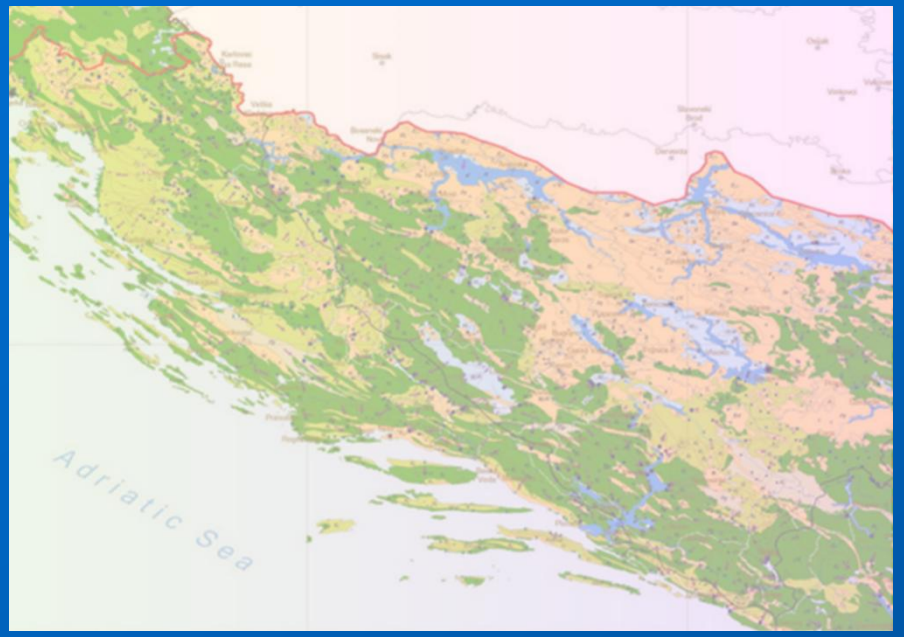
DIKTAS II

Implementation of the strategic action program (SAP) of the Dinaric karst aquifer system: improving groundwater governance and sustainability of related ecosystems.



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CROATIAN GROUNDWATER GOVERNANCE DIAGNOSTIC ANALYSIS (CGGDA)

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Guidelines for the development of GGDA

	Key elements for GGDA implementation
Phases	Implement GGDA in two phases: (1) national-level analyses in each country, (2) regional/transboundary synthesis.
Purpose of national GGDA	Conduct a comprehensive stocktaking of groundwater governance, including institutions, legal frameworks, policies, knowledge, enforcement, gaps, and opportunities.
Alignment	Ensure consistency with EU Water Framework Directive (WFD) and Groundwater Directive (GWD).
Scope of national GGDA	Evaluate institutional actors, legal instruments, strategic plans, enforcement capacities, and public awareness.
Methodology	Use harmonized criteria across countries to enable comparison and regional integration.
Focus areas	Identify strengths, gaps, and opportunities, especially in vulnerable regions (e.g., karst areas).
Reference framework	Follow the “Global Framework for Action to Achieve the Vision on Groundwater Governance” (GEF/FAO GGP).
Indicators for TBAs	Define a common set of indicators applicable to all Transboundary Basin Areas (TBAs) for future assessment.
Regional analysis outcome	Inform pathways for effective and responsive groundwater governance and support regional cooperation.

Key insights from chapters 2-4: Actors; Legal framework; Policy and plans

- **Multi-level governance structure**: Groundwater management in Croatia involves national institutions (e.g., Ministry of Environmental Protection and Green Transition and Croatian Waters), regional public health institutes, local utility companies, and NGOs, with vertical coordination well established but horizontal coordination mostly project-based.
- **Legal alignment with EU directives**: The Water Act and related regulations are harmonized with the EU Water Framework Directive (WFD) and Groundwater Directive (GWD), covering monitoring, abstraction permits, pollution control, and sanitary protection zones.
- **Karst-specific legal provisions**: Special methodologies are applied for karst aquifers, including threshold values and environmental quality standards, but gaps remain in regulating artificial recharge and wastewater discharge.
- **Institutional capacity disparities**: National bodies possess strong strategic and technical capacity, while local entities often face financial and operational constraints, especially in rural karst regions.
- **Policy coherence challenges**: Although Croatia's water policies align with EU objectives, operational coordination across sectors (agriculture, tourism, energy) is limited, hindering integrated groundwater protection.
- **Financial instruments for sustainability**: Eco-schemes under the Common Agricultural Policy (CAP) support sustainable practices in karst areas, but broader integration of groundwater objectives into sectoral strategies is needed.
- **Need for improved public awareness**: Institutional understanding of groundwater issues is high, but public awareness remains low, requiring targeted education and participatory governance initiatives.

Key insights from chapters 5-7: Adherence to EU directives; Knowledge, information and awareness; Socio-economic setting and challenges

- **Monitoring scope and gaps**: Groundwater monitoring includes water quality, abstraction volumes, ecological flows, and biodiversity indicators. However, further improvements in data granularity and public accessibility would enhance decision-making.
- **No unified GWDE database**: There is no centralized national database for groundwater-dependent ecosystems (GWDE), which hampers integrated planning and environmental risk assessment.
- **Data exchange and institutional coordination**: Environmental and water-related data are shared among institutions, but further strengthening of coordination frameworks - particularly between public authorities and private stakeholders - would enhance data accessibility, interoperability, and support more integrated groundwater management.
- **Socio-economic pressures in karst areas**: Illegal waste disposal, infrastructure deficits, and seasonal tourism peaks pose significant risks to groundwater, particularly in karst regions.
- **Cross-sectoral coordination deficiencies**: Despite groundwater's importance for drinking water, energy, agriculture, and tourism, local implementation is hindered by limited technical capacity and fragmented coordination across sectors.
- **Economic importance of groundwater**: Groundwater is a vital economic resource in Croatia, supporting drinking water supply, tourism, agriculture, and energy production, particularly in karst regions.
- **Investment and infrastructure gaps**: Sustainable groundwater management requires increased investment in monitoring systems, wastewater infrastructure, and remediation of legacy pollution sites, especially in rural and karst areas.

National SWOT Analysis

Strengths	Weaknesses
- Strong institutional framework with national bodies like Croatian Waters and Ministry of Environmental Protection and Green Transition. - Alignment of national legislation with EU directives (WFD, GWD). - Comprehensive River Basin Management Plan with karst-specific methodologies. - Established sanitary protection zones around springs and wellfields. - Functional monitoring systems for water quality, abstraction, and ecological flows. - Active participation in international water conventions and bilateral agreements. - Integration of groundwater (GW) protection into spatial planning and sectoral strategies. - Public health institutions conduct regular drinking water quality assessments. - Eco-schemes and CAP incentives promote sustainable agricultural practices in karst areas. - High awareness and expertise among scientific and professional communities.	- Fragmented horizontal coordination between sectors (e.g., agriculture, tourism, energy). - Uneven operational capacity at local levels, especially in rural areas. - Lack of institutional capacity and staffing for groundwater quantity data management. - Limited public awareness and engagement in groundwater governance. - Lack of standardized procedures for threshold values in karst aquifers. - Incomplete integration of groundwater-dependent ecosystems (GWDE) into spatial, environmental, and water resource management planning. - Insufficient regulation of artificial recharge and wastewater discharge in karst areas. - Inconsistent implementation of remediation programs in sanitary protection zones, particularly in karst areas. - Weak enforcement mechanisms for illegal waste disposal in karst areas. - Conceptual ambiguity in defining drinking water protection areas (DWPA) under WFD. - Limited access to raw groundwater data and interoperability across institutions. - Groundwater abstraction data primarily collected for fee calculation, not for resource planning. - Absence of overflow discharge measurements at major karst springs. - Inadequate quantification of water uses in agriculture and industry, hindering groundwater budgeting. - Limited integration of seasonal variability into groundwater management strategies. - Absence of unified national database for GWDE and GW data.
Opportunities	**Threats**
- Strengthening cross-sectoral coordination and participatory governance mechanisms. - Developing environmentally grounded economic and legal instruments for karst aquifer protection. - Enhancing public education and awareness campaigns on groundwater vulnerability. - Integrating GWDE into national biodiversity and conservation strategies. - Leveraging EU funding for infrastructure upgrades and wastewater treatment. - Promoting decentralized wastewater solutions in small karst settlements. - Implementing digital waste tracking systems (e.g. Digital Waste Shipment System, DIWASS) to prevent illegal dumping. - Supporting sustainable tourism and agriculture through targeted incentives. - Improving transboundary cooperation on shared aquifers and karst systems. - Establishment of a national program for systematic overflow monitoring at karst springs. - Development of a centralized groundwater quantity database with daily reporting obligations for all users. - Integration of seasonal variability models into groundwater management and planning. - Strengthening enforcement and accountability mechanisms for remediation program implementation.	- Illegal waste disposal and legacy industrial pollution in karst regions. - Seasonal tourism pressures leading to over-abstraction and wastewater overload. - Infrastructure deficits in rural areas affecting water supply and sanitation. - Climate change impacts on groundwater recharge and salinization risks. - Weak coordination between local governments and national institutions. - Economic activities (e.g., hydropower, lithium processing) threatening GW and GWDE. - Lack of formal environmental impact assessments for sensitive projects. - Fragmented data exchange reducing capacity for predictive water management. - Vulnerability of karst aquifers to rapid contamination due to geological features. - Inadequate regulation of cumulative pressures on GW and GWDE. - Failure to implement remediation measures increases long-term contamination risks in vulnerable karst aquifers. - High seasonal variability in karst systems due to precipitation patterns exacerbates risks of over-abstraction and ecological degradation. - Continued reliance on outdated or incomplete monitoring data may lead to misinformed policy decisions.

Governance Gaps

- **Fragmented cross-sectoral coordination**: Cooperation between water, agriculture, tourism, and energy sectors remains project-based, limiting integration of groundwater protection into broader development policies.
- **Uneven local implementation capacity**: Municipalities and utility companies in karst and rural areas often lack technical expertise, financial resources, and trained personnel.
- **Regulatory gaps in protection of karst aquifers**: Legal instruments do not fully reflect the environmental vulnerability of karst systems and lack site-specific criteria for pollution thresholds and cumulative impact assessments.
- **Weak enforcement of remediation measures**: Remediation programs in sanitary protection zones are inconsistently implemented, especially in karst areas, and enforcement mechanisms are limited.
- **Limited public engagement and transparency**: Public awareness is low, and access to raw monitoring data is limited, reducing opportunities for participatory governance.
- **Inadequate groundwater budgeting**: Absence of overflow discharge measurements and daily abstraction reporting hinders accurate groundwater resource planning.
- **Limited framework for transboundary aquifers**: Cooperation on shared groundwater resources is not supported by binding agreements or harmonized monitoring systems, reducing effectiveness in managing cross-border karst aquifers.

Actionable Opportunities

- **Cross-sectoral integration**: Strengthen coordination among water, agriculture, tourism, and energy sectors through institutionalized planning and harmonized policy instruments.
- **Monitoring system modernization**: Expand and digitalize groundwater monitoring networks, especially in karst areas, to enable early detection and adaptive management.
- **Decentralized wastewater solutions**: Promote small-scale, locally adapted wastewater treatment systems in karst settlements where centralized infrastructure is not feasible.
- **EU funding utilization**: Leverage EU financial instruments to support infrastructure upgrades, decentralized wastewater solutions, and environmental protection in vulnerable regions.
- **Legal and policy refinement**: Introduce site-specific threshold values, vulnerability mapping, and standardized methodologies for assessing cumulative impacts on karst aquifers.
- **Public engagement and education**: Enhance awareness through targeted campaigns, participatory programs, and transparent communication of groundwater status.
- **Transboundary cooperation enhancement**: Strengthen bilateral and regional agreements and establish joint monitoring and data-sharing protocols for shared karst aquifers.

Thank you

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