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Development of a Social Impact Assessment for the Water Environment: A Professional Perspective

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Abstract: Climate change and population growth are increasing the frequency of flooding and drought, resulting in conflict over water resources. Social impact assessments (SIA) of the allocation and management of water resources provide a way of reducing and resolving such conflicts. This article first explores the nature of SIA for water environments through an inductive analysis of the cases mentioned in more than 30 papers. Next, it identifies important advantages of SIA over integrated water resources management (IWRM) practices and indicates that while IWRM solves water-related issues to improve social well-being, it cannot entirely grasp the overall social impact of planned interventions. Following this, it analyzes the water environment governance structures in Taiwan, using questionnaire responses from water environment management professionals to discuss challenges of effectively implementing water environment SIA. The questionnaire covers 26 detailed tasks of SIA advocated by Vanclay et al. This research is the first to have evaluated the difficulty of the tasks. The survey results can be used as a reference for the implementation of SIA in other regions. The results show that (1) the water environment SIA is indeed necessary; (2) Taiwan's water environment professionals need to improve from their current lack of understanding of SIA; (3) it is difficult to implement the water environment SIA; (4) it is necessary for SIA to clarify and integrate the authorities and responsibilities of relevant government departments; (5) the professionals believe the myth of quantification of SIA; and (6) water environment SIA must be integrated with the existing IWRM. Finally, we emphasize the need to integrate SIA and IWRM in a mutually complementary way, and illuminate the need for an integrated SIA framework for water environment management.

Keywords: water environment; social impact assessment (SIA); governance; integrated water resources management (IWRM); Taiwan

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Citation: Lee, C.-C.; Huang, K.-C.; Kuo, S.-Y.; Cheng, C.-K.; Tung, C.-P.; Liu, T.-M. Development of a Social Impact Assessment for the Water Environment: A Professional Perspective. *Water* **2021**, *13*, 3355. https://doi.org/10.3390/w13233355

Academic Editors: David Katz and Nidhi Nagabhatla

Received: 12 November 2021
Accepted: 23 November 2021
Published: 26 November 2021

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1. Introduction

Approximately 70% of the Earth's surface is covered by water, which is essential to the continuation of all life on Earth. The water environment includes all surface and subterranean bodies of water, containing more than 97% salt water and less than 3% fresh water, along with their surrounding physical environments and ecosystems, e.g., riverbanks, coastlines, etc. [1–4]. Researchers in many fields including hydrology, water resource management, ecology, agriculture, hydraulic engineering, meteorology, environmental engineering, and environmental sciences use the hydrological cycle to understand and

explore mechanisms of water movement to better assess variations in distribution over time and space, and thus evaluate the impact of such variations on the natural environment, ecosystems and human communities [5–8]. Therefore, the interaction between the water environment and many fields is an important focus of cross-sectoral/interdisciplinary research topics. For example, the research on water–energy–food (WEF) nexus, which has flourished in recent years, explores the complex causal relationships between the three to seek their sustainable use (as key resources) [9–20]. However, resources (or the disasters they might cause) often induce conflicts due to allocation and availability issues, such as water conflicts. Because of the connectivity of water, it often leads to the problem of transboundary water governance/management between neighboring countries, the so-called hydropolitics [21–37].

The modern concept of the social impact assessment (SIA) was initially developed in the late 1960s as a result of the United States' National Environmental Policy Act (NEPA) regulations, which requires environmental impact assessments (EIA) of planned interventions on human society. SIA was first used to assess the social impact of dam projects; however, its application has since expanded to include electricity generation projects, water resource management and mineral extraction. Today, SIA is widely used in a broad range of development activities including tourism development, and the construction of (nuclear) power plants, airports, roads, bridges, and tunnels [38–43].

Adjacent water bodies are linked and interact in terms of volume and quality, and are impacted by their surrounding physical environments and ecosystems (e.g., river flow through an estuary will impact the coastline and the broader ecological environment). This interaction requires discussions of water-related issues to adopt the perspective of a larger water environment, leading to the development of conceptual tools such as integrated water resources management (IWRM) [44–49], integrated water management (IWM) [50–53], integrated watershed management (IWSM) [54–56], integrated river basin management (IRBM) [57–60], integrated catchment management (ICM) [61–64] and integrated coastal zone management (ICZM) [65–69]. The development of modern SIA practices has evolved over more than 50 years to reflect this holistic approach, and reference water environments for the construction of dams and hydroelectric power generation facilities [70–79], water resource management [80–85], water quality [86,87], rivers [88–90], flooding [38,91], coasts [92–95], wetlands [96–98], and water policies [99].

Water environment governance in Taiwan has for a long time depended mainly on IWRM-related concepts [100–102]; however, this approach is prone to overlooking the social issues involved in water environment development, which can lead to contentious disputes. Taiwan first instituted EIA requirements in 1994. Although the required practices include some SIA components, they are largely formalities with little impact. Satisfactory EIA results are required for development permits, and hence the EIA procedure is characterized by conflict among stakeholders including developers, government regulators, environmental protection groups, and academic researchers. This process is time- and resource-intensive, and damages social cohesion. Recent examples of contentious water environment-related EIA projects include the Central Taiwan Science Park Phase IV project and the Taitung Miramar Resort. The former required the diversion of huge amounts of water from agriculture, along with discharge of industrial wastewater into the Zhuoshui River, the longest river in Taiwan, along with potential land expropriation that would require evictions of current residents, triggering protests and litigation running from 2008–2018 (https://e-info.org.tw/node/215983 (accessed on 17 November 2021); https://e-info.org.tw/node/211761 (accessed on 17 November 2021)). The latter project as a BOT (build-operate-transfer) project pairing the Taitung County Government with private developers to build a large-scale resort hotel on the only sandy shore in eastern Taiwan, an area central to the daily life of local indigenous residents (https://e-info.org.tw/taxonomy/term/18113 (accessed on 17 November 2021)). SIA has been shown to be effective in clarifying and resolving social conflicts [103], and its value and necessity for implementation have increasingly been recognized in Taiwan.

Although SIA has obtained successful experience in many cases, the general characteristics of its application on water environment has not yet been discussed. Furthermore, while IWRM and its related concepts (IWM, IWSM, IRBM, ICM and ICZM) have been generally regarded as having the social function of promoting the well-being of residents and other stakeholders, what is the difference between IWRM and SIA? What are the flaws of IWRM? Can it completely replace SIA? There has never been a clear answer to the questions from researchers. All the unfinished points and questions will be elaborated in this article. In addition, most regions in the world have first experienced the application of IWRM-related concepts to achieve water environment governance, and then successively implemented water environment SIA. Taiwan is no exception. We used convenience sampling to invite one hundred water environment professionals to fill out the questionnaire. Their responses can be used as a research case for water environment governance towards water environment SIA in other regions. Additionally, since the questionnaire includes the most meticulous and rigorous 26 tasks in the 4 phases of SIA practice proposed by Vanclay et al. [104], we can understand the difficulty of each task for water environment professionals, which is beneficial to researchers and decision-making to overcome obstacles achieving a nexus of research and policy.

The rest of this article first introduces the research methods and analyzes the general nature of water environment SIA and compares it with IWRM to demonstrate its particular importance. After, it discusses Taiwan's water environment governance practices and provides an overview of impact assessment (EIA and SIA). Finally, it presents an investigation of water environment professionals' views on Taiwan's implementation of water environment SIA.

2. Research Methods

This research identifies the general nature of water environment SIA by inductively analyzing the cases in 31 papers [38,70–99] and clarifies the necessity of SIA by comparing with IWRM (Section 3). After, it introduces Taiwan's water environment governance and current status of impact assessment (Section 4). Finally, an online questionnaire was used to consult one hundred Taiwanese water environment professionals (via convenience sampling) about their intentions of implementing water environment SIA (Section 5).

2.1. Questionnaire Design

To understand the perceptions of water environment professionals on SIA, this study designed a questionnaire combining general and advanced questions (see Table A1). The questionnaire begins with seven general questions about the respondent's awareness of SIA and its meaning and function, whether SIA of Taiwan's water environment is necessary, its particular needs, difficulty of implementation, obstacles, and implementation. Advanced questions focus on actual SIA implementation challenges, and include 26 items on the four SIA phases taken from *Social Impact Assessment: Guidance for Assessing and Managing the Social Impacts of Projects* published by the International Association for Impact Assessment (IAIA) [104].

2.2. Questionnaire Distribution and Collection

A link to a Google Forms-based questionnaire was emailed to water environment professionals, including central government competent authorities related to water environment governance, academic research units, consulting companies, state-owned institutions, and NGOs (including professional associations and environmental groups). Invitations were sent from 15 June to 20 July 2021, and 100 completed questionnaires were collected from 16 June to 30 July of the same year.

2.3. Response Analysis

Respondents' affiliation included government agencies (27 government officials/civil servants from 7 institutions), academic research units (44 professors/researchers from

23 universities) and private firms (26 directors/managers/leaders/staff from 14 organizations), while three respondents were unwilling to disclose their employment affiliation. As shown in Figure 1, 29 respondents overall had never heard of SIA (29%)l however, relative percentages varied among government (33.3%), academic (27.3%) and industry (26.9%) respondents.

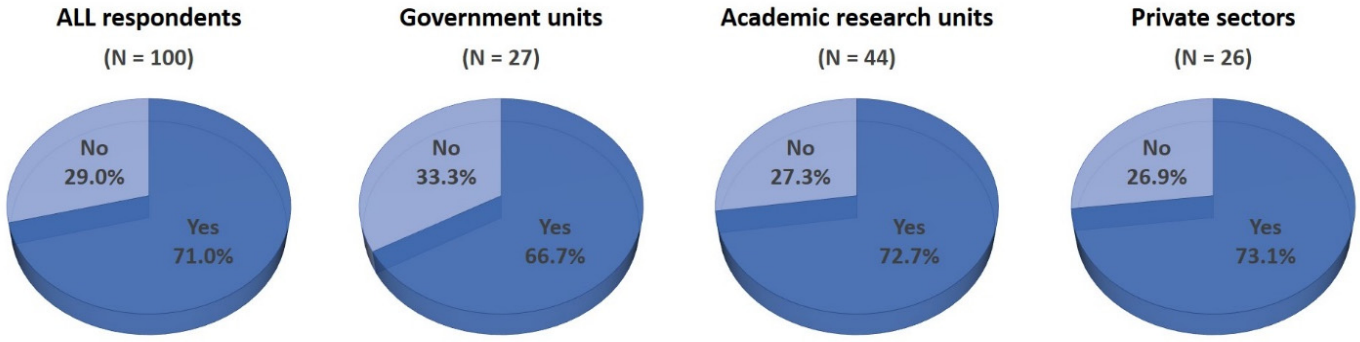


Figure 1. SIA awareness among water environment professionals. (Three respondents refused to disclose their affiliation.)

Responses were scored using a 5-point Likert scale ranging from "very necessary"/"very easy" (5) to "very unnecessary"/"very difficult" (1). SPSS statistical analysis software was used to perform one-way ANOVA, and Scheffe's method is selected for multiple comparisons to identify significant differences in mean responses between government, academic, and industry respondents. In addition to the quantitative analysis, this study qualitatively analyzed the results of the general open-ended questions to summarize the statements of respondents. The compilation process skips answers that are ambiguous, inconsistent in context, or off-topic (Section 5).

3. Water Environment SIA

3.1. General Characteristics

SIA has been widely applied to water environments for dam projects (including hydroelectric power generation facilities), water resource management (including water quality and water pollution), river management, flood management, coastal management, wetland conservation and formulation of policy directly or indirectly related to water environments. Of these, SIA for dam projects is among the most critical because such projects involve large-scale engineering construction, land acquisition, resettlement, and drastic environmental changes [70–79]. Water resource management focuses on the social impact of water allocation, and thus frequently ties into other areas, such as dam construction, river management, flood management, and wetland conservation [80–87]. River management SIA must consider entire river basins or watersheds, and thus also ties into other areas [88–90]. Flood management explores flooding disasters caused by extreme rainfall (exacerbated by climate change), and the social impact of floods can be analyzed in conjunction with the disaster management cycle (including mitigation, preparedness, response, and recovery) [38,91]. The introduction of SIA for coastal management (e.g., ICZM) [92–95] and wetland conservation [96–98] has also been demonstrated to have many benefits. Water policy-making has a clear impact on the water environment (for example, water pricing policies will affect the actual development of water resources) [99].

Generally, water environment SIA has the following three characteristics:

- It is used to assess the social impact of human interventions in solving water/water environment problems

For human society, the most important issues related to the water environment are water quantity and quality. Too much water can cause flooding, dam failures and sedimentation, while too little will cause drought (resulting in residential, industrial and agricultural water shortages), harm ecosystems, reduce groundwater levels and induce

seawater intrusion. Low water quality will endanger drinking water safety, damage fresh and saltwater ecosystems, and reduce the leisure value of lakes, rivers and beaches. Water quality and quantity problems are often addressed by large-scale engineering projects (e.g., dikes, pumping stations, reservoirs, sewage treatment plants, desalination plants, etc.), which inevitably have an impact on society, and thus require critical evaluation.

- It usually involves multiple water environment categories

Kirchherr and Charles [73] analyzed many historical dam project SIA cases and proposed the matrix framework shown in Figure 2. Dam construction is shown to be related to the categories water resources ("irrigation and water"), river management ("upstream" and "downstream") and flood management ("flood control"). Though it is not specified in the figure, dam projects are occasionally linked with wetland conservation and water policies.

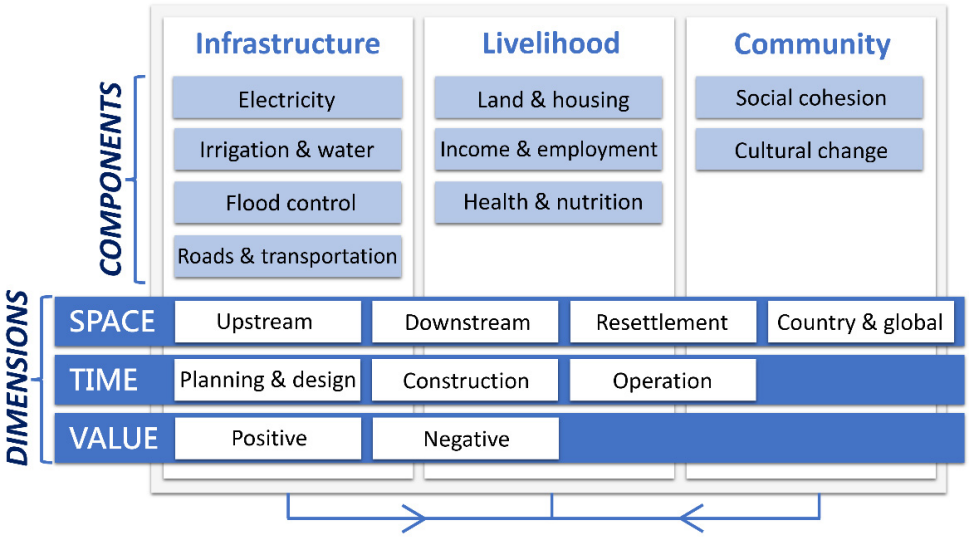


Figure 2. Matrix framework for social impacts of dam projects (Kirchherr and Charles [73]).

- It usually involves cross-sectoral issues

Water/water environment serves as a driving factor for floods, droughts, water pollution, sediment disasters (debris flow and sloping disasters), soil and water conservation, coastal erosion, ground subsidence caused by over extraction of groundwater, agricultural irrigation, hydroelectric power generation, and the water environment landscape, and also serves as a medium for waterborne disease (dysentery, cholera, etc.), and water heritage. Water/water environment also has an indirect impact on tourism, leisure and entertainment, employment, and right of residence. The severity or importance of the impact does not depend on whether it is direct or indirect, and local communities may attach greatest importance to indirect impacts. Therefore, water environment SIA largely has to deal with cross-sectoral issues. As shown in Figure 2, the SIA of dam projects is related to various components under "infrastructure", "livelihood", and "community", and it also covers the most important issue "resettlement".

3.2. Comparison of SIA and IWRM

Integrated solutions to water/water environment issues, such as IWRM, IWM, IWSM, IRBM, ICM and ICZM have been used for decades. These approaches overlap with each other to differing extents, and are more or less relevant to SIA. IWRM, which is strongly promoted by the United Nations, and which is likely the most widely used approach, is taken here as a subject of analysis for comparison with SIA. As shown in Table 1, while the popularity of IWRM has been increased by promotion from international organizations (e.g., UNESCO, UN-Water, Global Water Partnership, UNDP, UNEP, etc.), it is limited in

terms of environmental management for solving the water-related problems, such as lack of clean water and flooding. Even if IWRM accounts for a wide range of social issues (e.g., participation, gender, poverty, hunger, etc.), it still fails to comprehensively account for social concerns specific to water environment development. IWRM is designed to solve social problems and improve social welfare by solving water-related problems, rather than directly focusing on the social impact of the planned interventions. SIA was designed to address this shortcoming, though it still has quite a few challenges that need to be addressed (e.g., a lack of baseline or observational data, and difficulties in quantification and future predictions). The use of IWRM, which seeks to solve water-related issues to improve social welfare, might still result in highly negative outcomes to local residents and other stakeholders due to the lack of an assessment of a project's overall social impact.

Table 1. Comparison of SIA and IWRM.

Items	SIA [1]	IWRM [1]
Prevailing periods	1970s to present	Related concepts were mentioned as early as the 1930s, but were not widely discussed until after the 1990s.
Promoting units	IAIA, FAO, World Bank	UNESCO, UN-Water, Global Water Partnership, UNDP, UNEP
Advocacy documents	Equator Principles (private banks), Environmental and Social Management Guidelines (FAO), FAO's Environmental and Social Standards, Environmental and Social Framework (World Bank)	Dublin Principles, Agenda 21, Millennium Development Goals (MDGs) [105]
Definitions	"SIA includes the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment." [104,106]	"IWRM is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." [107] [2]
Features/advantages	• There are fundamental human rights that are shared equally across cultures, and by males and females alike. • There is a right to have those fundamental human rights protected by the rule of law, with justice applied equally and fairly to all, and available to all. • People have a right to live and work in an environment which is conducive to good health and to a good quality of life and which enables the development of human and social potential. • Social dimensions of the environment—specifically but not exclusively peace, the quality of social relationships, freedom from fear, and belongingness—are important aspects of people's health and quality of life. • People have a right to be involved in the decision making about the planned interventions that will affect their lives. • Local knowledge and experience are valuable and can be used to enhance planned interventions. [106]	Ordinarily, IWRM helps [108] [3]: • A shift from a sectoral to a more cross-sectoral approach to integrate ecological, economic and social goals to achieve multiple and cross-cutting benefits; • The coordinated management of water, land and related resources;· Integration of the technical, social and political aspects, including conflict resolutions in demand, use and perception, be it in the economic, environmental or geopolitical sense; • Integration across sectors, integration of use, integration of demand, integration with the environment as well as integration with the people; • Stakeholder participation to encourage wider ownership and to empower stakeholders. Active involvement of all affected and interested groups in resolving conflict and promoting general sustainability to bring more resource-efficient and socially responsible water management that benefits all sections of society will involve new institutional arrangements; and • A systems approach that recognizes the individual components, as well as the linkages between them, and that a disturbance at one point in the system will be translated to other parts of the system.

Table 1. *Cont.*

Items	SIA [1]	IWRM [1]
Social issues of concern	To deal with social impacts caused by policies, programs, plans, and projects, including people's way of life, culture, community, political systems, environment, health and wellbeing, personal and property rights, and fears and aspirations [106].	Following the Dublin Principles [107–110]: • Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment • Water development and management should be based on a participatory approach involving users, planners and policy makers at all levels • Women play a central part in the provision, management and safeguarding of water • Water has an economic value in all its competing uses and should be recognized as an economic good Comply with MDGs in respect of poverty, hunger, primary education, gender equality, child mortality, maternal mortality, major disease, and environmental sustainability [107,109,110].
When to use	It can be applied before, during and after the execution of policies, programs, plans, and projects.	Emphasizes "a spiral approach", which can be applied at any stage [111–113].
Implementation steps	Numerous tasks in different phases	One turn of the spiral includes such phases as [111,112]: • Recognizing/identifying pressing issues or needs. • Conceptualizing the problem itself and locating possible solutions. • Coordinating and planning among stakeholders to reach an agreement. • Implementing/monitoring/evaluating the plan and its outcome.
Cross-sectoral	SIA can be used to assess the impact of human intervention in any sector on society	IWRM can be applied to flood management, irrigation and water- and soil-related resource management
Time scale	May be as long as several years or even longer	May be as long as several years
Spatial scale	Unlimited	Commonly using hydrological divisions (such as rivers, watersheds, catchment areas, coasts, etc.) as the operating unit.
Feasibility of extended application	High, such as Environmental Social Impact Assessment (ESIA), Environmental, Social and Health Impact Assessment (ESHIA) [104] and Social Life Cycle Assessment (S-LCA), all related connotations of SIA.	High, such as IWM, IWSM, IRBM, ICM, ICZM, all have related connotations of IWRM.
Popularity	High	High
Limitations	It belongs to applied anthropology [114] and applied sociology [115]. Baseline and observation data are difficult to obtain. Qualitative methods are emphasized. SIA is difficult to be quantified and predict the future situation.	It mainly solves the water problems (such as insufficient clean water, floods) from the field of environmental management, and lacks thoughtful and meticulous operation on social issues.

[1] The content of SIA mainly quotes the well-known works of Frank Vanclay [104,106]. The IWRM section quotes recent literature after 2000. [2] See also Cap-Net and G. W. P. [109], Cap-Net and UNDP [110], Ibisch et al. [116]. [3] See also Cap-Net and G. W. P. [109], Cap-Net and UNDP [110].

4. Overview of Water Environment Governance and Impact Assessment in Taiwan

4.1. Water Environment Governance

4.1.1. Management Structure

Taiwan's water environment governance structure is shown in Figure 3. The main central authorities include the Water Resources Agency, Environmental Protection Administration, Irrigation Agency, Construction and Planning Agency, Soil and Water Conservation Bureau, Ocean Affairs Council and Ministry of Culture. Each unit conducts water environment governance in accordance with different laws and regulations. Taiwan has as many as seven central competent units for water environment governance with distributed and fragmented authorities and responsibilities. In practice, this often results in insufficient horizontal communication and coordination among agencies, resulting in spotty and conflicting administration. The water environment-related units of local governments are also

complex. When implementing an integrated water environment plan at the local level, the horizontal integration of different local government units and the vertical integration between local government units and their corresponding central units introduce another layer of complexity and must also be considered simultaneously.

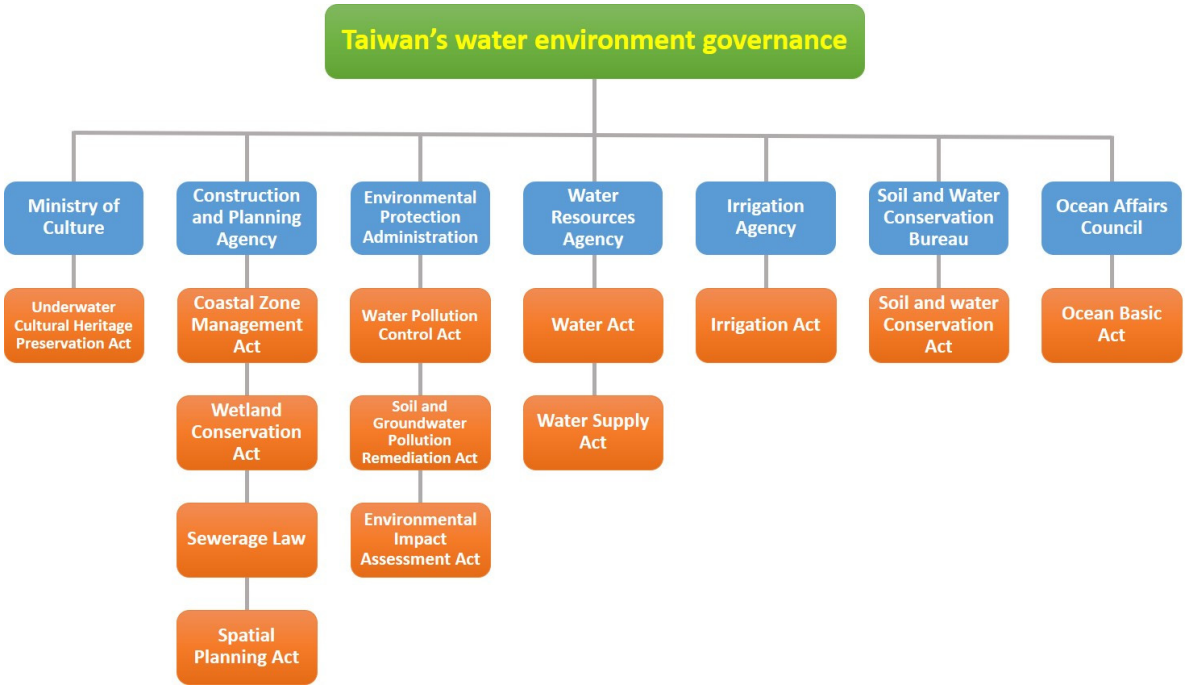


Figure 3. Taiwan's water environment governance structure. (In addition to those presented in the diagram, regulation of Taiwan's water environment is subject to additional government ministries and agencies (e.g., transportation, education, fishery, agriculture and food, forestry etc.) that are not listed.)

4.1.2. Major Water Environment Governance Plans in Recent Years

The Comprehensive Management Plan of River Basins (CMPRB) (http://iufm.cpami.gov.tw/wra (accessed on 12 November 2021)) received US$2.2 billion in total funding, with a project duration of 2014 to 2019. Overall planning had various central units and relevant local governments collaborating through cross-sectoral coordination and integration to achieve overall disaster reduction, along with attending economic, social and ecological environmental benefits. The plan would also improve flood protections standards in the subsidence area along Taiwan's southwest coast, along with related land conservation and sustainable development (Table 2).

The Forward-Looking Infrastructure Plan of Water Environment (FLIPWE) (https://flwe.wra.gov.tw/ (accessed on 17 November 2021)) received about US$ 900 million in total funding, with a project duration from 2017 to 2025. The scope of the plan covers rivers, wild streams, coasts, drainage systems, retention ponds, fishing ports and aquaculture areas, and tasks related to water purification and water environment improvement. Such improvements include watercourses and their surroundings, focused on upgrading the water environment along with facilities construction. Principles of the plan are shown in Table 3.

The CMPRB and FLIPWE both introduce IWRM (or IWM/IWSM/IRBM/ICM/ICZM) related concepts and emphasize the importance of public participation, and the latter introduces ecological checks to avoid and reduce the impact of the development projects on the ecosystem.

Table 2. Contents of the CMPRB [117].

Four Aspects	Six Focuses	Actual Acts
• Homeland disaster prevention • Comprehensive water control • Watershed management • Three-dimensional flood control	• Mitigate impact of global climate change • Prevent upstream sediment disasters • Reduce flooding in the middle and lower reaches • Improve storm sewer operations • Improve drainage in the subsidence area • Flood prevention in agricultural areas	Continuous processing: • Planning and management of river drainage, storm sewer drainage and farmland drainage • Soil and water conservation, and mountain and flood management of the upstream slope and state-owned forest land Innovations: • Improve technological disaster prevention and avoidance measures • Bridge reconstruction in consideration of water management • Outflow control and runoff sharing • Integrate various drainage interfaces • Urban low-impact development (sponge city) • Revitalize land use • Promote a grading system for mountain and flood management • Improve flooding in aquaculture production area • Food crop preservation and production area adjustment Management improvements: • Urban drainage asset management and improvement of flood control efficiency • Agricultural disaster prevention • Improve talent cultivation and technological development • Strengthen supervision of local government maintenance and management

Table 3. Principles of the FLIPWE [118].

No.	Contents
1	The improvement of the waterfront environment is based on the principles of restoring the original features of rivers, drainage and coastal areas; emphasizing water control, water purification and hydrophilicity; designing forest belts around creeks, rivers and coasts; replanting; and integrating the ecological space of water and land.
2	Urban gateways or embankments spanned by important traffic arteries will be improved with systemic greenways and landscape views.
3	In conjunction with the renovation and improvement of existing dikes, vegetation coverage, green corridors and slopes, and levees, trees will be planted to modify the environment and landscape, increase the connection between water and land, and expand the space for people and wildlife.
4	Identify dike sections with high utilization rates and low risk, focus on the construction of a hydrophilic environment with natural characteristics, and create a unique safe waterside environment and water-friendly recreational space.
5	Assess the overall environmental health of rivers, reduce obstacles to biological activity, improve habitat structures, and create waterfront habitats to form stable river basin biodiversity.
6	River sections with poor water quality will be improved through environmental projects implementing sewage interception, gravel contact oxidation, aeration purification and other methods.
7	Combine beach nourishment and sea dike construction to improve degraded coastal areas and create a vegetation environment in front of and behind the dikes to promote environmental conservation.

4.2. Impact Assessment

4.2.1. EIA

As early as 1975, the Taiwanese government began to study and adopt the U.S. EIA system. Taiwan's EIA system was formally established in December 1994 with the passage of the Environmental Impact Assessment Act (EIAA) [119]. This act places EIA activities in the purview of the Environmental Protection Administration (Figure 3) at the central government level. Based on EIAA, EIAs shall be conducted for the development activities listed in Table 4 for which there is concern of adverse environmental impacts. Among them, the fourth and the fifth items are of particular importance to the water environment.

Table 4. Development activities requiring EIA [119].

No.	Contents	Relevance to Water Environment
1	The establishment of a factory or the development of an industrial park	Fair
2	The development of a road, railway, mass rapid transit system, harbor or airport	Fair
3	The extraction of soil and rock or the exploration and extraction of minerals	Fair
4	The development of water storage, water supply, flood control or drainage projects	Very high
5	The development or use of land for agriculture, forestry, fisheries or livestock	High
6	The development of recreational areas, scenic areas, golf courses or sports fields	Fair
7	The development of cultural, educational or medical facilities	Fair
8	The construction of new municipal districts, construction of tall buildings or renovation of old municipal districts	Fair
9	The construction of environmental protection projects	Fair
10	The development of nuclear energy or other energies or the construction of radioactive waste storage or treatment facilities	Fair
11	Those other activities officially announced by the central competent authority	Fair

In contrast with many other countries, Taiwan's EIA system is conducted in two-phases and serves as a veto mechanism. Proposed development activities that might have an adverse impact on the environment initiate phase I EIA, focused on a written review. Negative outcome in this phase leads to the more rigorous phase II EIA (which has a statutory public participation mechanism). EIA cases are reviewed by a review committee, including officials from relevant government agencies, as well as experts and researchers with relevant academic expertise and practical EIA experience. If the committee fails to achieve consensus on a project, a vote will be held, and the project can be halted by a simple majority.

4.2.2. SIA

In the current EIA system [119], SIA items have limited scope and effect. However, in response to a growing awareness of the importance of SIA, the 2017 "Draft of SIA Technical Specifications" enhanced the role of SIA under the EIAA [120]. The proposed SIA items and factors for selection in the draft are shown in Table 5, including 6 items and a total of 53 factors. The draft provides optional SIA items and factors (Table 5), SIA operating regulations, a summary table of major social impacts to trigger phase II SIA, and an outline of SIA reporting content. However, this draft may be significantly revised as it proceeds through the approval process towards becoming statue.

Table 5. SIA items and factors suggested in the draft [120].

Items (Number of Factors)	Factors
Land use (6)	Use patterns, development characteristics, suitability of land use in the planned area, adjacent land use types, expropriated land or demolished above-ground objects and the affected population, urban (regional) plans under implementation or drafting
Public construction and services (11)	Public facilities, public services, public health, public safety, telecommunications, finance, energy and power, education, housing, disaster prevention and response, water rights and hydraulic facilities
Livelihood and economy (14)	Agriculture/forestry/fishery/animal husbandry, existing industrial structures and number of employees, industrial chain, community and living environment, living quality and affordability, employment and unemployment, local finance, land ownership, right of residence (including tenants, informal residents, homeless), land and real estate speculation, standard of living, income and its distribution, informal economic activities, food and food safety
Social relations (10)	Population and composition, social system, social psychology, security hazards, social security issues, community vitality and cohesion, formal and informal power relations, ethnic and community lifestyles, indigenous people, gender
Culture (12)	Monuments, historical sites, archaeological sites and antiquities, historic and monumental spaces and buildings, underwater cultural heritage, folklore, religions and beliefs, historical events, traditional arts, crafts and knowledge
Public concerns and matters designated by review committees	–

5. Survey Results

5.1. Quantitative Analysis

The analysis results are shown in Table 6. For all respondents, the highest average answer score is 4.19 (Question no. 1.3) (between "necessary" and "very necessary", more inclined to "necessary"), which shows they believe SIA should be applied to water environment governance in Taiwan. The lowest score is 2.21 (Question no. 1.5), indicating that the perceived difficulty of SIA implementation is between "fair" and "difficult" (more inclined to "difficult"). From the advanced questions, the highest score is 3.26 (Question no. 2.1.8), indicating that the difficulty of collating relevant baseline data for key social issues is between "fair" and "easy" (prefer "fair" more). The lowest score is 2.31 (Questions no. 2.3.6, 2.3.7), indicating the most difficult tasks are developing a social impact management plan (SIMP) and establishing partnerships to implement the SIMP. In terms of the cumulative mean scores for each phase, for all respondents, "predict, analyze and assess the likely impact pathways" is the most difficult (2.62), followed by "develop and implement strategies" (2.72), "understand the issues" (2.81) and "design and implement monitoring programs" (3.07). In terms of respondent professional affiliations, significant differences were only found for Question no. 1.3 (for which the mean academic affiliation score was 4.45, which is significantly higher than the 3.85 for government affiliation) and Question no. 2.2.3 (for which the mean score of government affiliation was 2.93, which is significantly higher than the 2.32 for academic affiliation). The former shows that academic respondents put greater importance on applying SIA to Taiwan's water environment governance than their government counterparts. The latter means that academics find it more difficult than civil servants to consider how the project will contribute to the cumulative impacts being experienced by the host communities.

5.2. Qualitative Analysis

Table A2 summarizes of the response results of the general open-ended questions. The statements of respondents are summarized into 55 comments (C 1.2.1–11, C 1.4.1–11, C 1.6. 1–15 and C 1.7.1–18). On the whole, the opinions of the respondents are quite rich and diverse.

Table 6. Average response scores.

Question No.	All Respondents (AR) (N = 100)	Government Units (GU) (N = 27)	Academic Research Units (ARU) (N = 44)	Private Sectors (PS) (N = 26)	The Average Difference Is Significant at the 0.05 Level
General questions					
1.3	4.19	3.85	4.45	4.23	ARU > GU
1.5	2.21	2.44	2.16	2.04	
Advanced questions					
Phase 1: Understand the issues					
2.1.1	3.04 (2) [1]	3.15 (1)	2.98 (2)	3.19 (2)	
2.1.2	2.72 (6)	2.74 (6)	2.84 (4)	2.58 (6)	
2.1.3	2.78 (5)	2.85 (4)	2.75 (5)	2.85 (5)	
2.1.4	2.49 (7)	2.63 (8)	2.45 (8)	2.46 (7)	
2.1.5	2.87 (3)	2.85 (4)	2.93 (3)	2.88 (4)	
2.1.6	2.48 (8)	2.70 (7)	2.48 (7)	2.35 (8)	
2.1.7	2.87 (3)	2.96 (3)	2.73 (6)	3.08 (3)	
2.1.8	3.26 (1)	3.11 (2)	3.32 (1)	3.38 (1)	
Mean	2.81	2.88	2.81	2.85	
Phase 2: Predict, analyze and assess the likely impact pathways					
2.2.1	2.78 (1)	2.96 (1)	2.70 (2)	2.85 (1)	
2.2.2	2.45 (6)	2.56 (6)	2.36 (5)	2.54 (5)	
2.2.3	2.52 (5)	2.93 (2)	2.32 (6)	2.50 (6)	GU > ARU
2.2.4	2.64 (3)	2.81 (3)	2.52 (3)	2.69 (3)	
2.2.5	2.57 (4)	2.78 (4)	2.43 (4)	2.65 (4)	
2.2.6	2.76 (2)	2.70 (5)	2.84 (1)	2.77 (2)	
Mean	2.62	2.79	2.53	2.67	
Phase 3: Develop and implement strategies					
2.3.1	2.93 (4)	2.78 (6)	3.02 (2)	3.08 (1)	
2.3.2	2.98 (2)	3.11 (1)	2.93 (3)	3.08 (1)	
2.3.3	3.01 (1)	3.07 (3)	3.09 (1)	2.92 (4)	
2.3.4	2.98 (2)	3.11 (1)	2.93 (3)	3.00 (3)	
2.3.5	2.64 (5)	2.81 (4)	2.55 (5)	2.73 (6)	
2.3.6	2.31 (7)	2.48 (8)	2.14 (7)	2.50 (7)	
2.3.7	2.31 (7)	2.56 (7)	2.11 (8)	2.46 (8)	
2.3.8	2.62 (6)	2.81 (4)	2.48 (6)	2.77 (5)	
Mean	2.72	2.84	2.66	2.82	
Phase 4: Design and implement monitoring programs					
2.4.1	3.17 (3)	3.19 (2)	3.23 (2)	3.19 (2)	
2.4.2	3.18 (2)	3.19 (2)	3.18 (3)	3.31 (1)	
2.4.3	2.69 (4)	2.93 (4)	2.57 (4)	2.77 (4)	
2.4.4	3.22 (1)	3.22 (1)	3.32 (1)	3.19 (2)	
Mean	3.07	3.13	3.07	3.12	

[1] The number in parentheses shows the order of the average score of the question in the same phase, and the rest are the same.

As far as Question no. 1.2 is concerned, compared to the well-known definition of SIA by Vanclay, "SIA includes the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment". [103,105] (see also Table 1), the understanding and expectations of SIA pay more attention to (1) science-based comprehensive and holistic assessment processes (C 1.2.1); (2) SIA's making up for the shortcomings of EIA (C 1.2.3); (3) feasibility analysis of the project based on SIA results (C 1.2.6); (4) stakeholder participation (C 1.2.7); (5) quantitative, objective and socio-psychological analysis (C 1.2.8–9); (6) self-evaluation of organizations and projects (C 1.2.10); and (7) respect for the texture of

local community (C 1.2.11). According to Question no. 1.4, the particularity of the implementation of SIA on Taiwan's water environment is that it can reflect the characteristics and systemic issues of the water environment in terms of natural environment. The rivers in Taiwan are relatively short, and there is no complicated interaction between upstream and downstream water users. Stakeholders are easy to identify. In terms of social characteristics, the social awareness of including multiple values of the water environment is gradually increasing, and the need for the water environment SIA is urgent. Water environment SIA is easy to be implemented (C 1.4.1–5). The advantages of implementing the SIA for Taiwan's water environment are the community's recognition that water environment has gradually increased, the overall atmosphere has become more open and diverse, the quality of the people has improved, and a large number of water environment related studies have been accumulated for SIA's reference (C 1.4.6–11). Judging from Question no. 1.6, the obstacles to the implementation of SIA are (1) the competent authorities are complex, and it is difficult for various departments to communicate and integrate, and form consensus (C 1.6.1, C 1.6.9); (2) the society is not familiar with SIA, and the related abilities and resources need to be improved (C 1.6. 2. C 1.6.8, C 1.6.11, C 1.6.13, C 1.6.14); (3) SIA is vulnerable to economic and engineering-oriented control, and it lacks legal and technical specifications, objective evaluation processes (including quantitative indicators) and a credible third-party appraisal unit (C 1.6.3, C 1.6.5, C 1.6.7, C 1.6.10); (4) stakeholders focus on their own interests, political factors and ideologies are above science and professionalism, competition between multiple values leads to chaos, and it takes a long time to invest a lot of resources to build consensus (C 1.6.4, C 1.6.6, C 1.6.15); and (5) there are many and serious water environment problems, and the introduction of SIA will make them even severe and difficult to solve (C 1.6.12). According to Question no. 1.7, the respondents think that if Taiwan decides to implement water environment SIA, it should (1) strengthen education to increase public awareness of SIA and local water environment (C 1.7.1, C 1.7.11); (2) clarify the division of authorities and responsibilities of government units, designate a high-level dedicated government unit to be responsible for integration and promotion, strengthen the SIA part of the existing EIA and seek complete legislation, encourage all sectors to implement SIA, and set a fixed budget every year for promotion (C 1.7.2, C 1.7.3, C 1.7.5, C 1.7.14, C 1.7.15, C 1.7.17); (3) develop a consensus on the social value system of the water environment and establish a communications platform for promotion, strengthen the transparency of relevant information, and jointly propose and implement promotion strategies by all stakeholders (C 1.7.4, C 1.7.7, C 1.7.10, C 1.7.13); (4) encourage related academic research and cultivate professional expertise, establish objective and reasonable quantitative evaluation methods (indicators), compile operating manuals (guidelines), pilot SIA of small-scale water environment projects, and refer to foreign promotion experience (C 1.7.6, C 1.7.8, C 1.7.9, C 1.7.12, C 1.7.18), and (5) the government must be determined to promote implementation (C 1.7.16).

6. Discussion

6.1. Necessity of Water Environment SIA

Cases of SIA applied to water environment are gradually accumulating. Through the inductive analysis of the cases mentioned in 31 papers [38,70–99], this article defines the general characteristics of water environment SIA: it is used to assess the social impact of human interventions in solving water/water environment problems, and it usually involves multiple water environment categories, as well as cross-sectoral issues. Furthermore, by comparing with IWRM [105,107–113,116], we have clarified the necessity of (water environment) SIA (Table 1).

Despite the fact that the current widespread IWRM can enhance social welfare by dealing with water-related issues, it cannot fully evaluate the social impact of planned interventions. Thus, it might still provoke huge controversy among members of society (e.g., the Central Taiwan Science Park Phase IV project and the Taitung Miramar Resort), even transboundary conflicts (e.g., the long-term disputes over the use of water resources

among countries in the Mekong River basin [14,25,32,36,81,88] and the Nile basin [20,21]) with the development rhetoric of elites in various countries [22,24,32,37]. If we have a better grasp of the social impact of planned interventions in the water environment and respond to it in advance, the disputes caused by water will be reduced or even eliminated. Because the WEF is highly relevant to society, based on water environment, the WEF nexus also has the opportunity to get better treatment through the water environment SIA ensuring the sustainability of water/energy/food [9–20].

6.2. Professionals' Awareness of SIA Needs to Be Improved

For water environment professionals in Taiwan, although respondents had different views regarding the definition and function of SIA (C 1.2.1–11), Table A2 presents a summary of the opinions of all respondents. Several respondents directly indicated they were unfamiliar with SIA, and some responses had no obvious connection with SIA. While respondents were all water environment professionals, about 30% (Figure 1) had not heard of SIA; thus, awareness among the general public must be even lower. School (basic) education and civic (social) education (C 1.7.1, Table A2) could be used to raise public awareness of SIA, and even to promote the popularization and localization of water environment knowledge (C 1.7.11, Table A2), thus promoting public understanding of the potential benefits of applying SIA to the water environment.

6.3. The Implementation of SIA of Water Environment Is Difficult

In Table 6, the scores of Question no. 1.3 and 1.5 are 4.19 and 2.21, respectively, indicating that the respondents generally suppose that it is necessary to implement SIA for water environments; however, they anticipate difficulty in doing so. In terms of the advanced questions for the 26 tasks in the 4 phases of SIA practice, only the tasks in the fourth phase are slightly easier, and the average value (3.07) exceeds the "fair" threshold (3.00). The average scores of the remaining three task phases (2.81, 2.62, 2.72) are all lower than the "fair" threshold (3.00) and imply perceived difficulty (Table 6). As respondents noted, the obstacles to the implementation of SIA for Taiwan's water environment are (1) there are many competent units engaged in defensive departmentalism (C 1.6.1); (2) there is insufficient professional knowledge and expertise (C 1.6.2); (3) the process is dominated by economic development interests and an engineering orientation, with a lack of consideration of social factors (C 1.6.3); (4) political factors and ideologies override science and professionalism (C 1.6.4); (5) there is a lack of a complete and objective standard evaluation process, and there are too few quantitative indicators (C 1.6.5); (6) the positions of various groups are diverse and opinions are numerous and complicated, which can easily lead to conflict (C 1.6.6); (7) public information is insufficient, and relevant information is difficult to collect (C 1.6.8); (8) a credible third-party appraisal unit is lacking (C 1.6.10); (9) existing water environment problems are numerous and serious (C 1.6.12); (10) civil society is immature and influenced by populism (C 1.6.13); and (11) the public sector is under pressure from development schedules (C 1.6.15) (Table A2).

Vanclay et al. [104,106] have made great contributions to the concrete implementation of SIA, but the difficulties encountered in its practical application have not yet been fully systematically analyzed. This article consults water environment professionals about the difficulty of the 26 tasks proposed by Vanclay et al. [104], which can be used as a reference for the implementation of water environment SIA (or simply SIA) in any region: predetermine which tasks are more difficult and how to solve them (although the context varies from place to place). Meanwhile, the 26 tasks are exhaustive, the response of the professionals can be regarded as a comprehensive diagnosis of implementing water environment SIA.

6.4. The Authorities and Responsibilities of Relevant Government Departments Must Be Clarified and Integrated

The water environment governance structure (Figure 3) is related to many central government units, which complicates jurisdictions, responsibilities and reduces management

efficiency. The authority and responsibilities of relevant departments must be clarified and integrated, requiring the designation of a (high-level) dedicated unit to be responsible for integration and promotion (C 1.6.1, C 1.7.3, C 1.7.15, Table A2). From the perspective of the legal system, the current EIA system already includes SIA items; however, they are fragmented and functionally incomplete. In addition to improving the quality of SIA under the existing EIA system (C 1.7.2, Table A2), ruling and opposition political parties should also urgently pursue discussions and negotiations on the content of the "Draft of SIA Technical Specifications" to establish it as the legal basis for a complete SIA system (C 1.7.5, Table A2).

6.5. Myth of Quantification of SIA

Quantitative methods are also very important in the fields of environmental science. It is not difficult to find research devoted to quantifying social impact [121–123]. Many respondents mentioned that SIA requires a complete set of quantitative indicators to be fair and objective (C 1.2.8, C 1.6.5, C 1.7.9, Table A2). However, this emphasis on quantitative indicators must be supplemented by qualitative evaluation. Quantitative and qualitative assessment methods have their own relative advantages with different epistemological views and can be combined to provide a more complete and balanced worldview [124,125]. The insistence of some water environment professionals that SIA quantification provides absolutely objective outcomes and can solve any problem reflects a lack of social science-related literacy. The fact is that SIA belongs to applied anthropology and applied sociology, which emphasizes qualitative methods [114,115] (Table 1). This raises the urgency of encouraging academic research related to SIA (e.g., assessment methods, implementation procedures) and cultivating professional talent (C 1.7.8, Table A2).

6.6. Water Environment SIA Must Be Integrated with the Existing IWRM

Table 1 presents a comparison of SIA and IWRM. Although IWRM also incorporates social factors, these items do not replace SIA. As previously mentioned, Taiwan has implemented CMPRB and FLIPWE in recent years as part of IWRM, but what little attention has been focused on the social aspects has mainly emphasized public participation. How do we create quality public participation, and how can it promote social values? The current methods do not address these concerns. However, when implementing the SIA of the water environment, IWRM and the two plans need not be abandoned, because they contribute to a holistic exploration of the entire water environment and social value system, and comprehensively examine the value of water environment services and possible negative impacts (C 1.7.4, Table A2), which is, in turn, supportive of SIA. Water environment SIA can also indirectly reflect systemic problems (C 1.4.1, Table A2) and assist in the implementation of IWRM. Thus, both approaches are mutually complementary and are not substitutes for each other. Moreover, IWRM is more about quantitative methods, and water environment SIA highlights qualitative methods. They are also complementary in methodology.

7. Conclusions

Water environment SIA focuses on assessing the social impact of human interventions to solve water/water environment problems and often involves several water environment categories and cross-sectoral issues. Though IWRM incorporates the Dublin Principles and MDGs and considers the social impact of measures taken to solve water problems (Table 1), the direct assessment of the social impact of various development activities could better account for the real voices of society.

As for CMPRB and FLIPWE, Taiwan's water environment governance mainly follows the concept of IWRM, and includes many competent units with complicated laws, regulations, norms, and a variety of practices related to water environment management. The values of concern are often inconsistent. While public participation and public-private collaboration are emphasized, a comprehensive understanding of social impacts is lacking. The existing EIA system is applicable to the water environment (Table 4); however, its

SIA part is weak. In response, the "Draft of SIA Technical Specifications" was formulated in 2017, but it is difficult to predict its agenda, including the time of legislation of the specifications and their final form for implementation.

On the other hand, water environment professionals are still somewhat unfamiliar with SIA and perceive actual implementation as being very difficult; thus, we suggest current efforts should focus on cultivating relevant talent and expertise for the implementation of SIA for the water environment and, also, on raising public awareness for the need for this process. Through research and demonstration pilot cases, we can accumulate experience and increase our understanding of and confidence in SIA. This is complementary to promoting its legislation and establishing a dedicated agency responsible for implementation. At present, few SIA studies or cases have been implemented in Taiwan for any field.

SIA can reduce and resolve social disputes and conflicts by effectively mitigating the negative social impacts caused by development projects [103,108]. Previous applications of SIA to water environment projects have focused largely on dam construction; however, even the complete integrated framework (Figure 2) for this type of project still requires further research and improvement in terms of assessment effectiveness. Since SIA and IWRM are mutually complementary, rather than alternatives to one another, further work is also required to determine best practices for integrating SIA and IWRM as a means of effectively protecting the water environment rights of the citizenry and improving overall quality of life.

Author Contributions: Conceptualization, C.-C.L. and C.-K.C.; methodology, C.-C.L., K.-C.H. and S.-Y.K.; formal analysis, C.-C.L. and C.-K.C.; investigation, C.-C.L. and K.-C.H.; writing—original draft preparation, C.-C.L., K.-C.H. and S.-Y.K.; writing—review and editing, C.-C.L., C.-K.C., C.-P.T. and T.-M.L.; visualization, C.-C.L., C.-K.C., C.-P.T. and T.-M.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: The authors sent emails to invite the water environment professionals to fill out the questionnaire. The research topic, method and follow-up publication plan are all included in the email.

Data Availability Statement: The data presented in this study are available from the authors.

Acknowledgments: The authors thanks all those who filled out the questionnaire for their assistance and support.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Questionnaire items.

No.	Questions	Answer Options
	General questions	
1.1	Have you heard of SIA?	☐ Yes ☐ No
1.2	What do you think SIA is? What is its function?	Open-ended question
1.3	Do you think it is necessary for SIA to be applied to Taiwan's water environment governance?	☐ Very necessary ☐ Necessary ☐ Fair ☐ Unnecessary ☐ Very unnecessary
1.4	What do you think are the particular needs for applying SIA to Taiwan's water environment? What are its advantages?	Open-ended question

Table A1. *Cont.*

No.	Questions	Answer Options
1.5	In your opinion, how difficult is it for Taiwan to implement SIA?	☐ Very easy ☐ Easy ☐ Fair ☐ Difficult ☐ Very difficult
1.6	What do you think are the obstacles to the implementation of SIA for Taiwan's water environment?	Open-ended question
1.7	How do you think Taiwan should implement SIA for the water environment?	Open-ended question
	Advanced questions	
	According to *Social Impact Assessment: Guidance for Assessing and Managing the Social Impacts of Projects*, SIA includes four phases and a total of 26 tasks. In applying SIA to Taiwan's water environment, what do you think is the relative degree of difficulty of each task?	
	Phase 1: Understand the issues	
2.1.1	Gain a good understanding of the proposed project, including all ancillary activities necessary to support the project's development and operation.	☐ Very easy ☐ Easy ☐ Fair ☐ Difficult ☐ Very difficult
2.1.2	Clarify the responsibilities and roles of all SIA stakeholders, including relationships to the other specialist studies being undertaken, and establish what national laws and/or international guidelines and standards are to be observed.	
2.1.3	Identify the project's preliminary 'social area of influence', along with communities and stakeholders likely to positively or negatively impacted.	
2.1.4	Gain a good understanding of the communities likely to be affected by the project by preparing a Community Profile which includes: (a) a thorough stakeholder analysis; (b) a discussion of the socio-political setting; (c) an assessment of the differing needs, interests, values and aspirations of the various subgroups of the affected communities including a gender analysis; (d) an assessment of their impact history, i.e., their experience of past projects and other historical events; (e) a discussion of relevant trends happening in those communities; (f) a discussion of the assets, strengths and weaknesses of the communities; and (g) optionally the results of an opinion survey. This task is typically called profiling.	
2.1.5	Fully inform community members about: (a) the project; (b) similar projects elsewhere to give them a sense of how they are likely to be affected; (c) how they can be involved in the SIA; (d) their procedural rights in the regulatory and social performance framework for the project; and (e) their access to grievance and feedback mechanisms.	
2.1.6	Devise inclusive participatory processes and deliberative spaces to help community members: (a) understand how they will be impacted; (b) determine the acceptability of likely impacts and proposed benefits; (c) make informed decisions about the project; (d) facilitate community visioning about desired futures; (e) contribute to mitigation and monitoring plans; and (f) prepare for change.	
2.1.7	Identify the social and human rights issues that have potential to be of concern (i.e., scoping).	
2.1.8	Collate relevant baseline data for key social issues.	
	Phase 2: Predict, analyze and assess the likely impact pathways	
2.2.1	Through analysis, determine the social changes and impacts that will likely result from the project and its various alternatives.	☐ Very easy ☐ Easy ☐ Fair ☐ Difficult ☐ Very difficult
2.2.2	Carefully consider the indirect (or second and higher order) impacts.	
2.2.3	Consider how the project will contribute to the cumulative impacts being experienced by the host communities.	
2.2.4	Determine how the various affected groups and communities will likely respond.	
2.2.5	Establish the significance of the predicted changes (i.e., prioritize them).	
2.2.6	Actively contribute to the design and evaluation of project alternatives, including no go and other options.	

Table A1. *Cont.*

No.	Questions	Answer Options
	Phase 3: Develop and implement strategies	
2.3.1	Identify ways of addressing potential negative impacts (by using the mitigation hierarchy).	☐ Very easy ☐ Easy ☐ Fair ☐ Difficult ☐ Very difficult
2.3.2	Develop and implement ways of enhancing benefits and project-related opportunities.	
2.3.3	Develop strategies to support communities in coping with change.	
2.3.4	Develop and implement appropriate feedback and grievance mechanisms.	
2.3.5	Facilitate an agreement-making process between the communities and the developer leading to the drafting of an Impacts & Benefits Agreement (IBA).	
2.3.6	Assist the proponent in facilitating stakeholder input and drafting a Social Impact Management Plan (SIMP) which puts into operation the benefits, mitigation measures, monitoring arrangements and governance arrangements that were agreed to in the IBA, as well as plans for dealing with any ongoing unanticipated issues as they may arise.	
2.3.7	Put processes in place to enable proponents, government authorities and civil society stakeholders to implement the arrangements implied in the SIMP and IBA, and develop and embed their own respective management action plans in their own organizations, establish respective roles and responsibilities throughout the implementation of those action plans, and maintain an ongoing role in monitoring.	
2.3.8	Assist the proponent in developing and implementing ongoing social performance plans that address contractor obligations implied in the SIMP.	
	Phase 4: Design and implement monitoring programs	
2.4.1	Develop indicators to monitor change over time.	☐ Very easy ☐ Easy ☐ Fair ☐ Difficult ☐ Very difficult
2.4.2	Develop a participatory monitoring plan.	
2.4.3	Consider how adaptive management will be implemented and consider implementing a social management system.	
2.4.4	Undertake evaluation and periodic review (audit).	

Table A2. Summary of answers to open-ended questions.

1.2 What Do You Think SIA Is? What Is Its Function?	
C 1.2.1:	SIA is a comprehensive and holistic assessment process, emphasizing system, science, and consistency, allowing relevant units to take SIA into consideration at different stages and propose early warnings and preventions
C 1.2.2:	SIA contributes to the sustainable development of society and the environment, and has positive significance for social harmony, industrial and economic development, human environment and environmental protection
C 1.2.3:	SIA is similar to the EIA (a part of it) and can make up for its shortcomings
C 1.2.4:	SIA can evaluate the positive and negative impacts of policies, plans, etc. on society, as a reference for decision-making
C 1.2.5:	SIA includes the evaluation and analysis of the culture, values, activities and even the environment involved in human behavior, and specifically analyzes the degree, methods and value changes of the impact on human society
C 1.2.6:	The feasibility and cost-effectiveness of project implementation can be analyzed based on the results of the SIA, as well as the rationality and fairness of the government's resource allocation, allowing for the evaluation of the development's necessity, so that the development behavior can maximize overall benefits to society
C 1.2.7:	SIA invites stakeholders to participate, helps communicate and seek solutions, reduces impacts, doubts and disputes, avoids wasting social resources and irreversible social impacts and injuries, and promotes social equity
C 1.2.8:	SIA covers a wide range, including which assessment content should be discussed to reach a consensus, and the assessment must be quantified in order to be objective
C 1.2.9:	SIA is an objective analysis of social psychology, which helps understand and reflect on the direction and cost of development behavior
C 1.2.10:	SIA can help organizations and projects to self-evaluate
C 1.2.11:	SIA respects the local texture, including the life of the individual and the operation of the group (community)

Table A2. *Cont.*

1.4 What Do You Think Are the Particular Needs for Applying SIA to Taiwan's Water Environment? What Are Its Advantages?	
Particularity of implementing SIA on the water environment:	
C 1.4.1:	SIA can indirectly reflect the systemic problems of Taiwan's water environment, so that the people will pay more attention to the value of water environment
C 1.4.2:	The vast majority of water environment development units are government units, and it is easier to introduce SIA
C 1.4.3:	The rivers in Taiwan are short, and as far as water resources are concerned, there is no complex problem of mutual influence between upstream and downstream users. When conducting SIA, the stakeholder interaction considered should be relatively simple
C 1.4.4:	Most activities are related to the water environment, and it is easy to determine their relevance and stakeholders
C 1.4.5:	The social awareness of considering the multiple values of the water environment is increasing, and the urgency of implementing SIA is high
Advantages of implementing SIA on the water environment:	
C 1.4.6:	Government agencies are paying more and more attention to the water environment and public participation, and the foundation of public participation and public-private cooperation is solid
C 1.4.7:	The public has a high sense of identification with water resources and the water environment, and many civic groups are concerned
C 1.4.8:	There has been considerable research on water environment issues for reference to SIA
C 1.4.9:	Taiwan's current society and media are relatively open and diverse, which helps highlight issues related to the water environment, shape social consensus, and build a new vision and new value for the water environment
C 1.4.10:	Few public or private units have conducted water environment SIA, and there is no well-known case, which provides greater opportunities for its development
C 1.4.11:	The quality of the people has improved, and they can put forward their own opinions
1.6 What Do You Think Are the Obstacles to the Implementation of SIA for Taiwan's Water Environment?	
C 1.6.1:	Competent units are complex, departmentalism defensiveness is a serious issue, cross-sectoral vertical and horizontal communication mechanisms are problematic, integrated system (or dedicated unit) operation and management is lacking, and it is difficult to gather a common vision
C 1.6.2:	Professional knowledge and experts are insufficient, and government units and all sectors of society have no consensus on SIA (whether or how to implement)
C 1.6.3:	The process is dominated by economic development interests and an engineering orientation, and social factors are not adequately considered
C 1.6.4:	Individuals or groups (such as environmental protection groups) focus on self-interest, and political factors and ideologies override science and professionalism
C 1.6.5:	Involving the public and private sectors increases complexity. There is no complete and objective standard evaluation process, and there are too few quantitative indicators
C 1.6.6:	Competition between multiple values causes chaos. The positions of various groups are diverse and opinions are numerous and complicated, which can easily intensify the confrontation
C 1.6.7:	Laws and technical specifications are insufficient and imperfect
C 1.6.8:	Public information is insufficient, and relevant information is difficult to collect
C 1.6.9:	Water resource management units are too self-centered and are resistant to external opinions
C 1.6.10:	A credible third-party appraisal unit is lacking, and it is difficult to reach consensus on the appraisal results
C 1.6.11:	Not familiar with SIA procedures
C 1.6.12:	Existing water environment problems are numerous and serious
C 1.6.13:	Civil society is immature and populism is flourishing. People lack civic literacy and understanding of various issues, are quick to express opinions that lack rationality or objectivity, are unable to think and judge independently, and are easily manipulated by others

Table A2. *Cont.*

C 1.6.14:	The general public does not understand the importance and urgency of water environment governance. They lack participation in public affairs, and do not pursue practical actions to improve the water environment
C 1.6.15:	It takes a long time to invest a lot of manpower and material resources, deeply understand the social context, and repeatedly communicate to build consensus. However, the public sector is under pressure from the development schedule and cannot spend too much time on detailed assessments
1.7 How Do You Think Taiwan Should Implement Water Environment SIA?	
C 1.7.1:	Strengthen school (basic) education and civic (social) education
C 1.7.2:	Strengthen the SIA part of the existing EIA
C 1.7.3:	Clear division of authorities and responsibilities of government departments
C 1.7.4:	Develop a consensus on the social value system of the water environment, and comprehensively examine the value of services provided by the water environment and possible negative impacts
C 1.7.5:	Complete laws and technical regulations (legislation)
C 1.7.6:	Compile operating manuals (guidelines)
C 1.7.7:	Establish a communications platform for promotion (such as public hearings, workshops), understand the intentions of all sectors, and widely integrate their opinions to facilitate communication and publicity
C 1.7.8:	Encourage academic research related to SIA (assessment methods, implementation procedures), and cultivate professional expertise
C 1.7.9:	Establish an objective and sound quantification methodology for SIA indicators
C 1.7.10:	Strengthen the transparency of relevant information
C 1.7.11:	Popularization and localization of water environment knowledge to help people understand water environment issues in depth
C 1.7.12:	Pilot SIA of small-scale water environment projects (e.g., quality improvement of community-based hydrophilic spaces)
C 1.7.13:	Industry, government, and academic research units, non-governmental organizations and the general public jointly propose and implement promotion strategies
C 1.7.14:	Develop an incentive mechanism that encourages promotion by all sectors
C 1.7.15:	Assign responsibility to a (high-level) dedicated unit for integration and promotion
C 1.7.16:	The government must be determined to promote implementation
C 1.7.17:	Set a fixed budget every year for promotion that is maintained despite changes in the political atmosphere
C 1.7.18:	Refer to foreign promotion experience

References

1. Baker, L.A. (Ed.) *The water Environment of Cities*; Springer: New York, NY, USA, 2009; p. 307.
2. Arnell, N.W.; Halliday, S.J.; Battarbee, R.W.; Skeffington, R.A.; Wade, A.J. The implications of climate change for the water environment in England. *Progr. Phys. Geogr.* **2015**, *39*, 93–120. [CrossRef]
3. Roux, P.; Fink, M. Green's function estimation using secondary sources in a shallow water environment. *J. Acoust. Soc. Am.* **2003**, *113*, 1406–1416. [CrossRef] [PubMed]
4. Henriques, C.; Garnett, K.; Weatherhead, E.K.; Lickorish, F.A.; Forrow, D.; Delgado, J. The future water environment—Using scenarios to explore the significant water management challenges in England and Wales to 2050. *Sci. Total Environ.* **2015**, *512*, 381–396. [CrossRef] [PubMed]
5. Tambo, N. Hydrological cycle and urban metabolic system of water. *J. Jpn. Soc. Hydrol. Water Resour.* **2002**, *15*, 101–105. (In Japanese) [CrossRef]
6. Gardiner, J. Environmental modelling in the hydrological cycle: What the client needs? *Water Environ. J.* **1997**, *11*, 105–108. [CrossRef]
7. Takle, E.S.; Jha, M.; Anderson, C.J. Hydrological cycle in the upper Mississippi River basin: 20th century simulations by multiple GCMs. *Geophys. Res. Lett.* **2005**, *32*, L18407. [CrossRef]
8. Hester, R.E.; Harrison, R.M. (Eds.) *Sustainable Water*; Royal Society of Chemistry: London, UK, 2011.
9. Bian, Z.; Liu, D. A Comprehensive Review on Types, Methods and Different Regions Related to Water–Energy–Food Nexus. *Int. J. Environ. Res. Publ. Health* **2021**, *18*, 8276. [CrossRef] [PubMed]

10. de Andrade Guerra, J.B.S.O.; Berchin, I.I.; Garcia, J.; da Silva Neiva, S.; Jonck, A.V.; Faraco, R.A.; de Amorim, W.S.; Ribeiro, J.M.P. A Literature-Based Study on the Water–Energy–Food Nexus for Sustainable Development. *Stoch. Environ. Res. Risk Assess.* **2021**, *35*, 95–116. [CrossRef]
11. Zhang, T.; Tan, Q.; Zhang, S.; Zhang, T.; Zhang, W. A Participatory Methodology for Characterizing and Prescribing Water-Energy-Food Nexus Based on Improved Casual Loop Diagrams. *Resour. Conservat. Recycl.* **2021**, *164*. [CrossRef]
12. Hussein, H.; Lambert, L.A. A Rentier State under Blockade: Qatar's Water-Energy-Food Predicament from Energy Abundance and Food Insecurity to a Silent Water Crisis. *Water* **2020**, *12*, 1051. [CrossRef]
13. Botai, J.O.; Botai, C.M.; Ncongwane, K.P.; Mpandeli, S.; Nhamo, L.; Masinde, M.; Adeola, A.M.; Mengistu, M.G.; Tazvinga, H.; Murambadoro, M.D.; et al. A Review of the Water-Energy-Food Nexus Research in Africa. *Sustainability* **2021**, *13*, 1762. [CrossRef]
14. Gao, J.; Zhao, J.; Wang, H. Dam-Impacted Water–Energy–Food Nexus in Lancang-Mekong River Basin. *J. Water Resour. Plann. Manag.* **2021**, *147*, 04021010. [CrossRef]
15. Pahl-Wostl, C.; Gorris, P.; Jager, N.; Koch, L.; Lebel, L.; Stein, C.; Venghaus, S.; Withanachchi, S. Scale-Related Governance Challenges in the Water–Energy–Food Nexus: Toward a Diagnostic Approach. *Sustainability Sci.* **2021**, *16*, 615–629. [CrossRef]
16. Zhang, T.; Tan, Q.; Yu, X.; Zhang, S. Synergy Assessment and Optimization for Water-Energy-Food Nexus: Modeling and Application. *Renew. Sustain. Energ. Rev.* **2020**, *134*, 110059. [CrossRef]
17. Simpson, G.B.; Jewitt, G.P.W. The Development of the Water-Energy-Food Nexus as a Framework for Achieving Resource Security: A Review. *Front. Environ. Sci.* **2019**, *7*, 8. [CrossRef]
18. Zarei, M. The Water-Energy-Food Nexus: A Holistic Approach for Resource Security in Iran, Iraq, and Turkey. *Water-Energy Nexus* **2020**, *3*, 81–94. [CrossRef]
19. Saidmamatov, O.; Rudenko, I.; Pfister, S.; Koziel, J. Water-Energy-Food Nexus Framework for Promoting Regional Integration in Central Asia. *Water* **2020**, *12*, 1896. [CrossRef]
20. Allam, M.M.; Eltahir, E.A.B. Water-Energy-Food Nexus Sustainability in the Upper Blue Nile (UBN) Basin. *Front. Environ. Sci.* **2019**, *7*, 5. [CrossRef]
21. Goher, M.E.; Mangood, A.H.; Mousa, I.E.; Salem, S.G.; Hussein, M.M. Ecological Risk Assessment of Heavy Metal Pollution in Sediments of Nile River, Egypt. *Environ. Monit. Assess.* **2021**, *193*, 703. [CrossRef]
22. Bréthaut, C.; Ezbakhe, F.; McCracken, M.; Wolf, A.; Dalton, J. Exploring Discursive Hydropolitics: A Conceptual Framework and Research Agenda. *Int. J. Water Resour. Dev.* **2021**, 1–16, ahead of print. [CrossRef]
23. Zeitoun, M.; Warner, J. Hydro-Hegemony—A Framework for Analysis of Trans-Boundary Water Conflicts. *Water Pol.* **2006**, *8*, 435–460. [CrossRef]
24. Conker, A.; Hussein, H. Hydropolitics and Issue-Linkage along the Orontes River Basin: An Analysis of the Lebanon–Syria and Syria–Turkey Hydropolitical Relations. *Int. Environ. Agreem-P.* **2020**, *20*, 103–121. [CrossRef]
25. Mirumachi, N. Informal Water Diplomacy and Power: A Case of Seeking Water Security in the Mekong River Basin. *Environ. Sci. Pol.* **2020**, *114*, 86–95. [CrossRef]
26. Hussein, H.; Menga, F.; Greco, F. Monitoring Transboundary Water Cooperation in SDG 6.5.2: How a Critical Hydropolitics Approach Can Spot Inequitable Outcomes. *Sustainability* **2018**, *10*, 3640. [CrossRef]
27. da Silva, L.P.B.; Hussein, H. Production of Scale in Regional Hydropolitics: An Analysis of La Plata River Basin and the Guarani Aquifer System in South America. *Geoforum* **2019**, *99*, 42–53. [CrossRef]
28. Grünwald, R.; Feng, Y.; Wang, W. Reconceptualization of the Transboundary Water Interaction Nexus (TWINS): Approaches, Opportunities and Challenges. *Water Int.* **2020**, *45*, 458–478. [CrossRef]
29. Hussein, H.; Natta, A.; Yehya, A.A.K.; Hamadna, B. Syrian Refugees, Water Scarcity, and Dynamic Policies: How Do the New Refugee Discourses Impact Water Governance Debates in Lebanon and Jordan? *Water* **2020**, *12*, 325. [CrossRef]
30. Nagheeby, M.; Warner, J. The Geopolitical Overlay of the Hydropolitics of the Harirud River Basin. *Int. Environ. Agreem-P.* **2018**, *18*, 839–860. [CrossRef]
31. Hussein, H. The Guarani Aquifer System, Highly Present but Not High Profile: A Hydropolitical Analysis of Transboundary Groundwater Governance. *Environ. Sci. Pol.* **2018**, *83*, 54–62. [CrossRef]
32. Mørck Jensen, K.; Lange, R.B. *Transboundary Water Governance in a Shifting Development Context New Development Finance, Development Spaces and Commitment to Cooperation; a Comparative Study of the Mekong and the Zambezi River Basins*; Dansk Institut for Internationale Studier: København, Denmark, 2013; ISBN 9788776055950.
33. Zeitoun, M.; Mirumachi, N. Transboundary Water Interaction I: Reconsidering Conflict and Cooperation. *Int. Environ. Agreem. Polit. Law Econ.* **2008**, *8*, 297–316. [CrossRef]
34. Zeitoun, M.; Mirumachi, N.; Warner, J. Transboundary Water Interaction II: The Influence of "soft" Power. *Int. Environ. Agreem. Politics Law Econ.* **2011**, *11*, 159–178. [CrossRef]
35. Zeitoun, M.; Cascão, A.E.; Warner, J.; Mirumachi, N.; Matthews, N.; Menga, F.; Farnum, R. Transboundary Water Interaction III: Contest and Compliance. *Int. Environ. Agreem. Politics Law Econ.* **2017**, *17*, 271–294. [CrossRef]
36. Middleton, C.; Allouche, J. Watershed or Powershed? Critical Hydropolitics, China and the 'Lancang-Mekong Cooperation Framework'. *Int. Spect.* **2016**, *51*, 100–117. [CrossRef]
37. Hussein, H.; Conker, A.; Grandi, M. Small is beautiful but not trendy: Understanding the allure of big hydraulic works in the Euphrates-Tigris and Nile waterscapes. *Mediterr. Polit.* **2020**. [CrossRef]

38. Aznar-Crespo, P.; Aledo, A.; Melgarejo-Moreno, J.; Vallejos-Romero, A. Adapting social impact assessment to flood risk management. *Sustainability* **2021**, *13*, 3410. [CrossRef]
39. Finsterbusch, K. In praise of SIA—a personal review of the field of social impact assessment: Feasibility, justification, history, methods, issues. *Impact Assess.* **1995**, *13*, 229–252. [CrossRef]
40. Burdge, R.J.; Vanclay, F. Social impact assessment: A contribution to the state of the art series. *Impact Assess.* **1996**, *14*, 59–86. [CrossRef]
41. Howitt, R. Social impact assessment and resource development: Issues from the Australian experience. *Aust. Geogr.* **1989**, *20*, 153–166. [CrossRef]
42. Craig, D. Social impact assessment: Politically oriented approaches and applications. *Environ. Impact Assess. Rev.* **1990**, *10*, 37–54. [CrossRef]
43. Jacquet, J.B. A Short History of Social Impact Assessment. 2014. Available online: https://www.researchgate.net/profile/Jeffrey-Jacquet/publication/291831313_A_Short_History_of_Social_Impact_Assessment/links/56a6f6a708ae860e0253d386/A-Short-History-of-Social-Impact-Assessment.pdf (accessed on 12 October 2021).
44. Giordano, M.; Shah, T. From IWRM back to integrated water resources management. *Int. J. Water Resour. Dev.* **2014**, *30*, 364–376. [CrossRef]
45. Benson, D.; Gain, A.K.; Rouillard, J.J. Water governance in a comparative perspective: From IWRM to a 'nexus' approach? *Water Altern.* **2015**, *8*, 756–773.
46. Lautze, J.; De Silva, S.; Giordano, M.; Sanford, L. Putting the cart before the horse: Water governance and IWRM. *Nat. Resour. Forum* **2011**, *35*, 1–8. [CrossRef]
47. Jønch-Clausen, T. *Integrated Water Resources Management (IWRM) and Water Efficiency Plans by 2005. Why, What and How?* TAC Background Papers No. 10; Global Water Partnership: Stockholm, Sweden, 2004.
48. Al Radif, A. Integrated water resources management (IWRM): An approach to face the challenges of the next century and to avert future crises. *Desalination* **1999**, *124*, 145–153. [CrossRef]
49. Foster, S.; Ait-Kadi, M. Integrated water resources management (IWRM): How does groundwater fit in? *Hydrogeol. J.* **2012**, *20*, 415–418. [CrossRef]
50. Meire, P.; Coenen, M.; Lombardo, C.; Robba, M.; Sacile, R. Towards integrated water management. In *Integrated Water Management: Practical Experiences and Case Studies*; Meire, P., Coenen, M., Lombardo, C., Robba, M., Sacile, R., Eds.; Springer: Dordrecht, The Netherlands, 2008; pp. 1–8.
51. Watson, N.; Walker, G.; Medd, W. Critical perspectives on integrated water management. *Geogr. J.* **2007**, *173*, 297–299. [CrossRef]
52. Meire, P.; Coenen, M.; Lombardo, C.; Robba, M.; Sacile, R. (Eds.) *Integrated Water Management: Practical Experiences and Case Studies*; Springer Science & Business Media: Berlin, Germany, 2008.
53. Apostolidis, N.; Hutton, N. Integrated water management in brownfield sites—More opportunities than you think. *Desalination* **2006**, *188*, 169–175. [CrossRef]
54. Gebremeskel, K.; Teka, K.; Birhane, E.; Negash, E. The role of integrated watershed management on soil-health in northern Ethiopia. *Acta Agric. Scand. B Soil Plant Sci.* **2019**, *69*, 667–673. [CrossRef]
55. Sharda, V.N. Integrated watershed management: Managing valleys and hills in the Himalayas. In *Watershed Management Challenges: Improving Productivity, Resources and Livelihoods*; Sharma, B.R., Samra, J.S., Scott, C.A., Wani, S.P., Eds.; Department of Agriculture & Cooperation Ministry of Agriculture: New Delhi, India, 2005; pp. 61–81.
56. Reddy, V.R.; Saharawat, Y.S.; George, B. Watershed management in South Asia: A synoptic review. *J. Hydrol.* **2017**, *551*, 4–13. [CrossRef]
57. Watson, N. Integrated river basin management: A case for collaboration. *Int. J. River Basin Manag.* **2004**, *2*, 243–257. [CrossRef]
58. Mokhtar, M.B.; Toriman, M.E.H.; Hossain, M.A.A.; Tan, K.W. Institutional challenges for integrated river basin management in Langat River Basin, Malaysia. *Water Environ. J.* **2011**, *25*, 495–503. [CrossRef]
59. Evers, M. An analysis of the requirements for DSS on integrated river basin management. *Manag. Environ. Qual. Int. J.* **2008**, *19*, 37–53. [CrossRef]
60. Delipınar, Ş.; Karpuzcu, M. Policy, legislative and institutional assessments for integrated river basin management in Turkey. *Environ. Sci. Policy* **2017**, *72*, 20–29. [CrossRef]
61. Batchelor, C. Improving water use efficiency as part of integrated catchment management. *Agric. Water Manag.* **1999**, *40*, 249–263. [CrossRef]
62. Mitchell, B.; Hollick, M. Integrated catchment management in Western Australia: Transition from concept to implementation. *Environ. Manag.* **1993**, *17*, 735–743. [CrossRef]
63. Fenemor, A.; Phillips, C.; Allen, W.; Young, R.G.; Harmsworth, G.; Bowden, B.; Basher, L.; Gillespie, P.A.; Kilvington, M.; Davies-Colley, R.; et al. Integrated catchment management—Interweaving social process and science knowledge. *N. Zeal. J. Mar. Freshwat. Res.* **2011**, *45*, 313–331. [CrossRef]
64. Rollason, E.; Bracken, L.J.; Hardy, R.J.; Large, A.R.G. Evaluating the success of public participation in integrated catchment management. *J. Environ. Manag.* **2018**, *228*, 267–278. [CrossRef]
65. McKenna, J.; Cooper, A.; O'Hagan, A.M. Managing by principle: A critical analysis of the European principles of Integrated Coastal Zone Management (ICZM). *Mar. Pol.* **2008**, *32*, 941–955. [CrossRef]

66. Alves, F.L.; Sousa, L.P.; Almodovar, M.; Phillips, M.R. Integrated Coastal Zone Management (ICZM): A review of progress in Portuguese implementation. *Reg. Environ. Chang.* **2013**, *13*, 1031–1042. [CrossRef]
67. Post, J.C.; Lundin, C.G. (Eds.) *Guidelines for Integrated Coastal Zone Management*; The World Bank: Washington, DC, USA, 1996.
68. Tiller, R.; Brekken, T.; Bailey, J. Norwegian aquaculture expansion and Integrated Coastal Zone Management (ICZM): Simmering conflicts and competing claims. *Mar. Policy* **2012**, *36*, 1086–1095. [CrossRef]
69. Fabbri, K.P. A methodology for supporting decision making in integrated coastal zone management. *Ocean Coast. Manag.* **1998**, *39*, 51–62. [CrossRef]
70. Tajziehchi, S.; Karbassi, A.R. Problems and challenges facing developing countries in order to execute the social impact assessment of dams—A review. *Eur. J. Sci. Res.* **2011**, *56*, 489–495.
71. Vanclay, F. *Environmental and Social Assessment for Large Dams*; World Commission on Dams: Cape Town, South Africa, 2000.
72. Kirchherr, J.; Pohlner, H.; Charles, K.J. Cleaning up the big muddy: A meta-synthesis of the research on the social impact of dams. *Environ. Impact Assess. Rev.* **2016**, *60*, 115–125. [CrossRef]
73. Kirchherr, J.; Charles, K.J. The social impacts of dams: A new framework for scholarly analysis. *Environ. Impact Assess. Rev.* **2016**, *60*, 99–114. [CrossRef]
74. Tajziehchi, S.; Monavari, S.M.; Karbassi, A. An effective participatory-based method for dam social impact assessment. *Polish J. Environ. Stud.* **2012**, *21*, 1841–1848.
75. Tajziehchi, S.; Monavari, S.M.; Karbassi, A.R.; Shariat, S.M.; Khorasani, N.; Narimisa, P. A critical look at social impact evaluation of dam construction by revised SIMPACTS software: A case study of Alborz Dam in Northern Iran. *Int. J. Environ. Res.* **2014**, *8*, 329–334. [CrossRef]
76. Égré, D.; Senécal, P. Social impact assessments of large dams throughout the world: Lessons learned over two decades. *Impact Assess. Proj. Apprais.* **2003**, *21*, 215–224. [CrossRef]
77. Aledo, A.; García-Andreu, H.; Pinese, J. Using causal maps to support ex-post assessment of social impacts of dams. *Environ. Impact Assess. Rev.* **2015**, *55*, 84–97. [CrossRef]
78. Hanna, P.; Vanclay, F.; Langdon, E.J.; Arts, J. The importance of cultural aspects in impact assessment and project development: Reflections from a case study of a hydroelectric dam in Brazil. *Impact Assess. Proj. Apprais.* **2016**, *34*, 306–318. [CrossRef]
79. Karjalainen, T.P.; Järvikoski, T. Negotiating river ecosystems: Impact assessment and conflict mediation in the cases of hydropower construction. *Environ. Impact Assess. Rev.* **2010**, *30*, 319–327. [CrossRef]
80. Mooney, C.; Tan, P.L. South Australia's River Murray: Social and cultural values in water planning. *J. Hydrol.* **2012**, *474*, 29–37. [CrossRef]
81. Johnston, R.; Kummu, M. Water resource models in the Mekong Basin: A review. *Water Resour. Manag.* **2012**, *26*, 429–455. [CrossRef]
82. Opher, T.; Shapira, A.; Friedler, E. A comparative social life cycle assessment of urban domestic water reuse alternatives. *Int. J. Life Cycle Assess.* **2018**, *23*, 1315–1330. [CrossRef]
83. Rahman, S. Environmental critique on water sectoral environmental impact assessment of Bangladesh. *Am. J. Environ. Sci.* **2014**, *10*, 236–243. [CrossRef]
84. Stević, S.; Milošević, H.; Stević, I.; Hadrovic, S. Sustainable management of water resources in Prokletije region. *Industrija* **2014**, *42*, 47–61. [CrossRef]
85. Taylor, N.; McClintock, W.; Mackay, M.D. *Wairarapa Water Use Project: Preliminary Social Impact Assessment*; Taylor Baines and Associates: Christchurch, New Zealand, 2014.
86. Alam, K.; Rolfe, J.; Donaghy, P. Economic and social impact assessment of water quality improvement. *Australas. J. Reg. Stud.* **2006**, *12*, 85–101. [CrossRef]
87. Kabir, M.R. Social Impact Assessment of Water Pollution: A Case Study on Bangshi River, Savar. Master's Thesis, BRAC University, Dhaka, Bangladesh, November 2014.
88. Wells-Dang, A.; Soe, K.N.; Inthakoun, L.; Tola, P.; Socheat, P.; Nguyen, T.T.V.; Chabada, A.; Youttananukorn, W. A political economy of environmental impact assessment in the Mekong Region. *Water Altern.* **2016**, *9*, 33–55.
89. Daouda Diallo, B. Social Impact Assessment of Water Management Projects—The Case of the Niger River Basin. Master's Thesis, Ohio University, Athens, Greece, August 2018.
90. Harris, C.C.; Nielsen, E.A.; McLaughlin, W.J.; Becker, D.R. Community-based social impact assessment: The case of salmon-recovery on the lower Snake River. *Impact Assess. Proj. Apprais.* **2003**, *21*, 109–118. [CrossRef]
91. Brouwer, R.; Van Ek, R. Integrated ecological, economic and social impact assessment of alternative flood control policies in the Netherlands. *Ecol. Econ.* **2004**, *50*, 1–21. [CrossRef]
92. Vanclay, F. The potential application of social impact assessment in integrated coastal zone management. *Ocean Coast. Manag.* **2012**, *68*, 149–156. [CrossRef]
93. Colten, C.E.; Hemmerling, S.A. *Social Impact Assessment Methodology for Diversions and Other Louisiana Coastal Master Plan Restoration and Protection Projects*; Water Institute of the Gulf: Baton Rouge, LA, USA, 2014.
94. Sorensen, J.; West, N. *A Guide to Impact Assessment in Coastal Environments*; Coastal Resources Center, University of Rhode Island: Kingston, CA, USA, 1992.
95. Mabon, L.; Kita, J.; Xue, Z. Challenges for social impact assessment in coastal regions: A case study of the Tomakomai CCS demonstration project. *Mar. Policy* **2017**, *83*, 243–251. [CrossRef]

96. Shaig, A. *Environment and Social Impact Assessment for the Proposed Community-Based Wetland Management Plan and Associated Activities in Eidhigali Kilhi and Koattey area of Hithadhoo Island, Addu City*; Ministry of Environment and Energy: Malé, Maldives, 2014.
97. Porter, A.L.; Fittipaldi, J.J. (Eds.) *Environmental Methods Review: Retooling Impact Assessment for The New Century*; Army Environmental Policy Institute: Atlanta, GA, USA, 1998.
98. Duvail, S.; Médard, C.; Hamerlynck, O.; Nyingi, D. Land and water grabbing in an East African coastal wetland: The case of the Tana delta. *Water Altern.* **2012**, *5*, 322–343.
99. Bremer, L.L.; Gammie, G.; Maldonado, O. *Participatory Social Impact Assessment of Water Funds: A Case Study from Lima, Peru*; Forest Trends: Washington, DC, USA, 2016.
100. Chen, R.S.; Tsai, C.M. Development of an evaluation system for sustaining reservoir functions—A case study of Shiwen Reservoir in Taiwan. *Sustainability* **2017**, *9*, 1387. [CrossRef]
101. Peng, L.C.; Lin, Y.P.; Chen, G.W.; Lien, W.Y. Climate change impact on spatiotemporal hotspots of hydrologic ecosystem services: A case study of Chinan catchment, Taiwan. *Water* **2019**, *11*, 867. [CrossRef]
102. Chang, F.J. Artificial intelligence for integrated water resources management in Taiwan. *J. Water Resour. Res.* **2013**, *2*, 316–322. (In Chinese) [CrossRef]
103. Prenzel, P.V.; Vanclay, F. How social impact assessment can contribute to conflict management. *Environ. Impact Assess. Rev.* **2014**, *45*, 30–37. [CrossRef]
104. Vanclay, F.; Esteves, A.M.; Aucamp, I.; Franks, D.M. *Social Impact Assessment: Guidance for Assessing and Managing the Social Impacts of Projects*; International Association for Impact Assessment (IAIA): Fargo, ND, USA, 2015.
105. Snellen, W.B.; Schrevel, A. IWRM: For sustainable use of water; 50 years of international experience with the concept of integrated water resources management. In Proceedings of the FAO/Netherlands Conference on Water for Food and Ecosystems, Wageningen, The Netherlands, 31 January–5 February 2005.
106. Vanclay, F. International principles for social impact assessment. *Impact Assess. Proj. Apprais.* **2003**, *21*, 5–12. [CrossRef]
107. Hassing, J. *Integrated Water Resources Management in Action: Dialogue Paper*; UNESCO: Paris, France, 2009.
108. Swatuk, L.; Mengistu, A.; Jembere, K. *Conflict Resolution and Negotiation Skills for Integrated Water Resources Management: A Training Manual*; Cap-Net: Pretoria, South Africa, 2008.
109. Cap-Net; Global Water Partnership; UNDP. *Integrated Water Resources Management Plans, Training Manual and Operational Guide*; Cap-Net: Stockholm, Sweden, 2005.
110. Cap-Net; UNDP. *Integrated Water Resources Management for River Basin Organisations (Training Manual)*; Cap-Net: Stockholm, Sweden, 2008.
111. Sonoda, T. *Introduction to The IWRM Guidelines at River Basin Level: Dialogue Paper*; UNESCO: Paris, France, 2009.
112. Nakajo, Y. A spiral approach to IWRM: The IWRM Guidelines at River Basin Level. In *Hydrocomplexiety: New Tools for Solving Wicked Water Problems*; Khan, S., Savenije, H., Demuth, S., Hubert, P., Eds.; IAHS Publication: Wallingford, UK, 2010; Volume 338, pp. 145–158.
113. Stakhiv, E.Z. *IWRM Guidelines at River Basin Level and Global Changes*; 2009 World Water Week: Stockholm, Sweden, 16 August 2009.
114. Goldman, L.R. (Ed.) *Social Impact Analysis: An Applied Anthropology Manual*; Routledge: New York, NY, USA, 2020.
115. Freudenburg, W.R.; Keating, K.M. Increasing the Impact of Sociology on Social Impact Assessment: Toward Ending the Inattention. *Am. Sociol.* **1982**, *2*, 71–80. Available online: https://www.jstor.org/stable/27702500 (accessed on 8 October 2021).
116. Ibisch, R.B.; Bogardi, J.J.; Borchardt, D. Integrated water resources management: Concept, research and implementation. In *Integrated Water Resources Management: Concept, Research and Implementation*; Ibisch, R.B., Bogardi, J.J., Borchardt, D., Eds.; Springer International Publishing : Cham, Switzerland, 2016; pp. 3–32.
117. Ministry of Economic Affairs. *Special Statute for the Comprehensive Management of River Basins*; Ministry of Economic Affairs: Taipei, Taiwan, 2014. Available online: https://law.moj.gov.tw/ENG/LawClass/LawAll.aspx?pcode=J0110090 (accessed on 8 October 2021). (In Chinese)
118. Ministry of Economic Affairs. *Forward-Looking Infrastructure Plan of Water Environment: National Water Environment Improvement Project*; Ministry of Economic Affairs: Taipei, Taiwan, 2017. Available online: https://www-ws.wra.gov.tw/001/Upload/oldFile//media/66652/%E5%85%A8%E5%9C%8B%E6%B0%B4%E7%92%B0%E5%A2%83%E6%94%B9%E5%96%84%E8%A8%88%E7%95%AB%E8%A8%88%E7%95%AB%E6%9B%B8%E6%A0%B8%E5%AE%9A%E6%9C%AC.pdf (accessed on 8 September 2021). (In Chinese)
119. Environmental Protection Administration. *Environmental Impact Assessment Act*; Environmental Protection Administration: Taipei, Taiwan, 1994. Available online: https://law.moj.gov.tw/ENG/LawClass/LawAll.aspx?pcode=O0090001 (accessed on 8 September 2021). (In Chinese)
120. Chou, K.T.; Ho, M.S. *A Study of the Application of Technical Guidelines for Social Impact Assessment in Environmental Impact Assessment*; Environmental Protection Administration: Taipei, Taiwan, 2017. (In Chinese)
121. Inghels, D. *Introduction to Modeling Sustainable Development in Business Processes: Theory and Case Studies*; Springer Nature: Cham, Switzerland, 2020. [CrossRef]
122. Wu, S.R.; Celik, I.; Apul, D.; Chen, J. A Social Impact Quantification Framework for the Resource Extraction Industry. *Int. J. Life Cycle Assess.* **2019**, *24*, 1898–1910. [CrossRef]
123. Ramos Huarachi, D.A.; Piekarski, C.M.; Puglieri, F.N.; de Francisco, A.C. Past and Future of Social Life Cycle Assessment: Historical Evolution and Research Trends. *J. Clean. Prod.* **2020**, *264*, 121506.

124. Creswell, J.W.; Plano Clark, V.L. *Designing and Conducting Mixed Methods Research*, 3rd ed.; Sage: Thousand Oaks, CA, USA, 2017; pp. 1–20.
125. Lee, C.C.; Chen, L.C. Who are the resident stakeholders in a flood project? A spatial analysis of resident stakeholders. *Nat. Hazards* **2011**, *59*, 107–128. [CrossRef]