

# RIHN Initiative Projects

KUBOTA Jumpei | Initiative Framework Unit Head

RIHN Initiative Projects are developed through intensive discussion at RIHN of past, present and future research objectives (see page 5). They operate within a major field of thought roughly analogous to the ancient Greek realms described by Gaia, Oikos and Ethos.

## GAIA Initiative

As human societies design their futures they require best understandings of the Earth's natural dynamism, and the significance of human action within it. The Gaia Initiative therefore performs investigations of the biophysical bases of humanity at multiple spatial and temporal scales. The Initiative emphasizes description of physical standards related to boundaries and thresholds so as to allow analysis of, and best eco-technological adaptations to, dynamic Earth environments.

## OIKOS Initiative

Research in the Oikos Initiative investigates the practices and knowledge systems through which cultures and communities humanize environments. It emphasizes the human ecologies and economies—from modern techno-centric to traditional—associated with environmental commons. The Oikos Initiative therefore emphasizes examination of the values associated with resource use, and the importance of linking a range of eco-technologies and social equity.

## ETHOS Initiative

The Ethos Initiative examines the values and dynamics affecting human ecological knowledge, especially in relation to the key areas of food production and human health. The Initiative describes the relationship between environmental knowledge, including that embedded as cultural value and sense of self, on quality of individual and community life.

Full Research	Leader	Title
C-09	KUBOTA Jumpei	Designing Local Frameworks for Integrated Water Resources Management
E-05	SATO Tetsu	Creation and Sustainable Governance of New Commons through Formation of Integrated Local Environmental Knowledge
R-08	TANIGUCHI Makoto	Human-Environmental Security in Asia-Pacific Ring of Fire: Water-Energy-Food Nexus



# Designing Local Frameworks for Integrated Water Resources Management

Interim Project Leader **KUBOTA Jumpei** RIHN

Professor Kubota earned a doctorate in forest hydrology from Kyoto University (1987). He was previously Assistant Professor at Kyoto University (1987-1989), Assistant Professor (1989-1996) and Associate Professor (1997-2002) at Tokyo University of Agriculture and Technology. He joined RIHN in 2002, and now directs the CRD and RIHN-China initiative. His major research fields are hydrology, water issues in arid regions, and human adaptation to societal and environmental changes.



## Backgrounds and objectives

Humanity's rapidly-increasing water demands has a dramatic impact on the global water cycle. Water availability is limited, and thus Integrated Water Resources Management (IWRM) has been developed as an effective measure to coordinate its sustainable use. Whereas IWRM was initially advocated as a philosophy and practice to comprehensively manage water resources involving various sectors and stakeholders, more recently it is challenged to develop regular techniques by which its significance and societal implementation can be evaluated. At the local level, new policy guidelines are required, because social structures often vary, as exemplified by decentralisation of water management in several of our study zones. It is also important to note that IWRM discourse has shifted dramatically, perhaps in relation to the Millennium Development Goals, from its previous emphasis on water quantity to its present concern for safe water quality. As a consequence, water resources managements now must address both water quality and quantity in relation to basin hydrology and ecosystem integrity. For this project, local level agricultural, industrial, and domestic use of water is of fundamental importance to understanding desired interactions between humanity and nature in the context of global freshwater use and supply.

The objective of the project is to propose knowledge structures and functions of water resources management for various local-level stakeholders who play an essential role in adapting IWRM into society. To this end, our project aims at developing *water consilience* for a desirable local water resources management and embodying co-creation of knowledge between science and society, in order to describe real-world functions and prerequisites of management structures composed by infrastructures, institutions, and organisations, throughout agricultural, industrial, and domestic sectors. We will derive evaluation indices of water management on a variety of spatio-temporal scales, and develop tools contributing to concrete goal-setting and evaluation measures. We will also address potential impacts of IWRM on global water resource dynamics that involve local water resources management in watersheds as well as virtual water trades, thereby providing scientific evidence of futurability to various stakeholders, such as policymakers and local end water users, towards solutions of global water environmental problems.

## Main results to date

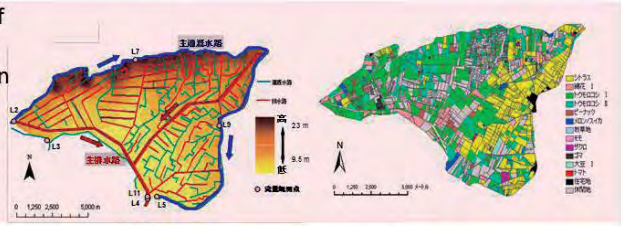
We have re-designed our research methodology to integrate the selected local case studies and global water resources assessment into a single transdisciplinary synthesis, *water consilience*. Validity of the selected case study sites was re-examined through an analysis of FAOSTAT that summarises national statistics on the socioeconomic activities and natural environment.

In each case study area, an interdisciplinary survey proceeded with rigorous scientific elucidation, upon which an attempt has been made to perform co-creation of knowledge between science and society, a key element of transdisciplinarity. In Turkey, we have figured out problems in water management operation such as divided information and unclear responsibilities in spite of privatisation. At the same time, surveys on river flow status, drainage water quality, and land use have revealed that excessive use of irrigation water and chemical fertilizer was responsible for degradation of watershed environment and land productivity. In Indonesia, field survey on Subak in Bali has pointed to a mechanism of organisational transition that public policies changed managing organisations from autonomous to cooperative unions. Furthermore, in South Sulawesi, the scheme to implement co-creation between science and society was established, in cooperation with individual farmers, municipalities, and local NGOs. For the Egypt site, we have developed methodologies to reconstruct the formation process of local water resources management over the past 5,000 years, as well as a palaeoenvironmental model of river flow and basin irrigation system of the Nile. At the Echi River site, hydrological surveys in beneficiary areas of the Eigen-ji Dam have revealed that water demands have depended on the transition of water resources management and form of agricultural management after dam construction. To complement these field-based studies, we ran a global water resources model and performed uncertainty and sensitivity analysis, in order to evaluate hydrological characteristics of each case study site. Our Bayesian uncertainty analysis helped to delineate several regions where uncertainties in the model predictions are significant, for which the model merits further improvement.



Integrated understanding of the impacts of institutions, technologies and outlook on natural resources of water users related to water resources management.

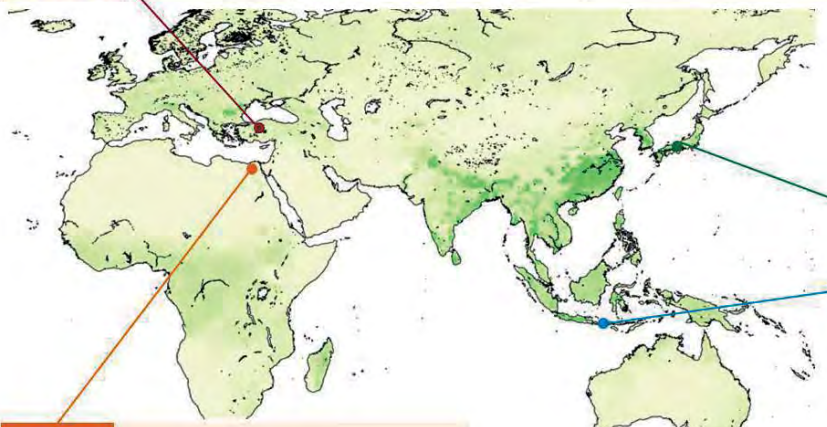
**TURKEY**



Examination of water resources management by clarifying water users' recognition of allocation and understanding water quality characteristics.

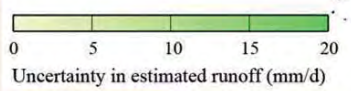
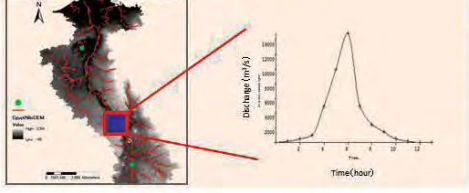


**ECHI RIVER**



**EGYPT**

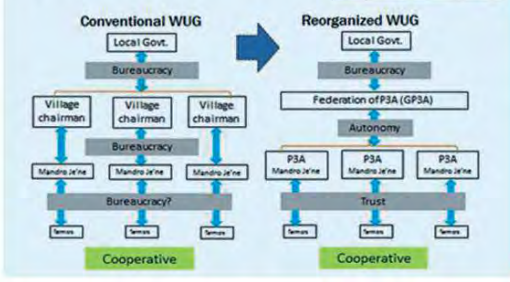
Historical elucidation of local water resources management based on reconstructions of stream flow and evaluation of irrigation improvement projects.



**GLOBE**  
Bayesian uncertainty analysis and numerical simulation linking local cases and global water resources dynamics: towards pro-humanistic assessment.

**INDONESIA**

Clarification of conventional water resources management systems in humid areas and attempts to co-creation of knowledge between science and society.



Progress of the Project C-09-Init at a glance. The map in the centre indicates the geography of uncertainties in a state-of-the-art water resources model for runoff predictions, on which the key elements of research problems and findings in the four case study sites on water resources management are featured. The map in the centre indicates that the deeper green is, the higher uncertainties are. This means that it is difficult to estimate the amount of water resources. We hereby figure out the significance to develop the model considering uncertainties of estimation. Local-level co-creation of knowledge between science and society in the context of global freshwater use will be realised so as to develop *water consilience* as a single transdisciplinary integration.

**Research plan**

Major challenges in the next step will be development of Bayesian ANthro-Socioeconomic-Hydrological systems Evaluation Emulator (BANSHEE) for pro-humanistic water resources assessment, as well as further field surveys in each case study areas. In detail, we aim at integrating patterns of decision making with scientific findings through hydrological observations. The former might be clarified through socio-economic surveys such as interview and questionnaires. The latter might be indicated by water quantity, water quality, and stream regime. Thus, it is necessary to describe “wisdom of land and water

management” from each case study area, both quantitatively and qualitatively, and to formulate local knowledge through collaboration with stakeholders in a proactive way.

Based on BANSHEE, our project aims at outreaching concrete outcomes for both science and society. We will propose pro-humanistic water resources assessment toward science as scientific innovation, and local water resources governance toward society as societal implementation, on the other hand. The former will further reveal how decision making among stakeholders should impact water resources dynamics in the future. On the basis of that, our project will concretely propose road maps for sustainable water resources management desirable in local areas.

Sub Leader

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# Creation and Sustainable Governance of New Commons through Formation of Integrated Local Environmental Knowledge (ILEK project)

Project Leader **SATO Tetsu** RHIN

Professor Tetsu Sato studied the ecology of cichlid fishes of African lakes for 20 years. Throughout his career including as Conservation Director of WWF Japan and professor of Nagano University, he focused on creating knowledge bases for community-based management of natural resources. He also led a project to create a network of local scientists producing Integrated Local Environmental Knowledge.

Co-Project Leader **KIKUCHI Naoki** RHIN

Professor Naoki Kikuchi has been working at the Hyogo Prefectural Homeland for Oriental White Stork as a residential researcher on environmental sociology regarding restoration of the Oriental White Stork. His transdisciplinary research focuses on solutions of environmental problems from the perspectives of local stakeholders.



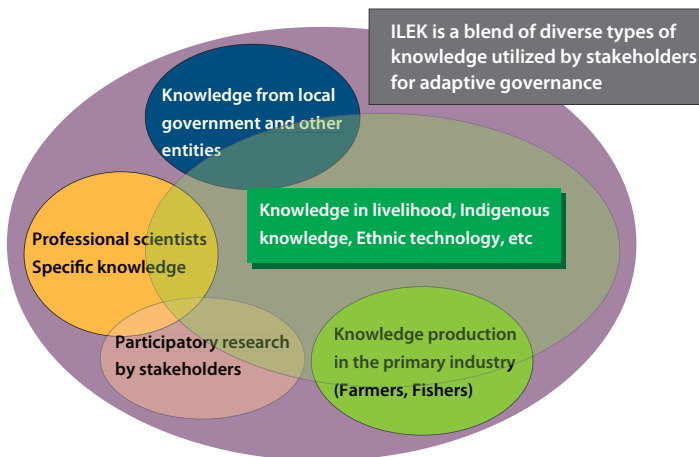
## Research objectives

Diverse local ecosystem services have deteriorated all over the world for various reasons. Ecosystem services should be managed as new commons by collaboration of various stakeholders with different values and interests, both within and from outside the communities. In order to create and sustainably manage such commons, the formation and circulation of local knowledge systems deeply embedded in real local settings is desperately needed. Integrated Local Environmental Knowledge (ILEK, Fig. 1), a novel concept of local knowledge blending scientific as well as various types of knowledge systems among stakeholders, is produced, circulated and utilized in diverse cases of local research and actions all over the world to achieve sustainable development of local communities. We aim to clarify mechanisms to facilitate production and circulation of ILEK and dynamic changes of social systems supported by ILEK to propose ILEK-based adaptive governance mechanisms of local communities. We also make a quest of mechanisms for integrating multi-scale governance for global environment problems, by analysing formation of multi-scale knowledge bases through knowledge flow mediated by bilateral knowledge translators promoting circulation of knowledge between knowledge producers and users, both within local community and across global, regional and local scales. By integrating a wide range of research results on these knowledge production and utilization systems, the project aims to understand formation mechanisms of ILEK and adaptive governance systems of local communities using ILEK as a knowledge base.

## Main results to date

We have selected 61 case study sites (32 sites from East Asia including Japan, 12 from developed countries in Europe and North America and 17 from developing countries) from RIHN projects and other examples of diverse local knowledge productions in the world in order to accumulate and analyse ILEK production mechanisms. The case study group consisted of researchers deeply involved in each local community who have conducted participatory research and meta-analysis to elucidate ILEK production and sustainable adaptive governance mechanisms leveraged by ILEK. Twelve candidate sites for social experiments to verify focused hypothesis have been identified among these case studies, including Shiraho community in Ishigaki Island, Yakushima Inland (Japan), Sarasota Bay in Florida (USA) and Karapinar area (Turkey) to design experimental procedures.

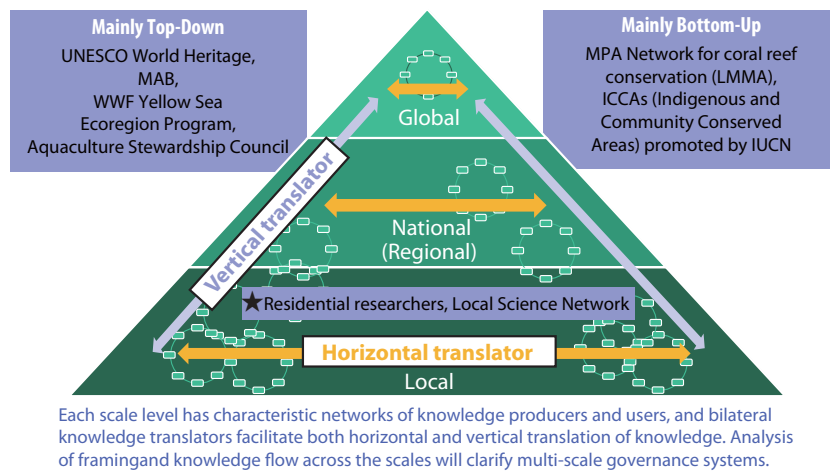
Case studies so far have revealed importance of residential researchers living in local communities and conducting transdisciplinary research as a member of local stakeholders in production of ILEK essential for community-based adaptive governance. Bilateral translators of knowledge promote circulation of ILEK among scientists and diverse knowledge users by evaluating and transforming scientific knowledge from the viewpoints of knowledge users, and by translating knowledge among stakeholders into scientific language. The project has been analysing transdisciplinary knowledge productions of these important actors from RIHN projects and diverse examples of solution oriented researches from the world, based on the cases of ILEK production and utilization



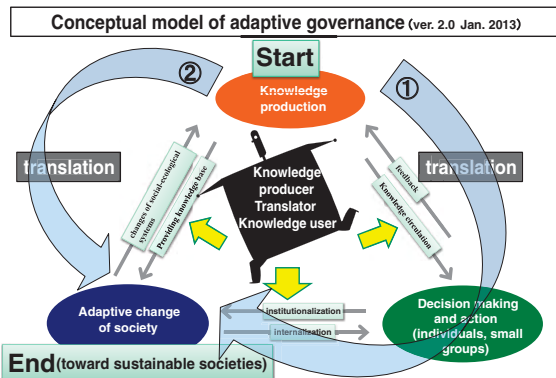
**Figure 1 Structure of local knowledge for environment and sustainability**

Production and circulation of ILEK is not exclusively performed by professional scientists. Rather, it is often produced and circulated by diverse actors in local communities, including skilled workers in primary industries, local government officials, local companies and NGOs, most of them being knowledge users at the same time. ILEK is formed and utilized through dynamic interactions among different actors/stakeholders in local communities, integrating scientific knowledge and local knowledge produced in daily livelihood and culture among local stakeholders.

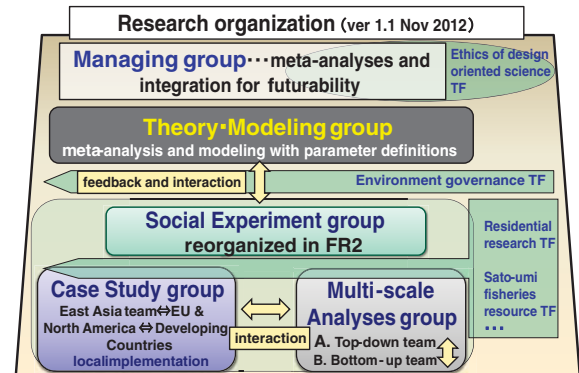




**Figure 2 Hypothetical framework of multi-scale analyses**  
This framework will be used to analyze the role of bilateral knowledge translators in supporting knowledge flow and adaptive governance across different scales from local to global.



**Figure 3 Conceptual model of adaptive governance based on ILEK**  
The pathways to achieve adaptive governance using ILEK are postulated in this model with two different processes starting from knowledge production resulting in adaptive societal changes via changes in individual decisions and actions, or directly influencing formal and informal institutions.



**Figure 4 Research organization**  
The ILEK project research groups are composed of case studies and multi-scale analysis groups at the empirical side and the theory and modeling group at the abstract side, interacting with each other to conduct meta-analysis and integration by brainstorming and participatory field research. Diverse taskforces focus on meta-analysis from specific perspectives. The managing group integrates all these results to postulate adaptive governance mechanisms toward sustainable societies.

accumulated among diverse residential researchers, local translators, visiting researchers and stakeholders in the Local Science Network for Environment and Sustainability. We also established the multi-scale analysis group to analyse knowledge circulation mechanisms across multiple scales from local to global levels facilitated by the bilateral knowledge translators, and thereby aim to understand multi-scale adaptive governance mechanisms through knowledge circulations across multiple scale levels (Fig. 2).

### Future research plan

We have established the preliminary conceptual model of ILEK-based adaptive governance for meta-analysis and modeling in collaboration with the mathematical scientists and conceptual theoreticians in the theory and modeling group to integrate diverse local case studies and multi-scale analysis. In this conceptual model, ILEK productions are hypothesized to lead to dynamic changes of social systems

toward sustainability through two different pathways: first, through changes of individual decision makings and actions resulting in adaptive changes of social systems; and second, through direct effects upon formal and informal institutions and collective knowledge systems in the community (Fig. 3). We also established several task forces (TFs) in the project to integrate diverse case studies from specific perspectives, including TF on the ethics of design-oriented science in order to examine ethical aspects of transdisciplinary sciences, environmental governance TF analysing governance theories of local environment from wider perspectives, and a residential research TF focusing on roles and functions of residential researchers (Fig. 4). We will explore accurate understanding of adaptive governance systems based on ILEK production and circulation by theoretical analysis and integration using this conceptual model in combination with analyses in TFs and focused social experiments.

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# Human-Environmental Security in Asia-Pacific Ring of Fire: Water-Energy-Food Nexus

Project Leader **TANIGUCHI Makoto** RHIN

Prof. Dr. Makoto Taniguchi is a hydrologist. He has been working on global studies of groundwater as a leader of UNESCO GRAPHIC Project “Groundwater Resources Assessment under the Pressures of Humanity and Climate Change”, Vice President (2007-2011) of the International Committee of Groundwater of IAHS under IUGG, and national representative (2007-present) of IAHS. He is also an editor of the books “Subsurface Hydrological Responses to Land Cover/Use Changes”, “Land and Marine Hydrogeology”, “The Dilemma of Boundaries” and “Groundwater and Subsurface Environments”.



## Research objectives and background

Climate change and economic development are increasing pressure on water, energy and food resources, presenting communities with difficult tradeoffs and potential conflicts among these resources. Therefore, the water-energy-food nexus is one of the most important and fundamental global environmental issues facing the world. As water is the central matter within this cluster, we will focus on the inherent tradeoffs between water and food, and water and energy. For the purposes of this project, we define human-environmental security as the joint optimization between human and environmental security as well as the water-energy and water-food connections. To optimize governance and management within these inter-connected needs, it is desirable to increase human-environmental security by improving social management of the water-energy-food nexus. In this research project, we intend to establish a method to manage and optimize human-environmental security of the water-energy-food nexus. We base our approach on the viewpoint that it is important for a sustainable society to increase human-environmental security and decrease vulnerability by optimizing the connections within the critical water-energy and water-food clusters.

We will take a regional perspective on these global environmental problems. The geological and

geomorphological conditions in our proposed study area are heavily influenced by the so-called Pacific Ocean “Ring of Fire”. Within these areas, including Japan and Southeast Asia, the hydro-meteorological conditions are dominated by the Asia monsoon. The populations that live under these natural conditions face elevated risk and potential disaster, while also benefitting from positive ecological goods and services. There are therefore tradeoffs and conflicts within the water-energy-food nexus, as well as among various stakeholders in the region.

The objective of this project is to maximize human-environmental security (minimize the vulnerability) by choosing management structures and policies that optimize both the water-food and water-energy connections in Asia-Pacific coastal regions. We define the joint security approach as optimized policy for both critical water clusters. Optimal policies will develop joint security approaches for human-environmental security in the coastal region of the Ring of Fire, including stakeholders and decision-makers.

## Research methods and organization

Five different interdisciplinary approaches, scales and clusters will be used in this investigation: (1) Environmental governance, science in/for society, and co-design/

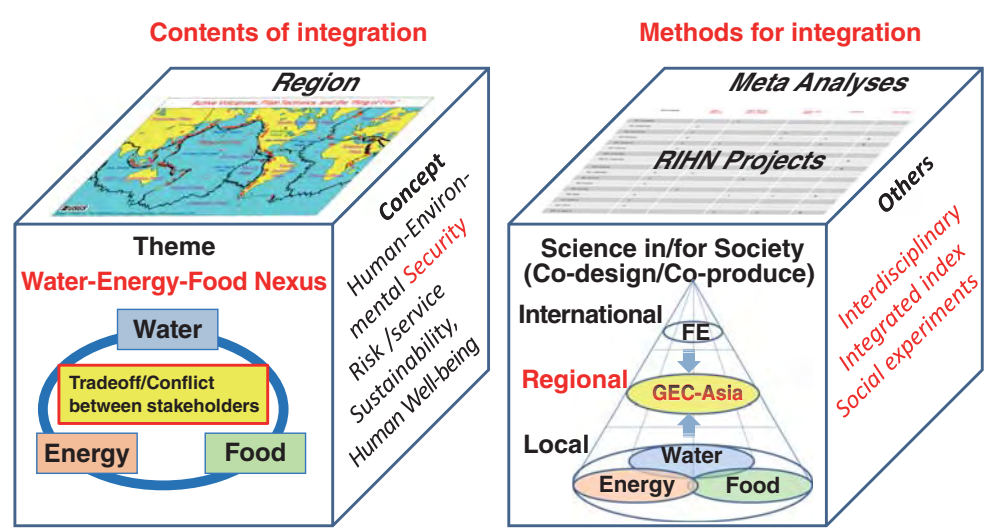


Figure 1 Integration of theme, concept, region, and methods.

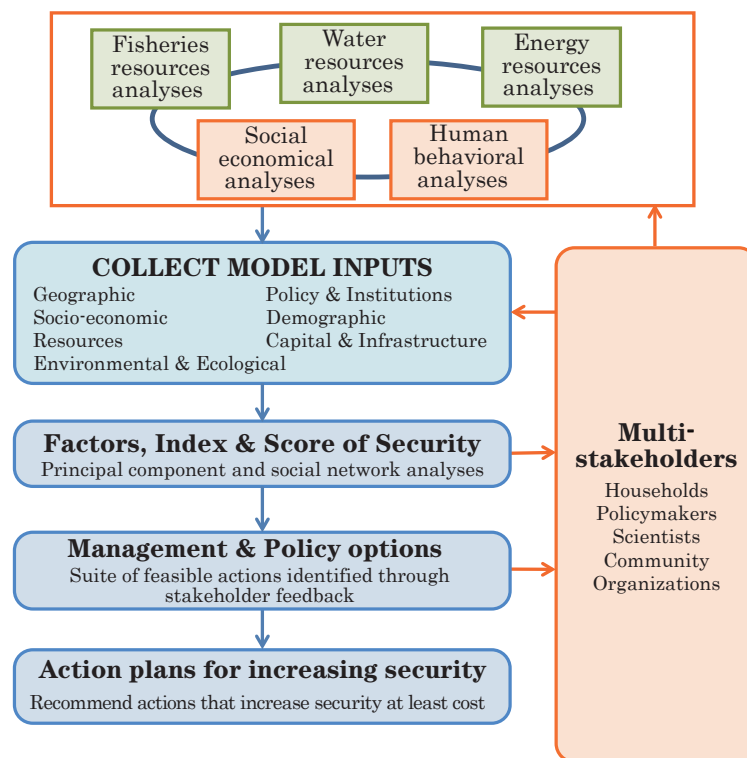


Figure 2 Analyses of human-environmental security in water-energy-food nexus

co-production approaches, in particular emphasizing regional scale stakeholders such as the GEC (Global Environmental Change) Asia Platform; (2) Biophysical measurements and analyses of the water-food (e.g., fisheries resources) nexus by using state-of-the-art geochemical, coastal oceanographic, geophysical, hydrologic, and ecological techniques including isotopic tracers to evaluate the linkages between land and ocean; (3) Biophysical measurements and analyses of the water-energy nexus by state-of-art space satellite, geothermic, and hydrogeological techniques to evaluate linkages between water and energy; (4) Social measurements and analyses of the water-energy-food relationships through community surveys, cost-benefit/efficiency analysis, and environmental valuation, based on sociology, economics, anthropology, psychology, and behavior-science methodologies; and (5) Development of integrated

indicators/indices and network analyses based on principal component analyses, social network analyses, and factors weights determined by feedback from stakeholder meetings and workshops.

### Expected results

1. Suggested guidelines to increase environmental security and reduce conflicts related to the water-energy-food nexus.
2. Recommendations for decreasing coastal vulnerability related to the separate governance of land and oceans.
3. Policy and governance structure recommendations for improved water management.
4. Suggestions for sustainable environmental management of the water-energy-food nexus in the Asia-Pacific region.

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