



ASIAN INSTITUTE OF TECHNOLOGY

RESEARCH BRIEF

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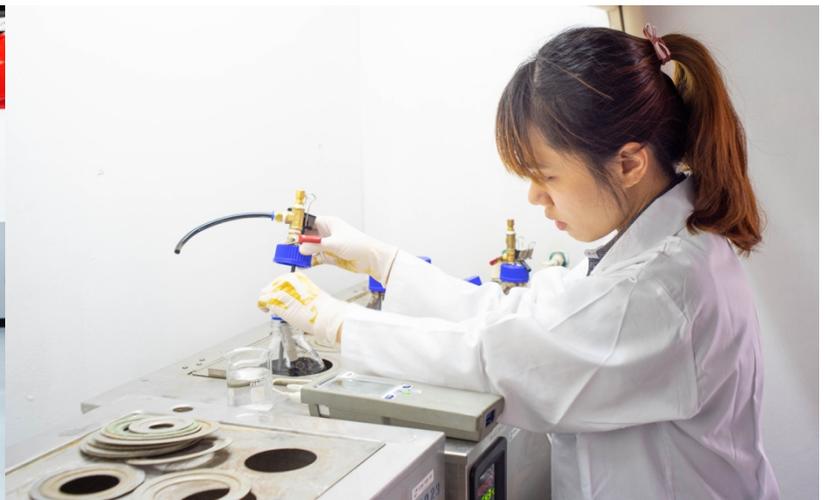


TABLE OF CONTENTS

| | |
|---|-----------|
| <i>CLIMATE CHANGE</i> | 4 |
| <i>SMART COMMUNITIES</i> | 11 |
| <i>INFRASTRUCTURE</i> | 15 |
| <i>TECHNOLOGY, POLICY, AND SOCIETY</i> | 19 |
| <i>WATER- ENERGY-FOOD (WEF)</i> | 24 |

RESEARCH BRIEF

Recognized as one of the leading academic institutes in the field of sustainability in Asia, AIT through its research projects, thrives to take-on new research frontiers to build a better knowledge base and facilitate actions towards the sustainable development of the region. With an aim to make a significant and lasting difference to the communities, AIT's research projects are designed to bolster technology development and application, environmental conservation, policy innovation thus promoting sustainability and sustainable development around Asia and beyond.

AIT's five thematic areas of research are, namely, Climate Change; Smart Communities; Infrastructure; Technology, Policy, Society and Water-Energy-Food. These all five research themes are interconnected and each of which is essential to creating a sustainable future for humans and the planet.



CLIMATE CHANGE



AIT conducts cutting-edge and solution-oriented research in climate change in an interdisciplinary setting. Research addresses the issues of how human activities and changing climate affect each other and explores the technology and policy options needed towards low carbon development and improve the climate resilience for sustainability. Through interdisciplinary approach taken, AIT research examines the greenhouse gas

emissions and the impacts of climate change from social, environmental, and technological perspective. The climate change research theme aims to help determine and support development of effective solutions with appropriate mitigation and adaptation strategies including economic, social, and ecological approaches that are also complementary to other challenges such as Sustainable Development Goals.

Sub-themes

- (1) Transition towards Net zero Emissions
- (2) Climate Change and Ecosystem
- (3) Enabling Technology and Innovations
- (4) Societal Dimension of Climate change
- (5) Cities and Climate Change
- (6) Climate Change Adaption & Resilience

Transition towards Net zero Emissions



With the continued rise of global greenhouse gas emissions at the present time that have caused global warming already at 1.1°C from the pre-industrial times, ignoring the transition to net-zero emission is no longer an option. The climate emergency requires the swift and ambitious action to reduce emissions urgently. Rapid energy transitions to renewable energy, addressing deforestation, the large-scale investment and innovation are needed to provide technologically viable and economically competitive alternatives to reduce GHG emissions across all sectors of the economy.



In view of this, AIT research focuses on analysis of the transition pathways to low-carbon energy system, and low carbon climate resilient communities. It includes greenhouse gas (GHG) accounting and the mitigation actions and policy options – encompassing study of emission sources and monitoring of GHG emissions in key sectors of energy, agriculture, forest and land use; sustainable forest management (REDD+); effective waste management; renewable energy such as solar, bioenergy and biofuel; energy storage technologies and its applications; clean coal technologies; carbon capture and storage; smart grids and microgrids; and climate policies, carbon pricing and carbon markets.



Climate Change and Ecosystem



Climate change threatens all ecosystems such as freshwater ecosystem, grassland, forests ecosystem, coral reefs, agro-ecosystems, and communities' livelihoods dependent on these ecosystems. Human and social systems also play a key role in both causing and responding to climate change. The drastic change in global climate and the earth's temperature is increasingly influenced by human-driven actions such as GHG emissions, land use/cover changes, deforestation, urbanization, etc. The climate change impact on ecosystems is to be exacerbated in ecosystems that already are under pressure from human activities, including air and water pollution, habitat destruction. The interactions between ecosystem vulnerability and human activities, and human well-being are the important

aspects that should be emphasized in face of growing population of the present time. Understanding the causes of climate change, ecological dynamics of climate impacts, has never been more important to pave the way for effective solutions in tackling the climate change and its impacts.

AIT's research under this sub-theme focuses on the climate change and its interaction with human activities as influenced by multitude of factors and environmental systems. It addresses the practical challenges in ensuring the sustainable use of natural resources, land, soil, water, and environmental management. The innovative ways of adapting to, mitigating, and reducing the impacts of climate change on vulnerable ecosystems are also explored. The topics covered under sub-theme include,

among others, the impact analysis and adaptation to climate change in water, land, agriculture sectors; modelling for future climate projections and ecosystem services, climate financing for adaptation and mitigation; the circular economy; microbiology and the environment.

Enabling Technology and Innovations



In the face of changing climate and its adverse effects, the development and adoption of new technology is an essential element of response actions to global climate change. These problems cannot be addressed without technology. Moving forward, technology continues to play an even more significant role as we pursue efforts through adopting climate-friendly technology for mitigation and adaptation.

In view of technological solutions playing a key role towards mitigating and adapting to impacts of climate change, the research under this sub-theme focuses on technology, policy options and strategies through AIT's leadership role to Technological Needs Assessments (TNA) in over 25 countries of Asia with United Nations Environment Program (UNEP) and technology enabling through UN Framework Convention on Climate Change (UNFCCC)'s CTCN programme, as well as other innovative mechanisms from technological, managerial, and institutional aspects in mitigating and adapting to the climate change.

Some of the AIT's areas that have covered sub-theme, are, for example, climate geo-engineering technologies; geospatial technologies (GIS, remote sensing, AI based approaches) in environmental monitoring and resource management such as water resource and air quality under changing climate conditions; climate smart agriculture technologies and practices; farm green innovation; early-warning and climate information services; innovative climate risk financing; technology clinic for Agro-food SMEs, data driven approaches in environmental research landscape, and the role of inclusive social media and digital platforms for climate adaptation and resilience building in Southeast Asia.

Societal Dimensions of Climate Change



Climate change affects the people's lives from several aspects of economic, social, and environmental dimensions. Certain social groups of the society with vulnerability to the climate crisis including women, children, persons with disabilities and the elderly face disproportionate impacts of climate change despite being the least contributor to the crisis. The social crisis caused by climate change highlights the need to step up the efforts in addressing issues of inequality on many levels between rich and poor, women and men.

The climate actions thus need to take a holistic approach addressing the social drivers of climate change across disciplines and the sectors.



AIT's research seeks to understand the social factors and conditions that make social systems vulnerable and resilient to climate change; and examine opportunities to adapt social systems in ways that are fair and sustainable. With a focus on social impacts and climate change, research covers a wide range of areas encompassing the role of economic, social, and institutional resources in building resilience to climate change. That includes education, knowledge, social learning and networking, health, livelihoods, gender, migration, lifestyle changes, civil society organizations and NGOs, and inclusive strategies for climate mitigation and adaptation support systems.

Cities and Climate Change

The cities are increasingly consuming the natural resources at large scale while producing growing amount of waste and emissions, which leads to negative impacts on the environment and the climate. Cities contribute to over 70% of global CO₂ emissions but they have enormous potential to incorporate strategies for reducing the root causes of climate change by changing people's lifestyles, enhancing resource efficiency, and other actions. At the same time, as the climate change continues, the growing effects of climate change are also increasingly felt by the



cities – including the impacts of climate induced disasters such as flooding, intense rainfall, landslides, and strong typhoons, etc. It is thus critical to make cities an integral part of the solution in combating the climate change.

 AIT's research addresses the urban carbon accounting, pathways to low carbon city development and analysis of city climate actions. Practical application of urban resilience approaches and promoting green city concepts are further key areas addressed under sub-theme. This includes urban resilience assessment to disasters and climate risks, urban cooling for heat island mitigation, urban ecosystem services exploration and valuation, climate change impact scenarios on cities, climate-resilient urban planning and design including green infrastructure planning and design, infrastructure resilience planning, smart energy building, circular economy, responsible consumption, urban water-energy-food sectors including groundwater vulnerability and resilience assessments; the policy analysis and options for harnessing the innovation potential in cities to foster resilience and sustainability

Climate Change Adaptation and Resilience



In the face of climate crisis, the efforts to adapt to the changing climate and reduce the climate-induced disaster risks have become a global priority. Promoting resilient societies to the climate risks require a range of complementary approach from climate change adaptation and disaster risk reduction concepts to prevent massive loss of life and destruction of infrastructure and hard-won development gains. The incomplete and uncertain knowledge bases, interplay of multiple actors for effective integration of disaster risk reduction and climate change adaptation in the development work are the issues that need to be urgently addressed.

 AIT's research focuses on climate change adaptation, disaster risk reduction and resilience building for sustainable society through risk-sensitive policies, practices and tools. Among other topics covered under sub- theme, some include the role of governments, NGOs in climate change adaptation;

early warning systems and tools for detection of natural disaster; risk, vulnerability, and impacts assessment of floods, droughts, tsunamis; solutions to overcome extreme seasonal events of floods and droughts, social vulnerability analysis; multi-hazard risk assessment; community-based disaster risk reduction; remote sensing and GIS in disaster risk reduction; risk sensitive land use planning; risk perception and implication on risk governance.

SMART COMMUNITIES



Due to rapid urbanization, urban rural disparity, growing environmental footprint and inequality, the communities are facing economic, environmental, and social challenges. However, they are also trying to leap-frog through grasping the new opportunities presented by the smart technologies, the digital revolution and the policy innovation that are rapidly emerging to issues facing them. Especially, experiences of smart urban and rural communities are supported by a wide range of information and communication technology (ICT) systems that provide advanced and innovative services to create a positive impact for the society

Sub-themes

- (1) Emerging Technologies for Inclusive Development of Rural and Urban communities
- (2) Ecosystem-based Environmental Solutions for Communities
- (3) Digital Transformation for Economy and Businesses

that spans all sectors. AIT's research focuses on transition to smart communities by leveraging the innovative technologies and practices in delivering the better economic, social, and environmental outcomes for the community. Within the changing context of smart communities from infrastructure supply-oriented to improving citizens' quality of life, the research is conducted in multi- and interdisciplinary way—integrating the different dimensions of development such as technology, environment, socio-economic, and governance.

Emerging technologies for inclusive development of rural and urban communities

As the technology becomes more prevalent, the technological infrastructure serves as an enabling platform providing essential services for the benefits of the community overall. Digital technologies bring the great benefits to the communities through its tools and innovative services, solutions to the challenges facing the fast-growing cities and communities — such as climate change, urbanization, issues of mobility, food and water security. It is important to note that smart communities concept application is considered not only in the urban area and its development, but also enabling each community's requirements to be identified and addressed to raise the standard of living for all.



While the technology continues to advance, society needs to be properly prepared for using their functionalities to effectively use the opportunities related to the development of modern technologies.

This sub-theme recognizes the social implications along with the development of smart communities including digital divide;

disparities among different communities in access and use of technology, related to geography (rural and urban areas), gender, economic status.

 AIT's research examines a wide variety of socio-technical aspects that bring the interconnected view of technology and the human systems that operate and interact with it. It encompasses the areas including community applications of different emerging technologies (artificial intelligence, Internet of Things, blockchain, 5G, machine learning); tools and smart devices that affect the human activities and capacities. Research also further explores the social implications of digital communities and the analysis of policies and regulations for communities that promote the innovation and investment through technologies.

The topics include, among others, ICTs application in delivering better education, health care, traffic management, real-time monitoring and management including air, water quality, renewable energy performance, and solid waste measurements (smart waste solutions); AI/IoT application in Geo-Engineering; telecommunication services; digital traceability in value chain; data protection and privacy; accessibility gap between urban and remote areas; and the factors that foster the digital inclusion.

Ecosystem-based Environmental Solutions for Communities

While the 'smart communities' uses information and communication technologies (ICTs) to provide innovative and efficient services for the communities, it is important to step up the efforts in reducing the human impact on the environment and promote the sustainability. The growth of urbanization and human settlements, coupled with limited planning are adversely affecting the natural resources and puts cities and communities at risk from climate change. These challenges have highlighted the

critical need to respond to sustainability issues by incorporating the environmental sustainability as one of the key important aspects to urban and rural planning.

Realizing the increasing negative impact of urbanization on wider ecological systems, the research promotes nature-based solutions in dealing with increasing complexity of environmental burdens in both urban and rural contexts. It explores the options to meet socio-ecological system needs in ways that promote healthy ecosystems, human well-being, and viable economies.

 Under this sub-theme, AIT's research promotes the socio-ecological systems approach to address a range of environmental issues related to energy, water security, land use, waste – such as sustainable land use planning and management, environmental systems analysis and sustainability assessment, adaptation approaches to disaster risks and climate change (nature-based flood management), waste management and circular economy, low carbon and sustainable transportation, logistics and sustainable consumption, sustainable metropolitan development, green and inclusive buildings.



Digital Transformation for Economy and Businesses

While the technology continues to bring changes in our daily lives, it has the substantial impact on the economy from several aspects of policies, innovation, productivity, growth, and employment. While the use of digital technology can solve business problems and make business processes more efficient and effective, it is also necessary to understand the impact of emerging technologies on economies from political and social aspects to ensure a sustainable and equitable economic growth.

🔍 AIT's research seeks to understand the process of digital transformation of businesses that drives the transformative change in economic efficiency, policy, and competitiveness including the adoption of digital financial services. The financial and social implications in response to technological advancement such as AI and IoT are further key issues addressed under sub-theme. The areas covered include, for example, the impact analysis of AI/IoT on economic policies, technological applications in production, operation, management, and marketing; communities' digital transaction; data-driven organizational management and business development; digital marketing and skills for the digital workplace; innovations and entrepreneurship in Agribusinesses including digital precision farming; marketing and traceability tool.



INFRASTRUCTURE

Infrastructure systems play a critical role in social and economic activities, and function as critical lifelines for connecting communities, industries, markets, goods and services as well as for efficient governance. Infrastructure forms the backbone of any social and political development of communities and countries. Hence, investments in infrastructure is increasing rapidly, especially in developing countries to meet the increasing demand for reliable and efficient transportation, power, telecommunication and water, often termed as the basic services essential for human and social well-being. However, across the world, millions of people are still facing severe absence and shortages of such systems.

Unreliable power grids, inadequate water supply and sanitation systems, poor transportation networks are still a huge plague in many developing nations. The improvement and resilience of infrastructure systems and services have become vital in the path towards sustainable development and for resilient and prosperous societies. In responding to the future trends and challenges with the rapidly growing communities, it is essential to ensure that infrastructure system and facilities are designed in sustainable, resilient, and inclusive approach. With technology expanding at the rate, it is now, infrastructures need to be flexible to adapt to technological improvements and incorporate better solutions as they become available.



AIT's infrastructure theme represents the physical components of interrelated systems providing commodities and services essential to enable, sustain, or enhance societal living conditions. That includes transportation systems and networks including roads, bridges, and mass transit; housings, buildings, and facilities; electrical grids, ICTs networks including telecommunications.

Sub-themes

- (1) Planning and Management
- (2) Water Infrastructure
- (3) Digital (ICTs) Infrastructure

Planning and Management



Economic growth and prosperity of the countries largely depend on the sustainable and resilient infrastructure resources and services which facilitate the daily social and economic activities to be more productive and efficient. Effective planning and management is therefore crucial in creating a resilient and sustainable infrastructure facilities which are the primary prerequisite for development of economic, social, and environmental aspects in countries. Well-planned infrastructure system strengthens the sustainability and livability of our cities and communities while moving towards a greener, equitable future.

 AIT's research focuses on the processes necessary for the planning and development of new infrastructure in a cost-effective manner, and on maintaining and operating mature infrastructure for sustainability while integrating economic, social, environmental and policy aspects along these processes. It addresses the issues related to city systems and network, transportation, environmental and social aspects, financing and investment, logistic and supply chain management, construction engineering & management including sustainable construction, quality and safety improvement, bridge engineering, maintenance management.

Specific topics addressed in relation to planning and management include the effective strategies for infrastructure development and project management; climate resilient, earthquake resistant urban infrastructure; appropriate costing methods of climate change adaptation in infrastructure development (roads); safety, and security measures for public/private schools and hospitals; traffic engineering such as traffic and road safety; highways and pavements designs; infrastructure financing options; financial and risk management in infrastructure development; operation and maintenance of facilities; geo-engineering aspects in civil engineering issues; the rural-urban interconnected infrastructure and the infrastructure sustainability. Recently completed infrastructure resilience project to develop coastal critical infrastructure resilience index in Thailand and also implementing pilot demonstration project "Climate Resilient Infrastructure for Social Transformation and Adaptation (CRISTA)" providing solution to the pressing gaps in infrastructure resilience towards climatic hazards in Nepal and Bangladesh certainly help developing sustainable community.

Water related Infrastructure

Water system is an essential infrastructure in water management, providing the basic services to growing populations. But rapid population growth, urbanization and economic development are increasing the demand for water bringing enormous pressure on water resources and supply. With this growing pressure on the water sector, investing in building resilience of water infrastructures to the adverse effects of climate change and emerging global health issues (pandemic) requires a comprehensive approach and a long-term outlook that contributes to economic productivity and environmental sustainability.



AIT's research on water related infrastructure addresses the issues related to planning, design, implementation, operation, and maintenance of water infrastructures – critically exploring the technology solutions and policy options to improve the water use efficiency, productivity, and security in context of changing environmental conditions.

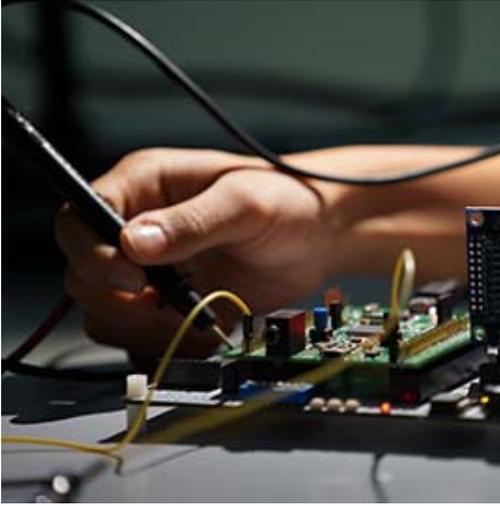
A wide variety of topics are explored under sub-theme such as water supply and distribution infrastructure in urban and rural areas; sanitation system services; wastewater treatment and disposal systems; impact of COVID-19 on waste water management, irrigation and drainage system; real-time hydrological information systems for urban flooding and drainage; innovative approaches for resilient water infrastructure including innovative water conservation technologies, climate smart WASH technology, climate friendly wastewater treatment, nature based solutions and transformative adaptation for water security; and analysis of the policies and business models applied to improve the water resource infrastructure planning and management.



Digital (ICTs) Infrastructure

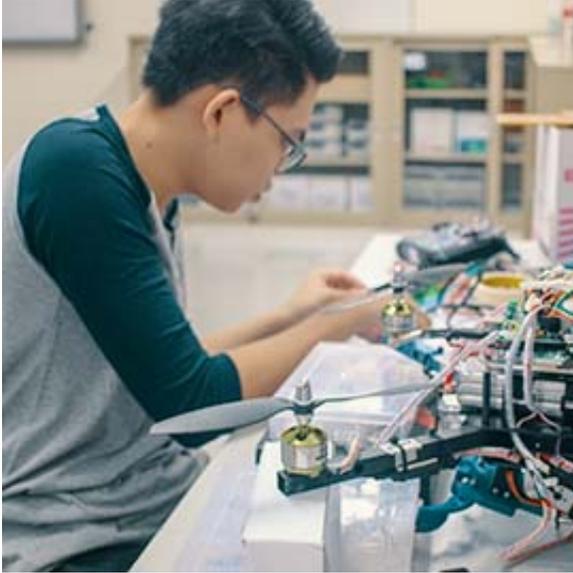
The development of Information and Communication, Technology (ICT) infrastructure has brought significant changes and impacts to our everyday lives from many aspects. The ICTs has become the part of every individual's life as the essential infrastructure to connect the people, share the information through a wide range of digital applications, services and solutions on which society and businesses rely.

 Recognizing the ICTs as a key enabler to the social and economic development, AIT's research seeks to ensure that the application, services, and investments of ICT based systems and processes



are efficient and sustainable for businesses, industries, communities, and the governments. Key areas of research include telecommunications, information systems and management, mobile phone applications, and ICTs applications for information society. The topics covered under sub-theme, include, among others, telecom market dynamics including service quality control and resource management; data modelling and management; data-driven organizational systems and management, data-driven approaches in methods in environmental research and urban issues, ICTs application in built environment and transport network system including road and traffic control management, ICTs in environment and climate monitoring and disaster management including early-warning and disaster relief networks and communications.

TECHNOLOGY, POLICY, AND SOCIETY



The future of economic prosperity and inclusive societal transformation depends on how we address the key societal issues benefiting from emerging innovative technologies and policies. The application of digital technologies, bio-process technologies, environmental technologies, energy technologies, and nanotechnologies holds the greatest potential for competitiveness and sustainable growth of the countries if can be used appropriately. Despite the major technological advancements, the complexity of technologies and the implications they have for many aspects of social life still needs to be fully understood and issues of disparity, divide and inequality remain. The understanding of the ongoing digital transformation and consequences of these new and emerging technologies is important to improve the

individual and societal outcomes, particularly in the face of increasing societal pressures.

AIT's Technology-Policy-Society research theme is cutting-edge research focused on the technology development and application, policy innovation, and development and societal issues including the nexus between them. The theme recognizes the growing need of bridging the gap between technology and policymaking that requires the understanding of the policy tools required for modern society and the modern technologies. In view of this, the research explores how social science and technology interact with everything from environmental issues to public policies, and better understanding on the impacts of emerging technologies (artificial intelligence, internet of things, big data, etc.) from societal and policy dimensions while moving forward to inclusive and sustainable development.

Sub-themes

- (1) Digital Technology Solutions and Societal Transformation
- (2) Innovative Policies for Coping with Rapid Transformation taking place in the Region
- (3) ICTs and the Environmental Management
- (4) Equitable Societal Change and Inclusive Development
- (5) Gender and forced displacement

Digital Technology Solutions and Societal Transformation

Modern digital technologies, information, and communication technologies (ICTs) services are fundamental in all areas of society today, and extremely important for social development. The technological advancements have brought major changes to our daily lives – changing the way we work, communicate, and do businesses. Artificial Intelligence (AI) is set to play an even more important role in every aspect of our daily lives in the future. It is thus important to look more closely at how these new and emerging technologies will affect the social equity, in particular gender dynamics and power relations. While the digital technologies present a significant threat to inclusive development, it is important to understand the potential opportunities and risks associated with these technologies and recognize their potential to make positive changes in societies, for example challenging oppressive gender norms. It is necessary for the societies to be able to adapt to the social changes that technology will continue to bring in future.



 AIT research under this sub-theme addresses the societal consequences of new and emerging technologies from the multidisciplinary approach. It provides a landscape for critical inquiries about technology and its intersections with socio-economic drivers. Research covers a wide range of areas – including information systems and management for health care, education, and transport, businesses sectors; nanotechnology focusing on application of nano particles (e.g., nanostructured anti-reflective coating for solar panels); application of AI and big data for agricultural productivity including aquaculture value chain; natural resources management using conventional and modern temporal and geospatial technologies; digital inclusion such as inclusive AI development; technological impacts on cultural and social aspects such as fake news, depression; digital policies and governance.

Innovative Policies for Coping with Rapid Transformation Taking Place in the Region

Recent decades have seen the increasing role of innovative policies in the areas of development and emerging technologies to generate solutions for the challenges such as climate change, and other emerging societal issues. While these rapid changes with emerging technologies present a significant opportunity to achieve the sustainable development, they also raise a major ethical, legal, economic, policy and social issues especially inequality - posing new challenges for policymakers to meet the

goals of sustainable development. The focus of policies has broadened significantly not only for the economic growth or sectors, but also to addressing the challenges of interconnected issues and synergies between environmental sustainability and sustainable development. Such shifting policymaking environment highlights a critical need for policymakers to use the multiple policy framings in dealing with the complex challenges and adapting to shifting social realities. Moving forward, just as technology and innovations are central elements of modern societies, it is equally important to recognize the role of innovative policies with government initiatives by integrating the scientific and technological knowledge into public policies to foster the strategic growth.

 The sub-theme through evidence-based research seeks to understand the policy approaches, which will help guide the direction of future policies and facilitate the transformative change in economic, environmental, and social aspects. AIT's research examines the question of how governance structures and their policies deal with the emerging challenges related to social, environmental, developmental, and technological aspects, and how they can have far-reaching impacts. It focuses on understanding the effectiveness of policy approaches, policy evaluation and impact analysis with a particular emphasis given on approaches that benefit low-income and other marginalized communities. The research focus areas in relation to innovative policies include science, technology, and data; gender and development, poverty reduction, business and regulations, social development; environment and energy sustainability; resilient cities and communities; agricultural development policies and strategies. The topics include, among other, evidence-based policies for the sustainable use of energy resources in the Asia Pacific Region; Labor migration & human trafficking laws, regulations & policies; Mainstreaming ecosystem services in national policies for sustainable management of freshwater ecosystems in South & Southeast Asia; and Strengthening ASEAN Member State Policies with Environmental Health Data on Costs of Inaction and Co-Benefits.

Information and communication technologies (ICTs) and the Environmental Management

While the increasingly widespread use of ICTs enables the socio-economic development, ICTs are also a growing contributor to addressing the world's most urgent and critical crisis of climate change and environmental issues, enabling the much-needed transition to circular economy.



 Focusing on the ICTs and its impacts on the environmental sustainability, AIT's research focuses on how ICT development with the frontier technologies, systems and applications can be harnessed for tackling environmental challenges including climate change.

Specific topics addressed are, for example, the data-driven natural resource management (water resources, air quality, land use); emerging technologies and tools

(AI, IoTs, big data, machine learning) applied for climate and environmental monitoring and management such as climate information system, early-warning, disaster relief communications and AI based energy management including microgrid platforms; GIS and remote sensing applications in agriculture and natural resource management.

Equitable Societal Change and Inclusive Development

Social equity and inclusion across all our communities is driven by the several factors of change including access to and control over resources, gender, education, technology, and the policies. Achieving social justice and equality requires long term and sustainable action to close the inequity gap among demographic and socio-economic segmentations. For instance, the digital literacy gap is present between women and men, in addition to the unique barriers of women and girls in accessing to and use of digital tools and services.



In the wake of growing recognition on importance of social equity to sustainable development, research under this sub-theme, addresses the drivers that determine equity and social inclusion – examining how they have shaped our identity, communities, and the role they play in promoting the inclusive sustainable development. This systematic understanding of drivers will support the development of policy priorities, decisions, and development programming to accelerate the poverty reduction and achieve the sustainable development.

🔍 AIT's research focuses on behavioral, social, and physical barriers and opportunities including policy options to ensure that individuals, groups, and communities participate fully in meaningful ways in society. Moving towards the achievement of the inclusive development, research addresses the issues from several aspects of social, cultural, economic, political dimensions. The areas covered under sub-theme include, among others, gender relations in the issues of migration, forced displacement, labour, agriculture, fisheries; cultural influence, human resource, and leadership development; women political participation, influencing factors on entrepreneurship, social capital in sustainable agriculture, equitable access to resources and technologies, policy interventions, the role of media and public perception on equitable social change.

Gender and forced displacement

Asia is witness to both on-going and emerging pressures that drive forced displacement in contexts where political systems range from unstable democracies to full-blown dictatorships. The Region is

also one of the most vulnerable to disasters and the impact of climate change; and continues to undergo rapid infrastructure development including dams, roads, ports, and Special Economic Zones that displace populations. Existing research and responses remain surprisingly gender blind, which in turn, results in poor policy and programmatic responses. In addition, gender is often understood in limited terms, focusing on impacts, or on women as victims in forced displacement. This hides many gender dimensions of forced displacement. For instance, the focus on impacts fails to highlight how drivers of displacements have strong gender dimensions, including policies designed by male-dominated political systems or conflict and gender-based violence being a cause of displacement or overlapping drivers. Or that a discourse of women as victims, reinforces stereotypes which negate women's agency and participation and contribute to less effective responses. Narrow understanding of gender obscures gender patterns where men can be victims, e.g., where men and boys have been forced into combat, or targeted as civilians; or hides potential where men can engage and contribute as agents of change and solidarity. Finally, our understanding with regards to sexual orientation and gender identity and expression (SOGIE) in forced displacement is extremely limited, making diverse SOGIE groups invisible in research and policy processes. AIT hosts the Center on Gender and Forced Displacement. The Center and affiliated research activities bring attention to the ongoing imperative to center gender issues globally.



The research under sub-theme addresses the gap between important drivers of forced displacement in the region with needed knowledge and policy responses when it comes to gender dimensions of forced displacement. It examines the drivers of forced displacement influenced by gender dynamics and the gender dimensions in experiences of forced displacement; and analyze the policy responses and the gaps in addressing the gender dimensions of forced displacement in the region at these different levels. Under this sub-theme, the areas focused include, among others, strengthening knowledge, evidence use and leadership on forced displacement; the impact of political trends, climate change and investments on drivers of forced displacement and their gender dynamics; displaced people and their vulnerabilities in various stage of displacement, and the effort in addressing gender needs in forced displacement.

WATER- ENERGY-FOOD (WEF)



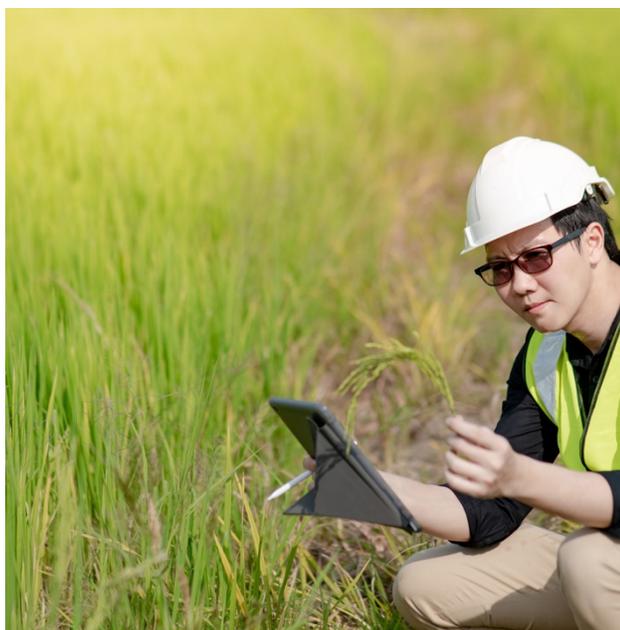
Water, Energy and Food are of vital and critically important to the human societies, and their economic and livelihood activities. They are inextricably interrelated to each other and with other societal goals. Global challenges of climate change, ecosystem degradation, intensive economic growth, population growth, and urbanization are increasingly threatening the security and services of WEF systems. With the growing demands of WEF resources driven by these challenges, the social and environmental implications are increasing with unpredictable impacts for livelihoods and the environment. In order to reduce the negative impacts of and to across WEF nexus, the effective solutions with integrated low carbon and multi-sectoral adaption strategies and policies are needed urgently. To achieve the long-term water, energy and water security, there is also a need to step up the efforts dealing with technology development in addressing the main environmental issues.

The research encompasses the field of each domain of WEF resources, and the nexus approach that considers all three different dimensions recognizing the interdependencies of different resource uses sustainably. The issues covered in relation to WEF sectors include efficiency, equity, resilience, and sustainability, as well as the key questions required to enhance adoption of technologies and policies to promote the strong synergies of food security, energy, and water investments.

Sub-themes

- (1) Food Security
- (2) Sustainable Energy
- (3) Water Management
- (4) Water-Energy-Food nexus (WEF nexus)

Food Security





The agri-food systems of present time are undergoing a series of profound changes brought by climate change, biodiversity loss, emerging technologies, and innovations. With the growing population, the need of more food to be produced to feed the world population is on rise. A well-functioning agricultural sector is essential to ensure the food security, and agricultural livelihoods as the agriculture is the provider of food and feed to the world, and its products are a major source of income for the communities. It is thus crucial to improve production techniques and boost the resilience and sustainability of agri-food system.

With an emphasis given on different dimensions of food security such as availability, accessibility, utilization, and stability, research addresses a wide range of aspects covering resilient food production, distribution and consumption through environmental solutions, sustainable agricultural technologies, policy responses.

 AIT's research topics include, among others, sustainable agricultural development; climate smart agriculture; Agri-Food value chain management; technological innovations in Agribusiness such as tech-clinic for Agro-food SMEs, AI driven precision agriculture; technological applications in soil, crop productivity, pests and disease management; food technology, food processing, food engineering; Food safety, and quality; biotransformation of Agro-industrial waste; market analysis; consumer behavior and practice; Nutrition, diet, and health; Aquaculture and aquatic resource management. The impact of economic and social forces on food security including public policies, programmes and services are also examined such as impact of property tax on food security.

Sustainable Energy

Sustainable Development Goals (SDGs 7 and 13), and the ambitious Paris Agreement on Climate Change have called for accelerated universal energy access combined with energy efficiency and deep-decarbonization for the energy sector. But the world today is yet on fossil-fuel pathways despite improving cost and efficiency of renewable energy technologies and facing energy crisis with the rising prices of gas, oils and growing demand on energy infrastructure driven by energy shortage problems resulted from countries' mismanagement and a post-pandemic rebound in demand.

With the global deepening energy crisis, it is important to make efforts to dramatically increase the use of renewable energy while reducing the environmental impacts. Energy efficiency brings several benefits from environmental, and economic perspective, including lower greenhouse gas emissions, decreased water uses and lower costs from daily utilities, and promoting job creation. Apart from the traditional energy sector, the transport sector is also converging onto the power sector via electrifying it for several reasons, so its potential and challenges need to be analyzed. The sustainable energy sector's transition phase needs societal change with new values, system thinking, technical and modeling skill, business, policy, and the governance.

 AIT's research in relation to energy is conducted in an interdisciplinary approach - encompassing a wide range of areas such as clean energy transition technologies, energy policies, environmental, social and management aspects. It addresses the issues related to the sustainable energy transition at the cities and national level for delivering a reliable, clean, affordable energy supply compatible with sustainable development.



The topics covered under this sub-theme include, among others, climate change mitigation from the energy sector, bioenergy and biofuel productions, application of AI, big data and machine learning in energy and power systems including energy demand changes brought by technologies, energy efficiency and barriers in industries; energy conservation, storage technologies and its applications; waste to energy technologies; techno-economic assessment of renewable energy technologies; evaluation of energy policies and stochastic

analysis through energy and power sector modelling at smaller time scale; energy access and security assessments; regional electricity trade, barriers, and system integration; smart grids and microgrids; demand response.

Moreover, a new dimension in the energy and transport sectors is emerging from integrating more intermittent renewable energy sources with the help of smart grid, demand response and energy storage, including hydrogen energy, to meeting the COP26 commitment by achieving carbon neutrality and net-zero GHG emissions goals.

Water Management

The impact of rapidly growing population, economic growth, and environmental changes have brought enormous pressure on the water security which is essential foundation to the peoples' lives and ecosystem services. The problems water sector faces today are daunting with the challenges in developing, conserving, and managing water resources, its safe and productive use, particularly with regards to sustainability and environmental impacts on both at supply and end-use sides.



The increasing challenges and urgency to ensure the water security in our time of unprecedented changes and shocks, highlights the critical need for a transformation in thinking and approach.

Moving forward, the adoption of new management capitalizing on innovative technologies in water sector is necessary to ensure the water security. Innovation and technology have a vital role to play in combating water scarcity and safety, water efficiency, utility operations, wastewater

management, monitoring and treatment and data and analytics. The risk management of water resources is also critical to prevent the damage and loss from natural disasters such as flooding and drought.

 AIT's research seeks to understand and respond to the issues related to the complexity of water use and water resources management including the water related risks influenced by climate extremes and human activities. It explores the new models, methods, technological innovations, and tools covering the focus areas of agricultural water; coastal water; urban water; water resources; wastewater; and extreme events and risk management.

Research projects include, among others, the data-driven approaches and nature-based solutions in water management; transformative adaptation for water security; water allocation planning; impacts of climate change and adaptation in water sector; integrated water resource management; water quality management; water recycling and resources recovery; groundwater governance and resilience; urban and rural water supply and distribution systems; irrigation and drainage system management; cropping systems; erosion and water quality problems; watershed management; social and environmental impact assessment of water resources. The extreme events and risk management including river flow analysis, flood control and mitigation, flood modeling and forecasting, flood plain development, and management, is also covered under the sub-theme.

Water-Energy-Food (WEF) nexus

The complex interrelationships between the water, energy and food systems have clearly highlighted need to transform the way we think in managing the complex challenges. In this context, the “business as usual” approach cannot achieve the realization of long-term water, energy, and food security. A new approach with nexus perception is necessary to better understand and systematically analyze the interactions between the natural environment and human activities. This paradigm shift is vital to achieving the sustainability development goals in an environment of global climate and economic change.

 AIT's research focuses on the interconnectedness of WEF systems including the tradeoffs and synergies between different resource uses; the dynamics of WEF nexus interactions with climate change and human intervention. Specific topics covered include, among others, food production with efficient use of water, energy, and other resources; innovative water conservation technologies for agriculture/horticulture productivity; energy and carbon footprint of urban and national water system; wastewater to resources/energy; resources nexus approach in addressing issues related to climate and environment; and the policy response options towards a more coordinated management of resources.

