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VALUING 'GREEN INFRASTRUCTURE' IN JEDDAH: A CITY LOST IN 'GREY' INFRASTRUCTURE

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Abstract. In the planning of the urban green infrastructure it is important how the decision makers and residents value their living environment. While the coverage of Green Infrastructure in the case of Jeddah appears negligible, the paper attempts to find out its causal factor. We primarily consider (1) what are the challenges of resident's well-being in Jeddah which Green Infrastructure can solve. (2) What are the constraints; obstructing the sustainable expansion and development of green infrastructure in Jeddah and (3) what are the policy interventions required as well as crucial issues to be considered while planning of green infrastructure in Jeddah. Primary data through satellite imagery and secondary data from extensive literature search incorporating internal and external linkages on the problems; could generate further discussion on the way by which green infrastructure planning could be successfully loomed.

Keywords: green recreational spaces, sustainability, city, urbanization, dynamics.

Introduction

Kingdom of Saudi Arabia is among highly urbanised countries of the world with 83 percent of urban population (CDSI 2012) that is far above from world's average of 50 percent (UN-Habitat 2013). Country's rapid urbanization is posing acute stress on the livability or well-being (Pacione 2003) of its urban inhabitants. This paper focuses at Jeddah; the second largest city of kingdom with a current population touching 4 million. Roaring oil economy has allowed kingdom to allocate immense aegis for urban infrastructure development; similarly in Jeddah urban infrastructures are in transitional phase whereas policy makers and planners are attempting to offer maximal infrastructure stock on the contrary city inhabitant feels that more attention is paid towards grey infrastructures such as roads, flyovers, sewer line expansion, and drainage provisions. Green Infrastructure (GI) is not attracting extensive attention from responsible authorities because its value and multi functionality is not well recognized while city acutely lacks adequate green spaces. Hence, this paper attempts to trace out major gaps prevailingin adequate expansion of Green Infrastructure in Jeddah; which would further serve as guiding norm for local policies in a city with costal arid climate conditions.

Value of GI

Body of knowledge worldwide over GI, is largely growing at present. Rapidly emergent growth of Green Infrastructure in USA and UK over last 2 decades has offered larger opportunities for urban planners (Mell 2014). The Ecosystem facilities provided by urban green spaces are among the vital factors causing well-being to the residents in urban areas (Bolund, Hunhammar 1999; Breuste *et al.* 2013). Green areas as a tract of urban landscape attend countless utilities as supplier of passive and active recreation, environmental advantages and a habitat for wildlife. Urban green spaces are the land parcels used for environmental greening and improvements. Public & private parks and gardens, trees in streets, grassy lawns, cultivates land, urban wetlands and forests are included in the taxonomy of urban green spaces while rooftop gardens are the latest addition to this group (Irvine *et al.* 1999; Skinner 2006; Kingsley *et al.* 2009).

Academicians argued that green spaces provide *social* and *psychological* services which are critical for the livability of modern cities and well-being of urban dwellers (Chiesura 2004). Many countries have focused their attention upon research and practice in the planning of green infrastructure (GI) in the past decade (Mell 2010). In fact GI determines the level of Quality of Life in cities at present.

Green infrastructure (GI) is an approach to green space that is catching pace. Recent advancement in urban practices has ratified green spaces to be redefined as an infrastructure; which wasasignificant effort to link GI precisely with economic development policy. It has certainly enhanced the scope of involvement for them who were previously less engaged making the term heavyweight (Horwood 2011).

Recognizing potential benefits urban professionals' interest in GI has increased in recent years (Krellenberg *et al.* 2014; Schäffler, A., Swilling, M. 2013; Alberti *et al.* 2003). In United Kingdom Kambites and Owen (2006) defined green infrastructure as the connected networks of multifunctional, predominantly unbuilt space that supports both *ecological* and *social* activities and processes. Because of its multi-functionality *GI* can solve many environmental problems in the cities concurrently.

Covered land surfaces in urban areas are the reason to generate Heat Island effect; these surfaces are made of materials like bricks, metals, concrete, cement and asphalts which in fact at first absorb the heat and later radiates in urban surroundings forming a heat island (Priyadarsini 2009; Baumann 2009; Theophilou, Serghides 2014). While these thermal effects are produced locally along with manmade built environment; GI are capable to spur climatic conditions at local level by absorbing heat and generating a cooling effect (Whitford *et al.* 2001; Wong, Yu 2005; Nowak, Dwyer 2004; Srivanit, Hokao 2014).

There is no doubt that that local micro-climate conditions do not occur in isolation and ultimately they contribute to global climate change through GHG emissions; various researchers has linked GI's adoptive and mitigating competences to global climate change and recommended to increase amount of patch and edge density of the green spaces specially in the cities located at arid and semi-arid regions where water availability is sacred (Maimaitiyiming *et al.* 2014). Planning for Climate Change adaptation could be classified into 3 larger groups including Grey (Hard) Infrastructure, GI and Soft (awareness, education, communication and incentives) approaches (European Commission 2009). Jones *et al.* (2012) have outlined a solid instance of various qualities of applying an approach which is 'eco-system based or EbA' to adapt and mitigate present and future climate change. Gaffin *et al.* (2012) has compared the role of both grey (hard infrastructure) and GI in adapting climate changes; found that though there are multiple co-benefits of both infrastructure types; the 'grey' one have only detention qualities while the 'green' have both detention and retention qualities.

Benefits of GI are not merely limited in tackling adverse heat impacts on microclimatic conditions in the city or adoption to global climate change rather it also improves city's health through regulating its uncontrolled resource uses of air, land and water in particular. Excess air pollution in a city can hamper its metabolism and affect people's health through numerous respiratory diseases from bronchitis to lung cancer because of its severity it is major global issue of public health (Seaton *et al.* 1995; Finkelstein 2003; Yang, Holgate 2013). The problem of air pollution is even worst in cities with higher car ownership; in fact a factsheet reveals that ambient air pollution caused 3.7 million deaths worldwide in the year 2012 (WHO 2014a). Studies confirm that natural outdoor environment can create positive health effects by minimising air pollution (Kuttler, Strassburger 1999; Yang *et al.* 2008; Purnomohadi 1994).

In addition; improvements in air quality is another pertinent function of GI, that could be associated with increased walkability and physical activities in urban areas by offering cool, calm and natural environment. Researchers have attempted modelling of green space walkability (Lwin, Murayama 2011). In fact GI enables a built environment for walking specially in the urban areas of arid regions. Whereas a city becomes more walkable its dependency on fossil fuel operated vehicles could be reduced as well as the emitted carbon; hence indirectly GI (through walkability enablement) can be a dominating factor in determining people's travel behavior in urban areas (Frank, Engelke 2005; Sallis *et al.* 2004).

Apart from walkability and physical activities studies endorses that GI also offers many recreational functions at parallel, in form of sports and leisure activities (Hörnsten, Fredman 2000; Arnberger 2006).

Cities often suffer with urban floods or storm water as a disaster damaging their property and people's life; it happens mainly during heavy rains associated with extreme weather events. Many studies has identified GI as a sustainable solution to urban storm water management, many German and Australian cities have successfully implemented such strategies (Begum, Rasul 2009; Keeley *et al.* 2013; Schroll *et al.* 2011). Particularly green roofs in urban areas proved more efficient in tackling challenges of storm water (Mentens 2006; Berndtsson 2010; Rowe 2011).

GI in an arid climate

There is no doubt that initially GI were planned and applied in temperate coastal regions though it has abilities to restore hydrological qualities even in arid and semi-arid regions. Proactive urban communities, researchers and designers in water scared areas are gradually regarding GI as an economical tool for urban storm water management and urban water conservation practices (EPA 2010). Arid cities like Phoenix has acknowledged that wetlands as a GI, are more valuable in an arid climates because of its protracted cooling and soothing effects rather than water rich environments; Rios Wetland is an excellent example of constructed wetland (Economides 2014). Peruvian capital Lima that is another city dominated by arid climate has evolved a city specific urban GI strategy called Lima Ecological Infrastructure Strategy – LEIS based on the scientific principles of interrelations, interdependence and interactions between flow of water and eco-system services. River Park Chuquitanta is a model of this strategy aimed at develop GI through reuses of treated wastewater (Hauck, Czechowski 2014).

Methodology

A mixed method of research was applied in this paper with both Quantitative and Qualitative approaches; while more emphasis was on qualitative approach; primary data regarding GI availability was obtained through satellite imageries while other secondary data was collected and analyzed from census department and other sources, Concept mapping tool was deployed in order to investigate linkages and interactions of GI with natural and cultural (built environment) settings.

Extraction of current GI

On-screen digitizing of high resolution satellite images proved to be a good approach to extract urban land uses. A recent high resolution satellite image of Jeddah city was used to extract GI in Jeddah city. GI where digitized as a polygons using in ArcGIS v9.3 software. Accordingly vector GI layer was obtained. Finally, accuracy assessments were performed based using ground truth survey. The average overall accuracy of land use maps produced by this approach was 94%>. This exceeds the minimum accuracy of land use data (85%) required for satisfactory urban land use maps (Anderson *et al.* 1976).

Content analysis

We also used the qualitative content analysis to support our argumentation. Content analysis could be defined as a systematic rule guided analysis of textual data and plays a critical role in propagating research knowledge and in shaping further research, policy, practice, and public perception (Mayring 2000; Calik, Sozbilir 2014). We analysed qualitative textual data mainly from the followings sources:

- Relevant content available online.
- Strategic Plan of Jeddah City.
- Newspapers are argued to be the representatives of ecosystem disservices (Lyytimäki 2014) therefore we used content of English Daily 'Arab News' which is credible and widely covers local issues on constant basis and maintains online archives too.
- Contents from Academic Research papers on Jeddah; published in reputed Journals.

All materials used for content analysis were in *English* to escape from *Arabic-English* translations. We stressed on qualitative content analysis as previous studies were just focusing on the provisional gaps regarding GI in Jeddah city while ignoring other pertinent qualitative issues.

Study area

Jeddah is the second largest city, located at Red Sea coast in the Province of Makkah, Kingdom of Saudi Arabia, located on; it is culturally, commercially and religiously an important city and serves also as gateway for the Muslim pilgrims from all over the world, going to perform '*Hajj*' and '*Umrah*' at Holy city of *Makkah*. It's a costal global city whose ecology is largely influenced by the marine ecology as well as desert ecology as it is located in between. The city has a population of 3.4 million spread over a total area of 748 km^2 (Fig. 1).

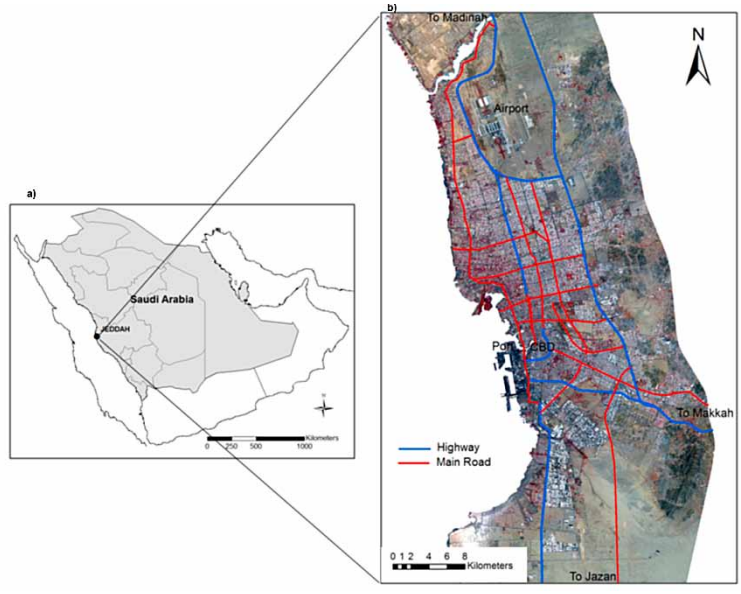

Fig. 1. a) Geographic location of Jeddah b) Jeddah city

Results and discussions

Existing status of GI in Jeddah

As discussed before, GI plays a central role in well-being of Urban dwellers through offering of multi-functional services including control on air pollution through fossil fuel propelled vehicles, reducing heat island effect, solving urban storm water problems, offering places to walk and physical activities as well as for recreation while social and psychological services are the other key benefits. All these cumulatively could contribute in enhancing urban health for city residents.

Jeddah is the most happening city in KSA but this attainment never been so easy rather it has consumed plenty of time and money that transformed it from a fishing settlement to a cosmopolitan city. Reports showsthat there was only 1 tree at the city in 1928 (Kirk 1994); while now it is believed to be home of 5 million trees at present. Though the amount of GI growth in the city in past 86 years is quite encouraging yet it does not gives us a clear and real picture of today hence it will be more contextual; to see micro details regarding availability of GI. Coverage of GI at distract level is shown in Figure 2.

Satellite imageries discloses that none of the Jeddah's district has more than 11 percent of GI considering their respective geographical areas whilst at city level coverage of GI is hardly around 1 percent of land area which is an issue of serious concern. Even per capita availability of GI is too less (1.7 m^2/capita).

Based on the geographical coverage (Table 1), and per capita availability (Table 2) of GI Jeddah's districts are categorized in 4 groups – Grey, Red, Yellow and

Fig. 2. Green Infrastructure in Jeddah City

Table 1. Districts having no Green Infrastructure

Sl.	District	Population(2010)	Area In Square Km
1	AL NASEEM	37057	6.66
2	AL AMMAREYYAH	17232	0.47
3	AL SAHEFAH	23500	0.43
4	AL MALEK ABDOULAZEZ DIS	25664	96.18
5	MRAYKH	4884	15.88
6	AL FADEL	30592	11.21
7	AL AMEER FAWAZ AL SHAMALY	21802	1.52
8	AL AMEER ABDOULMAJJED	49648	12.35
9	AL SENAEYA	871	17.69
10	AL SORORYAH	3790	10.94
11	AL KHOMRAH	14399	16.23
12	OBHUR AL SHAMALYYAH	4524	22.39
13	TEEBAH	4878	12.89
		238841	**224.84**

Green. These chosen colors are symbolic indeed which also denotes urgency of GI planning at district level-from most urgent to less urgent respectively.

We have analyzed data from 70 districts; out of all 113 districts; 43 districts were left as they are either institutional (for example, Jeddah Islamic Port) or their population is quite negligible. Data reveals (Table 1) that out of 70 reported Districts 18.5 percent do not have any significant amount of GI stock; although they are spread over an area of approximately 225 km^2 offering home to 239,000 people; these Districts are categorized as 'Grey'.

Additionally, we benchmarked geographical coverage of GI on the basis of their availability on a minimum of 5 percent of land area hence 4 percent districts were found in green category while 14.3 percent districts in yellow, 62.9 percent districts in red and remained falls in grey category (Table 2).

There are various criterions in practice regarding minimum per capita availability (pca) of GI ranging from 9 m^2 to 30 m^2; we have used *a minimum of 5 m^2 per capita availability of GI* criterion best suited into local context. Based on 2010 census data, we found a quite better scenario here while 17.1 percent districts categorized as Green while only 11.4 percent districts were classified as Yellowand a larger portion of 53 percent falls in Red category (Table 3).

It was also observed that all the 'grey' categorized areas are located at the outer periphery of the city except a few grey patches at the city core. Thematic maps indicate that green categorised areas are generally lays at the core (old city), surrounded by yellow and then red category districts (with fewer exceptions). It echoes a general notion that considerably less attention is paid on GI optimization while constructing and expanding new districts (Figs 3 and 4).

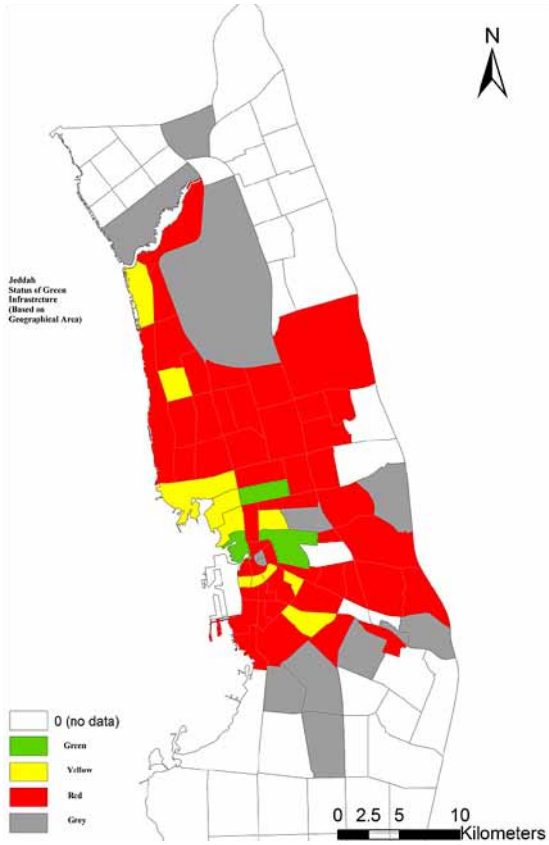

Fig. 3. Status of Green infrastructure in Jeddah based on geographical area

Table 2. Status of Green infrastructure in Jeddah (geographical coverage)

Category	Geographical coverage of Green infrastructure (in % of total area)	No. of Districts	% of Districts
Green	5% and above	3	4.3
Yellow	2.5 % to 5 %	10	14.3
Red	0.1% to 2.5 %	44	62.9
Grey	0%	13	18.5
	Total	70	100

Table 3. Status of Green infrastructure in Jeddah (per capita availability)

Category	Per capita availability of Green infrastructure (in m2)	No. of Districts	% of Districts
Green	5 m^2 and above	12	17.1
Yellow	2.5 m^2 to 5 m^2	8	11.4
Red	0.1m^2 to 2.5m^2	37	53
Grey	0 m^2	13	18.5
	Total	70	100

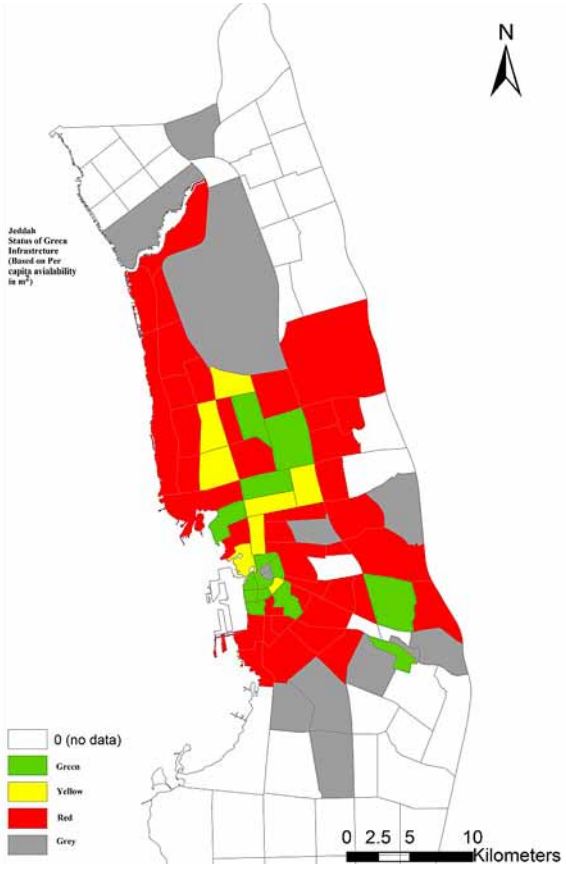

Fig. 4. Per capita availability of Green infrastructure in Jeddah (in m^2).

Spatial temporal analysis of urban growth in Jeddah city (Aljoufie *et al.* 2013) discloses that city's built environment development has followed its growth of transportation infrastructure; howeverit failed to offer corresponding GI with changing demography and competing priorities for sustainable development.

GI accessibility in Jeddah

Functionality of green spaces is equally influenced by the location and distribution (accessibility) in city boundaries (Grahn, Stigsdotter 2003; Neuvonen *et al.* 2007). A study on Jeddah reveals that around 70 percent population of Jeddah city is forced to walk more than 1/2 kilometer to avail GI services (Khalil 2014) which a major drawback for the improvements for the people's Quality of Life in the city.

Above discussions indicates that existing GI at city of Jeddah is inadequate. If we want to ensure a minimum of 10 m^2 per capita of GI availability in the city it would need more 28.3 million $m^2$of areas with GI which is not impossible but quite difficult.

GI constraints in Jeddah

General climatic conditions in Jeddah are not favorable for GI which is hampered because of Climate Change, unsustainable water flows, pollution of surface soil, exacerbated GHG emissions and air pollution and halfhearted planning intermediations. These constraints have internal and external complex linkages which are discussed further (Fig. 3).

Adverse climatic situations

Arid climate is prevalent over Arabian Peninsula; whereas it's larger portion could be considered as hyper-arid. Most of the region undergoes with less and irregular precipitation and the vegetation there are harassed with higher rate of evapotranspiration. Though nature is little generous at Jeddah (comparing arid regions of the KSA) yet weather conditions are still dominated by high temperature in summer season (from 43 to 50 degree Celsius) and quite moderate and pleasant during winter (from 18 to 25 degree Celsius), low precipitation (40 mm), high humidity (90 to 100 percent during summer) and speedy winds in general. Extreme weather conditions tend to continue beginning from the end of February to the end of October which hampers expansion and development of GI cumulatively.

Threats from climate change

Changes of any type causes extreme weather events for instance heat and cold waves, heavy precipitation and risk of elongated famine incidents occurrences (Kotwicki, Al Sulaimani 2009). Many of Saudi Arabian cities have experienced such extreme weather events as year 2010 was the warmest year ever recorded while on the 22nd June Jeddah's temperature reached up to 52°C. Extreme rainfall also hit the Jeddah city in 2009 and 2011 (Almazroui 2011a, b). In Jeddah evidences shows that general pattern of temperature is showing an linear increase with a decadal rate of 0.5°C to 0.72°C in the wet (dry) seasons while the rainfall along with Red coast shown increasing trend opposite to inland parts of Kingdom (Almazroui *et al.* 2012). In the extreme rainfall weather event of 2009 Al-Muntazahat, Quaizah, Al-Adl, Al-Sulaimaniyah and Al-Jamaa Districts were hard hit (Humaidan 2009) with a loss of 121 people's life and damage of property about 800 million USD which has compelled for public policy reform to enhance preparedness and response abilities for dealing with natural and manmade disasters (Momani, Fadil 2010).

Unsustainable water flow

Water flow efficiency has multiple links with the development of GI in Jeddah city. At first Jeddah city is getting its water supply through desalination plants being operated at Red Sea coasts. These desalination plants are operated by hydrocarbons fuels, hence emits

excessive CO2 and contributes to city heat island effect as wee as pollutes city's ambient air tackling with this challenge expansion in GI is a must. Secondly, city don't have enough sewerage systems and over rely upon septic tanks till recent past which have led underground water table rise (Abu-Rizaiza 1999) and its excess pollution from higher amount of nitrates which makes groundwater (through seepage) non-usable for GI irrigation and watering. Thirdly, while evapotranspiration is high due to high temperatures GI requires a lot of water to sustain while the daily supply of city's water is daily of 1 million cubic meters; unfortunately only 25 to 30 percent quantity is received for watering of GI in reuse mode. This less water availability is mainly due to inadequate urban infrastructure to ensure sustainable urban water flow including storm water and sewer or wastewater. Additionally less reuse of treated water is also hampering expansion of GI in Jeddah.

Soil pollution

Soil quality is one of the key determining factor for the GI sustainability, while researchers has concluded that the soil of the Jeddah city contains a significant level of highly toxic metals.Lead (Pb) and Zinc (Zn) are the major metals found in Jeddah's roadside soil (Khodeir *et al.* 2012). There are two possible reasons of lead contamination in urban soil *lead based paints* and *automobile emissions* (Rosen 2010). Further Zink(Zn) is an essential nutrient for plants as they use it for creating chlorophyll though its high amount can put most of the plants species at and life in the soil at risk including earthworms and microorganisms which keeps the soil fertile.

GHG emissions and air pollution

GHG Emission and Air Pollution Data of Jeddah is quite despairing which is because almost all activities in the city runs upon petro-energy whether it is commuting, water supply, power generation, or domestic and industrial energy requirements while a lot of GHG emissions generated because of cooling instrument at built environment. A World Bank estimates shows that GHG Emissions per capita in the city is 6.6 tCO2e while PM10 Concentration is 129 mcg/cu.m (Hoornweg, Freire 2013) which is higher than many of its comparable cities (in population) but unfortunately while other city have remedies for emissions and air pollution in form of GI in a considerable amount Jeddah merely have 1% GI over its geographical extent.

Strategic plan of Jeddah and GI

A 20 years strategic plan has emphasized the transformation Jeddah into a globalised and competitive city ensuring high quality of life to its dwellers with safeguarding natural environment to fulfill needs of present generation and the generations still to come. The plan itself appreciates the fragility of Jeddah's current GI scenario. Yet not developed; plan has identified eastern hill areas as potential natural reserve and park. While strategic plan has been adopted an Environmental Master Plan yet to come with the technical support from Jeddah Urban Observatory-JUO and United Nations Development Programme-UNDP. The Strategic plan also recognizes low awareness among citizens on environmental damage because of individual's actions and also the worth of environment for a higher quality of life (JM 2009). In brief Strategic plan has not properly addressed and accommodated GI issues in particular.

GI issues and interventions in Jeddah

In a case study of USA suburban areas; Schilling and Logan (2008) specified that despite political wills and commitments environmental capacity and support at local level are the crucial ingredients of urban GI development. Concerning Jeddah; there are a variety ofchallenging issues and required interventions for sustainable GI expansion and development such as awareness creation, need of a central park, using GI for improved urban health and overall wellbeing. Offering amenities through a proper business model would be an important strategy towards sustainability of GI in Jeddah.

Awareness towards GI

Arguably, GI is considered an activity to connect landscape with people (Benedict, McMahon 2006); this bond can be more enriched by espousing a collaborative approach, in which experiences of residents can cheer up the planning of urban GI (Faehnle *et al.* 2014). Additionally, residents' awareness is another vital tool, to ensure participation in the planning, management, expansion and development of GI. Unfortunately; Strategic Plan of Jeddah, confess that level of awareness among city residents on GI is relatively insignificant (JM 2009). Though there are a few initiatives are operational; such as 'Friends of Jeddah Parks' which was launched in 2006, to bring about changes through volunteering in urban environmental sector, they are showing their immense commitment towards keeping urban parks clean and green and encourage recycling; all above aimed at improving environmental health and safety. They are in fact raising awareness towards GI importance through direct involvement and also using social media (FJP 2014).

Multilevel provision of GI

We observed that optimise expansion of GI in Jeddah is not possible only through District level provisions rather it demands a multilevel provision internally at City, District, neghiourhood and Household levels and externally at peri-urban areas (Fig. 5).

Unfortunately there is no city level GI in Jeddah; besides its gigantic monetary wealth and high household income. Although getting a 'large central park'or a 'botanical garden' like Cambridge University's botanical garden, central park of New York and Tuileries in Paris is a prolonged desire of city dwellers in Jeddah (Bawazeer 2012). Vacant land is argued to possess greater potential of urban greening (Pearsall, Lucas 2014). We have detected a huge vacant lot at Old Airport site in Jeddah that could be a preferable location for central park or botanical garden; which is spread over 1200 hectares of land area. We propose that 2/3 of land could be used for residential and commercial purposes while the remaining balance could be a good choice for GI inform of central park or botanical garden according to experts and citizens.

GI should be also strengthen at other levels such as neighbourhood and household levels; green roofs could be an suitable option for GI optimization at household level; at district and neighbourhood level urban gardens and lawns should be sustainability provided and maintained. Apparently, distract level expansion must not be forgotten.

We also found that only internal (inside the city) expansion of GI is not an ultimate strategy rather it needs external expansion simultaneously, in this regard Jeddah municipality has started executing of a dense green forest area provision in nearby peri-urban area of Jeddah which was an infamous sewerage lake before; the project cost is 7.46 million USD aimed at planting 200 thousands tree over a 2.5 million square meter land area (Hatrsah 2008)which was previously being used as a sewerage lake where raw, untreated wastewater used to grow for 2 decades (before 2010) threatening to city's aquifers and vitality at many occasions. Currently the project is in halfway through appears considerably green. Many eco-system services are expected from this project such as big public park for entertainment and leisure activities, offering wood for construction and manufacturing purposes through 6 tree species while municipality have intension to further extend this project.

Proposal for Multilevel Green Infrastructure Provision in Jeddah

Location	Level	Example
Internal	City Level	Central Park
	District Level	Large Park
	Neighbourhood Level	Garden/Green Lawns
	Household Level	Garden/ Green Roof
External	Peri urban Level	Dense Forest

Fig. 5. Proposal for multilevel Green infrastructure provision in Jeddah

GI as solution for urban wellbeing in Jeddah

On one hand finding of Oil in Arabian Gulf has contributed to sustained growth in individual incomes and wealth on other hand it has transformed urban life style more inactive and dominated by junk food consumptions, socialising at air conditioned shopping malls, overreliance upon cars, low availability of pedestrian pathways and almost lack of green spaces and all these together has increased higher risk of obesity, high blood pressures, hyper tension, stress and Diabetes (Ng *et al.* 2011; UN-Habitat 2012).

In Saudi Arabia the scenario is not contradictory where in the year 2008 were 22 percent male and 21.7 percent female (aged 25 years and above) were suffering from raised blood glucose; while 32.9 percent male and 30.7 percent female (aged 25 years and above) were victim of raised blood pressure and 29.5 percent male and 43.5 percent female (aged 25 years and above) are stressed with obesity (WHO 2014b). Urban Health scenario in Jeddah is not different from above figures; hence it calls for more room for physical activities to its citizen which is possible only through sustainable development of GI.

Offering amenities at GI sites and preparation of a business model

A recent news report reveals that some of Jeddah's public gardens are not clean, lack basic amenities and maintained inappropriately. Lacking considerable attention, poor lighting, improper sanitation, increase of cats and mice are the factors impeding residents of the locality to use it (Hamid 2014). Hence the situations reported above draws considerations from policy makers to ensure cleanliness, proper lighting, provision of lavatory, refreshment, shades and chairs for GI users in their neighborhoods while these offerings could be financed through user pay charges. "Who is going to pay for it?" is the question asked at a glance for the financing of GI; many cities are exploring innovative methods of financing including access to capital market (Chen, Warren 2011). Koppenjan (2015) has identified Public Private Partnerships as an important instrument of GI provision, management and financing.

Conclusions

Worth of GI is being recognised globally because of its multifaceted functions; especially the urban areas need more stack of such infrastructure due to growing stress from high population growth and rapid urbanisation. Unfortunately Jeddah; which is the most happening and the second largest city of Saudi Arabia; is facing acute shortage of GI supply.

The study shows that while on one hand none of the district has more than 11 percent of GI stack, considering the geographical coverage, on the other hand, GI hardly cover 1 percent of the, total geographical area in the city. Additionally the per capita availability of GI in the city is only 1.7 square meters.

A four colour format –'grey', 'red', 'yellow' and 'green' was deployed to symbolise existing state of GI on the basis of sought attention from most urgent to least urgent. In 13 districts of Jeddah, the amount of GI coverage is insignificant which are representatively placed in 'grey' category. Moreover, considering the norm of GI availability over 5 percent of the geographical area, we observed that only 4.3 percent districts qualify in 'green' category while 62.9 percent districts falls under red category. On the contrary, only 17.1 districts were found eligible in 'green' category if a standard of 5 m^2 per capita availability of GI being set while 53 percent districts comes under 'red' category.

The study also reveals that GI stack is more generously exists around the old city (amid city core) which goes spares towards outer areas with a few exceptions around city center. In addition to that, accessibility of GI in Jeddah city is poor indeed as more than 70 percent of the city population is compelled to walk, over 500 meters to avail it.

Therefore; the provision of GI in the city of Jeddah is not acceptable in term of geographical coverage or in per capita availability while the accessibility of GI is also poor. On the contrary, a series of challenges prevailing in the city attracts serious interventions to expand expansion and offer adequate GI, these challenge includes hot and arid climate, future threats from climate change & extreme weather events, unsustainable flow of water, soil pollution, GHG emission and air pollution. These problems could be hopefully solved with the adequacy of GI for which policy makers promised in the strategic plan of Jeddah, and still awaited by the city dwellers who aspire also for a central park with the multilevel provision of GI aiming at the improvements in general conditions of health across the city. Obesity, high blood pressure and increased blood pressure is threatening livability and Quality of life in the oil rich gulf cities of which Jeddah is not an exception. Additionally, finding appropriate place for central park, creating awareness among people towards value of GI, offering miscellaneous amenities at GI sites and arranging innovation financing options through a sustainable business model for GI provisions are the essential task that should be carried out on the basis of top priority.

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