THA 2022 INTERNATIONAL CONFERENCE

REPORT ON MOVING TOWARDS A SUSTAINABLE WATER AND CLIMATE CHANGE MANAGEMENT AFTER COVID-19 FROM EXECUTIVE PANEL DISCUSSION DURING THA 2022

Executive Panel Discussions on Water Management/THA2022

Chief Editor

Associate Professor Dr. Sucharit Koontanakulvong

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Preface

Water management is an important issue for the world's socio economical development and security which also indicated in the UN Sustainable Development Goals. Recent impacts due to fluctuating climate induced huge damages in many parts of the world including Asia-Pacific region. Moreover, in the long term, climate change impacts will induce more risk on water management as seen in the action plans after COP16. Under COVID-19 pandemic as present, the world is facing health crisis and also impacted from financial difficulties. There is needs to review recent issues of water management in various aspect to set the near water planning under new circumstances. It is important for public planners, academia and private executives to know and be aware for adaptive measures for their preparation planning in the next five years.

The objectives of the executive panel speakers discussions, organized online in the 'THA 2022 International Conference on Moving Towards a Sustainable Water and Climate Change Management After COVID-19' between January 26 – 28, 2022 in Bangkok, Thailand, is to provide and share recent information on status/research, new idea/concept to cope with issues under climate change and move towards SDGs with the target groups of policy and planning executives, scholar, executives from private sector under the common questions of (1) confirm issues/problems/impacts faced and to be faced on the topic, (2)New concept/approach to cope with and meet SDGs and (3) sample or good practices to be learned.

During the executive panel speakers session for executives, there are four topics to be presented and discussed, i.e., Water Disaster Management and Climate Change, Water Management and Climate Change, Sustainable Groundwater Management towards SDG and Water Management under Water Security towards SDG with distinguished speakers from academia, international agencies, government planners and private executives.

Lastly, we would like to thanks to all distinguished panel speakers for their contributions and the National Research Council of Thailand (NRCT) for funding this report production.

Associate Professor Dr. Sucharit Koontanakulvong

March 2022

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Executive Summary

In the opening session,

For climate change, Mr. Benoit from WB presented that water is a key factor for ensuring adaptation. As the saying goes, "prevention is better than cure" in terms of managing increased hydrological variabilities by conducting better cost–benefit analysis, improving water use efficiency and managing evapotranspiration, implementing green–gray infrastructure to protect against floods and droughts, and increasing water storage. For coping with disasters, governments should invest in catastrophe risk models, implement early warning hydromet systems, consider risk parametric insurance, and retrofit build back infrastructure.

Mr. Christophe from UNDP shared that the big challenge now is how to handle worrying trends and questions on the lack of political views, along with the application of technological innovations through partnerships with the private sector. These are all excellent strategies to address SDGs, such as SDG6 and SDG14. While we hope for a "new normal" after the pandemic, the fundamental question would be whether we are able to use the lessons we have learned during this time. Specifically, we must look at the crisis as an opportunity to change and effectively manage water and climate change for a better future.

Dr. Surasee from ONWR presented Thailand's climate policy framework of ONWR with some important entry points for the integration of IWRM and ecosystem-based-adaptation (EbA) solutions to prevent and reduce the impacts of climate change and water-related disasters at the national and River Basin levels. In addition, the 20-year master plan on water resources management is the strategic foundation for the time period from 2018–2037 structured into six key strategies: water for domestic use, water security for the production sector, flood and water-related disaster management, water quality management, conservation and upstream rehabilitation and soil erosion prevention, and administration and management. IWRM and EbA are the key concepts of climate change adaptation in the water sector.

Session 1: Water Disaster Management and Climate Change

For a long time, Prof. Tachikawa presented that Japanese policy to combat floods is to simply construct dikes and dams. However, climate change affects the ability to control flood flow, thus calling for greater cooperation between river and land agencies. As a result, the first policy called "River Basin Disaster Resilience and Sustainability by All" was established. It is a measure to cooperate with all stakeholders in any place

around the basin, not only the river but also catchments, for disaster prevention, exposure reduction, and disaster resilience.

The lessons learned from the UNDP's experience, Mr. Taichi indicated that there is no one-size-fits-all solution, as they have to tailor the solution based on the local contexts and needs. In addition, there are multiple channels of support, such as the Central Ministry's planning and expenditure, local administration planning and expenditure, nongovernmental organizations (NGOs), civil society organizations, and other community groups.

Dr. Giriraj from IWMI presented the guidelines for implementing this bundling strategy under IWMI consist of nine principles, such as using new technologies or satellite data, improving weather data infrastructure, educating farming in the role of insurance, supporting regular monitoring, among others. The BISCA project has been pilot-tested in three states in India where the main participants—the farmers—are very active with the instrument. Moreover, BISCA has been introduced in Sri Lanka. It uses satellite data and develops an aggregator model with its value-chain partners. However, BISCA needs to transform into a larger product to work with multiple stakeholders.

At the national level, Mr. Abdul presented that the government of Indonesia formulated a framework that addresses related problems through four key components: (1) flood risk analytics and investment planning, (2) support for flood resilience investments, (3) capacity building and knowledge management, and (4) program management support. He also promoted the introduction of green infrastructure for greater co-benefits. In addition, the implemented scenario of coastal protection in North Java through water management, the improvement of efficiency through smart water management, and an early warning system for floods in Jabodetabek were presented with the best practices implemented for the urban renewal river project for Sungai Cikapundung-Citarum—an area that is well-organized and managed by the government and community. It has now become one of the famous public spaces in the city.

Session 2: Water Management and Climate Change

Dr. Oki concludes the presentation from ADAP-T program by summarizing the studies and stressing the importance of gathering and sharing adaptation counter-measures and other related information to develop good practices. Moreover, collaborations between stakeholders is also important, along with localized activities for the targeted areas. Finally, the involvement of the young generation is another key factor in achieving success in this field.

Speaker from Dr. Klaus from GIZ ended the session by reiterating that the use of certain areas as nature-based coastal protection systems is very effective and provides

co-benefits. He also stated that the EbA solutions (e.g., T-shaped, permeable and temporary bamboo fences) only work within a specific set of boundary conditions and must be site-specific and appropriate. He also reminded that we should avoid the pitfalls of NbS, such as green-washing and overemphasis on tree planting (Global Standard for NbS). Furthermore, different solutions and their costing should be part of an integrated River Basin master plan, which also integrates EbA and IWRM. This plan must follow a sustainable management approach and involve local communities to ensure the success of conservation and development.

The speaker, Dr. Sangham from AIT emphasized that climate change is the major stressor preventing the achievement of SDG 6, that research priorities should focus on the multiscale nature of impact and adaptation, Dr. and that accelerating adaptation to reduce water insecurity is an urgent task.

The speaker, Dr. Zaki from Malaysia reiterated the eight initiatives in the roadmap developed by the Malaysian government, along with the planning and water management implemented through IWRM in relation to future climate. the speaker also talked about planning, improving, and implementing water infrastructure safety and risk reduction for climate resilience, as well as mainstreaming and implementing climate change adaptation initiatives through the NAP and the MDP. Finally, the speaker emphasized the goal of water sector transformation under the MDP.

Session 3: Sustainable Groundwater Management towards SDG

Prof. Makoto, Japan summarized that enough food sources that consume groundwater are globally traded and that distant areas and countries are indirectly connected to the groundwater footprint. Therefore, the groundwater issue is not only a local but also a global issue. To achieve the SDGs, it is important to manage groundwater as a nexus that connects direct and indirect, local and global, water-energy-food, and economy-environment-society.
Furthermore, increasing the efficiency of groundwater use reduces energy consumption and creates a synergy among water and energy, thus leading to carbon neutrality and sustainable groundwater management. Finally, good practices, such as the one implemented in Kumamoto showing the synergy of the nexus and transboundary governance of groundwater, is also important for achieving SDGs at the local and global scales.

Prof. Yonghui from China concluded that, the possible solutions are crop adjustment, replacing groundwater with Yangtze River water for domestic and industrial use, and relying on relatively high rainfalls that are beneficial for regional groundwater sustainability. However, in the whole North China Plain, evapotranspiration is still increasing slightly, especially in the southern part. In general, groundwater decline has slowed down, but

stabilization is not yet a certainty. Although the goal may have been achieved in the present, the solution for the long term, especially in the southeast part of the area, may not yet be achieved.

Dr. Hans from UNESCO referred to the groundwater management practices applied in Denmark. The basic principles that have allowed for the sustainable management of water resource in Denmark are strong knowledge, strong national commitment, transparent regulatory system, partnerships, and generally high levels of public and political concern and awareness. The country also used the Five M's, an integrated management approach involving mapping, measurement, monitoring, and modeling, as the basic elements that have allowed for the sustainable management of groundwater in the country.

Dr. James from PELA GeoEnvironment concluded that there are a number of research trends in this area, and one of the more important ones is remote sensing, which is increasingly used for aquifer management, satellite data interpretation for drought, and long-term weather forecasting. Other trends include bringing more real-time reporting data online via the web; cross-disciplinary training; and regional, national, and international emphasis on improving water use agreements and best practices. More collaborative studies among consortium universities of corporations. And water as an economic commodity or is a natural right.

Session 4: Water Management under Water Security towards SDG

Mr. Thomas from ADB presented the key findings from Asian Water Development Outlook 2020 (AWDO 2020), which is the assessment of national water security across five key dimensions in Asia-Pacific, including case studies were presented. There are also two reports on water governance and finance and water security by OECD. The new normal and associated water sector investments for water security should focus on building capacity and strengthening financial sustainability and building resilience to absorb shocks and stresses due to pandemics, disasters, and climate change with good water governance.

Prof. Lee presented that the water sector reform in 2018 in Korea involved the establishment of the Water Management Basic Act based on IWRM, river basin management, stakeholder participation, and demand management, and the empowerment of the Ministry of Environment (ME) with more mandate shifted from Ministry of Land, Infrastructure and Transport (MOLIT) to Ministry of Environment (ME). In addition, the integrated dam operation in Korea was demonstrated aiming to avoid socio-economic and environmental impact, minimize and mitigate without significant gaps between regions. The water resources management in South Korea is moving from structural measures and economic growth and industrialization towards non-structural measures and sustainable.

Mr. Nguyen from Vietnam presented that there are pressures from socio-economic development resulting in increasing water demand and water allocation conflicts as well as water pollution, impacts from climate change and management issues. To achieve water security, the plans are to revise the Law on Water Resources, implement IWRM to integrate water resources management and other natural resources, increase investment to improve water use efficiency, and strengthen international cooperation.

For private sector, Mr. Somchai from Thailand presented that water management towards water security focuses on water supply, water demand, and water management. Water supply management aims to reduce vulnerability of scarcity by investment in increasing water supply. Water demand management is to increase water efficiency using 3R technology to reduce water usage, reduce water loss, and optimize water utilization. For water management, private sector has engaged with government to share data and information for planning and operation.

The key recommendations to achieve water security and reduce water insecurity from the Executive Panel Discussion are effective institutional reform, good governance, building resilience, and financing

Overall

From these executive sessions, we can find the keywords of water management to aim for more resilient and secured to meet SDGs via more integrated, more balanced, more natural based, more community involved, new technology innovation and wise finance and investment schemes with more information, knowledge and experiences sharing among regional and international communities.

Opening Keynote Speeches

The "International Conference on Moving Toward Sustainable Water and Climate Change Management after COVID-19," also known as THA2022, is the most important conference of the year due as it is dedicated to sustainable water management and climate change. The THA conference was first organized in 2015 and subsequently held in 2017 and 2019. With the COVID-19 situation and its ongoing impacts, the Thai government has raised concerns about the health and safety of participants. Therefore, the event has been converted to an online webinar format. The conference is organized by Chulalongkorn University in association with nine national partners, four international collaborative agencies, and one supportive agency, including academic institutes, and private and public sectors organizations, bringing together researchers, engineers, scientists, executives, and official domains of interest from around the world. It is a platform in which to share advanced research findings, perspectives, and experiences in water management and climate change, including new technology and water management, toward the achievement of Sustainable Development Goals (SDGs). Special attention will be given to developing certain skills, competencies, and general upgrading of performance capabilities to manage climate change, apply technology for predictive purposes, and attain progressive and sustainable development during the monsoon season in Asia.

Prof. Dr. Supot Techavorasinskun, Dean of the Faculty of Engineering, Chulalongkorn University, gave a speech to welcome all participants to THA2022. The theme of the current year is designed to match current global challenges. The three keynote speakers came from the World Bank, the United Nations Development Programme (UNDP), and the Office of National Water Resources (ONWR). There are four executive sessions focused on the topics of Water Disaster Management and Climate Change, Sustainable Groundwater Management toward SDGs, and Water Management under water security/SDGs respectively. There were also three themes discussed in the technical sessions: water and climate change, water and technology, and sustainable water management. In addition, there were training courses on hydrologic analysis using global/regional climate models (GCM), water security, and science–policy interface dialogs on water and climate change. They have been shown that climate change results in water crisis by inducing a cycle of unusual floods and droughts, as well as shoreline erosions. To decrease these impacts, the Thai government has committed to leading the country to achieve its carbon neutrality and zero-emission goals by 2050 and 2060, respectively.

Floods can happen anytime in the near future. Drought and water shortage may disappear, but without water management, drought can come back anytime. Governments must be prepared to protect human lives and properties. Pain and failure should be forgotten, and life should go on. However, experiences and lessons from flood events should always be remembered. Furthermore, this should bring greater awareness among people in terms of initiating a revolution. Nevertheless, only progress characterized by the inclusion of all relevant stakeholders can bring about sustainable development.

This conference would not have been executed without its supportive partners, including the Thai Meteorological Department, the ONWR, the Royal Irrigation Department, the Department of Water Resource (DWR), the Department of Ground Water Resource, Kasetsart University, Asian Institute of Technology, the Thailand Innovation Research and Innovation, National Research Council of Thailand, Kyoto University, Taiwan University, Korea Water Resource Association, Japan International Cooperation Agency, and so on. Moreover, this event is expected to the generate ideas and initiate discussions toward greater environmental sustainability for the next generations.

Air Chief Marshal Chalit Pukbhasuk, Privy Councilor of Thailand, delivered the official opening remark and keynote address for THA2022. In the past year, apart from COVID-19, several global threats have emerged, including the growth of natural disasters, climate change, biodiversity, and other environmental situations. The rapid advancement of climate change, such as extreme temperature, storms, floods, and drought, has become more visible this year.

In August 2021, the latest published government report regarding the pandemic and climate change concluded that there was a relevant link between the atmosphere and climate change. Climate changes have obviously affected people from across the globe, including those from developing countries, who are highly exposed and vulnerable to climate change. Counties must set immediate commitments to climate change and COVID-19, as these have impacts on every aspect of our lives, causing work ways and interactions. To overcome the challenges, the Thai government has supported studies and collaborations to transform the global economy and citizens' well-being, especially in terms of management issues, knowledge exchange, technology transfer, and innovations. All of these can drive our communities toward the achievement of SDGs by focusing on research forces. The impacts of climate change issues also have accompanying challenges. Thus,

THA2022 has provided opportunities for scientists, researchers, policy planners, and decision makers to discuss, share knowledge, and seek ideal solutions for issues related to water management and climate change throughout our region and the rest of the world. Air Chief Marshal Pukbhasuk thanked local and international participants who joined the event. Furthermore, he expressed hope for the success of THA2022.

The keynote address delivered by Air Chief Marshal Pukbhasuk cited the conference agenda, which include (1) water management and development in Thailand, (2) philosophy of sufficiency economy, and (3) royal initiative projects that drive Thailand toward sustainable development. First, water plays an important role in human life, as it is involved in economic development, efficiency in productivity across the economic sector, and the well-being of citizens, the community, and society. However, the water problem is also exacerbated by climate change. Previously, King Bhumibol Adulyadej traveled across the country to visit the Thai people. Furthermore, he established the philosophy of sufficiency economy, which aimed to foster balanced and stable development at all levels—from the individual, family, community, and societal levels—to cope with critical challenges arising from global conditions. This principle follows Buddhist beliefs of pursuing the middle path to conduct various ways of life in alignment with globalization. In other words, we should try to avoid extreme thoughts, behavior, and actions.

The philosophy of sufficiency economy has three components: moderation, reasonability, and self-immunity with appropriate knowledge and ethics. Sufficiency economy has been recognized as having a positive influence on people's lives. King Bhumibol had tirelessly worked for over 60 years to improve the lives of the Thai people and give rise to a sustainably developed country. Indeed, he preferred teaching people how to fish instead of giving them fish. Economic development must be done step by step. All efforts should begin with strengthening our economic foundation by ensuring the maturity of our operations. Once reasonable proposals have been achieved, people should embark onto the next step of the advanced level of economic development. King Bhumibol envisioned his goal of developing the land. Thus, he initiated the planting of vegetables, strawberries, tea, and lettuce. In Northern Thailand, the locals only knew how to grow poppy for their livelihood. Therefore, they were educated to grow coffee, which yielded higher returns. These actions address SDG1 (no poverty), SDG2 (zero hunger), SDG4 (quality education), and SDG10 (reduce inequality). For communities suffering from forest denudation, activists also worked to improve the regions where headwater areas can be found and helped

such communities avoid water-related disasters and other climate change-related issues.

Meanwhile, slash-and-burn agriculture is a traditional strategy implemented by many Thai farmers to clear areas, causing significant biodiversity losses over the years. This practice has also caused several problems, such as carbon dioxide emissions, soil erosion, and greenhouse effects. As a result, rice paddy terraces and appropriate use of fertile land were introduced. In addition, the basic infrastructure of existing reservoirs has been developed and renovated, thus ensuring that farming areas have a sufficient amount of water. These efforts respond to SDG11 (sustainable cities and communities), SDG13 (climate action), and SDG15 (life on land).

At present, there are 4,877 royal initiative projects across regions in Thailand distributed in various sectors, such as water resources, agriculture, career promotion, and social welfare. Moreover, his majesty, King Maha Vajiralongkorn, also runs a total of 127 royal initiative projects, including his initiation and citizen petition. Some examples of these projects were presented during the THA2022, including the Kao Tao Reservoir project, a water development project in Huahin District built for consumption purposes. Moreover, the Klong Lat Pho project and its improvement were built for managing excess water from the Chao Phraya River to the Gulf of Thailand. Another project is Monkey Cheek, which utilizes land and functions as a temporary flood control facility. This project also aimed to solve the problem of floods in Bangkok and other metropolitan areas. The Pa Sak Jolasid Dam project was constructed to support the agricultural sector in the dry season and prevent/reduce flooding problems during the rainy season. The royal Khun Dan Prakarnchon Dam project was established to reduce flood damages in the plains of Nakhon Nayok Province, including supplying water for agriculture and consumption areas. Overall, the royal philosophy of sufficiency economy and other initiative projects may provide you with ideas on how to implement projects that address SDGs and ultimately achieve sustainability.

Next, they were three interesting speakers delivered their keynote speeches. The first speaker was Mr. Benoit Bosquet with the topic “Water Disaster Management toward SDG and Post-Covid.” The second speaker was Mr. Christophe Bahuet with the topic “Water Management under Climate Change.” The final speaker was Dr. Surasee Kittimongkol with the topic “Water Management in Thailand toward SDGs.” in the opening ceremony moderated by Dr. Supattra Visessri, Chulalongkorn University.

Water Management under Climate Change

Mr. Benoit Bosquet

Regional Director for Sustainable Development,
East Asia and Pacific, The World Bank

Water Disaster Management toward SDG and Post-COVID

Mr. Benoit Bosquet talked about a notable crisis, COVID-19, along with other crises, including off-track ones, in relation to SDGs, climate change, and increasing water stress. Regarding the COVID-19 pandemic, East Asia and the Pacific was the first region to be affected. Even then, there were expectations for the region to also be the first to recover. Unfortunately, successive waves of the Omicron variant-driven surge hit the region, resulting in human and capital losses, such as children being unable to go to school or some people losing their jobs. Deep economic contractions also occurred, resulting in losses in the badly hit tourism sector. Furthermore, there have been disproportionate impacts on the most vulnerable members of the population, thus highlighting inequalities and the unsustainability of the conventional development pathway. COVID-19 has led to a significant increase in domestic water demand while water use decreased in certain commercial sectors, such as tourism. All these imply the importance of the water sector for humans and our health, particularly in terms of ensuring better hygiene practices.

Turning to the far off-track to meet SDGs, water is needed in almost all SDGs. To illustrate, under SDG6, two billion people (25%) lack safe sources of drinking water service, 3.6 billion (46%) lack safe sanitation services, and 494 million people still practice open defecation. Furthermore, 2.3 billion (29%) lack basic handwashing facilities at home, 44% of household wastewater is not safely treated, and 2.3 billion people live in water-stressed countries, of which 107 countries are not on track to have sustainably managed water resources by 2030.

Regarding climate change, the Paris Climate Commitment has gathered various sectors to limit the increasing degree of temperature. Although, countries stated that they will become carbon-neutral, we are still far from that point, as shown in Figure 1. Currently, most efforts must be deployed in the energy, agriculture, land use, and transport sectors, among others.

Furthermore, water stress levels are increasing, as demonstrated by the exponential trending in Figure 2, in which the blue and red lines represent the population and higher water withdrawal, respectively. Starting in the 1950s, it has become obvious that human population is growing faster, resulting in greater demand for water sources. Thus, the THA2022 conference has attempted to address the crises of water being too much (flood risk), too little (drought), or too dirty (water stress). This paradoxical situation is being experienced by countries, such as Thailand or Cambodia, which faced water shortage and possible flooding simultaneously. The significant

impacts around the world between 2000 and 2019 showed that 1.65 billion people are adversely affected by floods and another 1.43 billion are affected by droughts. In addition, floods and droughts have caused US$764 billion in recorded damages, plus US$1,390 billion from storm-related flooding. Major investments are truly needed to tackle all challenges, including protecting costs, economic investments in strengthening resilience, and preparing for microlevel impacts. For instance, an annual cost of US$150 billion is needed to deliver universal safe water and sanitation, while US$14 billion of water cost is used for utilities in each year. In addition, US$960 is requested by 93 developing countries for building irrigation facilities by 2050. Meanwhile, water security and sanitation comprise only 1% of commercial finance mobilized by development finance. This indicates that the private sector should develop more. Moreover, the public sector must also step up its water investments.

Related to the above, the World Bank Group (WBG)'s response to the climate crisis is thus presented. The WBG has proposed a climate change action plan summarizing its corporate commitment across public and private sectors. It prioritizes four key system transitions in the areas of (1) energy; (2) agriculture, food, water, and land; (3) cities and transport; and (4) manufacturing. The WBG has also strengthened capacities through diagnostics across country climate development reports and targeted 35% of WBG financing to include climate co-benefits. The Country Climate and Development Report (CCDR) aims to highlight finance development, policy advice, or the relevance of climate aspect actions, including mitigation and adaptation. These are based on rigorous data, analysis, and research. CCDR also aims to bring expertise, tools, and resources for the WBG. The macroeconomic analysis will be prepared in coordination with the IMF. Furthermore, they expect to inform country-level dialogs through which the CCDR can analyze how a country's development goals can be achieved.

Water underpins most of the SDGs. Consequently, the World Bank has integrated approaches on three main pillars, including sustaining water resources, delivering services to water sanitation and agriculture, and building resilience against climate change and pandemics. It has a strong portfolio supporting 144 projects reaching almost US$24 billion. The ways by which the water sector can contribute to water mitigation include the following: reducing methane emission from irrigated paddy rice fields, reducing greenhouse gas (GHG) emissions by increasing energy–water use efficiency, reducing methane emissions in sanitation facilities and promoting circular economies, reducing GHG emissions by building more multipurpose storage and incorporating renewables, and fighting deforestation.

Meanwhile, rice is the main food staple for half of humanity, especially Asians who account for 90% of global rice consumption. In Southeast Asia, rice accounts for 80% of its total crop area, with rice as the single largest user of land for flood production. However, rice has the largest GHG footprint among all field crops, because rice is often grown in flooded fields that release methane. In addition, there are straw burning in Vietnam after harvest. Excessive fertilized emissions are also generated from the production of nitrous oxide. In China, emissions from energy use for irrigation purposes account for 50%–70% of total emissions from energy used by the agricultural sector. Reducing such emissions can significantly reduce carbon dioxide, methane, and nitrous oxide emissions, as well as save energy.

Finally, for climate change, water is a key factor for ensuring adaptation. As the saying goes, "prevention is better than cure" in terms of managing increased hydrological variabilities by conducting better cost–benefit analysis, improving water use efficiency and managing evapotranspiration, implementing green–gray infrastructure to protect against floods and droughts, and increasing water storage. For coping with disasters, governments should invest in catastrophe risk models, implement early warning hydromet systems, consider risk parametric insurance, and retrofit build back infrastructure.

To conclude the presentation focused on Thailand, Climate Action Tracker rates

the updated 2020 Nationally Determined Contribution (NDC) of Thailand as "critically insufficient" in terms of overall country contribution to meeting the Paris Agreement commitment goals on global warming, as it would lead to rising rather than falling emissions. As a result, the Prime Minister of Thailand pledged net-zero GHG emission by 2065. In addition, Thailand has declared the "Bio-Circular-Green economy model (BCG)" as a forward-looking strategy, which is also the main agenda of the 2022 APEC meeting. In recent years, the Thai government has significantly devoted resources to water management. This approach has been successful so far, because many Thai people are able to access drinking water, generate abundant food supplies, and even generate hydro power. Nevertheless, we need to recognize that water is a limited resource across multitude sectors. Interestingly, the National Statistic of Thailand has developed a Water Management Index, which shows the critical level of water usage. The WBG is ready to support Thailand in thinking about the future of water management, including stimulating the private sector for additional investments.

Water Management under Climate Change

Mr. Christophe Bahuet

Deputy Assistant Administrator and Deputy Director of the UNDP Regional Bureau for Asia and the Pacific (RBAP)

Water Management under Climate Change

The keynote speech on "Water Management Under Climate Change" was presented by Mr. Christophe Bahuet, Deputy Director of the UNDP RBAP. First, he thanked Chulalongkorn University for establishing this linkage between climate change and water management. This is because it is actually a crucial link that the UNDP has been working on in most observation countries.

First of all, the climate emergency is still there despite the fact that most of the world has shifted its focus to the COVID-19 pandemic. Most of the headlines today are about the pandemic. You may have seen the announcement from the World Meteorological Organization that last year (2021) was one of the seven warmest years, reaching a global temperature increase of 1.1 degrees. This should call public attention and immediate action.

Second, there is no time to lose when it comes to water management even during the pandemic. If we look at the headlines about the extreme event disaster last year. Madagascar had a severe drought that impacted about one million people. In the Arctic, the ice caps are melting. In the Asia-Pacific region, which is highly vulnerable to climate change and disaster, several countries have experienced natural events: floods and droughts in China and India, typhoons and flooding in the Philippines, a tsunami in Tonga, and so on. Just the day before the speech was delivered, heavy rains were pouring in the Philippines. If we look at all those examples, there is one common point: water-related disasters.

Looking at the UNDP estimates, water-related disasters comprise about 75% of all natural disasters over the last twenty years. This means that all of them can be directly linked to climate change. As we can already see, the frequency of such disasters has begun to increase. Such water crisis has three dimensions. The most visible dimension is disaster related, including such as tsunamis, which affect residential structures, building and infrastructure, water supply, and livelihood. The second dimension is the unprecedented increase in water supply due to the melting glaciers, rising sea levels, and water salinization, all of which are gradually accelerating over the years. Though these are not visible to most of us, those who are living in the islands throughout the Pacific have already felt the impacts. The third dimension is scarcity, which is related to lack of access to clean drinking water, lack of water supply, depleted bodies of water, and rising demand from an ever-growing population.

All three dimensions mentioned above require management—be it immediate or reactive. It is important to emphasize that this is not just a purely technical issue but also has a very strong human dimension.

In particular, there is the problem of population growth in many countries in

the Asia-Pacific region. Thus, we have the demographic challenge and the increasing need for water. The second reason is rapid urbanization. About 55% of the population in the region live in the cities, which also need stable water sources and effective water management. The overall human dimension is very much there. Furthermore, there is still the problem of climate change, which has impacted human development as well. All of them are good reasons as to why we must ensure proper management.

Related to the above, it is important to picture reliable global governance that can also look at regional-level opportunities for water management. Then, we also have country-level governance, which is about the NDC, mitigation, and adaptation activities implemented by the national governments. In many countries, water research institutes or water departments administrations are gaining additional capacities for research development and policymaking. These institutes come up with increasingly integrated approaches and long-term strategies to resolve water-related concerns.

At the same time, governments have also increasingly constructed infrastructure for water management. In relation to the COVID-19 pandemic, the impact is quite negative at this moment. It is obviously a risk to return to full business mode, but Mr. Bahuet thinks the UNDP has a very clear goal of achieving sustainable, green recovery. He acknowledges that the risks involved make up an economic paradox. However, he believes that it is important for policymakers and institute organizations to analyze this economic paradox because it is important in achieving sustainable development. When we work together with the government on national development plans and strategies, we can see increasing efforts to solve sustainable water issues in their plans. Furthermore, we can see the concrete outcomes of such efforts at the community level. In fact, looking at examples found in the UNDP website, you can see that the UNDP's efforts have been successful, especially in the Asia-Pacific region. Regarding the issues tackled in the THA2022 conference, all efforts should consider the current state of climate change and water management and how governments can improve community life at the same time.

To conclude the presentation, he shared that the big challenge now is how to handle worrying trends and questions on the lack of political views, along with the application of technological innovations through partnerships with the private sector. These are all excellent strategies to address SDGs, such as SDG6 and SDG14. While we hope for a "new normal" after the pandemic, the fundamental question would be whether we are able to use the lessons we have learned during this time. Specifically, we must look at the crisis as an opportunity to change and effectively manage water and climate change for a better future.

Water Management in Thailand Towards SDG

Dr. Surasee Kittimongkol

The Secretary-General,

Office of the National Water Resources (ONWR), Thailand

Water Management in Thailand Towards SDG

The keynote speech on "Water Management in Thailand and toward SDGs" was presented by Mr. Surasri Kittimongkol, Secretary General of the ONWR. He started the presentation by providing a background on water management in Thailand. To integrate water management, the Thai government has developed four major pillars in water resources management: the 20-year master plan, the Water Resources Act of 2018, water management organizations, and the development of knowledge, innovations, and technologies.

The first pillar is a 20-year master plan on water resources management, as announced by the Royal Thai Government Gazette on September 18, 2019. It is a framework for addressing water-related issues and developing water resources in the country with the vision of "Every village has clean water for consumption, water security for production, reduced flood damage, and water quality that is within standard sustainable water management and under balanced development through the participation of all sectors." Its development guidelines include a strategic plan that includes the following: water consumption management, enhancing water security production sector, flood management, water quality management and water resources conservation, conservation and rehabilitation of degraded watershed forests, soil erosion protection, and management of all administrative departments.

The second pillar is the Water Resources Act of 2018, as announced by the Royal Thai Government Gazette on December 28, 2018 and came into force on January 27, 2019. It is the main law that oversees the systematic and unified water resources management for all sectors and integrates the allocation, use, development, management, maintenance, rehabilitation and conservation of water resources, and rights. The law consists of 9 chapters and 106 sections. The third pillar is the establishment of various water resources management organizations. The National Water Resources Committee is responsible for developing, supervising, and driving water resources management plans at the national level; the River Basin Committee oversees river basins at the provincial level; and the Water User Organization manages activities at the local level.

The fourth pillar is the development of knowledge, innovations, and technologies. The ONWR has worked on the Thai Water Plan, which is an application to develop, analyze, and monitor plans, projects, and budgets of all implementing agencies. The application is being developed to achieve updated and transparent management. Furthermore, the Thailand Water Assessment is an online database for the integration and monitoring work plans

for water resources management of the country, while One Map is a real-time disaster-warning website that uses a nearly real-time analytic approach. It provides accurate analysis results for better decision making. These are the four pillars used by the ONWR as mechanisms for managing water resources in the country.

Then, Dr. Kittimongkol moved on to the Thai government's performance based on the 20-year master plan on water resources management during 2018–2021. The first phase aims to increase water supply efficiency in 4675 villages, expand 570 water distribution areas, and develop clean drinking water in 1004 locations. The second aspect is providing basic water (430.97 million cubic meters) and groundwater supply (118.46 million cubic meters) for the agriculture sector and developing water storage/water control structure/new water distribution systems for the agriculture and industrial sectors. The third aspect is the development and improvement of 13 water-retarding areas, 118 water barriers, and 230 kilometers the natural waterways. The fourth aspect consists of 12 newly constructed treatment systems that control and regulate 1409 water pollution sources. The fifth aspect is the restoration of upstream forests comprising 24971 hectares, the reduction of soil erosion in upstream areas (13163 hectares), and reduction in soil erosion in agricultural areas (58864 hectares). The sixth aspect is the Water Act of 2018, along with 12 secondary legislations and the 20-year master plan. Currently, the ONWR is setting up a Water User Organization Forecasting on flood risk areas, which links plan levels 1, 2, and 3 and the main action plan. For water resources operation in Thailand, we will include SDG 6 (clean water and sanitation). We will also monitor and evaluate water activities to support national and international goals.

Last year, the status of SDG6 in Thailand was evaluated. The authorities found that the country still has plenty of challenging issues to address in relation to its goals. For example, people can already access clean drinking water, but there is still more work to do in order to provide better water quality and affordable prices. Furthermore, wastewater and water quality are in the process of being standardized in accordance with global levels. However, there is still much work to be done with the new water strategies, laws, and organizations in place, but we are confident that we will establish a better life with better water for the Thai citizens. Regarding national water security, we have exerted efforts to increase water security in five key dimensions after evaluating the status of water security in the country. The country garnered a medium score compared to other countries. Currently, water productivity and water quality in urban areas should be carefully addressed. Furthermore, water efficiency in the agricultural sector is also quite low when compared with the manufacturing and service sectors. Thus, we have to

strengthen policies and guidelines to improve operations.

After that, the status of the integrated water resources management (IWRM) in Thailand was presented. Although its status is the same as the average global value, this is expected to improve in the near future because of support from citizens. Last year, many water user groups registered, and these water-related communities pledged to support local water management. Moreover, Thailand's climate policy framework has established some important entry points for the integration of IWRM and ecosystem-based-adaptation (EbA) solutions to prevent and reduce the impacts of climate change and water-related disasters at the national and River Basin levels. In addition, the 20-year master plan on water resources management is the strategic foundation for the time period from 2018–2037 structured into six key strategies: water for domestic use, water security for the production sector, flood and water-related disaster management, water quality management, conservation and upstream rehabilitation and soil erosion prevention, and administration and management. IWRM and EbA are the key concepts of climate change adaptation in the water sector.

Finally, Dr. Kittimongkol discussed the topic of what preparations should be made in the post-COVID-19 world. As we all know, due to COVID-19, the country's GDP growth rate dropped to its lowest value. As a result, metropolitan residents who lost their livelihoods returned to their villages and engaged in farming. Furthermore, during September and October 2021, farmers suffered economic losses due to tropical storm Dianmu. For such extreme events, the ONWR developed a new system for economic damage assessment from satellite images to monitor flood damages in real time. We also discovered that the rice fields damaged by tropical storm Dianmu had a total area of around 5700 sq. km. (405 M.USD). Thus, all relevant parties gave timely assistance to those who were affected. In response, the ONWR has also planned to improve the water resources management master plan to reflect the current situation. In particular, the ONWR aims to improve the following targets included in the original water master plan:

1. Consider water security at the community and household levels from the beginning
2. Integrate water resource development by defining zoning using Agri-Map
3. Consider promoting fisheries in low-land areas during floods
4. Provide additional guidelines for the development of the Khok Nong Na Model into a reserve water source that can be used to store water in case of flooding
5. Emphasize the water management of water resources in accordance with climate change

6. Collaborate with NANOTEC to devise state-of-the-art water storage equipment and increase public interest in collecting more water

7. Promote the reuse of wastewater using the 3R principles

8. Using academic principles in public relations by presenting them in an easy-to-understand way

Executive Panel Session - 1

Water Disasters Management and Climate Change

Projection of Hydrologic Extreme Using Large and Ensemble Climate Change Scenario

Prof. Dr. Yasuto Tachikawa

Kyoto University

Introduction

The executive panel session one presented and discussed about the topics Water Disaster Management and Climate Change. The objective of this section is to generate research information and new ideas to cope with water disaster management and climate change issues with the ultimate goal of achieving the SDGs. Four experts were involved in this session with the topics; "Projection of Hydrologic Extreme Using Large and Ensemble Climate Change Scenario" presented by Prof. Dr. Yasuto Tachikawa, "Water Management in a Changing Climate" presented by Mr. Yusuke Taishi, "Bundled Solutions for Climate Risk Management" presented by Dr. Giriraj Amarnath and "Indonesia's National Water Disaster Management Plan" presented by Mr. Abdul Malik Sadat Idris. Then there is a general discussion at the end of the session.

Projection of Hydrologic Extreme Using Large and Ensemble Climate Change Scenario

First, Prof. Dr. Yasuto Tachikawa from Kyoto University presented his topic, "Projection of Hydrologic Extreme Using Large and Ensemble Climate Change Scenario." Every year, Japan encounters a natural disaster. In July 2018, frontal heavy rainfall caused 237 deaths, 8 missing people, and 37 breached levees, which generated economic losses amounting 1,094 billion yen. In October 2019, Typhoon Hagibis caused 99 deaths, 3 missing people, and 140 breaching levees and recorded economic losses of up to 2,180 billion yen. These recorded climate change projection data were used by policymakers to assess the impact of climate change on hydrologic extremes and to conduct adaptation strategy planning. Projection research highlights three cores: (1) the Database for Policy Decision making for Future climate change (D4PDF), which was developed by the Methodology Research Institute, (2) impact assessment, and (3) adaption strategy. In addition, floods and

inundation modeling for all basins in Japan were successfully developed, and existing estimation methods of flood damages were evaluated. Finally, the Japanese government has decided to consider the effects of climate change in flood planning.

The D4PDF is a kind of data simulation that consists of global atmospheric simulations using a 60-kilometer resolution and dynamically downscaled simulation with 20-kilometer resolution. There are two types of experimental designs: 2-degree scenario data and 4-degree scenario data as an extreme case. The important characteristic to consider is having 6,000 years of time-series data, which are crucial in evaluating an extreme event.

Related studies have focused on the Yodo River basin spanning Osaka and Kyoto, which are major cities in Japan. The results of the simulation on long-time series data showed the relationship between disaster probability and maximum rainfall in 24 hours in the Yodo River Basin. Figure 1a shows the 4-degree increased scenario in red line, which leads to higher rainfall in the return period of 200 years compared to current climate change in the return period of 900 years represented by the blue line. In addition, this causes a larger discharge amount, as shown in Figure 1b. The annual discharged rainfall from the River Basin is increased, especially because there is a higher ratio in the north of Japan. Moreover, in Figure 2, simultaneous flood probability is presented under a 4-degree scenario, which means there are more chances of overflowing basins.

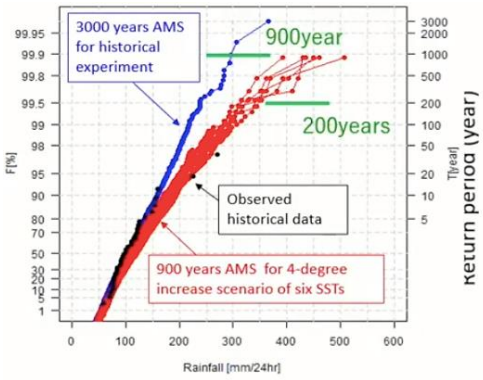


Figure 1a: Annual maximum 24hrs rainfall.

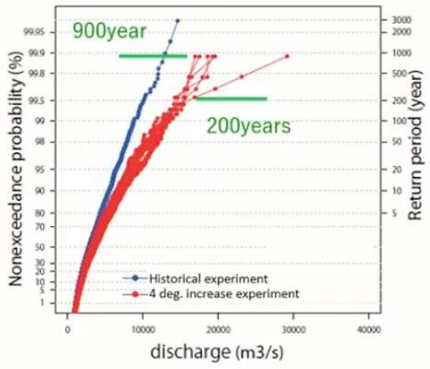


Figure 1b: Annual maximum peak flood.

Note. Adopted from "Future change analysis of extreme floods using large ensemble climate simulation data," by Tachikawa, Y., Miyawaki, K.,, Tanaka, T., Yorozu, K., Kato, M., Ichikawa, Y., Kim S. (2017). *Journal of Japan Society of Civil Engineers, 73*(3), 77-90.

According to inundation simulation, it is possible to estimate economic damages based on disaster probability. Therefore, a nationwide real-time flood prediction system is developed. With the aim of

strengthening flood control capacity by using forecast information, dam inflow prediction can be utilized for water prerelease capacity.

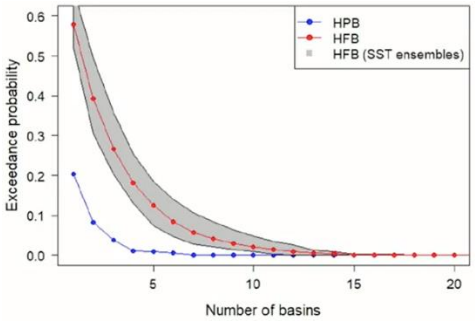


Figure 2: Exceedance probability of number of river basin in the western Japan.

Note. Adopted from "Simultaneous flood risk analysis and its future change among all the 109 class-A river basins in Japan using a large ensemble climate simulation database d4PDF" by Tanaka, T., Kobayashi, K., & Tachikawa, Y. (2021). *Environmental Research Letters, 16*(7), 074059.

In 2020, the Japanese government established a new policy on water-related disaster risk reduction. This policy takes comprehensive and multilayered actions. First of all, the policy calls for all stakeholders surrounding the river basins, including the national government, prefectures, municipalities, private enterprises, residents, and water users, to take action to ensure disaster resilience and sustainability. As Japan is considered an aging society, it is necessary to achieve a safe and secure network urban planning to maintain regional vitality. At the same time, new technologies, such as 5G, AI, and big data can be utilized for disaster reduction and evacuation.

For a long time, Japanese policy to combat floods is to simply construct dikes and dams. However, climate change affects the ability to control flood flow, thus calling for greater cooperation between river and land agencies. As a result, the first policy called "River Basin Disaster Resilience and Sustainability by All" was established. It is a measure to cooperate with all stakeholders in any place around the basin, not only the river but also catchments, for disaster prevention, exposure reduction, and disaster resilience. Meanwhile, the worsening impacts of climate change has resulted in increasingly discharged rainfall. Thus, the second policy is upgrading plans for flood control considering the impact of climate change. In the past years, Japan has prepared plans against floods, landslides, and storm surges based on data on past precipitation and river levels. In the future, the revised plan will consider climate change in assessing increasing rainfall and rising river levels. It is important to incorporate flood projection data with a disaster plan.

Water Management in a Changing Climate

Mr. Yusuke Taishi

Regional Technical Advisor for Climate Change Adaptation, UNDP

Water Management in a Changing Climate

The next speaker during the Water Disaster Management and Climate Change session is Mr. Yusuke Taishi from the UNDP, who presented the severe impacts of climate change on water management. In the Asian region, we are constantly expecting increased rainfall, yet drought still happens. At the same time, extreme weather conditions, such as heavy rain, heat waves, and dry days probably give rise to various disaster events. Some parts of Asia experience agricultural droughts while receiving higher annual rainfall, making it quite challenging to handle the issue of water management. There are many transmissions of climate change impact on human development. For example, intensifying cyclones affect saltwater intrusion into water bodies and damage infrastructure and livelihoods, which, in turn, affect water and food insecurity. An understanding of the multifaceted implications of water-related disaster management is very important in providing an effective solution.

Currently, the UNDP is supporting farmers in the Philippines with the provision of crop insurance against rainfall variability. In addition, ecosystem-based coastal management is being developed to strengthen resilience toward typhoons in the eastern provinces. Figure 1 shows the simulation of flood height from 1 in a 50-year typhoon with and without coastal ecosystems. As can be seen, Panel A presents the current situation of the coastal system, while Panel B reveals

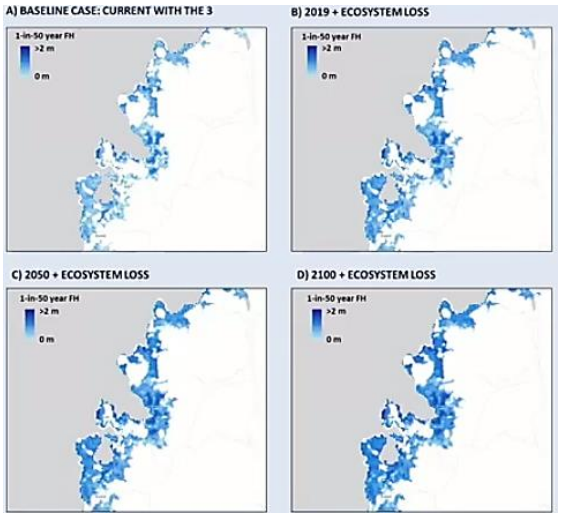


Figure 1: Flood height with and without coastal ecosystem (in a 1-in-50 flood).

that the loss of the ecosystem causes severe floods. Therefore, the ecosystem plays an important role in floods and subsequent damages. Next, the lower panel shows the future scenarios in 2050 and 2100, during which citizens may face greater damages from floods. In Sri Lanka, the UNDP is working with the government for the rehabilitation of ancient water cascades in the central dry zone, including an introduction of climate resilience agriculture. In Vietnam, last-mile irrigation is extended, which connects to vulnerable and ethnic minority

farmers and upgrades communal ponds for rainfed farmers. In the last example, Myanmar, the UNDP has integrated rural water management, rehabilitated degraded watersheds, constructed community irrigation channels and ponds, and raised climate resilience agriculture.

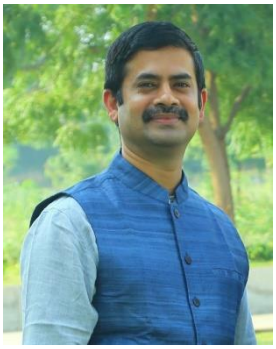
The lessons learned from the UNDP's experience indicate that there is no one-size-fits-all solution, as they have to tailor the solution based on the local contexts and needs. In addition, there are multiple channels of support, such as the Central Ministry's planning and expenditure, local administration planning and expenditure, nongovernmental organizations (NGOs), civil society organizations, and other community groups. The essential issue is to consider the effectiveness of different delivery channels following three key principles: (1) resilience cannot be built if communities are not empowered, (2) communities cannot be empowered if they are not engaged, and (3) communities cannot be engaged if they are not informed. Consequently, the effective engagement of local communities and informed engagement are critical for the long-term resilience of a community.

Recommendations for private sector entities are provided, although it depends on the kind of company and operation sector. The first principle aims to raise awareness about the company's operation through the following questions:

- What is the environmental footprint of the company's operations?
- What are the negative externalities that can be internalized?
- Who are engaged in supply chains, and are they made vulnerable to climate change?
- Where along the supply chain can we reduce emission or build resilience?

The second principle is to know what others are doing. For example, the Glasgow Financial Alliance for Net Zero is a commitment of financial institutes to achieve a net-zero society before 2015. There are other two concepts as well, namely, ESG information disclosure and UN Guiding Principles on Business and Human Rights, which may not directly relate to climate change, but illustrate the positive contribution to society in the perspective of climate change. Finally, it is strongly suggested that the Agenda 2030 for SDGs be examined, as it is an expansion of 17 SDGs with more in-depth details. The content will lead the company to think about the contributions it can make to climate change and water management.

Bundled Solutions for Climate Risk Management



Dr. Giriraj Amarnath

International Water Management Institute

Bundled Solutions for Climate Risk Management

This research focuses on national commitment, SDGs, the Sendai Framework, and the vulnerability of local farmers. To strengthen resilience, the participation of the public and private sectors is critical. In terms of the challenges resulting from disaster impacts in the Asia-Pacific region, the COVID-19 pandemic has led to a decrease in mortality and regional economic losses amounting to approximately US$675 billion (including drought impact). Therefore, each country should think of promoting local-scale development and adaptation. On the website, there were also analyses of floods, landslides, and droughts, which led to population exposure and economic losses. This is because countries and global investors need to know the priorities of disaster risk. Finally, research highlights system transformation, which covers Africa, South America, and Southeast Asia, all of which have been shown to have high risks.

Climate screening products for investing in disaster resilience is the map used for assessing individual hazards, such as floods, droughts, landslides, coastal inundations, cyclones, forest fires, earthquakes, extreme rainfalls, heatwaves, and rising sea levels. Multihazard risks are filtered to support the development of disaster risk management (DRM) policies and financial investments for building resilience. Meanwhile, adaptation does not only look at climate change but also examines exposures, impacts, and vulnerable areas. In addition, a Multihazard economic exposure map is an intelligence analysis that integrates Multihazard data, population exposure or gender risk, GDP data, and historical loss-event data. The maps can guide DRM policymaking and sustainable climate financing.

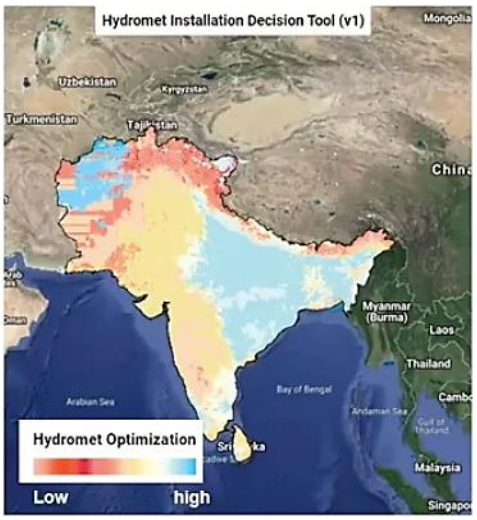


Figure 1: Hydromet installation decision tool.

The hydrological and meteorological (hydromet) optimization tool has also been developed to provide countries with information on where and how this tool should be installed. For example, the tool quantifies the data on rainfall

variability, extreme rainfalls, elevation, and flood occurrences, which can be generated using the hydromet installation decision tool in Figure 1. To illustrate, this tool plays an important role for (1) policy development, (2) guiding the process of impactful investment in hydromet and early warning services, and (3) strengthening hydrological simulations to manage disaster risks.

Only insurance may not help people in reducing losses directly. The right instrument of insurance should be introduced; therefore, the long-term development of an adaptation should be focused. However, insurance is still critical for climate change, sustainable development, and disaster risk reduction (DRR). At least six SDGs have direct relevance to insurance and improving climate adaptation through insurance leads to a higher level of resilience against climate risk. To prevent losses or provide timely action, we need to have a financing infrastructure perspective. In addition, we need to look at the existing risk in the communities, flood-prone areas, drought factors and so on. Then, we must come up with the idea of how insurance can be adapted.

At the same time, risks related to weather conditions remain a major challenge to farming in South Asia. A large fraction of rural households in South Asia suffer from drought sand floods. Thus, rainfed agriculture exposes farmers to huge risks in the lack of bundled solutions. In addition, climate shocks have a significant impact on the short- and long-term welfare of these households. The main actors who bear climate risk in agricultural sectors are the government, agricultural service providers, and farmers, all of which suffer from different kinds of risks. For example, the government faces the costs related to disaster response, while farmers cope with income losses and reduced consumption.

There are various available products to make the agricultural sector more resilient to climate risk. Consequently, bundling insurance with other services called BISCA is provided. To emphasize the role played by insurance, experts are working with farmers and critical service providers of climate resilience seeds to smallholder adaptations in Sri Lanka, giving expert advice based on climate and weather information, and ensuring timely grain procurement. The goals are to increase investments by the public/private sectors, increase gender quality and youth engagement, increase the use of genetic resources, and improve agricultural productivity with greater resilience. The key to the bundle is the link between financial and nonfinancial services and aggregators. Impacts are expected for

lower premiums, quality inputs, and reduced production losses. This opportunity creates new geographies, alternative indices, and product bundling. Nevertheless, there are several challenges that must be overcome, including the cost to farmers, financial literacy, weather data, triggers and designs, basis risk, and administrative costs.

The guidelines for implementing this bundling strategy consist of nine principles, such as using new technologies or satellite data, improving weather data infrastructure, educating farming in the role of insurance, supporting regular monitoring, among others. The BISCA project has been pilot-tested in three states in India where the main participants—the farmers—are very active with the instrument. Moreover, BISCA has been introduced in Sri Lanka. It uses satellite data and develops an aggregator model with its value-chain partners. However, BISCA needs to transform into a larger product to work with multiple stakeholders.

Indonesia's National Water Disaster Management Plan

Mr. Abdul Malik Sadat Idris

Bappenas Indonesia

Indonesia's National Water Disaster Management Plan

Next, the topic "Indonesia's National Water Disaster Management Plan" was presented by Mr. Abdul Malik Sadat Idris *(Bappenas Indonesia)*. Mr. Idris talked about general information on the disasters that have occurred in Indonesia. Specifically, he showed data on natural disasters that occurred in Indonesia during 2011–2021, which increased every year. Among these, floods were the most frequent and generated the highest amount of losses thus far, especially in 2021. Last year alone, 3504 disasters resulted in 700 fatalities and 5 million displaced individuals. As for the tangible losses, the disasters have also affected houses, education facilities, health facilities, worship facilities, offices, and bridges. Mr. Idris further explained the phenomenon of land subsidence on the North Coast of Java in Indonesia. Due to the uncontrollable water extraction in this area, the rate of land subsidence has increased up to 5–20 cm/year in highly dense cities. This has also increased coastal flood hazards by up to 5–200 cm. If we do nothing, the potential hazard will also increase by up 5–200 cm.

The speaker then discussed the impact of climate change in Indonesia. First, he explained the extreme rainfalls in Indonesia. In the coming years, Indonesia is projected to have shorter rainy seasons and longer dry seasons, while precipitation is expected to increase during rainy season. Second, temperatures have also continued to increase due to climate change. In fact, it rose from 1.5C (RCP 4.5) to 3.5C (RCP 8.5) by the end of the 21st century. Third, the sea level is also projected to increase by up to 0.7–1.1 cm/year (RCP 4.5).

In addition, Mr. Idris also spoke about Indonesia's national resilience infrastructure. Specifically, he talked about enhancing the disaster resilience of 20 provinces with high levels of disaster-related risks through three main strategies. The first strategy is DRR in 50 cities, which covers strengthening the resilience of critical infrastructure against disasters, spatial planning and building code regulations, devising a flood risk master plan, and building green infrastructure and an early warning system. The second strategy is coastal protection in five cities of North Java Coast by monitoring and prevention of land subsidence in the area, accelerated construction of sea and river dikes, and establishment of pumping installation in the coastal zone. The final strategy is the restoration of four critical watersheds

by improving conservation in the watershed area, as well as improving water quality and waste management.

The strengthening of flood resilience is achieved through an integrated flood risk management strategy implemented in 50 cities mostly in Java Island, including Sumatra, Kalimantan, Sulawesi, Bali, Nusa Tenggara, and Maluku. The activities are being conducted through the support of national/local budgets and investments from development partners.

The progress of the North Java can be attributed to a five-year project (2020–2024). The structural component target includes the installation of land subsidence monitoring stations and 100 stations for water quality monitoring, as well as the construction of domestic wastewater treatment plants, sea dike and coastal protection structured, and the Semarang–Demak toll road. Meanwhile, the nonstructural components include the formulation of an integrated coastal development plan for the north coast of Java and the enforcement of groundwater uptake regulations.

The four critical watersheds include the DAS Ciliwung, DAS Citarum, Das Cisadane, and DAS Asahan Toba. As a result of this undertaking, water quality was improved, erosion was reduced in the critical watershed area through the reforestation of critical land, and the impacts of floods were reduced in the provinces of Banten, DKI Jakarta, West Java, and North Sumatra.

The last topic was strategic planning for water disasters. The speaker discussed the four main strategies implemented by the Indonesian government: green infrastructures, IWRM, enhancing community preparedness, and strengthening the country's investment capacity through creative financing. Mr. Idris also presented the integrated flood risk management, which consists of six components: supervision and control, socioeconomic strengthening, hydrological and preparedness information system, forest and land rehabilitation, spatial planning and risk mapping, and disaster resilience infrastructure. Moreover, he shows examples of the Integrated Flood Management Integrated Action Plan for Jabodetabek Flood Management.

At the national level, the government also formulated a framework that addresses related problems through four key components: (1) flood risk analytics and investment planning, (2) support for flood resilience investments, (3) capacity building and knowledge management, and (4) program management support. He also promoted the introduction of green infrastructure for greater cobenefits. In addition, he showed the implemented scenario of coastal

protection in North Java through water management, the improvement of efficiency through smart water management, and an early warning system for floods in Jabodetabek. Finally, he presented the best practices implemented for the urban renewal river project for Sungai Cikapundung-Citarum—an area that is well-organized and managed by the government and community. It has now become one of the famous public spaces in the city.

General Discussion

The discussion session started with questions from the audiences moderated by Dr. Anurak Sriariyawat, Chulalongkorn University.

> Based on the forecast of future climate change presented, we can see the trend of higher rainfall various irrigation infrastructure—be they reservoir irrigation canals or embankments that have been used for a long time. The rehabilitation of this infrastructure to accommodate the increase in rainfall would require a huge investment. By the presentation of the project example, it may be considered a small- or midscale project. However, for large-scale projects with larger irrigation areas and a greater number of water users, what factors should be considered to achieve sustainable success?

This question was answered by Mr. Yusuke Taishi, who explained based on the example that he presented, that it was not necessarily a matter of whether a problem was small- or medium-scale. One example is Sri Lanka, where we are supporting the community, the rehabilitation of ancient water cascades to benefit more than half a million people in the central dry zone of the country; thus, it is not necessarily a small-scale project. Second, rehabilitating an existing infrastructure or degrading an infrastructure to benefit hundreds or thousands of people will cost a great deal of money, which many countries or communities don't necessarily have. Thus, I think it is very important to combine various incremental steps, if possible. Some interventions are possible. For example, better soil management and old farm water management are steps that farmers can immediately implement if they are trained. Implementing these measures does not cost a great deal of money, but intervention alone is not going to solve the problem. Rather, there are easier steps that a country can introduce, while some may entail huge capital investments. So, we must think about other technologically appropriate solutions.

The next question given is as follows:

> It seems that Japan is advocating for using the River Basin as the appropriate geographical scale for managing water resources and building resilience. Can you tell us, what is the time frame for Japan to make this shift to River Basin to achieve disaster resilience and sustainability? How does this solution create feasibility given that there are still some uncertainties about localized climate impact?

This question was answered by Dr. Yasuto Tachikawa, who explained that the basic policy to reduce flood disasters is conducted by the Japanese government. At present, plenty of research have been conducted by using future climate change scenario data, which reveal that the future rainfall intensity will increase without doubt. As a result, dealing with the flood-only rivers is difficult, especially as they are projected to increase in the coming years. This also requires good organization and planning, along with a proper timeframe. Then, the government must also consider uncertainties. Throughout this process, stakeholders must be informed, engaged, and empowered.

Next, the moderator asked the question:

Regarding the flood risk development, which is related to economic damage, please elaborate more on the criteria of economic damage that would be considered the main deciding factor in new policy improvement.

This was answered again by Dr. Tachikawa, who explained the relationships among flood damage, exceedance period, and exceedance probability. Understanding this relationship is very important. For agricultural and city areas in Japan, we can estimate the depth of future flood events based on relevant data. I think the government has recognized the importance of strengthening the link between damage and occurrence probability, although it is not yet included in the policy.

Next, the moderator asked Dr. Giriraj Amarnath to explain more about the insurance for the local people: ‘Can you share some of your experience about how to implement the insurance to the local people?’ Dr. Giriraj believes that rural climate insurance has seen significant growth in recent years, especially now that digital data collection is more commonly used. In the past, analyzing risk and damage data took a lot of time and mostly dealt with low-quality data from unreliable resources. Insurance companies were reluctant to invest in risk monitoring because risk insurance products were expensive; only the private sector

agreed to look for more development data and wanted high-quality data as well. Thus, there were numerous challenges between the companies looking for crop insurance and risk insurance, on the one hand, and insurance companies, on the other hand.

At present, insurance programs have vastly improved. At present, countries have started installing more automatic water stations and establishing more water level sensors. This means that insurance companies have better data, which allow them to better design risk products in relation to the projected cost. This represents growth in linking risk insurance with adaptation. Furthermore, the government has played a very important role in the emergence of such proactive participation, which must be further promoted. Some studies have warned of the increasing impacts of climate change, and that the frequency and intensity of the resulting natural disasters are going to vary significantly. Thus, with climate insurance, one can be assured of protection against any losses in the future, which is great news for the private sector. To further improve the situation, insurance companies need to proactively invest more on data collection and transparency.

For the next question, the moderator asked Mr. Idris for his presentation having done a great deal of work in Indonesia in the areas of infrastructure and community development. In Asia, many countries have experienced water-related disasters. Thus, a question arises: What is the most important policy for disaster resilience in your country? He answered that the Java approach is a successful example of resilience efforts in Indonesia, especially at the local level in which people are the first in line to experience natural disasters.

In the final question, the moderator asked about how to encourage people to do more for the community. Mr. Taishi answered that the reason why a bottom-up approach is important is because, in reality, it is difficult to predict the future. You cannot predict an approach alone because your future projection could be wrong, which is why no-regret options are important. When the future is uncertain, it is really important for local people to be resilient. Furthermore, natural hydrological science cannot perfectly predict the future as well. Thus, every single individual must be able to change their behaviors and perceptions to be able to respond well in the present. They are a partner in ensuring a resilient society. Related to this, having this mindset is really important so sharing information and effective engagement are practical steps to achieve this goal.

Executive Panel Session - 2

Water Management and Climate Change

Bundled Solutions for Climate Risk Management

Prof. Dr. Tainan Oki

Special Advisor to the President and Professor,

The University of Tokyo

Introduction

The executive panel session two presented and discussed about topics Water Management and Climate Change. The objective of this section is to generate the research information about water management and climate change issues with the ultimate goal of achieving the SDGs. Four experts were involved in this session with the topics; "Good Practices of Adaptation to Climate Change in Six Sectors in Thailand" presented by Prof. Dr. Tainan Oki, "Ecosystem-based Adaptation a Nature-based Solution for Flood Protection and Water Provision in River Basins" presented by Dr. Klaus Schmitt, "Research Priority of SDG 6 under Climate Change Scenario" presented by Prof. Dr. Sangam Shrestha and "Enhancing Water Management Towards Future Climate in Malaysia" presented by Ir. Mohd. Zaki b. Mat Amin. Then there is a general discussion at the end of the session.

Good Practices of Adaptation to Climate Change in Six Sectors in Thailand

Executive Panel Session 2 was opened by the first speaker, Dr. Tainan Oki, who talked about "Good Practices of Climate Change Adaptation in Six Sectors in Thailand." Dr. Oki showed examples of various research projects he had worked on. First, he explained his project called "ADAP-T," which is a research framework about impact assessment and climate change adaptation. This is observed in four major sectors: freshwater, coastal, sediment, and rural. The adaptation measure aims to work together with the Thai government, the stakeholders/policymakers, and citizens living in the targeted areas in order to demonstrate the costs and benefits of the adaptation on those major sectors.

The project also came up with the methodology for a well-balanced adaptation portfolio: conducting a meta-analysis by considering financial and other metrics related to the sectors involved. Such an activity should support the principle of codesign for good practices, which, in turn, support policymaking for

national master plans that are integrated with adaptations by various stakeholders. This initiative also intends to come up with good climate change adaptation practices/prototypes, which can be further refined and disseminated in neighboring states.

The study area of the ADAP-T can be broken down into several parts: sediment area: Chiang Rai, freshwater and forest are: Nan, rural area: Khon Khaen, urban area; Bangkok, and coastal area: Narathiwat. The ONEP is the core agency that oversees the climate change adaptation efforts in Thailand. The Climate Change Master Plan 2015–2050, initially formulated in 2015, is currently handling the mitigation and adaptation measures to combat climate change in the country under the 2050 vision: "Thailand becomes a Climate Change Resilient and Low-Carbon Development Society Following Sustainable Development Pathway." The National Adaptation Plan (NAP), which includes the implementation and adaptation scenarios, will be submitted to the cabinet in 2022.

There are currently 19 area-based researches under JICA: the ADAP-T program mainly focuses on adaptation options and risk maps. Dr. Oki further shared some of the research results on this topic. First, he presented "Shallow Ground Water Mapping for Agricultural Use" by Dr. Dessel Suanburi (Kasetsart University) and Dr. Koshi Yoshida (UTokyo). In the scenario of a severe drought, shallow groundwater is the only source of water for upland farmers. The supplemental use of SGW (not the main source of irrigation) is recommended to avoid the risk of over pumping. The research also shows that effective use of SGW can provide more benefits for farmers.

Next, a paper regarding a drought monitoring platform authored by Dr. Mingkol Raksapatcharawong (Kasetsart University) and Dr. Kazuo Oki (UTokyo) was presented. Here the evaluation of the drought (wet) conditions using satellite images and the estimation of rice yield via a simulation model is combined to produce drought risk indices (SPI, SDT, DSI) for semireal-time assessments. This will provide people with information regarding upcoming droughts and enable them to prepare on time. Unfortunately, the system is no longer working.

The next research was conducted by Dr. Sutissak Soralump (Kasetsart University) and Dr. So, Kazama (Tohoku University) entitled "Adaptation to Landslide Risk." This is about risk-based design level and adaptation approaches for mitigation impacts from landslide/slope failure/sedimentation. This research also developed and installed

community-based landslide warning systems and tools and conducted intensive community workshops to heighten community awareness regarding the impacts of climate change, such as landslides, and how to prepare for such events. DRR should also be considered a key factor in adapting to climate change.

The research entitled "Impact of Climate and Land Use Changes on flood Discharge" by Dr. Koichiro Kuraji (U. Tokyo) and Dr. Wanchai Arunpraparut (Kasetsart University) was presented. This research assessed the quantitative prediction of impacts of climate and land use changes on flood discharge in forest areas. This study developed a scenario in which an area could transfer between forest or farming land (or other related area in the research). Due to economic demands, landscape changes may occur wherein farmlands would increase and eventually replace the forest. The study also came up with the prediction model of a 10-year flood runoff based on this scenario and what kind of flood discharge would happen based on the land use to forest cover ratio.

The next study to be presented examined the adaptation to rising sea level in coastal zones, which was authored by Dr. Sompratana Rithphring (Kasetsart University) and Dr. Keiko Udo (Tohoku University) This research observed the current beach conditions at 133 locations and found instances of coastal erosion. Then, it examined counter-measures and how much volume of sand would be required for beach nourishment and accompanying costs. Apart from conducting surveillance and research, this team also interviewed 48 villagers living in the coastal zone regarding their views on climate change, coastal disaster, and the ongoing erosion problem. The research team also held workshops targeting the stakeholders for further capacity development.

The web application developed by Dr. Hiroaki Shirakawa (Nagoya University) and Dr. Weerakaset Suanpaga (Kasetsart University) was the last research presented by Dr. Oki in this ADAP-T field. The main output of this study was an interactive tool for evidence-based policymaking, which shows a map indicating the costs and benefits of adaptation in major sectors. It serves as a support tool for decision making regarding well-balanced adaptation portfolios. All these research activities are now compiled into one set of comprehensive results under ADAP-T, which are then delivered to NAP. This is slated to be approved by the Thai government in 2022.

Dr. Oki concludes the presentation by summarizing the studies and stressing the importance of gathering and sharing adaptation counter-

measures and other related information to develop good practices. Moreover, collaborations between stakeholders is also important, along with localized activities for the targeted areas. Finally, the involvement of the young generation is another key factor in achieving success in this field.

Ecosystem-based Adaptation a Nature-based Solution for Flood Protection and Water Provision in River Basins

Dr. Klaus Schmitt

Director of a GIZ Project on Ecosystem-based Adaptation

Ecosystem-based Adaptation a Nature-based Solution for Flood Protection and Water Provision in River Basins

The destruction of forest and wetlands and their conversion to other forms of land use are major contributors to flooding in the low-lying areas of river basins. This is worsened by the impacts of climate change. To address this, nature-based solutions (NbS) offer cost effective adaptation options and co-benefits, including biodiversity conservation and human well-being. If these solutions focus on human adaptation and assure livelihood benefits are implemented as part of a climate adaptation strategy, they are called ecosystem-based-adaptation (EbA). Such an initiative requires the participation of the local people in an integrated approach to implement adaptation strategies that can avoid path dependencies and maladaptations.

The unsustainable use of natural resources and rapid development in the coastal zones are threatening the protection function of the mangrove forest belt. The resulting erosion and destruction of the mangrove belts lead to dyke failure, overtopping, and flooding. For this reason, flood protection—in the muddy coastal areas with mangroves, in this case—is crucial. The tidal flats and mangroves are an "energy conversion system" that can be considered an effective nature-based system for coastal protection. The speaker shown this illustrated figure has emphasized the problem as Figure 1.

Figure 1: The problem from erosion and destruction of the mangrove belt.

The restoration of floodplains/tidal flats is a precondition for mangrove rehabilitation in sites wherein erosion has destroyed the mangroves and eroded the foreshore. The best solution for this problem is the use of T-shaped, permeable bamboo fences as shown in Figure 2. These are designed to minimize erosion and stimulate sedimentation, thus restoring floodplains and recreating conditions for mangrove regeneration. However, the design, technical specifications, and placement of T-fences require a

sound understanding of site-specific coastal processes (wind, waves, and currents), sediment transport, morphodynamics, hydrology, and coastal dynamics.

Figure 2: T-shaped of bamboo fences.

The specific conditions mentioned are then assessed in the laboratory to try to recreate the closest environment in order to determine the effectiveness of the T-fences, after which the design option is tested and implemented based on certain scenarios. Based on the experiments, the solutions are only feasible within a set of boundary conditions. The speaker elaborates on how to achieve these conditions. If we have a lower energy gauge and lower slope, then the T-fences can be used. Otherwise, if it has a higher energy gauge and higher slope, then we need rubble mounds or sea walls.

Dr. Schmitt also emphasized the importance of making the solutions sustainable in the long run, and that this could be achieved through shared governance. The root caused must be addressed, and one example is the unsustainable use of natural resources and development in the coastal zones (and catchment areas), which cause erosion. The involvement of local communities through shared governance is required to address the root cause.

Dr. Schmitt continued to elaborate further on the topic by explaining the quantification of benefits and cost effectiveness. The speaker showed related studies in the Mekong Delta comparing the values of mangrove planting with dyke upgrade based on the "saved wealth and saved health" principle. The study shows that the saved wealth index per USD is 19 times higher than that for the dyke upgrade. The speaker continued to show the other example of cost–benefit analysis in Lami Town, Fiji.

Up until these parts, the speaker talked only about the flooding on the seaside, while in the next section he talked about the other side. EbA measures can enhance water availability, improve water quality, and reduce water-related risk. In addition, they generate livelihood and economic and environmental benefits, and can be used for flood protection and water provision. Furthermore, he mentioned that overemphasis on tree planting (for carbon gain) may lead to adverse impacts on local communities and biodiversity, thus distracting from the need to protect intact ecosystems. he emphasized that it is more effective to protect and manage rather than rehabilitation (restoration) to address climate change.

On the topics of EbA and IWRM, water availability in adequate quality is highly dependent on healthy ecosystems and their provisioning functions and services. Healthy ecosystems also reduce water-related risks. Thus, IWRM should place more emphasis on promoting the ability and strengths of healthy ecosystems to reduce vulnerabilities to climate change in watersheds/river basins. Integrating the concepts and approaches of EbA and IWRM could also support the mainstreaming of climate change adaptation and risk management into IWRM. Furthermore, EbA measures should be a part of (forest and comprehensive) land-use planning and integrated into River Basin-wide plans as participatory approaches to conservation and development.

The speaker ended the session by reiterating that the use of certain areas as nature-based coastal protection systems is very effective and provides co-benefits. He also stated that the EbA solutions (e.g., T-shaped, permeable and temporary bamboo fences) only work within a specific set of boundary conditions and must be site-specific and appropriate. He also reminded that we should avoid the pitfalls of NbS, such as green-washing and overemphasis on tree planting (Global Standard for NbS). Furthermore, different solutions and their costing should be part of an integrated River Basin master plan, which also integrates EbA and IWRM. This plan must follow a sustainable management approach and involve local communities to ensure the success of conservation and development.

Research Priority of SDG 6 under Climate Change Scenario

Prof. Dr. Sangam Shrestha

Asian Institute of Technology

Research Priority of SDG 6 under Climate Change Scenario

SDG 6 is an initiative to ensure clean water and sanitation for all by 2030 and further consists of six targets. In 2021, the UN released a report on the progress of this project, revealing that the world in not on track to achieve this goal. In particular, 26% of the world's population still lacked safely managed drinking water as of 2020. Furthermore, 2.3 billion people still live in water-stressed countries, of whom 733 million live in high and critically water-stressed countries mostly located in Asia and Africa. The Integrated Water Management system must also be doubled in terms of the current rate of progress globally. The UN report further indicates that only 24 countries reported that all rivers, lakes, and aquifers that they share with their neighbors are covered by operational arrangements for cooperation.

Currently, SDG 6 is not on track and there are stressors that exacerbate the situation, including population growth, urbanization, and climate change. It is projected that, by the end of 2030, there will be 8.5 billion people in the world and such rapid population growth poses a challenge for the achievement of SDG6. In the context of urbanization, it is expected that almost 70% of the global population will be living in urban areas in the future. The report also states that climate change is likely to be a major stressor to SDG6 due to the higher levels of CO2 emissions and other GHG emissions that will occur in the coming decades.

The speaker also talked about how climate change can impact global water supply and induce socioeconomic vulnerability. The impact can be divided into two: primary and secondary impacts, and these can affect major economic areas, such as energy, agriculture, water, and wealth. The illustration below presents which subsectors are affected by climate change impact. In the context of global demographic of climate change, impact on water and socioeconomic vulnerability based on the region, one example would be Brazil, in which groundwater recharge is predicted to decrease by more than 70% by 2050. Furthermore, electricity production potential in existing hydropower stations can decrease by more than 25% by the 2070s in Europe.

In consideration of the scenarios previously mentioned here, there must be research priorities in this subject. Such priorities should consider the multiscale nature of the impacts of climate change from local to global and from short- to long-term solutions. Research should also

focus on the improvement of monitoring and prediction, impact assessment, adaptation, technology, environment, policy, and society. Such studies must be both trans- and interdisciplinary while considering the transboundary nature of the water resources.

One of the main foci is related to the monitoring and prediction of climate change, which can be done through the following research areas: use of ICTs, AI and big data, and GCMs/RCMs. However, there are still many uncertainties in the field of climate change impact and assessment, which derive from various sources. For example, the data used in the analyses often come from GCMs; these will be downscaled into appropriate methods based on the needs before being scaled down again for regional and local-scale variables. Therefore, the research priorities should focus on identifying the sources of uncertainties, quantifying the source of such uncertainties, and how to reduce uncertainties in impact assessment and adaptation. Another research area is the importance of climate change to the water-energy-food nexus.

The speaker also mentioned climate change adaptation (also known as adaption pathways) is a planning approach that addresses the uncertainties and challenges of climate changes decision making. It takes into account multiple outcomes of the future and the action-relative costs that are appropriate for each pathway.

The speaker then talked about his ongoing research, "Connecting Climate Change, Hydrology, and Fisheries for Energy and Food Security in the Lower Mekong Basin." This project was conducted in Lao PDR, Cambodia, and Vietnam, with the major objective of optimizing hydropower operations and fisheries under various climate change scenarios. There are four work packages included in the project: WP1-Development of high-resolution climate change scenarios; WP2-Climate change impacts on flows, dam, inflows and fisheries; WP3-Optimization of hydropower and fisheries production, and WP4-Building capacity and knowledge sharing. These can be achieved through the plans of research formulated in the image below.

In the closing remark, the speaker emphasized that climate change is the major stressor preventing the achievement of SDG 6, that research priorities should focus on the multiscale nature of impact and adaptation, and that accelerating adaptation to reduce water insecurity is an urgent task.

Enhancing Water Management in Malaysia towards Future Climate

Ir. Mohd. Zaki b. Mat Amin

Deputy Director General National Water Research Institute of Malaysia (NAHRM)

Enhancing Water Management in Malaysia towards Future Climate

Climate variability and climate change can result in both excess and less water supply, and their environmental impacts manifest in the form of increased flood, erosion, frequency of droughts, and so on. The speaker began his presentation by discussing the floods that occurred in the Malaysian peninsula in December 2021 as an example of disasters resulting from climate change. There are five components of the water sector that must be improved: (1) governance side, (2) the people, (3) improvements on the infrastructure, (4) information, and (5) finance.

To enhance the water sector in Malaysia, two problem statements can be considered: first, there is either too much water or less water, and second, the main problem is that water as a resource is not fully maximized compared to the energy sector. In the future, the water sector will be recognized and made more visible as a significant contributor to national growth, economically, socially, and environmentally through the National Agenda on water sector transformation.

Malaysia's water sector transformation has twin objectives: water security and sustainability and water as an economic opportunity. For the context of microplanning the water sector, this is divided into two: Planning for water resources and services management and planning for infrastructure safety and risk reduction (resilience). This is in line with the 12th Malaysia Development Plan (MDP, 2021–2022), in which Chapter 8 presents the goal of increasing the country's resilience against climate change and Chapter 9 focuses on transforming the water sector by accelerating the implementation of IWRM to achieve the relevant SDGs.

For the global approach to water management, IWRM requires a cross-sectoral, multilevel approach, as shown on the presentation, which also identified the important sectors that must cooperate to achieve efficient water management. The four phases of water sector transformation from 2020 to 2040 are formulated by the Malaysian government, and a roadmap is developed to outline the strategies, initiatives, and programs for each phase to ensure the success of the transformation. For the transformation of the water sector, five strategies are prepared: (1) Empowering the people, (2) Strengthening governance at all levels, (3) Enhancing capability in

data-driven decision making, (4) Ensuring sustainable financing, and (5) Developing sustainable infrastructure with cost effective technology.

Based on the five sectors mentioned in the beginning, a dedicated task force will be established under the National Water Council to guide, coordinate, monitor, and report progress. Based on the 12th MDP (2021–2025) there are 10 pillars under the water sector transformation, of which the speaker highlighted two: technology adoption pillars and the RDIC pillars. For the technology adoption, the application of the 10-10 MySTIE Framework to the water sector is proposed, in which 10 technologies will be connected to water supply lines using AI and IoT sensors for predictive maintenance, as well as drought and flood forecasting for reservoir management and early disaster mitigation. Furthermore, AI and deep learning algorithms will also be applied to monitor water quality and predict the future availability of transboundary water resources. For RDIC, the speaker showed the National Water Innovation Roadmap (2021–2040) with five main components: Clean River, Reserve Margin, Smart Water, DRR, and Water Finance.

On the topic of improving climate resilience, the speaker briefly explained the content of the Paris Agreement: Updated NDC (NDC, 2021). In terms of implementing low-carbon, clean, and resilient development, the Malaysian government identified four main strategies: Moving toward a low-carbon nation, Accelerating transition to the circular economy, Sharing responsibility in pollution prevention, and increasing resilience against climate change and disasters. The Malaysian government has also implemented its own NAP, which they hope to complete by 2025. The NAP 2025 is tailored to the NDC 2021 and aims to overcome the barriers to formulating, implementing, and monitoring the NAP processes in Malaysia. As shown in the presentation, the government is hoping to achieve four outcomes after implementing the NAP 2025.

The climate change adaptation framework aims to facilitate the formulation of sound policies and best practices that support sustainable water management. The framework also intends to serve as a resource for decision makers and serve as a guide to develop NAP in different sectors. The three main issues identified in the framework include water resources, water utilization, and water-related disasters. The speaker then elaborated on the strategies implemented across the water sectors for these issues: 18 strategies for

water resources, 20 for water utilization, and 11 for water-related disasters.

The speaker further elaborated one example of a water resource problem and how to implement water resources management in this area. He also explained the potential impacts and the possible solutions for these problems. To access information about the NAP, individuals can go to portal that offers various data, such as water stress index, water surplus-deficit, water yield, etc.

In conclusion, the speaker reiterated the eight initiatives in the roadmap developed by the Malaysian government, along with the planning and water management implemented through IWRM in relation to future climate. the speaker also talked about planning, improving, and implementing water infrastructure safety and risk reduction for climate resilience, as well as mainstreaming and implementing climate change adaptation initiatives through the NAP and the MDP. Finally, the speaker emphasized the goal of water sector transformation under the MDP.

General Discussion

In this part of the conference, the moderator, Dr. Pongsak Suttinon, Chulalongkorn University, emphasized that focusing only on technical issues cannot solve the problems at hand, because of the rise of new kinds of risks and uncertainties. There are various aspects that must be included as well due to the changes in nature. He then opened up the discussion session with a question from the audience to the speaker of this session. The first question was for Dr. Oki: How do we link the RnD to the policymakers and to the implementation of a project? Dr. Oki then answered that transdisciplinary study refers to the out-of-the-box study within a discipline, which must be connected to society. Initially, all parties related to the project must sit down together and discuss every step of the research from the beginning until the end to achieve a common ground.

The second question was addressed to Dr. Schmitt: How will climate change speed up the process of Bangkok sinking to below sea levels and what would be the best approach for the people? Dr. Schmitt then answered that it can certainly speed up the process and there would be no singular approach that can be considered as the “best” approach because a specific scenario requires precise solutions at the appropriate

conditions and time. Furthermore, the global model must be downscaled because different things happen in various ways. Thus, there must be a comprehensive study about the models and how they can be downscaled to suit each area. In other words, there is no best approach for this problem; we need to look at the specific situation and find the appropriate solution. Furthermore, there should be an integrated cross-sector approach to different solutions that complement one another.

The second question for Dr. Schmitt was given: Does GSS have guidelines for EbA design or the monitoring and the evaluation method of EbA when applied to irrigation infrastructure? His simple answer was "Yes." There are two Internet sources that can be used: *Adaptationcommunity.net*, which is source of anything related to adaptation, including publications, case studies, examples, and manuals, and *panorama.com*, which provide already tested and proven resources.

The third question for Dr. Schmitt was also asked: What is the best practice related to the building and expanding of dryland using gray structure, as well as others that can protect cities from being flooded, and is it ok to use gray matter if green structures, such as bamboo, are not available? Dr. Schmitt answered that there is no one-size-fits-all solution; sometime, we need to find appropriate solutions for each specific scenario. This is the same as the Bangkok question earlier in the sense that we have to analyze the situations carefully and come up with emergency engineering solutions to protect lives and properties. There are many different solutions and path dependencies; whatever we do in adaptation, it must be planned in a way that we do not "put our train on the wrong track." A thorough solution must be considered if we are facing various uncertainties related to solving the climate change-related problems.

The moderator passed on a question to Dr. Sangam: How can we solve the climate change problem when we need expensive power for economic growth, especially given the fact that renewable energy is more expensive than fossil fuel? To this Dr. Sangam answered by explaining that although the initial investments in renewable energies are high, in the long run, the operation expenses become cheaper. If we look at the statistics, fossil fuel is the dominant source of energy, but it emits massive amounts of emissions and GHGs. Thus, we need to change to renewable energy sources. However, we must keep in mind that switching to these alternatives should not entail destroying the environment. For example, it has been shown that hydropower plant establishment can actually cause off-shoot problems.

The last question in this discussion, addressed to Mr. Zaki, was: How can the use of new technology establish a link between the top-down and bottom-up approaches to research of the policymakers and all stakeholders? Mr. Zaki explained that one of the ways is to talk to all stakeholders at the beginning of the project, as previously mentioned by Prof. Oki. That depends on what, how, and where we want to resolve the issue. For example, how can we use AI technology for the benefit of a community? What Malaysia did as an example was to improve conventional flood forecasting, link these conventional methods, and transform them into an AI approach to minimize the processing of the forecasting results. Communication is the key to all these problems; hence, planning should include all stakeholders and must ensure that they are on the same page.

The moderator concluded this discussion session by borrowing the ideas laid down by Prof. Oki: transdisciplinary studies and out-of-the-box thinking are the buzzwords for water resource management under climate change in light of new risks and uncertainties. Furthermore, referring to past experiences/past solutions alone cannot thoroughly solve a problem at hand.

Executive Panel Session - 3

Sustainable Groundwater Management towards SDG

Sustainable Groundwater Management toward SDGs

Prof. Dr. Makoto Taniguchi

Research Institute of Humanity and Nature (RIHN), Kyoto Japan

Introduction

The executive panel session three presented and discussed about topics Sustainable Groundwater Management toward SDGs. The objective of this section is to generate the research information and some case studies that cope with the sustainable management of groundwater with the ultimate goal of achieving the SDGs. Four experts were involved in this session with the topics; "Sustainable Groundwater Management toward SDGs" presented by Prof. Dr. Makoto Taniguchi, "Assessing Recent Hydrological Changes and Groundwater Depletion under Various Policy Changes and Newly Delivered Water in the North China Plain" presented by Prof. Dr. Yonghui Yang and "Groundwater for Sustainability Contributions towards the 2030 Agenda and the Sustainable Development Goals" presented by Dr. Hans Thulstrup and "Groundwater Science: Issues and Research Trends" presented by Dr. James W. Lamoreaux. Then there is a general discussion at the end of the session.

Sustainable Groundwater Management toward SDGs

In this topic, global and local groundwater issues related to the SDGs were discussed. The historical changes related to groundwater and industrialization in Asia are shown in Figure 1, in which the Y-axis presents

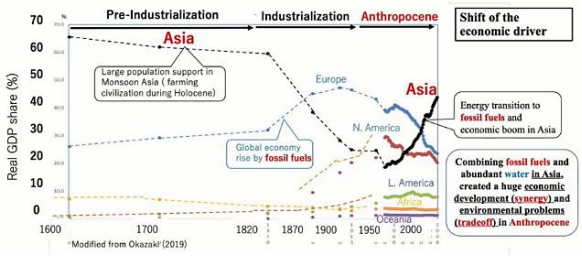


Figure 1: The industrialization and nexus (water-energy) changed history.

the real GDP share in the world. As can be seen, since the 17th century up to the preindustrialization period, the real GDP share had been the highest in Asia. However, during the industrial era, Europe and the US increased after 1950s (or after World War Two), and Asia increased again. Thus, one can see the shift of the economic driver and preindustrialization period, in which there was large support from monsoons enabling Asia to achieve such high figures. However, in the industrialization period, the global economy saw an increase in fossil fuel use and the economic boom in Asia World War Two. Thus,

combining fossil fuels and abundant water, including groundwater in Asia, created huge economic development and environmental problems, such as land subsidence, groundwater contamination, and so on.

However, if you look at another historical revolution, such as the Green revolution and the groundwater issues in relation to food, along with the application of the Harbor Bosch method to produce artificial chemical fertilizers, food production rapidly increased. Indeed, we need a lot of water for food production. Areas with rising total groundwater use increased rapidly after the 1950s, particularly in the US and India, marking a corresponding increase in groundwater consumption for irrigation. A lot of budget groundwater trade occurred from Asia and Africa to other areas and continents. The acceleration of groundwater depression reached 12 billion tons/year in 1960 and increased up to 28 billion tons/year in 2000. Thus, the huge depletion in groundwater can be considered a global phenomenon.

The third issue is urbanization and the groundwater-energy-food nexus. The world population increased by more than 7 billion, and this is expected to exceed 9 billion in 2050. Furthermore, urbanization is likely to increase from 30% in 1950 to 68% in 2050. Thus, we initiated the groundwater-food-energy nexus project under "The Belmont Forum framework and Intelligent Urban Metabolic System for Green Cities of Tomorrow." For this undertaking, we invited Japan, Taiwan, the US, and Brazil to examine and compare the state of the urban water-energy-food nexus in our respective countries. There are several scenarios we have developed, including which food policies to implement in case a food sufficiency issue arises and how much water-energy change would be required. Concerned about the climate change scenario, we also utilized eight GCMs models to predict how much the nexus would change in the near future.

We also considered the disconnect between groundwater management and other resources management in different sectors and institutions, including those4 between conservation and development, consumption and production, and conflicting resources management efforts in the water-energy-food nexus. Thus, if we have newcomers, such as water spring power generation or micro hydropower, we have to think about aquatic resources, as well as global versus national versus local municipal management and governance.

Thus, we adopted the nexus approach for system dynamics and consider the establishment of a tradeoff facility among various

resources, including groundwater, society, economy, environment, local, national, and global toward the achievement of SDGs. To do this, we collected all types of hard data related to SSE (society, economy, environment) and WEFL (food, energy, water, and climate change). From these, we devised indices related to the SDGs: SEE-Water, SEE-Energy, SEE-Food, SEE-Land, and SEE-WEFL. These were calculated and represented as warm color (showing less sustainability) and blue color (showing more sustainability) in terms of the SEE nexus indices, as shown in Figure 2.

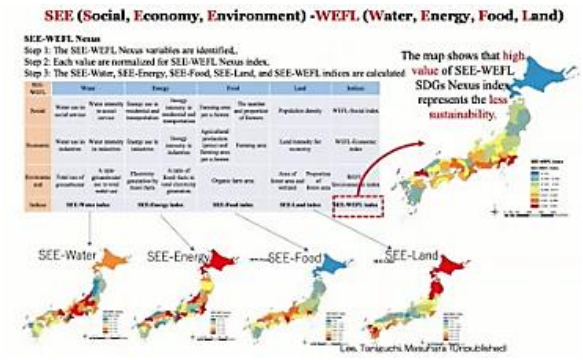


Figure 2: SEE-WEFL SDGs-nexus indicators.

One case study, "Recovery of the Lost Synergy of the Groundwater-Energy-Food Nexus," was conducted in Kumamoto City in Kyushu Island, Japan. Kumamoto City depends on 100% of the groundwater resources, which are recharged upstream of the basin beyond the city. We found an increase in impermeable areas in the upper stream of the basin and government policy changes due to the decrease in rice production. In turn, this caused a decrease in the groundwater recharge rate in the upstream recharge area. To allow the groundwater in the city to recover, the city government decided to implement transboundary governance of the groundwater and pay subsidies to farmers if they use recharge water in their paddy fields located outside the city. They could also use the groundwater as a water resource. Thus, in this case, the nexus synergy is applied to rice production with the groundwater recharge in the upstream, as well as the groundwater used downstream without any additional energy for water allocation.

Finally, we can summarize that enough food sources that consume groundwater are globally traded and that distant areas and countries are indirectly connected to the groundwater footprint. Therefore, the groundwater issue is not only a local but also a global issue. To achieve the SDGs, it is important to manage groundwater as a nexus that connects direct and indirect, local and global, water-energy-food, and economy-environment-society. Furthermore, increasing the efficiency of groundwater use reduces energy consumption and creates a synergy among water and energy, thus leading to carbon neutrality and sustainable groundwater management. Finally, good practices, such as the one implemented in

Kumamoto showing the synergy of the nexus and transboundary governance of groundwater, is also important for achieving SDGs at the local and global scales.

Assessing Recent Hydrological Changes and Groundwater Depletion under Various Policy Changes and Newly Delivered Water in the North China Plain

Prof. Dr. Yonghui Yang
Center for Agricultural Resources Research,
IGDB Chinese Academy of Sciences, China

Assessing Recent Hydrological Changes and Groundwater Depletion under Various Policy Changes and Newly Delivered Water in the North China Plain

The topic "Assessing Recent Hydrological Changes and Groundwater Depletion under Various Policy Changes and Newly Delivered Water in the North China Plain" was presented by Dr. Tonghui Yang. He started his presentation with a discussion of the problem of groundwater depletion—a huge concern in the area of food production. The North China Plain is one of the world's most concerned regions of groundwater depletion. He showed a comparison of the groundwater depletion map in North China Plain between the years 1974 and 2004. The map indicates groundwater overuse by 180–200 km3 in 2004. This problem has existed for a long time, but the Chinese government has only implemented a sustainable society goal in 2012. Specifically, the national government developed policies regarding the use of groundwater by largely reducing usage for the city and rural domestic purposes, cutting the plantation of high-water consumption winter wheat by 50,000–150,000 ha annually with governmental subsidy, and increasing water use from the Yangtze River.

Next, the speaker presented the trends of groundwater depletion, including the following. First, in the south to north water transfer projects, the water flow will basically transfer from the Yangtze River especially the middle route. The canal is efficient, because it always transfers water by gravity. The total investment for this project is around 208 billion RMB Yuan. The water delivery plan is around 9.5 km3 per year; since 2015, the total water delivered to Beijing–Tianjin–Hebei has reached 239.5 km3. Second, in terms of agriculture water saving, it is always difficult to solve agricultural water use in the North China Plain, because this sector is the biggest user in the country. According to the speaker, since the end of the 1970s, the trend of groundwater depletion has been going almost linearly. Upon the improvement of agriculture water use, the efficiency trend has consistently increased. However, given that the number of crops also

increases annually, the problem of groundwater use efficiency will never be solved. Thus, as the biggest water user, the crucial step in solving this problem and its effect in reducing wheat plantation remains uncertain.

As for the 2014 and 2015 trends, the speaker presented their assessment of groundwater withdrawal in the North China Plain, which has been largely stabilized. This is a good signal in the right direction. Then he presented some satellite data-based assessments and discussed how satellite images describe the evapotranspiration changes every year. For example, we can see that in the lower part of this map, the evapotranspiration (red color) actually increased from 2001 to 2019 as shown in Figure 1. The evapotranspiration significance map also shows that evapotranspiration has been increasing heavily in the southeast part, whereas it has been decreasing in the northwest part near the mountain.

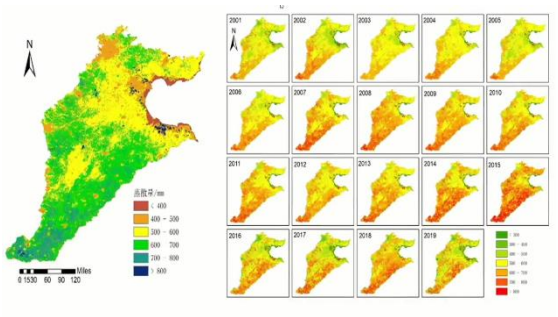


Figure 1: Evapotranspiration change from 2001 to 2019.

Next, the speaker analyzed the data showing what was happening in the area where decreased evapotranspiration was observed. As they were cutting wheat plantation, the areas dedicated to wheat planting also decreased. There is currently a government policy to reduce evapotranspiration use by wheat making. However, during the autumn season, evapotranspiration still increased even in the low evapotranspiration area due to food production. Furthermore, the southeast part shows the largest evapotranspiration increase; coincidentally, it also has the largest food production increase. Therefore, evapotranspiration in the agricultural regions is still increasing, along with the rising rates of food production. In comparison, the evapotranspiration is less in the mountainous areas. As for cities where many construction projects are happening, evapotranspiration in the central part is increasing, while that in the peripheral areas is decreasing.

What is happening with the groundwater? The speaker showed shallow and deep aquifers. Simple crop patterns need large efforts to maintain the sustainability of groundwater use. The current wheat plantation decrease, ranging from 50,000–150,000 ha, will not likely solve the groundwater depletion problem.

In some big cities like Beijing, the groundwater is recovering because of excess water from the Yangtze River. The speaker showed data on the observed groundwater levels in Luancheng Experimental Station, which have declined since 1975 but stabilized again since 2016, thus indicating recovery. For the North China Plain, according to the analysis of GRACE data, groundwater basically stabilized from 2016, despite previously experiencing a huge drop, thus indicating much higher rainfalls in 2016, 2018, and 2021.

Thus, the possible solutions are crop adjustment, replacing groundwater with Yangtze River water for domestic and industrial use, and relying on relatively high rainfalls that are beneficial for regional groundwater sustainability. However, in the whole North China Plain, evapotranspiration is still increasing slightly, especially in the southern part. In general, groundwater decline has slowed down, but stabilization is not yet a certainty. Although the goal may have been achieved in the present, the solution for the long term, especially in the southeast part of the area, may not yet be achieved.

Groundwater for Sustainability Contributions towards the 2030 Agenda and the Sustainable Development Goals

Dr. Hans Thulstrup

Senior Programme Specialist, UNESCO Jakarta

Groundwater for Sustainability Contributions towards the 2030 Agenda and the Sustainable Development Goals

The SDGs are a universal call for action to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity by 2030. The presentation focused on SDG6 (clean water and sanitation). The importance of groundwater with sustainability is a cross-central goal. The groundwater system is complex and related directly or indirectly to the way we live and the way we conduct various economic activities. This is also related to climate change, biodiversity, consumption, and production. Therefore, groundwater flows through all of the SDGs because without water, there would be no life. Indeed, according to the World Water Assessment Program:

> Sustainable groundwater is a key element in global resilience to climate change, a shield against ecosystem loss, and a defense against human deprivation and poverty. Groundwater underpins irrigated agriculture and energy production. It supports food security and economic development. It is essential to the health of all living things.

Meanwhile, the UN also released a statement on its the world water development report:

> Groundwater is invisible, but its impact is visible everywhere. Out of sight, under our feet, ground water is a hidden treasure that enriches our life. Almost all of the liquid freshwater in the world is groundwater. As the climate changes, its impact gets more severe, [and] groundwater will become more and more critical. We have to work together to manage the precious resource. Groundwater may be out of sight, but it must not be out of mind.

To make the invisible visible is what we should focus on. Appreciation of groundwater is not taught in elementary schools, and many university programs do not have hydrogeology courses in their undergraduate curricula. In other words, it is not generally known by people around the world. If we look at history, groundwater is closely associated with human civilizations all around the world. It is a sacred treasure, a prized resource, and at times, may even be a source of conflict. Somewhere along the way, we have lost sight of the big picture and what we need to do to make it "visible" once again. Related to this,

the lack of systematic communication and data information on groundwater is one of the most significant impediments to its management and governance. This has a direct implication on the contributions of groundwater to the SDGs.

In Asia, there are 129 shared aquifers. The total transboundary area is more than 9 million km2. A total of 38 countries in Asia have been identified as having internationally shared aquifer basins. However, aquifer stress in the region has increased significantly over the past 50 years, especially in areas, such as the Middle East of Saudi Arabia, Jordan, and the Mekong Delta region. A survey conducted by the Transboundary Water Assessment Program reported that out of 25 transboundary aquifers in Asia, only about 50% have water resources that are entirely suitable for human consumption due to serious groundwater quality issues. Thus, there is a risk of increased regional conflict due to competition over limited water resources.

Numerous activities have been initiated to improve our understanding of this issue and to develop better transboundary aquifer inventories. However, we lack reliable comprehensive data, particularly in developing countries and regions; expertise and institutional support; and large-scale cooperation in the identification, assessment, and governance of the resource.

The presentation mentioned some reference to the Greater Mekong sub region and the challenges and efforts involved in sharing data and undertaking cooperation across Cambodia and Vietnam. There is significant stress on the Lower Mekong Delta aquifer, in which groundwater levels have significantly declined, along with the rise of sea water intrusion and arsenic pollution. Thus far, only a limited institutional framework for the investigation of transboundary aquifers has been established. The UNESCO, FAO, and many other agencies are working together to develop new contexts to help address these challenges.

The speaker also referred to the groundwater management practices applied in Denmark. The basic principles that have allowed for the sustainable management of water resource in Denmark are strong knowledge, strong national commitment, transparent regulatory system, partnerships, and generally high levels of public and political concern and awareness. The country also used the Five M's, an integrated management approach involving mapping, measurement, monitoring, and modeling, as the basic elements that have allowed for the sustainable

management of groundwater in the country.

General Discussion

During the general discussion, questions from the audience for the speakers in the session panel were raised. The following are some of the interesting questions selected during the session by a moderator, Dr. Sucharit Koontanakulvong, Chulalongkorn University.

Question: Please recommend for the agency some solutions to the problem of groundwater development?

Dr. Makoto Taniguchi: Many countries have a problem regarding development, management, and governance. Development parties are separated into the different ministries, such as the agriculture and industry sectors; groundwater is managed by the Ministry of Environment. Many countries also have a separation of government, which may lead to problems in effective groundwater management. In Japan, we decided to conduct related activities under the Cabinet Office, which can take all responsibility and negotiate with each ministry, make tradeoffs, or make decisions when conflicts arise. This started a couple years ago. Groundwater is only part of the whole water issue, but that the committee under the cabinet works toward the future. We need more case studies and examples of good government and governance of groundwater.

Question: Please characterize three actions planned in the next five years to improve sustainable groundwater management?

Dr. James W. LaMoreaux: Groundwater research is one thing that can help us gain a global view of the issue. There are specific trends related to the pandemic that can be addressed directly. The second set would be more specifically related to a region or a state. That would help us to focus on our research and try to address the primary concerns in that regard. The next thing to keep in mind is whether COVID-19 is going away or is it something that we will have to deal with for a long time? How would that impact groundwater research? These are a few things that are important to address.

Dr. Hans Thulstrup: Increasing international cooperation and sharing of data and joint research are importance. We recognize that water, groundwater in particular, is not a resource to do certain frontiers about the national boundaries. We have to improve the way we share data and conduct research together. It is important to look at the global scale of research priority. For the post

pandemic context, this could be an excellent place to start.

Dr. Makoto Taniguchi: Research trends after the COVID-19 pandemic have shown an increasing use of AI or deep learning. Of course, observation and monitoring are still very important. At present, we already have a set of data across the world but the problem is how to analyze the existing data. We should do that kind of invisible traditional knowledge to be visible. We should think about how to connect with one another, even now when groundwater studies are invisible, so that we can make it more visible in the future. That is another issue we should consider in the coming days.

Groundwater Science: Issues and Research Trends

Dr. James W. Lamoreaux

Chairman at PELA GeoEnvironment, USA

Groundwater Science: Issues and Research Trends

The topic today is groundwater science issues and research trends as they relate to sustainable water and climate change management after COVID-19.

Hydrogeology plays a major role in all aspects of environmental planning, execution, and implementation. Without a safe and sustainable water supply, life cannot exist and hopes for prosperity are limited. Much of the future world demands will be made up of the groundwater component. In fact, the UN has identified water resources as a top priority. Attention is particularly drawn to freshwater stress, which relates water withdrawal to the percentage of water available. However, the UN is not optimistic about the global water outlook based on current rate of usage.

In fact, we see the groundwater stress from 1995 and the projected levels in 2025, which can be very distressing. To address the issue, we need to embrace sustainable water development (SWD), which refers to "the development of water in a manner in which (an) adequate supply of good quality water is sustained and the watercourse ecosystem is maintained for the uses of future generations."

Water quantity and water quality are inextricably linked; therefore, there must be rapid movements toward SWD in both developed and developing countries. To move toward SWD, freshwater should be managed in a holistic manner using an ecosystem approach: "Management of water resources is holistic when it's done on a catchment or drainage basin basis. This includes both land and water resources since land use can have significant impacts on freshwater and related ecosystems. Thus, water legislation should provide for a holistic, ecosystem approach to the management of water."

The UN has addressed SDG6 (access to water and sanitation). Clean, accessible water for all is an essential need of the world, and there are sufficient fresh water sources on earth to achieve this. However, due to bad economics or poor infrastructure, millions of people—most of them children—die from diseases associated with inadequate water supply, sanitation, and hygiene.

In turn, water scarcity, poor water quality, and inadequate sanitation negatively impact food security, livelihood choices, and educational opportunities for poor families. Drought afflicts some of the world's poorest countries, thus worsening

hunger and malnutrition. By 2050, it is expected that one in four people is likely to live in a country affected by chronic or recurring shortages of freshwater.

Some research conducted to address these problems are highlighted in selected prominent journals. The aims and scope of sustainable water resources management address a broad range of topics in water resources management; covers geopolitical and socioeconomic effects and constraints; and includes such topics as natural and man-induced contamination of water resources, surface and groundwater interaction, and managed aquifer recharge and restorage. They also address issues related to water resources management, sustainability of water resources, ground and surface water quality and quantity, water use and reuse, surface and groundwater interaction, aquifer recharge, storage and more.

The aims and scope of environmental earth sciences cover the interactions among humans, natural resources, ecosystems, special climates, or unique geographic characteristics. The major disciplines include hydrogeology, hydrochemistry, geochemistry, geophysics, engineering geology, remediation science, natural resources management, environmental climatology and biota, environmental geography, soil science, and geomicrobiology. The commissions of International Association of Hydrogeologists (IAH) deal with groundwater and climate change, groundwater and energy, groundwater research, cars hydrogeology, managing accurate recharge, mineral and thermal waters, regional groundwater flow, and transboundary efforts.

The UN Water Partners or IAH is a partner of IGRAC. Their groundwater resources are under increasing pressure due to human activities and climate change. Thus, the UNESCO and IGRAC have published information that showcases the essential issues of groundwater and related activities, thus enhancing knowledge exchange and collaboration and raising awareness about our most important hidden research.

One of the groundwater overview courses is climate variability. As the world's largest distributed store of freshwater, groundwater plays a central role in sustaining ecosystems and enabling human adaptation to climate variability and change. Aquifers have a buffering capacity and are naturally more resistant to external impact than surface waters. Given that the variability of surface water availability is increasing due to climate change, the strategic importance of aquifers for water and food security is also clearly growing.

In regard to trap governance, law, and transparent boundary issues, groundwater is a common-pool resource and is often utilized at an individual level, regardless of the overall impact on the aquifer. This is because neither use nor impact is necessarily immediately visible. The situation becomes even more complex when aquifers cross state or national borders (transboundary). Thus, aquifers must be governed through a process of shared responsibility and participation, information availability and transparency, and rule of law. Another aspect is to look at groundwater in the environment. Regardless of the kinds of ecosystems that end on groundwater—be they aquatic, terrestrial, subterranean, and others—groundwater is in the central part of any ecosystem-based adaptation measure, green infrastructure, or NbS. Moreover, groundwater in settlements is the main source of water supply in many cities around the world and is increasingly under pressure due to continuous urbanization, climate change, and inadequate water management. Groundwater depletion and land subsidence are serious problems, particularly in Bangkok and other similar, large cities around the world. The pumping rates in the megacities may be reduced and compensated by urban rainwater harvesting, rural–urban water transfers, aquifer recharge with wastewater, and other similar measures.

Sanitation, health, and pollution are other aspects to be considered and included. In fact, water-related diseases remain a major health concern in the world. The improvement of groundwater quality control, in conjunction with improvements in sanitation and personal hygiene, is the main strategy to reduce the proliferation of water-related diseases. Groundwater can be polluted due to various human activities, such as agriculture, sanitation, industry and mining, landfills and waste disposals, traffic and transport and also from chemical processes within geological environments. Therefore, regular groundwater monitoring, vulnerability assessment, protection from point-source and diffuse pollution, and pollutant removal, are some of the necessary actions in preserving and improving groundwater quality and health. In regard to food and energy, about 2/3 of all abstracted groundwater is used in agriculture. Global food production increasingly relies on groundwater over-abstraction; however, groundwater depletion may eventually lead to declining food production. About 1/4 of the energy used globally is spent on food production and supply, including groundwater pumping. Deep

aquifers, as a potential source and a sink for heat, can play a much more prominent role in the provision of renewable geothermal energy.

In regard to economics, groundwater resources are extensively used in production processes by large international companies all over the world. Accordingly, international investors are encouraged to share the broader societal and environmental costs of groundwater. Understanding the value of groundwater would be an additional incentive for investors and asset managers to participate, thus leading to investment risk reduction.

In summary, there are a number of research trends in this area, and one of the more important ones is remote sensing, which is increasingly used for aquifer management, satellite data interpretation for drought, and long-term weather forecasting. Other trends include bringing more real-time reporting data online via the web; cross-disciplinary training; and regional, national, and international emphasis on improving water use agreements and best practices. More collaborative studies among consortium universities of corporations. And water as an economic commodity or is a natural right.

Executive Panel Session - 4

Water Management under Water Security towards SDG

Asian Water Development Outlook (AWDO) 2020

Mr. Thomas Panella

Chair the Water Sector Committee / Group for ADB

Introduction

The executive panel session four presented and discussed about topics Water Management toward Water Security and SDGs. The objective of this section is to generate the research information and some case studies that cope with water management that is toward water security and sustainable development goals. Four experts were involved in this session with the topics; "Asian Water Development Outlook (AWDO) 2020" presented by Dr. Thomas Panella, "Institutional and Tactical Transformation for Border Security in South Korea" presented by Prof. Dr. Seungho Lee, "Orientation of Water Security in Vietnam" presented by Mr. Nguyen Minh Khuyen and "How Private sector prepare and plan for water security in EEC area Thailand & Things to be considered and prepared for more security" presented by Mr. Somchai Wangwatanaphanich. Then there is a general discussion at the end of the session.

Asian Water Development Outlook (AWDO) 2020

The topic "Asian Water Development Outlook (AWDO) 2020" was presented by Dr. Panella (Chair the Water Sector Committee/Group for ADB). This topic started with a discussion of the key dimensions of water security, which have been updated in the water security index and are directly related to SDGs. He showed the results of the AWDO project that was conducted in 2020. There is a positive trend wherein several ADB members have improved from the "Nascent and Engaged Rating" to the "Capable and Effective Rating." However, many people are still living in the Nascent and Engaged stages of water security despite the overall positive trend that has been reported.

For Key Dimension 1: Rural household water security, this is based on access to water supply, water sanitation, health impacts, and affordability. We have seen tremendous progress in many countries in terms of rural household water security, especially in Lao PDR and other places in Southeast Asia. The main recommendation from the report is that a holistic systems approach is needed to solve

the problem. For example, many countries have comprehensive WASH policies but have severely inadequate capital and human resources to implement them.

Key Dimension 2: Economic Water Security is a measure of the assurance of adequate water to sustainably satisfy a country's economic growth and to accommodate economic losses due to water-induced disasters. The dimensions across the economic water security include broad economy, agriculture, energy, and industry. We have witnessed a rise in investments in the area of economic water security, particularly in East Asia. One recommendation is to improve data monitoring and measurement. At the same time, water productivity must also be improved by ensuring that adequate water is available when and where it is needed. Then, the IWRM framework can help ensure adequate storage and distribution systems that can facilitate the mitigation of and adaptation to climate changes and sectoral reallocation.

Key Dimension 3: Urban Water Security is measured by access to water supply, sanitation service, affordability, drainage/floods, and environment in urban areas. Despite mass investments, the levels of urban water security have remained the same, and people living in urban areas still do not have adequate access to water supply and sanitation services. The recommendation is to place greater attention to future risks and management of related issues, including urban growth, nonrevenue water, water consumption and efficiency, and energy use. We also need more integrated solutions and leapfrogging opportunities.

Key Dimension 4: Environmental Water Security focuses on catchment and aquatic system health, as well as environmental policies. Almost all the countries are showing declining environmental water security due to the significant pressure on the ecosystem. There is a risk in traditional/gray infrastructure without environmental protocols that may boost one dimension of water security while impacting another. Moreover, a healthy ecosystem is not just something for rich countries. At the same time, the pressure of human alterations and the longer-term impacts of climate change also affect how ecosystems function throughout the regions.

Key Dimension 5; Water-Related Disaster Security includes three types of risks: drought, flooding, and storms and require a national-level assessment. Today, the capacity across the Asia-Pacific has increased slightly, while vulnerability has decreased slightly. The East Asia region has shown the most progress in reducing risks, while the Pacific is the most challenged by water-related

issues in recent years. Drought is the most prominent risk out of the three hazard categories across the Asia-Pacific. An interesting finding is that we need agenda-responsive approaches to DRR in climate change via international agreements.

Next, the speaker moved on to the topic of governance and water security. Using the 12 governance principles from the water governance initiative from the OECD, the findings show that most countries have an overarching water policy framework. However, the implementation of water-related policies has been largely limited by capacity constraints and funding gaps, as well as the limited uptake of water policy instruments to manage, particularly economic instruments to manage water. He recommends placing greater focus on economic instruments, adapting policy instruments to manage tradeoffs, and strengthening mainstream integrity and transparency practices across water policies, institutions, and governance frameworks. Looking at finance and water security, it is not all about raising greater profits but also maximizing available assets and financial resources, minimizing future investment needs, and harnessing additional sources of finance.

Next, the speaker presented a case study from Karnataka, India. India's NITI Ayog developed a Composite Water Management Index (CWMI) called the ACIWRM. This applied the AWDO methodology for Karnataka state and mapped CWMI indicators against AWDO indicators. The index largely influenced the new state water policy, as it allowed the streamlining of data collection and brought different stakeholders together. Another case study presented is the Water Sector Assessment in the Yellow River Basin, which gained support from the ADB. A total of 18 indicators in five key dimensions were selected for this assessment based on the AWDO methodology, the TOR of this project, the characteristics and problems of the Yellow River Basin, and on ADB indicators for similar purposes. In addition, he also quickly presented a comprehensive guidance underwater sector for the post-COVID-19 world.

Institutional and Tactical Transformation for Water Security in South Korea

Prof. Dr. Seungho Lee

Korea University, Korea

Institutional and Tactical Transformation for Water Security in South Korea

Dr. Seungho Lee of Korea University presented the topic of "Institutional and Tactical Transformation for Water Security in South Korea." The presentation was divided into two parts: Korean perceptions about water security and an interesting case of Korean water sector reformation that began in 2018 and the integration of operations in South Korea.

Water security has five dimensions: household, economic, urban, environmental, and resilience. At present, the Korean government is trying to accommodate all the important elements of water security to ensure that people can access clean water and that ecosystems can cope with water disasters. Based on the context of water security in Korea, the Korean government society in general believe that ensuring IWRM and having a strong foundation that includes rule-based management are very important considerations. Cross-party policies and politics are very significant as well. Nowadays, "resilience" has also become a key term related to climate change issues. The last thing that is related to governance issues is the significance of institutional settings and the coordinating mechanisms.

The assessment tool was developed involving five key areas, and a visualization of these five dimensions of the security assessment framework was presented. The blue color shows a positive message: Japan, South Korea, and Malaysia all have very similar results. However, in Western Asia, including India and Pakistan, we can see disappointing results in key areas of economic efficiency and sustainability. Thus, Japan, South Korea, and Malaysia can work together with the other countries to improve their results.

Then, there's the case study from South Korea regarding institutional reformation. Before 2018, Korea's water resources management is under the responsibility of two main ministries: the Ministry of Land, Infrastructure, and Transport (MLIT) and the Ministry of Environment (MoE); the former is in charge of water pump and water supply, while the latter is focused on water quality control. Then, the responsibility of the MLIT was shifted to the MoE, which was tasked to establish a good foundation after the institutional reformation. More responsibilities are given to one ministry, and we expect more coherent and efficient planning and management as well.

The vision is to emphasize ecofriendly policies instead of construction and development-oriented policies.

Another case study from South Korea dealt with the integration of dam operations. South Korea is ranked seventh in the world in terms of the number of dams, but the problem is that the dams are not interconnected and are not well operated as a system. Thus, researchers attempted to conduct some good experiments with the Han River Basin, such as an integrated approach to dam operations. The researchers found some major problems: there are two main public water companies and the Korea Hydro Neutral Nuclear Power is located in the area. Thus, effective stakeholder engagement is required and more technical assessments of single or joint operations are needed. Furthermore, effective management plans and procedures must be established. For water security assessment, we must be able to unlock the potential for international cooperation as well as apply an integrated approach to dam operation to achieve sustainability.

Orientation of Water Security in Vietnam

Mr. Nguyen Minh Khuyen

Deputy Director General Department of Water Resources Management, MONRE

Orientation of Water Security in Vietnam

The presentation was divided into two parts: (1) an overview of the institutional structure of water resources management in Vietnam and related achievements, and (2) the current situation and challenges to Vietnam's water security and the solutions and plans for the future.

There are two levels involved: national and regional local levels. At present, Vietnam has a regional council to support the government in terms of water resources management. At the same time, the Ministry of Natural Resources and Environment (MONRE) is the key ministry involved in this field.

Water resources in Vietnam include surface water. Vietnam has a high number of river basins (over 100), and the major ones include Red River in the north and Mekong River in the south. However, Vietnam still faces many problems related to water resources.

"Water security" is the ability of a population to ensure sustainable access to the required quantity and quality of water to maintain our livelihood, welfare, and socioeconomic development. Actually, Vietnamese law had not yet defined the concept of "water security." Thus, researchers have established a legal framework following an integrated analysis. In particular, the Department of Water Resources is in the process of reviewing and amending the law on water resources management, which is slated to be launched in 2022–2023.

The assessment and evaluation of the IDB about water security in Vietnam reveal that water resources in the country mainly depend on other countries and that the country currently faces severe water pollution. The groundwater in the Mekong River Delta has faced problems, along with sand subsidence, due to the increasing water demand and conflicts with various economic interests.

As part of its vision for the future, Vietnam is attempting to compete with the rest of the world by renovating the institutions, policies, and financial mechanisms of the water sector to the direction of smart governance. The country is also exerting efforts to improve the efficiency of management, monitoring, protection, development, and regulation of water resources allocation to proactively ensure the adequate supply of water for domestic and industrial purposes. Vietnam has many plans for the Mekong River, which is plagued by problems, such drought, floods, and

salt intrusion. Furthermore, the country is building a system of indicators for monitoring and assessing the relational water resources security. It has also authorized research activities and international cooperation in such areas as computer science and technology.

The vision for the near future is estimated to be achieved by 2045. To achieve this, the Vietnamese government has attempted to come up with comprehensive policy solutions, as well as management and economic tools to allocate water resources and ensure that water quantity and quality meet the demand. The government has also exerted effort to raise the national water security index to ensure effective water security in the region. The MONRE will continue to provide expert advice and submit the revised law on water resources, including major policies on water resources management, such as water security, water finance, and partnerships with the government and the national assembly. The aim of the latter is to promulgate and strengthen international cooperation and management measures to improve the efficiency of water resources management in the country.

How Private sector prepare and plan for water security in EEC area Thailand & Things to be considered and prepared for more security

Mr. Somchai Wangwatana-phanich

The Federation of Thai Industries, Thailand

How Private sector prepare and plan for water security in EEC area Thailand & Things to be considered and prepared for more security

The speaker opened the presentation by explaining about the concept of the "circular economy" and how the private sector in Thailand prepares and plans for water security, as shown in the illustration below. Then he continued to explain the latest developments from the eastern seaboard to the eastern economic corridor (EEC) in Thailand. The eastern seaboard of Thailand is home to several industrial estates focused in petrochemicals and heavy industries. Together, the petroleum and petrochemicals in the eastern seaboard contribute 8% to the Thai GDP (36 billion USD). For the future, there will be a focus on the EEC and area-based development in three provinces: Rayong, Chonburi, and Chachoengsao, specifically geared toward the following investment themes: health and well-being, digital development, decarbonization, and logistics. Furthermore, the EEC has promoted zones for targeting industrial activities, such as automation and robotics, digital parks, medical hubs, biotechnology, and so on, in 26 industrial estates.

Water management under water security/SDGs is executed by implementing three strategies that focus on Supply, Demand, and Water Management. For the water supply, the plan is to strengthen water supply management to reduce vulnerability of scarcity to business. Currently, the average rainfall in Eastern Thailand is 1,000–2,500 mm/year. The water grid network (492 km) is connected to reservoirs (high-precipitation areas), which distribute to demand-side areas to ensure water supply during periods of uncertainty. Based on EEC demand growth, the government has set a 20-year water resource master to construct new reservoirs located on high-precipitation areas to be able to transfer raw water through the network by minimizing water draining out to the ocean. The illustration below presents the master plan of the new reservoirs and the list of the projects to be undertaken by the private sector for the next 20 years.

For the demand project, the plan is to increase water efficiency via 3R (reduce, reuse, recycle) technology to reduce surface water withdrawal. The water usage will be reduced by increasing the efficiency of

production processes and products, treated wastewater will be reused by installing high-quality wastewater treatment systems, and advanced internal water treatment processes will be used to recycle the treated wastewater. Through training and practice, the capability of water management personnel will also be developed to raise the awareness and understanding of the importance of water resources, as well as the social and environmental impacts. In the presentation, the speaker explained how the 3R concept was applied in their projects.

Water management system strategies can be implemented using three approaches: government policy and regulation, water management structure and collaboration, and visualization of water management information. In terms of government policy and regulation, this is controlled by the National Water Resource Act. B.E 2561 (2018). Meanwhile, the water management structure aims to address local concerns in water security, with the industrial sector participating in the Water Committee and collaborating with authorities. Visualized water management information aims to achieve integrated water management of the EEC water grid. Finally, the speaker summarized the key takeaway: the private sector must help ensure water security.

General Discussion

The general discussion was opened for Q&A sessions by the moderator, Dr. Piyatida Ruangrassamee, Chulalongkorn University with the speakers. The first question was given to Mr. Thomas: How can we use the AWDO (Asian Water Development Outlook) publication on the quantitative framework published in terms of moving toward water security? Mr. Thomas answered that the AWDO is a national index that can provide objective data on whether efforts regarding water security are succeeding or failing. The AWDO can also help the authorities target policy reforms and investments, although it may require downscaling to lower geographical units.

The second question was given to Prof. Lee: What is the key success factor in the water sector reform in Korea and how can we shift toward the nonstructural measures? Prof. Lee stated that the success of Korea's water resources management can be attributed to the gradual progress of sustainability in terms of the social dimension (i.e., the people) and the fact that water and sanitation have vastly improved since the 1960s–70s. Apart from social development, the country has also reached a good level of economic development while taking note of other successful cases in countries, such as Germany.

However, success cannot be easily compared, because it is based on each country's characteristics and policies. Thus, it all depends on each country being assessed.

The next question was addressed to Dr. Tuan (on behalf of Mr. Nguyen Minh Khuyen): Regarding the outlook of Vietnam's management, does it focus on the climate change adaptation plan? Dr. Tuan briefly explained that, yes, Vietnam is focused on implementing its climate change adaptation plan. In fact, since 2016, the MONRE has developed climate change scenarios for Vietnamese regions, such as in river basins. Moreover, all the different plans on different levels follow the initiatives designed to address climate change.

As a perspective from the private sector, a question was given to Mr. Somchai: What are the significant gaps that can be seen and the needs to be addressed by the private sector? Mr. Somchai then answered that the private sector must have seamless collaboration with the government, especially during times of crises. An example is that they need to ensure that they can provide adequate water supply to everyone during these times. Furthermore, the industrial sectors in Thailand are not all located in the EEC; thus, the plan is to extend the base management water system to the entire area all over Thailand so that the private sector and related industries can have adequate water security. Here, water governance will play a key role.

The moderator then asked a question to all the speakers on what should be one if they encounter resistance in the areas where they are planning development projects and what is the recommended approach that must be used. Dr. Lee answered that this is a governance issue and has to do with how much a government can tolerate resistance against its projects. He added that the government must be ready to have dialogs with the locals and elaborate their concerns and demands so they can achieve a common ground. The government's role is significant in providing solutions for any issue that may arise. From the private sector's perspective, Mr. Somchai explained that we have to communicate the positive aspects of a project and the potential benefits to the communities. The locals must also be included as stakeholders during discussions so that can understand every perspective and all parties involved can achieve a win–win solution. Another approach to ensure that a project proceeds smoothly is through regulations, especially in terms of money, licenses, and permit. Usually, delays may be caused by project costs, so the private sector should find ways on how to shorten this process. Mr. Thomas then provided his perspective from the World Bank's

side by saying that most of the multilateral banks have guidelines and specifications for local communities to overcome these kinds of situations. From our perspective, it comes down to how do we proceed and how we should follow these guidelines and cooperate with the existing measures. If there is a project deemed harmful, usually the safeguard will help change or restrict that. Overall, it is important to include the stakeholders, especially those who will benefit or will be directly affected by a project. Their concerns must be heard so that a project can be accommodated by all parties concerned.

Next, a question was given to Mr. Somchai concerning the COVID-19 situation, which disrupted the Thai economy: Is the EEC plan modified in terms of water demand forecasting and what is the adaptation plan in the near future? Mr. Somchai then explained that, from an industrial side, it is still able to run the business close to normal levels with minimal impact from COVID-19, so water consumption is still the same. In fact, water consumption may even be reduced due to the restrictions imposed on the tourism industry. In other words, the planning of the water demand and forecasting is pretty much still the same.

Before the general discussion session came to an end, the moderator asked the speakers, Mr. Somchai, Prof. Lee, and Mr. Thomas, to give their three most important recommendations to achieve water security as their closing remarks. Mr. Somchai said that we have to manage the supply and demand sides very well and ensure effective water management system. Prof. Lee said that institutional reforms and adequate financing are essential (prioritizing investments and mainstreaming investments for water security-related policies and projects). Moreover, the nexus or integrated approach connecting water with other sectors has synergistic effects. Finally, Mr. Thomas explained that good governance and policies are fundamental, and that resilience is a new paradigm focused on water resilience and security. Appropriate financing measures must be in place to ensure water security.

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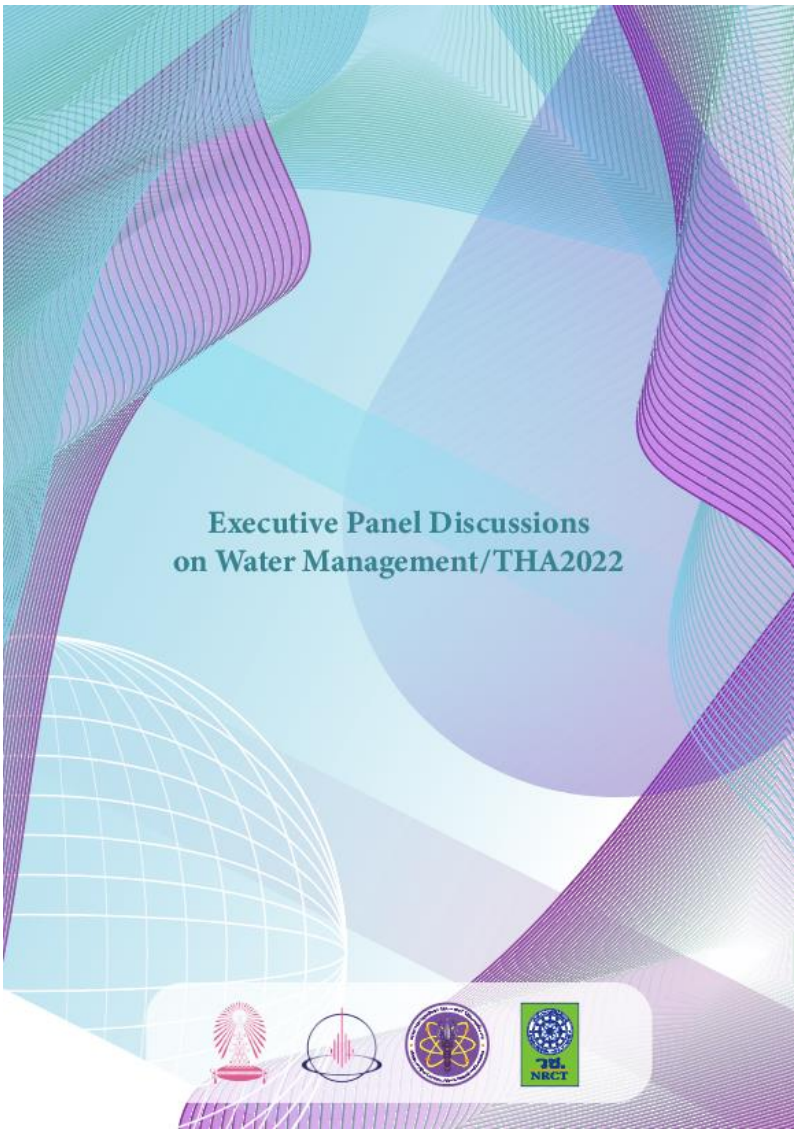
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