a development potential,

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brownfield redevelopment has become an essential tool for a sustainable land use strategy as well as a highly significant aspect for urban revitalization [3].

It was until the end of the twentieth century when it has reached a much more solid definition of ‘brownfield’ [4]. Actually, the Environmental Protection Agency (U.S. EPA) was the first to use the term “brownfield”, in 1992. And in 1997 it offered the most commonly cited brownfield definition in 1997: "Brownfields are abandoned, idled, or under-utilized industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination" [5].

The multi facet redevelopment process of brownfields is best interpreted within Sustainability understandings. This includes both the negative impacts caused by keeping them without development and the benefits achieved along the three axis of sustainability: environmental, economical, and social when these brownfields got developed. Concerning the negative impacts, brownfields reduce the nature of an urban setting; both outwardly and physically affecting the prosperity of the inhabitants living in the area just as potential financial specialists and representatives [6]. Brownfield properties are often deserted as their owners are not paying any taxes or even maintaining the properties. Furthermore, abandoned sites can become an unpleasant view in a distinctively short period of time, and may attract ruin and illegal acts, which pull down communities, damage the environment, and potentially put health in danger. Nonetheless, and on the positive side, the productive reuse of brownfields helps clean up the environment, reduce urban sprawl, increase the tax base, promote urban stimulation, reduce the costs to the society associated with adding infrastructure, and create jobs for the surrounding community. In other words, redeveloping brownfields connects and links environmental protection with economic vitality [7].

The paper follows a methodology that combines the findings of both literature review and examples’ analysis to extract a framework for sustainable brownfields’ development. The related literature was reviewed to investigate the threats of brownfields and the potentials, and benefits of their development. In addition, three international brownfield’s redevelopment examples are analyzed to show scale of

interventions, trends, and approaches practically used. In a further step, the findings of these theoretical and analytical studies are used to evaluate the redevelopment interventions used to remediate and reuse the International Park (The New Downtown for Alexandria) as replacing a previous brownfield; garbage dump. The theoretical framework developed along the paper is used to evaluate the proposed project regarding the three sustainability aspects; environmental, economical, and social.

Finally, the paper in its conclusion section sums up findings and proposes a set of recommendations in light of the presented theoretical studies, international examples and case study analysis.

2. BROWNFIELDS REDEVELOPMENT

The untailored definition of brownfield makes it accepts a large spectrum of classifications. Reviewing the literature, six main classifications for brownfields are highlighted. They are classified either to their formation origin [8], their position within an urban community [9], the typology of the site [9], their previous use [10-11], their probability of reuse [12], or the type of land and its definition [13]. Among these classifications, the 'formation origin' stands as a key one. This is based on degree of land contamination as a significantly important aspect when dealing with a brownfield land for redevelopment. Another important aspect is the location of the site whether in the center of the city or on its periphery.

The sustainability of brownfields remediation and reuse is a main concern in their context's redevelopment. Their role is expected to expand beyond just the narrow scope of reutilization or reintegration of land, to supply a combination of social, environmental, and economic benefits through a sustainable development perspective [2]. Consequently, brownfield redevelopment acts as an indispensable sustainability framework to revive the inner-city sociability, environment and economy [14].

RESCUE defines a sustainable regeneration of brownfield sites as "the management, rehabilitation and return to beneficial use of the brownfields in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations in environmentally sensitive, economically viable,

institutionally robust and socially acceptable ways within the particular regional context" [15]. Within this understanding, brownfields' remediation includes many returns to their regional economy and to the community nearby as illustrated in Fig. 1. So, these developments must be seen within existing development forms, and, must be integrated with other existing contexts [16].

Literature asserts the balanced achievements on sustainability tripod scale as a prerequisite for brownfields redevelopment long term success [17-19]. According to Silverthorne, any redevelopment of a brownfield site contains multidimensional improvements and therefore it faces inherent problems and costs associated with unimproved brownfield sites [17]. These costs can be classified as economic, social and environmental [20]. So, the main benefits of brownfields remediation projects could be as a sum of benefits that are achieved in all of the environmental, economical, and social dimensions as shown in Fig. 1.

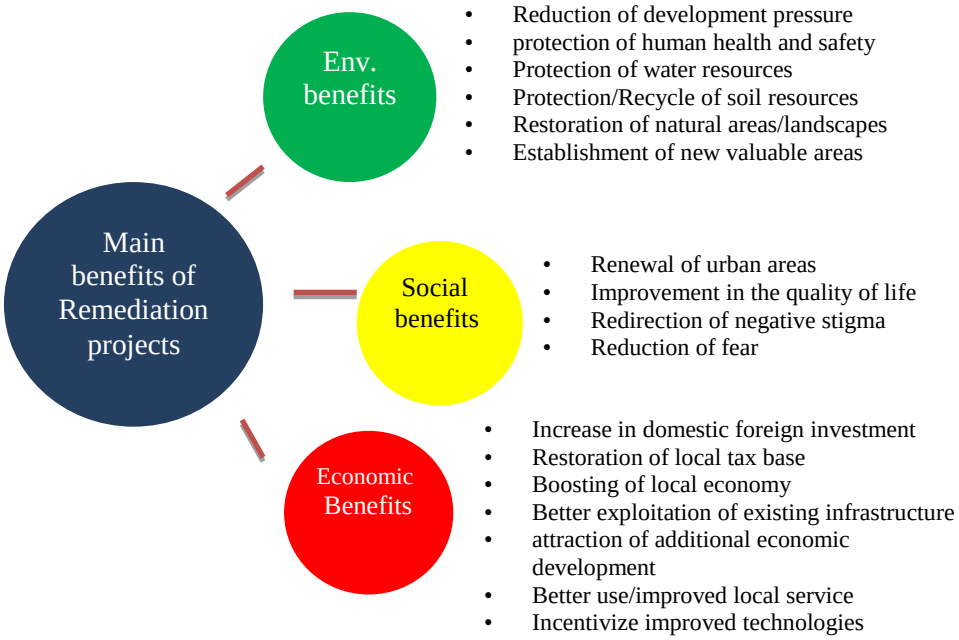

Fig. 1. Main benefits of redevelopment projects, [16].

According to Gatrell and Jensen, the success of brownfield redevelopment within sustainability understandings encompasses creating 'Livable' spaces that 'enrich the daily lives of residents'. Actually this perspective shows a move towards alternative economic development with 'smart growth' economic plans. English, M.,

shows that US approaches to balance the often competing interests of economical, environmental, and social qualities' of life by making more emphasize on local communities' livability and insuring sense of place [21]. Within these understandings the success of brownfields' remediation projects is achieved when if it yields extensive outcomes in the three pillars of sustainability [22], and a single intervention has the potential to solve many problems in many directions [23]. In these regards all of intervention's configurations –type and scale for example- affects merely the expected development's outcomes on short and long terms.

3. BROWNFIELDS REDEVELOPMENT MODEL

The main aspects of the brownfields redevelopment bring about vital consequences in the environmental, social/cultural and economic pillars of sustainable development, in addition to including all the significant stakeholders [24]. Figure 2 presents a conceptual model of successful brownfields redevelopment as based on balancing the intervention impacts on all of the three sustainability aspects: environmental, economical, and social. It shows three levels of interventions: the first level crashes into one of the main three aspects; the second level tackles two of these aspects (environmental-social, environmental-economic or social-economic) while neglecting the third aspect. The third level achieves goals related to all of the three aspects in a balanced matter, which guarantees its sustainability.

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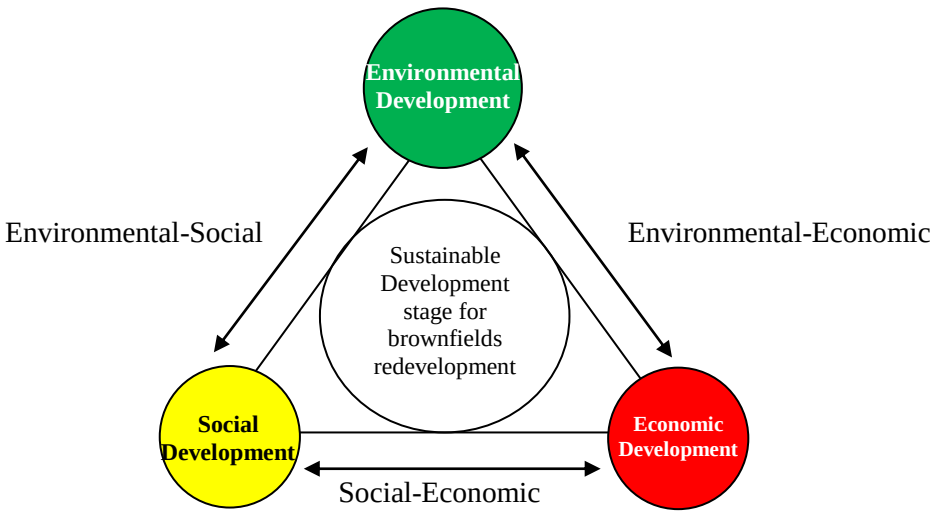

Fig. 2. The theoretical model for brownfields redevelopment trends.

Literature shows many studies have developed a breakdown for sustainability aspects to build an evaluation models for brownfields redevelopment. One of these leading studies is one presented by SuRF-UK, originally produced by AECOM [18]. It encompasses five categories of sustainability criteria for each of the sustainability dimensions: environment, economy, and society. These fifteen items for assessment are included in downloadable excel sheet that records a simple rankings (1=best, and 2=worst) [25]. These rankings are aggregated to provide a ranking for each item of sustainability and a ranking for the overall sustainability scale. This could be used for indicating the balanced impacts of redevelopment projects regarding sustainability aspects and to compare between the sustainability prospects for different interventions.

Another widely used evaluation system is one presented by Burinskienė, M., et al. [6]. It is originally based on a study performed by TIMBRE named 'Tailored Improvement of brownfield Regeneration in Europe' [26]. This study identified an expanded list of 152 indicators listed under three main categories; environmental, economic and social [6]. By the aim of this study, a combined list -consisting of 18 indicators (6 indicators for each aspect of sustainability Table 1) - is developed as a part of the theoretical framework used in this paper to address brownfields' redevelopment sustainability.

Actually these evaluation systems present a generic umbrella that has to be customized according to local contexts. It is extremely difficult to deal with brownfields in a stable and uniform manner around the whole world [1] as it differs from one country to another, from place to place, even from a project to another [5]. Nevertheless, some generalization could be used to come to a robust model to evaluate brownfields' redevelopments. This generalization is based on some common features of these interventions. One of these common aspects is functionality as most of development projects are based on converting brownfields into residential or residential and commercial land uses as direct results for population growth and the fast-economical gain [3]. Another important aspect is scale. These interventions could be classified based on scale categories, which help to determine approaches for

intervention. Three approaches could be distinguished based on intervention scale as follows:

- Temporary Uses: in the case of the inability of immediate redevelopment [27].
- Reuse/Adaptive Reuse: of existing industrial buildings integrating the past heritage with the future development [28].
- Comprehensive Reuse: redeveloping the whole site with full displacement and removal for any site contents for immediate redevelopment plans [27].

4. INTERNATIONAL EXAMPLES OF BROWNFIELDS

As a step towards developing more detailed framework, three international examples classified under three different approaches of intervention -temporary uses, reuse/adaptive reuse, and comprehensive reuse- are examined. This is by the aim of customizing the generic list of sustainability indicators according to intervention approach and scale.

4.1 Kings Waterfront (Liverpool regeneration), UK

The Kings Waterfront project (formerly Kings Dock) was set to be an industrial zone till its cessation in 1972. It was transformed by the Merseyside Development Corporation into a dull car park as a temporary use, which continued to work until the late 1990's [29]. This approach was the optimum intervention compared to site constraints and its development goals. Figure 3 presents the stages of development progress. The Kings Waterfront opened to all the people in January 2008. Entertainment and conference lobbies were established. The anticipated economic yields are 430 construction jobs, 2200 jobs in addition to $7 million in tourist expenses per year [29].

Fig. 3. Images of waterfront development. a. Kings Dock in the 1970s. b. Kings Waterfront September 2005. c. Kings Dock site and relationship to immediate neighbors in September 2008, [29-30].

4.2 Seaholm Power Plant Redevelopment, Austin, Texas, USA

In Austin, the Seaholm Power Plant redevelopment is significantly evaluated as a representative building of sustainable preservation. In 2005, the Austin City Council made a master plan for Seaholm Power Development with mix-used redevelopment, including office spaces, local retail shops, residential, and outdoor public spaces (City of Austin 2018). It was listed on the National Register of Historic Places as a Recorded Texas Historic Landmark on July 2013. Before the redevelopment of Seaholm Power Plant, it was just a generating building for energy production and private space as shown in Fig. 4. After the redevelopment, this strategic location has had tremendous economic, environmental, and social values. A new residential tower, trendy retail stores, and restaurants attract visitors and neighborhoods [28].

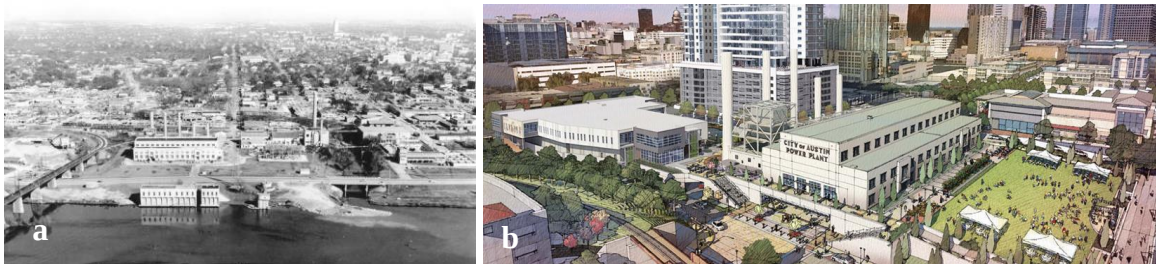

Fig. 4. a. Seaholm Power Plant in 1930. b. The new proposal for the residential commercial use [28].

The main architectural design company, STG Design, proposed preservation of the original power plant building and transformed the old structures into creative office spaces. It is currently used as a company head office which has an eco-friendly image [28]. This approach of adaptive reuse for the old building leads to its preservation and the proper reuse of existing infrastructures.

4.3 Redevelopment of Austria's Largest Gasworks-Site, Austria

On October 31st 1899, the newly constructed gas work in the Vienna district simmering began operation. In 1900, the private gas works stopped. Since 1993 a number of investigation campaigns have worked to detect contamination centers and to develop a good apprehension of the distribution of contaminants. Consequently, by the year 2000 the site was classified as "priority class 1", representing the need for financing and applying redevelopment procedures within the national redevelopment program after the elimination of all site contents and contamination sources as shown in Fig. 5 [31].

Fig. 5. a. Large diameter boreholes and steel piling coffers, b. The elimination of tar storage, c. Gasometer city, d. Aerial view operations center of "Wiener Netze" [31].

Based on the three examined examples a more comprehensive framework could be reached as illustrated in Table 1. It determines three levels of importance (less significant (LS), significant (S), and very significant (VS)) as a prerequisite for each of the environmental, economical, and social indicators to guarantee the overall sustainability of brownfield's redevelopment interventions. The framework could also be used as a scaled for evaluating achievements.

5. BROWNFIELD REDEVELOPMENT IN EGYPT

Although the term 'Brownfield' is commonly used in the Egyptian's urban planning practices, there is no specific or common definition for it. It is not mentioned in any of the Egyptian laws or regulations. However, relevant terms are used to refer to it such as "areas to be redeveloped", " Re-planning areas", and "Undervalued land "or" Unused assets [8].

Table 1. A framework to determine the priorities of achievements regarding sustainability indicators for each intervention approach.

				Brownfields Redevelopment Interventions	
	Indicators of the three aspects for sustainable brownfields redevelopment		Temporary Use	Adaptive Reuse	Comp. Reuse
Environmental Criteria	- Clean up works at the beginning for safer environment.	(E1)	LS	VS	VS
	- Alleviate future environmental concerns on the property.	(E2)	LS	S	VS
	- Local and governmental supports for redeveloping and cleaning.	(E3)	S	S	VS
	- Integration of landscape.	(E4)	S	VS	VS
	- Ecological transportation.	(E5)	S	LS	S
	- Increasing green area percentage if needed.	(E6)	VS	VS	VS
Economic Criteria	- Consider brownfields as community and economic opportunities.	(EC1)	VS	VS	VS
	- Connect brownfields initiatives to the broader community vision and redevelopment priorities.	(EC2)	LS	S	VS
	- Reach real funding sources to reach real results.	(EC3)	LS	VS	VS
	- Earn an appropriate return on investment.	(EC4)	S	S	S
	- Ensure the project succeed by redeveloping blighted properties and generating economic or community growth.	(EC5)	LS	VS	S
	- Ensure job creation and Remedy high unemployment rate	(EC6)	LS	VS	VS
Social Criteria	- Assemble a Strong brownfields Team with Leadership from the Top (Participation on different society groups).	(S1)	S	LS	VS
	- Community involvement like making use of the local community ideas to reuse a contaminated property like this.	(S2)	S	S	S
	- Responding with culture / historical fabric.	(S3)	S	S	VS
	- Linkage with surrounding districts.	(S4)	VS	S	VS
	- Long term unemployment rate.	(S5)	LS	VS	VS
	- Decrease criminal rate.	(S6)	VS	VS	VS

In the Egyptian contexts, independent projects attempted to utilize these sites without a comprehensive approach for the optimal intervention with those sites. Different state governments identified various redevelopment aspects to deal with those sites, while others restrict the development to particular uses in order to minimize exposure to leftover containments on-site [1]. Nonetheless, brownfields, in Egypt, occupy various sites at different locations which are sometimes unique for the development process for their locative potential as waterfronts, central business district or locations near the main transportation axes in the city, including excellent chances for redevelopment and, therefore, a key aspect of the success of the redevelopment of these sites.

5.1 The Case of the International Park (The New Downtown in Alexandria)

The area of The International Park is a good brownfield developed example due to its special location in Alexandria as shown in the attached maps in Fig. 6. It is located at the City's southern entrance. It is rectangular in shape (its area is about 123.5 Fadden (518,700 m^2)). It has undergone a number of development processes and changes for a long time and up till the moment. The latest development's aim is to increase the services and production abilities, in addition to the improvement of tourism and urban rectifiers [32].

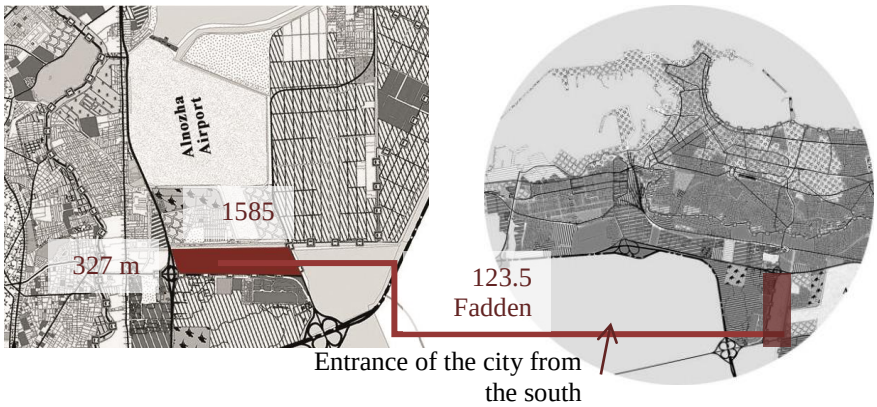

Fig. 6. Google Earth image of the location of the International Park from the south entrance of the city.

This park is considered the 1st park in Alexandria, built on a large area within the last 80 years and more after the presence of Antoniadis and Nozha parks which

were not enough for serving all the people after the boom in population. It was a vast garbage dump classified by developers as an old brownfield which was opened in 1987 after various development processes [32].

In 1998, the governance rented the park to Delta Egypt for tourism and Real Estate Development Company with a 20-year-BOTcontract, which has already ended in 2018. In 2010, the whole area was constructed to be commercial, entertainment and service areas, wedding places, restaurants, cafes, Downtown mall, a mosque, a public park, and two large private clubs just to ensure achieving the economic aspect. Then, in the beginning of 2018, when rent contracts terminated, the locale government announced that all late rents are due and that contracts shall not be renewed unless late rents are settled. The whole area was retrieved by the governance and added in the new real-estate development project proposed by the Local government and the Engineering Authority of the Military Forces in Egypt. Demolition began for the existing buildings in the middle of 2019 to commence the construction work in the whole area to be transformed into a huge touristic, commercial, entertainment, residential project [32].

A competition was announced by Alexandria government for designing the new downtown of Alexandria as the starting point for the redevelopment of the city itself and relocating Alexandria in its international context. Omran Architects won the first prize in The Downtown Development competition [33]. Figures 7 and 8 show the proposal diagrams for the International park project.

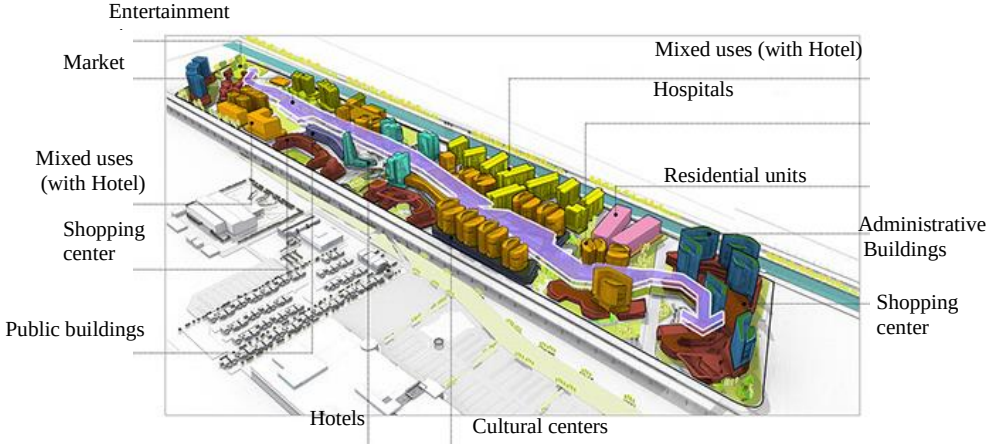

Fig. 7. A detailed diagram for the new proposal of the International park project (Alexandria new downtown), [33].

Fig. 8. An upper view for the proposal of Alexandria new downtown project, [33].

Nowadays, there is increased political attention towards brownfield regeneration. This goes back to the fact that vacant lands in densely populated areas became less available and more expensive [34].

The case study theoritical analysis can be divided into three stages of development. Each stage will be analyzed in terms of four aspects (steps of redevelopment, the approach used for redevelopment, the level of intervention of each approach and development type achieved).

- Stage 1 started in 1987 till 1998. The site was converted from a huge garbage dump into a park which mainly consisted of green areas, trees, pergolas, cafes, kids area, a model for the Romanian theater on an artificial lake with a stage for 400 people, district area as models for some of Alexandria districts and a model of Alexandria as an island in the center of a lake. In addition, it contained some models for the most important buildings in the city. The approach used for redevelopment is Temporary uses approach. According to the theoretical model of the sustainable redevelopment for brownfields, this stage did not complete its sustainability components, which led to its failure. The development type achieved is Environmental-Social development regardless of the economic aspect.

- Stage 2 started in 1998 till 2018. The Park was rented to Delta Egypt for tourism and Real Estate Development Company for a 20-year-contract which ended in 2018. Then, the company rented the whole area for more than 20 investors who constructed a lot of different projects, private clubs, restaurants, cafes, wedding places, conference halls and hotels to become one of the biggest investment zones in the governance. Comprehensive reuse approach for immediate redevelopment plans and

large parts of the garden were leased to obtain an economic return to ensure its sustainability. Environmental-Economic development type was achieved regardless the social aspect which also lead to its failure by time.

- Stage 3 started in 2018 till the present time. In 2018, when the rent contracts ended, the local government and the Engineering Authority of the Military Forces in Egypt began demolition of the existing buildings. In the middle of 2019, the construction work was carried out in the whole area to be converted into a huge touristic, commercial, entertainment, and residential project. It is considered now an investment project after brownfields redevelopment stages, despite its lack of the social aspect of the sustainability process, it tries to achieve the environmental and economic aspects. This stage is still under study due to the incomplete construction work. The type of development is determined according to the plan of development.

In line with the details of the International Park project, Table 2 below provides an analysis of the project according to the approaches used in the three different phases of development and its level of intervention in each indicator of aspects of sustainable brownfields development. Experts' opinions (urban planners and those in charge of the project from within the government) were used to arrive for objective assessment. The two check marks in the Table means completely achieved, the one check mark means partially achieved and the dash means not achieved.

Thus, analyzing the example arrives to the conclusion that after the failure to transfer the landfill to a garden due to its lack of one aspect, which is the economic aspect, the second development came to achieve this, but it was at the expense of another aspect, which is the social one.

5.2 The Analysis of the International Park Project (Alexandria New Downtown)

The analysis of the international park in Table 2 shows that the approaches used in development are temporary uses and comprehensive reuse. The first approach was chosen by the government at the international park development when it was opened in 1990 as green areas, trees, pergolas, cafes, and kids' area in place of the previous garbage store (1st development step).

Table 2. An analysis of the International Park project -Alexandria New Down-town (AND) in its three stages.

			Brownfields Redevelopment Interventions in Alexandria New Downtown (AND)					
			1st Stage		2nd Stage		3rd Stage	
Indicators of the three aspects for sustainable brownfields redevelopment			Temporary Use		Comp Reuse		Comp Reuse	
Environmental Criteria	- Clean up works at the beginning for safer environment.	(E1)	LS	✓✓	VS	✓✓	VS	✓✓
	- Alleviate future environmental concerns on the property.	(E2)	LS	✓	S	✓✓	VS	✓
	- Local and governmental supports for redeveloping and cleaning.	(E3)	S	✓	S	-	VS	-
	- Integration of landscape.	(E4)	S	✓✓	VS	✓	VS	✓✓
	- Ecological transportation.	(E5)	S	✓	LS	✓	S	✓
	- Increasing green area percentage if needed.	(E6)	VS	✓✓	VS	✓	VS	✓
Economic Criteria	- Consider brownfields as community and economic opportunities.	(EC1)	VS	-	VS	✓✓	VS	✓✓
	- Connect brownfields initiatives to the broader community vision and redevelopment priorities.	(EC2)	LS	-	S	✓	VS	✓
	- Reach real funding sources to reach real results.	(EC3)	LS	-	VS	✓	VS	✓✓
	- Earn an appropriate return on investment.	(EC4)	S	-	S	✓	S	✓✓
	- Ensure the project succeed by redeveloping blighted properties and generating economic or community growth.	(EC5)	LS	✓	VS	✓	S	✓✓
	- Ensure job creation and Remedy high unemployment rate	(EC6)	LS	-	VS	✓	VS	✓✓
Social Criteria	- Assemble a Strong brownfields Team with Leadership from the Top (Participation on different society groups).	(S1)	S	-	LS	-	VS	-
	- Community involvement like making use of the local community ideas to reuse a contaminated property like this.	(S2)	S	✓	S	-	S	-
	- Responding with culture / historical fabric.	(S3)	S	-	S	-	VS	-
	- Linkage with surrounding districts.	(S4)	VS	✓	S	-	VS	-
	- Long term unemployment rate.	(S5)	LS	-	VS	-	VS	✓✓
	- Decrease criminal rate.	(S6)	VS	✓✓	VS	✓	VS	✓✓

The second approach was chosen in the second and the third steps of development, when it opened in the year 2000 after being merely a green area. It turned into a commercial; entertainment zone with multiple services for citizens then in the development stage started in 2018 and did not finish until the present time. The economic aspect is the most aspect achieved during development processes, and according to the theoretical model, this causes unbalanced sustainable development due to the shortage in social and environmental aspects.

6. CONCLUSIONS

Brownfields -by way of optimal utilization- act as a potential and a key development aspect rather than being a merely threat for any community. Their development contribution to sustainable urban development is clear at both international and national scales. The paper discusses the case of International Park project (Alexandria New Downtown) as a new urban development in Alexandria, Egypt based on a comprehensive reuse for already existing brownfield.

The paper tackled an approach that considers the balanced achievements on the entire environmental, economical and social development axis as a guarantee to the sustainability of brownfield's redevelopment. It uses this understanding to develop a theoretical framework that determines three scales of significance for achieving 18 sustainability indicators (6 for each category) according to brownfield's redevelopment interventions. In this regards the paper identifies three types of intervention –as presented in the analytical examples- temporary use, adaptive reuse, and comprehensive reuse.

By analyzing the case study in light of the theoretical findings, it was clear that each type of brownfields requires a different type of development in addition to the impact of this development on the communities. The paper discusses applying more aspects of analysis on the local case study in Alexandria, Egypt (the International Park / The new downtown for Alexandria) according to three aspects of sustainability (environmental, economic and social aspects) and their indicators to achieve sustainable development within the approaches used in development.

The most common practices to achieve a sustainable redevelopment are identified through the theoretical studies in line with the three approaches discussed previously (temporary use, reuse/adaptive reuse of existing buildings, comprehensive reuse). Thus, the temporary use approach was found to be the most suitable solution in the case of improbable immediate redevelopment which is better than leaving the brownfield contaminated site harming the surrounding community as it does not cost a lot of money and may help developers achieve the sustainable development stage until the final development step. There are also several examples of using the temporary use approach in historic buildings. Nonetheless, reuse or adaptive reuse for the existing buildings is a preserving way in many cases especially for historical buildings as well as the temporary use approach. This approach takes advantage of the existing infrastructures and facilities, preserves historical buildings and saves a lot of funds. The last approach discussed is redeveloping the whole site with full displacement and removal for any site contents. This approach is followed when the government or the owner is ready for immediate redevelopment, funds are available, and no historical buildings exist in addition to the necessity of removing effects of contamination.

6.1 Regarding Brownfields in Alexandria, Egypt

The study explains the positive impact of brownfields redevelopment on the sustainable urban development in Egyptian context. It shows a shift in government vision towards brownfields to be as a potential for sustainable urban development rather than a threat. However, urban planning laws and regulations necessarily embrace a definition for the interpretation of unused or underdeveloped assets (brownfields), and their classifications in light of the circumstances of the local contexts. In addition, applying the theoretical framework to Alexandria case shows balanced interventions are the key for sustaining the development process on different scales and dealing with them must be well calculated in each phase to achieve its targets on the long run. Finally, brownfields redevelopment needs to be guided by national developing plans of Alexandria Government so as to enable planners of

combining them in the planning process which needs to be achieved via multiple approaches and scales.

DECLARATION OF CONFLICT OF INTERESTS

The authors have declared no conflict of interests.

REFERENCES

1. Abd Elrahman, A. S., "Redevelopment Aspects for Brownfields Sites in Egypt", Procedia Environmental Sciences, Vol. 34, pp. 25 – 35, 2016.
2. Ürkmez, G. K., "Brownfield Redevelopment in Turkey as a Tool for Sustainable Urbanization", INTECH, No. 6, 2016.
3. BenDor, T. K., Metcalf, S., and Paich, M., "The Dynamics of Brownfield Redevelopment", Sustainability Journal, Vol. 3, No. 6, pp. 914-936, 2011.
4. Chen, Ch., Tsai, Y. Ch., and Ma, H. W., "Toward Sustainable Brownfield Redevelopment Using Life-Cycle Thinking", National Taiwan University, Vol. 8, 2016.
5. Ionescu-Heroiut, M., "The Management of Brownfields Redevelopment, Europe and Central Asia Region: Sustainable Development Department", World Bank, 2010.
6. Burinskienė, M., Lazauskaitė, D., and Bielinskas, V., "Preventive Indicators for Creating Brownfields", Sustainability, Vol. 7, No. 6, pp. 6706-6720, 2015.
7. Kasich, J., and Butler, C, W., "Ohio Brownfield Redevelopment Toolbox", Ohio Environmental Protection Agency, 2007.
8. Ismael, M. H., "Sustainable Urban Regeneration of Brownfields", M.Sc. Thesis, Faculty of Engineering at Cairo University, 2016.
9. Perovic, S., and Folić, N. K., "Brownfield Regeneration – Imperative for Sustainable Urban Development", Gradevinar Journal, Vol. 5, pp. 373-383, 2012.
10. Ferber, U., and Grimski, D., "Brownfields and Redevelopment of Urban Areas", the Austrian Federal Environment Agency, 2002.
11. Hollander, J. B., Kirkwood, N. G., and Gold, J. L., "Principles of Brownfield Regeneration, Cleanup, Design, and Reuse of Derelict Land", Illustrated edition, Island Press, USA, 2010
12. Masala, E., and Melis, G., "Interactive Visualisation Tool for Brownfield Redevelopment", Celid, 2013.
13. Loures, L., and Vaz, E., "Exploring Expert Perception Towards Brownfield Redevelopment Benefits According to Their Typology", Habitat International, Vol. 72, pp. 66-76, 2016.
14. Becerra, M., "Environmental Justice for Whom? Brownfield Redevelopment and Gentrification in Chicago: 1990-2010", M. Sc. Thesis, Ohio State University, 2011.

15. RESCUE (Regeneration of European Sites in Cities and Urban Environments), "Guidance on Sustainable Land Use and Urban Design on Brownfield Sites", Workpackage 4 – Deliverable D 4.1., 2004.
16. Turvani, M., and Tonin, S., "Brownfields Remediation and Reuse: An Opportunity for Urban Sustainable Development", in Clini, C., Musu, I., and Gullino, M. L. (Eds.), Sustainable Development and Environmental Management: Experiences and Case Studies, Springer, pp. 397-411, 2008.
17. Silverthorne, T., "What Constitutes Success In Brownfield Redevelopment? A Review. Transactions on Ecology and the Environment", WIT Transactions on Ecology and the Environment, Vol. 94, pp. 39-49, 2006.
18. Li, X., Bardos, P., Cundy, A. B., Harder, M. K., Doick, K. J., Norrman, J., Williams, S., and Chen, W., "Using a Conceptual Site Model for Assessing the Sustainability of Brownfield Regeneration for a Soft Reuse: A Case Study of Port Sunlight River Park (U.K.)", Science of the Total Environment, Vol. 652, pp. 810-821, 2019.
19. Altarawneh, D., "Sustainable Brownfields Redevelopment and Tools of Computer Aided Design", 8th Conference of the Arab Society for Computer Aided Architectural Design (ASCAAD), London, 2016.
20. Burnham-Howard, C. E., "Building on Brownfields: Predicted Effects of New Liability Protections for Prospective Purchasers and An Exploration of Other Redevelopment Incentives", Journal of Professional Issues in Engineering Education and Practice, Vol. 130, No. 3, pp. 212-225, 2004.
21. English, M., "A Guide for Smart Growth", Forum for Applied Research and Public Policy, Vol. 14, No. 3, pp. 35-39, 1999.
22. Andrew, A. S., "Brownfield Redevelopment: A State Led Reform of Superfund Liability", Natural Resources and Environment, Vol. 10, No. 3, pp. 27-31, 1996.
23. Strother, P. C., "Brownfields of Dreams in the Old Dominion: Redeveloping Brownfields in Virginia", William and Mary Environmental Law and Policy Review, Vol. 23, pp. 269-304, 2000.
24. http://fast10.vsb.cz/bribast/document/handbook_EN_final.pdf, (Accessed 20/08/2020).
25. www.claire.co.uk/surfuk (Accessed 14/11/2020).
26. http://www.timbre-project.eu/ (Accessed 14/11/2020).
27. https://upcommons.upc.edu/bitstream/handle/2099.1/21140 /IvanNikolic.pdf, (Accessed 12/9/2020).
28. Kim, D., "Adaptive Reuse of Industrial Buildings for Sustainability; Analysis of Sustainability and Social Values of industrial Facades", M. Sc. Thesis, University of Texas at Austin, 2018.
29. Maliene, V., Wignall, L., and Malys, N., "Brownfield Regeneration: Waterfront Site Developments in Liverpool and Cologne", Journal of Environmental Engineering and Landscape Management, Vol. 20, pp. 5-16, 2010.
30. URS Project Team and Frank, K., "Kings Dock, Liverpool, Master Plan and Planning Brief", Homes and Communities Agency, UK, 2012.

31. Payá-Pérez, A., Kylander, M. E., Noemí Silva-Sánchez, N., and Otero, N., "Remediated Sites and Brownfields. Success Stories in Europe", Joint Research Centre, European Union, 2015.
32. Soliman, A. M., and Hassan, I., "Urban Management and Development, Development of the International Park in Alexandria / Case Study", the 7th Scientific Conference of Minia University, Art and the City in the Third Millennium, Minia, Egypt, 2002.
33. http://www.omranarch.com/projects/downtown (Accessed 23/11/2020).
34. El Fouly, H., and Hammam, R., "Identifying Brownfield Sites' Indicators for Establishing Green Open Spaces", Journal of Engineering and Applied Science, Vol. 67, No. 3, pp. 643-661, 2020.

نحو مدينة مستدامة: الأراضي الملوثة صناعيا كأداة للتنمية الحضرية

يشير مصطلح (Brownfields) إلى الأراضي الصناعية المهجورة والملوثة والتي بها مستويات عالية من النفايات الخطرة والملوثات. تنص المشكلة البحثية على أن هذه المواقع تتسبب في العديد من الآثار الجانبية على المجتمعات وصحة الإنسان ويعد تواجدها في المجتمعات العمرانية سببًا رئيسيًا في مشاكل (السلامة ، التلوث ، الصحة العامة ، الاقتصاد ، الثقافات و غيرها). لذلك ، يناقش البحث كيف تؤدي إعادة تطوير تلك الأراضي إلى مجتمع صحي وآمن وكيف يمكن أن تكون (Brownfields) عنصر قوة للتنمية الحضرية، كما انه يضع نموذجا نظريا لتطوير هذه الاراضي لتحقيق التنمية المستدامة. تم استخدام كل من النتائج النظرية والامثلة للوصول الي هذا الإطار النظري. كما تم اجراء دراسة الحالة في الإسكندرية، مصر – مشروع تطوير الحديقة الدولية – وتؤكد نتائج الدراسة التحليلية الارتباط الوثيق بين الجوانب الثلاثة للتنمية المستدامة وضرورة تحقيقها كضمان لنجاح عملية إعادة تطوير تلك الأراضي. كما توضح أن غياب أحد هذه الجوانب – محاور الاستدامة الثلاثة (البيئية والاقتصادية والاجتماعية) – أثناء عملية التطوير يمكن أن يكسر دائرة الاستدامة.