

ANDI PAPASTEFANI¹, LAURA SHUMKA¹, KIMETE TATAVESH²

¹ Department of Art and Design, Faculty of Applied Sciences and Economics,
Albanian University, Tirana, Albania,

² Department of Engineering, Albanian University, Tirana, Albania
e-mail: a.papastefani@albanianuniversity.edu.al

PLANNING AND DELIVERING NATURE-BASED SOLUTIONS (NbS) IN URBAN LAKES AND WATERSHEDS IN TIRANA MUNICIPALITY

SUMMARY

The aim of this paper is to streamline our position on nature-based solutions in urban lakes and catchments within territory Tirana municipality. The risk of ecosystems collapse becomes truth in the continuous era of climate changes, while devastation of natural disasters, biodiversity loss, and food and water scarcity are associated issues. Further on, urban lakes and watersheds, along with other freshwater ecosystems around the planet, are placed at the edges due to human induced factors. At the current circumstances urban lakes surrounding Tirana i.e. Bovilla, Tirana, Farka, Paskuqani, Kashari, Prushi Lakes, etc., are subject to some of land use changes and heaviest use and harmful anthropogenic impacts. Integration of lakes into strategic and territorial planning (even in a multi-center concept) will directly influence on climate mitigation, green areas increased (surface per capita due to linkage with surrounding environment) and improving the nature resilience capacity. So, the survey aimed at 1) analyzing the current position NbS in the circumstances and directions of planning, strategic and other plans in Tirana municipality; 2) Understanding the current activities related to NbS following the human-nature interaction mainly from the lakes position; 3) delivering the potential of including NbS with focus to lakes and green infrastructure in the local policy; 4) identifying the NbS integration challenges in urban policy. The role of NbS within entire green infrastructure in urban resilience is well addressed.

INTRODUCTION

Wetlands are key habitats connected physically and socially with processes over a much wider territory (AMEZAGA *et al.*, 2002; WANG *et al.*, 2020). Different analyses revealed that particularly in a transitional economies wetlands were regarded as

unhealthy land to be reclaimed for the benefit of mankind. One's connectivity is a key for social and ecological healthy system, wetland mismanagement and human intervention and practices either affected functionality of highly fragmented them. Nowadays one's Tirana capital city of Albania has been rapidly enlarged (in both urban coverage and population size) the consequence is that wetlands are among the most degraded of all ecosystems. The relatively recent acceptance of the socio-economic and ecological importance of wetlands even in developed countries has not yet succeeded in reversing this trend (SAUNDERS *et al.*, 2002).

Despite the significance of the water ecosystems, natural and human-made ones, the comparative studies between these systems at the landscape level are lacking (AMEZAGA *et al.*, 2002; SAUNDERS *et al.* 2002; SHUMKA, 2018). Incorporation of aquatic ecosystems within landscape and urban life remains a continuous challenge (DRAKOU *et al.*, 2008). An urban lake park is an urban park located in an urban built-up area or suburb, with a certain scale of natural lakes, artificial lakes, or reservoirs as the main ecological matrix (SONG, 2022), while urban lakes are an important part of the urban ecosystem, an important spatial component of the urban landscape pattern, and an important medium and leisure space for residents to get close to nature. This kind of space has a high ecological value, which can conserve water, regulate regional climate, and improve the urban ecological environment (WU, 2020). The main purpose of this article is the enhancement/establishment of landscape connectivity among different water ecosystems in Tirana region (lakes and reservoirs) through multifunctional green infrastructure corridor modeling and design. Green Corridor that connects isolated remnant habitat patches (e.g. parks) can increase connectivity and provide ecosystem services in wider area of Tirana. Further on the contribution provides a practical and replicable approach for assessing landscape connectivity patterns and identifying priority locations for green corridors.

While the human intervention through urban enlargements has scattered and fragmented connectivity, the lakes and reservoirs, rivers and streams are resulting in different landscape components. AMEZAGA *et al.*, (2002) claim that aquatic ecosystems are connected physically and socially with processes extending at a wider territory than the ecosystem itself. On the other hand existence of water bodies is directly connected to other components, so TURNER (1998) supports the dependence of aquatic ecosystem types on the conditions of the landscape that surround them.

In case of Tirana there are 14 different reservoirs (constructed after the year '60 for different purposes as irrigation, drinking water or recreation), one large river, six different permanently flowing streams and numerous intermittent one. Following SAUNDERS *et al.* (2002) the land immediately bordering freshwater ecosystems is of the utmost importance because it serves as the final buffer to land-use activities and hydrological flows. AMEZAGA *et al.* (2002) noted that wetlands are not isolated spaces but, on the contrary, dynamic, complex habitats with biotic and

abiotic connections all around. Further on having in mind that they are shaped by natural processes and social practices, they should be conserved by what Ramsar calls wise use (DAVIS, 1993), the sustainable utilization for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem (DAVIS, 1993; CHENG and DU, 2021).

MATERIAL AND METHODS

Study area

Our study areas included 14 different man-made lakes or reservoirs, one large river, six different permanently flowing streams and numerous intermittent one (Fig. 1). These aquatic ecosystems are partly included in the protected areas (enlarged Mountain of Dajti National Park). The vital importance is linked with securing drinking water (Bovilla) or reserving as nucleus for recreational purposes (Tirana Lake and Farka).

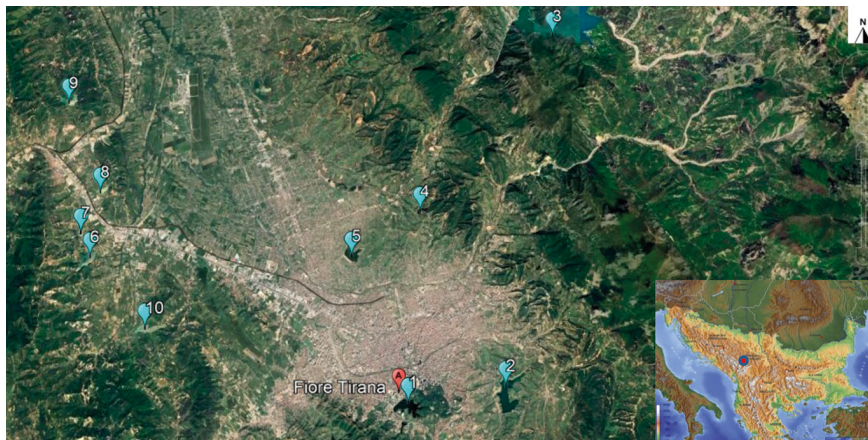


Fig. 1- Main water bodies setting in the area of capital city Tirana (generated from Google earth).

Analyses of current settings are aimed at establishment of a complete regional ecosystem. During the survey a spatial analyses were conducted following Google earth maps (Fig. 1), Land use and Land cover map (Fig. 2) using ASIG Geo-portal (<https://geoportal.asig.gov.al/map>).

During these analyses the reservoirs and other water ecosystems are considered as important ecological patches of Tirana city and other surrounding suburban areas. The relationship between water bodies and surrounding ecological corridors and patches need to be strengthened from a regional perspective to give full play to their core role in the regional ecological network due to proximity with

protected areas as Mountain Dajti National park, etc. Based on the regional ecological security pattern, identify the ecological core area of the urban water body areas, it has been proposed the “conservation area buffer area activity area” in a circle way, and rationally arrange the ecological functions of the parks (e.g. Tirana, Farka, Paskuqani and Bovilla Lakes), to determine the overall spatial structure of the urban parks, extraction of key ecological spaces, functional space layout, etc (Fig. 3).

RESULTS

The characteristics of main Tirana Lakes (Reservoirs) are presented in Tab. 1, where the analyses of land use and cover reveals the rate of connectivity with surrounding natural or seminatural areas.

Tab. 1- Characteristics of the main Lakes of Tirana and rate of connectivity (1-fragmented; 2-poor connectivity; 3-moderate connectivity; 4-promising connectivity)

No.	Name of the lake	Coordinates	Surface area (Ha)	Maximum depth	Purpose of establishment	Connectivity rate
1	Tirana	41°18'39.49"N 19°49'5.53"E	55	14	Recreation	1
2	Farka	41°18'59.46"N 19°51'39.99"E	75	16	Recreation/ Irrigation	2
3	Bovilla	41°26'23.48"N	4600	53	Drinking water	3
4	Kashari	19°53'6.81"E	17	13	Irrigation	3
5	Lepuri	41°22'35.22"N 19°49'24.37"E	13	8	Irrigation	3
6	Paskuqani	41°21'38.74"N 19°47'32.79"E	84	17	Irrigation	1
7	Pezëhelmësi	41°21'37.30"N 19°40'27.28"E	9	11	Irrigation	2
8	Prushi	41°22'59.79"N 19°40'37.72"E	7	17	Irrigation	3
9	Rov	41°24'56.39"N 19°39'35.90"E	3	7	Irrigation	3
10	Fjolla	41°20'9.01"N 19°42'2.63"E	11	14	Irrigation	3

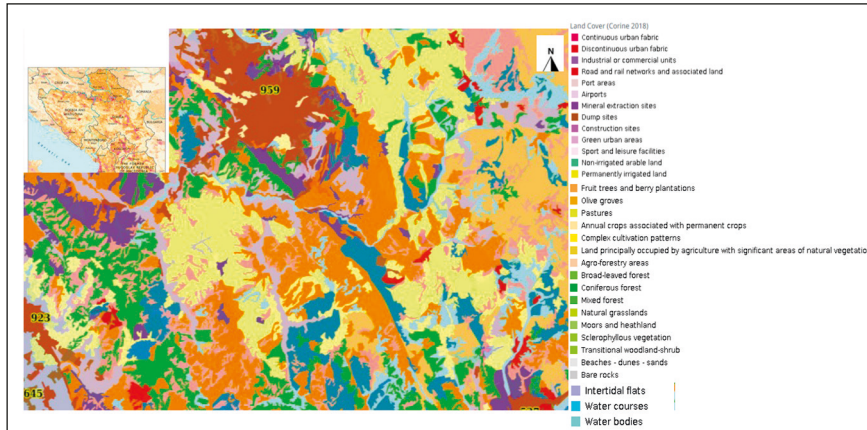


Fig. 2- Tirana Land cover map (2022/12 December 2022).

Among the other water bodies the most important is Bovilla Reservoir that is the main drinking water supply of the Tirana region including a population of about 850'000 inhabitants. The geologic formations in the watershed belong mainly to flyshes (clayey, sandy, alevrolithes). Limestones of Cretaceous II build up the lateral frames (KABO, 1991), mainly the high relief of the mountain chains of Kruja-Dajti and Skenderbeu Mali me Gropa. Only the formations in the higher parts seem to be resistant to the erosion. The Bovilla catchments belong to the sub-hilly Mediterranean climate, where two climate sub-zones are distinguished mainly: the hilly Mediterranean (up to 700-800 m a.s.l.) and the pre-mountainous Mediterranean (in higher altitudes). The mountainous Mediterranean climate is present only in higher peaks, too. The Reservoir was filled during 1998 and 1999 and Bovilla water started to be used as the main drinking water source for the city of Tirana. In parallel, the Drinking Water Treatment Plant in Kodra e Kuqe (Tirana) (elevation 217 m a.s.l.) was completed, through another soft loan from the Italian government. A steel pressure line of about 10 km length and 0.9 m in diameter delivers continuously about $1.8 \text{ m}^3 \text{ sec}^{-1}$ of water from the Reservoir to the Treatment Plant in Tirana (ÇULLAJ *et al.*, 2009).

DISCUSSION

Analyzing the current position NbS in the circumstances and directions of planning, strategic and other plans in Tirana municipality

The Albanian Parliament has passed on the 8th September 2016 the Law “On the accession of the Republic of Albania to the European Landscape Convention”. The convention was adopted by the Committee of Ministers of the Council of Europe on 1 June 2000. The Albanian Ministry of Foreign Affairs has completed

proceeding with the ratification instruments to be deposited through diplomatic channels to the Conventions” Secretariat. The data presented in Fig. 2 and Tab. 1, shows that rate of connectivity is at the very low level that appeals for further steps connected with both planning and investments.

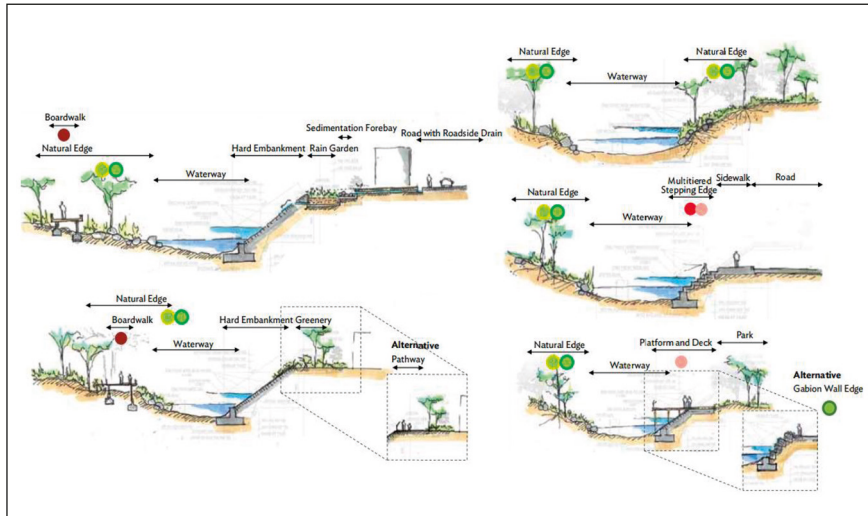


Fig. 3- Key Water Sensitive Urban Design Components (adapted from SONG, 2022).

Understanding the current activities related to NbS following the human-nature interaction mainly from the lakes position

The current state of lakes with regards to NbS and offer they provide towards biodiversity and landscape values is been emphasized by SHUKA *et al.*, 2011. Bio-diversity is an important factor affecting the stability and naturalization of ecosystems (SONG, 2022). By increasing the connectivity and contact surface between the water body and land, such as greening shoreline (Fig. 3, proposals) and increasing shoal wetlands, combined with the vertical transformation of nearshore and enriching revetment vegetation communities, a variety of habitats are provided for fish, amphibians, birds, and other organisms.

Delivering the potential of including NbS with focus to lakes and green infrastructure in the local policy

Considering connectivity within urban planning is mainly based on building/establishing green infrastructure as an integral part of local national policy. The considerations of lakes/reservoirs should be based on the complete ecosystem, give consideration to the people-oriented service function, and build an ecologically sustainable and dynamic public space in the city (ZHAO *et al.*, 2018). The establishment of buffer areas (a step already implemented by Municipality of Tirana in case of Tirana, Farka, Paskuani lakes), depending on the high-quality natural envi-

ronment, combined with low interference facilities such as access roads and small view spots, it provides a variety of natural recreation functions. It is worth to mention that management of visitors should be part of entire connectivity approaches.

Identifying the Nbs integration challenges in urban policy

It is important to include wetlands in watershed plans because of the important role they play in ecosystem function and watershed dynamics. Wetlands are a product of and have an influence on watershed hydrology and water quality (SHUMKA, 2018). Wetlands contribute to healthy watersheds by influencing important ecological processes. They recycle nutrients, filter certain pollutants, play a role in climatic processes by absorbing and storing elements such as carbon and sulfur, recharge groundwater, and provide energy production and habitat for fish and wildlife. Wetlands also provide goods and services that have economic value. Some examples of the goods wetlands provide include habitat conducive to food production, building products, and fresh water. Some examples of the services wetlands provide include the reduction of peak flows and flood damage, water storage, protection of erodible shorelines, water filtration and particulate removal, and recreational opportunities and amenities. Finally, societies value wetlands for their historic and cultural/religious significance. The detailed proposals in planing process are given in Fig. 3 (natural edges and other connectivity solutions)

CONCLUSIONS

At the current circumstances the design of conservation policies as a part of landscape planning, presupposes substantive understanding of the ecological functioning of protected areas, at habitat and landscape level.

The lake and other aquatic ecosystems are important green open space in the urban and sub-urban landscape. In this regard, there is a need for real consideration to the development of its ecological value and ecosystem service value and promote the harmonious coexistence of humans and nature in the urbanized area.

With specific considerations to Tirana water bodies this survey proposes an ecological approach to ensure water security and quality, establish connectivity in a landscape level, improve biodiversity, and open windows for incorporation into different planning procedures.

REFERENCES

- AMEZAGA J.M., SANTAMARIA L. GREEN A.J., 2002 – Biotic wetland connectivity- supporting a new approach for wetland policy. *Acta Oecologica* **23**: 213-222.
- CHENG Y., DU C., 2021 – Research on the renewal strategy of urban parks under the guidance of health - taking Chongqing Jiuqu River Park as an example. *Landscape Architecture*, **38** (3): 85-91.

- ÇULLAJ A., DUKA S., PJESHKAZINI L., 2009 – Vlerësimi kimiko-limnologjik i cilësisë së ujit të Ujëmbledhësit të Bovillës fokusuar në përdorimin për ujë të pijshëm / Chemico-limnological assessment of water quality of Bovilla Reservoir focused on drinking water use. In: BOTUARNGA A. MIHO, A. ÇULLAJ, R. BACHOFEN (Eds). *Bovilla (Albania) – Limnological Study / Studim Limnologjik*, FShN, University of Tirana: 49-100 pp.
- DAVIS T.J., 1993 – *Towards the Wise Use of Wetlands, Wise Use Project*. Ramsar Convention Bureau, Gland, Switzerland.
- DRAKOU E.G., KALLIMANIS A.S., SGARDELIS S.P., PANTIS J.D., 2008 – Landscape structure and habitat composition in reservoirs, lakes, and rivers, *Lake and Reservoir Management*, **24**(3): 244-260, DOI: 10.1080/07438140809354065.
- KABO M., 1991 – Physical Geography of Albania, Albanian Academy of Sciences. Geographic Centre. Tirana Vol. I, 1990: p. 400; Vol. II, 1991, p. 590.
- SAUNDERS D.L., MEEUWIG J.J., VINCENT C.J., 2002 – Freshwater Protected Areas: Strategies for Conservation. *Conservation Biology* **16**: 30-41.
- SHUMKA L., 2018 – Considering landscape and water in the Dumrea region: challenges for integrated planning and sustainability. *Thalassia Salentina* Supplement 1:147-154. doi: 10.1285/i15910725v40sup2p147.
- SHUKA L., CULLAJ A., SHUMKA S., MIHO A., DUKA S., BACHOFEN R., 2011 – Spatial and Temporal Variability of Limnological Properties of Bovilla Reservoir (Albania). *Water Resource Management*, **25**(12): 3027-3039. DOI: 10.1007/s11269-011-9788-z.
- SONG J., 2022 – Design of Urban Lake Park from Ecological Perspective Explore: Tangjiawan Zhongshan Park as An Example. *British Journal of Environmental Studies* **1**: 13-19. DOI: 10.32996/bjes.2022.2.2.3.
- TURNER T., 1998–*Landscape Planning and Environmental Impact Design*. Routledge. London.
- WANG X., ZHOU Y., YU J., 2020 – Research on the construction method of urban lake rain-water utilization system based on hydrological process, taking Mengze Lake in Wuhan as an example. *Landscape Architecture* **1**: 70-76.
- ZHAO R., GE X., LI X., 2018 – Research on the construction strategy of the urban forest in Beijing with habitat under the background of leaving blank to increase green. *Journal of Beijing Forestry University* **40**(10): 102-114.