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Brownfield Sites as Catalysts for Sustainable Urban Regeneration and the Demand for Objectives, Tools and Classifications for the Support of their Redevelopment

Examples from the city of Amman, Jordan.

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Abstract

Almost two decades today, the topic of brownfields has extensively been researched in urban sociology, urban planning, and human geography, and numerous Western-Centric studies have linked the redevelopment of the abandoned, contaminated, vacant or derelict sites to sustainable urban regeneration and achieving smart cities and sustainability goals in general. Yet, until this day, the concept has received little academic and practical attention in Middle Eastern contexts.

Western contexts on the other hand including Europe, UK and USA continue to offer unique perspectives on approaching brownfields in ways that reduce the alarming spatial cluttering and address socio-spatial disparities and spatial segregation in addition to achieving economic and environmental goals, and similar to the global scene, brownfield sites make a large portion of the post-industrial city of Amman, the capital of Jordan. However, with the lack of a systematic definition for the urban phenomenon objectives, methods to identifying potential brownfield sites and evaluating the prioritisation of their redevelopment that takes into consideration context particularities, and with the absence of participative approaches that include the local community in the decision-making regarding these spaces, city planners fail to include the increasingly growing number of brownfield site that proliferate their cities in the urban planning practice.

Through the examination of literature discussions on objectives, approaches, classification systems, methodologies, assessment and evaluation tools for the support of design and prioritising decisions for brownfield regeneration in different contexts, and through looking at the numerous potential alternatives for brownfield sites regeneration these contexts highlight, this paper bids to emphasise the importance of developing context specific, localised tools tailored for the Middle Eastern case.

Building on the above, this paper identifies five potential brownfield typologies in the context of Amman; (1) residual planning outcomes; (2) discontinued mines and quarries; (3) unfinished mega-projects; (4) contaminated and hazardous sites, and; (5) miscellaneous abandoned sites and buildings, and ends on the note that looking at the increasing demand to meeting smart growth and sustainability needs, these urban landscapes may function as catalysts for achieving comprehensive sustainable urban regeneration.

Keywords

Brownfield sites; Urban Regeneration; Amman

1. Introduction

1.1. Brownfield sites regeneration potentials

According to Doick, Sellers, Castan-Broto, and Silverthorne (Doick, Sellers, Castan-Broto, & Silverthorne, 2009a), numerous European governments place strong emphasis on integrated land use policies including the re-establishment of public open green spaces through brownfield regeneration, in their research on understanding success in the context of brownfield greening projects, they highlight that the UK government considers the regeneration of brownfield sites as a prime tool for delivering regional economic regeneration in addition to neighbourhood renewal as well as international biodiversity commitments. However, they stress that, the lack of monitoring and evaluation —combined with insufficient supporting revenue funds— results in failure to highlight site issues, challenges in local emphasis and ultimately lack of success with respect to project aims and site sustainability.

Atkinson, Doick, Burningham, and France (Atkinson, Doick, Burningham, & France, 2014) support this argument and add that brownfield regeneration to green spaces in particular, has been used to help reverse social and environmental decline in Europe and North America with typical benefits including increased flood retention capacity, temperature regulation, providing habitat for wildlife, community building, encouraging local engagement and providing space for play and recreation. According to them, setting regeneration objectives is important to maximize the benefit from brownfield regeneration at any given location and identifying the objectives of regeneration is crucial to lever the funding required to pump-prime activity.

Kristiánová, Gécová, and Putrová (Kristiánová, Gécová, & Putrová, 2016) also explore the transformation of another specific brownfield typology, old industrial sites, into parks. In their research they argue that the regenerating of former industrial sites into green spaces has numerous benefits including the provision of space for play and recreation in urban environments; enhancing the scenic beauty and neighbourhood appeal; improving the health of urban environments; raising property values; the provision of ecosystem services; habitats for wildlife, in addition to; fostering adaptation for climate change.

Moreover, in their research on renewable energy potential on brownfield sites in the city of Michigan, Adelaja, Shaw, Beyea, and McKeown (Adelaja, Shaw, Beyea, & McKeown, 2010) for example suggest that with the increasing demand to replacing conventional energy sources with renewable energy, brownfields make potential landscapes to intensify renewable energy generation especially that they have relaxed constrains such as ownership, land use or zoning regulations. Hartmann, Török, Börcsök, and Groma (Hartmann, Török, Börcsök, & Groma, 2014) support the brownfield regeneration for energy generating purposes argument by presenting a multi-objective examination and evaluation method which provides a basis for the business analysis of an energy purpose brownfield regeneration project.

Understood as the " ... intended temporary or final re-use of brownfield sites which are not based on built constructions or infrastructure ('hard' re-use)" (Bardos et al., 2015), Bardos et al. describe that the 'soft re-use' of brownfield sites including the creation of public open and green spaces has not been easy to demonstrate in strictly financial terms. Accordingly, in their research on optimising value from the soft re-use of brownfield sites, through suggesting a 'Brownfield opportunity matrix', they propose a value based approach to identify and optimize services provided by the restoration of brownfields to soft re-uses, on a permanent or temporary basis, and explore the links between soft re-use of brownfield sites and sustainability.

This notion of temporary use has been increasingly linked to brownfield regeneration and where weak planning was often blamed for failed regeneration attempts, successful examples of tactical non-planned temporary interventions have introduced effective models to approaching brownfield sites and thus became an important area to be considered in brownfield regeneration attempts. In their research on creative interventions in dynamic cities, Rall and Haase (Rall & Haase, 2011) for example explore a variety of temporary use projects in recently demolished

brownfields using a triangular integrated evaluation method combining indicator-generated and questionnaires with experts interviews. Their research results indicate that these uses have been more popular and have greater usage rate, however, they conclude that public acceptance for such interventions can be strengthened with more seating, punitive measures for property owners and increased communication about the method and it's potential as a planning tool.

1.2. Brownfield categorisation, typifying and prioritising

The debate on brownfield categorisation and typifying has also been little researched. Considering the ambiguity of the definition that includes a variety of potential interpretations which is often considered as a major setback to understanding the variety of brownfield sites types and ultimately contributing to hindering their regeneration to begin with.

Researchers such as Loures and Vaz (Loures & Vaz, 2018) have also shed light on this dilemma. In their research on exploring expert perceptions towards brownfield redevelopment benefits according to their typology, they argue that understanding brownfield characteristics and different typologies, between abandoned land, contaminated land, derelict land, underulitised land or vacant land, has a strong emphasis on achieving consistency that enables the creation of new methodologies and frameworks to deal with the redevelopment of these spaces.

Identifying the specific brownfield typologies they conclude has a great impact on realizing each site's potentials and result in more benefits on the different dimensions including the economy, community, ecology and health, moreover, they conclude that knowing the exact brownfield typology and the exact dimensions each has positive impacts on may aid designers, planners and decision makers make better informed designs and prioritising.

In addition to categorising and typifying, prioritising brownfield sites has also been problematic and literature discussions highlight its importance to the regeneration process. In fact, Limasset et al. (Limasset et al., 2018) identify five Points that need to be taken into consideration when designing tools for regional brownfields prioritisation including: (1) assessing end-user needs and orientation discussions; (2) availability and quality of the data needed for the brownfield prioritization tool; (3) communication and stakeholder engagement; (4) drivers of regeneration success, and; (5) financing and application costs.

Similarly, Bartke et al. (Bartke et al., 2016) argue that prioritising brownfields for redevelopment in real estate portfolios can contribute to more sustainable regeneration and land management and that numerous factors must be considered for prioritising actions, especially when adhering to principles. Their research suggests several Multiple Criteria Decision Analysis (MCDA) based on lessons learned from literature on success factor, sustainability assessment and MCDA approaches, in addition to the web-based Tailored Improvement of Brownfield Regeneration in Europe (TIMBRE), Timbre Brownfield Prioritisation Tool (TBPT) which they argue facilitates the assessment and prioritisation of a portfolio of sites on the basis of the probability of success and sustainable regeneration or according to individually specific objectives.

Lastly, and prior to identifying brownfield regeneration measures and tools, factors including stakeholders, perceptions, concerns, attitudes and information with regards to brownfield regeneration must also be identified. Rizzo et al. (Rizzo et al., 2015) present a participatory methodology applied in order to develop a system to support the categorisation of the needed information and to support the understanding of which typology of information is the most relevant for the specific categories of stakeholders also in relation with their concerns. The engagement process they present consist of five phases; (1) planning and preparatory work; (2) identification of stakeholder categories; (3) engagement activities (e.g focus groups and workshops); (4) submission of a questionnaire, and; (5) provision of feedback to the involved stakeholder. The results of their research they argue created a knowledge base for the future development of tailored and customised approaches and tools for stakeholders working in the brownfield regeneration field.

1.3. Brownfields regeneration objectives, approaches, measurement and evaluation tools

In 2002, Thomas (Thomas, 2002) developed a decision support tool augmented by Geographic Information System (GIS) that provide access to state, regional, and local geospatial databases; several informational and visualisation tools, and; assumptions useful in providing a better understanding of issues, options and alternatives in redeveloping brownfields for decision makers and policy analysts at all levels of governments to establish urban land use policy and development guidelines that may be applicable to related land use issues in a variety of urban and urbanising settings.

Similarly, one decade later, Chrysochoou et al. (Chrysochoou et al., 2012) developed an indexing scheme to screen large numbers of brownfield sites in wide areas, including municipalities, counties, states, or other types of districts, in order to develop initial planning strategies for fund allocation and redevelopment. Their scheme entailed three dimensions; socioeconomic, smart growth and environmental, each has an index constructed on the basis of location-specific variables irrespective of the target end use. The socioeconomic variables included; population density; property values, and; unemployment. Collectively, these variables demonstrate the potential contribution of brownfield redevelopment on economic growth. The second dimension, smart growth, or liveability index as Chrysochoou et al. describe, was developed on the basis of the U. S Green building Council Leadership in Energy and Environmental Design- Neighbourhood Development (LEED- ND) evaluation scheme, but isolating location-specific features. The third and last dimension, environmental index, incorporated variables that represent the potential sources of contamination (or past use); pathway to exposure (such as soil permeability), and receptors (including zoning, proximity to water bodies, parks, critical habitats, open spaces, wetlands and floodplains).

Schädler, Morio, Bartke, Rohr-Zaenker, and Finkel (Schädler, Morio, Bartke, Rohr-Zaenker, & Finkel, 2011) also introduced an integrated assessment model which evaluates redevelopment options of large contaminated brownfields aiming to support efficient and sustainable regeneration communication between stakeholders. Their assessment tool integrates three pinnacles of brownfield regeneration including: (1) subsurface remediation and site preparation costs; (2) market-oriented economic appraisal, and; (3) the expected contribution of planned future land use to sustainable community and regional development. Their assessment focused on early stages of brownfield redevelopment which, they argue, is characterised with limited data availability and by flexibility in land use planning and development scope. At this stage, their research found that, revealing the consequences of adjustments and alterations in planning options can foster efficiency in communication between involved stakeholders and thereby facilitate the brownfield regeneration process. Their research results indicated that the integrated assessment provides help in the identification of land use options beneficial in both sustainable and economic development.

On the complexity of decision support systems for brownfield sites regeneration, Stezar, Pizzol, Critto, Ozunu,and Marcomini (Stezar, Pizzol, Critto, Ozunu, & Marcomini , 2013) presented a comparison between two Decision Support Systems (DSS)s; the Spatial Analysis and Decision Assistance (SADA), and the Decision Support System for the Re-qualification of Contaminated Sites (DESYRE) with the main objective of showing the benefits of using DSSs to introduce and process data and then to disseminate results to different stakeholders involved in the decision-making process.

Lastly, with regards to brownfield regeneration meeting sustainability demands, in their research on defining the sustainability objectives of brownfield regeneration to green space, Doick, Pediaditi, Moffat, and Hutchings (Doick, Pediaditi, Moffat, & Hutchings, 2009b) identified the objectives that brownfield regeneration projects must meet in order to be considered sustainable. In addition to the proposed standard set of sustainability objectives, their research suggested designing sites to achieve specific functionality using participatory, context specific methods. The ‘pillars of sustainability’, as Doick et al. describe, include economic, social and environmental objectives. The economic objectives include: (1) being economically efficient and self-supporting; (2) providing employment opportunities; (3) promoting local and regional economic regeneration; (4) promoting attractive and functional landscapes, and; (5) promoting social affluence and community prosperity. The social objectives include: (1) encouraging social inclusion and cohesion; (2) promoting health and well-being; (3) providing good accessibility

to green space and local facilities; (4) facilitating education, and; (5) reducing crime and anti-social behaviour. Lastly, the environmental objectives include: (1) minimising the use of un-recycled resources; (2) promoting land, water, soil and air quality; (3) protecting biodiversity and the natural environment, (4) conserving natural and cultural heritage, and (5) combating the impacts of climate change.

1.4. Brownfield regeneration in the international context: lessons learned

The topic of brownfield regeneration is increasingly becoming popular worldwide. In China for example, Chen, Hipel, Kilgour, and Zhu (Chen, Hipel, Kilgour, & Zhu, 2009) present a strategic classification support system for brownfield redevelopment based on two characteristics; brownfield effectiveness and brownfield future needs, the resulting classification, they argue, is of valuable aid to cities and governments as they plan and budget their brownfield regeneration projects.

In another example from the Chinese experience, Zhu, Hipel, Ke, and Chen (Zhu, Hipel, Ke, & Chen, 2015) provide a framework for establishing and optimising an evaluation index system for brownfield redevelopment projects. Their framework involves three steps; (1) the initial design; (2) testing and optimising, and; (3) verification. In the implementation of their project they argue, extensive research has been conducted to ensure the reliability, validity and effectiveness of their evaluation system.

Moreover, and similar to what this paper aims to achieve and from the Chinese experience as well, Cheng, Geertman, Kuffer,and Zhan (Cheng, Geertman, Kuffer, & Zhan, 2011) attempted to identify potential brownfields and establishing priorities for their redevelopment. The identification of potential brownfield sites was done through a four-step system as follows; (1) defining input sites; (2) verifying environmental liability; (3) confirming tax delinquency, and; (4) cross-checking with industrial classification code.

The UK context has also provided extensive research on brownfield regeneration, Burke, Hough, Morgan, Hughes, and Lawrence (Burke, Hough, Morgan, Hughes, & Lawrence, 2015), for example, shed the light on the Leeds area of the West Yorkshire coalfield experience. Their research aims to identifying approaches to inform the re-development of brownfield sites by demonstrating how certain types of publicly available data allow a greater understanding of the interaction between human activity and natural superficial and bedrock geology. If successful, they argue that, this approach can help lessen the impact of delays and increased financial costs caused by unforeseen ground conditions.

The Central and Eastern European context was also grounds for testing brownfield re-use. Alexandrescu, Martinát, Klusáček, and Bartke (Alexandrescu, Martinát, Klusáček, & Bartke, 2014) for example look at the role of the entrepreneurial public sector as actors in brownfield regeneration in the Czech Republic, Poland and Romania. Their research focus on the proactive role the public may play to fostering passive change in the cases of brownfield regeneration whether through mobilising networks or leading by example which, they argue, defines an entrepreneurial path to addressing the regeneration of brownfield sites.

The above mentioned Rizzo et al. (Rizzo et al., 2015)'s research on identifying stakeholders, perceptions, concerns, attitudes and information needed for brownfield regeneration also took place in five European countries, Germany, Italy, Romania, Czech and Poland.

In the Czech Republic case in particular, Martinat et al. (Martinat et al., 2018) argued that the re-use plans for current brownfields are market-demand driven or public sector prioritised and do not always meet the requirements of local residents and visitors. By investigating the range of brownfield re-use options as suggested by the locals and visitors their research found that future brownfield uses including culture, sports and children parks are the most popular. Their research highlights gender as a fundamental overlooked factor to deciding future brownfield end uses as where women were inclined towards the previously mentioned uses, men were more interested in industry oriented end uses.

Osman, Frantál, Klusáček, Kunc, Martinát (Osman, Frantál, Klusáček, Kunc, & Martinát, 2015) studied the factors affecting brownfield regeneration in post-societal spaces also in the Czech Republic case. Their research was based

on two sets of data, one was the database of existing brownfields provided by the national CzechInvest agency, while the other was the database for successfully regenerated brownfields compiled by the authors themselves. The main types of functional transformation of space were identified and the factors that appeared to be significant determinants of brownfields regeneration were classified as the result.

Also, from the Czech Republic experience, on their research exploring the spatial patterns of urban brownfield regeneration in the case of Brno, Czech Republic, Frantal et al. (Frantal et al., 2015) challenge the assumption that 'the closer to the city centre, the better'. Their research results highlights that instead, regeneration seemed to be a function of local development potential, local occupier-demand for specific utilities, and planning regulation. Their research found that higher rates of regeneration have been detected in densely built-up areas (including inner city zones and housing estates), while lower rates are registered for areas with low population density and with a greater supply of green spaces (including garden colonies, green spaces, industrial zones and villa residential districts). Frantal et al. end on the note that the spatial location of brownfield sites has a considerable effect on potential investor decisions and brownfield regeneration.

Other examples from the European context include the above mentioned Stezar et al. (Stezar et al., 2013) comparative DSSs study which took place in Romania; Rall and Haase's (Rall & Haase, 2011) temporary use interventions in brownfield sites which took place in Germany; Kristiánová, et al.'s (Kristiánová, et al, 2016) research on the potentials for transforming old industrial sites into parks which took place in the city of Bratislava, the capital of Slovakia; Hartmann et al.'s (Hartmann et al., 2014) multi-objective method for energy purpose redevelopment of brownfield sites which took place in Hungary, in addition to; Bartke et al.'s (Bartke et al., 2016) research on TBPT which also took place in Germany, Czech Republic and Romania.

In spite of the aforementioned, on the regional scale, little research has been done on the topic of brownfields. In fact Abd Elrahman (Abd Elrahman, 2016) points out that, similar to the case of Jordan, brownfield sites in Egypt undergo independent attempts for development with no identified comprehensive approach. He argues that different state governments identify a variety of redevelopment potentials while others restrict the development to particular uses in order to minimise exposure to leftover contaminants on-site. His research identifies the numerous benefits of brownfield regeneration, yet he ends on the note that the success of such sites redevelopment heavily depends on their successful space utilisation.

1.5. Brownfields stakeholders and public participation

The lack of participative approaches in decision-making with regards to urban redevelopment in general and brownfield regeneration in specific was also not a problem exclusive to the study case. In fact, in his research on the public versus expert perspectives towards the benefits and barriers of the reuse of post-industrial sites in urban areas, Loures (Loures, 2015) highlights that post-industrial sites planning and redevelopment are increasingly becoming less the result of design and more the expression of economic and socio-cultural factors, and that designers tend to be primarily focused on aesthetics leaving society's other main goals to secondary status.

His research findings demonstrate that while the general public considers the biological, chemical and physical contamination impacts, liability and clean up to be the main barriers to post-industrial site development, experts look at the high redevelopment costs and the challenges to obtain financial support. Furthermore, while the general public consider the creation of open green spaces and the creation of jobs their main priority, experts were more considered with reducing urban sprawl and encouraging recreation and connectivity.

Although this paper stresses the importance of having measures and tools for the support of brownfield regeneration, it equally emphasise the importance of having specifically tailored tools for the variety of brownfield types in the study context. Similarly, Bartke and Schwarze (Bartke & Schwarze, 2015) argue that when it comes to brownfield regeneration and achieving sustainability, there is 'no perfect tool' that provides a 'one size fits all' solution. They highlight that although certain general principles have been proposed for the evaluation of brownfield sustainable development, the practical application for Sustainability Assessment Tools (SAT's) remains contingent

on the actual requirements of tool users, e.g planners or investors, to pick up such instruments in actual decision-making. Moreover, and more relevant to the idea of public participation this paper bids to highlight, they conclude that there are no perfect tools for brownfield regeneration and that in order to be meaningful, the user requirements of decision makers including the general public must take precedence in the design of SAT's.

Numerous studies have recognised the importance of stakeholder involvement in brownfield regeneration with a special emphasis on public participation including the previously mentioned Rizzo et al. (Rizzo et al., 2015) and Alexandrescu et al. (Alexandrescu et al., 2014). Buchecker, Hunziker, & Kienast (Buchecker, Hunziker, & Kienast, 2003) for example explored the social barriers associated to participative landscape development almost fifteen years ago today which they argue are mainly connected with the pressure to adopt collective standards and called for the need to embrace new communication instruments and concluded that fostering a participative landscape development requires a long-term learning process. Similarly, Valencia-Sandoval, Flanders, and Kozak (Valencia-Sandoval, Flanders, & Kozak, 2010) argued that in the lack of relevant resource data at appreciate scales to develop community plans, community engagement through the use of participative landscape development may be an effective mean of informing and impacting local policy related to sustainable community development.

García-Martín, Bieling, Hart, and Plieninger (García-Martín, Bieling, Hart, & Plieninger, 2016) also argue that in order to achieve a holistic approach to landscape management, the involvement and coordination between different sectors and stakeholders at many levels must be included. Similarly, through looking at the scope, representativeness, timing, comfort and convenience for five public participation in landscape development experiences, Eitar and Vik (Eitar & Vik, 2016), identify ten methods that contribute to increase their evaluation criteria thus underline the importance of combining methods to achieve effective participation within the restricted frameworks of concrete spatial planning processes.

The shifting focus from traditional top-down to bottom-up and integrated approaches through involving participation of local stakeholders has also been brought up in the work of Sevenant and Antrop (Sevenant & Antrop, 2010) as they explored ways to involve 'the local people' in an attempt to grasp their aspiration with regards to the landscape features of their surroundings. Lastly, the final example on public participation this paper highlights is Dramstad and Fjellstad (Fjellstad, 2011) research towards bridging the gap between science, policy and people where they reflect on the applications of landscape research and the issue of communicating scientific findings to policy, management, landowners and the general public.

2. Methods

This paper is an extension to previous research conducted for the author's doctoral thesis and identifies as a qualitative study thus implements qualitative approaches including observation, focus groups and semi-structured interviews.

The study targeted five groups of participants; (1) locals of Amman; (2) Non Governmental Organisations (NGO)'s projects and initiatives; (3) city authorities represented by Greater Amman Municipality (GAM) with its various departments including Geographic Information System (GIS)department, the Comprehensive Master Plan (CMP) department, the regulation department, the legal department, the planning and studies department, the building supervision department, the Private Sector Projects (PSP) department, the Environmental Follow Up (EFU) department, the Social Programs and Activities (SPA) department. In addition to ministries such as the Ministry of Environment (MoE) including the nature protection directorate, Sustainable Management of Land Use (SMLU) section; the monitoring and assessment directorate –including the environmental monitoring section and the State of the Environment and Environmental Indicators(SEEI) section—; the environmental inspection directorate –including the environmental inspection section and the Emergency Management and Environmental Control (EMEC)section—; the Waste Management and Hazardous Substances (WMHS) directorate–including the Solid Waste Management (SWM) section, the Hazardous Waste Management (HWM) section and the dump site division—; the Licensing and Pollution Prevention directorate (LPP) –including the environmental licensing section and the Environmental

Impact Assessment (EIA)section—. The Ministry of Planning and International Cooperation (MoP) including the policies and strategies department –including the national economy section, the sustainable development section, and social studies section—; the projects department –including the Services and Investment Infrastructure Affairs (SIIA) unit—; the Developmental Plans and Program (DPP) department; the Local Development and Enhanced Productivity Programs (LDEPP) department –including the civil society institutions section—. In addition to the Natural Resources Authority(NRA) including the mines and quarries directorate –including the licensing section; the Inspection, Monitoring and Quality Control (IMQC) section; the technical studies section and the follow-up section; the geographic information section at the information directorate. In addition to the Department of Land and Survey (DLS) and the Land Registration Office (LRO); (4) urban planning professionals including the academic and the private sector, and; (5) miscellaneous bodies associated to the research problem including private investors and estate developers in addition to environmental and legal consultants.

3. Potential identified brownfield typologies in Amman

Looking at the previously identified Thomas (Thomas, 2002) GIS-based decision support system for brownfield redevelopment; Chrysochoou et al.'s (Chrysochoou et al., 2012) GIS indexing scheme; Bardos et al. (Bardos et al., 2016) value based approach; Bartke and Schwarze (Bartke & Schwarze, 2015) stylised SATs' approaches; Hartmann et al. (Hartmann et al., 2014) multi-objective examination and evaluation method; Limasset et al. (Limasset et al., 2018) points of attention for brownfield regeneration tools development; Zhu et al. (Zhu et al., 2015) evaluation index system for brownfield redevelopment projects; Millar, Simeone, and Carnevale (Millar, Simeone, & Carnevale, 2001) logic model found in both Atkinson et al. (Atkinson et al., 2014) and Doick et al. (Doick et al., 2009a), and; Pediaditi, Doick, and Moffat (Pediaditi, Doick, & Moffat, 2010) 'ideal' brownfield sustainability monitoring and evaluation tool criteria, and without necessarily specifying a single framework, this paper identifies five potential brownfield typologies found in the city of Amman.

3.1. Residual planning outcomes

The urban planning of Amman underwent— and is until this day still undergoing— several attempts to regulate the city which were influenced historically by the early Ottoman occupation followed by the British rule and more recently with contemporary global trends. That in addition to population growth and the advancement of transportation and the resulting introduction of paved roads and motorised vehicles had a large impact on the urban plan of the city.

As a result of these changes, marginal spaces which are the foci of this potential brownfield typology emerged. According to this research findings, the definition of brownfields partially applies to three types of urban landscapes found throughout the city of Amman; the *Fadlih* (English: land leftover); the *Nutfih* (English: land bit), and; the *Arasah* (English: No known translation, but roughly equivalent to intermediate space between properties). The definition also applies to a fourth type called *Bour* (English: unfit for cultivation), however, this type was not taken into consideration as the definition implies it identifies as a rural brownfield where this research is solely investigating urban brownfields.

To further elaborate, a *Fadlih* which when taken back to its root word and according to the Arabic dictionary translates into: "what remains from something" (Almaany Arabic Dictionary, 2018) and in the planning practice in Amman refers to the piece of land which results from the opening of a street. Note at the figure below, the red line represents the right of way, the leftover piece of land which resulted from the intersection of the right of way or legal quarter—-understood as the up to 25% of any private-own land the government is allowed to acquire in order to provide public infrastructure including street opening—- line and the property outline would be the *Fadlih* (outlined in the red circle).

In most cases, the resulting shape is irregular and too small for the building regulations to apply on (i.e. setbacks

and building percentages) therefore remains vacant and neglected.

Figure 1. Land leftover land-use map. Source: GAM- GIS for the author (2016).

Figure 2. Land leftover land-use over aerial view map. Source: GAM- GIS for the author (2016).

On the other hand, a *Nutfih* which when taken back to its root word and according to the Arabic dictionary translates into: "little of something" (Almaany Arabic Dictionary, 2018) and in the planning practice in Amman refers to the remaining land bit which results from the division or regulation of a previously owned land parcel. The *Nutfih* is also often irregular in shape and too small for the building regulations to apply on. Note at the figure below the *Nutfih*'s outlined in blue, unlike the *Fadlih*'s, *Nutfih*'s are given separate lot numbers, also note *Nutfih*'s are given the same land use (residential D in the case demonstrated) and are given special regulations such as lower prices, less setback requirements or increased building percentages to encourage adjacent landowner(s) to buy them.

Figure 3. Land bit land-use map. Source: GAM- GIS for the author (2016).

Figure 4. Land bit land-use over aerial view map. Source: GAM- GIS for the author (2016).

The third and last marginal planning outcome, the *Arasah* which when taken back to its root word and according to the Arabic dictionary translates into: "the wide space between properties where there is no building" (Al-maany Arabic Dictionary, 2018) and in the planning practice in Amman refers to the land area found between two neighbouring parcels or two constructions in two adjoining parcels. No map was provided for this type as it was undetectable on the GAM GIS maps due to the setbacks and regulations to each land-use.

Interestingly, unlike the *Fadlih* and *Nutfih*, the term *Arasah* was found in regional planning regulations in Jordan in addition to neighbouring countries such as Syria and Saudi Arabia.

Landlord and tenants law no. (11) for the year 1994 amended by the law no. 2000/30 and law no. 2009/17 and law no. 2010/43 and amended law no. (22) for the year 2011 and law no. (14) for the year 2014 (DLS, 2014) states that; (A) for the owner of a rented Arasah for any purpose the right to clear it provided the following two conditions apply; (1) the tenants issued a legal building license; (2) that the owner has notified the tenant(s) through the notary not less than two months in advance. The tenant(s) afterwards have no right to return to the previously rented property and is only entitled to a compensation estimated by the concerned court. (B) If there exists any construction that the tenant(s) got permission from the landlord to build on the *Arasah* to be cleared — excluding kiosks, security rooms or the similar— they are not allowed to be removed unless they have been erect no less than ten years.

From another legal point of view regarding the *Fadlih* and *Nutfih*, the property law, article (173) states that unless within the legal quarter, a property owner is compensated for the complete value of the land if the street right of way

deducts the whole property or leaves a *Fadlih* or *Nutfih* invalid for construction or use which in this case becomes property of the municipality (DLS, 2015). In line with this law, the municipality currently owns abundant similar urban landscapes which are unfit for traditional use and construction which is problematic not only as these sites seize to participate in the economic growth, but also became an extra burden on the governmental authorities as they are already serviced with infrastructure and road network for example but fail to generate revenue to balance the acquired services.

Moreover, the *Fadlih* and *Nutfih* are also problematic to potential property owners for a variety of reasons, at least the two revealed through the investigations for this research, firstly, according to local participants and confirmed by local news, several incidents where buyers would forcibly buy the *Fadlih* or *Nutfih* as a prerequisite to buy the adjacent property were reported and published in local newspapers (Al-Said, 2015). According to Rum News Agency, the reported case is currently under investigation at the complaints department of the Board of Grievances (ibid), moreover, according to the locals statements, this is a recurring situation that often goes unnoticed due to the marginal difference to the property size that the buyer pays for unknowingly. Secondly, there are *Fadlih* and *Nutfih* hunters that buy these pieces of land as part of a deceptive scheme, the hunters are interested in *Fadlih* and *Nutfih* for two main reasons, firstly as mentioned earlier, they are often given special regulations and special prices therefore are more affordable, secondly, due to their location between the property and street especially adjacent to un-owned land, the hunters wait until the adjacent property is purchased and occupied to start a series of unpleasant activities such as piling waste or limiting street access which would force the new owner to either buy the *Fadlih* or *Nutfih* for a price much higher than the hunter bought it for or sell their own new property for a price much cheaper than what they bought it for.

Below are few images of *Fadlih*'s, *Nutfih*'s and *Arasah*'s scattered throughout the city. Note their deteriorated physical conditions.

Figure 5. Examples of *Fadlih*'s, *Nutfih's* and *Arasah*'s_1. Source: Author (2015)

Figure 6. Examples of *Fadlih*'s, *Nutfih*'s and *Arasah*'s_2. Source: Author (2015)

Figure 7. Examples of *Fadlih*'s, *Nutfih*'s and *Arasah*'s_3. Source: Author (2015)

Figure 8. Examples of *Fadlih*'s, *Nutfih*'s and *Arasah*'s_4. Source: Author (2015)

3.2. Discontinued mines and quarries

With the enactment of the Small Business Relief and Brownfield Revitalisation Act (also known as the 'brownfield law'), the definition of brownfields was expanded to include mine-scarred lands making these properties eligible for the benefits of the brownfields program. The Environmental Protection Agency (EPA) defines mine-scarred lands as "lands, associated waters, and surrounding water sheds where extraction, beneficiation (crushing or separating), or processing of ores and minerals (including coal) has occurred" (EPA, 2004).

According to EPA (EPA, 2005), mine sites have a variety of potential uses and their post-mining clean-up for redevelopment provides an opportunity to turn them into lands that have beneficial uses. However, similar to the situation in Jordan, complex economic, social and environmental issue face communities planning to redevelop them including finding resources to characterize and remediate sites with potential significant environmental issues; addressing state and local regulatory requirements, and; working through redevelopment issues with the local community and stakeholders.

To help address these challenges, the EPA through its Brownfield and Land Revitalisation Technology Support Centre, prepared a primer on Mine Site Clean-up for Brownfield Redevelopment which this study suggests adopting to provide information about the clean-up aspect of mine site redevelopment, including new and innovative approaches to more efficiently characterise and clean up those sites. The use of these approaches to streamline characterization and remediation of mine sites offers the potential for redevelopment at a lower cost and within a shorter time frame (ibid).

Meanwhile, in terms of the guidelines for rehabilitating mined and quarried land in Jordan, the management of mines and quarries post-activity in Jordan is extremely modest. The environmental impact assessment does not exceed the role of being a formality or a routine procedure, and despite having environmental rehabilitation guide-

lines, the mine/quarry owners prefers to pay the very little bail condition of half a Jordanian Dinar per meter square of waste.

The lack of follow up is also increasing the problem, according to research findings, in one case for example, where the owner declared they were going with the forestation option, however, the foundation rubble used to fill the site was not corresponding to the required specifications which resulted in landslides that affected the adjacent streets and constructions.

In another case, the site was rehabilitated for recreational purposes, however, after few years, the owner filed to change the land use from industrial into residential D and after providing the required documents and studies to the interested parties, the soil test showed the site is not suitable for traditional construction, despite that, the owner eventually attained the residential D land use change permission provided special building techniques are used. Unfortunately, the site was sold and construction commenced using traditional methods which led to the collapse of large parts of the site in addition to the new established construction.

See below examples of a discontinued quarry which when established was located outside the boundaries of the Amman, however, due to urbanisation and urban sprawl has become part of the city boundaries. The surrounding neighbourhoods are endangered of landslides and suffer from constant dust which is causing severe pulmonary problems especially to elderly and children whom are also endangered of falling into the steep cliffs, yet, nothing is being done about this according to the statements of the local area residents.

Figure 9. Quarry site within the urban setting in Amman. Source: author (2015)

Note at the figure below a quarry site discontinued since the early 2000s, located within an urban setting and has been given a green space land use as the post-mining end use. Today, more than a decade post its closure, the site still awaits treatment.

Figure 10. Discontinued quarry site aerial view map. Source: GAM- GIS for the author (2016).

Figure 11. Discontinued quarry site land use map. Source: GAM- GIS for the author (2016).

Figure 12. Discontinued quarry site land use over aerial view map. Source: GAM- GIS for the author (2016).

End land use in the mining industry is increasingly becoming a key consideration guiding the rehabilitation and closure planning and the need to develop comprehensive land use plan prior to conceptualising closure objectives and associated rehabilitation measures is also gaining momentum. Towards reinstating post-mining land capabilities to the pre-mining landscape and towards ensuring that mining operations consider ways of reinstating functional end land use that passively contribute towards the future biophysical and societal demands of people living in Amman or in proximity to the disturbed environment, mine closure planning (Kotze, 2013) which the study argues is missing in Amman must be considered, a mine closure planning that provides broad future land use objective(s) for the site, and a plan that describes the final and future land use proposals and arrangements (MPRDA, 2013).

3.3. Unfinished mega-projects

The economic boom in the early 2000s had considerable effects on the urban transformation of Amman. Large-scale property development ventures poured into the country and novelty planning methods such as gated communities and high-rise skyscrapers were introduced to the urban fabric of the city. Similar patterns of urban change emerged in neighbouring countries such as Beirut, Cairo, Dubai, Qatar and Damascus –prior to the Syrian crisis— (Daher, 2013), thus, this section focuses on a typology which is the manifestation of a particular outcome of the economic thrive and shortly following crisis in the context of Amman.

The socio-economic and political characteristics of Amman encouraged foreign investors to extensively operate in

it. Consequently, numerous oil capital projects from Arab Gulf countries mushroomed throughout the city. The term 'Arab Megaproject' was first introduced by Barthel (Barthel, 2010) to describe large-scale real estate development which he considered as vectors of contemporary Arab town planning and the circulated images of the back then proposals for the majority of mega projects in Amman mimicked images of similar western development projects (Adham, 2005). Moreover, the projects promised the provision of better services for the area; creating a competitive business environment that supports start-ups and entrepreneurs, and; create first-class tourism attractions.

However, in addition to other identified effects of the 'cutting-edge urbanism' (Daher, 2011) in Amman such as the excessive privatisation; the abrupt increase in property values; the pressure on the already struggling infrastructure system including transportation, water and power supply; the circulation obstructing urban flagship projects created, as well as; the social impacts such as emphasising the already apparent urban segregation through the promise to create a lifestyle that accommodates the contemporary needs for the elite in the centre of Amman and pushing lower-income groups to the city peripheries (Daher, 2013). This study therefore identifies another potential brownfield typology which is abandoned unfinished mega projects structures.

In order to keep up with the rapid change, benefit from what seemed to be an exceptional opportunity and compete with neighbouring countries to attract potential investments, poorly- planned extreme measures were implemented. For example, to speed the process, in many cases building permissions were obtained without the provision of all necessary documents such as soil tests, drainage analysis or environmental impact assessment. Moreover, the proposed projects were given abundant facilitations such as minimal—to none—setback requirements, additional floors, higher building percentages, and less open/ green space requirements, facilitations that according research findings, GAM today regrets. The following paragraphs demonstrate three controversial unfinished mega projects in Amman.

3.3.1. The Jordan Gate (Amman Gate) project

The Jordan Gate (also referred to as the Amman Gate) project which belongs to Bahraini- Kuwaiti developers for example commenced in 2005, has been suspended in 2009 post the global economic crisis and until this day remains on pause. The project faced two main accidents during its construction, a fire and collapse incident when fire broke in the eighth floor of the North tower in August 2006, fortunately, nobody was injured, however, one month later in September 2006, three floors of the same tower collapsed killing four workers and injuring 15 (Kheetan, 2009). In the second incident, a crane collapsed in May 2009 after being overloaded. Weighing 30 tons and hanging 200 meters high, the falling crane injured one Egyptian worker, moreover, for the following three days, residents living near the collapse area were evacuated to nearby hotels (Jordan Times, 2009). Another added complexity to the project is that according to research findings, the shorter tower was supposed to become a high-end brand hotel, however, in light of the lengthy halt and completion date uncertainty, the company withdrew their investment which put the project at a serious financial dilemma. Note below the figure for the project proposal versus the actual situation.

Figure 13. Jordan Gate (Amman Gate) project proposal. Source: Skyscrapercity.com (2006)

Figure 14. The current situation of the Jordan Gate (Amman Gate) project. Source: Jordan Times (2016)

The site was previously a public park which the children, youth and elderly of the area today much miss. Moreover, the project sits in a very vital area in Amman where circulation is already congested and the addition of the towers created a bottleneck affect which adds to the traffic jam.

According to the Jordan Times (Namrouqa, 2016), the $400 million project was supposed to commence within days of signing an agreement between GAM and the involved stakeholders in May 2016 with a new completion due date in 2018, no further data was obtained.

3.3.2. Sanaya Amman (Limitless towers) project

The second example for derelict mega projects this study looks at is the Sanaya Amman (also known as Limitless towers). Located in Wadi Abdoun, also commenced in the year 2005, however, their constructions stopped post the excavation phase leaving the site with 20+ meter deep hole. With a vision to become the largest Human Capital and Talent Management in the Middle East and North Africa (MENA) region (Sanaya.net, 2006), the venture is currently postponed due to current market conditions (Limitless.com, 2016).

See below the proposal renders versus the current situation of the project site.

Figure 15. Sanaya Amman (Limitless towers) proposal render. Source; Consolidated Consultants (2014)

Figure 16. Sanaya Amman (Limitless towers) hole in 2009. Source: Project: Manifesto, Holes on hold competition, Maiss El-Razem (2011)

Although the latter image has been captured in 2009, it still reflects the current conditions of the site, moreover, this image was selected specifically as it explains the circumstances where a 10-years-old boy who was playing in rain water which created a deep pool in the site and drowned and, sadly, passed away. No news was published on the accident, however, the local children commemorated their friend Mus'ab on the strips of metal sheets surrounding the site (see below image. The text reads: May your soul rest in peace Mus'ab). Post Mus'ab's accident, the hole was filled with sand and gravel. See figures below.

Figure 17. May your soul rest in peace Mus'ab, Sanaya Amman (Limitless towers) project. Source: The Living Voids thesis. Amr, Mazahreh and Muhtaseb. UJ (2011)

Figure 18. Sanaya Amman (Limitless towers) hole post filling it with sand and gravel. Source: Project: Manifesto, Holes on hold competition (2011)

According to the head of the SPS department, the project failed due to the lack of preliminary studies, the site is located in Wadi Abdoun, and as the name suggests, the Wadi (English for valley), is below street level from one side, therefore, excavations were impossible unless drainage is taken care of as it was surely to collect rain water which was exactly what happened.

3.3.3. The Living Wall project

The third and last example of derelict unfinished mega projects this study investigates in the city of Amman is the Living Wall project, a 134,000 meter-square mixed-use complex which also commenced in 2006 but put on hold midst construction. See below images of the design proposal and current situation.

Figure 19. The Living Wall design proposal. Foster+ Partners (2006)

Figure 20. The current situation of the Living Wall project site. Source: Project: Manifesto, Holes on hold competition (2011)

According to the head of the SPS department, unfinished projects including the living wall are, in addition to being failed and have already cost the government millions of Jordanian dinars, a burden to the government. They are hazardous to the surrounding neighbourhoods and are threatening the adjacent street networks, moreover, are a waste of land and building materials. Therefore, as a desperate measure, the government is providing further facilitations for investors to redevelop such projects. Regarding the Living Wall project in specific, in addition to the extra facilitations, a land-use alteration is being considered for a Saudi investor who is interested in the project under his condition to develop it into a hospital although less than few hundred meters away, the building marked in the red circle is Jordan's hospital. This would violate the Jordanian building regulation medical services buffer area guidelines, yet, the offer is still being discussed and might eventually be considered.

3.4. Contaminated and hazardous sites

Under the general brownfield definition, contaminated and hazardous sites are widely recognised. Similarly, in Jordan, there are numerous types of sites that identify as contaminated or hazardous. However, through the conduct

of the study, the following three types were the most prominent.

3.4.1. Near historical and archaeological sites

In Amman as in other Jordanian cities, many historical and archaeological sites are integrated within the urban fabric. According to GAM officials, land parcels that are immediately adjacent to historical or archaeological sites within the urban city are referred to as prohibited areas, prohibited in the sense that no construction or development is allowed in these sites. The areas are often deteriorated due to neglect and abandonment, GAM officials note that although the land use codes and building regulations do not allow for construction in those areas, their redevelopment as public spaces or through using temporary structures is a favoured idea. See below example of a prohibited site near Amman citadel (Arabic: *Jabal Amman*) in Downtown Amman. Note the hatched in brown diagonal lines area surrounding the historical site.

Figure 21. Prohibited area site aerial view map. Source: GAM- GIS for the author (2016).

Figure 22. Prohibited area site land use map. Source: GAM- GIS for the author (2016).

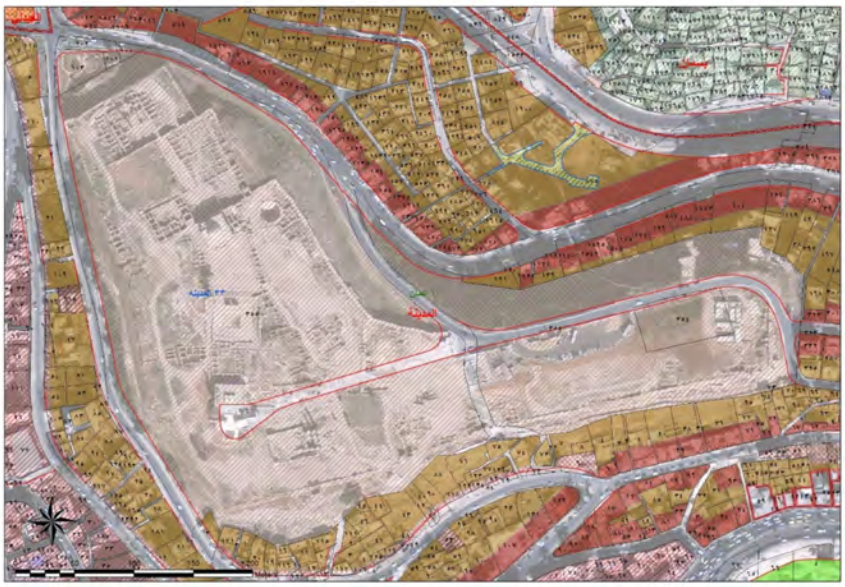

Figure 23. Prohibited area site land use over aerial view map. Source: GAM- GIS for the author (2016).

3.4.2. Landfills and scrap yards

Often located at the outskirts of the city, landfills and scrap yard sites in many cases become part of the city during its expansion. According to the head of CMP department and as the example below demonstrates, similar sites are often located outside the boundaries of the municipality regulation, therefore, remain out of its control. However, as the example below also demonstrates, the new regulation aims to remove such sites down the line –transformed into a highway in the example below and highlighted in the red circle–.

The situation is often problematic as the residents of the area and the occupants of scrap sites would have already constructed dwellings or established workshops or garages in the area and according to officers' statements, are not very collaborative and are often aggressive.

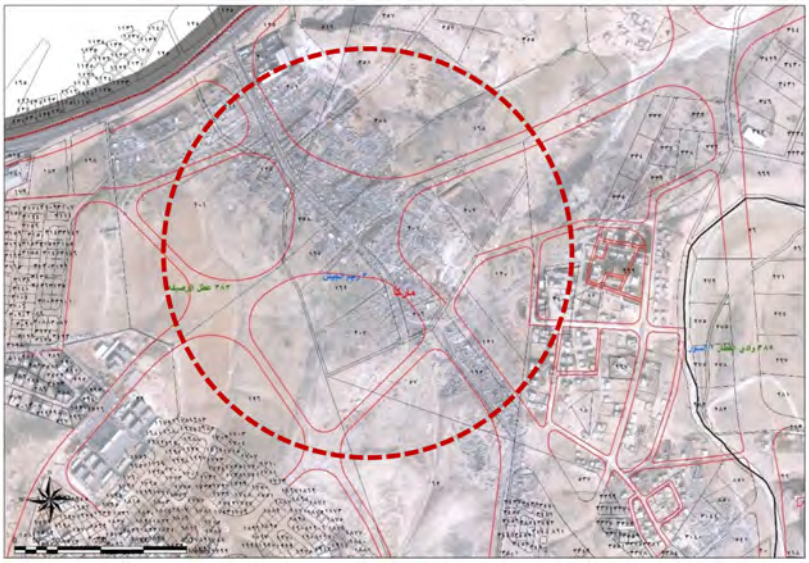

Figure 24. Scrap yard site aerial view map. Source: GAM- GIS for the author (2016).

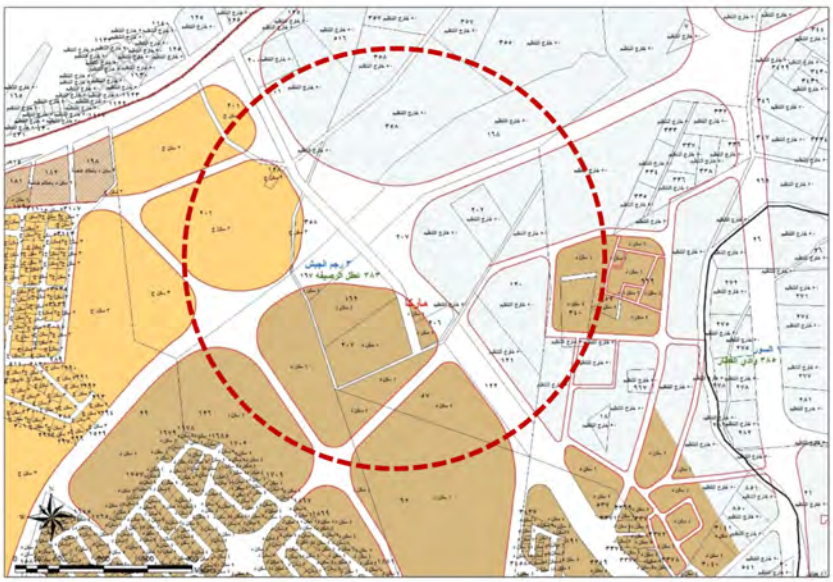

Figure 25. Scrap yard site land use map. Source: GAM- GIS for the author (2016).

Figure 26. Scrap yard site land use over aerial view map. Source: GAM- GIS for the author (2016).

3.4.3. Near high voltage electrical lines and towers

Another typology that falls under the contaminated and hazardous sites category and suggested by the head of the CMP department was the land parcels located adjacent to high voltage towers and along the strip parallel to the electrical line between the towers. Such properties are given special regulations, for example, the prices are extremely cheap, the setback requirements are reduced and the building percentages are higher, however, constructions are only allowed to be one floor high –in order not to affect or get affected by the electric current—. According to the statement of a local family in one near high voltage tower neighbourhood, living near the tower caused the father of the family to suffer from cardiac problems, he currently has a pacemaker, moreover, the house in addition to neighbours' houses suffer from electrical current inconsistency which ruined many of their electrical devices. See at the example below, high voltage towers are circled in red (note their shadows).

Figure 27. Near high voltage site aerial view map. Source: GAM- GIS for the author (2016).

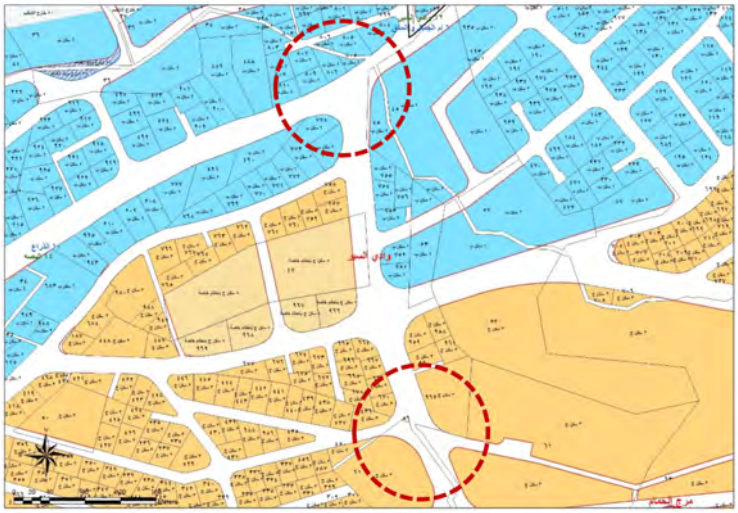

Figure 28. Near high voltage site land use map. Source: GAM- GIS for the author (2016).

Figure 29. Near high voltage site land use over aerial view map. Source: GAM- GIS for the author (2016).

In general, in terms of the contaminated and hazardous sites potential brownfield typology, much of the investi-

gations yielded in no significant results. For example, interviews with the assistant managers of the Waste Management and HazardousSubstances directorate (WMHS) –including the Solid Waste Management (SWM)section, the Hazardous Waste Management (HWM) section and the dump site division at MoE only uncovered the severe lack of a developed waste management method or cleanup strategy, a situation this study also aims to highlight. Moreover, as emphasised earlier, other types of contaminated and hazardous sites exist throughout the country, however, due to the time constraints and limited financial resources, this study was only able to investigate few which it argues will pave the way for broader, more extensive future research to explore the urban phenomenon in more details.

3.5. Miscellaneous abandoned sites and buildings

Whether due to demographic shifts or the constant transformation of the city, abandoned and neglected sites and buildings are dispersed throughout Amman. The following paragraphs shed the light on three famous examples.

3.5.1. The King Abdullah Park

Established in the 1980s as a recreational urban space with an integrated amusement park that includes a variety of rides, cafes and restaurants, outdoor spaces and plazas in addition to a skating rank and a cable car, the park (Arabic: *Hada'eq Al-Malik Abdullah*) was actively thriving in the period 1986-1999 until, according to participants statements, it became known as Amman's "red light district".

While interviewed officials failed to explain what went wrong with this urban space, the statements of local participants attempt to elaborate. One participant for example tells he was a tenant for five shops in King Abdullah Park, however, once infamous shops started opening and extending work hours to post-midnight, sometimes until next morning, families and schools started visiting the park less.

The park was evacuated and shut down completely by GAM in 2012 after shop owners have been warned since 2008. According to JO24 (JO24, 2012), a local news agency, the park has been closed after the four-year verbal notice deadline for shop owners with expired profession licenses and/or violations. Moreover, the news pointed out GAM is seeking alternative rehabilitation and redevelopment options for the 50-acre park which no longer serves the public and has become a disreputable place and a source of disturbance.

Figure 30. King Abdullah abandoned park. Source: City seeker (2016)

3.5.2. The Housing Bank Complex

The second example this study introduces to derelict projects in Amman is its iconic Housing Bank Complex (Arabic: English: *Mujamma' bank Al-Iskan*).

Figure 31. Housing Bank Complex-Amman. Source: photobucket.com (2016)

Established in the early 1980s, the complex consisted of retails shops, offices and restaurants and was thriving until the 1990s. Another phenomenon concerned authorities were not able to explain. According to the head of the CMP, perhaps it was the demographic shifts, the urban transformations of the city or the competing high-end shopping malls mushrooming throughout Amman. However, according to Al-Ghad newspaper (Al-Sheikh, 2011), post an acquisition change to a Libyan investor in 2001, the complex was bought for 11 million Jordanian Dinar which forced tenants to pay higher rents or close their shops considering the new considerably lower profit margin. As a result, the parking has been closed, the building has been stripped from banners and signs or any other indication of life inside the building, the closed shops are used informally as storage units and there was no adequate maintenance to the building in general which was becoming derelict day by day.

In a failed attempt to rehabilitate and revitalise the complex, a 7 million Jordanian Dinar budget was allocated. However, according to a previous tenant, the rehabilitation was limited to surrounding the complex with a fence which made the interior darker and the situation worse. He added that the 7 millions could have fixed the situation, however, the absence of governmental censorship and legal accountability on investors and developers is the reason the redevelopment failed.

There exists numerous other example of derelict, vacant or abandoned sites in Amman, however, as emphasised earlier, due to time constraints and the lack of financial resource, the study will stop at the aforementioned examples. It is important here to note that the study identifies a crucial need for a base-map for the amounts and locations of potential brownfield sites in Amman, in fact, having discussed a mapping project with the head of the GIS department in GAM displayed a genuine interest, however, this remains another potential future research project.

4. Conclusions

In the lack of brownfield databases and adequate information on the locations and conditions of potential brownfield sites in Jordan, and considering the increasing demand on meeting sustainability needs, and with rapid urbanisation whether due to population growth of natural causes or unnatural activities including the surrounding political turmoil and immigration and the resulting refugees infiltrations throughout the city, the demand for smart(er) ways to address contemporary city needs is constantly rising.

Through looking at the abundant research aimed for developing tools, approaches, assessment and evaluation methods that support the decision-making, prioritising, categorisation or typifying of brownfields and brownfield regeneration efforts, this paper highlighted the gap in research discussion in Middle Eastern contexts and accordingly, the urge to develop similar but context specific, tailored tools aimed to addressing the phenomenon in such contexts. It concludes that, supported by almost two decades worth of research today, a focus on the Middle East case is long overdue, and as research on brownfields in Middle Eastern remains insufficient to generate such tools, this paper aims to narrow this gap by presenting a proposed potential brownfield categorisation and typifying aimed to further the understanding of the urban phenomenon, thus, help in the development of these tools. The proposed identified potential brownfields included; (1) residual planning outcomes; (2) discontinued mines and quarries; (3) unfinished mega-projects; (4) contaminated and hazardous sites, and; (5) miscellaneous abandoned sites and buildings.

However, as demonstrated throughout the paper, the development of measurements and tools this paper concludes will not be an easy task, it may entail extensive research on multi dimensions including the socioeconomic, sociocultural, geographic and environmental amongst other, let alone the identification of potential typologies. Therefore, this paper emphasised that further efforts are needed to establish such tools and only suggest the presented types as 'potential identified brownfield sites' in reference to the cases found in the literature discussions with a prominent objective to unpack the rhetoric of these emerging urban landscapes to the different stakeholders and identify what establishes them as potential brownfield sites.

However, it is important here to note that, although this paper presented a proposed potential brownfield categorising and typifying looking at international, mostly Western-specific tools and measures identified in literature discussions, it remains the sole work of the researcher and thus remains liable to subjectiveness and error. Therefore, this paper ends on the note that further interested researchers are invited to the discussion table on brownfield regeneration in an attempt to achieve more inclusive and comprehensive approaches that address this urban phenomenon.

Towards achieving more sustainable and comprehensive urban development, this paper concludes that brownfield regeneration must be put at the top of future development priorities list.

Similar to the global scene, and according to research findings, this paper concludes that these urban landscapes whether a result of post-industry, experimental planning or natural causes have great potentials to diminish the spatial cluttering, socio-spatial disparities and spatial segregation as well as address urbanisation issues and achieve economic and environmental goals. Most popular brownfield regeneration plans in the case of Amman, Jordan this study found may include cultural and recreational uses including public open green spaces, open street markets and temporary spaces that allows emerging economies and entrepreneurs to experiments with their products and services, yet, these links between brownfield regeneration and the notion of temporary use this paper concludes need to be further explored in future research as regardless to the abundant land that may fall under the definition of brownfields, and in the absence of any frameworks that regulate their regeneration, numerous non-planned examples of temporary practices thrive throughout the city and such practices are increasingly generating.

Moreover, with public participation as a decision-making tool not being effective in developing countries contexts including the Middle East, which can lead to failure in regenerating brownfields, this paper highlighted the importance of the role of the general public in the decision-making through embracing participative approaches that equally includes all genders, ages, ethnicities and backgrounds in the debate around these urban landscapes towards achieving more cohesive, inclusive, accessible approaches that ultimately contribute to realising a better quality of life through the manifestation of brownfield sites as catalysts for sustainable urban regeneration.

5. References

1. AbdElrahman, A. S. (2016). Redevelopment Aspects for Brownfields Sites in Egypt. *Procedia Environmental Sciences, Elsevier B.V. 34(December 2015):* 25–35. Available from: http://linkinghub.elsevier.com/retri

eve/pii/S1878029616300251.

2. Adelaja, S., Shaw, J., Beyea, W., & McKeown, J. C. (2010). Renewable energy potential on brownfield sites: A case study of Michigan. *Energy Policy, Elsevier 38(11):* 7021–7030. Available from: http://dx.doi.org/10.1016/j.enpol.2010.07.021.

3. Adham, K. (2005). Globalization, neoliberalism, and new spaces of capital in Cairo. *Traditional Dwellings and Settlements Review 17(1):* 19–32.

4. Al-Said, N. (2015). Amman Municipality violates law and deceives citizens for years. *Rum News Agency*. Available from: http://www.rumonline.net/index.php?page=article&id=199829 (accessed 24 August 2018).

5. Al-Sheikh, G. (2011). Amman Financial Market News — From a place bustling with life to a lifeless structure with no identity— Housing Bank Complex. *Al-Ghad Newspaper*. Available from: http://ammanxchange.com/art.phpid=6a316826734929bac7d4b355f8233bdfb43b8c3f (accessed 24August 2018).

6. Alexandrescu, F., Martinát, S., Klusáček, P., & Bartke, S. (2014). The Path From Passivity Toward Entrepreneurship: Public Sector Actors in Brownfield Regeneration Processes in Central and Eastern Europe. *Organization and Environment 27(2):* 181–201.

7. Almaany Arabic Dictionary. *Almaany.com.* Available from: https://www.almaany.com/ar/dict/ar-ar/Arasah/, (accessed 24 August 2018).

8. Almaany Arabic Dictionary. *Almaany.com.* Available from: https://www.almaany.com/ar/dict/ar-ar/Fadlih/, (accessed 24 August 2018).

9. Almaany Arabic Dictionary. *Almaany.com*. Available from: https://www.almaany.com/ar/dict/ar-ar/Nutfih/, (accessed 24 August 2018).

10. Atkinson, G., Doick, KJ., Burningham, K., & France, C. (2014). Brownfield regeneration to greenspace: Delivery of project objectives for social and environmental gain. *Urban Forestry and Urban Greening, Elsevier GmbH. 13(3):* 586–594. Available from: http://dx.doi.org/10.1016/j.ufug.2013.04.002.

11. Bardos, R., , Jones P., Stephenson S.,Menger I., P., Beumer, V., Neonato, F., ... & Wendler, K. (2016). Optimising value from the soft re-use of brownfield sites. *Science of the Total Environment, Elsevier B.V. 563–564:* 769–782. Available from: http://dx.doi.org/10.1016/j.scitotenv.2015.12.002.

12. Barthel, P. A. (2010). Arab Mega-Projects: Between the Dubai Effect, Global Crisis, Social Mobilization and a Sustainable Shift. *Alexandrine Press 36(2):* 132–145.

13. Bartke, S. & Schwarze, R. (2015). No perfect tools: Trade-offs of sustainability principles and user requirements in designing support tools for land-use decisions between greenfields and brownfields. *Journal of Environmental Management, Elsevier Ltd 153:* 11–24. Available from: http://dx.doi.org/10.1016/j.jenvman.2015.01.040.

14. Bartke, S., Martinát, S., Klusáček, P., Pizzol, L., Alexandrescu, F., Frantál, B., & Zabeo, A. (2016). Targeted selection of brownfields from portfolios for sustainable regeneration: User experiences from five cases testing the Timbre Brownfield Prioritization Tool. *Journal of environmental management*, 184, 94-107.

15. Buchecker, M., Hunziker, M. & Kienast, F. (2003). Participatory landscape development: Overcoming social barriers to public involvement. *Landscape and Urban Planning 64(1–2):* 29–46.

16. Burke, H., Hough, E., Morgan, D. J. R., Hughes, L., & Lawrence, D. J (2015). Land Use Policy Approaches to inform redevelopment of brownfield sites : An example from the Leeds area of the West Yorkshire coalfield , UK. *Land Use Policy, Elsevier Ltd 47:* 321–331. Available from: http://dx.doi.org/10.1016/j.landusepol.2015.04.018.

17. Chen, Y., Hipel, K.W., Kilgour, D.M., & Zhu, Y. (2009). A strategic classification support system for brownfield redevelopment. *Environmental Modelling and Software, Elsevier Ltd 24(5):* 647–654. Available from: http://dx.doi.org/10.1016/j.envsoft.2008.10.011.

18. Cheng, F., Geertman, S., Kuffer, M., & Zhan, Q. (2011). An integrative methodology to improve brownfield redevelopment planning in Chinese cities: A case study of Futian, Shenzhen. *Computers, Environment and Urban Systems, Elsevier Ltd 35(5):* 388–398. Available from: http://dx.doi.org/10.1016/j.compenvurbsys.2011.05.007.

19. Chrysochoou, M., Brown, K., Dahal, G., Granda-Carvajal, C., Segerson, K., Garrick, N., & Bagtzoglou, A. (2012). A GIS and indexing scheme to screen brownfields for area-wide redevelopment planning. *Landscape and Urban Planning, Elsevier B.V. 105(3):* 187–198. Available from: http://dx.doi.org/10.1016/j.landurbplan.2011.12.010.

20. Daher, R.F. (2011). Discourses of Neoliberalism and Disparities in the City Landscape «Cranes, Craters, and an Exclusive Urbanity». Collections électroniques de l'Ifpo. *Livres en ligne desPresses de l'Institut français du Proche-Orient, Institut français du Proche-Orient (6):* 273–295.

21. Daher, R. F. (2013). Neoliberal urban transformations in the Arab city. *Environnement Urbain 7:* 99. Available from: http://id.erudit.org/iderudit/1027729ar.

22. DLS (2014). Landlords and tenants law amended with the law no. (14) for the year 2014. *Department of Land and Statistics*. Available from:http://www.farrajlawyer.com/viewTopic.php?topicId=966 (accessed 24August 2018).

23. DLS (2015). The Department of Lands issues the draft real estate ownership law — Jordan News Agency. *Petra News Agency*. Available from: http://petra.gov.jo/Public_News/Nws_NewsDetails.aspx?Site_Id=2&lang=1&NewsID=210282 (accessed 24 August 2018).

24. Doick, K. J., Sellers, G., Castan-Broto, V., & Silverthorne, T. (2009a). Understanding success in the context of brownfield greening projects: The requirement for outcome evaluation in urban greenspace success assessment. *Urban Forestry and Urban Greening, Elsevier 8(3)*: 163–178. Available from: http://dx.doi.org/10.1016/j.ufug.2009.05.002.

25. Doick, K. J., Pediaditi, K., Moffat, A. J., & Hutchings, T. R. (2009b). Defining the sustainability objectives of brownfield regeneration to greenspace. *International Journal of Management and Decision Making 10(3–4):* 282–302. Available from: https://www.inderscienceonline.com/doi/abs/10.1504/IJMDM.2009.024994.

26. Dramstad, W. E., and Fjellstad, W. J. (2011). Landscapes: Bridging the gaps between science, policy and people. *Landscape and Urban Planning, Elsevier B.V. 100(4)*: 330–332. Available from: http://dx.doi.org/10.1016/j.landurbplan.2011.02.003.

27. Eiter, S. and Vik, M.L. (2015). Public participation in landscape planning: Effective methods for implementing the European Landscape Convention in Norway. *Land Use Policy, Elsevier Ltd 44*: 44–53. Available from: http://dx.doi.org/10.1016/j.landusepol.2014.11.012.

28. EPA (2004). Brownfields Mine-Scarred Lands Initiative — Federal Agencies Collaborate with Communities. *Office of Solid Waste and Emergency Response.* EPA 560-F-04-252. Available from: www.brownfieldstsc.org/miningsites.cfm.

29. EPA (2005) Mine site Cleanup for Brownfields Redevelopment: A Three-Part Primer. *United States Environmental Protection Agency, National Service Center for Environmental Publications (NSCEP)*.

30. Frantál, B., Greer-Wootten, B., Klusáček, P., Krejčí, T., Kunc, J., & Martinát, S. (2015). Exploring spatial patterns of urban brownfields regeneration: The case of Brno, Czech Republic. *Cities 44:* 9–18.

31. García-Martín, M., Bieling, C., Hart, A., & Plieninger, T. (2016). Integrated landscape initiatives in Europe: Multi-sector collaboration in multi-functional landscapes. *Land Use Policy, Elsevier Ltd 58:* 43–53. Available from: http://dx.doi.org/10.1016/j.landusepol.2016.07.001.

32. Hartmann, B., Török, S., Börcsök, E., & Groma, V. O. (2014). Multi-objective method for energy purpose redevelopment of brownfield sites. *Journal of Cleaner Production 82,* 202–212.

33. JO24 (2012). Jordan News, the implementation of the decision to evacuate the King Abdullah Gardens at the end of the year. Jo24. *JO24.net*. Available from: http://www.jo24.net/post.php?id=13311(accessed 24August 2018).

34. Kheetan, T. (2009). Collapsed Jordan Gate crane to be dismantled this weekend. *Jordan Times*.

35. Kotze, C. (2013). Importance of end land use and mine closure planning increases in SA. *MiningWeekly*. Available from: http://www.miningweekly.com/article/importance-of-end-land-useand-mine-closure-planning-increases-in-sa-2013-11-22/rep_id%3A3650 (accessed 24 August 2018).

36. Kristiánová, K., Gécová, K., & Putrová, E. (2016). Old Industrial Sites–Conversion to Parks: Potential of Bratislava. *Procedia engineering, 161*, 1858-1862.

37. Limasset, E., Pizzol, L., Merly, C., Gatchett, A. M., Le Guern, C., Martinát, S., ... & Bartke, S. (2018). Points of attention in designing tools for regional brownfield prioritization. *Science of the Total Environment 622–623*: 997–1008.

38. Limitless.com (2016) Limitless Project Details Sanaya Amman. *Limitless.com*. Available from: http://limitless.com/en-gb/Projects/Middle East/SanayaAmman.aspx (accessed 24 August 2018).

39. Loures, L. (2015) Post-industrial landscapes as drivers for urban redevelopment: Public versus expert perspectives towards the benefits and barriers of the reuse of post-industrial sites in urban areas. *Habitat International, Elsevier Ltd 45(P2):* 72–81. Available from: http://dx.doi.org/10.1016/j.habitatint.2014.06.028 .

40. Loures, L. and Vaz, E. (2018) Exploring expert perception towards brownfield redevelopment benefits according to their typology. *Habitat International 72:* 66–76.

41. Martinat, S., Navrátil, J., Hollander, J. B., Trojan, J., Klapka, P., Klusacek, P., & Kalok, D. (2018). Re-reuse of regenerated brownfields: Lessons from an Eastern European post-industrial city. *Journal of Cleaner Production, Elsevier Ltd 188:* 536–545. Available from: https://doi.org/10.1016/j.jclepro.2018.03.313.

42. Millar, A., Simeone, R. S., & Carnevale, J. T. (2001). Logic models: A systems tool for performance management. Evaluation and program planning, 24(1), 73-81.

43. MPRDA (2013). Mineral and Petroleum Resources Development Amendment Act 49 of 2008. *Centre for Environemntal Rights, 49(36541):* 1–104. Available from: https://cer.org.za/wp-content/uploads/2014/02/MPRDA-28-of-2002.pdf.

44. Namrouqa, H. (2014). Jordan world's second water-poorest country — Jordan Times. *The Jordan Times.* Available from: http://www.jordantimes.com/news/local/jordan-world's-secondwater-poorest-country (accessed 24august 2018).

45. Osman, R., Frantál, B., Klusáček, P., Kunc, J., & Martinát, S. (2015). Factors affecting brownfield regeneration in post-socialist space: The case of the Czech Republic. *Land Use Policy 48:* 309–316.

46. Paull, E. (2008). The Environmental and Econonic Impacts of Brownfields Redevelopment. *Northeast-Midwest Institute, Washington, DC*: 1–53. Available from: www.nemw.org.

47. Pediaditi, K., Doick, K. J. & Moffat, A. J. (2010). Monitoring and evaluation practice for brownfield, regeneration to greenspace initiatives. A meta-evaluation of assessment and monitoring tools. *Landscape and Urban Planning, Elsevier B.V. 97(1)*: 22–36. Available from: http://dx.doi.org/10.1016/j.landurbplan.2010.04.007.

48. Rall, E. L. & Haase, D. (2011). Creative intervention in a dynamic city: A sustainability assessment of an interim use strategy for brownfields in Leipzig, Germany. *Landscape and Urban Planning, Elsevier B.V. 100(3):* 189–201. Available from: http://dx.doi.org/10.1016/j.landurbplan.2010.12.004.

49. Rizzo, E., Pesce, M., Pizzol, L., Alexandrescu, F. M., Giubilato, E., Critto, A., ... & Bartke, S. (2015). Brownfield regeneration in Europe: Identifying stakeholder perceptions, concerns, attitudes and information needs. *Land Use Policy, Elsevier Ltd 48:* 437–453. Available from: http://dx.doi.org/10.1016/j.landusepol.2015.06.012.

50. Sanaya.net (2006). About Sanaya. *Snaya.net.* Available from: http://www.sanaya.net/aboutsanaya(accessed 24August 2018).

51. Schädler, S., Morio, M., Bartke, S., Rohr-Zaenker, R., & Finkel, M. (2011). Designing sustainable and economically attractive brownfield revitalization options using an integrated assessment model. *Journal of Environmental Management, Elsevier Ltd 92(3)*: 827–837. Available from: http://dx.doi.org/10.1016/j.jenvman.2010.10.026.

52. Sevenant, M. and Antrop, M. (2010) Transdisciplinary landscape planning: Does the public have aspirations? Experiences from a case study in Ghent (Flanders, Belgium). *Land Use Policy 27(2):* 373–386.

53. Stezar, I. C., Pizzol, L., Critto, A., Ozunu, A., & Marcomini, A. (2013). Comparison of risk-based decision-support systems for brownfield site rehabilitation: DESYRE and SADA applied to a Romanian case study. *Journal of Environmental Management, Elsevier Ltd 131:* 383–393. Available from: http://dx.doi.org/10.1016/j.jenvman.2013.09.022.

54. Thomas, M. R. (2002). A GIS-based decision support system for brownfield redevelopment. *Landscape and Urban Planning 58(1)*: 7–23.

55. Valencia-Sandoval, C., Flanders, D. N. & Kozak, R. A. (2010). Participatory landscape planning and sustainable community development: Methodological observations from a case study in rural Mexico. *Landscape and Urban Planning 94(1)*: 63–70.

56. Zhu, Y., Hipel, K. W., Ke, G. Y., & Chen, Y. (2015). Establishment and optimization of an evaluation index system for brownfield redevelopment projects: An empirical study. *Environmental Modelling and Software, Elsevier Ltd 74:* 173–182. Available from: http://dx.doi.org/10.1016/j.envsoft.2015.09.012.