Power System Technology
ISSN:1000-3673

*Accepted: 28-08-2024* *Revised: 15-07-2024* *Received: 06-06-2024*

# Designing a Policy Support System to Foster Rationality in Water Resource Management

**1-Ali Asghar Pourezzat 2- *Abbas Nargesian 3- Nader Naghshineh 4- Seyed Abdolhamid Beheshti Rouy**

1- Professor., Department of Public Policy & Administration, College of Management, University of Tehran, Tehran, Iran https://orcid.org/0000-0002-1875-3479 mail: pourezzat@ut.ac.ir

2- Associate professor., Department of leadership & Human Capital, College of Management, University of Tehran, Tehran, Iran https://orcid.org/0000-0003-0598-5630 mail: anargesian@ut.ac.ir

3- Associate professor., Department of Information Sciences and Knowledge Management, College of Management, University of Tehran, Tehran, Iran https://orcid.org/0000-0002-0509-5454 mail: nnaghsh@ut.ac.ir

4- PhD Candidate, departement of Public administration and organization sciences, Alborz Campus, University of Tehran, Tehran, Iran https://orcid.org/0009-0000-8387-8545 mail: beheshti.h@ut.ac.ir

**Abstract :**

Water resource management, especially in critical regions, is one of the most pressing issues today in the context of climate change. Therefore, designing systems that can implement a rational approach to managing these resources, particularly in policymaking, can greatly benefit this field. The main objective of this study is to design a policy support system (PSS) aimed at enhancing rationality in water resource management. The study employs a qualitative content analysis method for designing this system. Data were collected through interviews, and the validity was confirmed using the CVR index, while reliability was verified using Cohen's kappa coefficient. The participants in this study were water management experts in Iran. Using the snowball sampling method, 17 participants were selected at the point of theoretical saturation. The analysis of the qualitative data identified 19 main components, forming the core elements of the proposed model. These components include data collection and analysis, the use of geographic information systems (GIS), modeling and simulation, stakeholder analysis, decision support tools (DSS), legal and policy frameworks, performance evaluation and monitoring, education and capacity building, ensuring public participation and transparency, technology transfer and innovation utilization, attention to climate change, inter-organizational alignment, continuous risk assessment and management, and integration with sustainable development. These components can be applied in implementing a PSS to enhance rationality in water management.

**Keywords :** Policy support system, rationality development, water management

Power System Technology
ISSN:1000-3673
Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

**Introduction:**

Water is the fundamental source of life for humanity, playing a crucial role in the formation of ancient civilizations and serving as one of the most important tools for development in both the modern and postmodern eras (Loucks, 2000). The increase in population and changes in lifestyle have led to environmental crises and climate change. The broader environment in water resource management has undergone significant transformations, to the extent that human life and communities are now facing serious threats from droughts and floods (Rahaman & Varis, 2005). Water resource management is a complex issue influenced by numerous variables, such as population, industrial development, climate, urbanization, environmental concerns, and future generations (Mariolakos, 2007).

The water industry has a direct impact on social, economic, and security factors. In other words, there is an interdependent relationship between water and these critical sectors. Consequently, policymaking in this industry has a profound effect on the governance structure of the country. Success or failure in water policy directly influences the public perception of the performance of government officials (Pahl-Wostl et al., 2007). Given this, increasing the degree of rationality in policymaking in this field directly affects rationality in policymaking across other sectors as well.

Rational policymaking models are rooted in positivism and rationalism, and they demonstrate higher effectiveness in decision-making processes compared to other models (Uzonwanne, 2023). According to the POSCORB model, the highest level of effectiveness in policymaking stems from systematic planning, organizing, decision-making, selecting, coordinating, recruiting, and budgeting. As a result, comprehensive rational decision-making models, which emphasize "exploring all possible options" and "providing the necessary resources for decision-making," have gained attention (Chalekian, 2013).

Herbert Simon's critiques of rational decision-making models, based on the limitations that prevent decision-makers from achieving full rationality, led to the development of semi-rational and non-rational models (Campitelli & Gobet, 2010). According to Simon, three major obstacles hinder full rationality in decision-making: cognitive limitations that lead to political decisions, limited understanding of the consequences of each decision (outputs and impacts), and the inability to assess the resulting outcomes or learn from them in future policymaking processes (Campitelli & Gobet, 2010).

A policy support system (PSS) contains elements that can serve as a foundation for enhancing rationality in effective policymaking (Hudson et al., 2019). By examining the functions of such a system, policymaking becomes an informed process based on sufficient data, gathered in the shortest time possible. In the next step, the PSS enables the provision of both analyses and meta-analyses on the available data to policymakers or think tanks. Finally, the system facilitates policy learning by implementing knowledge management as a sub-system in the policy process. This can reduce the costs of policymaking and help adjust or terminate

Power System Technology
ISSN:1000-3673
Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

implemented policies as necessary. In the area of policy evaluation, the PSS, by providing tools to stakeholders and actors, can become an effective tool for pre-implementation policy evaluation (policy labs), monitoring during execution, and post-implementation evaluations (Wu et al., 2007).

Given the nature of management information systems and the PSS as a management information system, designing a PSS model for policymaking enhances the capacity for information literacy in the policymaking process. It also facilitates problem-solving by collecting, classifying, analyzing, and sharing information (McLeod, 1983).

Given that poor management of water resources can lead to significant challenges in governance, solving water issues can serve as a solid foundation for policymaking in other areas of governance. The precision systems used in river engineering and dam management generate and store substantial amounts of data daily. Additionally, meteorological systems and the development of information analysis technology generate valuable data that can be used to design a PSS model for water resource management. Such a system would organize and analyze this data to form a comprehensive model for policymaking in water resource management. Given the complexity and difficulty of policymaking in the 20th century, this issue has become one of the biggest challenges for governments today. Countries are compelled to engage in policymaking and to develop and implement various policies. However, the rational models of policymaking have not reached the maturity of semi-rational and non-rational models, which has hindered the growth of rational decision-making frameworks across government sectors. As a result, there has been insufficient theoretical development of rational policymaking.

In other words, applying rational models in policymaking, and thus rationality in governance, has faced serious challenges. Academic studies and theoretical research in this field have not progressed as much as in other areas.

Given the long-term significance and critical impact of policymaking in national governance, developing rationality in policymaking can help solve public issues in a way that ensures lasting benefits for governance.

Therefore, the main question of this research is: What are the main and subsidiary components of a policy support system designed to enhance rationality in water resource management?

## Theoretical Foundations

### Policy Support System (PSS)

A Policy Support System (PSS) is a key tool in organizational management, designed to facilitate the development, implementation, and monitoring of policies and strategies (Dinica, 2006). PSS plays a vital role in ensuring that an organization's activities align with its established goals and objectives, enabling managers to make better decisions. By providing precise information, comprehensive analyses, and management tools, a PSS optimizes the

Power System Technology
ISSN:1000-3673
Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

policy management process and provides the flexibility needed to respond to both internal and external environmental changes (Maes et al., 2012).

One of the core components of a PSS is data collection and analysis. Using advanced technologies, the system gathers relevant information about the organization's performance, market trends, competitors, and the environment. This data is then presented in a comprehensible and analyzable format, allowing managers to identify trends, assess organizational strengths and weaknesses, and make strategic decisions based on real-world data. Additionally, a PSS can help predict potential changes and prepare the organization for future challenges (Andersen et al., 2007).

Another key feature of the PSS is its ability to facilitate policy development. With software tools, managers can quickly and accurately design, review, and approve new policies. These tools foster collaboration and coordination among team members, preventing conflicts and inconsistencies (Salewicz & Nakayama, 2004). Furthermore, a PSS helps maintain and continuously update policies to ensure they remain aligned with the organization's changing circumstances and external environment.

The effective execution of policies is another critical function of the PSS. Through management dashboards and reports, the system facilitates the tracking of policy implementation and provides managers with the means to continuously monitor the organization’s progress. The system also identifies areas needing improvement and offers suggestions for process optimization (Ranerup et al., 2008). This process ensures that the drafted policies are properly executed and meet their intended goals.

The role of education and knowledge enhancement in PSS should not be overlooked. By providing educational resources and learning tools, the system helps staff become familiar with organizational policies and processes, improving their ability to implement them effectively (Arampatzis et al., 2004). Enhancing employees' skills and knowledge not only improves policy implementation but also boosts motivation and commitment to the organization.

Data security is also a crucial aspect of PSS. Given the sensitivity of information related to organizational policies and strategies, the system must include strong security measures to protect against unauthorized access, breaches, and misuse. Technologies such as encryption, access control, and continuous monitoring must be considered during system design and implementation (Terribile et al., 2024).

Ultimately, the PSS acts as a strategic tool, helping organizations leverage accurate data, efficient management processes, and coordination across teams to achieve their goals and succeed in today's competitive environment. With the effective implementation of a PSS, organizations can enhance productivity, flexibility, and sustainability, thus improving their market standing (Mladineo, 1992).

Power System Technology
ISSN:1000-3673
Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

**Rational Policymaking**

Rational policymaking is a structured and systematic approach to decision-making in organizations, governments, or institutions, designed to achieve specified goals through logical and evidence-based methods (Mearsheimer & Rosato, 2023). This policymaking approach emphasizes the use of logic, data, and thorough analysis to formulate strategies that effectively and efficiently address problems. Rational policies are based on clear objectives, comprehensive data collection, and the evaluation of various options according to optimal criteria, ensuring the best course of action is selected. Rational decision-making is grounded in the belief that decisions should be made based on objective criteria, not emotions, biases, or arbitrary factors (Farhi & Werning, 2019).

A key characteristic of rational policymaking is setting clear and measurable goals. By precisely defining what the policy aims to achieve, decision-makers can align their strategies and actions toward these goals. This clarity helps evaluate the effectiveness of the policy over time and ensures that all stakeholders share a common understanding of the desired outcomes. Additionally, rational policies heavily rely on data and empirical evidence. This involves gathering relevant information, conducting research, and analyzing trends to inform the policymaking process. Decisions based on data are less prone to errors and more likely to produce desirable outcomes than those based on anecdotal evidence or assumptions (Jones & Thomas, 2012).

The development of a rational policy typically involves several systematic steps. First, problem identification is critical, where the specific issue the policy aims to address is clearly defined (Kørnøv & Thissen, 2000). Next, the policy’s goals are established. Once the goals are defined, various options or alternatives are generated and assessed based on feasibility, effectiveness, and potential impact. This evaluation often includes cost-benefit analysis, risk assessment, and consideration of the long-term consequences of each option. Afterward, the most suitable option is selected and implemented, followed by continuous monitoring and evaluation to ensure the policy's effectiveness and adjustments as needed (Regan, 1987).

Rational policies offer several advantages. They increase transparency and accountability in decision-making because the logic behind each decision is clearly documented and based on objective criteria (Jones, 2002). This transparency builds trust among stakeholders, including employees, citizens, and partners, as they can see that decisions are made fairly and logically. Moreover, rational policies are more responsive to changing conditions (Marsden et al., 2012). Since they are based on ongoing analysis and evaluation, they can be adjusted in response to new information or environmental changes, ensuring the policy remains relevant and effective (Vatn, 2005).

However, the development and implementation of rational policies also present challenges. One of the main challenges is the availability and quality of data. In some cases, relevant data may be scarce, incomplete, or difficult to obtain, making thorough analysis challenging.

Power System Technology
ISSN:1000-3673
Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

Additionally, the process of developing rational policies can be time-consuming and resource-intensive, requiring significant investment in research and evaluation (Jones, 2017). This can be a limitation, especially in situations where quick decision-making is necessary. There may also be resistance to rational policies from stakeholders accustomed to more traditional or less structured approaches. Overcoming this resistance requires effective communication and demonstrating the benefits of a rational approach (Kørnøv & Thissen, 2000).

Another potential drawback is the assumption that all relevant factors can be quantified and analyzed objectively. In reality, some aspects of policymaking involve subjective judgments, ethical considerations, and value-based decisions that may not be easily captured through data. Balancing rational analysis with these intangible factors is essential for creating comprehensive and effective policies. Moreover, over-reliance on rationality can sometimes lead to rigidity, where policies are overly prescriptive and fail to account for the nuances and complexities of real-world situations (Hoggett, 2001).

In conclusion, rational policymaking provides an ideal framework for decision-making that prioritizes logic, evidence, and systematic analysis. While this approach offers significant advantages in terms of clarity, effectiveness, and flexibility, it requires careful attention to potential challenges such as data limitations, resource requirements, and the integration of subjective elements. By embracing rationality while remaining adaptable and responsive to the complexities of real-world scenarios, organizations and governments can develop policies that are both robust and responsive, ultimately leading to better outcomes and increased trust among stakeholders (Frey, 1999).

**Decision Support Systems in Water Resource Management**

Decision Support Systems (DSS) play a vital role in optimizing the use and conservation of water resources. These systems integrate various data sources, advanced analysis techniques, and modeling tools to assist managers and decision-makers in making informed, evidence-based decisions (Droubi et al., 2008). Given the critical importance of water as a resource for human life, agriculture, industry, and ecosystems, DSS can significantly contribute to balancing water demand and supply, managing water crises, and improving water quality (Pallottino et al., 2005).

One of the core components of DSS in water resource management is data collection and analysis (Zaman et al., 2009). The data can include meteorological information, water consumption levels, water quality data, infrastructure conditions, and climate change impacts. By utilizing these datasets, DSS can forecast future water needs, identify regions facing water scarcity, and propose optimal strategies for resource allocation (Gastélum et al., 2009). For example, in arid and semi-arid regions, DSS can help determine the optimal irrigation levels for agriculture, thus preventing water wastage.

Power System Technology
ISSN:1000-3673
Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

In addition to data collection, DSS employs advanced models to simulate various scenarios (Giordano et al., 2007). These models allow decision-makers to predict the outcomes of different policies and management actions, enabling them to choose the best solutions (Su et al., 2024). For instance, in response to drought, DSS can evaluate the effects of reducing water consumption across sectors and suggest equitable and efficient distribution strategies (Zeng et al., 2022).

Another benefit of using DSS in water resource management is the increased transparency and collaboration among stakeholders. DSS presents information in an integrated and comprehensible format, allowing various stakeholders to easily access data and participate in the decision-making process (Souza et al., 2023). This promotes greater cooperation between different sectors, such as agriculture, industry, municipalities, and environmental organizations, reducing conflicts and fostering collective efforts (Pallottino, 2005).

Despite its advantages, implementing DSS in water resource management presents challenges. One key challenge is the need for accurate and up-to-date data (Reljić et al., 2023). Collecting and maintaining both qualitative and quantitative water-related data requires significant investments in information technology infrastructure and staff training. Additionally, ensuring that DSS is compatible with local and national policies and regulations can be complex, necessitating close collaboration between different institutions.

Another challenge lies in the reliability of the models and analyses provided by DSS (Zhang et al., 2014). To ensure the accuracy and predictive capability of these systems, continuous evaluation and updates to the models are essential, aligning them with real-world data (Johnson et al., 1986). Furthermore, it is crucial to train and empower end-users to effectively utilize DSS tools, enhancing their decision-making capabilities.

Ultimately, DSS can serve as powerful tools for sustainable water resource management (Teodosiu et al., 2009). By utilizing these systems, organizations and communities can make better decisions regarding water allocation, resource protection, and addressing water-related challenges (Anzaldi et al., 2014). This not only improves the quality of life for people but also plays a crucial role in maintaining ecosystem balance and supporting sustainable development (Nakhaei et al., 2023).

As human pressures and climate change intensify, the importance of using DSS in water management is growing. DSS can be a key tool in achieving a more sustainable future (Simonovic, 1996).

**Research Methodology**

In this study, which investigates the policy support system in water resource management, particularly in critical areas and the role of climate change, a qualitative research method using content analysis as the primary tool was employed. The main objective of this research is to

Power System Technology
ISSN:1000-3673
Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

design a policy support system to enhance rationality in water resource management. Data were collected through semi-structured interviews with 17 experts active in the field of water management in Iran, selected using the snowball sampling method until reaching the point of theoretical saturation. The validity of the interview tool was confirmed using the CVR index, and its reliability was verified through Cohen's kappa coefficient. The qualitative data analysis led to the identification of 19 main components within the proposed model, which include data collection and analysis, the use of geographic information systems, modeling and simulation, stakeholder analysis, decision support systems (DSS), legal and policy frameworks, performance evaluation and monitoring, education and capacity building, ensuring public participation and transparency, technology and innovation transfer and utilization, attention to climate change, inter-organizational alignment, continuous risk assessment and management, and integration with sustainable development. These components can be effectively used in the implementation of the policy support system to enhance rationality in water resource management.

## Data Analysis Results

### Demographic Description of Research Participants

In the descriptive statistics section of this study, information related to the demographic variables of the research experts was analyzed. The analysis of educational status shows that 52% of the sample holds a Master's or PhD degree, and 48% hold a Bachelor's degree. Regarding job positions, 41% of the participants work as deputies, 37% as managers, and 24% at the expert level. Furthermore, the work experience of the sample indicates that 65% of the experts have more than 15 years of experience, 18% have between 10 to 15 years, and another 18% have between 5 to 10 years. These results reflect the high level of education and professional experience of the participants in the field of water resource management, enhancing the credibility and depth of the research analysis.

Qualitative Study (Answering the Questions: What are the main and sub-components of the rational policy development model using the policy support system in the country's water resource management?)

### Identifying Corresponding Codes Based on Meaning Units

In this section, to identify the codes, the interviews, which were recorded as audio files, were transcribed verbatim. Then, each text was studied line by line in the Maxqda software, and since the content unit in this research was the text, every significant line and sentence related to the main question was extracted. Subsequently, based on the combination of meaning units that had semantic and conceptual similarities, these units were grouped together and presented as codes. At this stage, content analysis was conducted to examine the relationships between the codes and assess their conceptual proximity. Duplicate codes were eliminated, and the remaining codes were classified into initial subcategories, some of which are presented in Table 1.

**Table 1:** Identification of Codes Based on Meaning Units

| Row | Codes | Meaning Units (From Interviews) | Frequency |
|---|---|---|---|
| 1 | Physical Data | "One of the most fundamental elements in water resource management is having accurate and up-to-date information about the physical status of water resources. This includes river flow measurements, rainfall levels, groundwater discharge, and other water-related physical data, which form the basis of our decision-making." | 6 |
| 2 | Social and Economic Data | "In analyzing water management policies, one cannot overlook social and economic aspects. Information such as population, agricultural and industrial activities, as well as regional economic needs, play a crucial role in determining priorities and resource allocation." | 5 |
| 3 | Environmental Data | "The environment is one of the key factors in sustainable water resource management. Data on water quality, biodiversity, and the environmental impacts of watershed projects are of special importance and must be considered in any decision-making process." | 3 |
| 4 | Use of Information Systems for Water Resource Mapping | "By utilizing Geographic Information Systems (GIS), we can create detailed and comprehensive maps of water resources. These tools allow us to visually and analytically examine the distribution of resources, critical points, and water consumption patterns." | 3 |
| 5 | Use of Information Systems to Identify Critical Areas | "Information systems help us identify areas with water shortages or overconsumption. By analyzing spatial and temporal data, we can provide more accurate forecasts of future critical points and take appropriate preventive measures." | 3 |

Power System Technology
ISSN:1000-3673
Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

| | | | |
|---|---|---|---|
| 6 | Use of Information Systems for Effective Spatial Planning | "Effective spatial planning in water resource management requires precise data and advanced tools such as GIS. These systems enable us to optimize resource use based on geographic distribution and regional needs." | 5 |

**Evaluation of the Validity of Extracted Codes**

At this stage, after identifying subcategories, a survey was conducted to assess the validity of the reviewed codes and the process of coding and identifying subcategories. This was done by consulting experts to gather their agreement or disagreement on the extracted subcategories. Based on the CVR formula introduced in Chapter 3, the value of this index was calculated, and the approval or rejection of the relevant subcategory from the experts' viewpoint was presented as a percentage of this index. According to the Lawashi et al. table, with a total of 17 experts, a value above 0.49 (or 49%) indicates approval of the validity of the relevant subcategory.

**Table 2:** Extraction of Subcategories from Identified Codes

| No. | Subcategories | Abbreviation | Frequency | CVR |
|---|---|---|---|---|
| 1 | Physical Data | D1 | 6 | 75 |
| 2 | Social and Economic Data | D2 | 5 | 75 |
| 3 | Environmental Data | D3 | 3 | 87 |
| 4 | Use of Information Systems for Water Resource Mapping | S1 | 3 | 87 |
| 5 | Use of Information Systems for Identifying Critical Areas | S2 | 3 | 63 |
| 6 | Use of Information Systems for Effective Spatial Planning | S3 | 5 | 75 |
| 7 | Integration of Geographic Data | S4 | 3 | 75 |
| 8 | Development of Mathematical Models to Predict Future Water Resource Trends | M1 | 3 | 87 |
| 9 | Development of Simulations to Predict Future Water Resource Trends | M2 | 2 | 63 |
| 10 | Master Scenario Planning Based on Capacities and Conditions | M3 | 2 | 100 |
| 11 | Identification and Evaluation of Government Stakeholders | Z1 | 3 | 75 |

Power System Technology
ISSN:1000-3673
Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

| | | | | |
|---|---|---|---|---|
| 12 | Identification and Evaluation of Farmer Stakeholders | Z2 | 2 | 63 |
| 13 | Identification and Evaluation of Industrial Stakeholders | Z3 | 2 | 63 |
| 14 | Identification and Evaluation of Local Community Stakeholders | Z4 | 3 | 75 |
| 15 | Design of Decision Support Systems | DS1 | 2 | 63 |
| 16 | Implementation of Decision Support Systems | DS2 | 3 | 100 |
| 17 | Review and Formulation of Regulations Related to Water Resource Management | L1 | 3 | 100 |
| 18 | Ensuring the Implementation of Water Resource Management Regulations | L2 | 4 | 63 |
| 19 | Alignment of Laws with National and International Water Resource Policies | L3 | 2 | 63 |
| 20 | Continuous Compliance with Environmental Regulations | L4 | 4 | 87 |
| 21 | Creation of Continuous Evaluation Mechanisms | P1 | 2 | 75 |
| 22 | Continuous Revisions Based on Obtained Results | P2 | 3 | 87 |
| 23 | Enhancing the Knowledge of Employees and Stakeholders in the Use of Policy Support Systems | E1 | 2 | 87 |
| 24 | Enhancing the Skills of Employees and Stakeholders in the Use of Policy Support Systems | E2 | 1 | 63 |
| 25 | Enhancing Water Resource Management Knowledge | E3 | 3 | 75 |
| 26 | Creating Transparent Processes for Public Participation | C1 | 3 | 87 |
| 27 | Transparent Processes in Policy Formulation | C2 | 2 | 100 |
| 28 | Continuous Public Information Dissemination | C3 | 3 | 87 |
| 29 | Continuous Information Interaction with the Public | C4 | 4 | 87 |
| 30 | Utilizing New Technologies | N1 | 5 | 75 |
| 31 | Big Data Analysis | N2 | 4 | 87 |
| 32 | Artificial Intelligence for Improving Accuracy and Efficiency in Water Resource Management | N3 | 3 | 87 |

Power System Technology
ISSN:1000-3673

Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

| | | | | |
|---|---|---|---|---|
| 33 | Transfer of Water Resource Management Knowledge | N4 | 3 | 75 |
| 34 | Use of Sustainable Technologies | N5 | 2 | 63 |
| 35 | Incorporation of Climate Change Factors in Water Resource Modeling and Planning | CH1 | 3 | 100 |
| 36 | Considering Climate Change Indicators in Policymaking | CH2 | 2 | 63 |
| 37 | Climate Change-Based Policymaking | CH3 | 3 | 87 |
| 38 | Collaboration and Coordination Among Various Government Agencies | E2 | 3 | 75 |
| 39 | Collaboration and Coordination Among Various Non-Government Agencies | A1 | 3 | 75 |
| 40 | Coordination Between Policies and Laws | A2 | 3 | 63 |
| 41 | Coordination Between Policies and Operations in Water Resource Management | A3 | 2 | 63 |
| 42 | Identification of Water Resource Risks | R1 | 3 | 100 |
| 43 | Development of Risk Reduction Strategies for Water Crises | R2 | 2 | 63 |
| 44 | Alignment with Sustainable Development Goals | SU1 | 3 | 75 |
| 45 | Development of Multidimensional Approaches | SU2 | 3 | 75 |
| 46 | Creation of Economic, Social, and Environmental Interactions | SU3 | 4 | 78 |

**Extraction of Main Components Based on Subcomponents (Codes)**

In this section, by revisiting the identified codes and subcategories, a re-evaluation of the subcategories was conducted. The subcategories were grouped based on semantic and conceptual similarities, as well as the closeness of each subcategory to the main identified categories. Subcategories were categorized into 14 distinct groups. At this stage, if a subcategory did not fit into any of these categories, a new category was created. Through this process, the coding and categorization of subcategories resulted in the classification of 46 subcategories into 14 main categories. In the table below, the corresponding concepts for each category and the frequency of their occurrence are listed. Accordingly, the 46 identified subcategories were categorized into 14 main groups, as shown in the table below.

Power System Technology
ISSN:1000-3673
Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

**Table 3:** Selected Coding Table from Qualitative-Exploratory Study

| No. | Variable Title | Corresponding Concepts |
|---|---|---|
| 1 | Data Collection and Analysis | • Physical data |
| | | • Social and economic data |
| | | • Environmental data |
| 2 | Use of Geographic Information System | • Using GIS for water resource mapping |
| | | • Using GIS to identify critical areas |
| | | • Using GIS for effective spatial planning |
| | | • Integrating geographic data |
| 3 | Modeling and Simulation | • Developing mathematical models to predict future water trends |
| | | • Developing simulations to forecast future water trends |
| | | • Scenario planning based on capacities and conditions |
| 4 | Stakeholder Analysis | • Identifying and assessing government stakeholders |
| | | • Identifying and assessing farmer stakeholders |
| | | • Identifying and assessing industry stakeholders |
| | | • Identifying and assessing local community stakeholders |
| 5 | Decision Support Systems (DSS) | • Designing decision support systems |
| | | • Implementing decision support systems |
| 6 | Legal and Policy Frameworks | • Reviewing and drafting regulations related to water resource management |
| | | • Ensuring the implementation of water management laws |
| | | • Aligning laws with national and international water policies |
| | | • Continuous adaptation to environmental regulations |
| 7 | Performance Monitoring and Evaluation | • Establishing continuous evaluation mechanisms |
| | | • Ongoing improvements based on outcomes |
| 8 | Education and Capacity Building | • Enhancing knowledge of staff and stakeholders in using policy support systems |
| | | • Improving skills of staff and stakeholders in using policy support systems |

Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

| | | |
|---|---|---|
| | | • Increasing knowledge in water resource management |
| 9 | Public Participation and Transparency | • Creating transparent processes for public participation |
| | | • Transparent processes in policy formulation |
| | | • Continuous communication with the community |
| | | • Ongoing information exchange with the community |
| 10 | Technology Transfer and Innovation | • Utilizing modern technologies |
| | | • Big data analysis |
| | | • Artificial intelligence for improving water resource management accuracy and efficiency |
| | | • Knowledge transfer in water resource management |
| | | • Using sustainable technologies |
| 11 | Consideration of Climate Change | • Integrating climate change factors into water resource modeling and planning |
| | | • Considering climate change indicators in policy-making |
| | | • Climate change-based policy-making |
| 12 | Inter-organizational Alignment | • Collaboration and coordination among various governmental institutions |
| | | • Collaboration and coordination among various non-governmental institutions |
| | | • Coordination between policies and laws |
| | | • Coordination between policies and water resource management operations |
| 13 | Continuous Risk Assessment and Management | • Identifying water resource risks |
| | | • Developing risk reduction strategies during water crises |
| 14 | Integration with Sustainable Development | • Aligning with sustainable development goals |
| | | • Developing multidimensional approaches |
| | | • Creating economic, social, and environmental integration |

Finally, based on Table 3 and the findings, the final conceptual model of this study is presented in Figure 1.

Power System Technology
ISSN:1000-3673
Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

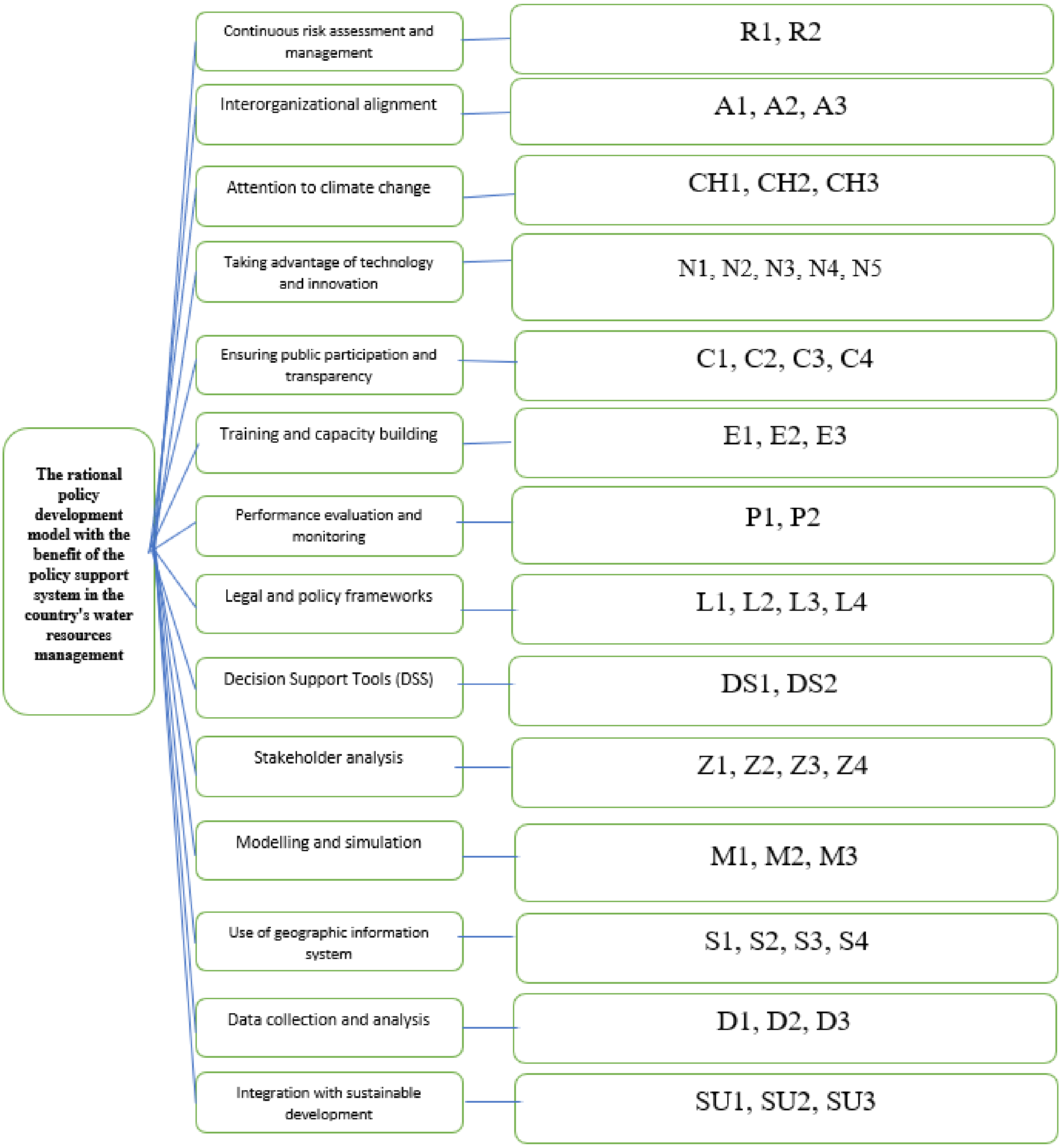


**Figure 1.** Policy Support System Model for Developing Rationality in Water Resource Management

Power System Technology
ISSN:1000-3673
Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

**Conclusion**

This study, which focuses on designing a policy support system aimed at enhancing rationality in water resource management, utilized qualitative methods and content analysis to identify and examine the main and subsidiary components of this system. The results derived from data analysis, collected through interviews with 17 experts in the field of water resource management in Iran, reveal the existence of a comprehensive and multidimensional framework for improving water resource management. The identification of 19 key components, including data collection and analysis, the use of Geographic Information Systems (GIS), modeling and simulation, stakeholder analysis, decision support tools (DSS), legal and policy frameworks, performance evaluation and monitoring, education and capacity building, ensuring public participation and transparency, technology transfer and innovation, attention to climate change, inter-organizational alignment, continuous risk assessment and management, and integration with sustainable development, highlights the need for a cohesive and coordinated policy support system that encompasses all these elements.

One of the key findings of this research is the emphasis on the importance of using GIS and advanced modelling for accurate water resource mapping and identifying critical areas. These tools enable managers to make decisions based on precise and up-to-date data. Additionally, stakeholder analysis plays a crucial role in identifying the needs and expectations of various groups involved in water resource management, which can lead to the formulation of comprehensive and actionable policies. The legal and policy frameworks identified in this study underscore the need for strong and consistent regulations aligned with national and international policies in water resource management. Furthermore, continuous performance evaluation and risk management related to water resources are vital to mitigating the negative impacts of water crises.

The emphasis on education and capacity building reflects the need to enhance the knowledge and skills of staff and stakeholders in utilizing policy support systems. Attention to climate change and integration with sustainable development goals are also key components of this policy support system, indicating the need for a comprehensive and multidimensional approach to water resource management. The use of modern technologies, such as artificial intelligence and big data analysis, can improve the accuracy and efficiency of water resource management and facilitate the transfer of water management knowledge.

The findings of this research demonstrate that the design and implementation of a comprehensive and multidimensional policy support system can significantly contribute to the development of rationality in water resource management. By providing the necessary tools and frameworks for data collection and analysis, stakeholder identification and evaluation,

Power System Technology
ISSN:1000-3673
Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

decision support, and ensuring transparency and public participation, such a system can enable water resource managers to make better decisions and achieve sustainability in water resource management. Ultimately, this research can serve as a foundation for future studies aimed at improving water resource management systems and developing effective policies in this field.

It is suggested that future research focus on the practical evaluation and assessment of this system in various environments and examine its impacts on improving water resource management, to comprehensively evaluate its practical capabilities. Based on the findings of this study, it is recommended that relevant organizations in the field of water resource management implement a comprehensive and multidimensional policy support system that includes the collection and analysis of physical, social, and environmental data, extensive use of GIS, and the development of advanced predictive modelling and simulation. It is also recommended to review and strengthen existing legal and policy frameworks to align them with national and international policies. Strengthening educational capacities and enhancing the skills of staff and stakeholders in utilizing decision support tools is essential, and transparent processes for public participation should be established to ensure that decisions are made based on transparency and broad collaboration. Moreover, leveraging modern technologies such as artificial intelligence and big data analysis can increase the precision and efficiency of water resource management, while special attention to climate change and integration with sustainable development goals is essential. Finally, it is suggested that future studies focus on the practical evaluation and impact assessment of this system in different environments and offer strategies for its continuous improvement to more effectively contribute to the development of rationality in water resource management.

**References**

1. Andersen, D. F., Vennix, J. A., Richardson, G. P., & Rouwette, E. A. (2007). Group model building: problem structuring, policy simulation and decision support. *Journal of the Operational Research Society*, *58*(5), 691-694.
2. Anzaldi, G., Rubion, E., Corchero, A., Sanfeliu, R., Domingo, X., Pijuan, J., & Tersa, F. (2014). Towards an enhanced knowledge-based decision support system (DSS) for integrated water resource management (IWRM). *Procedia Engineering*, *89*, 1097-1104.
3. Arampatzis, G., Kiranoudis, C. T., Scaloubacas, P., & Assimacopoulos, D. (2004). A GIS-based decision support system for planning urban transportation policies. *European Journal of Operational Research*, *152*(2), 465-475.
4. Campitelli, G., & Gobet, F. (2010). Herbert Simon's decision-making approach: Investigation of cognitive processes in experts. *Review of general psychology*, *14*(4), 354-364.

Power System Technology
ISSN:1000-3673
Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

5. Chalekian, P. (2013, December). POSDCORB: Core patterns of administration. In *Proceedings of the 20th Conference on Pattern Languages of Programs. The Hillside Group* (Vol. 17).
6. Dinica, V. (2006). Support systems for the diffusion of renewable energy technologies—an investor perspective. *Energy policy*, *34*(4), 461-480.
7. Droubi, A., Al-Sibai, M., Abdallah, A., Zahra, S., Obeissi, M., Wolfer, J., ... & Schelkes, K. (2008). A decision support system (DSS) for water resources management,–Design and results from a pilot study in Syria. In *Climatic changes and water resources in the Middle East and North Africa* (pp. 199-225). Berlin, Heidelberg: Springer Berlin Heidelberg.
8. Farhi, E., & Werning, I. (2019). Monetary policy, bounded rationality, and incomplete markets. *American Economic Review*, *109*(11), 3887-3928.
9. Frey, B. S. (1999). Morality and rationality in environmental policy. *Journal of consumer policy*, *22*(4), 395-417.
10. Gastélum, J. R., Valdés, J. B., & Stewart, S. (2009). A decision support system to improve water resources management in the Conchos Basin. *Water resources management*, *23*, 1519-1548.
11. Giordano, R., Passarella, G., Uricchio, V. F., & Vurro, M. (2007). Integrating conflict analysis and consensus reaching in a decision support system for water resource management. *Journal of environmental management*, *84*(2), 213-228.
12. Hoggett, P. (2001). Agency, rationality and social policy. *Journal of social policy*, *30*(1), 37-56.
13. Hudson, B., Hunter, D., & Peckham, S. (2019). Policy failure and the policy-implementation gap: can policy support programs help? *Policy design and practice*, *2*(1), 1-14.
14. Johnson, L. E. (1986). Water resource management decision support systems. *Journal of water resources planning and management*, *112*(3), 308-325.
15. Jones, B. D. (2002). Bounded rationality and public policy: Herbert A. Simon and the decisional foundation of collective choice. *Policy Sciences*, *35*(3), 269-284.
16. Jones, B. D. (2017). Behavioral rationality as a foundation for public policy studies. *Cognitive Systems Research*, *43*, 63-75.
17. Jones, B. D., & Thomas, H. F. (2012). Bounded rationality and public policy decision-making. *Routledge handbook of public policy*, 273-286.
18. Kørnøv, L., & Thissen, W. A. (2000). Rationality in decision-and policy-making: implications for strategic environmental assessment. *Impact assessment and project appraisal*, *18*(3), 191-200.
19. Loucks, D. P. (2000). Sustainable water resources management. *Water international*, *25*(1), 3-10.

Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

20. Maes, J., Egoh, B., Willemen, L., Liquete, C., Vihervaara, P., Schägner, J. P., ... & Bidoglio, G. (2012). Mapping ecosystem services for policy support and decision making in the European Union. *Ecosystem services*, *1*(1), 31-39.
21. Mariolakos, I. (2007). Water resources management in the framework of sustainable development. *Desalination*, *213*(1-3), 147-151.
22. Marsden, G., Frick, K. T., May, A. D., & Deakin, E. (2012). Bounded rationality in policy learning amongst cities: lessons from the transport sector. *Environment and Planning A*, *44*(4), 905-920.
23. McLeod, R. (1983). *Management information systems*. Science Research Associates.
24. Mearsheimer, J. J., & Rosato, S. (2023). *How states think: the rationality of foreign policy*. Yale University Press.
25. Mladineo, N., Lozić, I., Stošić, S., Mlinarić, D., & Radica, T. (1992). An evaluation of multicriteria analysis for DSS in public policy decision. *European Journal of Operational Research*, *61*(1-2), 219-229.
26. Nakhaei, M., Ahmadi, A., Gheibi, M., Chahkandi, B., Hajiaghaei-Keshteli, M., & Behzadian, K. (2023). A smart sustainable decision support system for water management of power plants in water stress regions. *Expert Systems with Applications*, *230*, 120752.
27. Pahl-Wostl, C., Craps, M., Dewulf, A., Mostert, E., Tabara, D., & Taillieu, T. (2007). Social learning and water resources management. *Ecology and society*, *12*(2).
28. Pallottino, S., Sechi, G. M., & Zuddas, P. (2005). A DSS for water resources management under uncertainty by scenario analysis. *Environmental Modelling & Software*, *20*(8), 1031-1042.
29. Rahaman, M. M., & Varis, O. (2005). Integrated water resources management: evolution, prospects and future challenges. *Sustainability: science, practice and policy*, *1*(1), 15-21.
30. Ranerup, A. (2008). Decision support systems for public policy implementation: the case of pension reform. *Social Science Computer Review*, *26*(4), 428-445.
31. Regan, D. E. (1978). Rationality in policy making: Two concepts not one. *Long Range Planning*, *11*(5), 83-88.
32. Reljić, M., Romić, M., Romić, D., Gilja, G., Mornar, V., Ondrasek, G., ... & Zovko, M. (2023). Advanced continuous monitoring system—tools for water resource management and decision support system in salt affected delta. *Agriculture*, *13*(2), 369.
33. Salewicz, K. A., & Nakayama, M. (2004). Development of a web-based decision support system (DSS) for managing large international rivers. *Global Environmental Change*, *14*, 25-37.
34. Simonovic, S. I. (1996). Decision support systems for sustainable management of water resources: 1. General principles. *Water International*, *21*(4), 223-232.

Accepted: 28-08-2024 Revised: 15-07-2024 Received: 06-06-2024

35. Souza, J. D. S. D., Cirilo, J. A., Bezerra, S. D. T. M., Oliveira, G. A. D., Freire, G. D., Coutinho, A. P., & Cabral, J. J. D. S. P. (2023). Decision support system for the integrated management of multiple supply systems in the Brazilian Semiarid Region. *Water*, *15*(2), 223.
36. Su, Q., Srinivasan, R., & Karthikeyan, R. (2024). SC. HAWQS: A User-Friendly Web-Based Decision Support System for Regional Water Resources Management Under a Changing Climate. *Water Resources Management*, *38*(4), 1261-1278.
37. Teodosiu, C., Ardeleanu, C., & Lupu, L. (2009). An overview of decision support systems for integrated water resources management. *Environmental Engineering & Management Journal (EEMJ)*, *8*(1).
38. Terribile, F., Acutis, M., Agrillo, A., Anzalone, E., Azam-Ali, S., Bancheri, M., ... & Basile, A. (2024). The LANDSUPPORT geospatial decision support system (S-DSS) vision: Operational tools to implement sustainability policies in land planning and management. *Land Degradation & Development*, *35*(2), 813-834.
39. Uzonwanne, F. C. (2023). Rational model of decision-making. In *Global encyclopedia of public administration, public policy, and governance* (pp. 11230-11235). Cham: Springer International Publishing.
40. Vatn, A. (2005). Rationality, institutions and environmental policy. *Ecological economics*, *55*(2), 203-217.
41. Wu, S. J., Gebraeel, N., Lawley, M. A., & Yih, Y. (2007). A neural network integrated decision support system for condition-based optimal predictive maintenance policy. *IEEE Transactions on Systems, Man, and Cybernetics-Part A: Systems and Humans*, *37*(2), 226-236.
42. Zaman, A. M., Rahman, S. M. M., & Khan, M. R. (2009, July). Development of a DSS for Integrated Water Resources Management in Bangladesh. In *18th World IMACS Congress and MODSIM09 International Congress on Modelling and Simulation: Interfacing Modelling and Simulation with Mathematical and Computational Sciences, Proceedings* (pp. 2756-2762).
43. Zeng, Y., Cai, Y., Jia, P., & Jee, H. (2012). Development of a web-based decision support system for supporting integrated water resources management in Daegu city, South Korea. *Expert Systems with Applications*, *39*(11), 10091-10102.
44. Zhang, K., Zargar, A., Achari, G., Islam, M. S., & Sadiq, R. (2014). Application of decision support systems in water management. *Environmental Reviews*, *22*(3), 189-205.