Workshop Report

Regional Workshop on the Asian Irrigation Governance and Management Network on "Resilient Community Irrigation Management in Context of Climate Change and multifunctional Rural-Urban Water Use competition in Asia"

24-27 June 2022

Milton E. Bender Auditorium, AIT, & Chiang Mai University, Chiang Mai

Ostrom Center for the Advanced study in Natural Resource Governance (OCeAN)

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THE UNIVERSITY OF HONG KONG

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1. Background

Climate change has degraded water and land resources, and its impact on these resources is rising. Erratic rainfalls and increases in temperatures have led to disasters, such as floods and droughts, impacting the resources. Agriculture consumes a significant portion of the water resources increasing the demand for irrigation. The conventional mode of irrigation systems for agriculture altered by natural resource degradations is further exacerbated by the overexploitation and contamination of the natural resource by anthropogenic activities. Alterations in irrigation systems affect the livelihood and well-being of those irrigation-dependent farmers in Asia.

A reason for the increased demand for water resources is the economic growth in the region. The economic growth has increased infrastructure development and industrialization impacting water resources and social conflicts. Although the growth has led to an increase in resource use efficiency and technology enhancement, it is insufficient compared to the rate of depletion of resources. To mitigate the degradation and depletion, and manage the resource to meet the demand, governments, NGOs, and academics must work together to formulate and implement appropriate policies.

Water resources have complex stakeholder relationships. Cooperation and conflict for governance and management of these resources are global issues. The resources are generally under the public agencies, but their demand is essential for people on daily basis. Interests of private companies add complexity to the dynamic of these public-people relationships. Hence, promoting effective policy and capacity-building of key stakeholders for sustainable water resource governance and management is urgently required.

This workshop was organized to highlight these issues to global audiences and policymakers. It aimed to answer essential questions about irrigation such as economic growth and sustainability of water resources, decentralization of water management rights and resource conditions, and polycentric policy approaches for water management and governance and environment and social sustainability. Various research projects by experts from Asia were presented at the conference. These research papers will be connected to the Asian Irrigation Institutions Systems (AIIS) database. Selected ones will be compiled in Volumes VI and VII of Ostrom Center publications on Natural Resources Governance and Management Issues in Asia.

Nepal Irrigation Institutions Systems (NIIS) was deemed an important source of information for water management study during the Ostrom Center of Advanced Study in Natural Resource Governance's (OCeAN) IASC meeting in 2019. The database is the largest of its kind in Nepal holding information on 233 irrigation systems across 29 out of the 75 (now 77) districts in Nepal. It holds data on irrigation system governance following, both, top-down and bottom-up approaches. This significant database system can be adopted for the AIIS that will have similar data collected from China, India, Indonesia, Nepal, Pakistan, Philippines, Taiwan, and Thailand. However, the changing water resource demand requires regular updates of the database.

The 3rd Ostrom Center Workshop was jointly hosted by the OCeAN of the Asian Institute of Technology and the Centre for Civil Society and Governance of the University of Hong Kong from 24 to 27 June 2022. The workshop was organized from 24 to 25 June at the Milton E. Bender Auditorium, AIT. The first 2 days of the workshop involved sit-in sessions of sharing and discussing recent developments and challenges in Asia. There were 6 sessions of research sharing covering the topic of community experiences, policies, governance, socio-

ecological systems, adaptation, common pool resource management, and related institutions. Additionally, a panel discussion on the future of Asian Irrigation Institutions and Systems (AIIS) and way forward sessions were carried out. A field visit was organized to Chiang Mai from 26 to 27 June by Chiang Mai University. The field visit was conducted to have direct interactions with the farmers and experience the irrigation system adopted from NIIS.

Relevant experts were invited to participate in the workshop. The participants were institution affiliates from 11 universities in various South and Southeast Asian countries. Additionally, a keynote speaker from the University of Giessen was present. While most of our participants joined the workshop offline, the travel time and other clashing schedules obligated some of our speakers to join remotely.

Sections 1 to 7 cover the contents of the presentations and discussions on each topic with the name of the presenter or discussant. The Way Forward discusses plans on publications and a prototype of how the data from multiple countries will be integrated for comparison. This report is written in chronological order for the events in the workshop, keeping the Chiang Mai field trip at the end.

2. Session 1: Inauguration & Keynote Speeches

Ganesh P. Shivakoti welcomed all the participants attending the workshop in person and online via Zoom. As most of the participants were AIT affiliates or alumni, he welcomed them back to the campus. He shared his nostalgic experience as a professor at AIT and his role as the founding director of OCeAN.

The origin of the center and its brief history were shared next. Elinor Ostrom was a significant figure for the common pool resource studies and OCeAN. The Asian region has vast data on common pool resources; however, they are published in local languages that hinder catching the attention of global audiences. OCeAN aims to publish the research paper collected from South and Southeast Asia in English to reach these audiences. The network members of the center are important in helping the center reach its objective. Annual or biannual events were organized by the center since it was founded, but the COVID-19 had halted these events since 2020. This workshop is the first event organized since then.

2.1 Welcome Remark

Vilas Nitivattananon warmly welcomed all the participants to the workshop as well as to AIT. He expressed his gratitude and adoration for Ganesh Shivakoti and emphasized the support of AIT School of Environment, Resource, and Development (SERD) to research on natural resource management. AIT will continue to work and promote innovation and sustainability with the help of centers such as OCeAN within the institute. He also mentioned the start of two additional programs within the school for research opportunities on the topic.

2.2 Vote of Thanks

Rajendra P. Shrestha expressed his gratitude to the network members of OCeAN and explained the center's current works. He explained that the core of the center is the research works done by the members such as the participants of the workshop. The contribution of the members has enabled the center to publish 5 volumes of journals, while the 6^{th} is on the way.

He expressed especial thank you to the co-host and the funding provider of the workshop - Center for Civil Society and Governance - along with Danny Lam and his team. Chiang Mai University and Juthathip Charlermphol has helped organize the latter half of the workshop; hence, thanks were given to them. He also acknowledged Ganesh Shivakoti for founding the center, keynote personnel of the workshop Ulrich Frey and Prachanda Pradhan, and everyone else that had made the workshop possible.

2.3 The Challenge of Developing and Sustaining an Irrigation Database

Ulrich Frey inaugurated the workshop with his presentation. He talked about the benefits of one common database - big data - which in the case of AIIS must be around 200 case studies that can be statistically used and compared to find patterns. Some problems may arise regarding coordination, institution, design, technical, and IT. Here are some reality checks for the database of existing data for AIIS:

- There are many good case studies, but the comparable data sets are limited and the extraction process is cumbersome that may take up to weeks.
- There are multiple failed projects of the past that made us gain a lot of experience.
- We have initiated the AIIS on joint effort and the process will not be easy.

He presented 3 challenges that are faced while developing the database for irrigation. The first is the missing social incentives. Coordination may be difficult as every individual has their perceived conception of how the database should be. It may be more difficult in the case

of AIIS where international coordination is required. Hence, it is important to start with a small group and expand from it. The process of variable selection should be efficient else it can be another issue as budget (and time) is limited. Lastly, a dedicated IT person is required that can be hired internally from the institution or outsourced.

The second challenge is technical decisions. Expertise in, both, irrigation and database is required to provide a good user experience, which is not an easy combination to find. It is important that open-source databases are required but the software must be reliable: tried and tested and should be in the market for more than 5 years. The databases should be NoSQL and not SQL to analyze the relation of data sets. The centralized database would be ideal for AIIS which is hosted in 1 institution; however, the decentralized database is also not discouraged.

The last challenge is facing complex design choices. The Social, Economic, and Political Settings (SES) Framework should be used as the top level followed by the 24 factors framework. The latter could pull all the concepts of the former on the same level easing the sorting process for analysis.

Frey emphasized the structuring of variables should be carried out by the selected framework or the data sets will not be workable. Using performance, 1-5 scale, or percentage variables is encouraged as it is ideal for comparison between different systems. The number of variables should be between 150-200; lesser than 150 could discourage the analysts and more than 200 is too much to analyze. As the analyses of AIIS tend to focus on concepts, it is important to match the variables to a certain framework so that all the variables are used for analysis. The collection of these data could be done electronically, if feasible, to ease the data collection and transfer.

3. Session 2: Sharing of community experiences

The second session was organized to share the findings of the local water use patterns in South and Southeast Asia. The researchers from India, Indonesia, Nepal, Pakistan, and Thailand presented their findings on the community experiences of the irrigation systems in their respective countries of research.

3.1 Adaptation to Socioecological and Technological Changes in Six FMIS in Nepal: Forty Years of Observation

The first speaker for this session was Prachanda Pradhan. He presented his paper that was observed over the span of 40 years. After the 1980s, Nepal experienced rapid migration, urbanization, road connection to remote villages, gender role change, climate change, and political and social transformations. The study was conducted in 6 Farmer Managed irrigation Systems (FMIS): Argeli (over 300 years old), Chherlung 1 and 2 (over 90 years old), Chhatis Mauja (170 years old), Andhi Khola (over 40 years old), and Kalleritar (over 40 years old).

All 6 of these FMIS are experiencing urbanization, while the intensity varies. The lack of sewage and wastewater treatment and canals has forced the irrigation canals to mix with polluted water from urban activities. The demographic shift of out-migration and change in gender roles was observed along with climate change impacts and agricultural mechanization. Despite the changes and challenges faced, the water users' association remained active by adjusting and adapting. Its self-governing, regulating, and supporting mechanism is the key to the sustainability of the FMIS.

This does not mean the FMIS does not face tough challenges. The head end of Chhatis Mauja channel was mixed with gutter and drainage. As the area is urbanized, the residents using the drainage are not a member of the FMIS and the FMIS has no control over this situation. This issue was supposed to be sorted by the government agencies; however, the agencies are in dilemma themselves. After the federalization of the country in 2015, the role of the federal, provincial, and local governments in irrigation policies and management is murky and no one is held accountable. The role FMIS was traditionally recognized as a community system and investment by the farmers and protected by the law.

Initially, the FMIS was not recognized by the government. Consistent and quality research in Nepal helped the FMIS gain recognition as an important resource for food production. The government and the donor agencies have recognized them for assistance as they constitute 70% of the irrigation systems in the country. This indicates the importance of researchers in elucidating the findings.

3.2 Muang Fai in Chiang Mai, Thailand: Is it still working?

Juthathip Charlermphol and Sukit Kanjina presented this research paper (Figure 1). Irrigated areas for agriculture by state irrigation systems account for 23.7% of the total agricultural land. As the state irrigated area is low, FMISs are required. Muang Fai groups are FMIS present in Northern Thailand. The canals of Muang Fai are made of natural materials like wood, bamboo, and rocks for water diversion into the main canal. The water user groups of Muang Fai select their head and committee which is recognized by the rulers of Thailand. Structure maintenance and water use regulations of Muang Fai are prevalent with help from the Sanpayang Sub-district Administrative Organization (TAO).

The research was carried out to test the efficiency of 2 types of Muang Fais: Wang Tong and Mae Lao. Wang Tong used a traditional semi-permanent weir made of wood and bamboo while the Mae Lao used permanent weir made of concrete. The Wang Tong could only

yield 1 crop per year with 65% (adequate) water during the wet season and 35% (inadequate) water during the dry season. The Mae Lao could yield 2 crops with 82% (adequate) and 18% (inadequate) water during the wet season and 19% (inadequate) and 81% (adequate) during the dry season. The earth canals used for irrigation is subjected to water loss. Permanent structures are required for sufficient water availability for irrigation.

According to the researcher, the Muang Fai could not deliver an adequate amount of water to farmers, especially during the dry season. However, the farmers opted for 2 crops with inadequate supply of water. As the cost of permanent structures for irrigation is high for Muang Fai groups, it is suggested that TAO and other government agencies intervene and provide sustainable solutions for the Muang Fai.

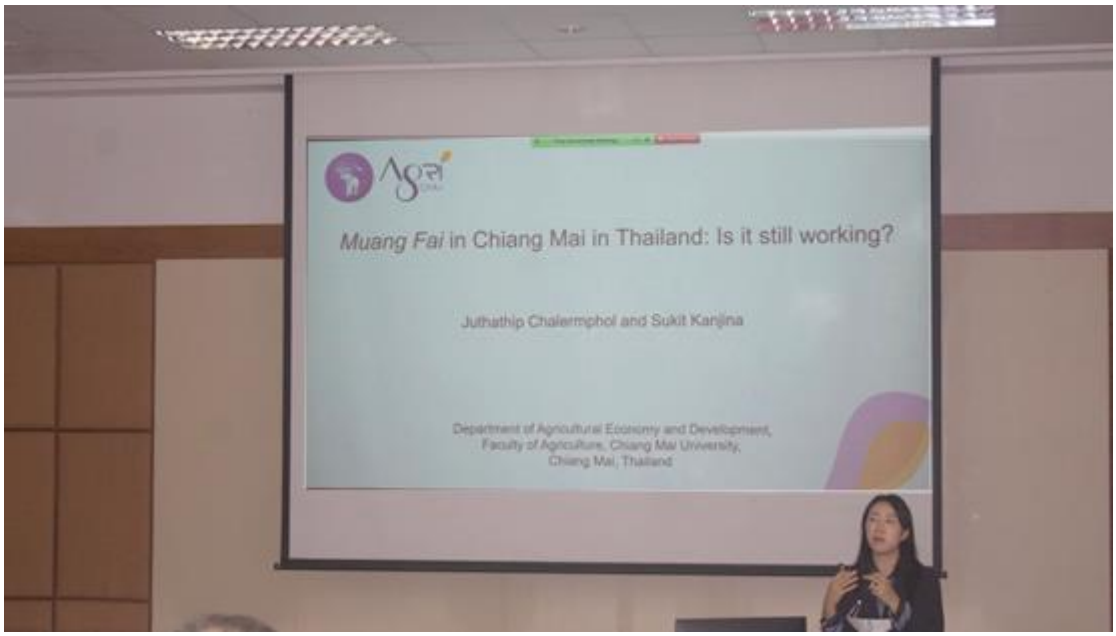


Figure 1: Juthathip Chalermphol presenting her findings on Muang Fai, Chiang Mai.

3.3 The Impact of Collective Actions on Sustainability of Irrigation System: Case study from Punjab

Raza Ullah presented that the study was conducted in 4 different villages of Faisalabad, Punjab to evaluate the collective actions of the irrigation system. Sustainability games were used as a tool to quantify the behavior of resource users. This quantified behavior is further used to interpret the sustainability of the resource.

Communication treatment between the users was observed to have the highest impact on collective action followed by baseline treatment. The income and scarcity treatment of water also plays a role in collective action but are not as significant as communication and baseline. The scarcity of resources has more impact than income.

Ullah, through this research on the sustainability of collective actions, disclosed that his findings suggested improving communications between users can significantly enhance the contributions made. The contribution from the community members increased when the group leader successfully established good communication between them. This improved communication increased trust between the members resulting in higher contributions to the

irrigation system's collective action. However, scarcity of resources and variation in income level also affect the contributions made.

3.4 Existence amidst Challenges: The Resilient Kuhls of Himachal Pradesh, India

This paper was presented by Pampa Mukherjee. The Himachal Pradesh state in India has a traditional water management system called the Kuhl system. Rural land users there are faced with conflicts between themselves and various state entities due to the redistribution of power, access, and control of the resources. The intra-conflict factors are gender-based household negotiation, competition for resource access, and control between different ethnicity, class, kin alliances, and economic interests.

The study was conducted in the Kuhls of Kangra Valley, Himachal Pradesh. They are the largest community-managed Kuhl in the world. The Kuhls are successful in managing the physical and institutional infrastructure from externalities like natural hazards, politics, economy, and socio-cultural conditions. The agricultural productivity, irrigation water availability post-monsoon, and intra-user group relations differ from one area to the other. In the selected sites, the entire cultivable land was irrigated by Kuhls. These Kuhls are mostly used for agriculture, but they are used for other purposes like domestic consumption, livestock, and construction.

Many changes and challenges are imposed on the Kuhls. The rising economy has increased out-migration and occupation shift from agriculture. The government started Public Distribution System (PDS) to provide food grains for lower economic households. There is a change in land use patterns due to tourism and outsiders purchasing farming land disrupting water rights. Climate change is another factor in water availability change. The impact of hydropower and the state agencies are also detrimental to the Kuhls.

However, the Kuhls have developed resilience through inter and intra-dependence. The community's social and ecological characteristics are flexible and shift with each regime. They respond to external stress by making changes at institutional and operational levels and defend the water claim of the Kuhl regime. The committees provide a forum to modify the old or create new rules and facilitate negotiations with various state agencies.

The flexibility and efficiency of community-managed Kuhls adapt better than agency-managed irrigations. However, their effectiveness may vary with the intra-conflict and nature of each Kohl's regime.

3.5 Rural-Urban Water Use Competition and Conservation in Indonesia: Perspectives from the SGD 1, 2, 6 & 15 Lens

Helmi talked about his paper on rural-urban water use competition in Indonesia. The growing urban demand for water is shifting the water consumption pattern from irrigation for agriculture to fulfilling urban demands. The urban need for water includes industries, energy, potable water, and leisure. However, this transition hampers the rural farmers making them vulnerable to 4 of the SDGs: 1, 2, 6, and 8.

A total of 133 river basins within districts/provinces, cross boundaries, cross provinces, national, and cross country in the country are facing the dilemma while failing to conserve the resource. The industrial investments of urban interest at the river basins have disturbed the catchment areas of the local rural region. The freshwater basins are now hosting the development of industrial parks, water-based tourism, and drinking water industries. The conflicting cross-boundary activities lead to the local governments focusing on generating income. These urban interests are pushing rural communities into irrigation scarcity. The

competition for water resources is increasing instances of inter and intra conflicts between farmer groups, private companies, and government agencies.

Review and lessons from the research suggested that using Ostrom's 8 principles along with social entrepreneurship can help rural communities. Social entrepreneurship can provide irrigation services and make money. The money can be used for co-financing the irrigation infrastructure development. It can also build mechanisms to generate stable revenue by providing services to the farmers like fertilizers (agricultural inputs) and rice HYVs (technology transfer).

3.6 Sustainability Irrigation Management as Agricultural Community Livelihood System

Indonesia has the highest rice consumption per capita in the world, states Yuerlita. Despite 77% of the farmers engaging in rice plantations, the country depends on rice imports. She presented that the government has adopted a policy framework for water resource management and irrigation to improve the food security and economic condition of the farmers. However, the implementation is faulty due to the limitation in institutional capacity and the absence of an accountability system.

The study uses 5 dimensions of sustainability (planet, people, peace, partnership, and prosperity) to analyze the impact of irrigation on farmers' socio-economic lives, especially irrigation systems sustainability, farmers' benefit generation improvement, and the need for ecological systems. The study was carried out in Banda Pemujaan, Solok, West Sumatra.

Results of the study indicated that 90% of the irrigated water here is used for rice farming and the remaining 10% is for fisheries and *sawah solok* (agro-tourism). The water for fisheries can be used for other activities such as horticulture using the hydroponic system. Irrigated water is the main source of water for agriculture making its allocation, distribution, and maintenance sensitive to the users for the sustainability of the resource. The community considers irrigated water only for agriculture. They blame the fisheries for depleting water quantity and frown upon using the resource for other activities. However, the degradation of water resources and irrigation is caused by various elements like logging, land conversion, inorganic fertilizers, natural disasters, and droughts. To use water for other activities, it is important to work with multiple parties and build an irrigation water utilization model.

Irrigation water is mostly used for rice cultivation; however, it should not be limited to it. Other businesses should be able to utilize the irrigated water. The partnership, peace, and prosperity dimension should be improved for the sustainability of irrigation management. This should of priority.

4. Session 3: Policy changes and irrigation governance

This session focused on the changes in water use policies and irrigation governance. The cases of Indonesia, Nepal, the Philippines, and Taiwan were presented in this session.

4.1 Irrigation Reforms for Eco-efficient Smallholder Agriculture: A Suburban Case in Taiwan

Ching-Ping Tang presented that in Taiwan, the civil association of irrigation agency has moved to a bureaucratic agriculture council to depoliticize and control the water distribution. The initial polycentric irrigation system had failed to provide innovative services. The new bureaucratic system was led by technocrats and initiated organic farming. The research was conducted on these community-based organic or eco-efficient farming areas in northern suburban Taiwan.

The challenges faced by the IA are climate change, an integrated development with value addition to agriculture, and water provision and allocation. An issue of the IA was that the government does work with farmer communities and social enterprises for solidarity-based coproduction. A collective action through solidarity is required in reducing inputs (water, land, energy) and impacts (eco-friendly, organic), while maximizing the outputs (materials, values, decarbonizing). The smallholder farmers need to work together to generate collective results for social and ecological scale improvement, value co-creation for producers and consumers, and coproduction of SDGs.

Previously, collective action worked well in promoting eco-efficient agriculture for rural sustainability. Pursuing collective action requires some coordinators. The IA in Taiwan tried to be the coordinator but failed because they failed in coordinating the water supply. The member farmers in rural areas started leaving the solidarity groups and the urban dwellers did not participate in solidarity. The government then started providing money for advocating organic farming and the co-creation of new values between consumers and producers that make co-production governing structures among multiple sectors.

4.2 Collaborative Governance in Philippine Water Provision and Irrigation

Theresa Marie Lorenzo presented this paper. She states that the Philippines lies in the west Pacific and serves as a buffer from typhoons to Southeast Asian countries. It has plenty of water resources that are affected by the climate. The country is economically transitioning from agriculture to the manufacturing sector. This transition has bolstered the prolonged water crisis due to climate change in the country gaining concerns recently for long-term solutions. The IA of the Philippines, the National Irrigation Agency (NIA), states that climate change and El Nino pose a lot of challenges to farmers, especially those engaged in water-intensive staple crops like rice. A solution NIA suggests is crop diversification to high-value crops like vegetables. No concrete long-term solution is formulated.

She further elaborates that the water resource management collaboration in the Philippines is particularly interesting: it is decentralized and integrated. Although this irrigation decentralization was considered a ‘Model’ during the 1970s as the NIA pushed for Communal Irrigation Organization, the collective action for the governance of the water resource is

characterized by power and patronage politics. The water provision and irrigation collaborations and connections were limited focusing only on the continuation of business as usual rather than working on adaptive innovations for future planning. They practice some resource sharing among the different water-sharing organizations, however, this is limited to the operation or helping each other to achieve legality and formalization.

According to the official channel, the NIA is the main organization for irrigation. Apart from NIA, the municipal government, provincial government, and Department of Agriculture Regional Office are involved in irrigation. The collaborations between government organizations are minimal despite the involvement of multiple entities in irrigation. The municipal and provincial government is designated to work with intermediary NIA for farmer's organizations, while the Department of Agriculture directly works with them. However, the research showed that although the NIA and the Department of Agriculture work directly with farmer organizations, they lack funding and labor. The farmer organizations depend more on the municipal and provincial government for patronage to receive the required funds, this is especially the case for national-level programs. There are programs that are supposed to teach the farmer organizations self-sustainability, yet they are more dependent on the patronage of the municipal and provincial government. These organizations also face free riding that undermines operations, maintenance, and rehabilitation.

On the other hand, there is no obligation to the municipal and provincial government to assist the farmer organizations. Utilizing third parties (like civil society groups and NGOs) can augment power asymmetries, however, their presence is limited. Access to these parties depends on proximities to the municipalities, hence, are accessible in the urban and peri-urban areas but absent in the rural areas. The presence of IWRM was not felt during the study nor was mentioned by any of the interviewees or municipal government officials. Connecting national-level programs may help the irrigation problems but the organizations refrain from communal solutions discouraging expansion or innovation.

4.3 Changes in Climate and Watershed Upstream-downstream Adaptation Policy in Indonesia

Rudi Febriamansyah presented the findings of the research paper. He stated the upstream farmers of the watershed and their activities in the Lembang-Sumani river basin have exacerbated the land and water resource degradation caused by climate change in the region. Some of the dryland farming activities are planting cash crops, chili, cabbage, onion, horticulture, etc. by the upstream farmers. The exacerbated resource degradation has decreased the production of rice for the rice farmers downstream who are faced with water scarcity during the dry season and frequent flooding during the rainy season.

The data collection for the research on changes in the watershed of the Lemabang sub-basin was provided for 1890, 1976, 1993, and 2004. Mr. Rudi has stated that the data collection is ongoing and will continue till they can. The data stated that the upstream dry grassland has increased by 448% while the forest has decreased by 88% from 1890 to 2004. The increase in grassland is a consequence of reduced forest cover. On the other hand, the downstream shrubs have increased by 131% and the forest has decreased by 21%. High population growth and

increasing agricultural activities are responsible for the reduced forest cover. Forest cover is important for water availability in the river basin.

Climate change also has various impacts on downstream farmers. There is an increase in rainfall per day, the number of consecutive wet days, and total annual rainfall. As the region is in a tropical climate zone, it receives more rainfall that the other zones. The increasing trend in the watershed area is higher in the downstream than the upstream. The excess rainfall in 2020 caused flooding and impacted the growth of rice of the downstream farmers. Paddy productivity has decreased over the years. The rainfall pattern is also uncertain which has affected the crop productivity for the downstream farmers. The temperature has increased, forest cover has decreased, and water availability is altered.

Indonesian regulation No. 37, Chapter 1, Articles 1 (2 & 8), 2 (4), and 3 initiated in 2012 covers policies related to watershed management of the upstream and downstream river. However, there is a gap in the implementation of these policies. Although initially, only the hydropower paid incentives to the downstream farmers, the research indicated that the activities of the upstream farmers are degrading the water and land resource for the downstream farmers and must compensate for the damages. This illustrates the importance of coordination even between farmer groups and necessary intervention from the District Government to manage decreasing forest cover in the upstream watershed.

4.4 Federalization and Changing Irrigation Management Dynamics in Nepal

This paper was presented by Ram Chandra Bastakoti. He states that agriculture contributes to 27.6% of Nepal's GDP with 60% of the total population dependent on it for employment and livelihood options. Before the decentralization in 2015, the data indicated the irrigation systems in Nepal followed the top-down approach and is still prevalent. In 2015, the Government of Nepal (GoN) initiated an Agriculture Development Strategy (ADS) for a period of 20 years. ADS is a guiding framework for overall agricultural development strategy in the country with 4 outcome sectors: governance, productivity, profitable commercialization, and competitiveness.

The water used for irrigation in Nepal is dominated by surface water, particularly Agency Managed Irrigation Systems (AMIS) followed by Farmer Managed Irrigation Systems (FMIS) in the hill regions. Other sources, typically groundwater, are also used in the country for irrigation in the southern plains. Only 25.2% of year-round coverage was offered by the irrigation systems in Nepal in 2015. The major focus of the ADS is to increase the year-round irrigation coverage target to 35% in 5 years, 60% in 10 years, and 80% in 20 years. A major concern is the change of government system from a centralized to a federal system in the country. After federalization, the largest agricultural lands are in the southern provinces of Karnali and Madhesh. Although the national-level target was set, the provincial targets are still murky.

In 2019, the GoN has formulated an Irrigation Master Plan that provides directions for planning and investment in irrigation for the next 25 years. The current area of irrigated land in the country is 1.454 million hectares and it has the potential to increase by additional 0.811 million hectares. The plan aims rapid development of irrigation systems from seasonal to year-

round by including inter-basin transfer, groundwater development along with conjunctive use of surface water, and gravity irrigation in the hills or sloped areas.

A National Water Resource Policy was drafted in 2020 to promote economic prosperity and social transformation by making multipurpose and sustainable use of water resources in coordination among the 3 tiers of the government. However, the institutional structures and mandates are still unclear. Although different agencies are allocated at the federal level, the connection between them and the provincial and local agencies is not defined. This could hamper irrigation management till clear instructions are publicized.

The following are the results of the irrigation systems analysis by using the social-ecological system (SES) theoretical framework which includes 4 of its sub-systems: resource system, resource unit, water users, and governance systems.

- The problems in irrigation systems between the resource and the users are changing rainfall patterns, variations in available water, and changes in water use patterns. This problem is not directly linked to the change in government systems, however, the FMIS have swiftly and collectively responded to the shocks and changing demands caused due to the changes in resource boundaries.
- The change in the government system has brought changes in the interaction between resource users and public infrastructure providers. The deliberation is declining, and the monitoring process is weak. The collective action among some FMIS has decreased due to changes in resource boundaries. AMIS are still not clear with the roles of the 3 tiers of the government, there is an increase in freeriding, and monitoring and enforcement of policies are very poor.
- The unclarity of roles between the government tiers has also negatively influenced infrastructure development leading to higher rates of structural failure, made the availability of resources unpredictable, made monitoring of groundwater extraction poor, and increased disputes among various individuals.
- Occurrences of droughts and floods are increasing. The limited financial resource has caused delayed response in fixing the damages to the infrastructure.
- Farmers are choosing to opt for migration and work non-farm jobs due to economic situations and risk aversion.

4.5 Prospective Policy

Nepal faces multiple environmental problems leading to the degradation of water resources. Trilochan Upreti mentioned the problems of climate change, pollution, solid waste management, and deforestation. This paper examined the challenge of global warming and climate change to sustainable and environment-friendly uses and development of water resources.

The economic situation of the country obliges it to depend on financial assistance from foreign countries for large infrastructure projects. To receive assistance, approval from the downstream country is required making it dependent on another country’s decision. The politics behind the use of water resources is concerning to many citizens depending on it. To

tackle natural resource issues in the country, national and international policies should be reprimanded.

The irregularity of water availability is increasing. Connection to divert water from one river basin to another should be made available. However, the diversion is not an easy process. Feasibility is questionable and domestic conflicts and social issues make those feasible projects more difficult. Integrated water resource management (IWRM) could be an approach to resolving this issue.

Currently, 1.4 million out of the 3.0 million hectares of agriculture are irrigated. Irrigation of the remaining farmland has the potential to increase domestic agricultural production and be beneficial to the country's economy. 70% of the total irrigates land is run by EMIS. Using FMIS for irrigation has and will contribute to food security and the national economy.

The laws and policies around water resources should be improved and implemented by resolving domestic and international conflicts for the benefit of the citizens. Adaptation to climate change and sustainable development must be practiced. Community participation in water resource and irrigation projects from planning to execution should be ensured for people's ownership and benefit.

5. Session 4: Socio-ecological systems and adaptation

5.1 External Disturbances and Precision Irrigation Options Shaping Future of Self-Governance of Irrigation Systems – Cases from Pakistan

The freshwater availability per capita in Pakistan is decreasing making the country top 30 among the water-stressed countries. However, Asif Kamran states that governance of the resource is a bigger issue than scarcity (Figure 2). The extreme external changes are adding impetus to the water resources and resource governance institutions. Currently, known technologies and reliance on institutional factors are implemented that are vulnerable to external shocks. Utilizing new technologies like intelligent tools, data-driven decisions, sensors, etc. can help cope with external changes, but the related externalities can pose a threat to self-governance and institutions. The aim of the research was to explore external shocks, new technologies, and their interaction with resource and governance outcomes.

The factors or external shocks affecting the irrigation systems are the increase in population, migration, climate change, water supply and demand mismatch, natural disasters like glacier lake outburst flood and drought, market opportunities, and land fragmentation. These factors alter incentives for different actors by directly impacting the biophysical context. In addition, the response mechanism is inadequate as the institutions have limited capacity to respond, the use of technologies is determined by institutions, and government support systems are not sensitive to external shocks.

The impact of technological interventions on the governance of irrigation systems and water resources is determined by biophysical and institutional contexts. The government's support is important in adopting technologies along with using the right nature of technology (individual-use or group friendly) to influence its impact on self-governance and local institutions. The centralized governance system promotes policies and technology adoption supporting state-run irrigation systems and individual incentives without considering self-governing systems and institutions. Using an irrigation database with case studies would be optimal to help understand external shocks and their repercussions. Lastly, it is also important to study failures through case studies.

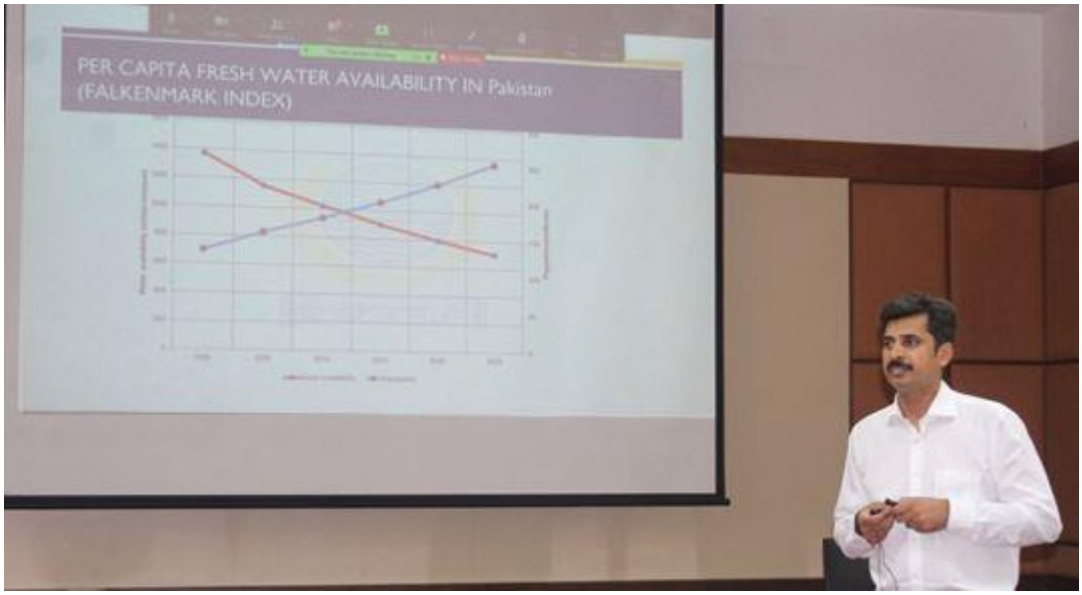


Figure 2: Asif Kamran presenting his paper.

5.2 Community Oriented Drought-proofing cum Water Conservation Interventions by Non-State Development Agencies in India: An Exploratory analysis using the IAD Framework

Watershed management and drought-proofing programs in India started in the 1880s. Suresh Appukuttan and P. K. Viswanathan presented 31 such programs in chronological order that worked for agricultural productivity, employment generation, food for work, poverty reduction, etc. This study was conducted across 5 states Maharashtra, Madhya Pradesh, Rajasthan, Karnataka, and Tamil Nadu, in collaboration with World Vision India (WVI) to study the water infrastructure development activities and a variety of drought-proofing interventions.

The study showed that WVI was on a growth pathway. Its expansion on natural resources management and community development using multifaceted activities was beneficial for villages and households across states. The organization's expenditure incurred in the sectors rose significantly. Agriculture, food security, and economic development were the 3 major areas of expense in 2020-2021. Water and sanitation were ranked in the top 3 highest in 2017-2018.

The agriculture development programs have benefited in various ways including increased productivity, crop diversification, increased adoption of drip irrigation, improved harvesting, post-harvesting practices, enhanced agriculture-based livelihood support, and groundwater recharge. Decreased out-migration with training and skill development programs helped change community attitude towards drought and natural resource management.

5.3 Visiting Seven Community Protected Areas (CPAs) with Ostrom's Design Principles in Mondulkiri Province, Cambodia

Cambodia's Ministry of Environment (MoE), as presented by Sam Chanty, has assigned more than 40% of the country's total land area as a conservation area. They have

allowed privileges to create community-protected areas (CPA) in the remaining land. As of the survey date, there were over 100 CPAs in the country.

The MoE has regulated policies for CPAs. The community must be a local, indigenous, or ethnic minority as stated by the government with a common goal of sustainable use and management of natural resources within the CPAs. The purpose of CPAs is to improve the community's standard of living. To operate a CPA, the community must make an agreement on a management plan with a period of use not exceeding 15 years signed by the MoE.

CPAs in Cambodia are gaining attention for structuring and building to ensure the correct implementation of management plans and rules. Fitting the principles with socioeconomic and cultural context is essential to remote indigenous communities. The inefficiency of CPA management could lead to the Tragedy of the Commons. This research used Ostrom's 8 principles for the analysis of CPAs. The CPAs are doing well in terms of physical boundary demarcation, recognition of rights to organize, consistency of appropriation and provision rules, and nested enterprise. The fundamental issues in the deterioration of CPAs are ineffective graduated sanctions, ineffective conflict resolution mechanisms, and poor monitoring and evaluation. Other reasons for such situations are limited collective actions, choices, finance, materials, cooperation, partnerships with authorities and I/NGOs, trust in graduated sanctions, local poverty, and external pressure.

5.4 Do Climate Risk Management Strategies Improve Farmers' Well-Being in India? Assessing Heterogeneous Impact of Crop Insurance

Around 80% of farmers in India are smallholder farmers from a low economic background. Chandra Sekhar Bahinipati and Dinamani Biswal presented that crop insurance policy in India started in 1972 and the government is actively working on newer schemes and programs. Despite the effort by the government, the farmers are reluctant to adopt crop insurance. By 2019 only 10% of farmers were crop-insured. The issue with crop insurance is the intensification of adoption; how many and what type of crops. However, the reasons for reluctance in crop adoption and intensification of crop adoptions differ.

The research depicted less chance of crop insurance adoption by the socially marginalized groups - schedule caste, schedule tribe, backward class, and female-headed households. However, this had an insignificant effect on the number of crops insured. The older the head of the households, the more likely they are willing to adopt crop insurance but with lesser intensity in the number of crops insured. The educated households head preferred to insure more than the illiterate, but primary and higher educated farmers insure a smaller number of crops. Landholdings, farm income, and livelihood diversification had a positive influence on adoption and the extent of it. Access to extension agents and mass media had a positive effect on insurance adoption. Although access to extension agents had no significant impact on the extent of adoption, access to mass media had a negative impact. The farmers' experiences with crop loss have also influenced them to adopt crop insurance, but it did not have a significant impact on its extent.

The PSM results stated that crop insurance improves farm income and input use among marginal, landless, and small farmers. The heterogeneous impact of insurance illustrates an increase in farm income among the treatment group of marginal and landless and increases farm income and input use between the treatment groups of socially marginalized castes.

Hence, crop insurance is beneficial, and its continuation is encouraged. Although the marginalized farmers, especially the landless, small, scheduled caste, and scheduled tribe, benefit from the insurance, the adoption of insurance among them is low. The government should work on promoting crop insurance and intensification of insurance for the farmers.

5.5 Vietnam Water Resource Management Reviews: Policy Implications

Tran Van Dat used field investigation in two provinces and secondary data review for his study. He stated that Vietnam has abundant water resources. About 80% of the water used in the country was for agriculture. The agriculture sector provides employment for 45% of the population but contributes to only 17-18% of the GDP. Hence, it is important to provide an efficient and sustainable solution for agriculture and irrigation. The solution should also entail coordination with other sectors outside agriculture.

Rice farming covers the largest area of irrigated land in Vietnam. Although it has the potential of being the world's largest rice bowl, two-thirds of the water flow in the country is dependent on the neighboring countries. The irrigation lands only have a management efficiency of 50-60% with only 26% of canals working at full capacity. The rice farms provide only 0.03 output per unit of irrigation water use. The income of farmers is low which impacts their livelihood.

The demand for water outside the agriculture sector has also increased. The surface irrigation in some basins is on a serious decline, yet cash crops are still planted and expanded. Efficient improvements to the expansion of cash crops are required rather than the traditional focus on the production stage that has low added value. A shift to other sectors using less water from rice agriculture is recommended.

As the result, 3 policy implications were listed in the study: strong restructuring of agriculture, better governance of irrigation, and constructing, operating, and maintaining irrigation infrastructure. Agriculture restructuring will generate higher returns improving the abilities of the government and water users. The increased income can be reused in irrigation for building, upgrading, and repairing. The restructuring can also facilitate water balance and distribution among different crops and sectors. A vulnerability of restructuring is changing roles of irrigation systems. It is important that the government and irrigation system owners conduct careful reviews and proceed with new construction or upgrade if necessary.

5.6 Watershed Environmental Services Valuation Study in Urban Areas, a Review

Yenni Yuliza presented the proposal for her Doctoral Program study at Andalas University. The research to be done will examine the importance of watershed environmental services related to causality relations between water availability-supply resource with environmental degradation-human behavior, natural disaster indication, and efficiency of support services of the watershed to complexities of urban activities.

The methods to be used will be the ecology assessment method, socio-culture assessment method, and economic assessment method. First, it will examine the environmental service concept of urban watershed areas with 4 services: provision, regulatory, support, and cultural. Second, it will examine the environmental services valuation assessments of urban watersheds with 3 approaches: ecological, socio-cultural, and economic. The study needs to use a socio-cultural approach emphasizing the benefits of regulation and culture in urban watersheds.

Shivakoti provided feedback, suggesting a reduction in the scope of her study and an increased highlight on the sociocultural aspect.

6. Session 5: Community-based common-pool resource management

This session was arranged and chaired by Takuji W. Tsusaka, the Chair of the Development and Sustainability program of AIT. The research for this section had been conducted in Myanmar, the Philippines, and Thailand. The presentations were delivered both in person and via Zoom connection. All the topics covered in this session were well aligned with the core mandate of the OCeAN.

6.1 Assessing the Forested Watershed Management Practices: The livelihood implications of indigenous knowledge in Shan state, Myanmar

The paper was presented by Win Myint Thein. In order to conserve water, systematic watershed management is required water cycles are associated with the land. Traditional ecological knowledge of local people can help in watershed management. The main challenge to watershed management in Myanmar are deforestation and the drought years between the 1970s to 1990s. Over the years, there were indigenous practices like the prevention of fuel wood cutting and fencing water sources, but specific studies on the traditional knowledge is limited. The objective of this research was to access watershed management with and without traditional knowledge.

The study used the comparison of 2 villages in Myanmar, 1 with indigenous knowledge and 1 without. Both villages have similar characteristics in terms of area and start date of community forest. The uses of watershed management in the area with indigenous knowledge were for NTFPs, water, and reducing siltation and they started the management to maintain their livelihood benefits. The use of in the area without indigenous knowledge was to sustain water availability and they started the management when they started to face water issues.

The village with indigenous knowledge had higher participation, stronger social relations, cooperation, and awareness, and not many depended on natural resources. However, there was no significant difference in income or the overall performances in 5 years between the 2 villages, according to the propensity score matching analysis.

6.2 Mangrove ecosystem services and community participation in its management: case of Ban Khlong Khon, Central Thailand

Mangrove deforestation was put to an end in the 1990s when mangrove recourse management began in Thailand with the support of government agencies and community actions, states Farah Y. Sevilla. This meant the prohibition of timber extraction, new livelihood eco-touristic activities, and increased extraction of NTFPs. New problems started to arise then. The post-deforestation phase prohibited logging activities that hampered the community's livelihood. Hence, there was a need to check if community participation is sustained.

The result showed that 41% of households depended on fishing or harvesting from the mangrove forest. Those who focus on mangrove forest management are of age between 41-50 and from high-income households where 1 or more members of the household earn from eco-tourism. These beneficiated most from mangrove management along with those who secure employment in resorts and restaurants.

Community participation in mangrove management is lower in the post-deforestation regime than before. Households that benefited the most from the mangrove resources participated in the management. The DMCR can't optimize community participation in mangrove management.

6.3 Impacts of Community Forestry on Livelihoods of Local People in Mindon Township, Magway Region, Myanmar

This research was presented by Aung Si Thu Thein on the impacts of the Myanmar Government's Community Forestry program on the local people's livelihoods. The research was done in Mindon Township, Magway.

The rural population makes up about 70% of the total Myanmar population. 81% of them depend on forest products, especially timber, forest wood, and bamboo. The government plans to extend the community forests (CF) by 73%. The demand for firewood and NFTPs has increased drastically. The study has conducted a household-level impact assessment of community forests using panel data and a difference-in-differences approach.

The results showed there were different levels of punishment from the Management Committees. For the 1st time violation, they issue a notice, for the 2nd time they are punished to plant new trees, and for more than 2 times they must pay fines. This committee is also responsible for regular, financial, and benefit-sharing meetings. 75% of the benefit-sharing revenue is used for development activities in the villages and the remaining 25% of the money is kept as funds. The study found that there were no thinning and fertilizers applied for silviculture activities, however, there were no fire protection activities. Community forest users stated that the quality of the forest increased as well as their livelihood conditions after CF protection. There has been an increase in human capital. Community forest user group (CFUG) members are provided with privileges like taking money loans from the management committee at a low-interest rate.

However, only a minority of users have knowledge about government management, governance, and regulations. There is no leadership or CF-based commercial program up-scaling training provided to the users.

Agriculture as a livelihood has decreased while livestock rearing has increased for farm and non-farm income sources but at different intensities. The collection of NTPF like firewood, poles and posts, bamboo, bamboo shoot, and mushroom for local consumption has increased, whereas the CF did not impact its commercial sales. The annual income of small businesses has also increased.

6.4 Assessment of Perceived Impacts of Rural Livelihood Activities on the Wetland Ecosystem Services: Case of Sunye Lake, Mandalay Region, Myanmar

According to the presentation by Myat Phu Mon, the wetland is an important natural resource in the country. Inland wetlands suffered losses higher than coastal wetlands, however, the studies on the inland wetlands in Myanmar are limited. Globally, wetlands play an important role in delivering SDGs, but they are threatened by human activities relating to social and economic development. These threats vary from region to region.

The study showed that 57.9% of the sample population practice farming, while agriculture is the most significant threat to wetlands. The residents of the nearby 6 villages depend on the Sunye lake for daily income through farming, fishing, lotus weaving, tourism, and making lotus souvenirs. The main source of livelihood in the area is farming and the collection of fuel wood. Other livelihoods are the harvesting of NTFPs, boat business, fishing, and shops and trading.

Most of the local respondents were aware of their livelihood activity's impacts on the wetland ecosystem services. The 2 main issues resulting from their livelihoods were a decrease in the number of fish, birds, and water birds, and wetland pollution.

The perceived wetland changes over the 10 years showed that the most affected wetland resource was the decrease in fish stock, birds, and water birds, and soil quality. The decrease in the 3 species is due to intensive hunting and fishing. A decrease in water flow and storage is due to the water used for agricultural encroachment by local farmers. However, the reason for soil quality degradation is unknown. The decrease in fuelwood and NTFPs is because of collection for cooking and vegetation harvesting.

Willingness to participate in conservation is highest for forest and water bird protection, and lowest for benefit sharing and community fishery. 77.$% of the households were willing to participate in the conservation of the wetland. The households' willingness to pay increased due to their higher income level and married status and decreased due to their field area and longer distance from the wetland. The average willingness to pay for future conservation was US $13.2 per resident and 93.8% of the households were willing to pay.

Some regulations should be formed to maintain the wetland ecosystem while not hampering the communities' livelihood activities. Community awareness should be done before the initiation of the wetlands to promote community participation. The results of willingness to pay can be used for financial incentives for the conservation of wetlands.

6.5 Palm Oil Production and Trading Towards Sustainable Development Goals

This was presented by Worawat Srisawasdi. The study is at a proposal stage and was open to feedback from the audience.

Palm oil has higher production per area than other oil crops making it the most widely consumed edible oil. The demand for palm oil is forecasted to almost double from 2009 to 2050. The production of oil contributes to SDGs 1, 2, and 8. However, the traditional practice is detrimental to tropical forests. Community-based management (bottom-up approach) can be a potential solution for palm oil management.

The literature review by Srisawasdi concluded a clear connection between palm oil production and SDGs achievements. Although there was previous research on the topic, it lacked quantitative analysis. The aim of the research is to quantitatively analyze the socioeconomic impacts and key SDG indicators on palm oil production and trade on a global scale.

7. Session 6: Panel Discussion on the future activities for AIIS governance and management in Asia

The Panel Discussion was chaired by Ganesh Shivakoti. He mentioned that the collection of the 50-irrigation data discussed in the last retreat could not be fulfilled due to the COVID-19 pandemic. The country representatives among the network members presented their findings in the remaining of this discussion. The previous retreat highlighted broader issues in the NIIS database, but this is to be halted after hearing Ulrich Frey mention the irrelevance of relational databases in the current data analysis platform. P. K. Viswanathan had the final draft of the AIIS instrument that was to be tested in Chiang Mai. Ulrich Frey was encouraged to provide feedback on the 250 already available variables to make the data easier for analysis.

Ganesh Shivakoti mentioned the variation in funding for the research projects from country to country. While India, Indonesia, and Pakistan had some internal funding for their research projects, Nepal did not. Danny Lam provided further insights into this as he joined the discussion remotely via Zoom. He stated that the project requires a lot of coordination and needs to gain momentum. Although some countries have internal funding, a larger pool to sustain the project is necessary. He proposed a consortium of databases with multiple institutions in Asia instead of having only one institute as a center for databases. This could also help source and efficiently utilize the funding.

Prachanda Pradhan shared his knowledge and experience with the development of the NIIS database. Lin Ostrom's effective communication on connecting and engaging different stakeholders was the key to building the database. The leader for AIIS should follow suit. He pointed out that knowing the use of this database is as important as building one. It would be a waste of resources if the functionality is not understood, and the data are seldom utilized.

P. K. Viswanathan spoke as a country representative for India among the network members. He stated that India demands a greater database of irrigation. For AIIS, the country is large and would require multiple data collectors. P. K. Viswanathan and Chandra Sekhar Bahinipati can provide data for South India and other colleagues from the northern states can contribute to data collection from North India. He suggested reaching out to network members within and outside the country to combine their research.

8. Session 7: Institution, incentives, and water resources performances

Institutional Change of Famer-Managed Irrigation Systems: Experience from Nepal

Jagadish Parajuli could not join the workshop; hence, this paper was presented on his behalf by Ram Chandra Bastakoti. The research examined the adaptation of the local-level FMIS irrigation systems to changing shocks and challenges. The focuses were institutional changes in irrigation, factors driving institutional changes, and the process of changes in institutionalism.

The FMIS was better than AMIS for various reasons. They were more transparent, socially inclusive, and cooperative. However, the CPR in Nepal is facing multiple biophysical, socio-economic, and political stresses. Parajuli's paper stated that there is an increase of 0.056 degrees in temperature annually, whereas the precipitation is decreasing. This is bound to impact water resources and agriculture. Macro-level changes like the economy shifting towards remittance from agriculture add to the negative impact on managing local CPR. Hence, it is crucial to understand how FMIS is adapting to these changes.

The research was conducted in 4 districts: 2 in the mid-hill areas and 2 in the Terai region of Nepal. It consisted of 9 FMIS from the NIIS database. On comparing the status of rules-in-use in the 1990s and 2018, it was evident that there were substantive changes in pay-off and information rules. Although the pace for changes in rules varied, the varying pattern is significant for governing irrigation systems. For the pay-off rules, fines were charged and made more explicit for violation of the rules. For the position rules, a rapid increase in labor out-mobilization caused the decline in the male population and the status of monitors was increased. For information rules, the record-keeping was stronger. However, there was no change in aggregation rules.

The existing process is unsatisfactory. Nepal still depends on rice as a staple food. Due to male out-migration, the feminization of FMIS has taken shape increasing the stress on the elderly and women. The WUA has an important role, but they are losing attraction.

8.1 Institutions, Incentives, and Information: Farm-level Adaptation to Climate Change in India

This paper was presented by Chandra Shekhar Bahinipati. Agriculture in India is a major source of employment; however, the contribution of agriculture to the GDP is declining. Climate change has increased the stress on agriculture affecting SGDs 1, 2, 3, and 12. These align with the major policy issues concerning sustainable livelihoods, mitigating agriculture volatility, and enhancing farm-level adaptation measures. This research studied the role of government policies in enhancing agricultural adaptation mechanisms.

The result stated that farmers taking adaptation measures maximized their profit more than those who did not. 91.3% of the farmers used adaptation options of which water and soil managements were practiced by the majority (0.70 and 0.68), followed by changing-of-crops and disaster-resilient crops (0.60 and 0.59). Altering crop calendars, crop diversification, and short-duration crops were also practiced for adaptation. No institution and incentive-based factors were vital determinants for climate-resilient practices. The study contradicts previous

research done for farmers by MGNREGS on the reduction of vulnerability to climate change by stating that no such benefits were observed.

The study suggests diversifying farmers' income sources and continuation of agro-advisory services as it is crucial for farm-level options. The government has centralized soil health cards in India since 2014 which is positively driving the farmers' behavior and access to agro-advisory seemed crucial in farm-level options, hence, scaling up both the schemes is important.

8.2 Institutional and biophysical factors responsible for variation in water productivity among upper and lower riparian Pakistani provinces of Punjab and Sindh

Asim Kamran shared that Punjab and Sindh are 2 provinces in Pakistan under constant conflict over water resource. Punjab lies in the upstream and Sindh in the downstream. Although the conflict was present since the colonial period, Water Apportionment Accord was signed in 1991 considering the historical usage and scarcity adjustment in a proportionate way. After the accord, it was evident that the Sindh canal received more water than the Punjab canal. This study aimed to check why such action took place.

This study analyzed the water productivity of irrigation systems in a canal in each of the 2 provinces. The crops used were wheat, cotton, and rice and the cropping systems were Cotton-Wheat and Rice-Wheat. The following observations were made between the provinces:

- Sindh received higher yield and crop water productivity than Punjab for cotton and rice crops.
- There was not a significant difference in yield for cotton-wheat and rice-wheat between the 2 provinces.
- The crop water productivity for rice-wheat was higher in Sindh. Although there wasn't a significant difference in crop water productivity for cotton-wheat, Sindh has higher productivity than Punjab.

For individual provinces, the following observations were made:

- Sindh: The efficiency score is higher for wheat and cotton crops at the tail end and higher at the head end for the rice crop.
- Punjab: The water-saving potential for the wheat crop is higher at the head, for the cotton crop is higher at the end, and is almost equal at both ends for the rice crop.

The cotton crop has higher economic value compared to the wheat and rice crop. The cotton production in Sindh matches the national level, whereas it is almost 27% less in Punjab. However, only a small portion of farmers approach resource optimization mechanisms in both provinces with more than 50% of them performing below 75% efficiency score. The study also showed that the head farmers in Sindh are over-irrigating their fields.

8.3 Muddling Through Waste: Self-Governance in the Wastewater Commons

Vishal Narain began his presentation by explaining the need to study the collective action of wastewater as urbanization and climate change are increasing. To do so, this paper describes the birth of co-operation and collective action norms between the watershed

irrigators. The type of research was ethnographic conducted in Budhera and Badsa villages of Gurgaon, Haryana, India.

The state of Haryana was a major source for food in India and also the first state to start the Green Revolution in India in the 1960s and 1970s. Gurgaon city underwent rapid and unique real estate development since the 1980s initiated by private companies and state agencies. This increased the demand for freshwater and wastewater management to meet the needs of the expanding city. The case of Budhera is such that they have to depend on wastewater for irrigation of their wheat and paddy field. Cooperation norms for canal extension allow up to 1 km from the outlet which can be jointly used by multiple farmers. A yearly nominal installment is paid to the government agency for the wastewater. The cooperation is justified by *bhaibandi* (brotherhood) which is a form of social capital.

In Badsa village, the wastewater canal was connected to a former rainwater pond for storage. This pond was then pumped to the adjacent fields for agricultural purposes. This ensured water availability during the dry season and ease of irrigation to the adjacent field farmers. The payment was made to dig the furrow to and from the pond depending on the proportion of land to be irrigated. However, free riders were allowed to consume the wastewater.

Although urbanization and climate change have added impetus to the draining water resources for the farmers, collective action and self-governance such as in the cases of Budhera and Badsa can be used to tackle the issue.

8.4 Food Estate Development Program for Increasing Rice Production in Swampland Area of Central Kalimantan

As presented by Arif Surahman, the Indonesian agriculture sector plays an important role in the economy of the country including during the COVID-19 pandemic phase when it was the only sector generating profit. However, agriculture faces challenges from population growth, climate change, urbanization, natural disasters, food transportation, the global economic situation, and global food price volatility. There are 5 action plans provided by government agencies to tackle the issues in agriculture. The focus of the study is Action 1 - Swampland Development: intensification and extensification. The Food Estate Program was developed as a product of this Swampland Development strategy.

The aim of the research was to study the existing condition and develop an increasing productivity model for rice farming in the Food Estate Program. This research was conducted in 2 different districts in Central Kalimantan: Kapaus District and Pulang Pisau District. Pulang Pisau was provided with technological assistance like plant spacing, superior varieties, seed doses, and organic and inorganic fertilizers, while Kapaus did not receive such assistance.

The following were the results:

- The business-as-usual model indicates that the rice stock in Pulang Pisau will decrease by 7.4% from 2021 to 2045 if the paddy field area is not expanded. The rice stock can still meet the demand of the regency. However, the decrease in rice stock at Kapuas will make the stock deficit in meeting the regency's demand by 2045.

- Using the second model of increasing rice productivity up to 3 tons per hectare and a 1% increase in the paddy field area, there was an increase in rice stock in Pulang Pisau of 21.9% by 2045 but Kapuas still had a deficit rice stock of 12% by 2045. However, the rice stock can meet the demand of Kapuas in 2045.
- The third model suggested increasing rice productivity up to 4 tons per hectare and a 1.5 % increase in the paddy field area. The result stated a surplus of 59.8% rice stock in Pulang Pisau and a surplus of 20.1% rice stock in Kapuas in 2045. Although the paddy field area was increased by 1.5% for both the regencies, the area is far below the potential agricultural land area.

Utilizing the swamp area could be a potential solution to increasing the agricultural land area. This can be done by using innovative technologies for water management, land use, and improving crop variety and management, integrating and synergizing management, and improving farmer corporation.

9. Way forward: OCeAN publication plans

9.1 Volumes I-V and Special Issue in Int. J. of the Commons

OCeAN has five previous book publications. Volumes I to IV were published in 2016, which conducted scientific and policy research relating to natural resource management over multiple terrains across Asia, highlighting the issues faced in each study location. The volumes were titled Sustainable Natural Resources Management in Dynamic Asia, Upland Natural Resources and Social Ecological Systems in Northern Vietnam, Natural Resource Dynamics and Social Ecological Systems in Central Vietnam: Development, Resource Changes and Conservation Issues, and The Reciprocal Relationship between Governance of Natural Resources and Socio-Ecological Systems Dynamics in West Sumatra Indonesia, respective to their volume number.

The latest, Volume V, was published after 5 years in 2021, titled Natural Resource Governance in Asia: From Collective Action to Resilience Thinking. This volume explored the impact of climate change and socio-political agenda for current and future natural resources management. Moreover, a special issue was organized and published in-between in the International Journal of the Commons in 2019 titled Agricultural and Natural Resources Adaptations to Climate Change: Governance Challenges in Asia. The papers studied adaptation measures for the labor shortage and global market competition adopted by the local communities for agriculture and natural resources.

9.2 Update on Volume VI

The designated editors are currently working on Book Volume VI titled “Redefining the Diversity and Dynamism of Natural Resource Management in the Global South.” The 3 co-editors are T. W. Tsusaka, F. Zulfiqar, and F. Y. Sevilla, and 2 editorial assistants are W. M. Thein and D. Joshi. Tsusaka updated the participants that there were submission delays due to the COVID-19 pandemic. Currently, out of the 29 initial expressions of interest, 13 chapters were submitted and are under pre-review, 8 of the chapter authors requested a deadline extension (the editors expecting a half of them to actually submit), and the remaining 8 are considered as withdrawn. It was communicated that a few more chapters can be accommodated and that the participants in this workshop are encouraged to submit chapters if there are any research already at their advanced stage.

9.3 Volume VII

OCeAN is currently at the initial planning stage toward developing Volume VII. Some candidate editors were named: C.S. Bahinipati, Asif Kamra., Yonariza, and Juthathip C.

9.4 Adaptation of NIIS forms to AIIS

P. K. Viswanathan talked about Agriculture and Operational Forms where he provided a preliminary set of variables and data tabulation techniques to ease cross-comparison between different water irrigation systems and countries. Adding more complexities to data can capture accurate data, hence, he suggested adding data relating to gender sensitivity, emerging technology like Artificial Intelligence, and assessing performance outcomes of irrigation and agricultural systems and resources with SDG Agenda 2030.

10. Chiang Mai field trip

A brief orientation and discussion for the field trip took place at the end of 25 June at Milton E. Bender, AIT. The field research tools in the forms were used to interview farmers in the irrigation area. Assigned individuals were responsible for making and distributing the forms to other participants.

All participants flew from Dong Mueang International Airport to Chiang Mai International Airport in the late evening of 25 June via Thai Lion Air. This trip was managed by Chiang Mai University.

The field trip to the irrigation system at Chiang Mai was organized on 26 June. The visit included interaction with the farmers and surveying the irrigation system using the forms adopted from the NIIS. The purpose of this survey was to test the forms from NIIS before adapting them to the AIIS.

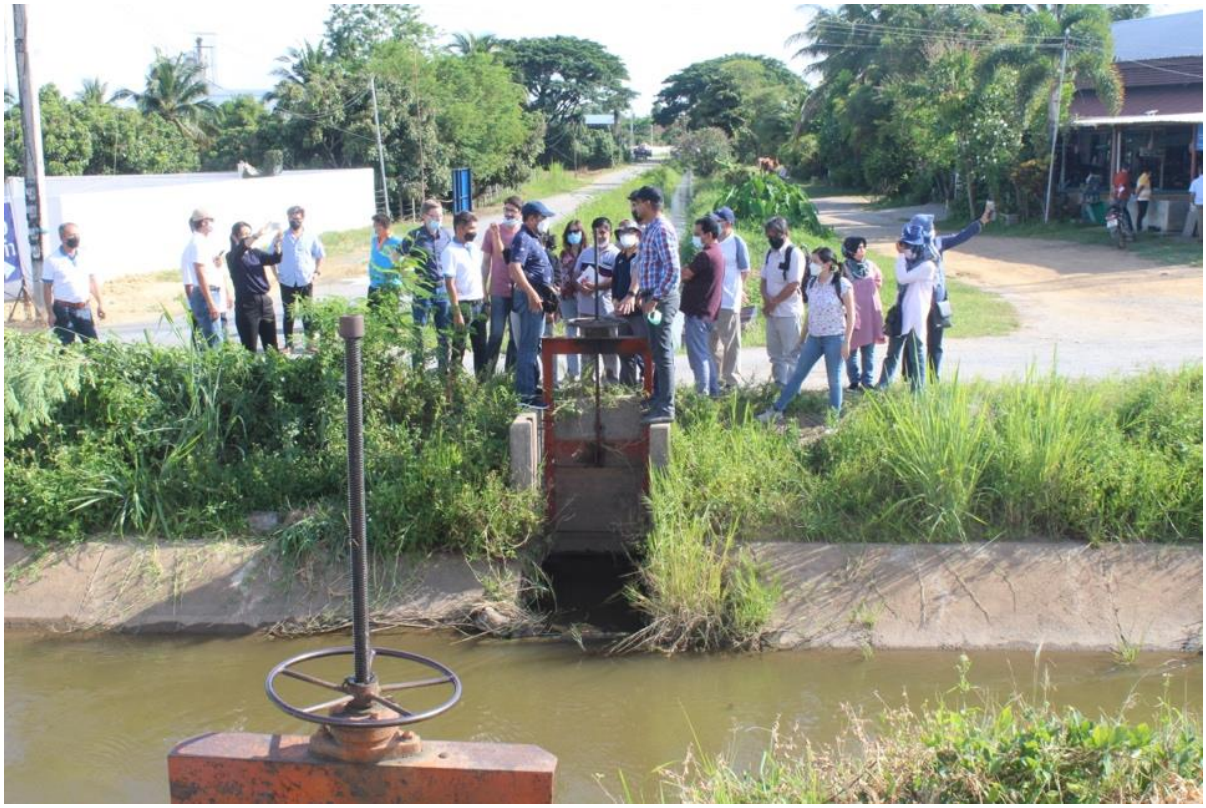


Figure 3: Chiang Mai field trip.

A panel discussion was held on 27 June 2022 with the participants of the workshop. They discussed the AIIS and its potential future. Viswanathan and Frey led the discussion on the adaptation of the AIIS forms from the NIIS forms. Ram Chandra Bastakoti and Van Dat led the discussion on collaboration between the Asian countries, while Lam and Shivakoti led the discussion on future networking and fundraising.

Appendix 1: Program Schedule

23 June (Thursday) Chair: Nasala Prajapati			***Venue***
15.00-21:00	Arrival and Registration of Participants Preparatory Meetings		*AITCC, AFE*
24 June (Friday)		**Speaker**	***Venue***
(09:00-09:50)	**Session 1: <u>Inauguration & Keynote Speeches</u>** Chair: Ganesh P. Shivakoti		*Milton E. Bender (MEB)*
09:00-09:05	Conference Background and Objectives	Ganesh P. Shivakoti (OCeAN)	
09:05-09:10	Welcome Remark	Vilas Nitivattananon (AIT SERD)	
09:10-09:25	Vote of Thanks	Rajendra P. Shrestha (OCeAN)	
09:25-09:40	Keynote Speech 1 "The Challenge of Developing and Sustaining an Irrigation Database"	Ulrich Frey (Univ. Giessen)	
09:40-09:50	Reflection and Comments	Marty Anderies (ASU) <u>(via Zoom)</u>	
09:50-10:10	*Coffee Break*		*MEB Lobby*
(10:10-12:15)	**Session 2: <u>Sharing of Community Experiences</u>** Chair: Ganesh P. Shivakoti		*Milton E. Bender (MEB)*
10:10-10:30	Adaptation to socio-ecological and technological changes in five farmer-managed irrigation systems in Nepal: Forty years of observations	Prachanda Pradhan (FMIS)	
10:30-10:50	*Muang Fai* in transition in Chiang Mai	Sukit Kanjina & Juthathip Chalermphol (CMU)	
10:50-11:10	Impact of collective action on sustainability of irrigation in Punjab, Pakistan	Raza Ullah (UAF)	
11:10-11:30	Resilient *Kuhls* in Himanchal Pradesh, India.	Pampa Mukherjee (Punjab Univ.)	
11:30-11:50	Rural-urban water use competition and Conservation in Indonesia: Perspectives from the SDG 1, 2, 6 &15 Lens.	Helmi (Univ. Andalas)	
11:50-12:15	Sustainability Assessment of Irrigation Management as Agricultural Community Livelihood System in Solok Sub-district, West Sumatra	Yuerlita, Helmi, & Cut Martiani (Univ. Andalas)	

12:15-13:30	*Lunch Break*		*AITCC Dining Hall*
13:30-15:00	**Session 3: <u>Policy Changes & Irrigation Governance</u>** Chair: Ganesh P. Shivakoti		*Milton E. Bender (MEB)*
13:30-13:50	Irrigation Reform for Eco-efficient Small Holder Agriculture in Taiwan	Tang, Ching-Ping (National Chengchi Univ.) <u>(via Zoom)</u>	
13:50-14:00	Collaborative Governance of Philippines Water and Irrigation	Theresa M. Lorenzo (HKU)	
14:00-14:20	Changes in Climate and Watershed upstream-downstream adaptation policy in Indonesia	Rudi Fabriamansah (Univ. Andalas)	
14:20-14:40	Federalization and changing Irrigation Management Systems in Nepal	Ram C. Bastakoti (NPC, Nepal)	
14:40-15:00	Water Resource Policies of Nepal in Retrospective: Community Engagement and Legal Pluralism	Trilochan Upreti (Water and Energy Secretariat, Nepal)	
15:00-15:20	*Coffee Break*		*(MEB Lobby)*
15:20-17:00	**Session 4: <u>Socio-ecological Systems & Adaptation</u>** Chair: Ganesh P. Shivakoti		*Milton E. Bender (MEB)*
15:20-15:35	Traditional Knowledge Inheritance and Biodiversity Conservation——A Case Study of Liufang Village, Liping County, Guizhou Province	Ren Xiaodong, Liu Kesheng and Huang Xia (Guizhou Univ.) <u>(via Zoom)</u>	
15:35-15:50	Precision Irrigation in Pakistan	Asif Kamran (Univ. of Agriculture, Faisalabad)	
15:50-16:05	Community oriented Drought-Proofing water conservation in India	Suresh, A., and P.K Viswanathan (Amrita Univ.)	
16:05-16:20	Visiting Seven Community Protected Areas (CPAs) with Ostrom's Design Principles in Mondulkiri Province, Cambodia	Sam Chanthy (NISA, Cambodia)	
16:20-16:35	Climate risk Management through crop Insurance in India	Dinamani, Biswal and CS Bahinipati (IIT, India)	
16:35-16:50	Overview of Water Resource Development Management in Vietnam: Policy Implications.	Tran Van Dat (IWEM, Vietnam)	
16:50-17:00	Peri-urban water resource management in West Sumatra.	Yenni Yuliza (Univ. Andalas)	

17:00-17:30	Wrap-up for Day 1 Guidance on the CMU Session	Ganesh P Shivakoti, Juthathip Chalermphol, & Sukit Kanjina	
18.30-20.30	Banquet dinner		*AITCC Dining Hall*
Day 2: 25 June 2022 (Saturday)			
09:00-10:30	**Session 5: <u>Community-based CPR management</u>** Chair: Takuji W. Tsusaka		*Milton E. Bender (MEB)*
09:00-09:15	Forested Watershed Management Practices: Livelihood Implications of Indigenous Knowledge in Shan State	Win Myint Thein (AIT AA) (in person)	
09:18-09:33	Mangrove Ecosystems and Community Participation in its Management: Case of Ban Khlong Khon, Central Thailand	Farah Y. Sevilla (UPLB) (Video)	
09:36-09:51	Impacts of Community Forestry on the Livelihoods of Local People in Mindon Township, Magway Region	Aung Si Thu Thein (EIA Consulting, Yangon) (Zoom)	
09:54-10:09	Perceived Impacts of Rural Livelihood Activities on the Wetland Ecosystem Services: Case of Sunye Lake, Mandalay Region	Myat Phu Mon (Myanmar Innovative Life Sciences, Yangon) (Zoom)	
10:12-10:27	International Trade & Management of Oil Palm Products	Worawat Srisawasdi (Chulalongkorn Univ.) (in person)	
10:30-10:45	*Coffee Break*		*MEB Lobby*
10:45-11:45	**Session 6: <u>Panel Discussion: Future Activities for the AIIS Governance & Management in Asia</u>** Chair: Ganesh P. Shivakoti		*Milton E. Bender (MEB)*
	Danny Lam, Univ. of Hong Kong <u>(via Zoom)</u> Prachand Pradhan (FMIS Promotion Trust, Nepal) PK Viswanathan (Amrita Univ., India) Helmi (Andalas Univ.) Asif Kamran (Univ. of Agriculture, Faisalabad)		
11:45-13:00	*Lunch Break*		*AITCC Dining Hall*
13:00-14:20	**Session 7: <u>Institutions, Incentives, and Water Resources Performances</u>** Chair: Ganesh P. Shivakoti		*Milton E. Bender (MEB)*
13:00-13:20	Institutional Change of FMIS in Nepal	Ram C. Bastakoti on behalf of Jagadish Parajuli	

13:20-13:35	Institutions, Incentives, and Information: Adaptation to Climate Change in India	Chandra Sekhar Bahinipati (IIT, India)	
13:35-13:50	Variation in Institutional and Bio-physical Factors, Variation in Water Productivity in Upper and Lower Riparian Punjab and Sindh Provinces, Pakistan.	Asif Kamran (Univ. of Agriculture, Faisalabad)	
13:50-14:05	Muddling through Waste- Self-Governance in Wastewater Commons	Vishal Narain (MDI, Gurgaon)	
14:05-14:20	Food Estate Development Program for Increasing Rice Production in Swampland Area of Kalimantan	Arif Surahman (IAARD, Indonesia)	
14:20-14:40	*Coffee Break*		*MEB*
14:40-15:30	**Session 8: <u>Chiangmai Irrigation Systems: Field Visit</u>** Chair: Ganesh P. Shivakoti		*Milton E. Bender (MEB)*
14:40-14:50	Review of NIIS (AIIS) Forms & Preparation for the Field Visit	Juthathip Chalermphol (CMU)	
14:50-15:00	Location & Resource Forms	Farhad Zulfiqar (AIT) and Raza Ullah (UAF)	
15:00-15:10	Agriculture & Operational Level Forms	P.K Viswanathan (Amrita Univ.) and Juthathip Chalermphol (CMU)	
15:10-15:20	Organizational Inventory & Structure Forms	Pampa Mukherjee (Punjab Univ.) and Ulrich Frey (Univ. Giessen)	
15:20-15:30	Subgroup & Rules Forms	Ram C. Bastakoti (NPC, Nepal) and Helmi (Andalas Univ.) *<u>(via Zoom)</u>*	
15:30-15:45	*Coffee Break*		*MEB Lobby*
15:45-16:00	**Session 9: <u>Ostrom Center Publications: Review & Plan</u>** Chair: Ganesh P. Shivakoti		*Milton E. Bender (MEB)*
15:45-15:50	Volumes I, II, III, IV, and V Special Issue in Int. J. of the Commons	Ganesh Shivakoti	
15:50-15:55	Volume VI	T.W. Tsusaka, F. Zulfiqar, F.Y. Sevilla	
15:55-16:00	Special Issue in Int. J. of the Commons	Danny L., PK Viswanathan, Raza U., Rudi F., Ram B.	
16:00-16:05	Volume VII	C.S. Bahinipati, Asif K., Yonariza, Juthathip C.	
16:05-16:30	Preparation for Departure	Dilasha Joshi	*AITCC*

16.30	Departure from AIT for Don Mueang Airport		*AITCC*
20:05	Flight Departure *(Land in CM at 21:20)*		*Thai Lion Air*
Day 3: 26 June 2022 (Sunday) Chair: Juthathip Chalermphol			
	Field Visit to Interact with the Farmers and NIIS ADOPTED Forms administered for one irrigation system		*Irrigation Systems of Chiang Mai Province*
Day4: 27 June 2022 (Monday) Chair: Juthathip Chalermphol & Bibhuti Thapa			
9:00–12:00	Panel Discussion with Stakeholders of Asian Irrigation Institutions and Systems on Future Activities of AIIS Adaptation of NIIS Forms to AIIS Forms: PK Viswanathan and Ulrich Frey Country collaboration and Data storage and retrieval: Ram Basatakoti and Tran Dat Future Network Meetings and Fund raising: Danny Lam (via Zoom) and Ganesh Shivakoti		*Chiang Mai University*
12:00	Afternoon Departures *(Participants with next day flight will check in AITCC overnight)*		
13:15	Flight back to Bangkok *(Land at 14:30)*		*Thai Lion Air*

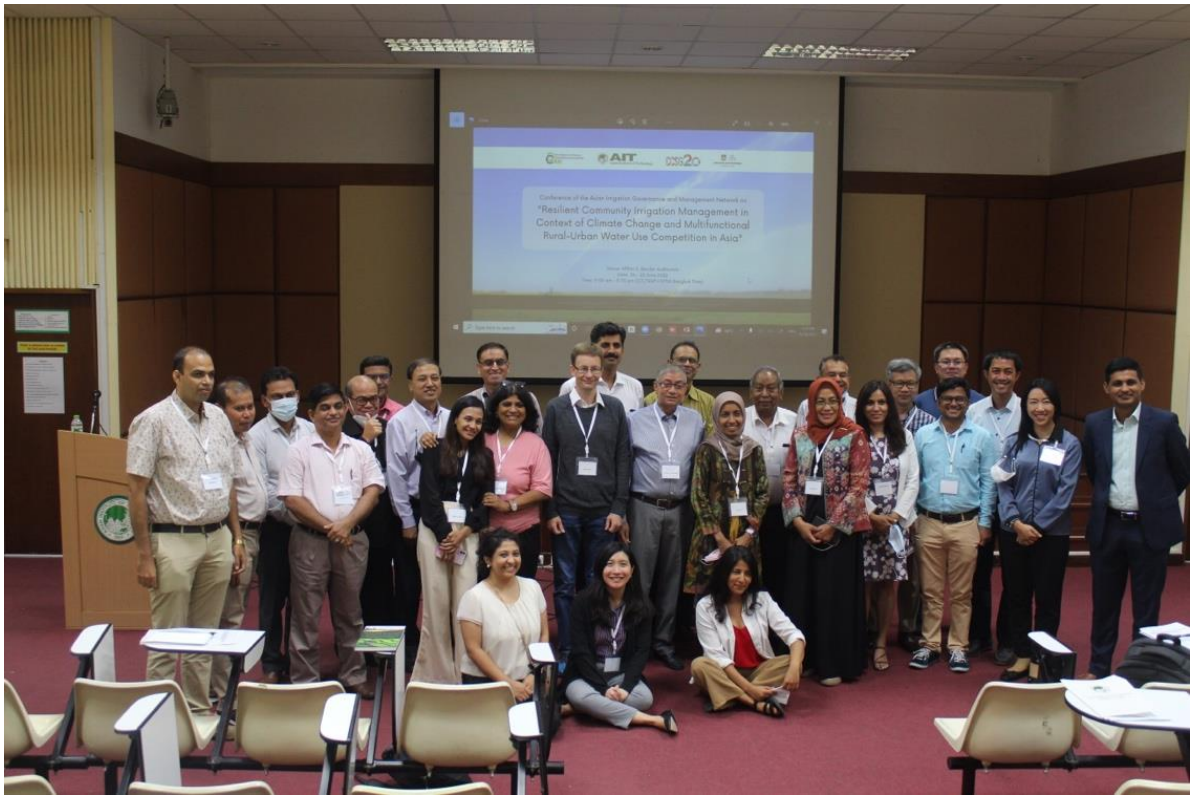
Appendix 2: List of participants

	Name	Affiliation	Role in Workshop
Attendance in person			
1.	Ram Chandra Bastakoti	EU Technical Cooperation Facility to the Agricultural Development Strategy, National Planning Commission of Nepal	Network member/expert
2.	Asmita Sharma	European Union Technical Cooperation Facility the Agriculture Development Strategy, Kathmandu, Nepal	Participant
3.	Sukit Kenjina	Department of Agricultural Economy and Development, Faculty of Agriculture, Chiang Mai University	Network member
4.	Juthathip Chalermphol	Department of Agricultural Economy and Development, Faculty of Agriculture, Chiang Mai University	Network member
5.	Sam Chanthy	Department of Sociology, National Institute of Social Affairs, Phnom Penh, Cambodia	Network member
6.	Tran Van Dat	Institute for Water Resources Economics and Management Hanoi, Vietnam.	Network member
7.	Mohd. Asif Kamran	Nuclear Institute of Agriculture and Biology Faislabad, Pakistan	Network member
8.	Asmut Ullah	CAS-W, Mehran University of Engineering and Technology, Sindh, Pakistan	Participant
9.	Prachanda Pradhan	FMIS Promotion Trust, Kathmandu, Nepal	Network member
10.	Ashmin Kasaju		Assisting Prachanda Pradhan
11.	A. Surahman	Indonesian Agency for Agricultural Research and Development, Jakarta, Indonesia	Network member
12.	Raza Ullah	Department of Agricultural and Natural Resources Economics, University of Faislabad, Pakistan	Network member
13.	P. K. Viswanathan	Department of Economics and Sustainability, Amrita University, Kochi, India	Network member
14.	Chandra Sekhar Bahinipati	Department of Humanities and Social Sciences, Indian Institute of Technology, Tirupati, India	Participant
15.	Yuerlita	Faculty of Agriculture, Universitas Andalas, Padang, Indonesia	Network member
16.	Theresa Marie Lorenzo	Center for Civil Society and Governance, University of Hong Kong	Participant

17.	Suresh Appukuttan	Amrita School of Business, Amrita University, Kerala, India	Participant
18.	Dinamani Biswal	Indian Institute of Technology, Tirupati, India	Participant
19.	Rudi Fabriamansyah	Faculty of Agriculture, Universitas Andalas	Network member
20.	Ganesh P. Shivakoti	Honorary Founding Director, Ostrom Center for the Advanced study in Natural Resources Governance (OCeAN), Asian Institute of Technology (AIT)	Workshop Organizer
21.	Trilochan Upreti	Trilochan Upreti, Water and Energy Secretariat of Nepal, Consultant on developing Master Plan for Water Sector Development, Kathmandu, Nepal	Network member
22.	Ulrich Frey	University of Giessen, Germany	Keynote speaker
23.	Vishal Narain	Management Development Institute, Gurgaon, India	Participant
24.	Yonariza	Andalas University, Indonesia	Participant
25.	Pampa Mukherjee	Department of Economics, Punjab University, Chandigarh, India	Network member
26.	Farhad Zulfiqar	Department of Food, Agriculture, and Bioresources, AIT	Co-editor
27.	Yenni Yuliza	Universitas Andalas, Padang, Indonesia	Participant
28.	Win Myint Thein	AIT Alumni Association	Editorial Assistant
29.	Worawat Srisawasdi	Chulalongkorn University	Participant
30.	Rajendra P. Shrestha	Director, OCeAN, AIT	Vote of Thanks
31.	Takuji W. Tsusaka	Development and Sustainability Program, AIT	Lead Editor; Chair of Session 5
32.	Vilas Nitivattananon	Dean, School of Environment, Resources and Development (SERD), AIT	Welcome Remark
33.	Agnes Pardilla	Department of Development and Sustainability, AIT	Administrative Assistance
34.	Chaiwat Bootchai	Department of Development and Sustainability, AIT	Technical Expert
35.	Dilasha Joshi	OCeAN, AIT	Editorial Assistant
36.	Nasala Prajapati	Development and Sustainability Program, AIT	Workshop Assistant
37.	Bibhuti Thapa	Development and Sustainability Program, AIT	Workshop Assistant
38.	Panupong Sriudom	Development and Sustainability Program, AIT	Technical Assistant
Attendance online via Zoom			

1.	Wai Fing (Danny) Lam	Centre for Civil Society and Governance, The University of Hong Kong	Participant
2.	Helmi	Ph.D. Program on Development Studies, Andalas University, Indonesia	Participant
3.	Ching-Ping Tang	Faculty of Social Science, National Chengchi University, Taiwan	Participant
4.	Myat Phu Mon	Myanmar Innovative Life Sciences, Yangon	Participant
5.	Aung Si Thu Thein	Environmental Impact Assessment Consulting, Yangon	Participant
Attendance via recorded video			
1.	Farah Y. Sevilla	University of the Philippines, Los Baños	Co-Editor, Participant

Appendix 3: Group photograph



Appendix 4: Session recording

The recording of the workshop sessions is available in the following link: http://ocean.ait.ac.th/session-recordings/