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Masoud Faryadi

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ENHANCING SUSTAINABLE COMMUNITIES THROUGH THE PROTECTION OF NATURAL BUFFER ZONES

Masoud Faryadi*

ABSTRACT

Certain regions within Middle Eastern countries are vulnerable to climate-related hazards, including floods and dust storms, resulting in adverse consequences for these nations and hindering the sustainable development of urban communities. The preservation and development of natural buffer zones, such as green spaces and surface waters, offer nature-based solutions to shield urban areas from the impacts of these hazards. This article examines the significance and legal protection of these buffer zones and concludes that, despite their effectiveness in mitigating floods and dust storms, natural buffer zones have not received distinct recognition as protective zones for urban areas in international and national legal frameworks. The study recommends the integration of natural buffer zones preservation and development into national and regional urban planning and disaster risk management policies and strategies, highlighting their role as nature-based solutions for enhancing urban sustainability in the Middle East, especially Iran.

Keywords: Buffer zones, dust storm, flood, green spaces, natural disaster governance, sustainable communities.

1. INTRODUCTION

The establishment of sustainable communities, particularly within urban areas and human settlements, constitutes an integral component of the social dimension of sustainable development. In this context, the 11th Sustainable Development Goal (SDG)

underscores the imperative for states to foster cities and human settlements that are inclusive, safe, resilient, and sustainable.[1] A fundamental aspect of resilient and sustainable urban centers is the safeguarding of human life and the enhancement of resilience in the face of natural hazards. These natural hazards have the potential to wreak havoc by decimating habitation spaces and undermining the sustainability of communities, particularly in regions prone to disasters, such as most of the Middle East (ME) countries. This geographical area is recognized for its vulnerability to various climate-related natural hazards, including floods, droughts, and dust storms, which pose significant challenges to the long-term sustainability of communities in this region.

In recent decades, climate-related natural hazards have significantly impacted various communities in the ME, resulting in severe environmental, social, and economic consequences, including threats to livelihoods and food security, heightened social vulnerability, and population displacement.[2] Notably, the majority of the ME region is characterized by arid and semi-arid conditions with low annual precipitation levels.[3] This vulnerability is exacerbated by factors such as climate change, desertification, diminished precipitation, and reduced vegetation cover, making the ME one of the world's most heavily affected areas by sand and dust storms and a substantial contributor to regional dust emissions.[4]

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* Associate professor of Faculty of Law and Political Sciences, University of Mazandaran, Babolsar, Iran. E-mail: m.faryadi@umz.ac.ir

1 UNGA, Resolution on Transforming our world: the 2030 Agenda for Sustainable Development, 17th session United Nations General Assembly, 25 September 2015, A/RES/70/1.

2 Erin K. McFee, ''Climate Change, Water Scarcity and Migration' International Organization for Migration, Desk Review (2023), 9-11 <https://environmental migration.iom.int/sites/g/files/tmzbdl1411/files/documents/2023-09/cwsm2.pdf> accessed 16 December 2023.

3 Kamal H. Batanouny, Plants in the Deserts of the Middle East, (Springer 2001), 11.

4 G. Zittis, M. Almazroui, P. Alpert, et al. 'Climate Change and Weather Extremes in the Eastern Mediterranean and Middle East' (2022) 60, Reviews of Geophysics, e2021RG000762, 5.

Climate change, driven by factors like extreme precipitation events, rising temperatures, and heatwaves, coupled with diminishing water quality and availability, will profoundly affect urban areas, undermining their sustainability.[5] In the upcoming years, many communities in this region, already grappling with the effects of climate change, are likely to experience a substantial increase in natural disasters, including floods and dust storms. The persistent occurrence of these natural hazards, particularly prevalent in parts of the ME, notably Iran, Iraq, and Syria, presents a formidable challenge to the establishment of sustainable communities and the attainment of the 11th Sustainable Development Goals (SDGs) in this region. These hazards bring about severe political, social, economic, and environmental consequences for the affected communities, precipitating social and economic crises. As acknowledged in the Quito Declaration on Sustainable Cities and Human Settlements for All, mounting pressures on ecosystems, escalating pollution levels, the emergence of natural and human-induced disasters, and the rising risks associated with climate change collectively represent unprecedented threats to urban centers.[6] These multifaceted threats undermine collective efforts aimed at achieving sustainable development.

Natural hazards result from a complex interplay of both natural and human-induced factors, including alterations in land use and ecosystem degradation.[7] Nevertheless, it is essential to recognize that human-induced factors tend to expedite the occurrence of natural hazards, thereby becoming a primary driver behind the decline in populations, outward migration, and the degradation of living

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5 Rutger De Graaf-van Dinther & Henk Ovink, The Five Pillars of Climate Resilience, in Rutger de Graaf-van Dinther (ed): Climate Resilient Urban Areas: Governance, Design & Development in Coastal Delta Cities, (Palgrave Macmillan 2021), 2.

6 United Nations, Quito Declaration on Sustainable Cities and Human Settlements for All (2016), United Nations Conference on Housing and Sustainable Urban Development (Habitat III), 17-20 October 2016, Quito, (Art. 63).

7 World Bank, Sand and Dust Storms in the Middle East and North Africa Region: Sources, Costs, and Solutions; (World Bank, USA 2019:), 9.

conditions within certain communities over time.[8] Consequently, as sand and dust sources have formed and floodplains have become increasingly unstable in specific regions of the ME, these hazards have played a pivotal role in hindrance of sustainable development in these communities.

A combination of human-induced and natural factors has left many human settlements in vulnerable ME regions either devoid of essential natural protective systems or has caused the degradation of such systems, rendering them susceptible to the encroachment of natural hazards. Therefore, to enhance the resilience of communities, a plethora of immediate preventive, mitigation, and adaptive policies are urgently needed. The establishment of disaster-resilient cities represents an indispensable component of fostering sustainable communities and achieving the SDGs in an era marked by the challenges of natural disasters. Consequently, in order to confront the hazards posed by climate change and to make the cities safe, sustainable and resilient in this region, it is imperative that urban structures undergo transformation and restructuring to effectively countering the emerging threats posed by new natural hazards and advancing toward the realization of sustainable communities through green space development, flood prevention, overheating mitigation, and building design.[9]

A fundamental vulnerability of urban areas in the ME region lies in the absence of natural shields and buffer zones encircling urban areas, leaving them susceptible to the onslaught of floods and dust storms. Natural ecosystems such as green spaces, wetlands, and rivers, possess the capacity to absorb airborne particulates, manage surface runoff, and mitigate the deleterious impacts of dust storms and floods. Based on this function, the protection and development of natural buffer zones (NBZs) within and surrounding vulnerable urban areas emerge

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[8] UNDESA, World Urbanization Prospects: The 2014 Revision, United Nations Department of Economic and Social Affairs Population Division, (2014) ST/ESA/SER.A/366.

[9] Julia Affolderbach & Christian Schulz, Green Building Transitions: Regional Trajectories of Innovation in Europe, Canada and Australia, (Springer 2018), 194.

as a nature-based solution for augmenting the resilience of these communities in the face of natural hazards. This is a cost-effective solution that offers substantial environmental and socio-economic benefits and stand as fundamental pillars in the pursuit of sustainable disaster-resilient communities. As a result, to effectively mitigate and adapt to climate-related natural hazards and enhance the resilience of communities facing these threats, appropriate national regulations for the protection and development of NBZs within and around vulnerable urban areas should be put in place.

With this objective in mind, this article seeks to explore the role of NBZ in promoting the sustainability of communities in climate change-affected ME regions and the necessary legal protection required for these zones. In doing so, the article delves into the functions of NBZs and their contribution to enhancing the sustainability of urban areas. It also elucidates the imperative for the protection and development of these zones and outlines the requisite legal measures necessary for their advancement. NBZs have not become a legal subject matter in the environmental law literature yet, and so this article seeks to commence an initial discussion on the necessity of legal protection of these buffer zones in the vulnerable urban areas in the ME region, particularly Iran as a case study. The main idea that the dual function of green and blue spaces - both as vital natural ecosystems and effective buffering systems- should be recognized in national environmental and disaster management law, in order to be more effectively protected by stringent regulations.

The discussion will be structured into three sections as follows:

The first section will provide a concise overview of the indispensable role and operational dynamics of NBZs. In the second section, we will delve into the existing legal frameworks governing the protection and development of NBZs within both international law and the Iranian legal system. The concluding section will put forth recommendations for establishing legal safeguards to protect NBZs within urban areas facing vulnerability.

2. THE NECESSITY AND ROLE OF NATURAL BUFFER ZONES

Urban areas, as acknowledged in Article 64 of the Quito Declaration, often exhibit characteristics that render both the cities themselves and their inhabitants highly susceptible to the adverse effects of natural hazards. These increasing hazards encompass extreme weather events, flooding, dust and sand storms, and heatwaves, all of which are increasingly prevalent in many ME regions due to the unprecedented impacts of climate change.[10] Over time, these hazards have evolved into natural and social disasters, posing new challenges for communities in the region. Consequently, given the escalating climate-related threats, urban areas and local settlements in these regions necessitate preparedness through the implementation of appropriate protective and adaptive mechanisms.

Floods, heatwaves, and dust storms constitute the typical natural hazards associated with climate change, often are related with improper land use practices. Amidst the array of available adaptation and mitigation measures, the establishment of physical barriers emerges as a viable strategy to mitigate these hazards and curtail their physical extent. Therefore, one of the primary approaches to manage these two hazards involves the creation of buffer zones encircling vulnerable communities to provide essential protection. In this section, first the necessity for the development and preservation of NBZs will be examined, followed by an exploration of the pivotal roles these zones play in mitigating the impact of natural hazards.

2.1 The necessity for NBZ development

Certain regions within the ME have a historical susceptibility to the floods, dust storms and heatwaves. These regions perpetually face the looming threat of sand and dust storms, which exert a profound influence on various socio-economic dimensions, including transportation, education, construction, recreation, and energy

[10] IPCC, 'Climate Change 2021: The Physical Science Basis', Working Group I contribution to the Sixth Assessment Report, AR6, (2021), 2-53, 8-34, 8-45.

production, and adverse effects on cardiovascular and respiratory health among residents[11] across the majority of ME countries.[12]

It is predicted that climate change will exacerbate extreme events such as droughts, floods, and dust storms in certain regions of the ME.[13] It's worth noting that a significant portion of the ME consists of arid or semi-arid regions, inherently predisposed to drought and desertification, which are the primary drivers of dust storms in this area. If these predictions hold true, these natural hazards will likely intensify, raising concerns about the capacity of ME societies to mount effective responses and enhance resilience in the face of these heightened threats.

However, the recent impacts of climate change have notably heightened both the frequency and severity of these hazards. Dust storms, in particular, have become increasingly prevalent across most parts of the ME due to a combination of geographical and climatic factors.[14] Over the past few decades, a reduction in surface water availability within the ME has given rise to hydrologic sources of sand and dust storms.[15] This reduction in surface water availability stems from the scarcity of water resources, which subsequently leads to soil and vegetation degradation—an essential factor in the

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11 Y.O. Khaniabadi, S.M. Daryanoosh, A. Amrane, R. Polosa, P.K. Hopke, et al. 'Impact of Middle Eastern Dust storms on human health' 2017, 8 (4), Atmospheric Pollution Research, 14.

12 Nick Middleton, Saviz Sehat Kashani, Sara Attarchi, Mehdi Rahnama, Sahar Tajbakhsh Mosalman, 'Synoptic Causes and Socio-Economic Consequences of a Severe Dust Storm in the Middle East' (2021) 12, 1435 Atmosphere, 10. https://doi.org/10.3390/atmos12111435.

13 Zittis 'Climate Change and Weather Extremes in the Eastern Mediterranean and Middle East' (n 5). See also Peter Läderach, Bezaiet Dessalegn, Arunima Hakhu et al., 'Strengthening Climate Security in the Middle East and North Africa Region', Position Paper No. 2022/3. CGIAR FOCUS Climate Security, (2022), 24 <https://cgspace.cgiar.org/bitstream/handle/10568/117616/MENA%20Position%20Paper.pdf?sequence=5&isAllowed=y> accessed 16 December 2023.

14 World Bank, Sand and Dust Storms in the Middle East and North Africa (MENA) Region- Sources, Costs, and Solutions, (2019 Washington, DC.) 4.

15 Ramin Papi, Sara Attarchi, Ali Darvishi Boloorani, Najmeh Neysani Samany, 'Characterization of Hydrologic Sand and Dust Storm Sources in the Middle East', (2022) 14, 15352 Sustainability, 10. https://doi.org/10.3390/su142215352.

formation of sand and dust storm sources.[16] Furthermore, additional factors such as overgrazing, mining, agriculture, wildfires, and inappropriate land use practices contribute significantly to the degradation of soil and vegetation cover, further exacerbating land desertification. In select regions of the ME, land degradation has dramatically accelerated the desertification process and the expansion of sand and dust storm sources.[17]

Floods and dust storms represent natural phenomena that are influenced or intensified by a combination of both natural and human-induced factors. Climate change, characterized by droughts and fluctuations in temperature and precipitation, is a contributing factor to the occurrence of extreme events such as floods and dust storms. Notably, over the past decade, there has been a discernible increase in dust and drought events in the southern and western regions of Iran and certain areas in Iraq and Syria, which serve as primary dust-producing areas.[18]

Additionally, anthropogenic factors have played a substantial role in exacerbating the occurrence and intensity of dust storms across various parts of the ME, particularly in Iran, Iraq, and Syria. These factors encompass mismanagement of water and soil, land degradation, and the unsustainable expansion of urban areas.[19] The primary sources of sand and dust storms in the ME region are typically found in deserts, arid landscapes, and notably desiccated

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16 M. Hamidi, 'The key role of water resources management in the Middle East dust events', (2020) 187, 104337 Catena, 4,10.

17 Katharina Waha, Linda Krummenauer, Sophie Adams et al., 'Climate change impacts in the Middle East and Northern Africa (MENA) region and their implications for vulnerable population groups', (2017) 17, Regional Environmental Change, 1631-1632. DOI 10.1007/s10113-017-1144-2.

18 Mojtaba Zoljoodi, Ali Didevarasl, Abbas Ranjbar Saadatabadi 'Dust Events in the Western Parts of Iran and the Relationship with Drought Expansion over the Dust-Source Areas in Iraq and Syria', (2013) 3 Atmospheric and Climate Sciences, 327, 334. http://dx.doi.org/10.4236/acs.2013.33034.

19 Ali Darvishi Boloorani, Ramin Papi, M. Soleimani, L. Karami, F. Amiri, N.N. Samany, 'Water bodies changes in Tigris and Euphrates basin has impacted dust storms phenomena', (2021) 50, 100698 Aeolian Research, 2.

wetlands and rivers.[20] In specific regions of the ME, such as Iran and Iraq, there has been a pronounced decline in groundwater levels.[21] The continuous depletion of water bodies and diminishing vegetation cover, driven by factors like drought, climate change, and unsustainable resource exploitation, has paved the way for the creation of new sand and dust storm sources, soil degradation and flooding in recent decades.[22]

In Iraq, the desiccated wetlands of the Euphrates and Tigris rivers in the southern region have emerged as significant sources of sand and dust storms.[23] Climate change and human activities have played a pivotal role in the development of sand and dust storm sources in Iran.[24] Over recent decades, the reduction in water bodies and the desiccation of lakes, exacerbated by the deterioration of natural

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[20] Hui Cao, Farshad Amiraslani, Jian Liu, Na Zhou 'Identification of dust storm source areas in West Asia using multiple environmental datasets', (2015) 502 Science of the Total Environment, 225. http://dx.doi.org/10.1016/j.scitotenv.2014.09.025.
Paul Ginoux, Joseph M. Prospero, Thomas E. Gill, N. Christina Hsu, Ming Zhao 'Global-scale attribution of anthropogenic and natural dust sources and their emission rates based on MODIS Deep Blue aerosol products' (2012) 50 Reviews of Geophysics.
Diana Francis, Ricardo Fonseca, Narendra Nelli, Deniz Bozkurt, Juan Cuesta, Emmanuel Bosc, 'On the Middle East's Severe Dust Storms in Spring 2022: Triggers and Impacts' (2023) 296, 119539 Atmospheric Environment, 2, https://doi.org/10. 1016/j.atmosenv.2022.119539.

[21] Papi 'Characterization of Hydrologic Sand and Dust Storm Sources in the Middle East' (n 16) 11.

[22] B. F. Zaitchik, J. P. Evans, R A. Geerken, R B. Smith, 'Climate and Vegetation in the Middle East: Interannual Variability and Drought Feedbacks' (2007) 20, Journal of Climate, 3938, DOI: 10.1175/JCLI4223.1.

[23] Ali Darvishi Boloorani, Seyed O Nabavi, Hosain A Bahrami, Fardin Mirzapour, Musa Kavosi, Esmail Abasi, Rasoul Azizi 'Investigation of dust storms entering Western Iran using remotely sensed data and synoptic analysis' (2014) 12, 124 Journal of Environmental Health Science & Engineering, 8.
Ali Moridnejad, Neamat Karimi, Parisa A. Ariya 'Newly desertified regions in Iraq and its surrounding areas: Significant novel sources of global dust particles' (2015) 116 Journal of Arid Environments, 3-4. http://dx.doi.org/10.1016/j.jaridenv .2015.01.008.

[24] A. Rashki, N. J. Middleton, A. S. Goudie, Dust storms in Iran–Distribution, causes, frequencies and impacts' (2021) 48,100655 Aeolian Research.

riverbanks, watercourses, wetlands, and green spaces, have been major contributing factors to the onset of dust storms in Iran.[25] Notable instances include the desiccation of lakes like Lake Urmia in the northwest,[26] Hawr-al-Azim wetland in the southwest,[27] and Lake Jazmurian and Hamoun marshes in the southeast of Iran, all of which are susceptible to soil degradation and wind erosion, leading to the release of substantial amounts of dust particles and serving as primary sources of dust storms in the country.[28] Moreover, Iran has witnessed an escalation in the scale of floods and the severity of droughts over the past few decades.[29]

The persistence of drought and ongoing land degradation processes are contributing to the development of sand and dust sources, which pose a growing threat of extreme dust storms in the future. These fine-grained particulate materials, emitted from deserts and the desiccated bottoms of wetlands, are carried towards nearby communities. In the absence of natural or artificial protective barriers

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[25] Y. Alizade Govarchin Ghale, M. Tayanc, A. Unal, 'Dried Bottom of Urmia Lake as a New Source of Dust in the Northwestern Iran: Understanding the Impacts on Local and Regional Air Quality' (2021) 262, 118635 Atmospheric Environment. Claudio Zucca, Nick Middleton, Utchang Kang, Hanspeter Liniger Shrinking Water Bodies as Hotspots of Sand and Dust Storms: The Role of Land Degradation and Sustainable Soil and Water Management' (2021) 207, 105669 Catena. https://doi.org /10.1016/j.catena.2021.105669.

[26] Y. A. G. Ghale, M. Tayanc, A. Unal, 'Dried bottom of Urmia Lake as a new source of dust in the northwestern Iran: Understanding the impacts on local and regional air quality' (2021) 262, 118635 Atmospheric Environment.

[27] A. Adib, M. Oulapour, A. Chatroze 'Effects of wind velocity and soil characteristics on dust storm generation in Hawr-al-Azim Wetland, Southwest Iran', (2018) 16(4) Caspian Journal of Environmental Sciences, 345. doi:10.22124/CJES.2018.3202.

[28] Leila Mahmoudi, Naoki Ikegaya 'Identifying the Distribution and Frequency of Dust Storms in Iran based on Long-Term Observations from over 400 Weather Stations' (2023) 15, 12294 Sustainability, https://doi.org/10.3390/su151612294.

[29] Reza Modarres, Ali Sarhadi, Donald H. Burn 'Changes of extreme drought and flood events in Iran' (2016) 144 Global and Planetary Change, 80. http://dx.doi.org/10.1016/j.gloplacha.2016.07.008.

and buffer zones, these particulates give rise to sand and dust storms.[30]

In addition to deserts, hydrologic sand and dust sources encompass dried lakes, intermittent wetlands, freshwater marshes, and floodplains. Bodies of water, such as rivers, wetlands, and both permanent and seasonal lakes, tend to accumulate fine-grained sediments that are highly susceptible to wind erosion. These erodible areas serve as hydrologic sources of sand and dust storms.[31] Changes in water resources, whether natural or anthropogenic, have played a significant role in the development of these sources. Instances like Lake Urmia in Iran[32] and Hamoun wetlands[33] in Iran and Iraq's lakes and wetlands[34] illustrate how environmental factors such as precipitation, surface runoff, surface water and groundwater resources, and vegetation cover exert a crucial influence on the formation or expansion of sand and dust sources. Simultaneously, the nature of land use and spatial-temporal alterations in water bodies

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30 CAO Hui, LIU Jian, WANG Guizhou, YANG Guang, LUO Lei 'Identification of sand and dust storm source areas in Iran', (2015) 7(5) Journal of Arid Land, 573, 575, 576, doi:10.1007/s40333-015-0127-8.

31 Papi 'Characterization of Hydrologic Sand and Dust Storm Sources in the Middle East' (n 16)16.

32 Mahdi Boroughani, Hossein Hashemi, Seyyed Hasan Hosseini, Sima Pourhashemi, Ronny Berndtsson, 'Desiccating Lake Urmia: A New Dust Source of Regional Importance' (2019) 17 IEEE Geoscience Remote Sensing Letters. https://doi.org/ 10.1109/LGRS.2019.2949132.

33 A. Rashki, D. Kaskaoutis, A. Goudie, R. Kahn, 'Dryness of ephemeral lakes and consequences for dust activity: The case of the Hamoun drainage basin, southeastern Iran' (2013) 1 Science of The Total Environment, http://dx.doi. org/10.1016/j.scitotenv.2013.06.045.
Abbas Miri, Saeideh Maleki, Nick Middleton, 'An investigation into climatic and terrestrial drivers of dust storms in the Sistan region of Iran in the early twenty-first century' (2021) 757, 143952 Science of the Total Environment, 2. https://doi.org/ 10.1016/j.scitotenv.2020.143952.

34 Darvishi Boloorani 'Water bodies changes in Tigris and Euphrates basin has impacted dust storms phenomena' (n 20).

have also contributed to the dynamics of sand and dust storm sources in the ME.[35]

Another prominent human-induced factor is unsustainable urbanization and urban sprawl observed in specific regions of the ME.[36] Urbanization contributes to heightened vulnerability of human settlements to both floods and dust storms for two primary reasons. Firstly, urbanization occurring in high-risk areas amplifies the susceptibility of these settlements to natural hazards. In some parts of ME countries, major urban centers are expanding in close proximity to deserts or within floodplains which places human settlements at potential risk of flooding.

The second reason lies in unsustainable construction practices. Unplanned urbanization in low-lying peripheral areas, systematic encroachments along river coasts, hindrances to natural water flow within floodplains, construction of dwellings in flood-prone areas and along riverbanks, and the deterioration of riverbeds and vegetation cover in certain regions have all accelerated the occurrence of floods in many Iranian cities. Urban sprawl and construction activities have a detrimental impact by erasing green zones, altering natural surface water pathways, encroaching upon river coastal areas, and desiccating wetlands. Unsustainable urbanization and construction have resulted in the alteration or degradation of natural spaces within and around urban areas, including rivers, wetlands, and green areas. Consequently, these developments have restricted the available space for the preservation and development of NBZs. Throughout this process, cities and human settlements have lost their natural protective barriers against the onslaught of natural hazards. The degradation or alteration of NBZs has heightened the

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35 Papi 'Characterization of Hydrologic Sand and Dust Storm Sources in the Middle East' (n 16) 2.

36 Héla Miniaoui, 'Climate Change in the Middle East and North Africa: Between the Repercussions of a Lived Reality and the Opportunities for a Brighter Future' Economic Research Forum Policy Brief No. 109, 4 <https://erf.org.eg/app/uploads/2023/04/1681168817_594_520971_pb109.pdf> accessed 15 December 2023.

vulnerability of local communities in regions prone to risks such as floods, desertification, and sand and dust storms.[37]

Many of the protective infrastructures intended to shield cities from natural hazards are typically situated within the urban areas themselves. These include facilities like parks, sewer systems, flood drainage systems, and underground pipes designed to swiftly redirect water away from the city.[38] Paradoxically, these internal protective systems, if be misallocated or mismanaged, can inadvertently heighten the vulnerability of cities to severe natural hazards. In contrast, external protective systems, such as NBZs, have the potential to offer expansive protective zones for the safeguarding of cities. Additionally, it's worth noting that not all cities are equipped with the necessary infrastructures such as comprehensive sewer systems and storm drainage systems to effectively mitigate the severe impacts of floods.

The degradation of natural ecosystems surrounding urban areas leads to the elimination of their buffer zones, rendering disaster-prone communities, particularly informal settlements, increasingly vulnerable to extreme events such as dust storms, wildfires, and floods. In these areas, natural hazards can inflict significant health consequences on affected communities, including elevated risks of respiratory and cardiovascular mortality following dust storm exposures in the ME.[39] The gravity of natural hazards and their

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[37] World Bank Group, 'Middle East and North Africa Climate Roadmap (2021-2025): Driving transformational climate action and green recovery in MENA', World Bank, 6 <https://thedocs.worldbank.org/en/doc/6f868d4a875db3ef23ef1dc747fcf2ca-0280012022/original/MENA-Roadmap-Final-01-20.pdf> accessed 15 December 2023.

[38] Nanco Dolman, Integration of Water Management and Urban Design for Climate Resilient Cities, in Rutger de Graaf-van Dinther (ed): Climate Resilient Urban Areas: Governance, Design & Development in Coastal Delta Cities, (Palgrave Macmillan 2021), 27, 33.

[39] Zahra Soleimani, Pari Teymouri, Ali Darvishi Boloorani, Alireza Mesdaghinia, Nick Middleton, Dale W. Griffin, 'An overview of bioaerosol load and health impacts associated with dust storms: A focus on the Middle East', (2020) 223,

present as well as anticipated impacts on human settlements necessitate proactive measures by states and communities to establish sustainable and disaster-resilient urban areas. NBZs represent one of these essential mechanisms in this endeavor.

2.2 The Roles of NBZs in Sustainable Urban Areas

Considering the threats outlined in the preceding section, a pressing need exists for effective protective mechanisms in vulnerable urban areas throughout the ME region to mitigate wind erosion, flooding, and dust transport. The development and preservation of NBZs represent a viable nature-based approach to address these natural hazards and enhance the resilience of human settlements in adapting to such challenges.

NBZs need to be legally defined for more clarification. UNESCO defines buffer zones as "areas surrounding the site with complementary legal and/or customary restrictions placed on use and development to provide an additional layer of protection".[40] In this context, NBZs can be defined as designated areas strategically employed to safeguard vulnerable cities and settlements from the impacts of natural hazards. These zones encompass green buffers, such as green spaces and neutral soils, as well as blue buffers, comprising wetlands and rivers. Naturally, NBZs possess the capability to accumulate, encompass, and reduce the excesses of water, sand, and dust. Consequently, NBZs play a crucial role in averting or minimizing the emission of additional sand and dust particles and the dissemination of flood runoff into residential areas.

NBZs are specifically natural spaces located inside and outside of urban areas, serving as a vital buffer that shields human communities from the impacts of hazards such as floods and dust storms. These areas constitute functional ecosystems with the inherent capability to

117187 Atmospheric Environment, 20, 36. https://doi.org/10.1016/j.atmosenv.2019.117187.

40 UNESCO, 'Operational Guidelines for the Implementation of the World Heritage Convention', World Heritage Centre, WHC.23/01 24 September 2023, Decision 39 COM 11, Para. 104.

absorb, store, and manage excessive rainfall and runoff, utilizing soils, vegetation, and wetlands during storms and floods. In doing so, they effectively reduce the risk of flooding within the nearby communities.[41] Consequently, NBZs represent invaluable natural ecosystems that warrant careful management and ongoing monitoring to ensure the continued protection of urban areas against the encroachment of natural hazards.

NBZs represent nature-based, sustainable solutions for mitigating certain natural hazards, offering cost-effective measures with numerous environmental and social advantages. As per UNEP, "nature-based solutions" encompass actions that protect, conserve, restore, sustainably use, and manage natural or modified ecosystems which effectively address social, economic, and environmental challenges, exhibiting adaptability and playing a pivotal role in achieving the SDGs.[42]

The IUCN also underscores the development of nature-based solutions as mechanisms for ecosystem-based natural disaster management, which tend to incur lower costs and fewer adverse effects than artificial solutions like constructing dams and dikes.[43] It has been established that the development and restoration of floodplain forests, for instance, often prove to be more cost-effective than relying solely on high-cost technical measures such as channel construction, dam installation, and floodplain reservoirs.[44]

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41 UNESCO, 'Managing Natural World Heritage', World Heritage Resource Manual, (United Nations Educational, Scientific and Cultural Organization, France 2012), 12-13.

42 UNEP, 'Nature-based solutions for supporting sustainable development', United Nations Environment Assembly of the United Nations Environment Programme, Resolution adopted by the United Nations Environment Assembly on 2 March 2022, UNEP/EA.5/Res.5, Article 1.

43 IUCN, Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of NbS, (IUCN 2020) <https://portals.iucn.org/library/sites/library/files/documents/2020-020-En.pdf> accessed 18 November 2023.

44 European Commission, 'Communication on Green Infrastructure (GI) — Enhancing Europe's Natural Capital', COM (2013) 249 final.

Urban green spaces, comprising parks, vegetation cover, and grasslands, play a pivotal role in enhancing the health, well-being, and overall quality of life for urban communities.[45] Moreover, these urban green areas serve a dual purpose as densely vegetated barriers that mitigate the deposition of dust storms and as essential safety valves that absorb excess water, thereby diminishing the risk of flooding within human settlements.[46]

Urban blue spaces encompass wetlands, rivers, and riparian areas that play a critical role in capturing water runoffs, retaining dust, and maintaining soil humidity. The effectiveness of wetlands in mitigating floods hinges on various factors, including the condition of vegetation cover and the state of the coastal zone. Healthy and intact wetlands have the capacity to store floodwaters, thus acting as a protective barrier that shields nearby human settlements from flood-related damages. Additionally, coastal mangroves represent another form of NBZs that offer protection against coastal flooding and are employed for runoff mitigation within floodplains.

Dust storms and floods often possess a magnitude and force that make avoidance and resistance impractical. Therefore, one of the most effective solutions for safeguarding cities against these hazards lies in the development of NBZs. These zones serve a multifaceted role and offer additional co-benefits. It is essential to bear in mind that NBZs, while valuable, are not standalone measures sufficient to address the root causes of natural hazards. They cannot entirely shield communities from these hazards. Instead, they function as tools to mitigate the severity of the impacts of natural hazards and reduce the vulnerability of communities to these challenges.

The primary function of NBZs is to intercept floods and dust storms and mitigate the damages they can cause. NBZs encompass green and

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45 World Health Organization, (2012). Health Indicators of sustainable cities in the Context of the Rio+20 UN Conference on Sustainable Development. WHO/HSE/PHE/7.6.2012f.

46 European Commission, 'Communication on Green Infrastructure (GI) — Enhancing Europe's Natural Capital', (n 5).

blue infrastructures that seamlessly integrate with the urban environment, offering a multitude of functions, including:

a) Protection against flooding

The foremost value of NBZs lies in shielding human settlements from threats, whether originating within or outside the cities, with a particular focus on floods and various types of water outflows. Surface water bodies, such as wetlands, ponds, marshes, and rivers control runoff and purifying water, especially in the urban areas. Wetlands and rivers situated in proximity to urban areas absorb water runoffs, thwart water outflows, and prevent flooding, thereby mitigating the adverse impacts of severe floods and reducing associated damages in flood-prone regions.[47]

Thoughtfully designed green spaces within and surrounding urban areas can significantly enhance water storage capacity and soil infiltration, leading to improved urban drainage systems that, in turn, lessen the severity of storms.[48] Additionally, surface water bodies serve another vital function by impeding the spread of wildfires into human settlements. Green public spaces also contribute to the mitigation of natural hazards and flood prevention through their capacity to absorb overflow waters and maintain wetlands.[49] The presence of vegetation cover fosters increased water absorption, thus reducing water loss and soil degradation.[50]

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47 Duck-Gil Kim, Jae-Won Kwak, Soo Jun Kim, Hung Soo Kim, Tae-Jin Ahn, Vijay P. Singh 'Wetland Construction: Flood Control and Water Balance Analysis' (2010)15(4) Environmental Engineering Researches, 204. https://doi.10.4491/eer.2010.15.4.197.
Marianne Courouble, Nick Davidson, Lars Dinesen, Siobhan Fennessy et al., Global Wetland Outlook: Special Edition 2021, (2021 Switzerland, Secretariat of the Convention on Wetlands), 18.

48 Erik Zimmermann, Laura Bracalenti, Rubén Piacentini, Luis Inostroza 'Urban Flood Risk Reduction by Increasing Green Areas for Adaptation to Climate' (2016) 161 Procedia Engineering, 2245. https://doi.org/10.1016/j.proeng.2016.08.822.

49 Nerma Omićević, Bojana Bojanić Obad Šćitaroci, The Urban Rehabilitation of Post-Disaster Scapes (Springer 2023), 11.

50 Batanouny, ibid. 45, 65.

b) Protection of Human Communities Against Air Pollution

Air pollution, particularly in the form of particulate matter emissions and dust storms, constitutes a significant environmental challenge in certain regions of the ME, notably in Iran and Iraq. Urban green spaces, such as urban parks, street trees, and green roofs, serve as regulators of urban temperature and air quality,[51] actively absorbing carbon and particulate matter from the air.[52] Consequently, green spaces play a fundamental role in mitigating certain air pollutants, including particulate matter and dust, within urban areas. Indeed, the development of green spaces has been shown to contribute to the reduction of air pollution and the mitigation of the urban heat island effect in some polluted urban areas.[53]

Similarly, blue spaces such as rivers, marshes, and wetlands maintain the land's moisture and prevent the formation of dust storm sources in proximity to human settlements. The presence of both green and blue spaces, in conjunction with fresh air corridors within urban environments, serves to regulate temperatures and mitigate the urban heat island effect,[54] thereby helping to alleviate the overall temperature in urban areas.

c) Mitigation of the Impacts of Climate Change

NBZs, comprising elements like green spaces, neutral soils, and riparian areas, possess the capacity to play a vital role in mitigating the effects of climate change by acting as buffers against extreme

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[51] Briony A. Norton, Andrew M. Coutts, Stephen J. Livesley, Richard J. Harris, Annie M. Hunter, Nicholas S.G. Williams, 'Planning for cooler cities: A framework to prioritise green infrastructure to mitigate high temperatures in urban landscapes' (2015) 134, Landscape and Urban Planning, 136. https://doi.org/10.1016/j.land urbplan.2014.10.018.

[52] Jon Bryan Burley, Na Li, Jun Ying, Hongwei Tian, Steve Troost 'Metrics in Master Planning Low Impact Development for Grand Rapids Michigan', in Mustafa Ergen (ed): Sustainable Urbanization, (ExLi4EvA 2016), 70. http://dx.doi.org/10.5772/637 08.

[53] Swati Rajput, Kavita Arora, Rachna Mathur, Urban Green Space, Health Economics and Air Pollution in Delhi, (Routledge 2021), 16, 39.

[54] European Commission 'Communication on Green Infrastructure (GI) — Enhancing Europe's Natural Capital' (n 45).

climate events and moderating urban weather patterns.[55] NBZs serve as natural sinks for carbon dioxide, thus fulfilling a dualistic role by reducing this gas and mitigating climate-related hazards within human settlements. To combat carbon dioxide emissions from rapidly expanding cities in the ME,[56] mitigation strategies such as carbon-neutral urban design and sustainable urban planning are recommended. In this context, NBZs offer both mitigation and adaptation benefits.[57]

Additionally, wetlands contribute to mitigating wildfires, a growing threat exacerbated by climate change and drought in recent years. Wildfires pose a significant climate-related danger, particularly as sprawling cities encroach upon forests, making them increasingly susceptible to devastating wildfires during the warmer seasons.[58] In such cases, blue buffer zones, including rivers and wetlands, can help reduce the threats posed by natural hazards such as dust storms, wildfires, heatwaves, and floods to cities and settlements situated within these zones.

d) Providing Natural Areas for Tourism and Recreation Activities

Wetlands and green spaces, including urban forests, represent essential urban and peri-urban locations that offer tourism and

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55 S. Stolton, N. Dudley, Arguments for Protected Areas: Multiple Benefits for Conservation and Use, (Earthscan 2010).
Samar Al Skaff, 'Resilience Through Public Spaces: Transforming Vulnerability into Opportunity', in Federica Rosso, Donato Morea, Didit Okta Pribadi (eds): Innovations in Green urbanization and Alternative Renewable Energy, (Springer 2022) 73.

56 Priyadarshi R. Shukla, Jim Skea, Andy Reisinger et al., 'Summary for Policy makers. In: Climate Change 2022: Mitigation of Climate Change', Contribution of Working Group III to the Sixth Assessment Report of the IPCC, (2022), 95, 97.

57 Mohammed Mahmoud, 'The Future of Climate Change Mitigation in the Middle East and North Africa', Middle East Institute (November 2023), 12, 18 <https://www.mei.edu/sites/default/files/2023-11/The%20Future%20of%20Climate%20Change%20Mitigation%20in%20the%20Middle%20East%20and%20North%20Africa_1.pdf> accessed 16 December 2023.

58 UN-Habitat, 'World Cities Report 2020: The Value of Sustainable Urbanization', United Nations Human Settlements Programme, HS/045/20E, Kenya, (2020), xxiii, 131.

recreational opportunities.[59] They serve as foundations for sustainable, environmentally-friendly entrepreneurship in these areas.

e) Protection of Biodiversity and Natural Ecosystems

Another important ancillary function of NBZs is the safeguarding of urban natural ecosystems, biodiversity, and specific vulnerable spaces. NBZs can establish connections or connectivity to adjacent natural areas, such as urban forests,[60] contributing to the preservation of water and soil quality around human settlements while serving as a site for biodiversity and natural ecosystems.

3. LEGAL PROTECTION OF NBZs

NBZs are vulnerable zones that face external pressures stemming from urban expansion, construction, exploitation, and degradation. Given their critical role in safeguarding human settlements against natural hazards, it is imperative to establish legal protections and promote their development in environmental law and disaster management law. The development of NBZs for vulnerable cities necessitates the implementation of multiple legal instruments encompassing ecosystem protection, land use management, regional zoning, and disaster risk management.

NBZs should be legally protected for two primary reasons. Firstly, their ecosystem services and functions contribute significantly to environmental sustainability. Secondly, they play a crucial role in mitigating natural hazards and enhancing resilience. Blue and green spaces possess a considerable buffering capacity against climatic hazards, underscoring the need for special legal instruments, both at

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[59] Davide Geneletti, Chiara Cortinovis, Maria Susana Orta-Ortiz, Jarumi Kato-Huerta, Davide Longato, Enzo Falco 'Mainstreaming Nature-Based Solutions in Cities Through Performance-Based Planning: A Case Study in Trento, Italy', in Israa H. Mahmoud, Eugenio Morello, Fabiano Lemes de Oliveira, Davide Geneletti (eds): Nature-based Solutions for Sustainable Urban Planning: Greening Cities, Shaping Cities (Springer 2022) 21.

[60] UNESCO 'Managing Natural World Heritage' (n 42) 60.

the national and international levels, to safeguard these buffer zones adjacent to urban areas.

The development and protection of NBZs should be considered as measures aimed at mitigating the impacts and damages of natural hazards on communities and enhancing their sustainability. NBZs represent low-cost risk prevention measures that are adaptable to the environmental conditions of various regions. Therefore, the development and protection of NBZs should not only be an integral component of international and national systems for safeguarding natural ecosystems, such as environmental law, but should also be seamlessly integrated into national urban planning and disaster management policies and programs.

Consequently, the protection and development of NBZs become a legal matter, and governments, particularly those in disaster-prone regions, need to provide effective legal support for these zones. While wetlands and green spaces have, to some extent, been protected individually under international and certain domestic laws, they have not yet been fully integrated into disaster governance policies when considered as NBZs. Hence, this section will investigate the legal status of NBZs and their integration into the legal instruments and disaster governance policies, both at the international level and within Iran's national law.

3.1. NBZs in International Law

One of the primary objectives of international environmental law, as articulated in the Sustainable Development Goal 11, is to enhance the sustainability and resilience of communities in pursuit of sustainable development. Given that NBZs surrounding human settlements can serve as effective mechanisms to achieve this goal, their protection should be considered and recommended within the framework of international environmental law.

It is noteworthy that the development of buffer zones was initially recommended by the IUCN as a tool for protecting vulnerable

natural zones, such as forests.[61] However, NBZs have not yet been officially recognized as a protective system for mitigating natural disasters in international environmental law and international disaster management law. Two types of international regulations address the natural ecosystems related to NBZs:

3.1.1 Climate Change and Disaster Management

The first category of documents pertains to legal obligations or recommendations related to climate change mitigation and adaptation, as well as the development of natural sinks for greenhouse gases (GHGs). These documents call upon states to adopt appropriate policies and measures for mitigating climate-related hazards and adapting to their impacts, as NBZs have significant potential in GHG removal and climate change impact mitigation.

3.1.1.1 United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC urges its Parties to take precautionary measures to mitigate the adverse effects of climate change (Article 3-1) and to develop and enhance sinks for all GHGs (Article 4-1b, 2a).[62] The Paris Climate Agreement also encourages Parties to take action to conserve and enhance sinks and reservoirs of GHGs (Article 5-1).[63]

3.1.1.2 Sustainable Development Goals

The United Nations' Agenda for Sustainable Development includes targets that indirectly address the protection of NBZs in terms of

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[61] See s 5.1 Operational Guidelines on buffer zone management, World Heritage Committee <http://whc.unesco.org/en/guidelines> accessed 10 November 2023. Management Guidelines for IUCN Category V Protected Areas Protected Landscapes/Seascapes, World Adrian Phillips, Commission on Protected Areas (WCPA) (IUCN 2002) <https://portals.iucn.org/library/efiles/documents/pag-009.pdf> accessed 10 November 2023.

[62] UN General Assembly, United Nations Framework Convention on Climate Change (UNFCCC), Adopted 9 May 1992, at <https://unfccc.int/resource/docs/convkp/conveng.pdf>, accessed 16 December 2023.

[63] UNFCCC, The Paris agreement, CCC/CP/2015/10, (Adopted 12 December 2015) <https://unfccc.int/sites/default/files/english_paris_agreement.pdf> accessed 16 December 2023.

promoting sustainable urbanization, disaster management, climate change mitigation, and adaptation.[64] Relevant targets include:

a) enhancing sustainable urbanization and capacity for sustainable human settlement planning and management in all countries (SDG 11.3),
b) ensuring access to safe, inclusive, accessible, green, and public spaces (SDG 11.7),
c) implementing integrated policies and plans that encompass inclusion, resource efficiency, mitigation, adaptation to climate change, disaster resilience, and holistic disaster risk management policies in cities (SDG 11.b).

SDG 13 specifically links climate change with natural disaster management, urging states to combat climate change and its impacts by strengthening resilience and adaptive capacity to climate-related hazards. It also emphasizes the integration of climate change measures into national policies, strategies, and planning.

3.1.1.3 Quito Declaration on Sustainable Cities and Human Settlements for All

The Quito Declaration addresses the importance of sustainable settlements by calling upon states to adopt and implement disaster risk reduction and management policies.[65] This includes reducing vulnerability, building resilience to natural and human-made hazards, and fostering mitigation and adaptation to climate change in cities and human settlements (Principle 13). The declaration also emphasizes the protection, conservation, restoration, and promotion of ecosystems, water resources, and natural habitats.

3.1.1.4 Sendai Framework for Disaster Risk Reduction 2015–2030

This document is a significant legal initiative for disaster risk management. It places a strong emphasis on strengthening disaster

[64] UNGA, Resolution on Transforming our world: the 2030 Agenda for Sustainable Development, (n 2).
[65] United Nations, Quito Declaration on Sustainable Cities and Human Settlements for All (n 7).

risk governance, managing disaster risk effectively, and encouraging the establishment of mechanisms and incentives to ensure compliance with safety-enhancing provisions of existing sectoral laws and regulations. These provisions may encompass land use and urban planning, building codes, environmental and resource management, and health and safety standards. The framework highlights the need to update these regulations, where necessary, to give adequate attention to disaster risk management.[66] However, Sendai Framework does not underscore the necessity of NBZs for protection of urban areas against the natural disasters.

3.1.2 Wetlands and Forests

The second category of documents focuses on the protection of ecosystems individually, with a particular emphasis on wetlands and forests. These documents call upon states to protect wetlands and forests primarily for their biodiversity and ecosystem values, without specifically recognizing them as natural protective systems that act as buffer zones.

International wetlands have been protected by the Convention on Wetlands of International Importance, especially as Waterfowl Habitat.[67] This convention primarily focuses on wetlands of international importance, rather than all domestic wetlands. However, it does provide a legal framework that encourages states to protect their domestic wetlands.

In contrast, there is no binding convention specifically dedicated to the protection of forests. Nevertheless, certain non-binding international documents emphasize the importance of protecting forest ecosystems and provide non-binding principles for the management, conservation, and sustainable use of forests. For example, the Non-Legally Binding Authoritative Statement of

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[66] United Nations, Sendai Framework for Disaster Risk Reduction 2015-2030, United Nations General Assembly (resolution 69/283, annex II) (Adopted 2015), (Art. 26 d).

[67] UNESCO, Convention on Wetlands of International Importance especially as Waterfowl Habitat, Ramsar, Iran, (Adopted 1971).

Principles for a Global Consensus on the Management, Conservation, and Sustainable Development of All Types of Forests[68] highlights the need for forest preservation and sustainability (Principle 8(b)).

Additionally, the United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (UNCCD) calls upon states to take measures to conserve natural resources, including vegetation cover and forests, in their national action programs.[69]

It's worth noting that while various international documents emphasize the importance of forests, urban forests have received limited attention in the context of international forest management. One notable exception is the EU Forest Action Plan, which encourages member states to plan, create, and manage urban and peri-urban forests.[70]

Considering these international documents, the development and protection of NBZs, which serve as natural sinks for greenhouse gases, mitigate dust and flood risks, and contribute to sustainable urbanization, can be viewed as part of a state's responsibilities in global efforts related to climate change, natural disaster management, and the creation of sustainable communities.

3.2. NBZs in Iranian law

Iran is situated in one of the most hazard-prone regions of the ME, experiencing various natural hazards, including dust storms and floods, as well as extreme climate events. These disasters have significant social and economic costs for the country, with the government having spent approximately 29 billion USD on disaster-

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68 UNCED, Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests, 1 (Adopted 3 June 1992).

69 United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (UNCCD), (Adopted 17 June 1994) (Art. 8-3 (b)).

70 Communication from the Commission on the Council and the European Parliament on an EU Forest Action Plan, COM (2006) 302 final, (Key action 12).

related expenses in the last 100 years.[71] Consequently, disaster prevention and management are top priorities in Iran, leading to the adoption of numerous laws, programs, policies, and the establishment of the Organization for Disaster Management of Iran in 2008.

Although the development and preservation of NBZs around human settlements have not been explicitly recognized as a disaster management strategy in Iran's legal system, there are existing regulations that protect ecosystems may serve as NBZs, such as wetlands, riverbanks, and green spaces, for environmental purposes. However, similar to international law, these regulations tend to treat such natural ecosystems individually rather than recognizing them collectively as protective buffer zones. For instance, the Act on Protection, Restoration, and Management of Wetlands (2017) and the Bylaw on Prevention of Irreversible Degradation and Pollution of Wetlands (2018) aim to safeguard wetlands and prohibit their destruction and pollution. Iran's National Wetland Conservation Strategy and Action Plan outline strategies for preserving and restoring the country's wetlands.[72] However, factors like drought, inter-basin water transfers, and the construction of numerous dams on rivers flowing into wetlands have led to desiccation and degradation of these ecosystems. Consequently, more effective regulations are required to protect water ecosystems, particularly ponds, marshlands, and wetlands, especially in urban areas.

In Iran, construction in riverbeds, riparian and coastal zones has been a significant factor contributing to the degradation of rivers and causing harmful floods in human settlements. To address this issue, the Bylaw on the Riparian Zones of Rivers, Streams, Lagoons, and Water Channels (2000, as amended in 2003) has designated protected areas and boundaries in river coasts and riparian zones, effectively

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[71] Hamed Seddighi, Sadegh Seddighi, 'How much the Iranian government spent on disasters in the last 100 years? A critical policy analysis', (2020) 18:46 Cost Effectiveness and Resource Allocation, 4, https://doi.org/10.1186/s12962-020-00242-8.

[72] Department of Environment, Iran's National Wetland Conservation Strategy and Action Plan (adopted 2011).

creating buffer zones around human settlements. These buffer zones are intended to protect water quality, ensure unobstructed water flow, and prevent damage from potential floods.

The development and protection of green spaces, both within and outside urban areas, are governed by Iran's environmental and urban laws. The Act on the Preservation and Development of Urban Green Space (2009) regulates tree planting in urban areas and prohibits illegal logging. The Act on Forests and Ranches Protection and Utilization (1967) focuses on forest protection and afforestation. More recently, the Sixth Development Plan Act (2016) introduced comprehensive restrictions on logging in natural forests to preserve the country's forested areas.

While the Act on the Management of Disaster (2019) outlines initiatives for natural disaster management and disaster risk reduction programs, it does not provide specific legal mechanisms for the protection and development of NBZs as a protective policy against natural hazards. Therefore, it can be concluded that NBZs have not yet been fully integrated into Iran's national disaster management policy. However, the Clean Air Act (2017) stands out as the only legal instrument that recognizes green spaces and wetlands as NBZs for protecting urban areas from the adverse effects of air pollution and dust storm invasions. According to this Act, various ministries and municipalities are obligated to protect wetlands and develop green belts around urban areas to mitigate the adverse effects of air pollution and dust storms. This Act demonstrates the potential for integrating natural ecosystems as NBZs into policies for sustainable urbanization and natural disaster risk reduction.

3.3 Challenges in development of NBZs

The development of NBZs are confronted with a myriad of ecological, social, economic, institutional, and legal challenges. Consequently, the preservation and advancement of these nature-based solutions are not straightforward endeavors. Implementing quick-fix policies to establish sustainable urban areas in vulnerable regions of the ME within a short timeframe is a daunting task that

demands significant social collaboration, political resolve, and substantial financial resources—an undertaking that remains beyond the reach of many communities in this region.
Foremost among these challenges are the institutional hurdles, water scarcity, and land limitations for development of NBZs within and around the urban areas. Institutional challenges encompass issues such as inadequate regional cooperation, discord among responsible organizations, and fragmented local and urban management systems in this region. The presence of fragmented and overlapping structures in environmental governance weakens efforts toward sustainable urbanization and resilience in urban areas.[73]

Natural challenges such as water scarcity and desertification may impede development of NBZs. Nearly all ME countries are situated in one of the world's most water-scarce regions.[74] Consequently, preserving and developing hydrological buffer zones within and around urban areas faces significant obstacles due to severe water scarcity. Another formidable challenge is the limited availability of suitable areas for establishing NBZs around urban centers, particularly in densely populated cities or industrialized zones. NBZs are typically developed in uninhabited regions or public lands. However, due to urban sprawl, the continuous expansion of crowded residential areas, and rising land prices, the space available for NBZ development, especially within large cities, is severely restricted. Moreover, the proliferation of physical obstacles, such as slums and informal settlements along urban perimeters, particularly along riverbanks, further impedes the design and development of NBZs in these areas. Consequently, these challenges should be considered in NBZs development policies and land use regulations.

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[73] UN-Habitat 'World Cities Report 2020: The Value of Sustainable Urbanization' (n 59) 122.

[74] Jean Axelrad Cahan (ed), Water Security in the Middle East: Essays in Scientific and Social Cooperation, (2017 Anthem Press). See also World Bank, Beyond Scarcity: Water Security in the Middle East and North Africa, (2017 World Bank Publications), 9.

Furthermore, urban greening initiatives, while beneficial, may lead to the displacement of low-income residents.[75] As noted by the European Commission, urbanization processes, often a result of inadequate territorial planning, can have adverse impacts on the environmental equilibrium of terrestrial ecosystems and pose significant threats to sustainable development.[76] Therefore, any plan to develop NBZs within and around urban areas must be implemented in harmony with other aspects of regional sustainable development.

4. RECOMMENDATIONS

The development of nature-based protective systems harmonized with the increasing natural hazards is an urgent imperative for ME states, particularly Iran. NBZs possess represent efficient tools for fostering sustainable human settlements. Consequently, the legal system, encompassing both environmental and natural disaster laws, should devise appropriate instruments for the development and preservation of these zones. Given their critical significance and inherent vulnerability, NBZs warrant safeguarding through specialized legal mechanisms at the international, regional, national, and local levels.

At the international and regional levels, there is a need to emphasize the significance of protecting and developing green and blue spaces as NBZs in various negotiations and initiatives. These zones should be seamlessly integrated into policies for sustainable urbanization, disaster management, and climate change mitigation and adaptation.

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[75] UN-Habitat 'World Cities Report 2020: The Value of Sustainable Urbanization' (n 59) xxiii.

[76] European Commission, Guidelines on best practice to limit, mitigate or compensa te soil sealing, SWD (2012) 101 final <https://ec.europa.eu/environment/soil/pdf/ soil_s ealing_guidelines_en.pdf> accessed 8 December 2023. See also European Commission (2013) Green Infrastructure (GI). Enhancing Europe's Natural Capi tal, COM (2013) 249 final <https://ec.europa.eu/environment/nature/ecosystems/ docs/ green_infrastructures/1_EN_ACT_part1_v5.pdf> accessed 8 December 2023.

It is advisable for states, especially those in disaster-prone regions, to formulate appropriate legal frameworks for planning and enhancing NBZs, focusing on location, quality, and ecological resilience against external pressures. International organizations engaged in natural disaster management, such as the World Bank, World Water Council, World Health Organization, Global Facility for Disaster Reduction and Recovery, United Nations Office for Disaster Risk Reduction, World Meteorological Organization, and UNEP, can play a crucial role by offering recommendations and guidelines for the integration of NBZs into national disaster risk reduction policies. Furthermore, fostering international and regional cooperation among states is required, particularly in sharing information, collaborative planning, and safeguarding and developing NBZs, especially in border areas. Joint efforts, such as water resource management in countries sharing basins like Turkey, Iran, Iraq, and Syria, should be explored.

In the national context, it is imperative to integrate the protection and development of NBZs into national disaster risk reduction strategies. By treating NBZs as integral components of disaster risk reduction frameworks, they can benefit from rigorous preservation regulations and be elevated to the highest level of protection within national environmental and disaster management laws. Given that disaster management rules are designed to respond urgently to emergencies, prioritizing the preservation and development of NBZs as essential components of disaster reduction measures will ensure more effective enforcement and practical implementation.

The various facets of a legal system, encompassing the protection of natural ecosystems, disaster risk management, land use planning, and urbanization, should collaborate to advance an integrated NBZs management system at both the national and local levels. In the pursuit of greater urban sustainability, a multitude of proactive and decentralized governance measures are essential for establishing a robust legal framework that promotes the preservation and development of NBZs within urban and suburban areas, as well as in the context of water bodies and land planning.

4.1 Urban Policies

The escalating impacts of climate change on human settlements necessitate significant alterations in urbanization and land use patterns to enhance city resilience. The ability of human settlements to withstand and recover from natural disasters hinges on sustainable urban planning and management practices in disaster-prone regions.[77] To establish a basic level of buffer zones, local governments should take proactive measures to create green spaces in accessible areas, including waterways and wetlands, around human communities. To facilitate this, the legal system should assign relevant competences and provide support to local governments.

Disaster-prone countries in the Middle East must prioritize the alignment of their urban laws with the challenges posed by climate-related disasters. As a precautionary strategy, urban areas susceptible to irregular floods and dust storms should be safeguarded by designated NBZs. This entails the development of spatial zoning and land use policies that incorporate NBZs within and around vulnerable human communities. Efficient zoning and site selection methods, coupled with ecosystem management, are essential for the successful implementation of this strategy. Urban management and disaster risk reduction plans should include a comprehensive NBZ system, and urban governance systems should be adjusted to harmonize urbanization with the preservation of functional green and blue zones within urban areas, adhering to sustainable urban development principles.

4.2 Protection of Ecosystems

Protecting natural ecosystems in urban environments is crucial due to their increased vulnerability. Implementing proactive urban greening and preserving blue buffer zones can offer numerous benefits, including enhancing the economic, environmental, and social values

[77] Robert Home, 'Urban law and resilience challenges' in Damilola S. Olawuyi (ed): Climate Change Law and Policy in the Middle East and North Africa Region, (2022 Routledge), 164.

of urban areas.[78] Therefore, the preservation and development of green and blue spaces within and around urban areas should be an integral part of urbanization and regional development plans.

To ensure the efficiency and effectiveness of these NBZs, it is essential to keep them intact and in their natural state. Ecosystem protection regulations in NBZs should be stringent and distinct from other areas. To enhance the protection of NBZs, the utilization of natural resources within these zones should be limited to non-consumptive purposes, such as tourism and environmental sustainability objectives. Special regulations should be established to govern the conservation of green and blue spaces in and around human settlements. Establishing a network of polycentric water, land, and forest governance structures is necessary to coordinate the relevant bodies and instruments involved in the preservation and development of NBZs. This polycentric and adaptive approach can facilitate better design, planning, preservation, and expansion of NBZs within and around urban areas while integrating NBZ governance with climate change and natural disaster management efforts.

Additionally, more effective regulations should be enacted to protect and restore wetlands in urban areas and prevent erosion in coastal zones to restore their natural functions. Managing water bodies and watersheds in urban and suburban areas should prioritize the maintenance of blue buffer zones, flood regulation, and the development of green spaces. Flood-prone regions and floodplains should be safeguarded against destruction and covered with vegetation and left by neutral soil covers. Implementing adaptive pathways and buffer zones is essential in flood risk management and the development of resilient waterfront areas within and around urban areas.[79]

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[78] UN-Habitat 'World Cities Report 2020: The Value of Sustainable Urbanization', (n 59) 112.

[79] Jeremy Gibberd, Anticipating and Preparing for Future Change and Uncertainty: Building Adaptive Pathways, in Robert J. Howlett, Lakhmi C. Jain, John R.

In densely populated and industrial urban areas, it is crucial to implement effective legal and economic instruments to both expand and preserve green spaces. Developing agro-forestry around suitable human settlements can be a sustainable approach to combine forestry, agriculture, and pasture management, creating green buffer zones within and around urban areas.

In regions prone to dust storms, preventing the expansion of sand and dust storm sources requires various soil and plant resource management measures. These measures may include preventing wind erosion, managing fine-grained particles during transport and deposition, stabilizing soil surfaces through mulching, planting climate-compatible plants and trees, and creating mechanical and biological barriers.[80] To prevent soil degradation and the expansion of sand and dust storm sources in the ME, it is crucial to conserve vegetation cover and soil moisture through appropriate land use systems.[81] This, in turn, necessitates the implementation of legal instruments to enhance soil protection in dust storm-prone regions.

5. CONCLUSION

Certain parts of the Middle East, particularly countries like Iran, Iraq, and Syria, face severe extreme climate hazards such as floods and dust storms. The uncertainty surrounding future hydrological cycles, precipitation patterns, temperature changes, water consumption, and rapid urbanization may exacerbate these hazards, leading to unforeseen consequences for local communities. To enhance disaster resilience, these communities must adopt appropriate adaptation and mitigation strategies. One such strategy is the preservation and development of natural buffer zones (NBZs) both within and outside

Littlewood, Marius M. Balas (eds): Smart and Sustainable Technology for Resilient Cities and Communities (Springer 2022) 257.

[80] Nick Middleton, Utchang Kang, 'Sand and Dust Storms: Impact Mitigation' Sustainability, (2017) 9, 1053, 2,6.

[81] Thomas L. Thurow, 'Hydrologic effects on rangeland degradation and restoration processes', in Olafur Arnalds & Steve Archer (eds): Rangeland Desertification, (Springer 2000), 56.

urban areas, making human communities more sustainable and resilient to climatic hazards.

NBZs, encompassing green and blue buffer zones, refer to common natural urban and suburban spaces like rivers, green areas, wetlands, and neutral soils. These areas serve specific purposes, such as flood protection, greenhouse gas reduction, water conservation, and the creation of recreational spaces. While NBZs cannot provide complete protection against hazards like heatwaves, floods, and dust storms, they function as nature-based mechanisms to mitigate the impacts of these hazards on urban areas.

Given their nature-based functions, common green and blue spaces, in addition to their intrinsic ecosystem values, should be legally recognized as natural buffer zones. Consequently, they should receive double protection and be developed both within and around urban areas through appropriate legal measures. Currently, international law does not provide distinct protection for NBZs. However, some natural ecosystems like wetlands and forests, which can serve as NBZs, have been recommended for protection in international law. Additionally, some international documents such as the UNSDGs recommend making urban areas more sustainable and resilient against climate change and natural disasters. In this context, safeguarding and developing NBZs within and around urban areas is a significant mechanism to achieve these goals. Since these zones can effectively shield and absorb the impacts of floods and dust storms, and since states are encouraged to adopt policies that enhance urban areas' resilience and preparedness against climate-related natural hazards, protecting and developing NBZs in alignment with regional environmental considerations should be recognized in both international and national environmental law.

Given the severity of climate-related hazards in the Middle East, regional collaboration is required for the protection and development of NBZs in disaster-prone areas, ultimately fostering sustainable and disaster-resilient communities in the region. Iran, as a vulnerable country to natural hazards, has already implemented legal

instruments to support the development and protection of certain natural ecosystems serving as NBZs. For example, the recently enacted Clean Air Act mandates the protection of wetlands and the development of green spaces to shield urban areas from dust storms.

In conclusion, the existing set of legal instruments for the development and protection of NBZs as nature-based solutions is inadequate. Therefore, new legal instruments are required to address this gap. The legal framework concerning green spaces and surface waters must implement more effective, stringent, and urgent laws and regulations for the protection and development of NBZs within and around urban areas. To achieve this, the legal system should incorporate the development and protection of green and blue common spaces into local and regional land use and development plans, as well as disaster risk management strategies.

Integrating NBZs into essential components of national and regional disaster risk policies is an effective strategy to ensure the enforcement of protection and development measures for these ecosystems. It's important to recognize that NBZs are not merely recreational areas but serve as crucial natural shields that protect urban areas against the growing threat of natural disasters. Therefore, national urban policies should prioritize the design, site selection, placemaking, development, and protection of NBZs in vulnerable regions of Middle Eastern countries. These measures are essential for building resilient and sustainable communities in the face of increasing climate-related hazards.