Asia-Pacific Economic Cooperation

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Integrated Water Resources Management (IWRM): Best Practices, Norms and their Implementation within the APEC Region

APEC Policy Partnership on Science, Technology and Innovation

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1. OVERVIEW

Water is the most important component for an economy to function as many, if not all, sectors of the economy depend on it. Agriculture is one industry which is strongly dependent upon cheap and readily available sources of both water and energy. The agricultural industry accounts for around 70% of global water withdrawals in competition with other industries such as heavy industry (mining, manufacturing etc.), forestry and light industries (electrical component manufacturing, textiles etc.) and human consumption as well. Most water resources are shared by different economies, so mismanagement at one end can lead to the limitation of water resources at the other and therefore can be a source of conflict between different economies/regions and between different sectors of the economy (virtual water and embedded water in trading). Fragmented approaches to manage water resources do not necessarily solve conflicts by competition of catchment and therefore are unable to ensure the sustainability of watersheds. Integrated water resources management (IWRM) for different actors/sectors is crucial, considering different legal frameworks that regulate the allocation of water resources in different economies (private, public, or shared property).

The project will address IWRM bringing together stakeholders from different sectors and regions and promoting maximization of benefits on economic and social areas. It will also introduce digital technologies available (Digital Earth Australia, etc.) that allow improved integrated management of water recourses between and within different economies. As the report on the current and future value of earth and marine observing to the Asia Pacific Region submitted by Australia this year says, “access to open data is not a game-changer for economies that lack the analytical capabilities to convert data into information to inform decision making. These economies will benefit most from collaboration through data products and EMO insights that are ‘ready to use’.” Data available through digital observations can provide detailed information on the water level of rivers, for example, that can help stakeholders to decide on actions and their timeframe. The leaders of EMO in APEC are well placed to support their efforts. The project´s uniqueness is that it involves not only the agricultural sector but rather tries to incorporate all sectors of the economy due to the importance of water resources for their functioning. It also does not restrain its focus on management related to climate change outcomes as it is mostly used in recent days but also includes man-related issues around shared water resources.

In order to create an ecosystem among APEC economies a 3 days’ workshop was held in September 2021 by the online platform on 27-28 September, 30 September- 1 October and 5-6 October in two-hour sessions each day. The workshop was attended by 48 participants (15 women) from twelve (12) economies representing different vies from research, industry, and government:

1. Australia
2. Chile
3. China
4. Hong Kong, China
5. Indonesia
6. Korea
7. Malaysia
8. Peru
9. Philippines
10. Chinese Taipei
11. Thailand
12. United States

The workshop, at first, has created opportunities for all participants to better understand the state of art on water security and IWRM in different economies as well as analysed challenges and advances related to it within each present economy. It then allowed participants to work in groups to discuss the challenges in natural disaster resilience and its connection to science, technology, and innovation and generate recommendations for policy making that can be drawn from participants´ personal professional experience and expertise.

As a result of a mutual learning exercise among stakeholders from both developed and developing APEC economies, this initiative has generated recommendations through which it intends to contribute to the policy-making process on natural disaster resilience based upon STI evidence.

This set of recommendations will therefore boost APEC economic integration; support competitiveness and innovation in APEC economies by better preparedness and resilience policies to cope with disasters of natural origin. The main benefit of this initiative will be the improvement and consolidation of new R&D capacities with a focus on IT platforms providing more efficient responses via the identification and understanding of IWRM.

2. PROJECT OBJECTIVES

Develop capacity on IWRM using best practices (at least 5 best practices both from regulatory/policy and digital technologies aspects), through generating common understandings of IWRM in the APEC region and science policy recommendations to encourage on how it can benefit economies and connect related actors within the region.

3. METHODOLOGY

The project was hosted an online event for 3 days in September 2021. The workshop also aimed to connect experts on IWRM of the APEC region and build their capacity, especially on usage of available digital technologies.

- Session 1: 27-28 September 2021 (two-hours session)
- Session 2: 30 September - 1 October 2021 (two-hours session), and
- Session 3: 5-6 October 2021 (two-hours session)

This conference was conducted in a GMT-3 time zone and started at 10.00 PM on September 27 in Santiago, Chile. Since the conference is a virtual event and no cross-border travel will be required, participants should make sure the correspondent time is in their respective time zone.

This event was held online and therefore, participants were required access to a computer and internet services capable of supporting interactive video streaming. Smartphones were not suitable. It was highly suggested that participants could attend the conference in a quiet, undisturbed environment to ensure the quality of the event for themselves and other participants. An operational manual was provided to the speakers and participants after nomination, while two test runs were conducted to ensure all participants can be well connected.

All participants were kindly requested to use their full name and name of the economy (based on the APEC Nomenclature) upon login to assist in identification during the conference as shown below.

The three-day workshop was designed as follows:

- For each session, there were several pre-recorded presentations (two keynote speeches and economies´ presentations) and documents (case studies, other relevant materials) that should be revised by participants prior to the event. The platform was available at least one-week prior to the event.
- All 21 APEC member economies were welcome and invited to participate in sharing experiences related to IWRM and any digital applications used for IWRM and any examples of industry-academia-government interactions.
- There were 3 days between the sessions to ensure that participants can revise materials and be prepared for the next session at a convenient time for each participant. For fruitful discussions during the sessions, all participants needed to review pre-recorded and published materials before the session.
- Session 1 gave insights into IWRM in general and provide opportunities to experts to discuss their economy´s situation and seek solutions from participants. In addition, the experts discussed common challenges that could be resolved by collaborating approaches.
- Session 2 was focused on capacity building related to the use of digital applications, like Earth-Marine Observatory and/or others, for better IWRM. In addition, the experts discussed how to transfer knowledge and technology between them, looking for opportunities driven by digital technologies.
- Session 3 summarized discussions and experience gained during two sessions, draw recommendations for better IWRM and develop a roadmap for possible cooperation between economies in the future through integrating the STI sector.

In order to be able to support the methodology and gather the attendees on the virtual workshop, a temporary website was deployed (https://live.eventtia.com/en/apec-iwrm-workshop-2021/Home/). The website was designed to include a repository space capacity to upload videos to make available the presentations of keynotes and speakers the whole time. Also, the website included a designed space by economy introducing the participants and cases studies to be downloaded in PDF format. Further, the website made available the option to update information post-registration with processes related to:

- Uploading and updating personal information according to the personal interests of attendees.
- Optional access to get B2B meetings between attendees.
- Open access to chats for discussing and sharing comments about the case of studies.

In order to be able to generate policy recommendations, the workshop was divided into four main parts.

1. Introductions of the current state of IWRM by preloaded videos and cases by economies;
2. Two Hours of Discussions of previously recorded talks about case studies of IWRM;
3. Two Hours of Capacity Building session. "Capacity Building: Digital Technologies and participatory modelling tools for water management";
4. Two Hours session on conclusion and recommendations. Final Remarks and Policy Recommendations to drive the research collaboration;

The workshop focused on the following's: Days 1 and 3 were covered three topics: day 1: - (i) Successful and unsuccessful case studies of IWRM in APEC Economies (ii) Best IWRM practices, tools and their alignment with Sustainable Goals linked to the use of digital technologies; day 2 was for (i) Capacity building on digital technologies available by linking data access and the framework data management provided by data observatories.; and day 3 (i) Policy Recommendations in IWRM driven by Scientific Evidence and Available Data, (ii) Recommendations in STI Policies to encourage the research collaboration and exchange based on data analytics and research synthesis.

Please see the case study form and case study examples ANNEX IV and ANNEX V respectively.

In order to achieve the project´s objectives, the event was divided into four parts.

For the first part, two presentations were previously uploaded about "Global challenges in Water Security: A viewpoint from research to policy" by Prof. Upmanu Lall, Department of Earth and Environmental Eng., & Civil Eng. & Eng. Mechanics and Director, Columbia Water Center; and about "A global assessment in Integrated Water Resources Management" by Prof. Guillermo Donoso, Professor at Facultad de Agronomía e Ingeniería Forestal, Pontificia Universidad Católica de Chile and Director Executive Board. International Water Resources Association (IWRA). These presentations have introduced different aspects to discuss the state of the state about water resources management. Also, we received case study presentations made by such economies as China, , Korea, Malaysia, Philippines, Russia, Chinese Taipei Thailand, and Perú. Please see the case studies in ANNEX VI.

During Part 2, the first online session, all participants were divided into 3 small groups ensuring diverse representations in each group of economies, economic sectors, and institutions. At the beginning of the session, each group had time to make introductions within their groups so that each group member could identify their piers from the beginning. In order to generate better discussions on the case studies, three moderators were appointed for different small rooms. Moderators were chosen from the academy that did not present their case studies at the workshop. The moderator addressed the discussion and questions to build a common view according to the experience in each economy to enrich discussions within the groups. The moderators encouraged the discussions through the questions such as:

1. What do we understand by IWRM?
2. Are enabling conditions for the implementation of an IWRM?
3. From a social, political, and technological perspective, what are the main gaps detected?
4. How the data and IT platforms could contribute to collaborating and sharing information between economies?
5. What should be the role of institutions for allocating funds to invest in technologies, IT platforms, getting data to "water efficiency"?
6. What are the main obstacles (or threats) to achieving a good IWRM?
7. What kind of initiatives could be deployed to collaborate into APEC Region in IWRM?
8. What kind of initiatives could be deployed to exchange knowledge and resources into APEC Region to multiple-partnership?

Before group discussions, a moderator for the small room made a brief introduction to the plenary and established the main conclusions of each group discussion. The idea was to make recommendations based on the experiences of each group member. According to discussion into small groups, the IWRM needs the enabling conditions to build a shared vision between stakeholders but supported by policing to gather public, private, and civil society. The policymakers must understand the particularities in the territory to encourage the discussion into basins.

During Part 3, the first online session, all participants were into a “Capacity Building session”. "Capacity Building: Digital Technologies and participatory modelling tools for water management. The first online presentation was provided by Mr. Jonathan Hodge, CSIRO Australia, about “A domestic approach to digital tools and solutions for water management – the Australian story.

The Hodge’s presentation showed the Australian government's timeline to develop integrated data systems for water management. He discussed the barriers and approaches to creating collaborative data systems by involving stakeholders. The information and tools for management provided six main components.

- Near real-time water data;
- Short and medium-term streamflow forecast;
- Domestic water balance models;
- Domestic reference stations;
- Continental-scale water balance;
- Domestic Water Account;

The platform is based on Open Licenses by Creative Commons licenses providing international legal frameworks commonly used worldwide for sharing data. The National Collaborative Research Infrastructure Strategy enabled more than $US3 Billion since 2004 with an additional commitment of US· billion until 2029. He discussed the common data, standards, and formats needed to deploy this system based in:

- Geospatial data Fabric;
- Water Data Transfer Format;
- Water Information Standards;
- Water Accounting Standards; and
- Flood Warming Infrastructure Standards.

After the first presentation, Mr. Edmundo Claro presented a specific case, “SimRapel: Participatory Modelling for Water Governance”. The Claro’s presentation discussed the “participatory science for the sustainable governance of water”. He mentioned the impacts of megadrought in Chile’s central zone over 80% of the total population located living there. He showed how the participatory process in water management could alleviate water scarcity in a specific case in Rapel River Basin. The participatory approach was through the dialogues between private, public, and civil society to create a shared vision about the basin and develop common planning in water uses and extraction. Based on an information platform, the main challenge discussed was about without a higher entity to coordinate and transfer information it’s difficult to advance with the application of these tools and achieve the vision. Therefore, it’s fundamental to advance with a governance model in parallel to the development and implementation of the proposed tools.

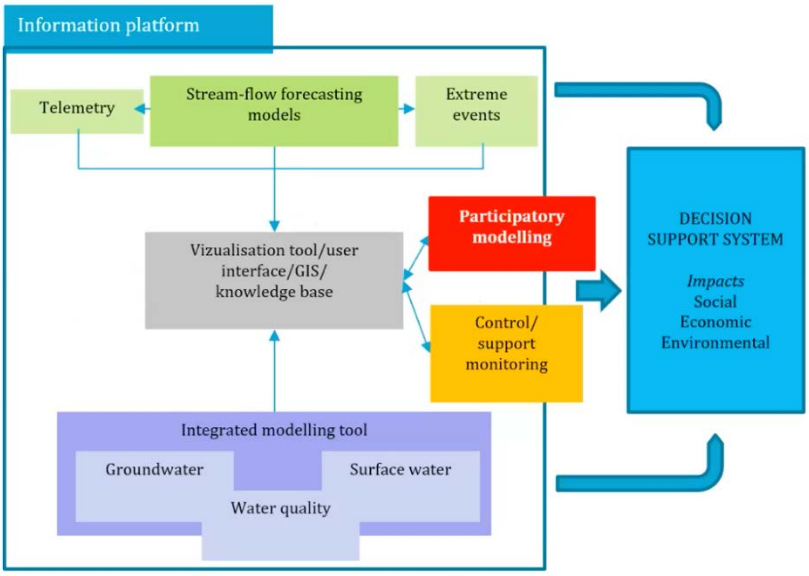

Figure 1. Information platform in Rapel River Basin.

To achieve the goals, he discussed participatory modelling to support water governance based on three kinds of scopes to be deployed:

- Co-design and use participatory workshops,
- Stakeholder analysis, and
- Hydrological model.

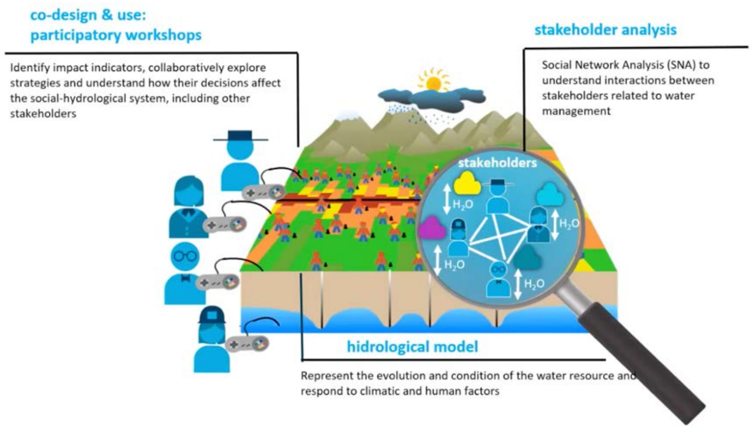

Figure 2. Participatory modelling at Rapel river basin

The governance proposal included a Rapel river basin committee as a transitionary period proposed before its formalization as a non-profit corporation. The main results were an established participatory process between local stakeholders by inventorying the primary needs and challenges of the basin; definition of shared vision and a co-developed water governance agreed upon between stakeholders using an exploratory and interactive tool to support the governance by using participatory science.

Finally, during Part 4, there was just one plenary room ensuring diverse representations in each group of economies, economic sectors, and institutions to make a wrap-up about previous sessions. In order to generate better discussions on the case studies, keynotes' presentation, and the capacity-building sessions, the moderators addressed the discussion and questions to build a shared view according to the experience in each economy to enrich discussions within the groups. The moderators encouraged the discussions through the questions such as:

1. What could be the policy actions are needed to move ahead in IWRM?
2. What kind of policies could be helpful in a transition towards IWRM based on IT?
3. What could be the focus to drive collaborative research between economies?
4. What kind of policies could by enabling conditions for the implementation of an IWRM and digital platforms?
5. What kind of initiatives could contribute to collaboration and sharing information between economies?
6. What kind of initiatives could be deployed to collaborate into APEC Region in IWRM and Data Analytics?
7. What kind of initiatives could be deployed to exchange knowledge and resources into APEC Region to multiple-partnership?

According to the discussion, the transition toward IWRM needs the coordination and responsibility of official entities into economies to gather stakeholders from public, private, and civil society. This coordination is crucial in creating proper governance into the participatory processes. Further, the needs of data tools, platforms, and technologies could leverage resources by opening access to communities and getting specific funds to deploy them into basins. Finally, the workshop addressed highlighted four key conclusions.

- The participatory process is a key component of IWRM
- The IWRM needs to define proper system governance by bringing continuity and stability through time.
- The participatory process and its governance need to be driven by official entities into the economies.
- The IWRM based on participatory processes supports the definition of proper funding.
- The Digital Technologies and participatory modelling tools for water management support adequate IWRM after the governance and the participatory process have been defined.

The agenda of the workshop is available in ANNEX I.

4. DELEGATES

The set of actions to be developed within this project aims to benefit a broad range of stakeholders involved in the domestic ecosystems for science, technology, innovation, and resilience related to IWRM. Beneficiaries are expected to be directly involved in the governmental preparation, promotion, and implementation of decisions and understanding of IWRM on their economy in order to produce a robust exchange of ideas and conclusions. Beneficiaries are also expected to be knowledgeable with their economies' priorities for policies and policy actions to drive the research collaboration and policy recommendations based on data analytics to support the decision-making.

In order to ensure that policy recommendation to be developed within the workshop, the organizers have invited participants from a broad range of institutions and economies.

The workshop was attended by 48 participants from twelve (12) economies:

- 3 from developed economies:
  - Australia (2);
  - USA (1);

- 45 from developing economies:
  - Chile (9);
  - Chinese Taipei (7);
  - Hong Kong, China (1);
  - Peru (3);
  - Indonesia (1);
  - Malaysia (1);
  - Philippines (3);
  - China (3);
  - Thailand (17).

Beneficiaries were also expected to be knowledgeable with their economies' priorities for IWRM. The results of the project were mainly target:

1. Governmental entities (ministries, councils, others) related to policymaking on IWRM
2. Domestic bodies of science, technology, and innovation
3. Funding agencies of science, technology, and innovation
4. Relevant experts from public or private universities/institutions/research centers/
5. Relevant experts from the private sector.

The participants per sector were:

- Government, 28 participants
- Academy, 13 participants
- Non-Governmental Organizations, 2 participants
- Industry, 1 participant
- Other, 4 participants

Throughout its lifecycle, the project involves both women and men willing to exchange experiences of good practices with a gender perspective oriented to IWRM. Gender diversity can certainly contribute to the development of the set of recommendations on IWRM; therefore, the project sought to go beyond the set-up women participation target of 30%. However, the project got a women participation to 25,5% (12) against 74,5% men

(35). The participants per sector were:

- Government, 28 participants
- Academy, 13 participants
- Non-Governmental Organizations, 2 participants
- Industry, 1 participant
- Other, 4 participants

According to areas of interest of participants, the participants state interested mainly in “Research Collaboration”, Technology Transfer Collaboration” and “International Grant Application”:

Table 1. Areas of Interest of Participants

Research collaboration	41	29%
Technology transfer collaboration	21	15,1%
Outreach collaboration	6	4,3%
International grant application	18	12,9%
Domestic grant application support	8	5,8%
International network creation	24	17,3%
International public policy collaboration	5	3,6%
Multiple stakeholder partnerships	16	11,6%

For more details, please see the list of participants at ANNEX II.

5. SPEAKERS

The set of actions to be developed within this project aims to benefit a broad range of stakeholders involved in the domestic ecosystems for science, technology, innovation, and water resource management. Beneficiaries were expected to be directly involved in the governmental preparation, promotion, and implementation of decisions and understanding the importance of integrated water resource management within their economies and across the APEC region in order to produce a robust exchange of ideas and conclusions.

- KEYNOTES SPEAKERS
  - Prof. Upmanu Lall presented the "Global challenges in Water Security: A viewpoint from research to policy". First, he described the state of water resources and their link with water security issues. Then, he proposed the crosslink and contributions between research evidence and policy that need the decision-makers for policymaking. His presentation was about the steady-state of water security in a climate change framework. He showed how the human population grew dramatically, as did its per capita use of many resources, including water, translating into significant gains in the standard of living in most regions of the earth. Innovations in dam construction, energy and drilling made water sources more reliable and accessible and reduced the risks from floods and droughts. Innovations in observing systems now allow us to monitor water quantity and quality and understand the state of the system better than ever before. Globally and regionally, concerns with water security are growing, and anthropogenic climate changes are a concern. However, at least in terms of water-related climate hazards, in many places, it is clear that today's population and human activity may have very high exposure to past expressions of climate risks that represent natural decadal to century-scale variability. The relatively short records used to design water infrastructure may lead to a significant under-design relative to the target level of risk mitigation. This concern is even more poignant once we consider that the space and time clustering in the occurrence of climate extremes translates into recurrent and persistent exposure for many regions and supply chains and could lead to global disruption. It is not clear how these modes of climate may change in the future, but there is an urgent need to consider information from paleoclimate as well as from future climate scenarios in designing adaptation strategies for future climate risk mitigation.
  - Prof. Guillermo Donoso presented "A global assessment in Integrated Water Resources Management". His critical view about why despite the discussion about IWRM started some decades ago, the outcome is a scarce implementation through the economies. He showed a general overview of Chile's water resources, its water institutionality and water legislation, and the obstacles that have prevented a decided adoption of an integrated water management framework. He identified key actions that are required to effectively advance towards an integrated water management framework in Chile. The most important of these are the following. Groundwater users must implement groundwater user associations and integrate these to the Juntas de Vigilancia to apply conjunct surface and groundwater management. Additionally, the Water Code of 1981 establishes that water use rights owners are responsible for water management. However, it is imperative to strengthen all Water User Associations (WUAs) so that each one develops a strong rule of law, effective conflict resolution, and effective collective management. Finally, water users should implement Supra Organizations of Juntas de Vigilancia to integrate different river sections and aquifer hydrogeological sectors allowing for integrated management of different river sections and

aquifer hydrological sections. This does not require a water legislation modification.

The main finding of both presentations were how to address the IWRM as a socio-technical approach to solve water scarcity into basins as water resources as a common pool of shared resources. The conclusions focused on the gap between policymaking and research needs on reliable data for proper water management. Further, stakeholders' data availability and access are critical components to transit toward an IWRM. Finally, adaptation measures may include a basket of policy and technology options in any given region by including the IWRM. Given how pervasive the effects of climate induced water risk may be on food, energy, urban, transportation and economic systems, a sequential decision process for the timed implementation of different options to climate risk mitigation is needed.

5. CASE STUDIES

We required from economies case studies on IWRM. We received fifteen (15) case studies from eight (8) economies listed below. For more details, please see ANNEX VI.

- **China (two cases)**
  1. China's water-energy nexus: Assessment of water-related energy use. In this case, there was analyzed energy consumption as a major restricting factor to the water sector on the whole China scale.
  2. Water Resources Management Strategies for Development of a Water-Saving Society in Golmu City, Qinghai Province, China. This case showed the Water Resources Management Strategies for Development of a Water-Saving Society in Golmu City, Qinghai Province, China.
- **Korea (two cases)**
  1. Full-scale IWRM in the Republic of Korea: This case analyzed the overlapping of plans and projects as well as hindered the integrated water resource management to satisfy human and environmental objectives.
  2. Development of the IWRM strategies to diversify the Nakdong River water intake: to resolve the Daegu-Gumi Water Intake Source Conflict: The study showed how was resolved the water conflict through IWRM plans with measures to improve the water quality of the main Nakdong River and to diversify water intake sources (e.g. riverbank infiltration) based on the comprehensive water quality and water quantity modelling results and the stakeholder consultation & communication
- **Malaysia (one case)**
  1. National Water Balance Management System (NAWABS) in Muda River Basin: This case describes the National Water Balance Management System or NAWABS, where was established for five (5) river basins of various catchment sizes in Malaysia in the first phase. The system focuses on the ICT's contribution to the evolution of scientific and technological disciplines, such as satellite earth observations, real-time monitoring networks, geographic information systems, and their interconnection to integrated water resources management.
- **Peru (two cases)**
  1. DNA metabarcoding and morphological identification of microalgae and cyanobacteria: biological indicators to assess lake Titicaca water quality: The study described the evaluation of the water quality of Lake Titicaca using microalgae and cyanobacteria. For this, they proceed to the morphological and molecular identification by DNA METABARCODING of these microorganisms, as well as to determine their abundance to apply different biotic indices.
  2. Peruvian Glacier Retreat and its Impact on Water Security (Peru GROWS): This case showed to cover the little information that exists for efficient management of the water resource within the Rio Santa basin, as well, a study on the impacts that could be generated with glacier retreat and climate change from a systemic view including social, ecology and governance.
- **Philippines (two cases)**
  1. Enhancing multi-functionality of agriculture through rainwater harvesting system: This study showed that the rainfall-runoff analysis within the sub-

watershed is essential in the rainwater harvesting planning and management and paves the way to improve current methodologies on rainwater harvesting scheme development.

2. Enhancing multi-functionality of agriculture through rainwater harvesting system: The study showed the multifunctionality of rainwater harvesting systems particularly small water impounding projects (SWIPs) located in the barangays of Maasin and Buted, Nueva Ecija, in recharging the groundwater through collected surface runoff, rainfall, and mitigating soil erosion through trapped sediments while providing irrigation water in the downstream rice paddy service areas.

- **Russia (two cases)**
  1. Water resources management in Russia Nº1: The case showed how the Federal Water Resources Agency was authorized by the Government of Russia to develop SIUPWB, a Schemes of Integrated Use and Protection of Water Bodies. Currently, 69 projects have been completed.
  2. Water resources management in Russia Nº2: One of the most important tasks of Buryatia (subject of the Russian Federation) is to maintain an appropriate balance of environmental goals, as well as dynamic and sustainable socio-economic development, considering that most of its territory belongs to Lake Baikal basin. Lake Baikal is a unique water body and ecosystem, including in the UNESCO World Heritage Sites list. It opens wide opportunities for recreational and tourist complex development and eco- activities.
- **Chinese Taipei (two cases)**
  1. Result from Trial of Refined Efficient Irrigation Technique in Chianan Irrigation Area: This case analyzed the role of technologies and subsequent maintenance and their adoption in elderly irrigators. Also, this case uses IoT-related technologies to assist irrigation water allocation and improve irrigation efficiency.
  2. Smart Control of Multi Water Sources: The study showed the Multi Water Sources Smart Control Project uses meteorological forecast information and smart Internet of Things related technologies to establish decision support services for water sources regulation, which could effectively improve the water sources utilization efficiency and water supply stability of Shihmen Reservoir through management methods.
- **Thailand (two cases)**
  1. Integrated Water Resources Management in Eastern Economic Corridor (EEC). The study described the Eastern Economic Corridor (EEC) in Chachoengsao, Chon Buri and Rayong provinces areas the major investment zone enhancing Thailand’s development into “Thailand 4.0”. In addition, target industries are set for concrete investment. There has also been investment in basic infrastructure and public utility systems to increase its potential for investment and economic activities development, including human resource development and technological accumulation system management for the sustainable future of Thailand.
  2. Integrated Water Resources Management during the Dry Season in the Lower Chao Phraya River Basin: The study analyzed the causes by using the data from the water quality tele-metering system and salinity forecasting from the mathematical model and to discharge fresh water in the amount in accordance with sea tide. In addition, the Royal Irrigation Department requests

cooperation from every sector for water-saving.

A global analysis of cases shows a trend of providing customized to local solutions to problems but driven by technologies as a common ground. The diversity of problems related to water issues allows proposing the ICT's contribution to the evolution of scientific and technological disciplines and the integration of geographic information systems to solve common challenges into basins. Therefore, there is a strong interconnection between IWRM and IT Techs but requires proper capacity building adopted by local communities and used by stakeholders.

6. EVALUATION

Participants were required to complete and return an Evaluation Form by the end of the event. In this form, each participant is encouraged to share their views and advice on the event's impact and efficiency and possible suggestions and policy implications for future APEC-related cooperation programs and activities.

The survey included 27 questions opened two weeks before the workshop. For more details, please see Annex VII

About objectives, the participants were asked about the grade of achievement of objectives.
The rate of respondents achieved around 47%, 54,5% women and 45,5% men. According to the training objectives, 100% agreed and strongly agreed that these were clearly defined, and 54% thought that the workshop achieved its intended objectives. In addition, 59,1% think that the items and topics were relevant.

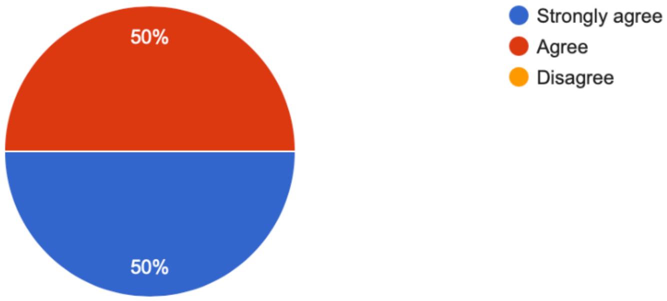

Figure 1. About definitions of objectives of Workshop

63,6% of respondents think that the trainers/experts/facilitators were well prepared and knowledgeable about the topic. However, 18,2% disagree that the time allotted for the training was sufficient. Although the online platform could be helpful to attend the workshop, face-to-face interactions could be needed. A 77,3% of respondents prefer face-to-face meetings against a 22,7% that prefer virtually. Also, all of them think that this project is relevant for their economies.

According to respondents, 50% rated their knowledge high and very high before o sessions meanwhile, after the workshops, this proportion increased a 30% by achieving around an 81,8%.

7. POLICY RECOMMENDATIONS

Based on discussions of the previous two sessions, the third and concluding sessión was focused on developing policy recommendations related to IWRM in the APEC region. All participants were encouraged to discuss common questions in the plenary room. The questions were:

1. How could the data and IT platforms contribute to collaborating and sharing information between economies?
2. What should be the role of institutions for allocating funds to invest in technologies, IT platforms, getting data to "water efficiency"?
3. What are the main obstacles (or threats) to achieving a good IWRM?
4. What kind of initiatives could be deployed to collaborate into APEC Region in IWRM?
5. What kind of initiatives could be deployed to exchange knowledge and resources into APEC Region to multiple-partnership?

Although the objective of the group work and discussions was explained prior, each group has developed a different approach to generate recommendations. While considering broader aspects of IWRM priorities, the groups focused on specific issues which need to be highlighted in the near future. The main conclusions were.

1. How could the data and IT platforms contribute to collaborating and sharing information between economies?

   According to the attendees' s discussion, the integrated IT platforms between economies could be helpful to share data and models from different geographical contexts. The IT platforms could be developed by Science and Technology official entities supported by government, private and civil society. These IT platforms could gather standardized information from different sources. Open access to this kind of information will allow knowledge exchange by connecting institutions, experts, practitioners, and researchers.

2. What should be the role of institutions for allocating funds to invest in technologies, IT platforms, getting data to "water efficiency"?

   According to the attendees' discussion, the role of institutions for allocating funds could be driven by strengthening networks collaborating by working on common research cases or similar approaches. In addition, the efforts could be driven to build a shared database of cases, data, models, and cases.

3. What are the main obstacles (or threats) to achieving a good IWRM?

   According to the attendees' s discussion, the main obstacles are the lack of data, models, and collaborative work between sectors.

4. What kind of initiatives could be deployed to collaborate into APEC Region in IWRM?

   According to the attendee's discussions, a workshop on the strategic approaches on critical analysis, problem-solving, and water resources management could be the next steps. Also, new workshops are needed to enhance the institutions' capacity to pursue the research and development gaps. In all cases, they are extending the collection of water issues from different economies—finally, Follow-up meetings, sharing of expertise.

5. What kind of initiatives could be deployed to exchange knowledge and resources into APEC Region to multiple-partnership?

   According to the attendee's discussions, to deploy a sharing platform by establishing a formal collaboration with ASEAN economies.

Taking the abovementioned into account, the group has developed the following policy recommendations:

Policy Recommendation 1: Institutional framework between APEC economies, supported by entities such as Ministry of Science & technology in order to offer cooperation, technical support, considering the crossing of borders, with a comprehensive integrated system of information with knowledge vision including all major groups and other stakeholders, such as business and industry, children and youth, farmers, indigenous people, local authorities, non-governmental organizations, scientific and technological community, women, workers and trade unions;

Policy Recommendation 2: To continue providing training and engagement between APEC economies by formal training in workshops on the strategic approaches on critical analysis, problem-solving, and decision making on water resources management, as well as enhancing the capacity of the institutions to pursue the research and development gaps

Policy Recommendation 3: A percentage of public investment in research, development, and innovation related to IT open platforms for IWRM built by networking institutions in APEC economies,

Policy Recommendation 4: Designing a long-term pathway on IWRM between APEC economies by fixing milestones in collaborative initiatives by encouraging the creation of networks between attendees.

8. FOLLOW UP STEPS

As a follow-up action, Chile will be sharing the report with the APEC economies through the Policy-Partnership for Science, Technology, and Innovation Fora as well as legal representatives of the economies in Chile. Furthermore, to bring continuity to the project, we'll propose to build a collaborative developed for the workshop in order to keep the report available to stakeholders at different levels, local, regional and global, along with other related reports collected for this purpose by including and getting more cases to encourage the cooperation between economies.

ANNEX I. WORKSHOP AGENDA

Session 1: 27-28 September 2021
Session 2: 30 September - 1 October 2021
Session 3: 5-6 October 2021

September 15: Some pre-recorded presentations

Keynote speakers
Global challenges in Water Security: A viewpoint from research to policy. Upmanu Lall, Alan & Carol Silberstein, Professor of Engineering Department of Earth and Environmental Eng., & Civil Eng. & Eng. Mechanics Director, Columbia Water Center
A global assessment in Integrated Water Resources Management Guillermo Donoso, Professor Facultad de Agronomía e Ingeniería Forestal Pontificia Universidad Católica de Chile Director Executive Board. International Water Resources Association (IWRA)

DAY 1, 27-28 September: Two Hours of Discussions of previous recorded talks about Case studies of IWRM.: IWRM in APEC Economies: Practices, tools and Digital Technologies **PREVIOUS REQUIREMENTS: All participants have to watch/revise pre-recorded presentations**
Discussion about successful and unsuccessful case studies of IWRM in APEC Economies
Discussion about best IWRM practices, tools and their alignment with Sustainable Goals linked to use of digital technologies
Deliverable: A set of common practices between APEC economies that could be replicated as framework to open research collaboration
DAY 2, 30 September - 1 October: Two Hours of Capacity Building session. "Capacity Building: Digital Technologies and participatory modelling tools for water management" **PREVIOUS REQUIREMENTS: All participants have to watch/revise pre-recorded presentations**
Capacity building on digital technologies available by linking data access and the framework data management provided by data observatories.
Use of earth observation and participatory modelling tools for water management. The cases of Australian initiative about National Collaborative Research Infrastructure Strategy (NCRIS)
Discussion about the concerning the minimum efforts and capabilities needed to deploy this kind of tools in other economies. A help guide should be distributed to be read by the participants before the discussion.
Deliverable: A set of data sourcing available as open sourcing to be shared and compiled among APEC economies users.
DAY 3, 5-6 October: Two Hours session on conclusion and recommendations. Final Remarks and Policy Recommendations to drive the research collaboration **PREVIOUS REQUIREMENTS: All participants have to watch/revise pre-recorded presentations**
According to previous discussions on the workshop, the attendees will discuss policies and policy actions to drive the research collaboration and policy's recommendations based on data analytics to support the decision-making. They'll prepare a brief blueprint with keys and central policies identified to be proposed to APEC Economies.
Deliverable: Policy Recommendations in IWRM driven by Scientific Evidence and Available Data, as well as STI Policies to encourage the research collaboration and exchange based on data analytics and research synthesis.

*A span of about 3-4 days between each session is to allow participants to revise pre-recorded materials.

ANNEX II. LIST OF PARTICIPANTS

Economy	Full name	Job title	Sex	Organisation
AUS	Jonathan Hodge	Senior Researcher	M	CSIRO Chile
AUS	Edmundo Claro	Senior Researcher	M	CSIRO Chile
CHL	Sharapiya Kakimova	Internationalization expert	F	National Agency for Research and Development
CHL	Damaris ORPHANOPOULOS	Partner, General Manager	F	RODHOS Asesorías y Proyectos SpA
CHL	Alejandra Stehn	Professor, Facultad de Ciencias Ambientales & Centro EULA	F	Univercity of Concepcion
CHL	Diego Rivera	Professor, School of Engineering	M	University of Desarrollo
CHL	Mario Lillo	Professor, Faculty of Engineering and Agriculture	M	University of Concepcion
CHL	Mathias Kuschel	Principal Researcher	M	IDIA Foundation, Chile – IANSA Company
CHL	Alex Godoy	Director, Center of Research in Sustainability (CISGER)	M	University of Desarrollo (UDD)
CHL	Guillermo Donoso	Professor	M	Pontific Catholic University of Chile
CHL	Alejando Leon	Associate Professor	M	Universidad de Chile
CT	Yang	Project Manager	F	Industrial Technology Research Institute
CT	SU	Deputy Director	M	Southern Region Water Resources Office, Water Resources Agency, Ministry of Economic Affairs
CT	KUO	Section Chief	M	Southern Region Water Resources Office, Water Resources Agency, Ministry of Economic Affairs
CT	CHEN	Associate Engineer	M	Southern Region Water Resources Office, Water Resources Agency, Ministry of Economic Affairs
CT	HSU	Assistant researcher	M	Water Resources Planning Institute, Water Resources Agency, Ministry of Economic Affairs
CT	CHEN	Senoir Engineer	M	Water Resources Agency
CT	Lee	Section Chief, Management Division	M	Water Resources Agency
HK	Nicholas BROOKE	Principal Advsior to APEC PPSTI	M	Professional Property Services Ltd
IND	Lena Sumargana	Researcher	F	National Research and Innovation Agency
MAL	Zelina Zaiton	Environmental Analyst, Faculty of Forestry and Environment	F	Universiti Putra Malaysia
PE	Fanny Enciso	Official	F	Ministry of Energy and Mines
PE	Jose Luis Alarcon Tello	Water Resources Specialist	M	Ministry of Agrarian Development and Irrigation
PE	Elvis Tello	Official	M	Ministry of Energy and Mines
PHI	Alissandra Pauline B. Mariano	Science Research Specialist II	F	Department of Science and Technology
PHI	Susan P. Abano	Chief, Policy and Program Division	F	National Water Resources Board
PHI	Diosdado Manalus	Engineer IV, Department of Science and Technology	M	Bureau of Soils and Water Management
PRC	Yi ZHENG	Profesor	M	Southern University of Science and Technology
PRC	Haiyun SHI	Associate Professor	M	Southern University of Science and Technology
PRC	Ximeng XU	Assitant Professor	M	Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences
THA	Areerat Anuchon	Chief of Sediment and Water Quality Branch	F	Bureau of Water Management and Hydrology, Royal Irrigation Department
THA	Nisakorn YINGKAJOHN	Head of Community Water Resource Management Informatics Section	F	Hydro-Informatics Institute

THA	Piyamarn SISOMPHON	Head of Hydro-Informatics Modeling System Section	F	Hydro-Informatics Institute
THA	Aisawan CHANKARN	Research Associate	F	Hydro-Informatics Institute
THA	Sarawadee PHATTHARAK IJKULTHORN	Head of Community Water Resource Management Network Section	F	Hydro-Informatics Institute
THA	Watchara Suiadee	Acting Executive Advisor on Irrigation Engineering	F	Royal Irrigation Department
THA	Kriengsak Phumnak	Director of Water Management and Maintenance Division	M	Regional Irrigation Office 9, Royal Irrigation Department
THA	Adisorn Champathong	Director of Hydrology Division	M	Bureau of Water Management and Hydrology, Royal Irrigation Department
THA	Sutat WEESAKUL	Director	M	Hydro-Informatics Institute
THA	Mongkol NGMJAREAR NWONG	Head of Community Water Resource Management Technology Section	M	Hydro-Informatics Institute
THA	Surajate BOONYA-AROONNET	Director of Hydro-Informatics Innovation Division	M	Hydro-Informatics Institute
THA	Winai CHAOWIWAT	Researcher	M	Hydro-Informatics Institute
THA	Kritanai TORSRI	Model developer	M	Hydro-Informatics Institute
THA	Chalearm CHANKARN	Telemetry developer	M	Hydro-Informatics Institute
THA	Manorot TANGSAVEEP HAN	Head of Informatics Development Section	M	Hydro-Informatics Institute
THA	Narongsak PIMPUNCHAT	Director of Community Water Resource Management Division	M	Hydro-Informatics Institute
THA	Lerboon Udomsap	Director of Water Watch and Monitoring System for Warning Division, Bureau of Water Management and Hydrology	M	Royal Irrigation Department
USA	Upmanu Lall	Director	M	Columbia Water Center

ANNEX III. CASE STUDIES FORMAT

Title	
APEC Economies	
Place - Basin	
Case Study Author (researcher in case of availability of scientific publication)	
Relevant Stakeholders (Name and Type of Stakeholder if possible)	Governmental Entities: XXX Civil Organizations: XXXX Private Sector: XXXX International Organization: XXXX Other: XXXX
Brief (no more than 1000 words)	
Challenge, SDGs and Digital Technology used (no more than 500 words)	

ANNEX IV. CASE STUDIES EXAMPLES

EXAMPLE 1:

Title	The Transboundary Paso del Norte Region: Stakeholders' Preferences Allowing Water Resources Adaptation
APEC Economies	Mexico-United States
Place - Basin	Rio Grande/Bravo Basin
Case Study Author (researcher in case of availability of scientific publication)	Luzma Fabiola Nava Center for Global Change and Sustainability, C.A. (CCGS), Villahermosa, Tabasco, Mexico.
Relevant Stakeholders (Name and Type of Stakeholder if possible)	Governmental Entities: Paso del Norte Watershed Council. Municipalities of Las Cruces, El Paso y Ciudad Juarez. Government of Texas Civil Organizations: International Boundary and Water Commission, Paso del Norte Water Task Force (PdNWTF), Private Sector: XXXX International Organization: XXXX Other: XXXX
Brief	This case illustrates the potential to advance transboundary water resources management in a more comprehensive approach. The focus is given to the transboundary Paso del Norte (PdN) region which is considered as the most environmentally damaged, hydrologically developed, and prolific irrigation area in the Rio Grande/Bravo Basin. Stakeholders from the US-Mexico PdN region provides insights into what needs to be done to foster sustainable adaptation of water allocation and management. A preliminary set of policy recommendations aims to highlight stakeholders' preferences and interests and their integration into regional water resources management.
Challenge, SDGs and Digital Technology used	The USA and Mexico share a nearly 3200-km-long border that crosses three river basins: the Colorado River (CR), the Tijuana River (TR), and the Rio Grande/Bravo (RGB). This paper focuses on a significant RGB transboundary region: the surface water resources of the Paso del Norte (PdN) region (hereinafter the term water refers to surface water resources unless otherwise specified). The PdN region is located right at the midpoint of the US-Mexico border.

EXAMPLE 2:

Title	Water Resources Management in California
APEC Economies	United States
Place - Basin	California
ResearcherCase Study Author (researcher in case of availability of scientific publication	Samuel Sandoval-Solis Department of Land, Air and Water Resources, University of California, Davis, CA, USA
Relevant Stakeholders Involved (Name and Type of Stakeholder if possible)	Government: US. Bureau of Reclamation, Government of State of California, State Water Resources Control Board, California Department of Water Resources, Federal Energy Regulation Commission Civil Organizations: xxx Private Sector: xxx International Organization: xxx Others: XXX
Brief	California has an intense history of water management and resources manipulation. The main drivers for some of the largest water management infrastructure projects are (1) a spatial mismatch between where most of the precipitation falls on the state and where most of the water is needed and (2) a temporal mismatch of precipitation during winter months and the agriculture season on summer. This case describes the legal framework and water allocation systems to manage surface water, groundwater, and environmental water that are guiding California toward adopting an integrated water resources management framework.
Challenge, SDGs and Digital Technology used	Define the purpose of this infrastructure is to transport water where it is needed; the California Aqueduct and the Delta-Mendota Canal move water from the north to the south of the state; the Hetch Hetchy and Mokelumne aqueducts transport water from the Sierra Nevada to the San Francisco Bay Area; Los Angeles and Colorado aqueducts move water to Southern California to supply urban and agriculture water needs.

ANNEX V. APEC – CASES OF STUDY

Title	China's water-energy nexus: Assessment of water-related energy use
APEC Economies	China
Place - Basin	China
Case Study Author (researcher in case of availability of scientific publication)	Xiaozhi Xiang[a,b], Shaofeng Jia[a] a) Key Laboratory of Water Cycle and Related Land Surface Processes, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, 100101, China b) College of Environment and Resources, University of Chinese Academy of Sciences, Beijing, 100101, China
Relevant Stakeholders (Name and Type of Stakeholder if possible)	Governmental Entities: Water Resources Bureau, China.
Brief	In China, with the rapid economic expansion and industrialization, energy used for water conveyance, treatment and distribution processes is increasing significantly. The shift toward more energy-intensive water is likely to have an appreciable impact on future energy demand and has drawn public attention gradually. As the water-energy nexus has quickly risen to the forefront of international attention, the emerging shortage issues of water and energy are more noteworthy around the world and their inextricable dependence upon each other is becoming more evident. The water-related energy consumption is one of the core concepts in water-energy nexus, yet the classification and estimation values of its numerous branches have not been well documented in China. To address this gap, this case sorted out water-related energy use processes after setting forth the implication and boundary of water activities, and then calculated their detailed energy flows. The results showed that the total energy consumed by China's water sector was about 732 million GJ in 2015, accounting for 0.6% of the domestic energy consumption. The electricity power is the basic power source for water processes and the electricity consumed by water sector accounts for 3.4% of the total electricity consumption in China. From the perspective of different water activities: 54% of the energy consumption was attributed to raw freshwater collection, extraction and conveyance activities, 41% of the energy used in water treatment, distribution and wastewater treatment while the water resource construction activities occupied the remaining 5%.
Challenge, SDGs and Digital Technology used	The main challenge is: 1) very little analysis has been done to quantify water-related energy use at the central-level to establish a benchmark for today's conditions. 2) In current studies, not only the estimation methods are less expressly stated, but even the definition boundary of water-related energy use is obscure. In this study, the analysis suggested that the energy consumption has not become a major restricting factor to water sector on the whole China scale, while heavy energy burdens were likely to lower the current and future effectiveness of certain water projects or policies.

Title	Water Resources Management Strategies for Development of a Water-Saving Society in Golmu City, Qinghai Province, China
APEC Economies	China
Place - Basin	Qinghai Province
Case Study Author (researcher in case of availability of scientific publication)	Runjie Li[a], Yongan Wen[b], Kaixiang Guo[c], Zhuping Sheng[d], Shaofeng Jia[e] a) Qinghai Institute of Water Resources and Hydropower, Qinghai, China b) Golmu Water Resources Bureau, Qinghai, China c) Qinghai Institute of Water Resources and Hydropower, Qinghai, China d) Texas AgriLife Research, Texas A&M University, 1380 A&M Circle, El Paso, Texas 79927, USA e) Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China
Relevant Stakeholders (Name and Type of Stakeholder if possible)	Governmental Entities: Qinghai Water Resources Bureau, China.
Brief	In this case, the authors present a case study in Golmud City, Qinghai Province in China to demonstrate components of the integrated water conservation plan. Based on assessment of current water demands and supplies, water conservation potentials were estimated for agricultural application, industrial production, municipal and domestic uses and ecosystem needs. Current agricultural water diversion is 32,940 cubic meters per hectare, which is almost 4 times of the China's average. Residential water use is approximately 1 cubic meter per capita per day.
Challenge, SDGs and Digital Technology used	Present water allocation is not well regulated. A great potential for water conservation allows water stakeholders to achieve the goal of a water-saving society: using the currently available water to meet future demands for sustaining agricultural and industrial production, human consumption and healthy ecosystem. Several measures were recommended, including appropriate exploitation of water resources, and water conservation in agricultural, industrial, municipal and ecological sectors.

Title	Result from Trial of Refined Efficient Irrigation Technique in Chianan Irrigation Area
APEC Economies	Chinese Taiepi
Place - Basin	Guantian District, Tainan City
Case Study Author (researcher in case of availability of scientific publication)	Yu-Sheng Chen [1],Ming-Cheng Chen [2], Ya-Ju Lee[3] [1]Water Resources Agency, Ministry of Economic Affairs, Southern Region Water Resources Office, Associate Engineer.

	[2]Water Resources Planning Institute, Management Division,Section Chief. [3]Water Resources Planning Institute, Management Division, Engineer.
Relevant Stakeholders (Name and Type of Stakeholder if possible)	Governmental Entities: Southern Region Water Resources Office, WRA, MOEA Civil Organizations: Chianan Irrigation Association (reorganized into Chianan Management Office, Irrigation Agency in October 2020) Private Sector: TSMC International Organization: N/A Other: Chunghwa Telecom
Brief (no more than 1000 words)	There is a clear contrast between dry and wet seasons in the southern region of Chinese Taipei. New water sources are also hard to find, leading to more challenges in water sourcing. Building on the traditional manual irrigation technique employed by the Chianan Irrigation Association, the Water Resources Agency (WRA) tried to combine IoT, improved irrigation equipment developed by suppliers, Chunghwa Telecom's 4G technology, NBIoT, and system apps, TSMC's electric gate technology, and the association's in situ irrigation operations and trials between 2017 and 2020. The project took place over a 114-hectare irrigation area in Guantian District, Tainan City. Sensors and electric gates were installed in irrigation canals, and transmission devices sent field data to the cloud platform. The association and its managers and irrigators used mobile phones to monitor if the water level in the field was too high or too low. A smart decision making process was followed to determine priorities in water resource allocation. The result showed that irrigation efficiency could be improved further by 4.5%.
Challenge, SDGs and Digital Technology used (no more than 500 words)	Challenge: The average age of irrigators handling in situ irrigation at the Chianan Irrigation Association was over 70. Each irrigator was managing 50 hectares on average. The workforce was aging rapidly, and older workers needed to be more open to new technologies and subsequent maintenance work. Both were believed to be the most critical challenges in expanding the operation to the entire irrigation area in the future. Digital Technology used: IoT, 4G technology, sensors, electrical gates, cloud platforms, and smartphones.

Title	Smart Control of Multi Water Sources
APEC Economies	Chinese Taipei
Place - Basin	Taoyuan City / Dahan River
Case Study Author (researcher in case of availability of scientific publication)	Chia- Chuan Hsu[1], Lan-Chieh Pi[2], Chan-Ming Tsai[3], Chun-Hung Chen[4], Jiun- Ming Ye[5], Ming-Cheng Chen [6], Ya-Ju Lee[7] 1 Water Resources Planning Institute, Water Resources Agency, Ministry of Economic Affairs, Assistant researcher. 2 Water Resources Planning Institute, Water Resources Agency, Ministry of Economic Affairs, Engineer. 3 Water Resources Planning Institute, Water Resources Agency, Ministry of Economic Affairs, Chief. 4 Water Resources Planning Institute, Water Resources Agency, Ministry of Economic Affairs, Director. 5 Water Resources Planning Institute, Water Resources Agency, Ministry of Economic Affairs, Deputy Director. 6 Water Resources Planning Institute, Management Division,Section Chief. 7 Water Resources Planning Institute, Management Division, Engineer.
Relevant Stakeholders	Governmental Entities: Northern Region Water Resources Office, Water Resources Agency, Ministry of Economic Affairs
Brief (no more than 1000 words)	Due to the severe hydrological and geological conditions and the impact of climate change, the rainfall in local area is heavy and urgent, which makes extremely high pressure and difficulty in water resources dispatching and flood control operation of reservoirs. In order to stabilize the water supply, reduce the risk of water shortage, and improve the systemic flood control capabilities, the Internet of Things technology is introduced and the cloud computing, artificial intelligence and big data analysis technologies are integrated. The innovative overall solution of Multi Water Sources Smart Control is developed through the combination of data and physical models. It can dynamically produce decision-making suggestions and provide flexible online decision-making auxiliary analysis services, which is suitable for reservoir flood control operation and regional water sources regulation. This case has been successfully applied to the water supply area of Shihmen Reservoir, which has relatively high frequency of water supply reduction in recent years. It provides high-quality digital water services, is expected to effectively improve management efficiency, increases water resources utilization efficiency, and reduces water shortage risks.
Challenge, SDGs and Digital Technology used (no more than 500 words)	The hydrological condition in dry and wet season varies greatly. n the case of difficult development of water resources facilities, how to ensure domestic water demand, food security, social and economic development, and maintain water security are important issues for water resources management. The Multi Water Sources Smart Control Project uses meteorological forecast information and smart Internet of Things related technologies to establish decision support services for water sources regulation, which could effectively improve the water sources utilization efficiency and water supply stability of Shihmen Reservoir through management methods.

Title	**Full scale IWRM in the Republic of Korea**
APEC Economies	Republic of Korea
Place - Basin	South Korea (Domestic Level)
Case Study Author (researcher in case of	Haejin Han (Section Chief) Korea Environment Institute, Division of IWRM Research

availability of scientific publication)	
Relevant Stakeholders (Name and Type of Stakeholder if possible)	Governmental Entities: Ministry of Environment, Ministry of Land, Infrastructure and Transport, Ministry of Agriculture and Forestry, Presidential Water Commission
Brief (no more than 1000 words)	This case describes the key features of the water policy reform in Republic of Korea such as the enabling legal framework and institutional arrangements along with the adoption of the IWRM Agenda in 2018. In 2018, Korea has overhauled its domestic water management system that had fragmented responsibilities among ministries into an integrated structure with the Ministry of Environment as the single authority to maximize the administrative efficiency in water management. The framework Act on Water Management was also enacted in the same year to provide a statutory base for IWRM including the establishment of National Water Commission, the development of the Basic Plan for National Water Management and the Comprehensive plan for basin water management and introduction of the water dispute mediation system. The Presidential Water Commission, involving heads of 8 ministries related to water management fostered policy coherence and cross-sectoral coordination.
Challenge, SDGs and Digital Technology used (no more than 500 words)	In the Republic of Korea, multiple ministries had been engaged in water management including Ministry of Land, Infrastructure and Transport (water resource), Ministry of Environment (water quality), Ministry of Agriculture and Forestry (water resource for ag.), Ministry of Security and Public Administration (disaster management), but no overarching control tower that oversees and coordinates. This sometimes resulted in the overlapping of plans and projects as well as hindered the integrated water resource management to satisfy human and environment objectives.

Title	**Development of the IWRM strategies to diversify the Nakdong River water intake: to resolve the Daegu-Gumi Water Intake Source Conflict**
APEC Economies	Republic of Korea
Place - Basin	Nakdong River Basin
Case Study Author (researcher in case of availability of scientific publication)	Haejin Han Korea Environment Institute, Division of IWRM Research
Relevant Stakeholders (Name and Type of Stakeholder if possible)	Governmental Entities: Ministry of Environment, Local governments along the Nakdong River Basin (City of Daegu, City of Gumi) Civil Organizations: Other: XXXX
Brief	While far from perfect, this case may offer lessons to other regions that are increasingly faced with water conflicts over securing clear water. The water disputes between Daegu city and Gumi city have been drifting for a long time. To resolve the conflict, the ministry of Environment developed the IWRM plans with measures to improve the water quality of the main Nakdong River and to diversify water intake sources (e.g. river bank infiltration) based on the comprehensive water quality and water quantity modeling results and the stakeholder consultation & communication.
Challenge, SDGs and Digital Technology used	The conflict between Daegu City and Gumi City began in 2009. While the Daegu City has called for the joint use of safe and unpolluted water to Gumi and Daegu Citizens, Gumi City opposed the relocation of the water intake plant due to water shortage and quality issues.

Title	**National Water Balance Management System (NAWABS) in Muda River Basin**
APEC Economies	Malaysia
Place - Basin	Muda River Basin – States of Kedah and Penang
Researcher Case Study Author (researcher in case of availability of scientific publication	Ir. Bibi Zarina binti Che Omar Director, Water Resources Management and Hydrology Division, Department of Irrigation and Drainage (DID) Malaysia
Relevant Stakeholders Involved (Name and Type of Stakeholder if possible)	Government: Ministry of Environment and Water, Department of Irrigation and Drainage (DID) Malaysia, DID Perlis, DID Penang, DID Kedah, National Water Services Commission (SPAN), Muda Agriculture Development Authority (MADA), Kedah Water Resources Board (LSANK), Penang Water Regulatory Body (BKSA) Civil Organizations: - Private Sector: Water Operator – Syarikat Air Darul Aman (SADA), Syarikat Air Perlis (SAP), Perbadanan Bekalan Air (PBA) Pulau Pinang International Organization: none Others: none
Brief	Adaptation of IWRM begun with the 8th Malaysian Plan in 2001. In 2003 National Water Resources Council agreed to National adaptation for Integrated Water Resources Management. The implementation of IWRM BMPs started in 2009. In 2012, the government had launched the National Water Resources Policy (NWRP) after the completion of the National Water Resources Study (NWRS) in 2011. The implementation of IWRM in Malaysia is still in progress until Malaysia can achieve UN Sustainable Development Goal (SDG) 6: Clean Water and Sanitation. The general framework of IWRM is divided into 3 categories namely Management Instrument, Enabling Environment, and Institutional Roles. The development of the water balance model (under management instrument), is also known as integration of information and communication technology (ICT).

	National Water Balance Management System or NAWABS was established for five (5) river basins of various catchment sizes in Malaysia in the first phase. The system focuses on the ICT's contribution to the evolution of scientific and technological disciplines, such as satellite earth observations, real-time monitoring networks, geographic information systems, and their interconnection to integrated water resources management. The main reason for the development of a water balance system which typically includes a modeling tool is to provide a comprehensive solution to water resources management issues such as providing updated information on water availability, water demand, and options for water transfer, water-storing and allocation, and integration of surface water and groundwater. The key elements in NAWABS are to provide a comprehensive management instrument that could provide multiple functions including accounting for water resources, providing real-time online information on water availability, an assessment tool to evaluate operation options for efficient water allocation, and a forecasting system to assist in the decision management processes. The main objectives of the NAWABS's project are many folds, which includes: 1. Conduct a water balance study and other relevant studies for the basin; and 2. Plan, design, develop and execute a water balance model together with a Decision Management Support System (DMSS) To fulfill the objectives, five (5) water resource studies were conducted which are Water Resources Balance Study, Demand Management Study, Water Resources Conservation Plan, Environmental Flow Study, and Water, Food, Energy Nexus & Water Footprint Study. The studies also developed various models which are the Rainfall-runoff NAM model, MIKE BASIN surface model, MIKE SHE groundwater model, Climate Change model, and Tank/SWAT model. NAWABS has been established for Muda River Basin, Kedah River Basin, Bernam River Basin, Kelantan River Basin, and Melaka River Basin. There are 14 river basins currently under development and will complete in 2025. Muda River Basin is a transboundary water source management. It also faces multiple challenges, especially future climate, and a rapidly growing population that is driving increased social development, globalization, urbanization, and food production (paddy). This causes insufficient water during the months of February to April, especially during planting season. Therefore, NAWABS as a tool to water managers will provide 9 outputs to help water resource managers to manage water in the basin effectively. The 9 outputs are Water Accounting, Water Availability, Water Demand, Water Allocation, Water Prioritization, Water Quality, Dam Storage and Releasing, Water Resource and Drought Index, and Water Auditing. The study strongly recommended increasing water storage by the construction of the Tawar-Muda Dam and the off-river system to support future water use in the basin.. NAWABS System helps water managers in Kedah to manage water resources more effectively and minimize the risk of future droughts. In 2019 and 2020, the forecast reduces impacts to downstream with dam regulation/releasing and allocate water when supplies are inadequate to meet all needs; and facilitate efficient water use.. To ensure this tool meets the needs of the water manager, it requires a management approach to enable gradual uptake of the NAWABS system, and feedback from users is recorded and assessed for possible actions. Individual operators need to be supported so they become familiar with NAWABS and the information can be used to increase the efficiency of the way they operate. The system also needs regular maintenance to ensure model simulations have run successfully and outputs are available on the respective web pages. Greater collaboration among forecasters, water resource managers, and policymakers would support the system to sustain in the future.
Challenge, SDGs and Digital Technology used	Issues and Challenges 1. A major challenge is mindset change among all Water User agencies (public and private) to shift from current sectoral to integrated management ("Think IWRM, Act Sectoral") 2. Need also for a Cultural Shift to seek a viable balance between Water Supply Management (WSM) and Water Demand Management (WDM) 3. Develop appropriate strategies and action plans to ensure all water use sector targets are met through stakeholder consultations, collective action, and shared partnerships 4. Undertake R&D programs for each sector 5. Conduct continuing capacity building programs to ensure competent personnel at all levels to perform optimally according to the new paradigm 6. The Federal Government should reconsider its plans to centralize the water sector by taking it over from State Governments. This is because centralization would be contradictory towards the involvement of all stakeholders and also pose problems to many states that had already privatized the water sector 7. NAWABS as digital technology used as DMSS tools for water manager requires collaboration across ministries through a multisectoral approach, which often cannot be effectively implemented without direct support from high-level policymakers

Title	**Enhancing multi-functionality of agriculture through rainwater harvesting system**

APEC Economies	Philippines
Place-Basin	Nueva Ecija
Case Study Author (researchers in case of availability of scientific publication)	Samuel M. Contreras, Rogelio N. Concepcion, Wilfredo B. Sanidad, Arnulfo B. Gesite, Gina P. Nilo, Karen A. Salandanan, Katherine Manalang, Sharon de Vera
Relevant Stakeholders (Name and Type of Stakeholder if possible)	Governmental Entities: Bureau of Soils and Water Management
Brief (no more than 1000 words)	This case study looks into the multifunctionality of rainwater harvesting systems particularly small water impounding projects (SWIPs) located in the barangays of Maasin and Buted, Nueva Ecija, in recharging the groundwater through collected surface runoff, rainfall, and mitigating soil erosion through trapped sediments while providing irrigation water in the downstream rice paddy service areas. Furthermore, the study showed that the rainfall-runoff analysis within the sub-watershed is essential in the rainwater harvesting planning and management and paves the way to improve current methodologies on rainwater harvesting scheme development.
Challenge, SDGs, and Digital Technology Used (no more than 500 words)	Availability of water in a tropical economy like Philippines is a major problem especially during drought conditions. Implementation of rainwater harvesting systems in the Philippines has been successful in the past years but there are still a lot of potential sites where these can be constructed. Other rainwater harvesting systems can be developed but integration of rainfall-runoff analysis is key to its functionality.

Title	**Comprehensive Water Resources Assessment for Major River Basins as a science-based decision support tools for planning and policy formulation**
APEC Economies	Philippines
Place-Basin	Nueva Ecija
Case Study Author (researchers in case of availability of scientific publication)	Susan P. Abano National Water Resources Board Philippines
Relevant Stakeholders (Name and Type of Stakeholder if possible)	Governmental Entities: Water-related National Government Agencies; concerned local government units Civil Organizations: XXXX Private Sector: Selected major water users International Organization: XXXX Other: Academe
Brief (no more than 1000 words)	This case illustrates the processes and results of the conduct of water resources assessment for major river basins in the Philippines. Previous water resources assessment studies were used as basis for allocating water resources however, these were already outdated being conducted more than 25 years ago when water is not yet as critical as today and climate change is not yet a global issue. To address this gap and to ensure effective and equitable resource allocation, updating of these water resources assessments with current hydrological data is necessary together with developed capacities on GIS-based modeling and computer-based decision support system. The results of the assessment serve as a science-based decision support tools for planning and policy formulation towards sustainable management and development of water resources. Specifically, the program aims to update the NWRB's basis for water resource allocation and provide detailed understanding of basin's water resources for better planning and decision-making. Based on the results of the assessment Water Resources Management Strategies were likewise developed including the Design of Monitoring Network both for groundwater and surface as a guide for future installation of monitoring stations. To date, Comprehensive Water Resources Assessment (CWRA) for Agno, Panay, Davao, Jalaur and Bicol River Basins have been completed while CWRA for Cagayan de Oro River Basin and Tagoloan River Basin are still ongoing. Water Allocation Policy for Agno River Basin has been developed and implemented.
Challenge, SDGs, and Digital Technology Used (no more than 500 words)	The program is contributory to the SDG Indicator 6.5.1-Degree of IWRM in terms of adapting IWRM management instrument for better resource management. One of the major challenges in implementing the program is the availability of sufficient relevant data/information across the basin for a more comprehensive resource assessment. In addition, the program is significantly affected with the current pandemic due to travel restrictions which resulted to delays in the ongoing assessment in four major river basins.

Title	**Water resources management in Russia**
APEC Economies	Russia
Place - Basin	General Information about water resources
Relevant Stakeholders (Name and Type of Stakeholder if possible)	Governmental Entities: Russian Ministry of Natural Resources
Brief (no more than 1000 words)	Russia, occupying 1/9 of the entire earth's land with a length of 60.9 thousand km of water coast, is washed by 12 seas. In Russia there are more than 2.5 million large and small rivers, more than 2 million lakes, hundreds thousands of swamps and other water resources. The total volume of static water resources in Russia is estimated 88.9 thousand km3 of fresh water, which a significant part is concentrated in underground waters, lakes and glaciers.
Challenge, SDGs and Digital Technology used	Water scarcity in south regions of the economy, significant water losses during transportation, irrational use of water resources, harmful effects of water (floods, floods, flooding, etc.).

(no more than 500 words) **SIUPWB**	Schemes of Integrated Use and Protection of Water Bodies (SIUPWB) include systematized materials of their status and use. They are the basis of water management measures implementation, as well as measures for protection of water bodies, which are located within river basins. In fact, they are the basis for Integrated Water Resources Management (IWRM). The Federal Water Resources Agency was authorized by the Government of Russia to develop SIUPWB. Currently, 69 projects have been completed.
Region Management Center 6 in Russia (2015-2030)	Russia has made significant progress in providing clean water and sanitation services for population, associated with Region Management Center targets 6.1 "Ensuring access to safe and affordable drinking water" and 6.2 "Ensuring universal and equitable access to adequate sanitation". In 2018, 91.5 % of Russian population was provided with safe drinking water. **Improving the quality and reducing water pollution (target 6.3)** - through implementation of the federal project "Clean Water" within domestic program "Ecology" framework. The Strategy of Environmental Safety of the Russian Federation for the period up to 2025 defines development of technologies, aimed to reduce the volume or mass of discharges pollutants into water bodies as one of the priority areas. **Improving the efficiency of water use in sectors and addressing water scarcity (target 6.4)** Absolute water consumption in all sectors is declining rapidly. The indicator of recycled and consistent water use has increased since 2005. (Ministry of Natural Resources of Russia, 2019) The main reserve for improving the efficiency of water resources use is to reduce water consumption in the main water-consuming industries, especially fresh water, through implementation of water-saving technologies, and reduction of the use of fresh water for household needs. The second direction is the elimination of numerous water losses at all stages of its use.

Title	Water resources management in Russia
APEC Economies	Russia
Place - Basin	General Information about water resources
Relevant Stakeholders (Name and Type of Stakeholder if possible)	Governmental Entities: Government of Buryatia Civil Organizations: XXXX Private Sector: XXXX International Organization: OECD, UN Other: Organizations responsible for water resources management
Brief (no more than 1000 words)	One of the most important tasks of Buryatia (subject of the Russian Federation) is to maintain an appropriate balance of environmental goals, as well as dynamic and sustainable socio-economic development, taking into account that most of its territory belongs to Lake Baikal basin. Lake Baikal is a unique water body and ecosystem, included to UNESCO World Heritage Sites list. It opens up wide opportunities for recreational and tourist complex development and eco- activities.
Challenge, SDGs and Digital Technology used (no more than 500 words) **Project**	However, implementation of new water resources management methods, including IWRM, also means strict restrictions for the Lake Baikal and the Baikal Natural Territory protection from Negative impact of anthropogenic, human and natural factors. The OECD project, which was implemented on the Government of Buryatia request, was aimed to develop recommendations for improving the use of economic and other water management tools. It was also aimed to ensure sustainable development of water sector, as well as the socio-economic development of Buryatia overall. The outcomes of this international project, implemented under the auspices of OECD, where recommendations to improve the water management system, including: 1. Improvement management of natural resources system of Baikal Natural Territory. 2. Improvement sustainable use and conservation of water resources tools. 3. Promotion the capitalization of the Baikal Natural Territory. 4. Improving the efficiency of water supply and sewerage facilities and irrigation systems tools. 5. Improving the system of state support for water sector and Increasing its economic efficiency. 6. Water-related risk management tools.

Title	Integrated Water Resources Management in Eastern Economic Corridor (EEC)
APEC Economies	Thailand
Place - Basin	Bang Pakong River Basin)Chachoengsao Province(and Eastern Coast Basin)Chon Buri and Rayong Provinces(
Case Study Author	Regional Irrigation Office 9, Royal Irrigation Department (RID), Ministry of Agriculture and Cooperatives, Thailand
Relevant Stakeholders	**Governmental Entities:** Regional Irrigation Office (RIO) 9 and 11, RID. **Government-appointed Committee:** Eastern Regional Water Resources Management Sub-committee, Bang Pakong River Basin Committee, Eastern Coast Basin Committee, Eastern Economic Corridor Provincial Water Resources Sub-committee **State Enterprises:** Provincial Waterworks Authority (PWA) **Civil Organizations:** Agricultural Water User Groups both using freshwater for rice farming and orchard, and brackish water for aquaculture, and residents in Chachoengsao, Chon Buri and Rayong areas using water for their domestic consumption **Private Entities:** Eastern Water Resources Development & Management PCL. and Industrial Sectors.

Brief	• Eastern Economic Corridor (EEC) in Chachoengsao, Chon Buri and Rayong provinces is the major investment zone enhancing Thailand's development into "Thailand 4.0". In addition, target industries are set for concrete investment. There have also been investment in basic infrastructure and public utility systems to increase its potential for investment and economic activities development, including human resource development and technological accumulation system management for the sustainable future of Thailand. • However, due to limited water resources in the eastern area and drought in some years, the amount of water in the reservoir was lower than average or less than the need for water usage. Physically locating close to the Gulf of Thailand, the area is also influenced by saline intrusion, thus affects water usage. As there is no suitable area for large reservoir construction, available water has to be economically allocated to each sectors, with the first priority for domestic consumption and second for ecological preservation. In the agricultural and industrial parts, prioritizing is by areas. • Based on the mentioned management problems and limitations, Regional Irrigation Office 9 collaborated with government, private, industrial, and agricultural sectors through participatory planning, supervising, monitoring water management by using the reservoir, irrigation and water grid systems as current and future operational tools. The Office of the National Water Resources also planned to develop sources of water and provide water resources for each concerned sectors. The following 7 measures have been implemented to support the expansion of EEC: 1. Increasing existing reservoirs' storage capacity. 2. Developing additional reservoirs. 3. Developing water resources diversion linkage system. 4. Developing private sector's reserved water resources. 5. Developing groundwater for industries and for deficient areas. 6. Applying new technologies such as Reverse Osmosis of the sea water and utilization of treated wastewater. 7. Using Demand Side management such as enhancing water usage efficiency, reducing water losses or adjusting cultivation system.
Challenge, SDGs and Digital technologies used	• **Current Challenges** 1. Water supply - Climate change - Limitations and high costs of water pumping and diversion - Limited amount of reservoirs / long time to construct and low amount of the runoff through the reservoirs is decreased - Lower amount of rainfall and runoff and in shorter period 2. Water usage)Demand) - Increasing demand in domestic consumption and industries - Increasing water usage in economic crops and increasing planting area (orchards). - Decreasing amount of water from natural sources and lower quality of water. • **SDGs** - SDG 2 ZERO HUNGER: an amount of water supply, water pumping and diversion system to support water requirement in all activities - SDG 6 CLEAN WATER AND SANITATION: an amount of water distributed through water pipeline systems to areas with saline water intrusion during the dry season - SDG 13 CLIMATE ACTION: water management using irrigation and water grid systems, the use of telemetry system and mathematical model to monitor and analyze the change of water quantity and quality - SDG 17 PARTNERSHIPS FOR THE GOALS: a principle of participation and integrated implementation with all concerning sectors • **Digital Technologies Used** - Monitoring the change of water quantity, quality and level by using the real-time telemetry system in deciding to increase or decrease the discharge from reservoirs in order not to affect the community or agricultural areas, and for emergency warning during the rainy season, also for decision making for increase/decrease amount of water to be discharged for controlling saline water in the river during drought season - Using a real-time telemetry system to measure rainfall in order to collect statistical data. This data is used to forecast a rainfall trend in that year by comparing to a year that has a similar rainfall. As a result, we would have the amount of reservoir's discharge to plan water management. - Using mathematical models with statistics of reservoir's discharge quantity to determine the criteria of Dynamic Rule Curve management and forecast for water management planning - Using social media to communicate, publicize, build network and warn

Title	**Integrated Water Resources Management during the Dry Season in the Lower Chao Phraya River Basin**
APEC Economies	Thailand
Place - Basin	Lower Chao Phraya River Basin
Case Study Author	Bureau of Water Management and Hydrology, Royal Irrigation Department, Ministry of Agriculture and Cooperatives, Thailand
Relevant Stakeholders (Name and Type of Stakeholder if possible)	**Governmental Entity:** Royal Irrigation Department
	State Enterprises: Metropolitan Waterworks Authority, Provincial Waterworks Authority
	Private Entities: People using waterworks in Bangkok and its vicinity, farmer groups using water from the Chao Phraya River
Brief (no more than 1000 words)	• Chao Phraya River Basin is the great basin of the economy where most population live. Its geography is a central plain suitable for cultivation and also the economic growth area. With

	this reason, water use activities occur in several sectors. With the physical characteristics adjacent to the Gulf of Thailand, the influence of sea water may cause more salinity intrusion if the amount of fresh water discharging from the upper area is insufficient. • In the Year 2562 (2019), Thailand faced the drought problem because it is the year ranked as the second highest rain shortage of Thailand. Therefore, the amount of water resources in the dams and water storage sources reduced. Water needed to be allocated economically to different sectors to avoid the effect on waterworks production, some types of industries and some periods of agriculture, especially for domestic consumption -- the first priority that the water must be sufficient - From the mentioned problem, the Royal Irrigation Department collaborated with the Metropolitan Waterworks Authority and Provincial Waterworks Authority to analyze the causes by using the data from water quality telemetering system and salinity forecasting from the mathematical model and to discharge fresh water in the amount in accordance with sea tide. In addition, the Royal Irrigation Department requests the cooperation from every sector for water saving.
Challenge, SDGs and Digital Technology used (no more than 500 words)	• **Challenge** There is a limited amount of water resources and water must be allocated to every sector sufficiently to meet the requirement. • **SDGs** - SDG 2 ZERO HUNGER: The amount of water distributing from the upper water storage supports the agricultural sector which is the food supply of Thailand and also export to foreign economies. - SDG 6 CLEAN WATER AND SANITATION: Monitoring the amount of water in reservoirs and dams controls the salinity so that the waterworks meet the standards, considering the suitable amount of water and the influence of tidal currents. - SDG 13 CLIMATE ACTION: Water management by using irrigation system and the data from telemetering system and mathematical model for monitoring the change of the amount of water and salinity. • **Digital Technology used** The real-time telemetering system monitors the change of the water quantity discharging from the upper area and the salinity value. Then, the analytical result of salinity forecast is used in water discharge to push the salinity.

Title	**DNA METABARCODING AND MORPHOLOGICAL IDENTIFICATION OF MICROALGAE AND CYANOBACTERIA: BIOLOGICAL INDICATORS TO ASSESS LAKE TITICACA WATER QUALITY”**
APEC Economies	Peru
Place - Basin	Puno
ResearcherCase Study Author (researcher in case of availability of scientific publication	Maribel Baylón Coritoma Departamento Académico de Hidrobiología y Pesquería, Facultad de Ciencias Biológicas, Universidad Nacional Mayor de San Marcos, Lima, Perú.
Relevant Stakeholders Involved (Name and Type of Stakeholder if possible)	Government: Perú, Puno regional government Organizaciones civiles: Do not correspond Sector privado: Do not correspond Organización internacional: Do not correspond Others: CONVENIO N° 130-2020-FONDECYT.
Brief	In recent decades, Lake Titicaca has experienced high anthropogenic pollution in the aquatic ecosystem, caused by the lack or poor management of the wastewater treatment system, inadequate disposal of tailings, and metal contamination due to mining activities. Due to the inadequate management of the lake's water quality, this research presents rapid assessment techniques for monitoring water quality, specifically the use of biological indicators. Microalgae and cyanobacteria allow us to decipher any phenomenon or current event related to the study of an environment and are used as biological indicators of water quality. This research describes the evaluation of the water quality of Lake Titicaca using microalgae and cyanobacteria. For this we proceed to the morphological and molecular identification by DNA METABARCODING of these microorganisms, as well as to determine their abundance to apply different biotic indices.
Challenge, SDGs and Digital Technology used	The main challenge is to monitor the ecosystem of Lake Titicaca in the Puno region using biological indicators to assess water quality. The SDG 6 s_a_y_s_ _“t_o_ _e_nsure availability and sustainable management of water and sanitation for all has as one of its targets to improve water quality”, therefore the purpose of this research is to assess water quality using microalgae and cyanobacteria as biological indicators.

Title	**Peruvian Glacier Retreat and its Impact on Water Security (Peru GROWS).:**
APEC Economies	Peru
Place - Basin	Ancash – Rio Santa Basin.
ResearcherCase Study Author (researcher in case of availability of scientific publication	Edwin Loarte Cadenas National Institute for Research on Glaciers and Mountain Ecosystems (INAIGEM), Huaraz, Ancash, Peru.

Relevant Stakeholders Involved (Name and Type of Stakeholder if possible)	Governmental Entities: Regional government of Ancash. Civil Organizations: Rural communities of Llullan, Quillcay and Yanayacu (Ancash).
Brief	Rio Santa basin there are important agricultural and electricity generation activities that depend on the waters coming from the glaciers. We will exploit the knowledge produced to promote reduction of multiple vulnerabilities and enhance resilience by analysing feasible adaptation strategies to water scarcity and extreme events. This case seeks to cover the little information that exists for an efficient management of the water resource within Rio Santa basin, as well, a study on the impacts that could be generated with glacier retreat and climate change from a systemic view including social, ecology and governance.
Challenge, SDGs and Digital Technology used	Combined with growing populations, poor governance and limited regulations on water users and rights as well as a recent review of water laws, these changes in the climate and glaciers, modifying crucial water resources, have the potential to increase social conflicts, destabilise Peruvian societies, inhibit economic growth and adversely affect the equitable sharing of resources in Rio Santa basin. The project will integrate new and existing field and remote-sensing data with physically-based models of glaciers and hydrology to simulate the past, present and future changes in the climate, cryosphere and hydrology of the Rio Santa catchment.

ANNEX VI. APEC PROJECT EVALUATION SURVEY

APEC Project Survey PPSTI 05 2019
PPSTI 05 2019
Integrated Water Resources Management (IWRM): Best Practices, Norms and their Implementation within APEC Region
Session 1: 27-28 September 2021
Session 2: 30 September - 1 October 2021
Session 3: 5-6 October 2021

Thank you for attending the PPSTI 05 2019 Integrated Water Resources Management (IWRM): Best Practices, Norms and their Implementation within APEC Region workshop on 28, 30 & 6 October in Chile where event is being virtually. We would now like to gather your feedback with regards to how well the event has been organised and how it has helped build capacity for you. We value your inputs and this survey takes about 10 minutes to complete. We would appreciate the completion of this survey no later than October 10th. Thank you.

Objetives
Develop capacity on IWRM using best practices (at least 5 best practices both from regulatory/policy and digital technologies aspects), through generating common understandings of IWRM in the APEC region and science policy recommendations to encourage on how it can benefit economies and connect related actors within the region.
1a. The objectives of the training were clearly defined *

- Strongly agree
- Agree
- Disagree
- Otro:

1b. How many sessions were you a participant?

- Session 1
- Session 2
- Session 3
- Sessions 1 and 2
- Sessions 1 and 3
- Sessions 2 and 3
- Sessions 1, 2 and 3

2. The project achieved its intended objectives *

- Strongly agree
- Agree
- Disagree

3. The agenda items and topics covered were relevant *

- Strongly agree
- Agree
- Disagree

4. The content was well organised and easy to follow *

- Strongly agree
- Agree
- Disagree

5a. The Pre-recorded videos and case studies were useful for the discussion

- Strongly agree
- Agree
- Disagree

5b. Would you like to have obtained more cases and videos from other economies? which ones?

6. The trainers/experts/facilitators were well prepared and knowledgeable about the topic *

- Strongly agree
- Agree
- Disagree

7. The time allotted for the training was sufficient *

- Strongly agree
- Agree
- Disagree

8. Please comment (if any) about your answers given in question 1 to 8.

About deliverables

Policy Recommendations in IWRM driven by Scientific Evidence and Available Data, as well as STI Policies to encourage the research collaboration and exchange based on data analytics and research synthesis.

10a. How relevant was this project to you and your economy? *

- Very relevant
- Mostly relevant
- Somewhat relevant
- A little relevant
- Not much relevant

10b. Please explain your answer given in 10a.

11. In your view what were the project's results/achievements? *

12 How was your capacity built by this project? What new skills and knowledge did you gain? *

13. Rate your level of knowledge of and skills in the topic prior to participating in the event: *

- Very high
- High
- Medium
- Low
- Very low

14a. Rate your level of knowledge of and skills in the topic after participating in the event: *

- Very high
- High
- Medium
- Low

- Very low

14b. Please explain your answer given in 14a.

15. How will you use the skills and knowledge gained from this project to build capacity in your home economy? Please provide examples (e.g develop new policy initiatives, organise trainings, develop work plans/strategies, draft regulations, develop new procedures/tools etc). *

16. What needs to be done by next by APEC? Are there plans to link the project's outcomes to subsequent collective actions by fora or individual actions by economies? *

17. How could this project have been been improved? Please provide comments on how to improve the project, if relevant. *

18. What could be the next workshop to bring continuity to this project?

19. What could be improved in this modality?

20. About modality. What do you prefer?

- Held face to face meeting
- Virtually

Participant Information (optional)

25.Name:

26.Organisation/Economy:

27.Gender:

- Male
- Female
- Don't say