14th BIENNALE
OF EUROPEAN TOWNS
AND TOWN PLANNERS
NAPOLI

Enhancing urban regeneration and spatial justice with Nature-Based Solution:
Nature-based solutions for improving efficiency in urban settlements. A model for its measurement

FEDERICA CICALESE* AND ISIDORO FASOLINO
Department of Civil Engineering, University of Salerno
*fcicalese@unisa.it

Naples, 22 April 2024

► European Union-funded Project

Nature for sustainable cities:
planning cost-effective and just solutions for urban issues
(NatSolis)

► What are Nature-based Solutions (NbS)?

Nature-based Solutions are "*solutions inspired and supported by nature that are cost-effective, provide simultaneous environmental, social and economic benefits and help build resilience. Such solutions introduce a greater quantity and variety of nature and natural features and processes into cities, landscapes and seas through systemic, locally adapted and resource-efficient interventions*"

(EC, 2022)

► NbS as an umbrella concept
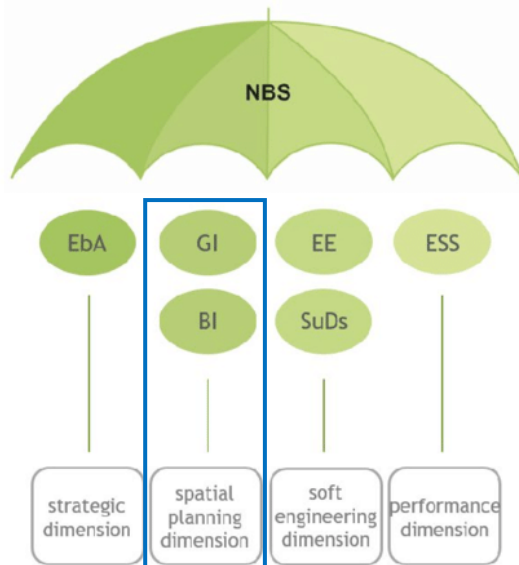
EbA → Ecosystem-based adaptation
GI → Green infrastructure
BI → Blue infrastructure
EE → Ecological engineering
SuDs → Sustainable urban drainage systems
ESS → Ecosystem services

► Procedural framework

STEP 1

Device identification

STEP 2

Identification of a set of indices to quantify the different functions exercised by vegetation in urban ecosystems.

STEP 3

Development of equations to be associated with each indicator to quantify the functions provided by different green materials (trees, shrubs, hedges)

STEP 4

Comparison between the identified devices and the Abacus of NbS proposed in the Metropolitan Territorial Plan of the city of Milan.

Fascicolo 7.3/2017/18   Allegato 21/pag.1 di 78

Città metropolitana di Milano

Piano Territoriale Metropolitano

Fascicolo 7.3/2017/18   Allegato 21/pag.2 di 78

Consiglio metropolitano n. ...... del ....

...de metropolitana
...re Based Solutions (NBS)

Rete Verde Metropolitana

Abaco delle Nature Based Solutions

...uglio 2020

► Evaluating the performance of NbS

NbS	Measure
Green areas	Permeability $$P = \frac{G_p + \phi_s G_s}{G}$$
Rain Garden	Rainfall interception $$Ri = \sum_{i=1}^{N}\left(1 - e^{-kw_i L_i \Omega_i}\right)\cdot p_i$$
Street trees Natural green shelters	Shading $$S = \sum_{i=1}^{N}\left(1 - e^{-k_i L_i \Omega_i}\right)\cdot p_i$$
Green barriers	Acoustic and visual insulation $$I = \sum_{i=1}^{N}\rho_i v_{i\|w}\, e^{-\tau d_{i\perp w}}$$

Parameters	Description
i	ith element of vegetation
N	Number of vegetation elements
G	Lot area
Gi	Area occupied by i
Gp	Permeable area
Gs	Semipermeable area
φ_s	Permeability coefficient
pi = Gi/G	Fraction of G occupied by i
Si	Number of stems
Ω_i	Clumping factor
$v_{i\|w}$	Volume of linear green elements parallel to w
ρ_i	Vegetation density
$d_{i\perp w}$	Vegetation distance from w
L_i	Leaf area index
k_i	Extinction coefficient for direct radiation
kw_i	Extinction coefficient for rainfall interception
τ	Insulation effect at increasing $d_{i\perp w}$