4D	
SUSTAINABILITY AND RESILIENCE	**Principle 16. Environmental resilience**

Target group / Relevant stakeholder: National Policy-Makers, Municipal Governments, Regulators, Urban Water Utilities, Medium Water Utilities, Rural Service Providers, Watershed or River Basin Organisations, User Groups, Networks or Platforms, and/or Private Sector

DESCRIPTION

Protect the ecological functions to supply, purify, and protect the water sources on which services, health and well-being of communities depend (Salvetti and Focacci, 2024, 25).

EXPECTED RESULTS

Outputs:

- The risk of disruptions in essential water services is limited and the capacity to rebound quickly after a shock is increased.
- Coherence in actions across water use, protection and clean-up.
- Domestic water needs, environmental flows and water usage for agriculture, irrigation, energy, and industry benefit from collaborative decision-making, deliberate information sharing and joint access to funding.
- Strategies to prevent, monitor, and respond to floods, droughts, and climate change impacts.
- Dedicated budgets and funding mechanisms for rural and vulnerable areas.
- Financial revenues dedicated to disaster response and ecosystem protection.
- Biodiversity strategies and adherence to nature restoration law goals.
- Pollution charges and regulations to mitigate environmental impacts.

CONDITIONS FOR SUCCESS

- Policy is adjusted to strengthen critical ecosystems resilience.
- System-based approaches tackle complexity and interdependency of water sub-systems.
- Cooperative frameworks strengthen environmental resilience that stresses information sharing and consensus building on policy design and objective setting.
- Sufficient water allocation sustains healthy ecosystems (OECD, 2012).
- Financial sustainability is factored in from the start into planning.
- Expertise is available to make complex technical and non-technical choices, and to undertake comprehensive options assessments.

BARRIERS

- Gaps in policy implementation, weak institutional coordination, and limited financing (Ali et al., 2024).
- Water for domestic use remains largely isolated from other human and environmental needs, managed through separate systems with differing structures, spatial scopes, infrastructure, and expertise (UNDP, SIWI and UNICEF, 2023).
- Fragmented policy and institutional settings with gaps, duplications, unnecessary delays, high transaction costs, patchy data and information for decision-making.
- Lack of policy coherence: A range of policy areas, such as climate change, land-use, environment, agriculture, urban development and infrastructure, influence environmental resilience, but tend to be insufficiently coordinated. Such mismatches can fuel stakeholder conflicts and generate investment inefficiencies.
- Absence of a well-defined pathway to sustainability (Di Vaio et al., 2021).
- High complexity and interdependence among infrastructure and WASH sub-systems (OECD, 2019).

- Infrastructure resilience policies do not address the growing complexity of shock events, interdependent systems and countries, and the rapid pace of innovation in infrastructure sectors (OECD, 2019).
- The aging of infrastructure presents an increasing policy challenge (OECD, 2019).

SOLUTIONS

- Alignment of policies, strategies and approaches in the water sector and other key sectors, particularly agriculture and energy (OECD, 2012).
- Fill information gaps: Development of water information systems to support more efficient and effective delivery of sustainable water resource management and policies, improve the understanding of hydrological systems in the context of climate change and other sources of uncertainty, and encourage innovations in water data collection.
- Enhanced coordination across local, regional, basin and national levels of government: While national governments lead policy development and water resource strategies, effective environmental management requires shared responsibility. Multi-level cooperation facilitates trade-off management, information sharing, and upstream-downstream coordination. River basin organisations play a key role in fostering inter-municipal and regional flood cooperation.
- Stakeholder engagement can foster inclusive policies, strategies, and plans that ensure the fair distribution of governance benefits and costs for environmental resilience (Di Vaio et al., 2021).
- Partnerships between government and infrastructure operators can enhance information sharing and investment (OECD, 2019).
- Institutional integration between WASH and IWRM (UN Water, 2020) across different governance levels. Enhance WASH engagement with IWRM in sustainable water use, source-water protection, and pollution prevention, while ensuring water management upholds human rights to water and sanitation and a healthy environment (UNDP, SIWI and UNICEF, 2023).
- Cooperation between WASH and IWRM in flood and drought mitigation and preparedness planning as well as sharing early warnings and coordination during response, recovery, and learning.
- Collaboration across WASH and IWRM in the formulation of policy and strategy; coordinated participation can facilitate joint working and information sharing. There are also benefits to be gained from greater collaboration in planning processes, water resources monitoring, regulation, and capacity development interventions at local, sub-national, national and transboundary levels.
- Equitable water resources allocation should consider domestic water use at every step of decision-making in planning and allocation processes.

EXAMPLES

Restoring Degraded Streams in France to Strengthen Ecosystems and Water Security During Droughts

SDGs linked

Water risks

In response to increasing drought vulnerability in France, the LIFE-Artisan project, led by the French Office for Biodiversity (OFB), is restoring degraded river streams to enhance water security and ecosystem resilience. A key initiative in the Néal River watershed, which supplies drinking water to 470,000 people, has successfully reconnected local communities with their river while encouraging farmers to adopt voluntary water-use reductions. Despite initial low engagement, targeted communication efforts led to increased local ownership, with one village revitalising a neglected riverside space. The project also established river committees to improve governance and facilitate coordination. While France has advanced environmental planning at the national level, project-level

NbS impact assessments remain limited, highlighting the need for further integration of monitoring frameworks to demonstrate effectiveness and secure sustainable financing.

Linkages to Governance Principles

The project reinforces environmental resilience by restoring streams and promoting NbS to enhance water availability during droughts. Stakeholder engagement has been central, with neutral agricultural chambers fostering direct farmer participation and river committees coordinating efforts across sectors. The project also contributes to M&E, generating insights into NbS effectiveness through localised assessments.

Nature-Based and Cost-Effective Wastewater Responses to Climate Change in Ireland

SDGs linked

Water risks

Ireland has faced a decline in water quality over the past two decades, largely due to agricultural pressures. Uisce Éireann, the national water utility, has responded by integrating NbS into its Biodiversity Action Plan, with integrated constructed wetlands (ICWs) offering a cost-effective wastewater treatment solution, particularly for rural areas. The Dunhill ICW, in operation since 1999 and expanded in 2012, serves as a model for sustainable wastewater management. It is maintained as part of Uisce Éireann's standard wastewater treatment infrastructure and benefits from minimal operational costs. The project's success has been driven by cross-departmental collaboration, strong monitoring and evaluation frameworks, and community engagement.

Linkages to Governance Principles

The Dunhill ICW case demonstrates environmental resilience by providing a sustainable wastewater treatment alternative suited to climate variability and agricultural pressures. Stakeholder engagement has been key, with collaboration between Uisce Éireann, local authorities, and communities driving implementation. Additionally, robust M&E systems ensure continuous tracking of performance, with technologies such as flow recorders, lysimeters, and piezometers supporting adaptive management and long-term sustainability.

Strengthening Groundwater Resilience through Winter Irrigation in Milan, Italy

SDGs linked

Water risks

The Interreg CE-MAURICE project is an ongoing European research initiative addressing groundwater resilience in the Milan metropolitan region, alongside six other countries in Central Europe, where groundwater supplies are essential for public and industrial use, while surface water plays a key role in irrigation and aquifer recharge. Climate change-induced droughts threaten future water availability, prompting the need for adaptation measures. The project explores winter irrigation as a groundwater recharge solution, using traditional irrigation canals to infiltrate available water into aquifers. A pilot site near Milan assesses the feasibility of this approach, ensuring both water sustainability and the preservation of cultural heritage. Stakeholder engagement is central, with farmers voluntarily implementing winter irrigation and regional authorities reviewing legal and governance frameworks. The project underscores the importance of collaborative governance, proactive data collection, and policy coherence to enhance long-term water management strategies.

Linkages to Governance Principles

The project strengthens environmental resilience by enhancing groundwater buffering capacity, making the aquifers' systems more adaptable to climate change. Stakeholder engagement is also key as farmers, irrigation consortia, and regional authorities collaborate to implement and scale winter irrigation practices. Monitoring and evaluation ensure the effectiveness of recharge measures, providing essential data for informed decision-making. Policy coherence is also relevant, legal and institutional frameworks should align with local practices to support the viability of adaptation measures, demonstrating the need for cohesive governance processes to sustain long-term water security.

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