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Why is a systems-thinking approach needed to address the global water problems?

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Abstract:

The global water crisis continues to intensify, with an increasing prevalence of floods, droughts, and limited access to safe water. To effectively address these complex challenges, a systems thinking approach is crucial. This article highlights the significance of systems thinking in sustainable water management and emphasizes the need for a multidisciplinary and transdisciplinary approach.

Systems thinking offers a holistic perspective, considering the interactions and interdependencies within the water system. It helps identify the underlying causes of water problems and facilitates the design of effective and sustainable solutions. By understanding the complexities and interconnections of water-related issues, decision-makers can develop comprehensive strategies that balance social, economic, and environmental dimensions.

Furthermore, systems thinking recognizes that water problems are intertwined with social, economic, and environmental factors. It emphasizes the need for collaboration and inclusiveness, involving diverse stakeholders such as communities, industries, governments, and environmental organizations. By incorporating multiple perspectives, systems thinking enables inclusive decision-making processes and promotes integrated strategies that prioritize long-term sustainability.

A multidisciplinary approach complements systems thinking by integrating knowledge from various disciplines, such as hydrology, ecology, economics, sociology, and engineering. It fosters collaboration and enables a comprehensive understanding of the interconnected aspects of water problems. The collaboration of diverse stakeholders facilitates innovation, knowledge sharing, and the ability to effectively address the complex challenges associated with water resources.

Moreover, systems thinking is particularly relevant for solving wicked water problems—seemingly intractable issues involving competing interests and multiple systems. By adopting a systems thinking approach, decision-makers can understand and address the interconnectedness and dynamics of the system. This approach helps identify leverage points,

anticipate unintended consequences, foster collaboration, and facilitate iterative learning and adaptation.

In conclusion, systems thinking offers a valuable framework for understanding complex water systems and developing sustainable solutions. By embracing a multidisciplinary and transdisciplinary approach, individuals and organizations can address the diverse dimensions of water challenges, foster collaboration, and make informed decisions that consider the broader impacts and long-term consequences. This article highlights the interrelation between systems thinking and a multidisciplinary approach and the importance of adopting systems thinking approach to navigate the complexities of global water problems and ensure the availability and quality of water resources for future generations.

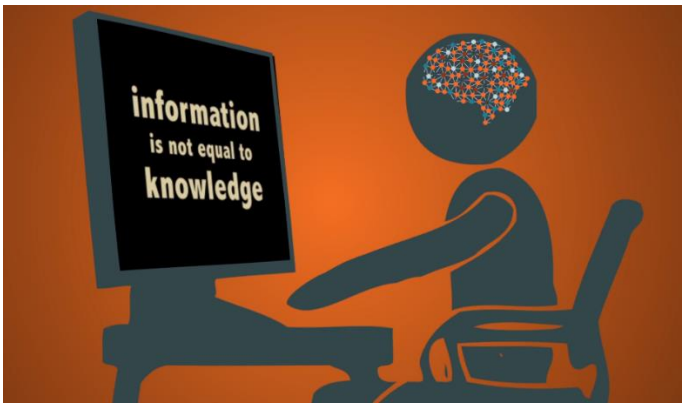
Keywords: Systems thinking, Water problems, Multidisciplinary approach, Transdisciplinary approach, Wicked water problems,

1. Introduction

Energy, food production, and ecosystems are driven by water, which is central to the nexus approach.

In international water conferences, it has been confirmed that global water problems are intensifying: floods and droughts are becoming more prevalent, too many people continue to lack access to safe water, and the degradation of aquatic ecosystems continues apace.

Throughout the event, it was widely acknowledged that addressing the water crisis must be a global endeavor. It requires systems thinking, breaking down siloes, intersectoral collaboration, strengthening gender and social inclusion in water institutions, capacity building, and research processes and outcomes. Business as usual is not an option; nexus approaches are a must.



Systems thinking is an approach to problem-solving that considers the interactions and interdependencies of various components within a system. When it comes to solving water problems, systems thinking is particularly relevant because water-related challenges often involve complex, interconnected systems.

Therefore a systems-based approach involves addressing water holistically across engineering, environmental, economic, and social dimensions to ensure that benefits across these domains

are achieved. It also considers the interconnections, interdependencies, and influence between different users – and it involves collaboration between them all.

2. Systems thinking approach to water problems

System thinking has a holistic perspective that involves looking at the entire water system, including its various components, feedback loops, and interactions. Instead of focusing on isolated issues, it considers the broader context and how different elements influence each other. Systems thinking seeks to understand the underlying causes of water problems rather than just addressing symptoms. By identifying the root causes, it becomes possible to design more effective and sustainable solutions.

Systems thinking also acknowledges that water problems are often interconnected with social, economic, and environmental factors. It recognizes that changes in one aspect of the system can have ripple effects on other components, and thus, it considers multiple perspectives and stakeholders when developing solutions. Systems thinking also emphasizes considering the long-term implications of interventions and solutions. It encourages planning and decision-making that takes into account the potential future consequences and sustainability of actions.

By adopting a systems thinking approach, water problems can be approached more comprehensively and effectively, taking into account the complexities and interconnectedness of the water system.

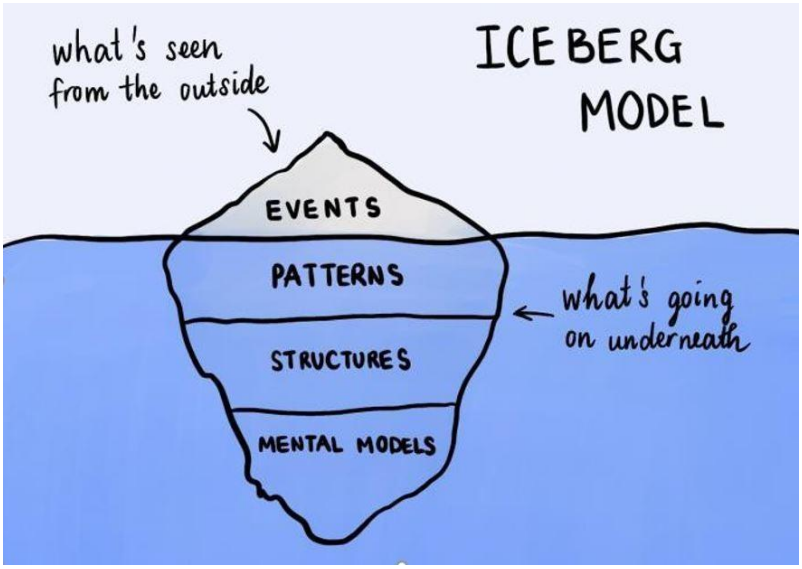
2.1.Why is systems thinking crucial for sustainable water management

Water management involves dealing with complex systems that include natural resources, infrastructure, social dynamics, and environmental factors. To address the challenges and ensure long-term sustainability, it is important to adopt a systems thinking approach.

Systems thinking in water management refers to an approach that considers the water system as a complex, interconnected system of components, processes, and stakeholders. It involves understanding the relationships, feedback loops, and interdependencies within the water system to develop effective strategies for managing water resources sustainably.

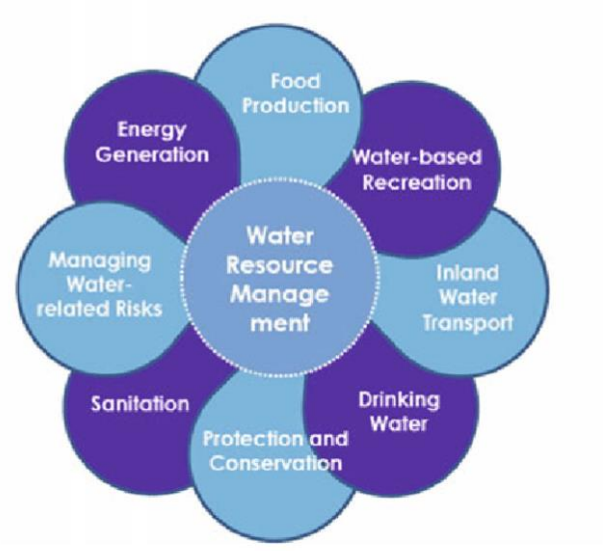
Systems thinking emphasizes looking at the entire water system rather than focusing on individual components or issues in isolation. It considers the interactions and interdependencies between various elements such as water sources, infrastructure, ecosystems, communities, and institutions.

Systems thinking aims to identify the underlying causes of water management challenges rather than merely addressing the symptoms. It involves understanding the social, economic, and environmental factors that contribute to water issues, enabling decision-makers to develop more effective and sustainable solutions.



2.2.Applying systems thinking in water management

Sustainable water management involves considering the interests and perspectives of various stakeholders, including communities, industries, governments, and ecosystems. Systems thinking promotes inclusiveness by recognizing and incorporating these diverse perspectives. It facilitates collaboration and the development of integrated strategies that balance social, economic, and environmental priorities., Considering multiple perspectives, systems thinking encourages inclusive decision-making processes that involve engaging and incorporating the input of various stakeholders, including communities, water users, industries, governments, and environmental organizations.



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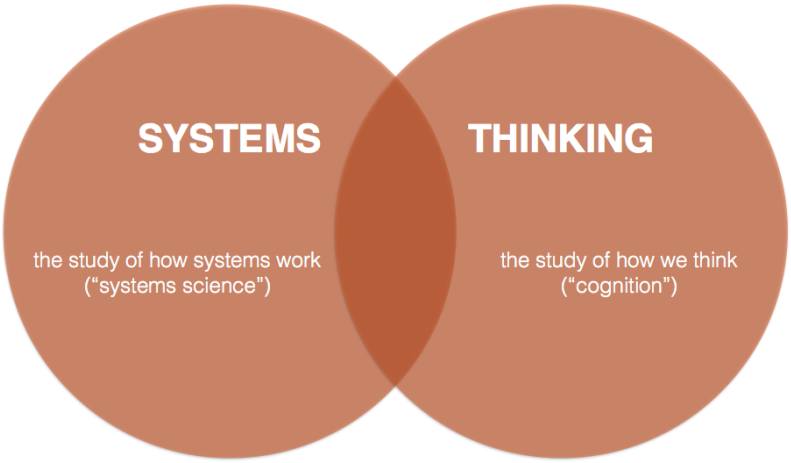
Systems thinking also emphasizes the need to plan for resilience in water management. It involves anticipating and preparing for potential disruptions, such as climate change impacts, population growth, or infrastructure failures. Planning for resilience helps in developing strategies that can adapt to changing conditions and ensure the sustainable availability of water

resources. By considering future scenarios and potential risks, decision-makers can develop adaptive strategies that ensure water systems remain robust and sustainable over time.

Overall, systems thinking is essential for sustainable water management as it enables a comprehensive understanding of the complexities, interconnections, and dynamics of water systems. By adopting a systems perspective, decision-makers can develop more effective, equitable, and resilient strategies that promote long-term sustainability in water management.

By applying systems thinking in water management, decision-makers can gain a more comprehensive understanding of the water system and develop effective strategies that balance social, economic, and environmental aspects. It enables a more sustainable and integrated approach to managing water resources for the benefit of present and future generations.



3. Interrelation between systems thinking and multidisciplinary approach

Systems thinking in water management recognizes the need to integrate knowledge from various disciplines such as hydrology, ecology, economics, sociology, and engineering. It encourages interdisciplinary collaboration and the use of diverse expertise to understand the complexities of the water system and develop comprehensive solutions.

Water problems, such as water scarcity, water pollution, and water management challenges, often require a multidisciplinary approach due to the complex nature of the issues involved.

By bringing together experts from various disciplines, a multidisciplinary approach enables a more comprehensive understanding of the interconnected aspects of water problems. It allows for a holistic assessment, the consideration of multiple perspectives, and the development of integrated and sustainable solutions. Moreover, the collaboration of diverse stakeholders fosters innovation, knowledge sharing, and the ability to address the complex challenges associated with water resources effectively.

Systems thinking is an approach that views a system as a whole, where the components and their interactions are studied to understand the system's behavior and patterns. It emphasizes the interconnections, feedback loops, and dependencies within a system. Systems thinking enables a holistic understanding of how various elements within a system influence and affect each other.

On the other hand, a multidisciplinary approach involves drawing knowledge and perspectives from multiple disciplines or fields to analyze and solve problems. It recognizes that complex issues often require insights from different domains, such as economics, psychology, engineering, or sociology. A multidisciplinary approach encourages collaboration and integration of diverse expertise to gain a comprehensive understanding of the problem.

Both approaches emphasize collaboration and the integration of different perspectives and have similar complementary perspectives, deeper and interconnected problems analysis system. They also lead to more effective strategies and interventions to address complex challenges.

In summary, systems thinking and a multidisciplinary approach complement each other by offering different perspectives, facilitating collaboration, and enabling a more comprehensive understanding of complex problems. Their interrelation can lead to improved problem-solving and the development of innovative solutions.

4. System thinking and solving transdisciplinary wicked water problems

The real promise of systems thinking lies in its utility for addressing trans-disciplinary “wicked problems”: seemingly intractable, complex issues that involve competing interests and multiple systems (e.g., economic, social, political).

In planning and policy, a wicked problem is a problem that is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize. It refers to an idea or problem that cannot be fixed, where there is no single solution to the problem; and "wicked" denotes resistance to resolution, rather than evil(1).

Systems thinking has long been applied in academic disciplines, communities, government, industry, and all sorts of organizations

4.1.Transdisciplinary wicked water problems

Transdisciplinary wicked problems(1) are complex, multifaceted problems that cannot be easily defined or solved within the boundaries of a single discipline. They often involve multiple stakeholders, conflicting interests, and uncertainty.

Transdisciplinary wicked water problems typically involve multiple stakeholders, including government agencies, communities, industries, and environmental organizations. Systems thinking promotes stakeholder engagement, fostering collaboration and the integration of diverse perspectives. It helps create a shared understanding of the problem, leading to more effective solutions(8).

When applying systems thinking to solve transdisciplinary wicked water problems, involves understanding and addressing complex water-related challenges that cut across multiple disciplines and involve diverse stakeholders

In summary, systems thinking provides a framework for understanding and addressing transdisciplinary wicked problems by considering the interconnectedness and dynamics of the system. It helps identify leverage points, anticipate unintended consequences, foster collaboration, and facilitate iterative learning and adaptation. By adopting a systems thinking approach, it becomes possible to tackle these complex problems more effectively.

For example; Iterative learning and adaptive management is very important implementation of sustainable and effective water management system. Systems thinking promotes iterative learning and adaptive management approaches. It involves monitoring the effects of interventions, collecting feedback, and adjusting strategies based on new insights and changing conditions. This iterative process allows for continuous improvement and the ability to respond to emerging challenges effectively.

By applying systems thinking to transdisciplinary and wicked water problems, it becomes possible to develop more holistic and effective solutions that address the complexity and interconnectedness of water systems. It enables stakeholders to collaborate, understand the underlying causes, consider long-term implications, and adapt strategies over time for sustainable water management.

5. Conclusions

Overall, systems thinking offers a valuable framework for understanding complex systems, identifying the underlying causes of problems, and formulating holistic and sustainable solutions. By embracing systems thinking, individuals and organizations can navigate the complexities of our interconnected world more effectively and make informed decisions that consider the broader impacts and long-term consequences.

Water problems are complex and require expertise from multiple disciplines as well as a transdisciplinary approach. Systems thinking promotes collaboration among hydrologists, ecologists, engineers, social scientists, policymakers, and other stakeholders. By integrating diverse perspectives and knowledge, a multidisciplinary approach can generate innovative solutions and address the various dimensions of water challenges. It also provides a framework for understanding and addressing transdisciplinary wicked problems by considering the interconnectedness and dynamics of the system. Systems thinking promotes stakeholders including government agencies, communities, industries, and environmental organizations engagement, fostering collaboration and the integration of diverse perspectives. It helps create a shared understanding of the problem, leading to more effective solutions.

Water problems often involve complex, dynamic systems with inherent uncertainty. Systems thinking acknowledges these complexities and embraces the uncertainty by employing modeling, scenario planning, and iterative approaches. It allows for adaptive management strategies that can respond to changing conditions and evolving knowledge(8).

Applying systems thinking to water problems facilitates a more comprehensive and integrated approach to addressing the challenges related to water scarcity, pollution, resource management, and sustainability. By understanding the interconnections and dynamics of water systems, engaging multiple disciplines, and considering long-term implications, systems thinking provides a valuable framework for developing innovative and sustainable solutions to ensure the availability and quality of water resources for future generations.

Advances in technology and communications and the globalization of an increasing array of phenomena mean we all live in a very complex, volatile, and uncertain world. This necessitates a new multidisciplinary and transdisciplinary approach to organization, problem-solving, and planning. Water problems are also complex problems that create uncertainty and need also system-thinking approach

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Biography

Dursun Yıldız (Msc.) is a hydropolitics specialist and Director of the Hydropolitics Academy Association located in Ankara-Turkey. He is a civil engineer and used to be Deputy Director at State Hydraulic Works in Turkey; completed a hydroinformatics postgraduate course at the IHE in Delft, a Technical training program in USBR-USA, and a master's degree in Hydropolitics at the Hacettepe University-Turkey. He has over 5 years of teaching experience in some Turkish Universities and now works as head of his own Hydro Energy & Strategy consulting company located in Ankara. He has published several international articles and 15 books. He received the Most Succesful Researcher Award on International Water Issues from Turkish Agricultural Association in 2008 and from the Central Union of Irrigation Cooperatives in 2016. He received the Professional Services Award of Excellence from İstanbul Çekmeköy Rotary Club in 2021. He becomes a part-time lecturer at the IZTECH International Water Resources Department in In the 2020-2021 academic year

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