TRANSCEND

POLICY BRIEF

Barriers and innovative adaptation policies in TRANSCEND's river basins

This project has received funding from the EU Horizon Europe Programme

TRANSCEND'S RIVER BASINS

Reno basin – 4,628 km² – Italy

- Mountainous and plain landscape; from temperate Mediterranean to mountain climate
- Main land use: agriculture (55%); main water use: irrigation (80%)
- Anthropic and vulnerable landscape: dams for hydropower use in the mountain part and channels for agriculture in the plain
- Growing climate risk (drought and floods) exacerbated by climate change
- Ecosystems (wetlands, forests, rivers) that benefit from water wastes of traditional irrigation at risk for new efficient technologies

Nitra basin – 4,501 km² – Slovakia

- 2094 km²
- Broadleaf and mixed forests dominate the mountains, while grasslands and agricultural land dominate the valley bottoms and lowland plains; diverse climates
- Industrial and domestic water use
- Region in transition with uncertain socio-economic future due to phasing out of coal mining
- Water supply expected to be reduced by climate change and discharge from the mines due to their closure;
- Increasing droughts and low stream flows during winter months

Orontes basin – 24,660 km² – Lebanon

- Lebanon part: 1,718 km²
- Transboundary basin (Syria, Turkey),, upstream portions in Lebanon, with cooler climate and consistent year-round flow
- Main land use: agriculture; main water use: irrigation (groundwater)
- Imbalanced water allocation and use across countries
- Geo-political conflicts and migration
- Growing competition between irrigation and domestic uses.

Júcar basin – 22,200 km² – Spain

- Upland plateaus and mountains and coastal plain; semi-arid climate
- Water use: 80% irrigation; 20% urban supply, industrial, and environmental requirements
- Conflicts between upper and lower basin farmers; groundwater depletion, theft.
- Absolute water scarcity; drought episodes exacerbated by climate change

Tympaki basin – 265 km² – Greece

- Mountainous in the north, low-lying plain in the south; diverse climates
- Main land use: agriculture (90%); main water use: irrigation (95%)
- Water demand exceeds the supply, despite the Faneromeni Dam
- Vulnerability for aquifer overdraft, saltwater intrusion, poor groundwater qualitative and quantitative status

Mahanadi basin – 141,589 km² – India

- Mountainous borders surrounding a flat interior; tropical monsoon climate
- 54% agricultural land use, 37% irrigated crops
- Irrigation demand exceeds water supply
- Growing scarcity and floods (delta) under climate change
- Intersectoral and interstate conflict over water allocation between Chhattisgarh (upstream) and Odisha (downstream).

Titicaca-Desaguadero-Poopó system – 143,900 km² – Peru, Bolivia

- 143,900 km²
- Transboundary system with cooperation in development since the early 90s
- Pastureland (40%) and irrigated cropland (10%); main water use: irrigation
- Arid region, sensitive ecosystems to climate change (Poopó Lake in Bolivia)
- Competition between upstream (agriculture) and downstream (irrigation, livestock)
- Inequity (permit holders in Peru vs unregulated irrigation system)
- Operational protocols for Lake Titicaca gages in development

Júcar river basin – Spain

- 22,200 km²
- Upland plateaus, mountains and coastal plain; semi-arid climate
- Water use: 80% irrigation; 20% urban supply, industrial, and environmental requirements
- Conflicts between upper and lower basin farmers, groundwater depletion, theft
- Absolute water scarcity; drought episodes exacerbated by climate change

BARRIERS TO THE ADOPTION OF INNOVATIVE ADAPTATION POLICIES

Barriers	Example
Rigid regulations	The polluter-pays-principle stated in the Water Framework Directive can preclude other beneficiary policies
Discretionary water allocation mechanisms	Water allocation uncertainty hinders irrigated agriculture insurance
Limited institutional know-how on novel technologies and governance mechanisms precludes transformation	Subsidies to increase irrigation efficiency allocated to save water, despite much evidence showing the contrary
Limited monitoring, as well as enforcement, and institutional capabilities	Even when illegal abstraction is widely documented, many offenders remain unpunished
Limited penetration and marketability of innovative policies	Lack of awareness of transformational potential, lack of foresight data can generate concerns about safety (e.g. of treated wastewater)
Innovative solutions demand high return from investments hindering their implementation	Extensive paybacks periods and uncertainty about effectiveness of innovative solutions, such as NBS or insurance systems, limit their implementation
Decision-making and people's awareness are strongly influenced by personal beliefs (based on experiences, memories, group dynamics etc.)	River basin authorities are mostly made of hydrologists, who tend to support engineering approaches over soft/economic instruments

POTENTIAL INNOVATIVE ADAPTATION POLICIES

1. Introduction of **novel agricultural insurance** for irrigated crops. 2. Implementation of a **dynamic water pricing system** to reflect water scarcity.

Reno river basin – Italy

- 4,628 km²
- Plain and mountain landscape; from temperate Mediterranean to mountain climate
- Main land use: agriculture (55%); main water use: irrigation (80%)
- Anthropic and vulnerable landscape: dams for hydropower use in the mountain part and channels for agriculture in the plain
- Growing climate risk (drought and floods) exacerbated by climate change
- Ecosystems (wetlands, forests, rivers) that benefit from water wastes of traditional irrigation at risk for new efficient technologies

BARRIERS TO THE ADOPTION OF INNOVATIVE ADAPTATION POLICIES

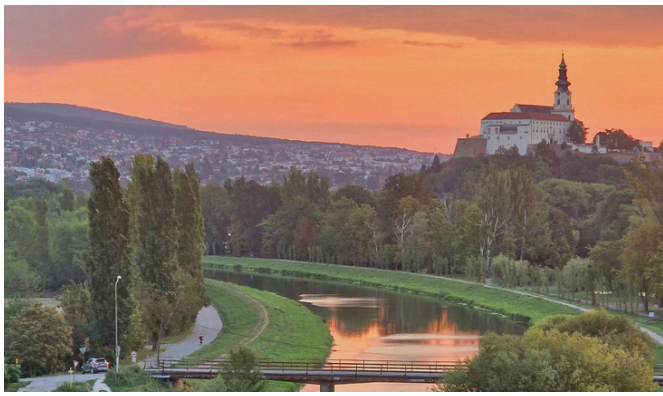
Barriers	Example
Rigid regulations	The regional Rural Development Program (PSR) incentivizes traditional measures precluding transformative approaches
Limited penetration and marketability of innovative policies	Lack of administrations and citizens knowledge can lead to concerns about safety (e.g., treated wastewater)
Limited institutional capacities and know-how on novel technologies and governance mechanisms precludes transformation	**1.** Subsidies to increase irrigation efficiency allocated to save water, despite much evidence showing the contrary **2.** Institutions lack the technical background to use modelling and understand the results, limiting their capacity to make urgent decisions
Innovative solutions demand high economical return from investments limiting their implementation	Extensive paybacks periods and uncertainty about effectiveness of innovative solutions, such as NBS or insurance systems, limit their implementation
Decision-making and people's awareness are strongly influenced by personal beliefs (based on experiences, memories, group dynamics etc.)	River basin authorities are mostly made of hydrologists, who tend to support engineering approaches over soft/economic instruments

POTENTIAL INNOVATIVE ADAPTATION POLICIES

1. **Revision of the water abstraction/allocation rules** within the next-coming regional Water protection Plan: setting of new thresholds, integration of ecological flows, and development of river contracts as governance instrument. 2. Introduction of **flexible reallocation systems through water banks** (voluntary economic instruments). 3. **River natural space restoration**, limiting channels and enhancing rewilding and delocalization. 4. Transition to **more sustainable crops/agriculture** for a decrease of water use, soil erosion and an increase of soil quality. 5. **Creation of wetlands in the estuary area** as a countermeasure to saltwater intrusion. 6. **Groundwater recharge also through wastewater**.

Nitra river basin – Slovakia

- Total area: 4501 km²; project area: 2,094 km²
- Broadleaf and mixed forests dominate the mountains, grasslands and agricultural land dominate the valley bottoms and lowland plains; diverse climates
- Industrial and domestic water use
- Region in transition with uncertain socio-economic future due to phasing out of coal mining
- Water supply expected to be reduced by climate change and discharge from the mines due to their closure;
- Increasing droughts and low stream flows during winter months



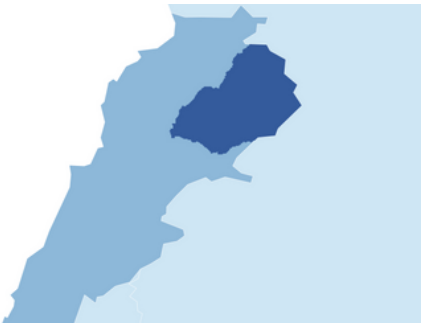
BARRIERS TO THE ADOPTION OF INNOVATIVE ADAPTATION POLICIES

Barriers	Example
Rigid and conflicting regulations	Conflicting legislation—such as the Mining Act and Nature Protection Act—creates regulatory contradictions. EIA processes are often inefficient and resource-intensive, which discourages some stakeholders from implementing NBS
Regulatory and institutional uncertainty	Change in political regime in 2023 created large uncertainty in regulatory frameworks and in many institutions involved in water management
Limited institutional capacities and know-how on novel technologies and governance mechanisms precludes transformation	Large infrastructure debt and lack of capacities including modeling and monitoring capacities. Water management competencies are dispersed across many institutions and authorities that follow old paradigms
Limited monitoring, as well as enforcement, and institutional capabilities.	Lack of transparent and central registry of water permits and abstractions. The small abstractions below the threshold are not monitored, yet the cumulative impact can be large. No clear priority rules regarding the water use during water scarcity
Innovative solutions demand high return from investments hindering their implementation	Lack of effective examples of innovative solutions, such as NBS or insurance systems, limit their implementation
Decision-making and people's awareness are strongly influenced by personal beliefs (based on experiences, memories, group dynamics etc.)	Authorities tend to support old paradigms and engineering approaches over soft/economic instruments. The complexity of the systems is often ignored. Cost benefit and impact assessment analyses are often lacking
Gaps in modelling	No micro- or macro-economic modeling. Lack of data availability and systemic exchange among the institutions
Decisions-makers tend to avoid (transformational) instruments characterized by high degree of risk	Difficulties in the implementation of new technologies, NBS.

POTENTIAL INNOVATIVE ADAPTATION POLICIES

1. **Improved system and registry of water permits and abstractions** including monitoring. 2. **Availability and open access data exchange among institutions and stakeholders**. 3. **Assess the impact of reduced discharge** and estimate the dynamics of water levels in the mines to prevent future outbursts. 4. **Implementation of ecological flows** into water management practice. 5. **Strengthen policies to adapt to rare but high-impact events**. 6. **Water Retention & Landscape Restoration**.

Orontes river basin – Lebanon



- Total area: 24,660 km²; Lebanon part: 1,718 km²
- Transboundary basin (Syria, Turkey), upstream portions in Lebanon, with cooler climate and consistent year-round flow
- 18,000–20,000 hectares irrigated (mainly groundwater) out of a total cropped area of 57,600 hectares
- Imbalanced water allocation and use across countries
- Geo-political conflicts and migration
- Growing competition between irrigation and domestic uses

BARRIERS TO THE ADOPTION OF INNOVATIVE ADAPTATION POLICIES

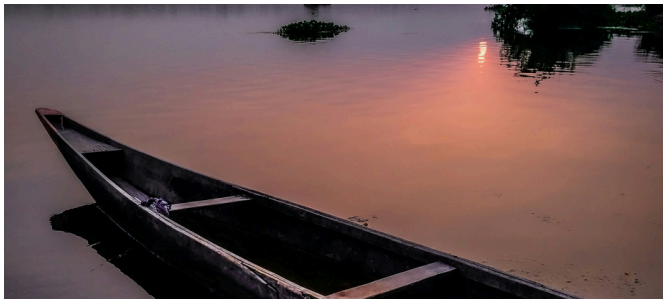
Barriers	Example
Discretionary water allocation mechanisms	Fragmented decision-making, delayed implementation of different policies, lack of monitoring especially for illegal wells
Costs of transforming institutions to adopt novel policies and governance mechanism	Huge economic (and political) costs towards efficient monitoring and metering technologies, lack of investment in 'human capital' for other NBS or conventional technologies
Limited penetration and marketability of innovative policies Limited monitoring, as well as enforcement, and institutional capabilities.	Green plan for land reclamation and agricultural development suffered budget reduction and insufficient staff; lack of legal framework and of targets for development and diffusion of NBS and non-conventional water resources
Authorities tend to align policy choices and investments with widespread beliefs and attitudes among citizens that strengthen their political legitimacy	Lack of clear framework
Limited monitoring, as well as enforcement, and institutional capabilities	Lack of monitoring technologies and metering systems; common private illegal wells
Innovative solutions demand high return from investments hindering their implementation	Extensive paybacks periods and uncertainty about effectiveness of innovative solutions, such as NBS or insurance systems, limit their implementation
Decision-making and people's awareness are strongly influenced by personal beliefs (based on experiences, memories, group dynamics etc.)	River basin authorities are mostly made of hydrologists, who tend to support engineering approaches over soft/economic instruments
Overselling of traditional policies, tendency to avoid high risk and lack of ex-post evaluation creates inertia to transformative changes	Difficulties in implementation of objectives and planned policies in water management and limited accountability/learning from previous outcomes, resulting in repeated inefficiencies and reduced adoption of innovative approaches
Gaps in modeling	No macro- or micro- economic modeling available, limiting the understanding of the impact of water allocation, land use and policies on rural livelihoods/household well-being

POTENTIAL INNOVATIVE ADAPTATION POLICIES

1. Encouraging farmers to adopt **water-efficient irrigation through policy incentives**. 2. Encouraging farmers to adopt **climate-resilient crops through policy incentives**. 3. Building **data collection systems to track water usage and crop yields** for evidence-based policymaking. 4. **Water allocation policies**. 5. Enforcing **stricter regulations on well drilling and water use**. 6. Restoring the Orontes River by **reducing pollution and improving water quality**. 7. **Evaluating the feasibility and benefits of building the Assi Dam** to secure a more reliable water supply.

Mahanadi river basin – India

- 141,589 km²
- Mountainous borders surrounding a flat interior; tropical monsoon climate
- 54% agricultural land use, 37% irrigated crops
- Irrigation demand exceeds water supply
- Growing scarcity and floods (delta) under climate change
- Intersectoral and interstate conflict over water allocation between Chhattisgarh (upstream) and Odisha (downstream).



BARRIERS TO THE ADOPTION OF INNOVATIVE ADAPTATION POLICIES

Barriers	Example
Rigid regulations	Regulatory principles, e.g. interstate and intersector headwater priority, provide a conflicting and confusing framework which limits other possible beneficiary policies
Water (re)allocations can generate costs to third parties	Energy and industrial sector have some sort of priority use; inter-state headwater priority
Discretionary water allocation mechanisms	Frequent inter-state conflict, slow tribunals, different and often unwritten (groundwater) rules and overall conflicting on different levels
Limited institutional know-how on novel technologies and governance mechanisms precludes transformation	Lack of water rights reforms, harmonization between sectors and supply-side infrastructural development
Costs of transforming institutions to adopt novel policies and governance mechanism	Institutional fragmentation, slow water allocation from tribunal, week expertise in stakeholder inclusion, inefficient current policy, high cost for monitoring technologies (currently absent) and political costs for groundwater legislation
High information, bargaining and enforcement costs can limit the diffusion of new (re)allocation instruments	Intersectoral competition, confusing laws, lack of local institutions create uncertainty in water access, quality and quantity.
Overselling of traditional policies, tendency to avoid high risk and lack of ex-post evaluation creates inertia to transformative changes	Overreliance on 'traditional methods', NBS and supply-side projects and difficulties in policy implementation
Public political or regulatory entity is co-opted to serve the interests and needs of a minor group	Large land-owners have advantage in groundwater abstraction; free water access, especially for industrial-energy sector; inequalities between farmers and industry-energy companies
Limited monitoring, as well as enforcement, and institutional capabilities	Lack of monitoring technologies and legislation for groundwater abstraction
Decision-making and people's awareness are strongly influenced by personal beliefs (based on experiences, memories, group dynamics etc.)	Policymaking heavily relies on hydrological models over economic ones; rain harvesting and other traditional techniques are applied with little or no scientific tools and validation

POTENTIAL INNOVATIVE ADAPTATION POLICIES

1. Development of **inter-sectoral and inter-state water rationing frameworks**. 2. **Modernization of irrigation infrastructure and control systems**, such as improving efficiency. 3. **Reconfiguration of cropping patterns** based on water availability and climate forecasts.

Tympaki river basin – Greece

- 265 km²
- Mountainous in the north, low-lying plain in the south; diverse climates
- Main land use: agriculture (90%); main water use: irrigation (95%)
- Water demand exceeds the supply, despite the Faneromeni Dam
- Vulnerability for aquifer overdraft, saltwater intrusion, poor groundwater qualitative and quantitative status

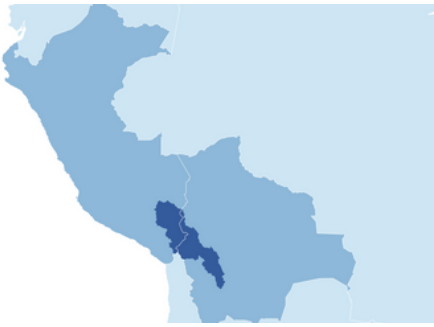
BARRIERS TO THE ADOPTION OF INNOVATIVE ADAPTATION POLICIES

Barriers	Example
Rigid regulations	The polluter-pays-principle and water-user- pay principle, stated in the Water Framework Directive, provide a conflicting and confusing framework which may exclude other beneficiary policies. The Regional /National Rural Development Program incentivizes traditional measures precluding transformative approaches
Limited institutional know-how on novel technologies and governance mechanisms precludes transformation	Subsidies to increase irrigation efficiency allocated to save water, despite much evidence showing the contrary. Gap in communication between institutions and water providers on the use of novel solutions and governance that promotes water efficiency. Institutions lack the technical background to use modelling and understand the results, limiting their capacity to make urgent decisions. Lack of a holistic contingency plan to deal with extreme flash floods and drought events.
Discretionary water allocation mechanisms	Lack of coordination between administrations to introduce innovative policies. Lack of know-how, funds, and specific regulation to implement innovative approaches.
Innovative solutions demand high return from investments hindering their implementation	Extensive paybacks periods and uncertainty about effectiveness of innovative solutions, such as NBS or insurance systems, limit their implementation
Decision-making and people's awareness are strongly influenced by personal beliefs (based on experiences, memories, group dynamics etc.)	River basin authorities are mostly made of hydrologists, who tend to support engineering approaches over soft/economic instruments; Farmers ignore how to use water deficit irrigation to deal with periods of drought; Use of innovative solutions (e.g. change crop cultivations) by farmers is limited by market uncertainties
Gaps in modeling	No micro- or macro-economic modeling

POTENTIAL INNOVATIVE ADAPTATION POLICIES

1. **Implementation of deficit irrigation** (despite reduction in profits/revenues) during dry years. 2. **Transition to less water demanding agriculture, through greenhouses or new crops** (avocados, figs, olives, prickly pears, aloe, Hippophae). 3. **Development of main Water storage infrastructure** (construction of planed reservoir) and of actions to save water according to NBS (e.g. artificial aquifer recharge, small dams). 4. **Reduction of water losses/leakages** of pipeline system. 5. **Improving the infrastructure of wastewater treatment plants** to meet quality standards for irrigation or artificial groundwater recharge. 6. **Adjustment of the water pricing policy** so that the indiscriminate use of water leads to increased water prices (fines on overconsumed water eg. the price to double or triple). 7. **Development of a holistic contingency plan to deal with extreme flash floods and drought events**. 8. **Improving control over water users**.

Titicaca Desaguadero Poopó System: Bolivia-Peru



- 143,900 km²
- Transboundary system with cooperation in development since the early 90s
- Pastureland (40%) and irrigated cropland (10%); main water use: irrigation
- Arid region, sensitive ecosystems to climate change (Poopó Lake in Bolivia)
- Competition between upstream (agriculture) and downstream (irrigation, livestock)
- Inequity (permit holders in Peru vs unregulated irrigation system)
- Operational protocols for Lake Titicaca gages in development

BARRIERS TO THE ADOPTION OF INNOVATIVE ADAPTATION POLICIES

Barriers	Example
Rigid regulations	Lack of water allocation rules in Bolivia and temporary water rights in Peru without update protocols; lack of transboundary regulations and joint management
Limited institutional know-how on novel technologies and governance mechanisms precludes transformation	NBS are almost entirely NGOs projects. Bolivia and Peru only follow supply-side solution. Novel technologies such as artificial glaciers are options known by stakeholders but require support for the implementation
Costs of transforming institutions to adopt novel policies and governance mechanism	Lack of: 1. legal framework for water allocation between riparian nations; 2. local water authority generating transaction costs due to one-size-fits-all policies inefficient in specific regions of the river systems; 3. common inter-state body for ecological monitoring or infrastructural action
High information, bargaining and enforcement costs can limit the diffusion of new (re)allocation instruments	Uncertainty in water rights in case of drought years. Lack of efficient regulatory framework for insurance
Water (re)allocations can generate nontrivial and asymmetric impacts on other strategic sectors such as food industry, tourism, etc.	Water rights in Peru can be negated in case of drought to preserve the ecological functioning of the river
Public political or regulatory entity is co-opted to serve the interests and needs of a minor group	Privilege for some water users
Limited alternative mental models (e.g., awareness of feasibility of soft policies such as trading) leads to the persistance of conventional mental models and policies	NGOs push NBS; lack of transnational cooperation, enforcement, etc.
Limited monitoring, as well as enforcement, and institutional capabilities	Lack of binational regulation to penalize infringements, and of monitoring process to detect theft in Bolivia, groundwater formalized at 5% in Peru
Innovative solutions demand high return from investments hindering their implementation	Extensive paybacks periods and uncertainty about effectiveness of innovative solutions, such as NBS or insurance systems, limit their implementation
Decision-making and people's awareness are strongly influenced by personal beliefs (based on experiences, memories, group dynamics etc.)	River basin authorities are mostly made of hydrologists, who tend to support engineering approaches over soft/economic instruments

POTENTIAL INNOVATIVE ADAPTATION POLICIES

1. **Nature Based Solutions**: creation of artificial glaciers. 2. **Agriculture insurance mechanism**. 3. **Definition of gages management rules in the Titicaca Lake** by the Binational Climate Service, including hydrological, ecological, and economic criteria. 4. **Water banks for the environment**: flexible water allocation, in case of drought, with compensation system.

TRANSCEND

Transcend is a 4-year Horizon project that focuses on developing Transformational Adaptation Policies (TAPs) to address water scarcity and achieve sustainable, equitable economic growth amid deep uncertainty.
This initiative brings together over 50 researchers and professionals from 15 universities and institutions across Europe, South America, and Asia. The project started in January 2023 and will run until December 2026.

TRANSCEND PARTNERS