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## TABLE OF CONTENTS

1	Infrastructure Project Management and Implementation: A Case Study Of the Mokolo-Crocodile Water Augmentation Project in South Africa <i>Elkington Sibusiso Mnguni</i>	1
2	Extending Feature Models with Non-Functional Feature Modeling in Software Product Line Evolution <i>Olfa Ferchichi, Raoudha Beltaifa, Lamia Labeled</i>	2
3	Hybrid Method for Smart Suggestions in Conversations for Online Marketplaces <i>Yasamin Rahimi, Ali Kamandi, Abbas Hoseini, Hesam Haddad</i>	3
4	English Language Teaching in Moroccan Higher Education: Achievements and Challenges <i>Elhoussain Idbahsine</i>	9
5	Motivational Strategies and Job Satisfaction as Correlates of Library Service Delivery in Selected Tertiary Institutions in Southwest Nigeria <i>Esther Kelechi Soyele</i>	10
6	The Interpretation of Prof. Luigi Viola: An Implicit Provocation and Criticism of the Current Italian Judicial System <i>Snezana Lazovic</i>	11
7	<b>Nature-Based Solutions: The Holy Grail of Green Urbanism</b> <i>Israa H. Mahmoud</i>	28
8	A Flexible Real-Time Eco-Drive Strategy for Electric Minibus <i>Felice De Luca, Vincenzo Galdi, Piera Stella, Vito Calderaro, Adriano Campagna, Antonio Piccolo</i>	36
9	Understanding Farmers' Perceptions Towards Agrivoltaics Using Decision Tree Algorithms <i>Mayuri Roy Choudhury</i>	37
10	The Application of Green Technology in Construction and How It Affects Cost Reduction During an Economic Crisis <i>Jason R. Rebamontan, Karl Danielle A. Cua, Samuel Reginald T. Lacuna</i>	38
11	Synthesis, Structural and Spectroscopic Studies of NaSrVO <sub>4</sub> Doped with Nd <sup>3+</sup> . <i>Parul Sharma, Kamni Pathania</i>	39
12	India's Neighborhood Policy and the Northeast: Exploratory Study of the Nagas in the Indo-Myanmar Border <i>Sachoiba Inkah</i>	40
13	Clubhouse: A Minor Rebellion against the Algorithmic Tyranny of the Majority <i>Vahid Asadzadeh, Amin Ataee</i>	41
14	Migration and Policy Dedication in Ethiopia: A Study of Migration of Hadiya People <i>Solomon Tagesse</i>	42
15	Conceptualizing IoT Based Framework for Enhancing Environmental Accounting By ERP Systems <i>Amin Ebrahimi Ghadi, Morteza Moalagh</i>	43
16	Impact of Economic and Financial Factors on Tax Revenue as Percentage of GDP: Evidence from Pakistan <i>Abdul Mannan</i>	44
17	Subdued Electrodermal Response to Empathic Induction Task in Intimate Partner Violence (IPV) Perpetrators <i>Javier Comes Fayos, Isabel Rodríguez Moreno, Sara Bressanutti, Marisol Lila, Angel Romero Martínez, Luis Moya Albiol</i>	45
18	Difficulties in the Emotional Processing of Intimate Partner Violence Perpetrators <i>Javier Comes Fayos, Isabel Rodríguez Moreno, Sara Bressanutti, Marisol Lila, Angel Romero Martínez, Luis Moya Albiol</i>	46

19	Examination of Porcine Gastric Biomechanics in the Antrum Region <i>Sif J. Friis, Mette Poulsen, Torben Strom Hansen, Peter Herskind, Jens V. Nygaard</i>	47
20	Improving Glycemic Control in Pediatric Patients with Type 1 Diabetes Mellitus <i>Amanda Baine</i>	48
21	Management of Geriatric Bipolar Disorder: A Case Series and Review of Current Evidence-Based Treatment Guidelines <i>Rana Jawish, David Atkinson</i>	49
22	Maternal Experience During the Establishment of Feeding among Infants Who Have Feeding Issues, at Selected Neonatal and Pediatric Units in Gampaha District, Sri Lanka <i>Lakna Mignon Fernando</i>	50
23	Electromyographic Analysis of Trunk Muscle Activity of Healthy Individuals While Catching a Ball on Three Different Seating Surfaces <i>Hanan H. ALQahtani, Karen Jones</i>	51
24	Modern Contraceptive Use Among Female Refugee Adolescents in Northern Uganda: Prevalence and Associated Factors <i>Ritah Bakesiima, Amanda Cleeve, Elin Larsson, James K. Tumwine, Kristina Gemzell-Danielsson, Rose Chalo Nabirye, Jolly Beyeza-Kashesya</i>	52
25	Evaluation and Association of Thyroid Function Tests with Liver Function Parameters LDL and LDH Level Before and after I131 Therapy <i>Sabika Rafiq, Rubaida Mehmood, Sajid Hussain, Atia Iqbal</i>	53
26	Basic Guidelines of Bacteriophages Isolation and Characterization <i>Safia Samir</i>	76
27	Bacteriophage Therapy is an Emerging Novel Solution of Antimicrobial Resistance <i>Sanjay Shukla, A. Nayak, R.K. Sharma, A.P. Singh, R.V. Singh, K. Jadav, S.P. Tiwari</i>	77

# Nature-Based Solutions: The Holy Grail of Green Urbanism

Israa H. Mahmoud

**Abstract**—Cities are living systems. A holistic vision for urban sustainability looks at the city as an integration of energy, environment, mobility, urban design, new technologies, and most importantly “people and nature”. In this article, the aim is to shed the light on the role of Nature-based solutions (NBS) towards addressing climate change crisis and tackling a variety of socio-ecological challenges. Firstly, and most importantly, we review the role of NBS in shaping urban planning policies as a result of expansion and densification of cities. Secondly, we reflect on the co-benefits generated by NBS within the social and cultural regeneration of cities. Lastly, in this article we give examples from Nice, Boston, and Milan in order to showcase those cities spatial strategies to implement NBS through different scales. As a result, we reflect upon the residual impact on cities territorial planning which remains mainly environmental and less explored culturally and socially.

**Keywords**—Urban regeneration, nature-based solutions, green urbanism, socio-cultural regeneration.

## I. INTRODUCTION

While many scientific contributions discuss the definitions and the theoretical frameworks of nature-based solutions [1-3,6,9,38]; however, hands on experiences and evidence-based methodological frameworks are still needed to improve our understanding to the wider range of economic, social and environmental benefits provided by NBS in cities, in order to promote their inclusion in urban planning policies and decision-making processes. The fundamental research question is about how the embeddedness of NBS in cities greening strategies tangibly affects urban morphologies and radically impacts on our approach to green urbanism and strategic planning. Currently, cities are making use of nature as a solution to many challenges, without radically and critically address the full potential of using urban greening as a design feature. Cities like Copenhagen and Paris deal with change in their historic urban plans to cope with pressuring climate challenges and risks [1]; nonetheless, cities such as Milan plan ambitiously to plant three million trees by 2030 [2]. Integrating nature and NBS seems happening more and more frequently in city plans and visions; however, a deep recognition of the role of green in shaping the overall imagery of cities and renovating the green as a quintessential element of design and planning seems lacking a deeper and conscious debate.

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## II. NBS RELEVANCE IN URBAN PLANNING

### A. Literature Review

The original definition of NBS derives from the International Union for Conservation of Nature (IUCN) 2013-2016 Programme as: “actions to protect, sustainably manage and restore natural or modified ecosystems, which address societal challenges (e.g., climate change, food and water security or natural disasters) effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits” [3]. The European Commission [4] gives a broader definition of NBS, as “actions inspired by, supported by or copied from nature that aim to help societies address a variety of environmental, social and economic challenges in sustainable ways”. According to the European Commission scopes, NBS can transform environmental and societal challenges into innovation opportunities, by turning natural capital into a source for green growth and sustainable development for application in urban areas [5]-[8].

Top notch scientists have long discussed the importance of greening cities and the benefits of green infrastructure to reduce environmental pollution, mitigate climate change, enhance social cohesion and improve people well-being towards sustainable communities [9]. It is often believed that NBS simultaneously provide co-benefits for biodiversity and human health and well-being while fulfilling the functions of urban infrastructures using or mimicking natural processes. Raymond et al. [10], [11] assess a theoretical framework of NBS implementation in urban areas and their generated results as follows: 1) co-benefits for human health and well-being; 2) integrated environmental performance (e.g., the provision of ecosystem services); 3) trade-offs and synergies to biodiversity, health or economy; and 4) potential for citizen’s involvement in governance and monitoring. However, in urban contexts, the co-benefits of NBS are being increasingly recognized as a result of provisioning and improved availability of urban green spaces, such as parks, green corridors, etc. Even though not exhaustive of NBS types of interventions, literature often refers to “climate co-benefits” as result of intended positive side effects of a policy from climate change policies [12]-[14]. Such positive collateral benefits include also: improved quality of life, mental and physical health [15], and reinforced cultural identities, supporting a sense of belonging and place stewardships, etc. [6], [16]-[18]. Moreover, an overarching review of the literature highlights the importance of health benefits specifically generated by NBS, in particular see [19]-[21]. Taking this aspect of multi-functionality into account and considering the plethora of co-

benefits produced, NBS are often seen to represent more efficient and cost-effective solutions to climate change threats than conventional approaches, such as regular sewage or air conditioning systems, see [22]. Demonstrating these co-benefits, in that sense, could guarantee both stakeholder groups support, and funding opportunities to ensure a longer mainstreaming and acceptance of NBS across urban policy areas [23], [24]. Based on this understanding, decision-makers are encouraged to approach science-driven minds to plan, co-design and co-develop NBS [25], [26], towards making urban areas more sustainable and resilient [27].

#### *B. NBS Role in Solving Challenges of Complex Cities'*

NBS have proven outcoming positive impacts on cities environmental challenges without a doubt; nonetheless, the major challenge planners and designers have to face in NBS implementation refers to the land use regulations and the spatial allocation. Many cities and regions nowadays give-a-go towards more integrated urban solutions that work on multiple urban spatial scales, from nano to macro, such as green roofs and walls on buildings, green and eco-furniture in public spaces, as well as urban green corridors that also act as ecological habitats aiming to increase biodiversity.

With pressuring climate change challenges, many cities tend to use greenery and greening strategies to enhance existing infrastructure while offering side co-benefits to its citizens [28]. Hence, urban living labs (ULLs) are assumed to be the most convincing form of application for testing shared governance experiments, since nature and NBS are relevant to citizens' wellbeing due to the multiple co-benefits these later provide in terms of scales and costs. However, citizen engagement and empowerment in the procedural implementation of these strategies makes it longer and exhaustive to municipalities and decision makers to embark on. Mostly, in urban planning policies, the process of citizen empowerment is often figurative and ignored by local authorities. Spatial challenges and shared governance challenges are nowadays considered the war-line of citizen-centered urban planning. Nonetheless, many greening strategies require a lot of technical times to get executed, that process is lengthy, exhaustive, and mostly radically changing cities interfaces in a time of climate change uncertainty.

Literature argues on many spatial levels the need for a real operational pathway for NBS implementation - and other types of UGI - that overcomes the silos thinking in urban planning policies in order to cope with the emerging needs of cities and rapid urbanization [29], [30]. To put in place such a complexity of urban regeneration processes, the place-based implementation is most likely to take place in a physical ULL. The term is commonly used in urban planning to exploit dynamics of an innovative process to ideate, design and implement new products and services, in this case the service is the NBS deliverance. Nevertheless, in practice, very few experiences of shared governance in urban greening policies are considered successful in regeneration processes since it is hard to develop tailored policies, because of the following aspects:

- 1) Spatial challenges: hard to frame the different NBS that apply on different scales: NBS are very different amongst each other: The spatial implementation tends to be the most challenging since it varies from building scale interventions, public space interventions, water body systems, transport linear infrastructure, natural areas and ecological habitat interventions. These differences drive the need to be addressed with careful implementation techniques and capacity building to overcome the long-term maintenance timelines and responsibilities issues.
- 2) Governance challenges: breaking internal silos and prioritization in public discussion: While shared governance is an evident need in NBS lifetimes, the methods and procedural procurement in the public administration did not develop with the same rhythm. Internal silos still withhold a smooth implementation due to lack of communication and coordination strategy between different departments and a multi-scalar perspective of stakeholders' engagement. Nonetheless, most public administrations lack a more holistic approach to integrate NBS in urban policies by focusing on a comprehensive set of economic, social and environmental "win-win" co-benefits.
- 3) Temporal challenges of different projects and scales: Diversity in NBS types and scales brings in different timelines across ULLs scales of implementation. In one case of ULL implementation, there could be a variety of NBS in-place that need different timelines and skills for co-design and co-implementation.
- 4) Financial challenges: economic feasibility and resources to activate: While the willingness to pay for ecosystem services changed paradigmatically during the last years because of the pressing issues of climate change adaptation and resilience coping strategies; yet the NBS granular financial challenges are more of an adequacy of activation of resources and an economic feasibility during the implementation timeline. Public works and sponsorships follow different rules and timing making coordination very difficult.

### III. SPATIAL SCALES AND METHODOLOGICAL ANALYSIS

Throughout the literature review, few questions were raised on the spatial challenges, governance challenges, and financial challenges related to NBS implementation practices. NBS are considered quite complex from a multifunctional point-of-view and require a multiplicity of stakeholders' collaboration during the realization of the intervention. The following section analyses the complexity and diversity of spatial scales challenges through NBS creation, implementation and long-term maintenance.

Firstly, NBS are not stand-alone systems; to be effectively implemented at urban scale in order to reverse ecosystem degradation trends; they need evidence-based standards, benchmarks and coordinated guidelines for practitioners to be developed, see also [31], [32]. Limited land space and time frameworks are widely reviewed restrictions of NBS, especially in dense urban areas such as cities inner centers. In

general, NBS require more land (and longer time) to provide expected co-benefits than conventional grey, blue and green infrastructures [33]. It is also important to highlight that NBS should not be considered an ‘either-or’ alternative to other grey solutions. In some larger metropolitan scales, “Hybrid solutions” that blends NBS with engineered systems may provide the optimal impact considering environmental challenges, spatial requirements and financial resources [7], [34].

Secondly, during the implementation of NBS, spatial dimension is also considered as a two-faced coin. The peculiarity of urban regeneration processes is the multiplicity of stakeholders in the same spatial proximity; that could be an advantage and a disadvantage at the same time. While stakeholder’s collaboration in a small spatial proximity is important to create a cluster that easily gets together, shares information and traffics knowledge exchange; it also creates competition and conflicts of interest. Another evident aspect of NBS in urban regeneration projects across cities is the green gentrification [35]. Like any other green strategies, if they are successful, they may exclude ultimately some residents and business from accessibility, and eventually exclude vulnerable populations. In this sense, urban green projects can set off rounds of gentrification, dramatically altering housing opportunities and lower income communities which are more acute for liveable and attractive cities [36].

NBS typologies and application scales can vary along the implementation and maintenance timeframe [37]. This perspective calls for a multiplicity of stakeholder groups to collaborate a long time to maximize the delivery of NBS in place, and to embark on adapting climate change by means of NBS while fulfilling stakeholders’ specific agendas. Examples from across European cities show cases that NBS spatial challenge is instrumental [38], see knowledge repositories such as [39], [40]

One Pilot project, KLIMATEK [41] categorizes NBS by scales of interventions (types) and by urban typologies diagnosis (climate threats and expected environmental co-benefits). Their work highlights the need to “easy replicate, coherent and clear methodology” to spatially map existing NBS and potential new deployments in order to address a variety of climate threats (such as: flood, sea level rise, droughts, and urban heat islands) while providing social and economic co-benefits as well. However, the NBS literature covers a wide array of interventions with a variety in scopes (from pervious pavements to urban forests), scales (from individual buildings, urban furniture to metropolitan forests and beyond), and range of functions (water detention, urban heat island mitigation to social inclusiveness and cohesion), see [42]-[46].

Summing up, the spatial scale challenges of NBS drastically change the resources needed to get implemented, the cost of maintenance on a longer term and the need to address a specific place-based challenge. While environmental challenges are the most pressing answer to NBS deployment, social and economic co-benefits should also be highly considered in possible urban regeneration processes that take

place in dense built-up areas with remarkable spatial vulnerability.

The following section of case studies exposes the examples of three spatial differences: micro, macro and meso scales. The idea is to reflect on how at all spatial scales, the use of the NBS does not cease at being a simple park or a green promenade but rather performs as a socio-cultural infrastructure for cities as well.

#### IV. CASE STUDIES

##### A. Micro Scale: A Neighborhood Park

*Biblioteca degli Alberi (BAM)*, in the heart of Porta Garibaldi and Isola neighborhood of Milan, is more of a simple green neighborhood park. Its stiches the entrances of the neighborhood with the main street of Via Gioia, one of the oldest city’s traffic veins and Mind axes towards the city center.



Fig. 1 Example of seating areas and trees in the BAM park. Spring 2021



(a)

(b)

Fig. 2 The BAM Park during morning ((a) Municipality conference, Summer 2020) and night events ((b) a free musical concert, Spring 2021)

In [47], a critical reading for the role of BAM in the city urban design planning related to green infrastructure is

provided. Coima company, as the main landowner and maintenance provider for the park, sponsor social and cultural events in the BAM in order to maintain its sociability and livability. In winter, covered up terraces and areas work as possible social activities places. Nowadays, and due to COVID-19 social distancing regulations, all promoted social activities are held in open air only and with respect to sanitary regulations.

*B. Macro Scale: A Green and Blue Corridor*

*Promenade du Paillon, Nice* in France is one of the most relevant Meso scale examples of NBS. It is a green walkway throughout the city center with open air games for children, water elements and mist sprays for cooling, run-off collection and social entertainment to lower perceived temperature in summer. The Lush Park crosses the old city center towards the coastal passage is also considered a cultural hotspot for events. This example also has a socio-cultural aspect in it, the park also is a scene for summer festivals and open-air concerts. The promenade is also promoted as one of the must-go touristic spots in all city's recommendations.



Fig. 3 Google earth map for Promenade du Paillon location



Fig. 4 Water elements at Promenade du Paillon, Nice. Summer 2019



Fig. 5 Green elements at Promenade du Paillon, Nice. Summer 2019

*C. Meso Scale: A Green way*

*Rose Kennedy Greenway of Boston, Massachusetts, USA* is an example of how a different combination of green and blue infrastructures can blend into a strong socio-cultural urban regeneration process. The greenway crosses three different districts and has many parks allocated along the pathway, such as: Northend park, the Wharf District Park, the Dewey Park, and the Chinatown Park.



Fig. 6 The Mapped location of the Northend Park along the Green way in Boston, MA [50, based on 51]

The Greenway of Boston came a long way of urban regeneration process from a highway into a greenway in the 2000s [48]. The radical change started by replacing an elevated highway in 2004. That Highway have lengthy bludgeoned the downtown of Boston by a Greenway

containing a series of parks as seen in Fig. 6. Nowadays, the series of parks connecting the emerald necklace with the waterfront are also scene of cultural and social urban regeneration.



Fig. 7 The Wharf district park as seen from the middle of the greenway, Summer 2017



During good weather seasons, the park is flooded with tourists and locals that attend musical festivals, yoga classes and lounge in the Italian adjacent neighborhood and coffee shops. The cultural programming handled by the Rose Kennedy Greenway conservancy also includes a wide range of cinema festivals, open-air museums expositions, Christmas markets and touristic historical tours.



Fig. 8 The Northend Park along the Greenway in Boston. Summer 2018

#### V. DISCUSSIONS AND CONCLUSIONS

Green and Blue infrastructure and NBS should be systematically integrated into urban planning, including in public spaces, infrastructure, and the design of buildings and their surroundings. The most winning formula for cities willing to implement NBS successfully is a mix between green, blue, and socio-cultural elements.

From the cases studies presented in this article, it is evident that NBS territorial impact is environmentally explored to extremes, contrarily less evident from a socio-cultural perspective. In Milan, the BAM as situated in a rich and lately regenerated neighborhood brings a lot of touristic attraction to the area also to see the world famous “Bosco-Verticale” building. On the extremities of the BAM, economic activities generate income because of this cultural flow. In Boston, the greenway crosses a historical and contemporary pathway through the city bringing together different social classes, cultural events, and most importantly economic impacts. In Nice, the scale of the promenade does not allow much of the income generation to adjacent economic activities due to a vicinity to the waterfront that attracts much more touristic flows.

Clearly, NBS have a socio-cultural role on many meso and macro spatial scales, less clearly an economic urban generated impact at micro scale. From evidence-based research, many cities have developed strategic and urban planning mechanisms that favor nature embeddedness in future urban regeneration processes. However, social and cultural urban regeneration results as marginalized topics in comparison. Clear obligations in terms of binding policies at all spatial and political scales should emerge, especially after the latest development of climate crises in the last decades. NBS in this sense look like the “Holy grail” to sustainability and resilience

planning<sup>1</sup> as a provider for environmental, social and cultural co-benefits; nonetheless, the road to measure by scientific evidence the economic spillovers of NBS on the longer terms is still a bumpy and winding road to go.

#### DISCLAIMER

All images are author’s own unless cited.

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<sup>1</sup> The term holy grail is borrowed from Michael Newman, Viewpoint article: Is resilience planning’s holy grail? [49]

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