PhD School on Agriculture, Environment and Bioenergy

(http://sites.unimi.it/dottorato_aab/)

(XL cycle, 2024-27)

Project draft

1.Field of interest

AGR/10 – Rural Buildings and Agro-Forest Land Planning

2.Project title

Design and management of Nature-Based Solutions (NBS) and urban green areas for sustainable stormwater management (SUDS)

3. Tutor (membro del Collegio dei Docenti)

Giulio Senes

Co-tutor

Natalia Fumagalli

4. Relevance of the topic and state of the art

Cities around the world are increasingly tackling seriously the issue of climate change, trying to make the urban environment more resilient. In Italy, finally, last December, after a 6-year process, the National Plan for Adaptation to Climate Change, PNACC in Italian (DM 434/2023) has been approved. It is the national strategy designed to make our country resilient to the climate crisis, with the dual objective of establishing national governance and providing guidance for adaptation actions to climate change. Among the effects of climate change we have to note an increasing number of flooding events, both in urban and rural areas, due to the increasingly frequency of intense meteoric events and the insufficient capacity of conventional drainage systems (Tao et al., 2014).

The great proportion of impermeable surfaces due to the intense urbanization of the past decades (Guan et al., 2015), has caused the increase in the water surface runoff and peaks of maximum flow, the decrease in the amount of rainwater infiltrated into the soil, the alterations in the recharge cycle of the aquifers and the deterioration of water quality (Chen et al., 2017).

In the last two decades, the academic and professional worlds have increasingly investigated the effectiveness of using Nature Based Solutions for the creation of a multifunctional green infrastructure, both in urban areas and in the countryside. Sustainable Urban Drainage Systems (SUDS) includes a range of nature-based techniques to drain water by restoring drainage conditions existing prior to site development (Ashley et al., 2015; Abdelkebir et al., 2021).

Green Infrastructures play an important role in the stormwater management (in addition to the existing grey infrastructure), enhancing the natural processes of infiltration, evapotranspiration, filtering and reuse of water, and providing several benefits, such as rainwater detention, flood alleviation, less sewer overflow events, reduction of the realization and management costs for grey infrastructures, (Dhakal and Chevalier, 2016; Joshi et al., 2020; Vogel et al., 2015).

In this context, the goals of the project are: (i) to study the concrete functioning of green infrastructure and nature based solutions in real conditions; (ii) to understand the problems related to location and design that influence their drainage capability; (iii) to define how to assess and measure the ecosystem services provided by NBS to the local communities; and (iv) to define design characteristics and species composition of different NBS solutions in different contexts and conditions of the northern Italy.

5. Layout of the project (draft)

5.1. Materials & Methods

The project goals will be achieved through a series of research activities, organized in the following Work packages (WPs).

WP1 – Literature review. The relevant literature will be analyzed, with particular regards to the design criteria and the methods for measuring the NBS performances.

WP2 – Identification of real case-studies where verifying the concrete functioning of NBS in real conditions, in order to assess the problems related to location and design that influence their drainage capability.

WP3 – Definition of the most suitable indicators for the evaluation of the ecosystem services provided by NBS to the local communities.

WP4 – Definition of design guidelines related to NBS characteristics and species composition in different situations.

WP5 – Design and realization of prototypical NBS in real situations, monitoring their functioning and measurement of the adopted indicators.

WP6 - Writing the Ph.D. thesis.

5.2. Schedule and major steps (3 years)

The research activities will be carried out in the 3 years of the project, according to the following general schedule.

- **First year**: literature review; identification of the cultural ESs of GIs and greenways; definition of the most suitable indicators for their assessment.
- **Second year**: analysis of the ESs offered by the study areas; analysis of the demand of ecosystem services by the local population, tourists and businesses.
- **Third year**: assessment of the ESs offered by the study areas; their integration in the rural land planning and design practices of the study areas; writing the thesis.

Activities	1st year				2nd year				3rd year			
WP1 – Literature review												
WP2 –Assessment of real case-study areas												
WP3 – Definition of the indicators												
WP4 – Design guidelines												
WP5 – Monitoring												
WP6 - Writing the Ph.D. thesis												

6. Available funds (to support research)

29960 - COLL_PR19GSENE_01: Euro 21.500

7. Financing (to support the bourse)

BrianzAcque will entirely finance the Ph.D. Scholarship.

8. Literature

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- Chen J.Q., Theller L., Gitau M.W., Engel B.A., Harbor J.M., 2017. Urbanization impacts on surface runoff of the contiguous United States, J. Environ, Manage, 187, 470–481. https://doi.org/10.1016/j.jenvman.2016.11.017
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- Guan M.F., Sillanpaa N., Koivusalo H., 2015. Modelling and assessment of hydrological changes in a developing urban catchment. Hydrol. Process. 29 (13), 2880–2894. https://doi.org/10.1002/hyp.10410
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- Tao W.D., Bays J.S., Meyer D., Smardon R.C., Levy Z.F., 2014. Constructed wetlands for treatment of combined sewer overflow in the US: a review of design challenges and application status, Water-Sui 6 (11), 3362–3385. https://doi.org/10.3390/w6113362.
- Vogel J. R. et al. (2015), Critical review of technical questions facing low impact development and green infrastructure: a perspective from the great plains, Water Environ. Res., 87, 849–62.
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