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Challenges and Achievements beyond Decision-Making Power of Planners: How Are Decisions on Planning for Stream Restoration Made in South Korea?

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Abstract: This research covers existing planning theory and possible ways to improve the decision-making process in Korean stream restoration. First, it attempts to recognize what extent the Korean stream restoration case follows Western environmental decision-making models. Additionally, key concepts and factors of environmental decision-making are discussed to build a foundation of planning theory. This research reveals key works in the broad and changing field of stream restoration that provides the foundation for understanding Korean water resource planning. To recognize the challenges and achievements of this planning, this paper first notes that, while technical perspectives of the engineering field have historically dominated stream restoration, current thinking recognizes the much greater complexity of stream restoration requires more than only engineering perspectives. After reviewing the literature in related areas, this research considers what the planning field has to offer. In the conclusion, this author argues that the application of citizen-oriented decision-making approaches could lead to better water resource management. Admittedly, this may still be hindered by political uncertainty and power conflicts caused by science-dominant environmental planning.

Keywords: planning in South Korea; decision-making in stream restoration; environmental planning; water resources planning; challenges and achievements of planners in decision-making

1. Introduction

Environmental planners consider conditions before anthropogenic influence and aim to return damaged streams to those conditions. Their focus has almost exclusively been on the biophysical elements of the stream. One might assume that it would be important to address the interests, values, scientific knowledge, and related constraints of stakeholders involved in the restoration process. Therefore, a balance between scientific knowledge and societal context are crucial to achieving successful stream restoration.

This research aimed to explore the decision-making process in Korean stream restoration. First, one needs to recognize what extent Korean stream restoration follows Western environmental decision-making models. Thus, key concepts and factors of environmental decision-making are discussed to build a theoretical foundation. According to some scholars [1–3], good environmental decision-making can result from balanced attention to different stakeholders, as well as their values and interests.

The following section presents relevant scholarship in the broad and evolving field of stream restoration. This researcher first notes that, while technical perspectives of the engineering field have historically dominated stream restoration, current thinking recognizes the much greater complexity of stream restoration. After reviewing the literature in related areas, this research considers the interface between human and natural systems, as well as what can improve current planning strategies.

2. Historical Domination of Technocratic Perspectives of Stream Restoration

In the traditional water planning process, natural science and available engineering technologies are paramount in decision-making. Stream restoration is conceived as scientific and environmental modification to existing streams and adjacent basins [4]. Water planning involves hydraulic modeling and structuring, ecological revitalization, and fluvial geomorphic approaches to watersheds [4,5].

In Western society, scientists restore streams to enhance water quality, manage riparian zones, improve in-stream habitats, improve fish passage, and stabilize the banks of waterways [6]. To assist the recovery of a degraded, damaged, and destroyed ecosystem, engineers and natural scientists intentionally alter a site to re-establish an original ecosystem [7]. Ecological restoration returns degraded streams to healthy streams [8]. Engineers and natural scientists apply biological, hydrological, and geomorphic approaches to the restoration process [8].

While an engineering focus of stream restoration remains common, recent scholarship has acknowledged a more complex interdisciplinary system including eco-hydrology. The term eco-hydrology indicates an interdisciplinary field that studies the interaction of ecosystems and water [9]. Eco-hydrology is often observed in water resource management, such as the quantification of the hydrological cycle, the understanding of biological processes, the influence and function of the river-flow of vegetation, and feedback between ecological and hydrologic effects [10].

3. Tensions Resulting from Narrow Perspectives

Researchers have noted friction among people who rely on a single perspective to make decisions, evaluate outcomes, and implement planning for stream restoration. One case of this friction stems from disparities between technological and inclusive approaches. Technological approaches value rationality, certainty, and clearly defined outcomes. Early rational planning models reflected technocratic goals and effectiveness-oriented top–down decision-making. Under rational planning theory, technocratic scientific information is the most important factor in decision-making because it is believed that the effectiveness and efficiency of decision-making results based on commonly known evidence can set people at ease from uncertainty.

Rational planners are considered technically trained experts who cope with uncertainty in their specific subjects. Therefore, in a rational planning model, the planner's primary role is to guide professional deliberation. In fact, under powerful political regimes, the rational planning model can be viewed as an ideal approach because planners can implement quickly changes after deciding their plan. Many other societies, such as China (and other communist societies controlled by powerful regimes) can be considered good examples of the use of traditional rational planning [11]. This type of rational planning with a top–down decision-making system has been popular in developing societies such as Korea—whose environmental decision-making is prone to be formulated under a top–down administrative structure [12].

However, the 'rational planning' model has faced many criticisms. Critics have argued that the rational planning model applies too narrow of a focus [13]. For example, planners of the traditional rational model hold professional knowledge on engineering technology to advise stakeholders to make better decisions based on instrumental rationality among many alternatives. They believe that instrumental rationality with professional scientific knowledge can convince the public [14].

Conversely, more integrated perspectives that value a broader range of decision makers' ideas embrace uncertainty. This includes the inclusion of decision makers who live around a particular water supply. Planning and implementing dynamic ecosystems correct disturbances and changes in a watershed environment caused by human actions [15]. The integration of technocratic and social perspectives is termed a "socio–ecological system" (SES). An SES links changes in local water systems with changes in the wider social context [16]. An SES incorporates the full range of existing values and perspectives across all stakeholders of watershed management.

4. Elements of Integrated Water Resource Management

Research has identified essential factors in integrated water resource management. References [17,18] adds key factors such as uncertainty and decision makers' values, backgrounds, and ability to deal with the environmental decision-making process. One important task is to clarify the values and preferences of both stakeholders and decision-makers in environmental issues because a wide range exists among the parties [17,19]. For successful decision-making in environmental management cases, the various values and preferences need to be appropriately and collaboratively shared and communicated among the parties. If not, the risk for conflict is higher [17]. The process of accepting and understanding diverse values and preferences recognizes that there is no single best value or preference among many different opinions [17].

4.1. Decision-Makers' Value, Background, and Ability

The characteristics of individuals and groups involved in environmental decision-making have profound impacts on the environment [17,18]. It is important to appropriately select who participates in a decision-making process [19]. Environmental scientists, civil engineers, and ecologists play major roles in environmental decision-making [20].

In environmental planning, engineering and scientific knowledge is used to help identify and mitigate risky uncertainties [17,19]. Because decision-makers are required to have certain credentials or knowledge in order to understand scientific data, they may tend to neglect non-scientific values and data when searching for the best alternative solution to environmental issues.

Decision-makers' backgrounds are also significant factors in the decision-making process. Individuals and groups involved in the decision-making hold different academic and professional backgrounds that can impact their values, preferences, and interests within the process. Some environmental decision-makers may have completed their training before their schools incorporated social or non-scientific requisites into their training programs [19]. Gregory and Keeney [19] stated that experts in the natural sciences may not usually apply and consider factors of social sciences. In addition, environmental decision-makers may have the misperception that social science approaches are mere common sense [19], which can delegitimize the contributions of many stakeholders.

4.2. Uncertainty within Decision-Making

Within environmental decision-making, participants and stakeholders inevitably face issues of future uncertainty due to miscommunication in the planning stages [21]. Scientists and engineers need to continually reduce and mitigate the risks of uncertainty caused by non-scientific factors [22]. Howarth and Monasterolo [21] argued for dealing with mixed issues and incorporated various values, such as both social factors and scientific knowledge, that can give rise to potential uncertain risk. In this sense, it is important to manage and mitigate uncertain risks [22]. In addition, the authors of [22] suggested that stakeholders or decision-makers pay attention to communicative networks and participatory culture in order to better control the risks of uncertainty (such as social conflicts and disharmony resulting from a lopsided decision-making culture led by scientists) [19,21,22]. Hence, it is critical to acknowledge that open communication among participants may decrease the level of uncertain risks when handling differing perceptions about environmental change [22].

The concept of "muddling through" was developed to cope with the intractability of decision-making within a rational model oriented around scientific information by the authors of [19,23]. The present science-oriented system of environmental decision-making has been mostly evaluated by a cost–benefit analysis that the natural scientists prefer [24]. However, this cost–benefit analysis does not and cannot always control and manage the unintended antagonistic relationship among the decision-makers [19]. These authors of [19] suggested building a structure of decision-making in which decision-makers' diverse values can be combined and integrated to identify both scientific and non-scientific objectives while utilizing a wide range of knowledge.

In addition, environmental decision-makers are frequently prone to strongly insist upon their individual interests and values, based on efficiency and effectiveness, in applying various types of information and data in the decision-making process. This is because the groups of stakeholders and decision-makers are often composed of natural scientists and environmental engineers in order to reduce risks [25].

In environmental decision-making, individuals often compromise their own values in favor of those pursued by a group [26]. In terms of ethical decision-making, participants often seek both the right value and efficiency. Because of this, individuals in the group consider whether their organizational decisions are ethical or rational. When group dynamics are an increasingly vital measure of organizational success and regulations or standards regarding decisions are meticulously considered in regard to the context of profit and integrity, it is imperative that the group conceptualizes the impact of their decisions. However, the efficiency issue may be a priority in fields such as stream restoration, which is occupied and controlled by scientists and engineers.

Ostrom [27] and Hong et al. [28] urged for strategies that embrace both natural and social scientific factors. Environmental decision-making faces ongoing complex issues resulting from a lack of democratic procedure. The issues cannot always be expected, estimated, or prevented by the scientific knowledge held by the decision-makers.

5. Moving Beyond Conventional Technology-Dominated Approaches

Recently, researchers in multiple disciplines have found that some governmental policies based on decisions by engineers and scientists may accelerate resource destruction without appropriately integrating other intellectual disciplines. On the other hand, consumers with diverse knowledge through their cultural and social experiences make an effort to accomplish sustainable natural resource management [29]. In other words, lay users might have more sustainable ideas on natural resource management, but governmental policies might not accept the idea of individuals challenging governmental regulations. This difference can cause the unbalanced management of natural resources and social fragmentation due to conflicts among stakeholders.

To establish a better decision-making process for stream restoration, definitions of stream restoration should be identified before considering how one designs frameworks to link scientific information to social contexts. Some researchers have been studying the concept of stream restoration to be in a better position to understand how to make a healthier water environment and a more efficient water distribution system.

Additionally, a wide range of vaguely defined goals and interests makes it difficult to define a successful model of efficient stream restoration due to different intentions for the streams. Due to these issues, the stream restoration movement has become a broad grassroots movement and a new focus for local ecological restoration that integrates social mechanisms [30–33]. Those researchers have also argued for highlighting the use of connectivity, feedback, and resiliency between the social and ecological mechanisms of a stream for sustainable and long-lasting decision-making. Gregory and Wellman [34] argued for using scientific ecological knowledge, reflecting social values of various stakeholders, and accepting the precise economic valuation of stream restoration into the policy decision-making in order to establish successful stream restoration governance. More simply, the responsible allocation of resources in streams can be managed from the bottom–up based on local social values in addition to strictly ecological values. The grassroots movements in resource management could be indicators of the need for both ecological and social values in stream restoration. Thus, restoring streams means aligning conservation interests with those of the community, including stakeholders and residents in the stream's revitalization. This balanced stream restoration process provides a method for conserving and utilizing social elements for efficient water resource management in neighborhoods at the local scale. In particular, streams in urban areas have been contaminated due to human activities in the surrounding areas and in the streams themselves.

Interactive methods with stream restoration stakeholders can be helpful tools to continually assess the quality of community support for a stream. The main concepts from interactive disciplines, such as eco-hydrology (Figure 1), are future-oriented keys for this integrated framework of stream restoration.

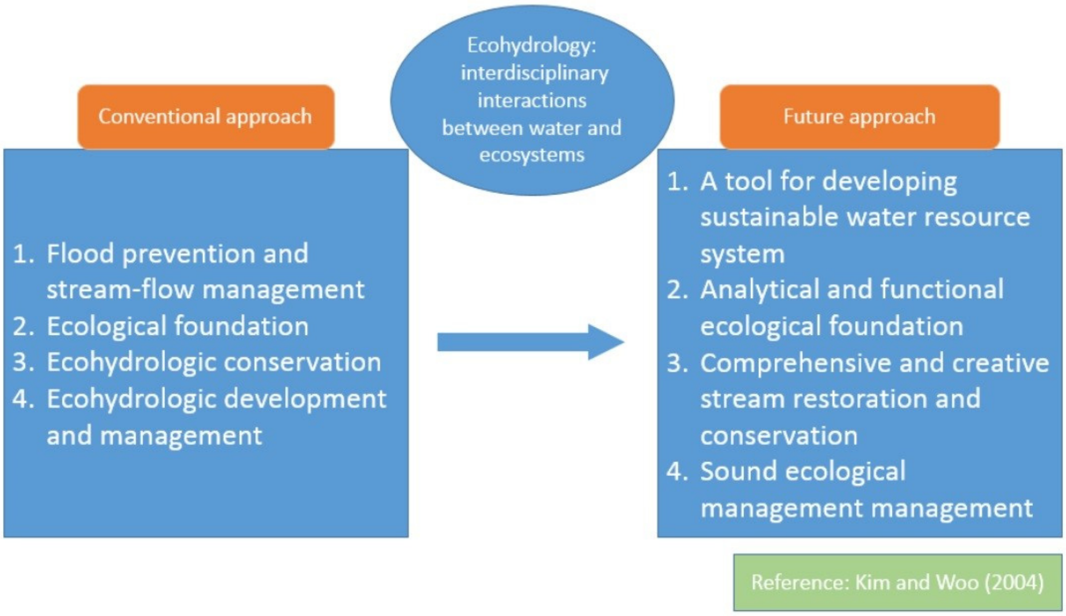

Figure 1. Paradigm shift under conceptual model of eco-hydrology.

Ecological restoration-oriented projects have had various social and cultural elements. However, they have also had cultural problems even though they have achieved successful results.

6. Planning and Stream Restoration

Planning is a professional field that seeks not only to manage the current strategy but also to set up a framework for managing the long term strategy. In addition, planning addresses both the biophysical aspects and the social structures and relationships needed to make and sustain change. Planning theory includes a strong theoretical foundation of practical and readily available principles about the social systems established by human activities. A planner is a professional who works in the field of urban and regional planning for the purpose of optimizing the effectiveness of a community's infrastructure.

Hoch [35] argued that understanding and adopting various planning models helps to seek possible solutions in anticipating and dealing with uncertainties. In particular, he mentioned comparing the characteristics of different planning models as being beneficial to reducing social, political, and scientific miscalculations. Technical analysis, the value of including non-scientific information, and the participation of non-expert stakeholders and underrepresented decision-makers all work together to help achieve water management goals.

Sevaly [36] defined planning as the process of making places better or making decisions by listening to underrepresented voices, compensating for market failures, and adapting to economic, social, and political changes. In this interactive and complicated planning paradigm, many planners and planning scholars have studied various approaches in their efforts to anticipate, cope, and reduce uncertainties.

Collaborative planning allows for equal voices to those groups who have not historically been able to affect the process [28,37,38]. Communicative action theory looks at the process of cognitive exchange through social learning [39,40]. Collaborative planning, a more inclusive decision-making approach, embraces various values including socio-cultural importance in stream restoration, that is, inclusive decision-making sets forth steps for handling uncertainty that science-based approaches cannot predict by themselves.

Innes and Booher [41] explained that due to the complexity and rapid changes inherent in decision-making, there is a need for increased shared awareness within the existing structure of decision-making. This rising awareness may contribute to highlighting the need to consider and prepare for future uncertainties. The authors of [41] compared collaborative rationality with existing instrumental rationality. In a society that has become more culturally and politically diverse, decision makers are prone to be called on to deal with a wide range of different values, interests, and perspectives of the public to meet both rationalities [41,42].

In environmental planning, collaborative rationality rebuts the reliance on instrumental rationality as coping with uncertainty in any issues and assumes that all decisions are justified by procedure-oriented, multiparty negotiation [41,42]. During the decision-making process that utilizes the collaborative rationality model, efficiency and effectiveness are not the only necessary conditions to consider. Evaluating possible alternatives is also necessary because it can offset risks that result from uncertainty by selecting better alternatives through interdependent engagement among the stakeholders. According to Innes and Booher [41] and Susskind [42], such decision-making processes based on collaborative rationality help to not only to seek new and better ways to move forward but also to stimulate collective decision-making when facing inevitable new challenges.

Complexity in environmental decision-making can be reduced when individual stakeholders interact dynamically by sharing and exchanging relevant information for mutually agreed-upon outcomes [42]. In negotiation among stakeholders, interdependence between all parties should be considered. The complex interplay of different interests held by stakeholders can amplify the possibility of deterministic collaboration in terms of procedural rationality.

The field of planning theory has been the bridge between social systems and engineering technologies in many environmental decision-making processes [43]. In addition, Reed [30] noted that participatory processes and interdependence emphasized in collaborative planning can lead to strong and durable decisions in finding common interests and embracing different values from both social and ecological systems. Consequently, a collaborative approach is one of the most useful and workable models for sustainable decision-making in environmental issues.

6.1. The Role of Power in Making Decisions about Stream Restoration and Understanding Planning Paradigms in Stream Restoration

Power in rational planning is assumed to be centralized in agencies placed at high levels where decisions are made—a top–down paradigm because power can serve as an obstacle to democratic consensus building [44]. To overcome inequitable power, Smith [45] urged the use of professionally trained mediators. In planning, a mediator refers to a person whose job is to help resolve a disagreement or power imbalances among decision makers.

Under the collaborative planning model, the concept of power is quite less concentrated. In this respect, collaborative planning can be an alternative to top–down centralized decision-making in favor of consensus-building among diverse stakeholders with varying degrees and types of power. Healey [46] noted the benefits of communication between competing actors so that everyone can understand each other's interests.

This collaborative planning is a discourse-oriented model based on communicative action and communicative rationality models [47]. The collaborative planning model has become a popular concept among urban planning researchers in the attempt to reduce uncertainties in both practice and ideology by building diverse institutional relationships around environmental issues [47,48]. In other words, the discourse based on communicative rationality exists to maximize deliberation while resolving conflicts and planning for uncertainty. There is a link between this communicative rationality and inter-subject reasoning. The collaborative planning model can be reflected with discursive democracy [44] and emancipatory communicative rationality, as defined as the medium of power and the method of critique to attain freedom and autonomy [38] in building interdependence among individuals. As stakeholders from varying backgrounds negotiate and share information, conflicts can be minimized.

Collaborative planning is strongly associated with negotiation theory because stakeholders in the planning process can find clear solutions based on mutual consent through successful interest-based or principled negotiation [49,50]. Negotiating is a valuable tool in reaching solutions in environmental debates among stakeholders because it can solve and cope with miscommunications in decision-making over disputes [51].

As stakeholders in stream restoration share their own interests, collaborators can discuss issues of fairness and efficiency [52]. Open discussions among stakeholders can overcome differences between technocratic and social values so that all participants can concentrate on feasibility. A successful and wise resolution that reflects various opinions requires good faith collaboration to avoid manipulation and distortion by some experts. Obtaining a decision that does not neglect any individual opinions emphasizes procedural fairness, efficiency, and feasibility [52].

Collaborative planning is treated as a structure based on equal opportunity that aims to neutralize power among actors [46]. However, power relations are not equalized simply by virtue of the process being labeled "collaborative" [53], and planners are called upon to facilitate communication and interaction with diverse interest groups and stakeholders [47,54]. Interaction or discussion can resolve and mediate conflicts by recognizing an uneven distribution of power [55]. Moreover, planners have the duty to help quarrelling decision makers find solutions for conflicts [56]. Planners think that mediators do not have the power to make a decision in the planning process. As a matter of fact, they do have power in the decision-making process because they are involved in fostering communication and they influence the stakeholders during democratic deliberation. Hence, planners and mediators alike possess power in mediating conflicts. However, whether they use it or not is an open question.

6.2. Power in Collaborative Planning

The definition of power may be elusive because power has different meanings depending on the context and the people involved [41]. Bryson and Crosby [57] argued that power is a leveraging tool that can enable individuals and groups occupying certain positions to engage in the decision-making process. This suggests the existence of tacit power in the background, such as when decisions have economic and political dimensions, or an institutionalized religious structure.

According to Galbraith [58], secular power consists of three types—condign, compensatory, and conditioned power. Galbraith [58] stated that individuals and groups seek power to advance their own pecuniary interests and values, such as budget allocation and financial compensation in social relationships. "Condign power wins submission by inflicting or threatening appropriately adverse consequences. Compensatory power, in contrast, wins submission by the offer of affirmative reward—by giving something of value to the individual so submitting. In addition, conditioned power, by contrast, is exercised by changing belief." [58] In this type of research, both conditioned power and compensatory power are typical concepts used to address power relations among stakeholders in environmental decision-making processes.

In environmental decision-making, decision-makers' approach to power distribution is influenced by their backgrounds, such as individual personality, property, and affiliated groups. Galbraith [58] depicted three sources of power: personality, property, and organizations. Some organizations can exert condign power. For example, the government can exert legal punishments. Galbraith addressed factors that influence the power of organizations and their purposes. In other words, if there are various purposes of an organization, the power of the organization will be greater. For instance, corporations are organizations that primarily possess property and, hence, compensatory power, but they extend this power to conditioned power through public relations, advertising, and political lobbying. Planners' expertise or knowledge influences negotiations and decision-making under the instrument of conditioned power described by Galbraith [58].

Innes and Booher [59] argued that power in a network is a jointly held resource that enables networked organizations or individuals to accomplish things they could not individually achieve (and that the responsibility of a planner or mediator is to facilitate this information sharing). Giddens [60] contributed to research on this network power by understanding the structure as a boundary of power. Addressing the function of the structure, he argued three types of power: the power of action, the power of ideas, and the power of deep structure. These types of power shape network power overall, because the ideas and actions of each stakeholder influence the network (the structure) [59]. In Galbraith's perspective, this power can be defined as conditioned power through exchanging information [58]. For example, environmental negotiation cases such as water resource management often include structured, shared, and agreed-upon information on water data as the power of ideas in a conditioned format within mutual interactions like negotiations. In this conditioned format of water data, hydrologists and engineers examine the water pollution standards that can control human activities in a river basin.

The most important aspect of network power is the ability of networked organizations to improve the choices available to all stakeholders as a result of collectively developed innovative ideas [59]. Network power among cooperative stakeholders can be considered the most democratic and equitable form of power, requiring the inclusion of all stakeholders and openness to social learning and cognitive politics [59]. The strengthening of network power through trust-building may both inspire and provide the motivation for networking coalitions to engage in more complex governing and planning agendas as civic capacity and social capital grow. Network power can create governance in a practical way. This governance is about fostering inclusiveness and open dialogue with various stakeholders [40].

There are sometimes preconditions for network power: diversity and interdependence [59]. Diversity is a mandatory element of network structure because it provides various resources for building network-creating conditions and solutions. For instance, the wide range of life experiences, interests, values, knowledge, and resources in society creates challenges for planning and impedes efforts to reach an agreement and finally act [59]. However, diversity is a prerequisite for organizational strength because it enables consensus building regarding common perspectives and resource allocation [61].

Interdependence based on self-interest and reciprocity among diverse participants fuels network power [59]. Interdependence means that each organization needs something from the others. According to Innes and Booher [62], the condition of interdependence holds that agents must depend, to a significant degree, on each other organization in a reciprocal way. Reciprocity operates on the basis of trust [62]. The existence of trust and reciprocity, in turn, means organizations will have a reason to continue to work together. This helps assure that participants will maintain the interest and energy to engage with each other throughout the process, as well as have an incentive to reach an agreement [63]. Negotiation theory notes that interdependence among diverse interests is key to creative mutual gain [62]. This interdependence means that stakeholders cannot reach their objectives alone. Interdependence makes this dynamic possible and keeps the stakeholders at the table.

6.3. Collaborative Planning Methods to Mitigate Conventional Sources of Power

As noted earlier, multiple forms of power are wielded in a collaborative planning process. Stakeholders of environmental conflicts can vary considerably in terms of the power they exercise; advocacy groups with limited resources often oppose corporate interests with nearly unlimited resources [64]. Amy [65] explained how these power imbalances can result in systematic biases that threaten the fairness of the procedure and outcomes. For instance, unequal access, sweetheart deals, a lack of technical expertise, and quasi-forced participation can all defy collaboration, achieving consensus, and forging lasting agreements [66]. Reed [30] stated that stakeholder participation can promote empowerment, equity, trust, knowledge distribution, and social learning in environmental issues.

Planners as conveners (a trained mediating person who arranges meetings among stakeholders) or mediators also exercise power through the administration of rules, the utilization of legitimate discretionary power, and the creation of a political culture surrounding planning. This legitimate discretionary power and the culture of planning influence how power relations are defined and shaped. Benveniste [14] argued that professional planners are obliged to play a political role in the planning process by modifying and justifying political power relations among stakeholders, as well as fairly sharing technical information. Thus, planners must appropriately consider political realities while addressing technical information.

Though mediators cannot be perfect protectors for conflicting stakeholders, they can design procedures and techniques to address some of these power imbalances [66,67]. One such technique is "joint fact-finding," which aims to transform the use of scientific and technical expertise from a weapon in an adversarial setting into a tool for consensus [68–70]. Joint-fact-finding may provide a venue to share sound scientific information in a power-neutral manner for stakeholders [68]. In particular, power imbalances due to gaps in technical information and scientific uncertainty may be balanced by offering joint-fact-finding [69]. However, in cases with severe power imbalances and disparities in access to relevant expertise among the stakeholders, joint-fact-finding may not be appropriate if conditions cannot be easily adjusted due to some powerful parties' oligopolistic occupation [71].

Joint-fact-finding can often assist both professional and non-professional stakeholders to craft agreements about scientific issues through joint determination and a well-organized information gathering and analysis process [71]. In this joint-fact-finding, the roles of a mediator [67] merge technocratic and social knowledge in the decision-making process of stream restoration. In stream restoration, joint-fact-finding could include a convener (trained mediators) to assist in the identification of the stakeholders and to enhance consensus-building dialogue among the stakeholders [68].

According to Schultz [72] and Herman et al. [68], there are several principles to meet for a joint-fact-finding process to be effective. First, representation is essential in forming a decision-making system. All of the stakeholders have to be included in framing and sharing the issue of the decision-making process, as well as working together to discuss, debate, and research the facts by strategic communication [68,70]. Second, a neutral professional expert is selected and invited to the decision-making process through ongoing conversations about the implications by the participants [68]. Lastly, the convener agrees to accept a written statement from the participants and pledges to be responsible [68]. In other words, the convener ties participants under a written agreement to follow the mutual consensus in evaluating and analyzing specific scientific information and knowledge. In addition, professional expertise should be shared with all parties in the planning process through ongoing monitoring and data collection led by trained experts [67]. These three characteristics can test if a stream restoration case includes an appropriate format of joint-fact-finding.

McCreary et al. [73] explained common points of success in joint-fact-finding. First, the mediation team has to aim to produce new findings. Second, it has to distinguish the goals of the joint-fact-finding process from other efforts. Third, experts in the team have to evaluate the consequences of policy choices regarding scientific issues. Lastly, when dealing with technology, experts should present their findings and jointly agree on the synthesis of scientific information in public.

Ozawa [70] found that uncontrolled scientific uncertainty, complexity, and disagreement can aggravate existing conflicts among stakeholders. Thus, technocratic environmental planning cases should be approached with careful negotiation and a well-organized facilitation plan in dealing with and using the scientific data.

7. Environmental Planning Paradigm Evolution of South Korea

The planning theories of Western society have influenced South Korean planners, both theoretically and in practice [74]. Since the 1960s, after the devastation of the Korean War, South Korea's planning has focused on economic development [75]. President Jeong-Hee Park implemented strong policies on regional development based on conventional rational planning concepts. Most Korean public officials have studied engineering and other applied sciences [76]. In South Korea, planning is directed toward improving industrial exports. However, this creates disputes between urban and rural settings, managers and workers, and income levels [75].

South Korea has a different planning background than the United States and has carried out radical changes based on globalization in rational planning [75]. In 1962, President Park's regime established the Law of Urban Planning, which originated in the Japanese Urban Planning System under the Japanese Government-General of Korea [77,78]. Many urban planners and engineers went to Japanese institutions to learn and experience engineering-oriented urban development and regional planning. The Tokyo Urban Comprehensive Development Plan acted as a textbook for urban engineers in the Department of Construction at the time [74]. Thus, most Korean cities built during the 1960s and 1970s are similar to those built under the Japanese urban system [74,77].

During the 1960s, the urban concentration of populations and lack of infrastructure systems were a major focus of Korean urban planners [74]. To carry out zoning, land-use reform, and improvement of transportation infrastructure, the Korean government amended the Law of Urban Planning in 1972 [79]. With the Sae-Mah-Eul movement, urban and regional planning was designed to cope with the issue of uneven national development. This national development focused on the major cities under a national master plan. The radical industrialization-focused uneven development patterns initiated by South Korean leadership involved a top–down regional development plan that was a typical example of a rational planning model and was based on Korea's need for rapid industrialization [76]. Most urban planners were urban engineers or civil engineers, and this trend noticeably influenced the watershed planning of Korea [74].

In 1971, President Park established the Plan of Four Major Rivers Comprehensive Development. Under this plan, new multipurpose dams in river basins were constructed [80]. In 1972, the Korean government created the green belt outskirts of Seoul, which is similar to the urban growth boundary of Portland, Oregon. During the 1970s and 1980s, the Korean Central Government planned for many new towns and cities to redistribute the congested populations of urban areas thanks to loosening restrictions of the green belt [80]. As part of this trend, the Korean Water Resources Corporation planned dams and reservoirs to provide affordable water for the cities. The civil engineers of the government and the Korean Water Resources Corporation designed plans for dam construction that were based on a top–down, centralized, and rational model. Unfortunately, this model brought about environmental disputes and social conflicts during the 1990s [79].

In the 1990s, as Korean institutional changes moved toward more localized political decision-making influence, changes were implemented through government reform that allowed for public participation in planning. Local economies began experiencing turbulence that increased citizen awareness. This caused people to begin considering a more democratic decision-making process in urban and regional planning [80]. Citizen awareness and social circumstances thus sparked the evolution of the planning field. Today, collaborative planning models are commonly adopted among public administrators in South Korea [81].

Environmental laws like the Law of Urban Planning were amended to incorporate collaborative and participatory decision-making in environmental and green regional development [82]. In 2003, President Roh established regulations including participatory and bottom–up planning for effective river basin management [83]. These new regulations stated that river basin management committees should involve local residents and local governments, as well as non-governmental organizations (NGOs) [81]. However, there continues to be dissonance among stakeholders because urban engineers design most watershed plans [83].

In addressing the similarities and differences between the planning institutions and practices of South Korea and the United States, it is meaningful to compare the degree of public participation and centralization to functional rationality based on scientific efficiency and effectiveness. Understanding the flow of information and available resources helps us determine whether planning is goal- or process-oriented, as Mannheim [84] distinguished functional rationality with substantial rationality. Korean environmental planning appears to rely on functional rationality more than the United States.

However, in the environmental planning of the United States and South Korea, there are many similarities in regulations and citizen awareness due to well-organized social capital (networks).

As is the case in most of the world, what is legislated often differs from implementation [85]. Even though South Korean laws and regulations require participatory decision making, water management strategies continue to be designed and planned by civil engineers and hydrologists. [81]. These technological scholars and professionals rely on centralization and use technical jargon when they communicate with ordinary stakeholders. For instance, this can be seen in the use of integrated water resource management (IWRM) with the four major rivers of Korea. The integrated water resource management process can be defined as a procedure that promotes the coordinated conservation and management of water, land, and related resources in order to maximize the resultant economic and social welfare in an equitable manner [86].

> "South Korea is reforming its water policy by adopting a new water paradigm, which is required by changes in political, economic, and social environments since the 1960s. The reforms were also influenced by global opinions about water management and the environment. The water development ideology of South Korea must be adapted to sustainable development and reflect the changing paradigm from water development to water management. The new water paradigm must support needs for water supply, pollution control, flood control, and other purposes of water management, and [it must] be characterized by best practices in the basin-wide approach, integrated management, and sustainable development." [86]

According to Park and Grigg [86], the model of Korean IWRM is mostly designed by a central organization, the Korea Water Resources Corporation. Many citizens recognize the importance of both environmental conservation and political democratization in Korea [87]. Meanwhile, IWRM represents a typical Korean-styled approach to stream renovation using only modern technologies against the interests of the people. The announcement of IWRM by the Korean Water Resource Corporation included a statement about the importance of public participation and cooperation with stakeholders [88]. However, in reality, civil engineers have been at the forefront of IWRM and have tended to favor technology in planning and implementing most stream restoration projects [83,87]. This has skewed the stream restoration process in favor of engineering technologies [87].

The engineer-oriented structure drove decision-making processes from the top down [83,86]. Additionally, the Water Resources Corporation is the only organization in charge of water resources in Korea. The citizen stakeholders could not have appropriate information and could not have fair participation in stream restoration decision making under Korean IWRM because the dominant participants were scientists or engineers [83]. In Korea, engineers and economists have been playing the most important role until now [86]. Social scientists and NGOs have participated in the decision-making of water resource management to satisfy "public acceptance" since the late 1990s (Table 1). However, the Korean water resources management mechanism is still evaluated as a rational model reliant on scientific information [89].

In the United States, water resource planning cases based upon both top–down and bottom–up models have often been discussed and examined in its history. Regional development and transportation masterplan projects in the United States were actively designed and planned under rational planning models from the 1930s until the 1950s. In this period, integrated river basin management was introduced under the supervision of the federal government [90].

However, due to water contamination issues, planners and engineers changed the water resource management model to local watershed planning based upon localized governance [90,91]. "Multi-disciplinary participation in water policy has been common in the United States since the late 1960s because public acceptance became the main factor to justify the water resource management project." [86]. IWRM has also been used in the United States; however, this form of IWRM is completely planned and designed through local collaborative governance [91].

Many different stakeholders participate in a local institutional system [92]. Many water resource management strategies have been maintained and monitored by local people who want to improve their rivers [91]. Though conflicts may arise, they are willing compromise in order to be involved with decentralized and participatory planning with their neighbors [93]. Moreover, various methods of public meetings can be arranged, designed, and planned to provide appropriate information and resources to stakeholders.

Table 1. Major key decision-makers in water resource management (U.S. vs. Korea).

Period	United States	South Korea
Before 1970s	Engineers and economists	Engineers
1970s	Engineers, economists, and *environmentalists*	
1980s	Engineers, economists, environmentalists, and *social scientists*	Engineers and *economists*
Early 1990s	Engineers, economists, environmentalists, social scientists, and *affected stakeholders*	Engineers, economists, and *environmental scientists*
Mid 1990s		Engineers, economists, environmental scientists, and affected stakeholders
Late 1990s	Engineers, economists, environmentalists, social scientists, affected stakeholders, and NGOs	Engineers, economists, Environmental scientists, affected stakeholders, *NGOs*, and *social scientists*
Early 2000s	Engineers, economists, environmentalists, social scientists, affected stakeholders, NGOs, and *public "acceptance"*	Engineers, economists, Environmental scientists, affected stakeholders, NGOs and social scientists, and *public "acceptance"*

Source: [86,94]. Note: Newly added participants are denoted in italic font.

More recently, in South Korea, many have become familiar with a bottom–up, participatory, and decentralized method; however, in practice, their management of water resources still indicates the typical traits of conventional planning [81,89]. The Cheong-Gye stream in Seoul is a good example of this top–down method of stream restoration without appropriate and sustainable partnerships with stakeholders [95]. Additionally, local politicians in Korea are prone to use this issue for their political purposes. These issues hinder solutions to Korea's water management challenges. There have not been many studies on the relationship between democratic decision-making processes and stream restoration in Korea [81].

8. Conclusions

This research established a theoretical foundation for linking the systems of social and ecological factors to the study of stream restoration. Changing perspectives on stream restoration were demonstrated by a trend from a single bio-physical focus to a focus on the roles of human users and institutional factors. Moreover, this research reviewed the planning literature to suggest how planners who act as the bridge between public agencies and residents, experts, laypersons, and long-term planning can potentially help shape the dynamics of interactions in urban stream restoration.

In addition, this research discussed the Korean restoration planning literature to help the reader understand how planners (urban engineers and public administrators) typically view the dynamics of decision-making processes in environmental management. Despite complexity arising from traditional planning disciplines, this research project could theoretically address how to handle political evolution towards a more resident-oriented participation model in stream restoration.

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