Iceland Liechtenstein Norway grants

Environmental Education – OERs for Rural Citizens (EnvEdu - OERs)

Water Resources and Water Balance for Sustainable Community

TM 5

5.3 Sustainable Practices for Improving the Water Cycle in Local Communities

Ivana Stepanovic – Reykjavik University, Iceland

Stella Schwegmann – Reykjavik University, Iceland

David Christian Finger – Reykjavik University, Iceland

Contents

Introduction 3

Water supply, wastewater management and storm water control 3

Water Supply: 3

Waste water Management (see also TM 5.2): 3

Storm water Control: 3

Nature-based solutions, smart infrastructure and community engagement 4

Nature-Based Solutions (NBS): 4

Smart Infrastructure: 4

Community Engagement Initiatives: 4

Conclusion 5

Literature 5

These documents are made with the financial support of the EEA Financial Mechanism 2014 - 2021. Its content (text, photos) do not reflect the official opinion of the Program Operator, the National Contact Point or the Office of the Financial Mechanism. The information and opinions expressed are the sole responsibility of the author(s).

Introduction

The sustainable management of the water cycle is a critical concern for local communities worldwide, given the increasing demands on water resources, growing urbanization and the impacts of climate change. This lecture explores a range of innovative and eco-conscious practices designed to enhance the local water cycle, promote resource efficiency and ensure long-term water security. By focusing on three key components of the water cycle—water supply, waste water management and storm water control - this lecture reviews a diverse set of strategies, including nature-based solutions, smart infrastructure and community engagement initiatives. The lecture underscores the importance of integrated, adaptable approaches that empower local communities to actively participate in safeguarding their water resources and collectively addressing the pressing challenges of the 21st century. In advocating for these sustainable practices, we aim to support local communities in forging a path towards a more sustainable and water-secure future.

Water supply, wastewater management and storm water control

Water supply, waste water management and storm water control are three fundamental components of the water cycle in urban areas, each with unique challenges and sustainability practices:

Water Supply:

- Water Conservation: Promoting water conservation through public education, water-efficient appliances and leak detection to reduce overall demand.
- Source Diversification: Sustainable water supply practices involve diversifying water sources, including harvesting rainwater, utilizing treated wastewater (potable reuse) and exploring alternative sources like desalination.
- Infrastructure Efficiency: Upgrading and maintaining water supply infrastructure to minimize water loss through leaks and pipe bursts.
- Demand Management: Implementing demand management strategies such as tiered pricing and restrictions during droughts to encourage responsible water use.
- Collaboration: Engaging communities, businesses and governments to develop regional water plans.

Waste water Management (see also TM 5.2):

- Treatment Technologies: Employing advanced waste water treatment technologies, such as membrane bioreactors and anaerobic digestion, to improve the quality of treated water and energy efficiency.
- Reuse and Recycling: Implementing systems for the safe and responsible reuse of treated waste water in non-potable applications, reducing the environmental impact and strain on freshwater resources.
- Green Infrastructure: Integrating green infrastructure, such as constructed wetlands and reed beds, to naturally filter and purify waste water before discharge.
- Decentralized Systems: Implementing decentralized waste water treatment systems, like septic tanks and package plants, in areas without access to centralized sewage systems.

Storm water Control:

- Low Impact Development (LID): Utilizing LID practices such as permeable pavements, green roofs and rain gardens to capture and treat storm water runoff at its source.

Transilvania University of Brașov

These documents are made with the financial support of the EEA Financial Mechanism 2014 - 2021. Its content (text, photos) do not reflect the official opinion of the Program Operator, the National Contact Point or the Office of the Financial Mechanism. The information and opinions expressed are the sole responsibility of the author(s).

- Retention and Detention Basins: Constructing retention and detention basins to manage storm water, control flooding and reduce pollution entering natural water bodies.
- Vegetated Swales and Filters: Implementing vegetated swales and filters in urban areas to reduce storm water runoff velocity and improve water quality.
- Smart Drainage Systems: Installing smart drainage systems with sensors and real-time monitoring to manage storm water efficiently and reduce the risk of overflows.

Nature-based solutions, smart infrastructure and community engagement

Nature-based solutions, smart infrastructure and community engagement initiatives are integral for achieving sustainable water management practices. Here's a brief overview of each:

Nature-Based Solutions (NBS):

- Constructed Wetlands: Utilize natural wetland ecosystems to treat waste water and storm water, enhancing water quality.
- Riparian Buffer Zones: Preserve vegetated areas along water bodies to filter pollutants and reduce runoff.
- Green Roofs: Employ vegetated rooftops to capture and treat rain water, reducing storm water runoff.
- Living Shorelines: Utilize natural vegetation and materials to protect coastlines and filter contaminants in runoff.
- Reed Beds: Use reed plants to absorb and break down pollutants in waste water.
- Algal Ponds: Utilize microalgae to remove nutrients from waste water.
- Riverbank Filtration: Let water pass through natural riverbanks to remove contaminants.
- Soil Infiltration Systems: Employ natural soils and vegetation to filter and treat waste water.
- Floating Treatment Wetlands: Use floating islands of vegetation to absorb pollutants in water bodies.

These nature-based approaches use natural ecosystems and vegetation to address water quality and conservation, offering environmentally friendly solutions.

Smart Infrastructure:

- Real-Time Monitoring: Employ sensors and data analytics to monitor water quality, flow rates and infrastructure conditions.
- Remote Control and Automation: Use technology to remotely control water treatment and distribution systems for efficiency and response to changing conditions.
- Leak Detection Systems: Implement systems to detect and address water leaks in supply and distribution networks promptly.
- Data Management Platforms: Utilize data platforms for storing and analyzing information related to water management and usage.
- Energy-Efficient Technologies: Integrate energy-efficient systems and technologies in water treatment and distribution to reduce operational costs.

Community Engagement Initiatives:

- Education and Awareness: Engage and educate the community on the importance of water conservation, responsible use and the role of each individual in preserving water resources.
- Stakeholder Participation: Involve local residents, businesses and organizations in water management decisions and projects.

Transilvania University of Brașov

These documents are made with the financial support of the EEA Financial Mechanism 2014 - 2021. Its content (text, photos) do not reflect the official opinion of the Program Operator, the National Contact Point or the Office of the Financial Mechanism. The information and opinions expressed are the sole responsibility of the author(s).

- Citizen Science Programs: Encourage citizens to participate in data collection and monitoring efforts, fostering a sense of ownership.
- Water Efficiency Programs: Promote water-saving technologies, such as low-flow fixtures and appliances, through incentives and rebates.
- Community-Based Water Quality Monitoring: Train and involve the community in monitoring water quality and reporting any concerns or issues.
- Public-Private Partnerships: Collaborate with local businesses and organizations to support sustainable water management projects.

By integrating these Nature-Based Solutions, smart infrastructure and community engagement initiatives, local communities can enhance the efficiency and sustainability of their water management practices, reduce water wastage, mitigate pollution and improve the overall resilience of their water systems.

Conclusion

In summary, this lecture explores multifaceted challenges and opportunities associated with sustainable water management at the local level. It emphasizes the need for responsible water management, conservation and pollution control, especially in the context of climate change. Special emphasis is given to the superior effect of nature based solutions (Keesstra et al. 2018) smart infrastructure and community engagement initiatives.

Literature

Gholipour A., Fragoso R., Galvão A, D. C. Finger (2023), Mapping the causality of interacting perceptions for nature-based solution and sludge treatment reed bed: A causal loop diagram in Iceland, Nature-Based Solutions, Volume 3, 2023, 100049, ISSN 2772-4115, https://doi.org/10.1016/j.nbsj.2023.100049.

Keesstra S., Nunes J., Novara A., Finger D., Avelar D., Kalantari Z., A. Cerdà (2018) The superior effect of nature based solutions in land management for enhancing ecosystem services, Science of The Total Environment, Volumes 610–611, 2018, Pages 997-1009, ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2017.08.077.

Oral H. V., Carvalho P., et al., Finger D. C. (2020) A review of nature-based solutions for urban water management in European circular cities: a critical assessment based on case studies and literature. Blue-Green Systems 1 January 2020; 2 (1): 112–136. doi: https://doi.org/10.2166/bgs.2020.932

Transilvania University of Brașov

These documents are made with the financial support of the EEA Financial Mechanism 2014 - 2021. Its content (text, photos) do not reflect the official opinion of the Program Operator, the National Contact Point or the Office of the Financial Mechanism. The information and opinions expressed are the sole responsibility of the author(s).