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INTERREG ITALY-CROATIA PROGRAMME 2021 – 2027

NbS implementation manual

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REGEA

KARLOVAČKA ŽUPANIJA In medias res

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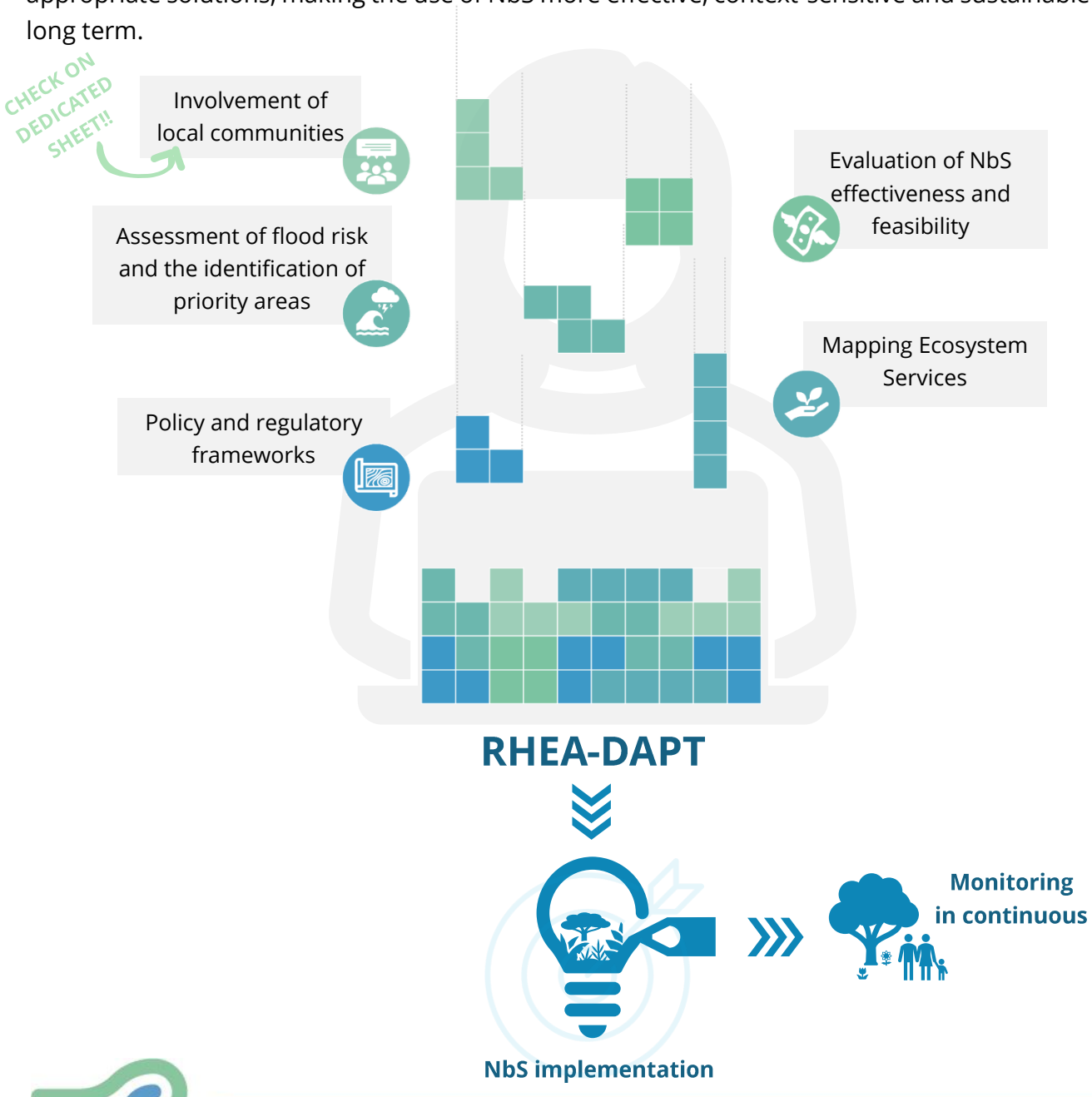
Ministero delle Infrastrutture e dei Trasporti

The strategy for prioritization

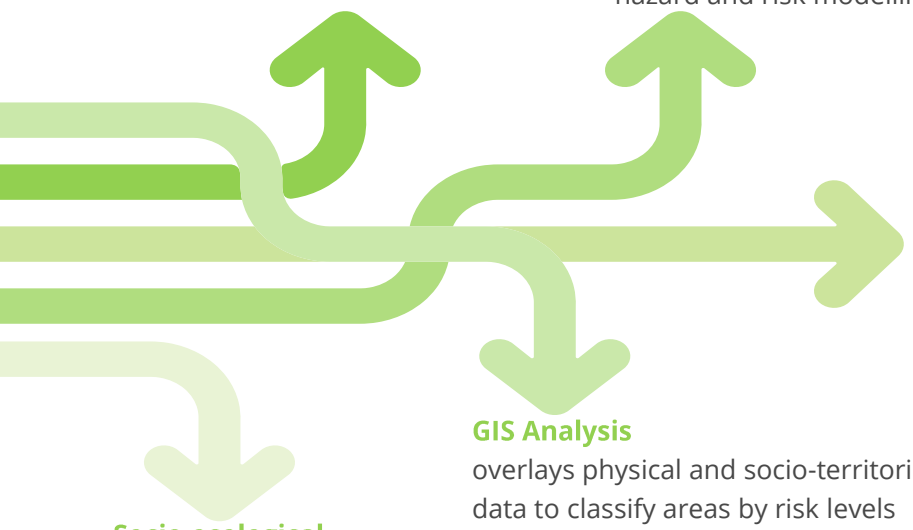
Nature-based Solutions (NbS) are effective measures to address environmental and climate change risks such as floods, droughts and biodiversity loss, while also delivering significant benefits for human well-being and urban quality of life. However, their implementation is often fragmented and lacks a shared strategic vision, due to territorial, institutional and functional differences across contexts. For this reason, a structured but flexible prioritization strategy is needed, capable of integrating NbS within spatial planning and climate adaptation policies and considering not only environmental aspects but also social and institutional dimensions. The AcquaGuard project responds to this need by developing RHEA-DAPT, a decision-support tool that through participatory processes and evaluation methodologies, supports public authorities in selecting the most appropriate solutions, making the use of NbS more effective, context-sensitive and sustainable in the long term.



RISK ASSESSMENT AND IDENTIFICATION OF PRIORITY AREAS

Hydrological Models
use real-time data to simulate water accumulation and propagation, enhancing flood prediction accuracy.

European Directive
provides a framework for member states to develop Flood Risk Management Plans based on hazard and risk modelling.



National and Subnational Plans
integrates with urban, territorial, and environmental planning frameworks to implement adaptation and mitigation policies.

GIS Analysis
overlays physical and socio-territorial data to classify areas by risk levels and intervention priorities.

Socio-ecological Indicators
consider social and ecological vulnerabilities to inform adaptive capacity.

CURRENT REGULATORY LEVELS: SPATIAL PLANNING

Spatial planning, in a context of increasing environmental pressures and climate uncertainty, must be understood as a strategic instrument rather than a purely regulatory layer. Its role extends beyond land-use control: it provides coherence across public objectives where risk reduction, environmental protection, and sustainable development intersect. Central to this function is the capacity to interpret territorial complexity. Planning constructs the spatial narratives through which Institutions understand vulnerabilities, priorities, and opportunities, making it the area where feasibility and desirability are negotiated. Its effectiveness depends on how well it integrates prioritisation methods within existing governance structures, ensuring alignment with land-use plans and sectoral policies. Moreover, planning is essential for addressing uneven vulnerabilities and ensuring socially just interventions by recognising the spatial distribution of risks, capacities, and institutional readiness. Ultimately, planning serves as the infrastructure of decision-making: a framework that grounds solutions in context, prevents fragmentation, and ensures that Nature-based Solutions are not applied superficially but embedded within the territorial and institutional conditions necessary for long-term impact. This approach is illustrated through two concrete examples developed within the Italian and Croatian pilot sites:

VENETO REGION

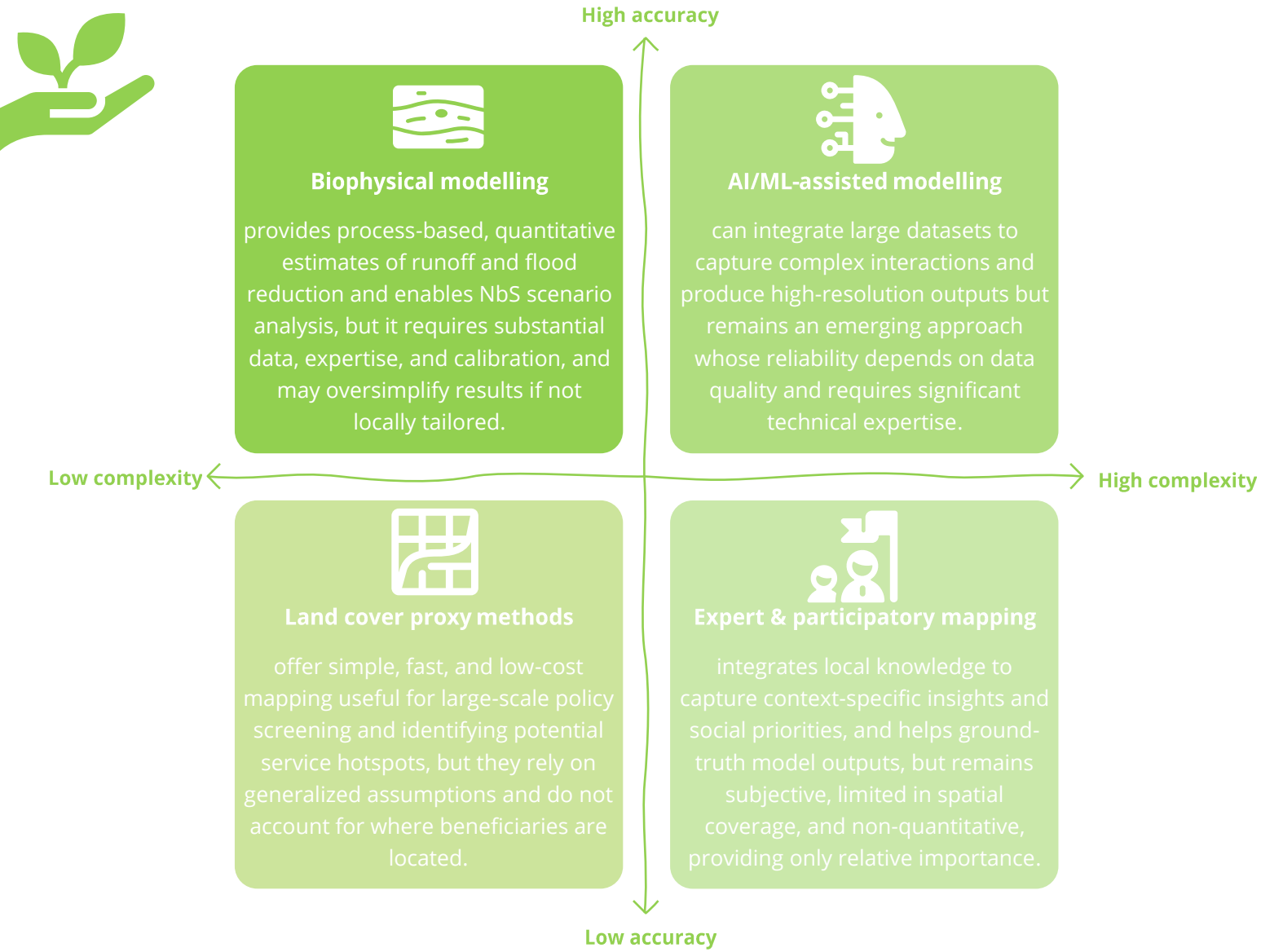
Plan	Planning level	Key inputs
Regional Strategy for Adaptation to Climate Change (2024)	Regional	- Climate risk scenarios, - Ecosystem Service evaluation, - NbS integration guidelines.
Regional Territorial Coordination Plan	Regional	- Strategic environmental objectives, - Ecological connectivity, - Regional cartography for vulnerability assessment.
Master Plan for the Venice Lagoon Drainage Basin	Basin level	- Hydraulic infrastructure planning, - Inter-municipal coordination, - Functional sub-basin delineation.
Flood Risk Management Plan – EU Floods Directive 2007/60/CE	River basin (EU Floods Directive)	- Flood hazard maps, - Vulnerability scenarios, - Preventive planning basis.
Hydrogeological Plan	River basin	- Hydrogeological hazard zoning, - Geomorphological risk classification, - Spatial constraints on land use.
Water Management Plan - EU Water Framework Directive 2000/60/CE	River basin (EU Water Framework Directive)	- Water body status, - Pollutant source mapping, - Ecological restoration priorities.

KARLOVAC COUNTY

Plan	Planning level	Key inputs
Programme for Mitigation and Adaptation to Climate Change of Karlovac County (2024)	Regional	- Climate risk assessment, - Greenhouse gas inventory, - Adaptation and resilience measures.
Development Strategy of Karlovac County (2021–2027)	Regional	- Legal and strategic framework, - Socio-economic baseline, - Funding and implementation mechanisms.
Spatial Plan of Karlovac County	Regional	- Legal and policy framework, - Existing spatial and land use data, - Sectoral plans and strategies.
Operational Flood Defence Plan for the area of small Kupa River	River basin	- Flood risk maps and zones, - Hydrological and meteorological data, - Preventive planning basis.
Water Management Plan for the 2021–2027	National	-Water body status, - Assessment of significant water management data, - Organizational structure and response measures.

MAPPING ECOSYSTEM SERVICES

Mapping Ecosystem Services (ES) is a fundamental step in strategies that prioritize Nature-based Solutions for climate-related risk mitigation. ES assessments translate ecological functions into information that supports territorial planning. According to established classification frameworks, ES include provisioning, regulating and maintenance, and cultural benefits. In NbS planning, different levels of ES mapping allow for a multidimensional understanding of spatial dynamics. This helps identify areas with strong ecological performance, detect inequalities in the distribution and accessibility of ES (particularly for vulnerable groups) and clarify trade-offs and synergies among services. Integrating ES mapping into NbS prioritization strengthens transparency and supports decisions that consider ecological capacity, spatial conflicts, and climate vulnerabilities. It becomes a strategic tool for designing interventions that deliver long-term, context-specific, and socially inclusive benefits.



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COST EVALUATION OF NBS EFFECTIVENESS AND FEASIBILITY

To support informed decision-making, different economic evaluation methods can be used to analyse Nature-based Solutions, each offering a distinct perspective, from focusing on the full spectrum of costs over time, to assessing the efficiency of investment in delivering measurable outcomes, to comparing overall monetary benefits against total costs.

Cost - focused ⟵ ⟶ Benefit - focused

Life-Cycle Cost Analysis

assesses all costs and benefits of a NbS over its full lifespan, from planning and implementation to maintenance, accounting for capital expenditures or operational expenditures, co-benefits or funding options, and governance considerations.

Cost-Effectiveness Analysis

evaluates how efficiently an NbS converts financial resources into measurable outcomes. CEA converts costs into measurable outcomes, allowing comparison of alternatives while accounting for multiple services, long-term effects, and uncertainties.

Cost-Benefit Analysis

compares monetary costs and benefits of an intervention to assess its economic justification. It captures broader societal impacts such as Ecosystem Services and avoided harm but faces challenges in monetising non-market benefits and long-term gains.

LONG-TERM MONITORING OF THE NBS

In nature-based adaptation strategies, monitoring should be seen as an integral part of implementation rather than a final technical step. Combining scientific measurements with citizens' active involvement creates a continuous relationship between communities and their environment, strengthening local skills, trust, and stewardship while enriching technical data with context-specific insights that support long-term learning and adaptive management.

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Traditional monitoring

By using in situ measurements, field surveys, and remote sensing, it involves systematically collecting baseline data and key indicators to track environmental, hydrological, and ecological changes. Monitoring should start early and follow consistent protocols to detect both immediate and delayed effects. Although it requires planning, resources, and institutional commitment, this approach provides the scientific evidence needed to validate NbS, support adaptive management, and guide replication, complementing participatory and local knowledge.

Participatory monitoring

By involving communities in indicator definition, data collection, and result interpretation, it transforms NbS evaluation into a mechanism for social engagement, fosters local awareness, capacity-building, civic stewardship, and collective responsibility. When structured inclusively and sustained over time, it enhances both the quality of information for decision-making and the legitimacy, resilience, and long-term effectiveness of interventions, turning monitoring into a platform for learning, dialogue, and active citizenship.