**Industrialization of Nature in the Time of Complexity Unawareness - The Case of Chitgar Artificial Lake, Iran**

**Abstract**

To find answers to the challenges linked with ecological well-being, policymakers and authorities now prefer the ecosystem-based approach, as the solutions inspired by nature may deflect from ecological collapse. Hereupon, nature-based solutions (NBS) are rhapsodized both in practice and academia, as a means to achieve sustainable development. However, NBS, which inherently is supposed to bring forth positive outcomes, may also lead to unsustainable turmoil. On the other hand, the majority of the studies about NBS are from Western countries and studies focusing on the paradoxical functionality of NBS are scant, especially in the Middle East. In an attempt to bridge this gap, the current study uses one of the largest blue man-made infrastructures in the Middle East as a case. Following the phenomenological interpretive approach, the authors argue that NBS may fabricate unintended problems when the complexity of the supra systems are overlooked. Theoretical and practical contributions are discussed.

Keywords: Nature-Based Solutions, Ecological Modernization, Complex systems, Chitgar Lake

**Introduction**

Climatic changes and the increase of air temperature and their adverse outcomes in big cities have led to negative effects on human’s well-being (Ramkissoon & Sowamber, 2018), particularly in urban spaces. To overcome these sorts of challenges, Nature-based solutions (NBS) have been celebrated by the European Union as potential interventions and global sustainable solutions (European Commission, 2017; Maes and Jacobs, 2017; Panno et al., 2017). NBS, as a newly embellished panacea to tackle environmental problems, aims to enhance sustainable urbanization, restore damaged ecosystems, improve climate change adaptation, enhance risk management and resilience (European Commission, 2015) and boost human well-being and health (Cohen-Shacham et al., 2016). This umbrella concept (Cohen-Shacham et al., 2016) is an ambiguous conflation of ‘nature’ and ‘solution’, as ‘nature’ in NBS appears to be in the non-human realm over the long-run and where there is the uttermost use of resources by humans. The division between humans and their delayed reflexive actions from nature is very much entangled in environmental science, which is the cause of great confusion (Williams, 1983). Therefore, regardless of human actions, NBS inherits a bipolarity between human and nature; thus, NBS views human as a separate part of nature (see Waldrop, 1992).

On the other hand, ‘solution’ is defined as a robust answer to a known problem (Merriam-Webster, 2018). Yet, environmental problems are neither agreed upon nor obligate a straight forward solution. As such, the combination of both words deludes to an understudied radical reform prescription that neglects the complexity of environmental problems and may produce “potentially dangerous distractions from more human-scale solutions” (Simms et al., 2010).

However, a concept as ill-defined as NBS has been extensively defended (eg. Keesstra et al., 2018; Cohen-Shacham et al., 2016; van den Bosch, 2017; Lafortezza and Sanesi, 2019) and criticized (Schaubroeck, 2017). A detailed look at the literature reveals that majority of work on NBS has relied on case study evidence validating the positive effects of NBS on the well-being of residents in urban areas (Frantzeskaki et al., 2017; Keesstra et al., 2018; Nesshöver et al, 2017). Although such studies are valuable for detailing the advantages of ecosystem services, what is unforeseen is that first, alternative solutions may bring the same, if not more, benefits and outcomes. Secondly, NBS may produce a myopic straight-forward solution that disregards the complexity of other supra systems. In other words, the challenges of NBS are multidimensional that the existing frameworks in the literature do not take that feature into account (Raymond et al., 2017).

Hence, it is essential to put NBS to the most rigorous of evaluations. The central issue, then, is whether NBS's claims are theoretically and empirically coherent and valid compared to all other alternatives. Thus, this study is trying to find an answer to the following question:

*Research Question:*  *What are the challenges faced by the local community members about the introduction and functioning of Chitgar Artificial Lake?*

To proceed with the aforementioned discussion and regarding the premise that such solutions may also lead to unsustainable outcomes, this study contributes to the literature dominated mostly by the positive aspects of NBS (Frantzeskaki et al., 2017; Nesshöver et al, 2017; Dondajewska et al., 2018; Santoro et al., 2019). Therefore, the current research expands on knowledge about the paradoxical functionality of NBS in destinations other than the developed countries by taking Chitgar’s artificial lake in Iran as a case. The case of Chitgar, located in the northwest of Tehran, Iran, presents a good example when considering the functions of NBS in broader systems. Chitgar Lake (Figure. 2) is the biggest blue man-made infrastructure in the Middle East (Khezr Sedigh Mazinani, 2015). Further, it was once constructed in the philosophy of a generic city based on modernization theory to bring about ecological services to the surrounding area (for example, to improve the air quality; District22 - Tehran Municipality, 2019). However, the project has drifted away from its purpose, became its theme, reflexed in itself and thus, has produced unintentional risks that turn the project into another case of green gone wrong (Rogers, 2010). In other words, it had “no choice but to seek to maximize profits and grow forever regardless of social need and scientific rationality, just like any other for-profit business.” (Smith, 2016, p. 95). As a result, the project confronts various risks in pursuing pathways to sustainability.

In the successive paper, the authors criticize profit-seeking with environmental goals in general and explicate such ill-fated green capitalist project in detail. This paper argues that a more holistic approach in terms of systems thinking is appropriate to demonstrate every component and element within the connected and interrelated framework. The approach refers to the whole as the most proper framework to study a phenomenon. Therefore, a complex systemic worldview as a complementary framework has been embedded in the research design to gain insights into the case of the study. Accordingly, wide-ranging concerns, such as social, political and environmental issues that influence NBS as a system, and/or are influenced by NBS are discussed.

Consequently, the study contributes to the literature by reframing the current understanding of NBS in the complex world. The holistic approach of this study adds to the existing research by moving beyond validating positive or negative impacts of NBS, towards authentication of the prerequisites and outcomes of NBS as a system within a supra system.

In addition to theoretical contributions, the present study also emphasizes on practice by moving the NBS agenda to embrace the complexity of the systems as a complimentary framework in decision-making, planning and implementation phases.

**Theory and Background**

**Ecological modernization, NBS and the force of complexity**

A global turn to restore ecological balance within the urban landscape to have healthier societies and resilient ecosystems has recently emerged (Lafortezza et al., 2018). The fundamental role of “nature” in this trend that advocates the integration of natural ecosystems in the concept of sustainability is evident. The initial objective of these so-called “nature” based solutions is to address the societal challenges. Thus, NBS as a response to long ecological challenges provides a tool on the pillars of the modern capitalistic era to bring about more sustainable cities and societies through facilitating benefits to environment and people (Lafortezza et al., 2018). In that, NBS that is inherently confined within the framework of growth overlaps with the tenet of ecological modernization which is to interpret and understand the way that modern industrialized societies approach environmental problems (Buttel, 2000; Gilman, 2003; Mol, 2003). Nonetheless, unlike ecological modernization which “should be seen as a necessary, but not sufficient, condition for sustainable development” (Langhelle. 2000. p. 303) the NBS provides numerous social, environmental and economic benefits particularly in brownfield sites including the increased human well-being and contribution to the air quality, heat-island effect and noise reduction in the short term (for a review, Song et al., 2019). Despite its beneficial implications in growth, however, “there are also environmental complexities that need to be addressed in implementing NBS” (Song et al., 2019, p. 577) to prevent the invariably sacrificed environment in cost of the growth (Smith, 2016).

Moreover, NBS is dealing with natural living systems that are dynamic and evolving and this characteristic pose a complex problem as they are not fully predictable (Fernandes & Guiomar, 2018). Consequently, this means a demand for a wider knowledge and new approaches to various aspects of the systems (Fernandes & Guiomar, 2018). Accordingly, adopting a systemic worldview approach can provide a more promising framework through which a dynamic and complex phenomenon like NBS can be observed, the argument of which is detailed as below.

**NBS and growth**

Ecological modernization (see Buttel, 2000), quests a solution within the problem. It prescribes radicalization of modernization to tackle environmental problems. In this regards, Mol (1995) claims that "the only possible way out of the ecological crisis is by going further into the process of modernization" (p. 42). This theory proposes that efficiency and technological innovation will lead to a development which reduces negative ecological impacts (Mol et al., 2009). Nonetheless, this theory has received significant critiques about its premises and there are limited proofs of support for such predictions (Dietz et al., 2012; Gonzalez, 2012; York and Dunlap 2012). Given the state of the planet, contrary to the predictions of ecological modernization theory, CO2 emissions have been soaring and the highly modernized nations now have the highest environmental impacts by consuming the most resources worldwide (York et al., 2002; York et al., 2003).

Particularly, this theory is unable to include the emergence of ecological concerns in less-developed communities although it is not limited only to developed nations (Lawrence & Abrutyn, 2015). In other words, this theory is considered as "a highly restrictive theory of social change that promotes a panglossian socio-technical optimism, while marginalizing people and projects who depart from that vision by conceptualizing them as deviant, backward, or irrational" (McLaughlin, 2012, p. 186).

Moreover, the changes in modernized societies may be dominated by unintended side effects (Schaubroeck, 2018); in which modernization projects turn into self-destruction in a way that an enhancement in one type of modernization destabilizes and changes another (Price, 2017). Consequently, these changes will finally cause a second modernization, which is well defined by the reflexive modernity theory (Beck, 1994). The remedy for this reflexivity is as Beck (1994) suggests in terms of the radicalization of rationality, which is to dig deeper into the modernization process via technological advancement. In this regards, scholars found that the concept of modernization is assumed to be a partial fix for [economic, environmental and social](https://www.sciencedirect.com/topics/social-sciences/social-economics) challenges, and although it may promise short-term ecological benefits, it promotes green economic growth (Martin et al., 2019).

Nevertheless, what has been overlooked in the context of nature is the risk of limited natural resources. Furthermore, environmental problems as here-now issues may not benefit a yet to come magical green techno-fix (Holgersen and Malm, 2015). Moreover, such utopian rhetoric may lead to green illusions (Zehner, 2012) that manipulate the industry practices palatable to our social norms (Font et al., 2017).

Thus, a naïve faith in the industry and state environmentalism are criticized to ‘greenwash’ or ‘greenhush’ without a tangible vow for a long-term vision in balancing economic, social and ecological interests (Royo et al., 2014; Martin et al., 2019).

Therefore, resolutions may eventually lead to a political campaign, favoring a particular set of policies and resulting in the skepticism of science and alternative approaches in understanding and addressing global environmental challenges. This raises the issue of whether scientific knowledge is being exploited by the industry and political elites, or if not, whose interest projects as NBS serve?

Consequently, much like NBS, without any further scientific evaluation of the side-effects, green capitalism has been green-lit by authorities based on the belief that the only way to solve environmental issues is by accelerating growth (Sapinski, 2015).

However, confining the research agenda within the frameworks of green capitalism with its overriding goals of the endless economic growth and profit maximization could not be aligned with the actual green ambition of the society through mimicking the nature (Smith, 2016).

Therefore, what is needed is a paradigm shift out of the modernization and capitalism box that reorients not only science but also, the industry in a more socially responsible and environmentally sustainable manner (Haghighi, et al., 2018; Housemann and Housemann, 2011).

Although there is no universal recipe for environmental problems, an environmental fix must move beyond leftist and rightist ideas of growth or de-growth. Instead, the agenda must move towards a selective synthesis where the best outcome arises when a solution to a local issue addresses the complexity of a broader system that caused the problem (Barrett, 1994; Hoel 1991; Chander and Tulkens, 2006). Therefore, as part of the cure for myopic NBS projects, the research proposes adoption of a holistic and systemic framework to understand why the implementation of the NBS may result in a problematic and unsustainable development. A complexity worldview firstly acknowledges that NBS, as a system, functions within a supra system, which has crucial components outside of NBS system and will influence the outcomes of such projects. It secondly recognizes that the NBS system influences other components within the extensive complex systems; thus, a discussion on this topic is presented in the following section.

**Embedding Systemic Worldview as a Complementary Frame**

The issues to be addressed by NBS are complex, multi-facet and require the involvement of a variety of stakeholders, experts and researchers to select and assess these solutions (Raymond et al., 2017; Albert et al, 2019; Frantzeskaki, 2019). Therefore, to avoid the undesirable aftermath of NBS, as is the case of this study, the authors suggest embedding a systemic worldview as a complementary framework.

Thus, NBS is challenged by an uncertainty in proposing, designing and implementing its projects and whose implementation also requires economics, as well as scientific and political aspects to be addressed by various stakeholders (Albert et al, 2019; Hristov & Ramkissoon, 2016; Hristov, Minocha, Ramkissoon, 2018; Maes and Jacobs, 2017). Researchers and practitioners may miss processes occurring at a more macro level (York et al., 2003) as NBS, in its current form, seeks to make changes at the micro-level through a reductionism lens. Reductionism, however, has created significant problems in deep ecology (Rowe, 1997). As such, a “complex system cannot be reduced to its basic components, not because they do not exist within the system, but because important relational information may be lost in the process” (Cilliers, 1998, p. 10). Accordingly, NBS should be embedded and combined with a more systemic approach that prescribes non-linear oblique solutions to the wicked problems.

As a complexity system approach proposes synthetic reasoning instead of analytical reductionism (Byrn, 2002) and it looks at the relations of the interdependency of the whole system rather than a quick ‘green patch' for environmental wounds.

This holistic approach questions the basis of the necessity or sufficiency of NBS itself. Thus, for the NBS which at best could be considered as a weak expression of ecological modernization (see Blowers, 2000) following the environmental goals it could be a necessity rather than sufficient condition. (Woodside, 2014, 2016; Olya and Altinay, 2016).

Therefore, this study would draw the attention of researchers and practitioners to question the borders of environmental problems, as a straightforward solution to a complex problem may result in unforeseen consequences that exacerbate the problem itself, let alone solve it (Olya and Akhshik, 2019).

**Methodology**

***Study area***

The lake of the Martyrs of the Persian Gulf also known as Chitgar, which is an artificial lake in Tehran, opened in May 2013 to enhance ecological wellbeing, tourism, recreation capacity and the economy of the region (Bayat et al., 2019; District22 - Tehran Municipality, 2019). The idea of Chitgar Lake dates back to 1960s when in the comprehensive city plan of Tehran, a lake was predicted to be in Western part of the city to serve as a flood retention pond for its upstream urban watershed (Khorasani et al., 2018). After decades of postponing because of the lack of funding and low priority, this plan once again was proposed in the second and third comprehensive plan of Tehran later by embedding ecological and recreational concerns (Jamshidian et al., 2015). However, the construction did not actualize since October 2010 that finalized in 2013.

Multiple stakeholders of the lake, involving in decision making and operation power were identified as “Tehran Provincial Government”, “Iran Department of Environment”, “Tehran City Council”, “Tehran Municipality”, “Tehran Agricultural Jahad Organization”, “Tehran Regional Water Company”, “Department of Natural Resources and Watershed Management of Tehran”, “Tehran Rural Water and Wastewater Company”, “Tehran Water and Wastewater Company” (Khorasani et al., 2018, p. 110).

This recreational off-stream lake provides disparate tourism and entertainment facilities for visitors. Besides lots of restaurants and shopping centers, visitors can also participate in various leisure activities such as boat riding, among others. Additionally, this Lake has three man-made islands which are used to various social-cultural purposes. However, the eutrophication and algal bloom in Chitgar impede this destination to reach its recreational goals. On the other side, the lake is blamed for preventing southern agricultural land of Tehran to receive adequate water (Khorasani et al., 2018). Moreover, a considerable amount of water also is required for the green space of the lake.

“Due to some reasons including the unique integration of recreational activities around the lake and its large dimension in the first years after the construction, the lake has failed to appeal to anyone. On a large scale, the disparate elements of the lake in the landscape and environment have caused a break in the foothill landscape” (Jamshidian et al., 2015, p. 68). Previous studies have comprehensively observed the problems and proposed solutions for the water quality management and eutrophication management of the lake focusing on various stakeholders (Estalaki et al., 2016; Khorasani et al., 2018). However, unlike previous studies, the current research tries to address the views of marginalized locals/users of the lake rather than the aforementioned list of governmental institutions.

The 320-acre lake (Figure 2) is 853 feet above sea level and the depth of the lake is 300 inches. Additionally, the 8 million cube meter reservoir is mostly fed by the Kan River, located in the west of Tehran as the main source of water, while the remaining run-off comes from subsurface waters. A residential area of 22 municipalities of Tehran is located south of the lake. The lake has promised to bring refreshing air for the city, as it is located in the direction of Tehran’s local surface winds, which blow from west to east. The lake is also located close to Alborz Mountain and is connected to the nearby forest.

***Research approach***

An interpretive phenomenological research method was used to understand the experiences of the local community regarding the influences of Chitgar Lake on their lives. Initially, the phenomenology is often described as the exploration of human experience (Polkinghorne, 1989) and the science of a phenomenon (van Manen, 1990). Numerous studies in various disciplines including tourism and hospitality (Robinson, Solnet, & Breakey, 2014) have used interpretive phenomenological approach (IPA) in their studies since it is “a method that analyses data in an idiographic manner and which aims to explore the participants’ experiences, cognitions and meaning makings” (Milton, 2004, p. 118).

Data was collected through semi-structured interviews with the residents living adjacent to Chitgar Lake. A total of 21 residents were interviewed through convenience sampling until data saturation was achieved (Guest et al., 2006). Each interview lasted between 15 to 30 minutes. Out of the respondents, 11 were males and 10 were females. Further, they were between the ages of 19 – 55 (Table 1). Interviews were audio-recorded and transcribed later to be included in the data analysis procedures (Rezapouraghdam et al., 2018).

Moreover, the secondary source of data (including newspaper headlines, Google Earth historical imagery and other publicized information sources about the district plan) was also included in this study which enabled the authors to view the case study more broadly, from various angles.. Secondary data sources are commonly used in qualitative studies, especially in interpretive phenomenological research (Alipour et al., 2017; Lee and McFerran, 2015; Sparrman, 2005). These reports about “Chitgar Artificial Lake” which were published in officially approved and recognized URL web pages and national newspapers were selected following the criteria of Alipour, Olya, Hassanzadeh, & Rezapouraghdam (2017).

**Data Analysis and Findings**

The data has been coded using focused coding techniques (Charmaz and Belgrave, 2007), which allow the researchers to limit the codes that were developed by generalizing and re-categorizing them. The validity and reliability concerns in IPA can be approached from a dependability and trustworthiness perspective (Robinson et al., 2014). The current study took several steps to ensure the trustworthiness of the research, as suggested by Noble and Smith (2015). First, to reduce the research bias, all of the researchers in this study participated in the data analysis and interpretation procedures. Secondly, to support the findings, “rich” and “thick” narrations of respondents in support of the findings were included in the study. Thirdly, a meticulous record and transcription of the raw data were kept and reviewed by all of the researchers to ensure the transparency and consistency of the interpretations. Finally, the findings from interviewees were triangulated with the secondary data available in official media and newspapers to produce and ensure a more comprehensive set of findings (Figure 1). This selective process contributes directly to construct and clarify the theoretical phenomenon. During the process, all sources of data were conducted by an open-coding data analysis process. Thus, each interview has been transcribed and analyzed line-by-line to conceptualize the undergoing research project. Moreover, the axial coding technique was used to categorize the already existing open codes and to build a higher level of the phenomenon (Sirvastava and Hopwood, 2009). The guidelines by McLellan et al. (2003) have been considered to comprehend, ‘What is going on?' in the context of the blue infrastructure.

**Insert Figure 1 in here**

The residents' experiences of living next to the lake highlighted the sociological impacts of the project. Thus, the analysis of the data enriches the research by comprehending the real condition of living at the site. Data analysis suggests that although some of the skyscrapers enjoy the view of the lake, they block the view for the ones in the back rows. Moreover, the lake itself has caused problems for residents. Our findings are consistent with previous studies (e.g., Nunkoo et al., 2013; Ramkissoon & Durbarry, 2009; Ramkissoon & Nunkoo, 2011). Negative impacts include the health issues and unpleasant smell of the lake, annoying aquatic insects and mosquitoes, and over-crowdedness. However, traffic jams, which were reported to have the greatest negative influence on the livelihood of the residents, caused significant dissatisfaction in the neighbourhood.

**Insert Table 1 in here.**

The majority of the respondents had a consensus about the problems created by the lake; for instance:

Interviewee No. 1: “When the weather is hot and windy, a very unpleasant smell always bothers me and my family even when we are indoors”.

Interviewee No. 2: “The mosquitoes around the lake are so strange! They do not bite but when you are passing by, they suddenly fly into your eyes. That has happened several times to me, which caused my eyes to be infected”.

Interviewee No 11: “We have water outage problem in here it happens times during a month and I believe they redirect our drinking water to fill up the lake.”

Interviewee No 14: “There are lacks of infrastructures for residents, most of the facilities are serving tourists…as an example we only have one bakery and one grocery shop around here, which is not enough for too many people that moved here.”

Numerous media channels also confirm the outcome that a lack of planning in constructing the buildings and specifically, the mismanagement of the lake, has resulted in potential harms, such as decreasing the well-being and social hardship of the residents (Financial Tribute, 2016; IRIB, 2019; Titreshahr, 2018).

Salamat News (2018): Chitgar Lake was supposed to work as a mechanism for conditioning the air and as a means of creating leisure and well-being for the people. However, because of the inadequate focus on the consequences of the plan, now the area is experiencing unsavoury outcomes that disturb the locals' well-being.

Interviewee No 19: “…buildings are everywhere, and they [construction companies] are racing to build as near to the lake as possible.”

With the further development of more malls, shopping centers and restaurants, the pattern of visitors has changed from benefiting the ecosystem and nature-based tourism to retail and shopping tourism.

The interviews revealed that the most of the visitors are attracted to luxury stores and fine dining restaurants rather than the lake itself. As such, this is one of the sources of over crowdedness, lack of parking spaces and traffic jams in the region.

Interviewee No. 3: “This Lake is the only recreational infrastructure in the surrounding area where people can spend their free time, though the place created much crowdedness”.

Interviewee No 12 “We came to enjoy the food court; unfortunately, we were unable to find a spot to park our car. The parking lot is full, and we may need to go around the lake several times to find a proper parking space.”

**Discussion**

The challenges of Chitgar Lake in pursuing sustainable outcomes based on the analysis of the primary and secondary data emerged as water supplement, water quality and scarcity, deforestation of nearby jungles, air quality, traffic, health problems, land pricing and construction competition (see Figure 6). These are interpreted below:

**Insert Figure 2 in Here.**

**1. Water supplement, quality and scarcity**

The project is contradictory in its nature, to be operationalized in a country where the arid climate is dominant the majority of the seasons (Rezapouraghdam and Esmaeili, 2017) and water shortage is the main issue. This is where the largest artificial lake has been built and this has had a significant ecological and social impact on the region. Ecologically, since the beginning, the project has suffered from water supplement problems that were intertwined with different governmental agencies. In 2013, 8 million cubes meter of the Lake were fed by the Kan River, though the vast evaporation of water from the surface of the lake was close to 2 million cubes meter/year, which exacerbates the problem.

The problems in the case of Chitgar Lake are not uncommon in nature. For instance, eutrophication, which is defined as the addition of excess nutrients to a water body, is a widespread environmental problem facing both natural and artificial lakes (Winfield, 2015). Scholars discussed that due to the “rate of tourism activities in the upstream” and also “the entry of pollutions related to restaurants and villages to the river” (Kan River, the source of water supply of the lake), the level of nutrients in the lake has been affected (Bayat et al., 2019, p.1447). However, finding an alternative solution to overcome Chitgar eutrophication is so difficult since “the available water resources, such as Kan River, urban surface runoff and treated domestic wastewater, to supply water for the lake have high concentrations of phosphorus and since phosphorus treatment cost is dramatically high in Iran, there is an urgent need to find a sustainable way to supply water with acceptable nutrients concentration for the Chitgar Lake” (Estalaki et al., 2016, p. 15).

**2. Deforestation of nearby jungles**

The water scarcity and evaporation of a large amount of water - notably significant environmental impact (Ramkissoon & Sowamber, 2018; Sowamber & Ramkissoon, 2019) - has caused the authorities to divert the water quota from a nearby jungle to the lake (Haghighi, et al., 2018; Financial Tribute, 2016). As a result, the nearby forest that once covered an area of 1,450 hectares and brought to life to prevent dust storms from reaching Tehran over forty years ago, barely covers 840 hectares these days (Rousta et al., 2018; Etemadonline, 2019; Financial Tribute, 2016). This deforestation (Figure 3) has also been well reported by the local news agencies who blame the lake directly for the disappearance of the nearby jungle (Etemadonline, 2019; Farsnews, 2019; SalamatNews, 2018; Financial Tribute, 2016; Khabaronline, 2017). This is also well documented by local authorities who reported that “parts of Chitgar forest were destroyed to make way for the construction of buildings and a highway” (IRIB, 2019). Moreover, a study of the spatiotemporal analysis of land use/land cover of Tehran reveals that vegetation has been vastly depleted to shove impervious lands in 2008 compared to 2018 in the study area (Figure 7; Rousta et al., 2018).

**Insert Figure in 3 Here.**

**Insert Figure 4 in Here.**

**3. Air quality and airflow**

The NBS project has promised to purify the air in district 22 and western part of Tehran (Tehran Municipality, 2019). However, unlike the expectations, the geographical positioning of the lake in the northwestern part of the city has created a heat island that blocks the airflow to move smoothly from west to east. Bahraini (2017) claims that this heat island is one of the sources of air pollution in Tehran. The study of Rousta et al. (2018) also indicates the changes in the land surface temperature in Tehran between 1988-2018 (Figure 8). Moreover, the short-term economic goals, including the construction of high-rise buildings around the lake, also have exacerbated the wind flow blockage in the region (ISNA, 2019; Salehi et al., 2016).

**Insert Figure 7 in Here.**

**Insert Figure 8 in Here.**

**4. Traffic**

Although inner spaces are well equipped for pedestrians around the lake, accessibility to the waterfront from other parts of the city is not easy due to a lack of public transportation. As a result overcrowding and traffic jams in the area is a usual picture of district 22 that creates a psycho-social impact and decrease the residents’ quality-of-life (Ramkissoon, Mavondo, & Uysal., 2018; Uysal, Sirgy, Woo, & Kim, 2016). Attachment of different shopping malls to the basic plan of the lake, such as Iran Mall and Bamland (one of the largest business centres in the Middle East, with 1,200,000 m2 constructed area), has led to heavy traffic density in the area. That is, such facilities attract a large number of visitors to the lake and its surrounding particularly in holidays and weekends (IRNA, 2019). ILNA (2018) reports that the construction of the lake without allocating the necessary transportation facilities such as adequate parking spaces, and public transportation has increased traffic congestion in the area. This problem has been an issue of controversies in the body of governmental media and public tribunes since the lands around the Lake was overused for various economic purposes (Hamshahrionline, 2018; IRNA, 2019).

**5. Health risks**

The health risks related to the manmade NBS project may not be underestimated as in case of Chitgar Lake a number of undesirable health issues were emerged as follows.

The stagnant lake suffered from a proper filtration system once the lake was introduced, which created an unpleasant smell and caused the invasion of insects (Tasnimnews, 2014). As a remedy, the regional municipality injected frogs into the lake’s ecosystem as a means to control and eradicate invasive insects such as mosquitos and flies (Tabnak, 2014; Pasko et al., 2014); however, the cure, which turned into a case of ‘the Hanoi rat massacre' (Vann, 2018), well demonstrates the ironic ways that modernization projects can have unintended consequences (Pemberton 2014; Price, 2017). In this context, it was turning frogs into a new man-made problem for the lake. However, this issue has finally been dealt with by installing costly water filtration systems in 2017 (Asresakhteman, 2017).

Moreover, there have been reports on finding dead migratory birds diagnosed with avian flu around the lake (see Figure 5) that has caused some concerns over human outbreak (TehranTimes, 2018). The negative psychological impact of such incidents has proven to have consequences on residents and visitors (Person et al., 2004).

**Insert Figure 5 in here**

**6. Land price increase**

The creation of Chitgar Lake has caused a drastic increase in the price of the lands, apartments and buildings that are adjacent to the lake (IRNA, 2019). Based on the findings reported in the official news and according to the residents’ comments, the price of lands and apartments that have a better view are higher than similar apartments in the region Khabaronline, 2014; YJC, 2014). In general, the statistics indicate that in comparison to the time before the lake is projected to be completed, the prices have experienced a considerable change. IRNA (2019) reports that nowadays the price of an apartment is so high that it is almost a dream for the majority of the people to be able to own a place in the region. Moreover, these economic changes in the land prices and its benefits for the landowners have eradicated the chance for the middle class to rent an apartment in the area (Titreshahr, 2018).

**7. Construction competition**

The presence of Chitgar Lake has led to the creation of very severe competition in the construction sector and a race for what’s left in the area (Tejaratonline, 2018). Many new and tall buildings are constructed continuously to respond to the increased demand by the rich class mostly to resell the properties at higher prices in the future (IRNA, 2019). Furthermore, the new and taller buildings are being built in front of the older ones and are in a race to approach the lake as close as possible (ISNA, 2019). This massive construction trend is also evident in the statistics based on which the district 22 of Tehran now has populated over 2 million residents which is in contrast with the initial plan for the area that was supposed to include only a number between 150000 to 200000 people (IRNA, 2019). This has created a messy shift towards short-termism economic development strategy in the region (McLennan et al., 2010), which contradicts the premises of sustainable urban development and economic sustainability of tourism development (Qiu et al., 2018).

**Insert figure 6 in here.**

**Conclusion**

The introduction and functioning of NBS in its current form disregards the unknown new qualities of fabricated and sometimes undetectable risks in the context of other systems and human activities. The man-made risks associated with NBS may overlap with a cluster of other irreversible risks that we face in global societies. The study unveils an NBS project that is primarily aiming to improve air quality; conversely, the lake exacerbated air pollution and fabricated new problems such as health risks that never existed before (Figure 6). In sense, the functionality of the lake has been shaded by economic short-termism, hence the now marginalized NBS project, grounds a battlefield for construction companies who are exploiting the resources in ever more creative ways by introduction of an understudied shiny environmental fix that may distract practitioners from achieving sustainability goals. Therefore, the significance of a concept such as nature-based solutions is in recognizing different pathways that exist as an alternative to environmental problems; however, uncertainty abounds and complexity is ubiquitous, which makes human choices limited. NBS, however well-intended, is neither completely correct nor completely incorrect. Instead, the judgment is likely to be, “it depends” (see More, 2002). Considering the wide-ranging problems (Figure 6) produced directly or indirectly by this project, this study cautions us against an unnecessary commitment to the NBS project, as it may blind us to the alternative options that may have greater potential in a complex ecological system towards sustainability.

The study sheds light on the significance of fundamentals necessary to implement the NBS projects, such as a sound environmental system. Moreover, sustaining these prerequisites in the long-term is utmost important. As findings suggest, the project brought to life by turning a blind eye to the water supplement and massive evaporation of the lake water; this has caused further unintended risks. Thus, future studies should address the prerequisites of NBS and then compare them to other alternative solutions.

However, the study and listed challenges are not proving or disproving the validity of NBS; instead, they are intended simply to be examples, illustrating the need for further theoretical development to take place in tandem with further research. Hence, implementing an NBS project, such as the case of this study, echoes the question of, ‘Why is the government in the lake business?’ (see LaPage, 1976). However, this "state environmentalism" may lead to a decisive move towards sustainability (see Jänicke, 1990). After all, it may worth taking Marx’s advice to “ignore lofty goals and aspirations, [and] focusing instead on finding out whose interest are served” (as cited in More, 2002; Hristov and Ramkissoon, 2016). Nevertheless, we tend to lose sight of the goal we hope “green fixes” accomplish. Thus, proposals such as NBS have the potential to move the research agendas to focus on a context largely determined by the governing body or industrial elites within the framework of development, resulting in the deceptive agendas that turn the researchers into "hired prize fighters" for green capitalism (Marx, 1965), which can distance NBS from its genuine objectives. In the end, it should be noted that to a larger extent, the success or failure of NBS depends on the role of developers and the way they deliver these solutions (Hristov & Ramkissoon, 2018; Wild et al., 2017). However, the findings of this study, because of its limitations, cannot be generalized and thus, further research is required to observe other cases in the Middle East so that a comprehensive understanding about the functionality of NBS may be acquired in the region. Only in that case will a holistic picture of the various aspects and the functionality of NBS be achieved. Additionally, future studies respecting the complex nature of NBS in societies should involve all of the stakeholders' viewpoints in observation of the cases (Hristov, Minocha, and Ramkissoon, 2018), a factor that is considered a limitation for the current study, which resulted from a lack of adequate resources.

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