Workshop on

SMART Informatics for Sustainability

Royal Orchid Sheraton Hotel, Bangkok, Thailand
21-23 March 2018

CONTENTS

About ASEAN

About ASEAN

The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967. The ASEAN Declaration committed the signatory States to cooperate for the purpose of economic growth, social progress, cultural development, and regional peace and stability. Currently, ASEAN has ten Member States which are Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam.

ASEAN 2025 : Forging Ahead Together

As the ASEAN Community building is an evolving process, the ASEAN Community Vision 2025 chart the ten years 2016-2025 path for a more rules-based and people-centered ASEAN Community where "our peoples enjoy human rights and fundamental freedoms, higher quality of life and the benefits of community building". New blueprints for ASEAN political-security, economic, and socio-cultural cooperation are also drawn for the period 2016-2025, building on the previous Blueprints. The peoples and stakeholders of ASEAN, including civil society organizations and the private sector, are expected to play a greater role in the development of the ASEAN Community.

Message from ASEAN Secretariat

CHEONG Lee Sing (Alice)

Assistant Director and Head of Science and Technology Division Sectorial Development Directorate, ASEAN Economic Community Department (AEC)

"The ASEAN Community Vision 2025 builds upon the foundation of ASEAN's motto of one vision, one identify, one community. This vision expresses the collective will of ASEAN to be people-centric and among the commitments in various areas, to also undertake actions to enhance the capacity and capability of its people to adapt and respond to social and economic vulnerabilities, disasters, climate change as well as emerging threats and challenges. We currently have many tools in our hands, including big data analytics, internet of things, sensors, and other technologies and innovation. The usage of these tools together with collaborative efforts of sharing and analyzing data obtain in the areas of hydrology, meteorology, and geophysics can provide the intelligence and window of opportunity for actions to be taken before floods occurring, crops dying from drought, tsunami reaching the shores and many other scenarios happening. It can also be used for economic benefits such as to optimize the crop types to be planted for higher income. This workshop on SMART informatics for sustainability is one of the first steps, to bind us together and for us to work together towards the goal of overcoming the common external threats. You are the hope of our people, for a life that is not only more secure from hydrology, meteorology, and geophysics phenomenon, but also one that can improve their life. "

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About ASEAN Committee on Science and Technology (COST)

The ASEAN S&T sectoral body is established with the predecessor (ad-hoc Committee on Science and Technology) of ASEAN Committee on Science and Technology (COST) since April 1970 to conduct ASEAN cooperation in the area of science and technology. The area of cooperation was expanded in 2016 to also include innovation. The sectoral body since 1980 is headed by the ASEAN Ministerial Meeting for Science and Technology body which sets the policies, while the ASEAN COST consisting of one representative (up to the level of Vice-Minister) per member state, meets twice a year and also communicate as required to actualize these policies through its subsidiary bodies. The 2016-2025 ten-year plan of the sector commits to strengthen collaboration among stakeholders, enhance mobility of scientists and researchers, support enterprise and raise public awareness. This is aimed at realizing an ASEAN community which is empowered by science, technology and innovation for social and economic benefits.
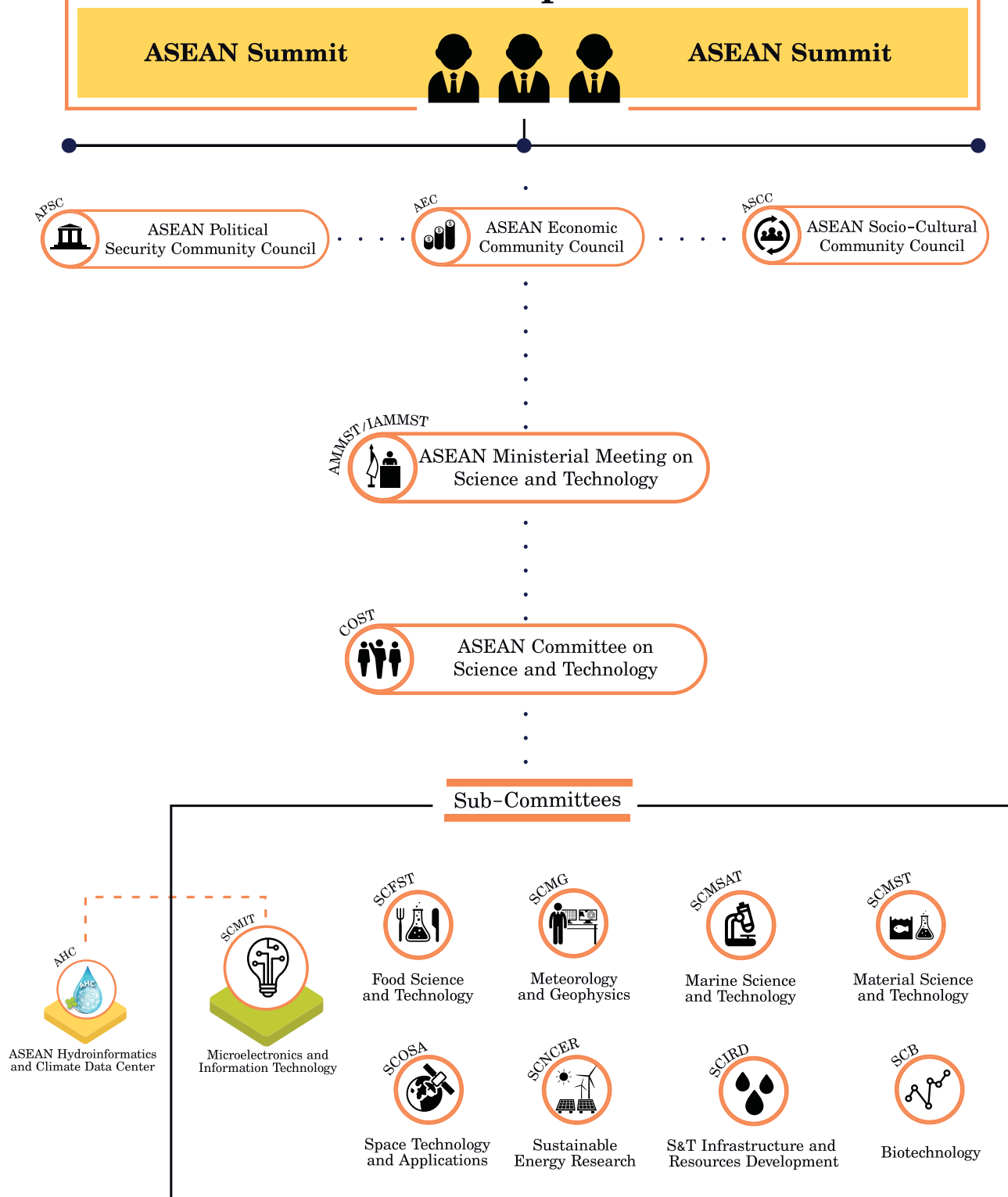
About Sub-Committee on Microelectronics and Information Technology (SCMIT)

The predecessor (ad-hoc Working Group on Microelectronics) of ASEAN COST Sub-Committee on Microelectronics and Information Technology (SCMIT) was established in June 1985. SCMIT is currently represented by one representative per member state, from diverse background from government ministry, academia to research institute. SCMIT's current focus areas are microelectronics, multimedia and mobile communication applications, internet of things, big data processing analytics, cyber security, embedded systems and sensors, robotics and automation, open platforms, cloud computing and artificial intelligence.

Structure of STI Cooperation in ASEAN

ASEAN Summit **ASEAN Summit**

APSC — ASEAN Political Security Community Council

AEC — ASEAN Economic Community Council

ASCC — ASEAN Socio-Cultural Community Council

AMMST/IAMMST — ASEAN Ministerial Meeting on Science and Technology

COST — ASEAN Committee on Science and Technology

Sub-Committees

AHC — ASEAN Hydroinformatics and Climate Data Center

SCMIT — Microelectronics and Information Technology

SCFST — Food Science and Technology

SCMG — Meteorology and Geophysics

SCMSAT — Marine Science and Technology

SCMST — Material Science and Technology

SCOSA — Space Technology and Applications

SCNCER — Sustainable Energy Research

SCIRD — S&T Infrastructure and Resources Development

SCB — Biotechnology

About
Ministry of Science and Technology (MOST)

**Assoc.Prof.
Soranit Siltharm M.D.**

*Permanent Secretary
Ministry of Science and
Technology, Thailand*

The Ministry of Science and Technology (MOST) is presently tasked with forwarding the policy and strategic plan for science, technology and innovation and seeing to its effective and substantive implementation, both in terms of research and development as well as in terms of creating cooperative mechanisms between all sectors of society, with a view to promoting economic benefits and enhancing quality of life. Under the vision of "excelling as the steward or main organization in the development of science, technology and innovation" the Ministry of Science and Technology aims to create and enrich the intellect of Thai society, in a manner that will support economic and social development and sustainable competitiveness. There are 16 important supporting agencies to assist in this respect, namely the government agencies, autonomous agencies, state enterprises, and public organizations, which all come under the structure of Ministry of Science and Technology.

For more information, **www.most.go.th/en**

About
Hydro and Agro Informatics Institute (HAII)

Hydro and Agro Informatics Institute (HAII), is a public organization under Ministry of Science and Technology, Thailand, focusing on research and promoting used of informatics in Thailand, especially on hydrology, water resource management and agriculture. HAII aims to develop and apply science and technology knowledge for agricultural and water resource management in Thailand, which will enhance partners to be climate change and disaster risk resilience. HAII also expand its collaboration and accomplishment on integrated water resource management nationally and internationally. Official website: **www.haii.or.th**

In 2011, HAII has established a central ICT platform to integrate online hydro-meteorological information from 35 agencies in Thailand and provide services so called National Hydroinformatics and Climate Data Center (NHC) **www.thaiwater.net**

to collect and analyze data for decision support and water-related crisis management operation. ASEAN Hydroinformatics and Climate Data Center (AHC) **www.aseanwater.net** for water and disaster risk management is an attempt to promote the implementation of hydroinformatics and related S&T for efficient water management and disaster risk reduction within ASEAN

Message from HAII Diretor

HAII are delighted to have you here to participate and share your expertise in the "SMART Informatics for Sustainability" workshop on March 21 - 23, 2018 at Royal Orchid Sheraton, Bangkok, and field visit to good practices community in Tak, Thailand. This workshop will strengthen the connectivity among water, weather and disaster experts in ASEAN region and will illustrate the understa nding of informat

Dr.Sutat Weesakul,
Director of HAII

ics implementation towards sustainability through the ASEAN Hydroinformatics and Climate Data Center (AHC) project.

There are countless ways for you to get involve and maximize benefit from AHC such as sharing information, matching technologies, joint R&D activities and etc. I encourage you to take advantage of all that we offer during your time here. Prepare yourself to be challenged, excited and inspired for our collaboration in the nearest future. Sincerely yours,

About ASEAN Hydroinformatics and Climate Data Center (AHC)

Background

On 8 March 2017, Ministry of Science and Technology (MOST) of Thailand by Hydro and Agro Informatics Institute (HAII) hosted the Workshop on Establishing ASEAN Hydroinformatics and Climate Data Center (AHC) to support Water Resource Management System in ASEAN. Participants of the workshop agreed in the concept of 1) S&T implementation 2) strategic data sharing related to water data, tools and ICT infrastructures 3) capacity building in transferring S&T for data management and sharing water-related experiences 4) good practices by creating sustainable community water resource management and 5) collaboration network to regional and international level.

Later in May 2017, the ASEAN Hydroinformatics and Climate Data Center (AHC) Project, proposed by HAII, has been approved as a new project under Sub-Committee on Microelectronics and Information Technology (SCMIT) at the 46th SCMIT meeting and endorsed by the 72nd ASEAN Committee on Science and Technology (COST) Meeting in Brunei Darussalam. The project will be a platform to support data connectivity from ASEAN's water, weather and disaster related agencies. ASEAN Member States can also share knowledge and experiences related to water, weather and disaster and also match technology that could support AHC in data sharing toward its future operation and implementation.

What is ASEAN Hydroinformatics and Climate Data Center (AHC)?

ASEAN Hydroinformatics and Climate Data Center (AHC) is a data-driven initiation to enrich the significant of Information Technology (IT) tools to integrate data from various sources within ASEAN region. The centralized information will enhance the accuracy of existing forecasting system which will benefit to all related partners. The project will create monitoring and modelling system to increase situation awareness for proper decision support. The information derived from this center will be a data visualization platform in a visual context to provide better preparedness and solution to solve the unprecedented.

AHC also focus on the implementation and dissemination of the outcome by generating actionable learnings and promoting practical use of IT at community level to raise community action on disaster awareness and preparedness. This will also contributes to the inspiring UN's Sustainable Development Goals and ensure a safer forthcoming for ASEAN. For more information, please visit AHC official website at www.aseanwater.net

Toward regional and global agenda

AHC will be the fundamental tools for ASEAN region to accomplish the UN 2030 Sustainable Development Agenda and the ASEAN Vision 2025 by implementing it at the community level. In Thailand, HAII has introduced hydroinformatics concept to the policy level and started the implementation work from the local level by using the concept of Community Water Resource Management (CWRM). The concept included community involvement of learning to utilize hydroinformatics to create efficient water management. Thailand, by HAII, has more than 10 years of expertise in community-based water resource management and has currently expanded their CWRM network to cover more than 1,200 communities within Thailand. The participated communities also find solutions that best suited to each circumstance to cope with the changing climate.

Through trial and error, Thailand has eventually find the right solution for the country. Hence, Thailand would like to share their experiences to other ASEAN fellows in accordance with the ASEAN vision to "Leave No One Behind".

ASEAN Hydroinformatics Center (AHC)

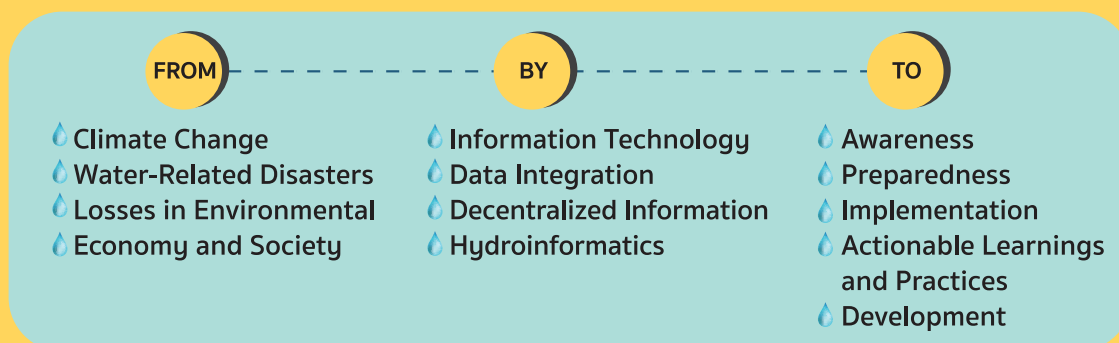**for Water and Disaster Risk Management**

What is Hydroinformatics?

The application of information and communications technologies (ICTs) in addressing the increasingly serious problems of the equitable use and efficient management of water for various purposes including social context and related disasters.

www.aseanwater.net

a first step to NEXUS ready

FROM - - - - - - **BY** - - - - - - **TO**

FROM	BY	TO
Climate Change	Information Technology	Awareness
Water-Related Disasters	Data Integration	Preparedness
Losses in Environmental	Decentralized Information	Implementation
Economy and Society	Hydroinformatics	Actionable Learnings and Practices
		Development

We aim

» ASEAN Center of hydroinformatics and related technologies for water and disaster risk management
» A platform for Information and knowledge sharing and collaboration in collecting, integrating and sharing relevant information among ASEAN
» A networking of partners determining to strengthen ASEAN capacity in water and disaster risk management, and climate change adaptation

We do

» To promote the implementation of hydroinformatics and related technologies for efficient water management and disaster risk reduction within ASEAN
» To share and broaden country's learnings, experiences and good practices through active networking and collaboration
» To strengthen capacity in applying hydroinformatics among ASEAN member states

Beneficial to all ASEAN

• **Economic** : cost-effective method to reduce losses in water and disaster recovery
• **Social** : community-based organization and learning network
• **Environmental** : solve the future water scarcity and ensure sustainability
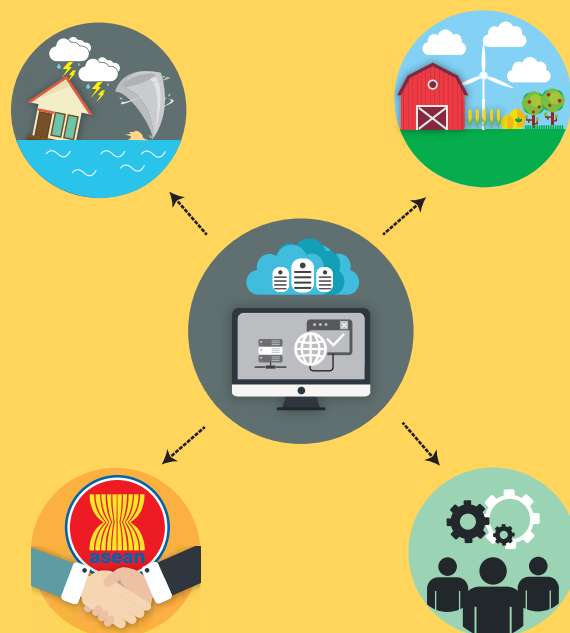
Workshop General Information

S: Synergy   **M**: Management   **A**: Accurate   **R**: Real-time   **T**: Technology

Workshop on SMART Informatics for Sustainability

The Workshop on "SMART Informatics for Sustainability" is one of the workshop held during the "ASEAN NEXT 2018: Rising STI Networking for Innovative ASEAN". It organizes by the Ministry of Science and Technology, the Kingdom of Thailand and Hydro and Agro Informatics Institute (HAII). It held during 21 - 23 March 2018 at the Royal Orchid Sheraton Hotel, Bangkok and Huai Pla Lod Community, Tak Province. The workshop have been considered as a regional initiative to increase SIT cooperation within ASEAN.

Turning information into action

HAII hosts this workshop to discuss how cooperation between ASEAN members on the gathering of information from tools, technologies and innovation in order to take action to tackle a range of global challenges such as climate change, food security and sustainability.

This workshop aims to convey the work and process of information integration from tools and technologies for climate and water resources management. It raises and answers questions on the current vision for ASEAN cooperation, how the regions cooperate and what is the way forward.

This workshop is also intended not only to reinforce strategic partnership in the areas of science and technology, water, weather and disaster, but also to further intensify joint research, which will brings mutual benefits for all participants. In conclusion, the outcome will bring the contribution in technology matching, knowledge sharing, capacity building and connectivity among AMS for the ASEAN Hydroinformatics and Climate Data Center (AHC) project.

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Format of the Event

This three-day event consists of one day workshop and two days field visit. The workshop on 21 March 2018 is divided into three sessions for deeper understanding and discussion on role of S&T in various areas such as; global and regional trend, ASEAN informatics, and country showcase & demonstration. The invited speakers are experts in the field of informatics, climate change, and water management.

Session 1
Global and Regional Trend

The session will expose the participants to the world outlook and regional framework on informatics synergy towards sustainability by experts from well-known organizations on climate change adaptation and water resource management.

Session 2
ASEAN Informatics

This session will focus on understanding and increasing awareness of informatics implementation within ASEAN region, especially hydroinformatics and its application and operation system in Singapore, Vietnam and Thailand.

Session 3
Country Showcase & Demonstration

This session will focus on technology sharing and demonstrating ongoing research effort, lessons learned and matching interest of ASEAN Member State (AMS) on S&T implementation toward disaster risk reduction and sustainability. In conclusion, there will be an exchange point of view to determine the way forward of AHC project.

Field visit

On 22 – 23 March 2018, participants will experience a tangible good practice site in community level where they are able to apply science and technology into their living and enriching their life. The field visit will be held at Huai Pla Lod Community, Tak province. It is located in the forest area of northwest of Bangkok, time travelling approximately 5.5 hours by van. The local people are the Black Muser hill-tribes who live in the forest area.

This community is one of a great showcase of Public – Private and People Partnership that enable local people to learn and adapt themselves to achieve water, food and energy security.

Time	Agenda Item	Speaker
Wednesday 21st March 2018 **Workshop on SMART Informatics for Sustainability (hosted by HAII)** **Venue: Ballroom 2, Royal Orchid Sheraton Hotel**		
08:30 – 09:00	**Registration**	
09:00 – 09:05	**Welcome Address**	**Mr. Pathom Sawanpanyalert** *Deputy Permanent Secretary Ministry of Science and Technology, Thailand*
09:00 – 09:05	**Photo Session**	
09:20 – 09:30	**Introduction to ASEAN Hydroinformatics and Climate Data Center (AHC)**	**Dr. Sutat Weesakul,** *Director, Hydro and Agro Informatics Institute (HAII), Thailand*
09:30 – 09:45	**Coffee Break**	
09:45 – 10:30	**Session 1: Global Experiences on Informatics Synergy towards sustainability**	**Keynote speakers** » *Global Service on Climate Prediction and Adaptation for Sustainability* **By Dr. Chung Kyu Park** *Director, Regional Office for Asia & the South-West Pacific World Meteorological Organization (WMO)* » *Towards Sustainable Climate Information Services* **By Dr. Hyunrok Lee** *Team Leader, Information Service Team APEC Climate Center (APCC)* » *Bridging the Gap between Science and Policies for Disaster Risk Management and Resilient Development* **By Dr. Peeranan Towashiraporn** *Chief of Party, SERVIR-MEKONG ASIAN Disaster Preparedness Center (ADPC)*
10:30 – 10:45	**Q & A**	
10:45 – 11:30	**Session 2: ASEAN Informatics**	**Keynote speakers** » *Capture opportunity of big data and advanced analytics for SMART operational urban water management systems* **By Dr Jair Smits** *Managing Director Hydroinformatics Institute Pte. Ltd., Singapore* » *Some features of research and application of climate models, hydrology at Institute of Hydrometeorology and Climate Change* **By Mr. Vo Dinh Suc** *Researcher, Department of Science, Training and International Cooperation Viet Nam Institute of Meteorology, Hydrology and Climate Change (IMHEN), Vietnam* » *S&T for Water Management focusing on applying Hydroinformatics for water resource management* **By Dr. Surajate Boonya-aroonnet** *Director, Hydroinformatics Division, Hydro and Agro Informatics Institute (HAII), Thailand*
10:30 – 10:45	**Q & A**	
11:45 – 13:00	**Lunch**	

Time	Agenda Item	Speaker
13:00 – 15:30	**Session 3: Country Showcase & Demonstration** *Knowledge sharing and demonstration on "SMART Informatics in operation towards sustainability"*	**Keynote speakers** » **Ms. Thitiporn Meeprasert,** *HAII, Thailand* » **Mr. Lap Bui Dinh,** *NHMS, Vietnam* » **Mr. Morni Mamat,** *FRDM, Malaysia* » **Dr. Serene Tay,** *H2I, Singapore* » **Mr. Chiam Shiun Shu,** *DID, Malaysia* » **Mrs. Irina Rafliana,** *LIPI, Indonesia* » **Mr. Hoang-Anh Nguyen,** *IOIT, Vietnam* » **Mr. Alvin E. Retamar,** *DOST-ASTI, Philippines* » **Mr. Weeraphong Phimsarn,** *Mattayom Suwitserianusorn School, Thailand* » **Mr. Quang Hung An,** *Disaster Management Policy and Technology Center, Vietnam*
15:30 – 15:45	**Coffee Break**	
15:45 – 16:30	**Way forward to ASEAN Hydroinformatics and Climate Data Center (AHC) and Closing Remarks**	» *Contribution (Knowledge sharing, Technology matching and Capacity Building)* **By Dr. Sutat Weesakul** *Director, Hydro and Agro Informatics Institute (HAII)*
Thursday 22nd March 2018 **Visit Good Practices site on Community Water Resource Management: Huai Pla Lod Community, Tak Province**		
07:00 – 14:00	**Departure from Hotel, Bangkok to Rajamangala University of Technology Lanna, Tak Campus including lunch at Ban Pak Rak Tawan Restaurant, Tak Province**	
14:00 – 14:30	**Break**	
14:30 – 14:40	**Welcome Address**	**By Mr. Charoenrit Sa-nguansat** *Governor, Tak Province* **Maj. Gen. Supachok Tawatpeerachai** *Deputy Commander, The Third Army Area*
14:40 – 16:00	**"Collaboration in Water Management following H.M. The King's initiative Ban Huai Pla Lod"** **Venue: Payom Room, 2nd Floor, Faculty of Engineering, Rajamangala University of Technology Lanna, Tak Campus**	**By Dr. Royboon Rassameethes,** *Deputy Director, HAII* **Mr. Suthon Weingdow,** *Super Intendant of Taksin National Park* **Mr. Chakkrapong Mongkolkiri,** *Former Head of the Village (2007-2011)*
16:00	**Travel to White House Hotel, Tak Province**	
18:00	**Dinner at Iyara restaurant, Tak Province**	

Time	Agenda Item	Speaker
Friday 23ʳᵈ March 2018 **Visit Good Practices site on Community Water Resource Management:** **Huai Pla Lod Community, Tak Province**		
07:00	**Breakfast**	
08:00 – 09:00	**Departure from hotel to Huai Pla Lod Community, Danmaelamoa Sub district, Mae Sot District, Tak Province** (40 kms.)	
09:00 – 09:05	**Welcome address and introduce the former heads of the village**	**By Mr. Prairat Kiratiyukkiri** *Head of the Village (2013 - present)*
09:05 – 09:15	**Introduction to Huai Pla Lod Community**	**By Mr. Chakkrapong Mongkolkiri** *Former Head of the Village (2007-2011)*
09:15 – 11:45	**Site Visit**	**» Category 1:** Huai Pla Lod Community Water Resource Management Live Museum following His Majesty King Bhumibol Adulyadej's Initiative and Automated Telemetry Station **By Mr. Chakkrapong Mongkolkiri** *Former Head of the Village (2007-2011)* **» Category 2:** Field visit on Huai Pla Lod Community Water Resource Management ● **Ecosystem** (check-dam, Agro Forestry: Live in harmony with the forest) **By Mr. Saksit Chaisomritkij** *Former Head of the Village (2011-2013)* ● **Hydroelectric power** **By Mr. Chanchai Thanompongdee** *Head of the village's assistant* ● **Integrated Agriculture** **By Mr. Jakrit Taprayoon** *Former Head of the Village (2003 – 2007)* **» Category 3: Ban Huai Pla Lod Local Market (Ong Lang)** **By Mr. Jakrit Taprayoon** *Former Head of the Village (2003 – 2007)*
11:45 – 11:50	**Departure Huai Pla Lod Community to Taksin National Park**	
12:35 – 13:30	**Lunch**	
13:30 – 14:00	**Wrap up on Water Resource Management following His Majesty King Bhumibol Adulyadej's Initiative**	
14:00 – 20:00	**Departure from Taksin National Park to Bangkok including dinner**	
Saterday 24ᵗʰ March 2018 **Visit Good Practices site on Community Water Resource Management:** **Huai Pla Lod Community, Tak Province**		
All day	**Departure of speakers and participants**	

SPEAKERS

Dr. Sutat Weesakul

Director, Hydro and Agro Informatics Institute (HAII), Thailand
www.haii.or.th

An expert in Hydraulic and Coastal Engineering, Dr. Weesakul is the Director of Hydro and Agro Informatics Institute (HAII), Thailand. He got his Ph.D. in Engineering (Hydraulic/ Coastal) from the Asian Institute of Technology (AIT), Thailand. Over 35-year experience in teaching and researches, he has been involved with many national and international projects with private sectors, government agencies and academic institutions to enhance water resources management in Thailand.

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ABSTRACT

Introduction to ASEAN Hydroinformatics and Climate Data Center (AHC)

"Hydroinformatics" is the applications of ICT in addressing the increasingly serious problems of the equitable use and efficient management of water for various purposes including social context and related disasters. Aims to deal with climate change and achieving sustainability, ASEAN Hydroinformatics and Climate Data Center (AHC) has been initiate as a data-driven initiation to enrich the significant of Information Technology (IT) tools to integrate related data from various sources within ASEAN region. The centralized information will be used for analysis, implementation and outcome dissemination to provide better preparedness and solution to solve the unprecedented in regional, national and local level. It will benefit to all ASEAN people in economic, social and environmental context. This end result will support the inspiring UN's Sustainable Development Goals (SDGs), ASEAN Vision to "Leave No One Behind" and ensure a safer forthcoming for ASEAN.

KEY MESSAGES

- "Hydroinformatics" is a key tool for water and disaster risk management.
- The accurate and reliable information leads to a better preparedness, prevention, response, recovery and sustainability.
- The involvement of ASEAN related agencies will bring ASEAN forward a resilient and sustainable community.

Dr. Chung Kyu PARK

Director of Regional Office for Asia & the South-West Pacific
World Meteorological Organization (WMO)
www.wmo.int

Dr. Park joined the World Meteorological Organization (WMO) in 2013 as the Director of the Regional Office for Asia and the South-West Pacific after 16 years of experience in the national services at the Korea Meteorological Administration (KMA) and 10 years of research experience in the U.S., including extensive work at NASA's Goddard Space Flight Center. During the tenure at KMA, Dr. Park coordinated the international cooperation for climate services under the Asia-Pacific Economic Cooperation (APEC) Climate Network (APCN) project, and contributed to the establishment of the APEC Climate Center (APCC) in Busan, Korea.

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ABSTRACT

Global Service on Climate Adaptation and Disaster Risk Reduction for Sustainability

The world is increasingly exposed to severe weather and extreme climate events amid rising global temperatures. A recent report indicates that in Asia storms had the highest impact on the number of deaths, while floods caused the greatest economic loss. The damage could have been much higher without the advancement in early warning services. Recent activities of WMO focusing on the multi-hazard early warning system as a key element of disaster risk reduction will be introduced with examples particularly from Southeast Asia, including the Severe Weather Forecasting Demonstration Projects (SWFDP) and Flash Flood Guidance System (FFGS) in this region, and the WMO Global Multi-Hazard Alert System which is under development as a platform of authoritative hydro-meteorological warnings for global users including UN Humanitarian Organizations.

ORGANIZATION PROFILE

World Meteorological Organization (WMO)

The World Meteorological Organization (WMO): As a specialized agency of the United Nations, WMO is dedicated to international cooperation and coordination on the state and behaviour of the Earth's atmosphere, its interaction with the land and oceans, the weather and climate it produces, and the resulting distribution of water resources. Through its Technical Commission, Programmes and Regional Offices as well as by synergistic partnerships, WMO facilitates the maintenance and expansion of its Members' atmospheric, oceanographic and land-based observational networks; the free unrestricted exchange of the resulting data and information; and related capacity development and research in order to optimize the production weather, climate and water-related services worldwide.

Dr. Hyunrok Lee

APEC Climate Center (APCC)
www.apcc21.org

Dr. Hyunrok Lee is the leader of the Information Service Team at the APEC Climate Center (APCC) and is responsible for APCC's operation and management of its Climate Information Service and the development of Climate Information Service Platform. Dr. Lee completed his Ph.D. in Computer Science at the Korea Advanced Institute of Science and Technology (KAIST). His research interests are information system modeling, software performance engineering, and climate service platform design. Before joining APCC, he served as a researcher at the Electronics and Telecommunications Research Institute (ETRI), a research institute funded by the Korean government.

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ABSTRACT

Towards Sustainable Climate Information Services

The World Meteorological Organization (WMO) defines climate services as the provision climate information tailored to the user's needs. Based on the demand of end users in the Asia-Pacific region, APEC Climate Center (APCC) provides various climate services through its website such as the climate outlook, CLimate Information toolKit (CLIK) for customized climate prediction information, and the APCC Data Service System (ADSS) to provide digitized raw climate data, amongst others. The presentation will introduce APCC's key climate service, CLIK, and the processes and major achievements of the Republic of Korea-Pacific Islands Climate Prediction Project (ROK-PI CLIPS) which has been developed to create sustainable climate services. The ROK-PI CLIPS project aims to strengthen the adaptive capacity of communities vulnerable to climate risks at the seasonal timescale.

ORGANIZATION PROFILE

APEC Climate Center (APCC)

The Asia–Pacific Economic Cooperation Climate Center (APCC) aims to contribute to the economic growth and prosperity in the Asia Pacific region, support the protection of lives and property, minimize economic losses, and enhance economic opportunities. APCC promotes the socioeconomic well-being of the region by utilizing up-to-date scientific knowledge and applying innovative climate prediction techniques through its three main pillars of work: (1) climate prediction & climate information services; (2) climate information application & climate change response; and (3) capacity building.

Dr. Peeranan Towashiraporn

Director of Geospatial Information, Asian Disaster Preparedness Center (ADPC)
www.adpc.net

Dr. Peeranan Towashiraporn works as a Director of the Geospatial Information department at ADPC. His main area of focus is using science to address challenges related to disaster risk management, including quantification and mapping of disaster risk, and linking geospatial technology to disaster preparedness and response. In recent years, he has taken parts in projects to identify and map disaster risk in many countries in Asia. He is now leading a project SERVIR-Mekong, promoting uses of geospatial information to address various challenges, including hydro-meteorological disasters, in the Lower Mekong region.

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ABSTRACT

Bridging the Gap between Science and Policies for Disaster Risk Management and Resilient Development

Science and technology provide tools that will help governments handle disasters more effectively. Quantitatively understanding disaster risk often requires scientific models to mimic natural phenomenon such as floods and their consequences to the society, assets, people, and the environment. The results guide disaster managers in preparing for and mitigate the impact of these events before they take place. Geographic Information System and remote sensing techniques are often used in the mapping of hazard frequency and severity. Applications of science and technology offer strong potential in making disaster risk management more effective. The main challenge is on getting policy makers to buy into the use of scientific approaches for practical disaster risk management. This requires that the messages on science and technology are conveyed appropriately to policy makers. More importantly, linking science and technology with policies goes beyond just producing credible scientific evidence and extends into continuous engagement with users to build capacity sustainably. The talk provides some good examples in bridging the science and policies.

ORGANIZATION PROFILE

Asian Disaster Preparedness Center (ADPC)

Established in 1986, ADPC is an independent regional organization working to support countries in disaster risk management and climate resilience through use of scientific approach to inform decision making in developing systems for disaster risk management and apply them on the ground.

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Jair Smits

Managing Director, Hydroinformatics Institute (H2I)
www.h2i.sg

Mr. Smits is passionate about water and innovation in the urban environment, Co-Author of 'Healthy Cities' and Managing Director of Hydroinformatics Institute (H2I).

He is an experienced project manager and a Dutch professional civil engineer with a master degree in water resources manage- ment from the Delft University of Technology. Mr. Smits has been working in Singapore for over 5 years. He is project director and advisor of all H2I projects, including: rainfall radar prediction project for Singapore, operational water management system mainte- nance project for coastal and inland waters of Singapore.

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ABSTRACT

Capture opportunity of big data & advanced analytics for SMART operational urban water management systems.

In urban environments, a large increase in the use of sensor networks facilitating data collection resulted in a shift towards so-called Smart City paradigm. The literature claims that the implementation of data rich, intelligent infrastructure will lead to vast improvements in the urban environment. Clearly, the data collected within (Smart) Cities may be extremely beneficial in informing local decision-makers.However, data itself does not constitute value. True value of the data needs to be derived through high-level processing of raw observations and fusion with the physical, biological and chemical sensing of the city. This talk describes a number of innovative approaches to harnessing big city data, which form a new versatile water mana- gement modelling instrument which not only supports SMART operational water management, but also decision making processes and dissemination of information to public during disasters.

ORGANIZATION PROFILE

Hydroinformatics Institute (H2I)

Hydroinformatics Institute (H2I), established in 2014, is a specialist company providing service solutions and specialist consulting services in the fields of hydrodynamics, hydrology, water quality, and operational water management systems. H2I is established with the purpose of leveraging on the potential of big data and state-of-the-art computing for better inland and coastal water management.

Vo Dinh Suc

Researcher, Vietnam Institute of Meteorology, Hydrology and Climate Change, Vietnam (IMHEN)

I was born in Nghe An Province in 1981. I graduated from the University of Natural Sciences, Hanoi National University in 2003, specializing in ecology, landscape and environment. After that, I started working for the Center for Agricultural Meteorology - Vietnam Institute of Meteorology, Hydrology and Climate Change. From 2007 to 2009, I studied and received a master's degree in geography.

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ABSTRACT
Some features of research and application of climate models, hydrology at Institute of Hydrometeorology and Climate Change

Vietnam Institute of Meteorology, Hydrology and Climate Change (IMHEN) is the leading research institute in Vietnam for research on meteorological, hydrological and climate change issues. Accordingly, the application of climate, hydrological and environmental models is one of the tasks of IMHEN, in this presentation I would like to introduce the models that have been and are being applied at IMHEN (models for Weather forecasting and climate forecasting, models for Hydrological forecasting; models for marine forecasting, models for environmental forecasting and models for agro-meteorological forecasting). In addition, some international cooperation projects and some urgent tasks assigned, IMHEN used models with the support of foreign experts to apply new models to Vietnam's specific conditions.

ORGANIZATION PROFILE
Vietnam Institute of Meteorology, Hydrology and Climate Change (IMHEN)

Vietnam Institute of Meteorology, Hydrology and Climate Change (IMHEN) is a governmental research institute under the Ministry of Natural Resources and Environment (MONRE). It's functioning in scientific research and technological development of meteorology, climatology, climate change, agricultural meteorology, hydrology, water resources, marine hydrometeorology and environment; postgraduate training in meteorology, hydrology and environment.

The Institute of Meteorology and Hydrology (IMH) was established in 1977 as a research agency of the General Hydro-meteorological Service of Vietnam (GHMS). In 2002 with the formulation of MONRE, IMHEN had been expanding functions and mandates of a leading research institution in the assigned fields in MONRE. IMHEN has acquired its current name since 2014.

Dr. Surajate Boonya-aroonnet

Director of Hydro Informatics Division
Hydro and Agro Informatics Institute (HAII)

Dr. Boonya-aroonnet has long experiences in hydroinformatics and modeling of water resource systems. He is competent in developing the operational weather and flood forecasting system and also skilled in integrating simulation results with GIS to assess risks or estimate damages of flooding. He is also capable of using technologies to acquire hydrological and geometry data e.g. telemetry, remote sensing, river surveying and automation, UAV for flood mapping.

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ABSTRACT
S&T for water management focusing on applying hydroinformatics for water resource management

Thailand has long encountered variety of water-related problems and disasters such as water scarcity, flooding, and water pollution which interfere the economic wealth and social growth of the country. HAII's emphasis is to develop and apply S&T knowledge of informatics for both agricultural and water resources management. Therefore, this presentation will demonstrate how hydroinformatics was implemented in Thailand which includes the integration and implementation of advanced computational science, data mining, machine learning, High-Performance Computing (HPC), software developing, and communicating technologies, with high quality and large quantity of near real time observation data. Currently, terabyte servers and HPC are in-used in clustering format to process the flood and weather models; store big data sets such as Thailand telemetering data, geoinformatics data, and the data cooperated with relative 35 water resources and weather related agencies on hydroinformatics data warehouse through National Hydroinformatics and Climate Data Center. (NHC)

ORGANIZATION PROFILE
Hydro and Agro Informatics Institute (HAII)

Hydro and Agro Informatics Institute (HAII), a public organization under the Ministry of Science and Technology was originally established in 1998 by the initiative of the King Bhumibol Adulyadej aiming to develop a coherent plan to improve water resources management in Thailand by setting up the process of data gathering and forming research and development networks among various organizations to collectively contribute in all aspects of water resources management.
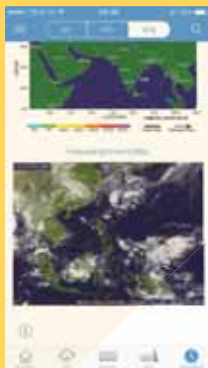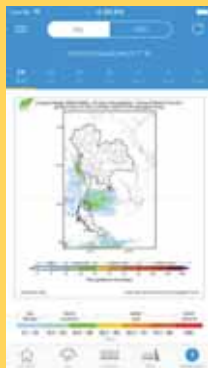
D

EMONSTRATORS

ThaiWater Mobile Application

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Hydro and Agro Informatics Institute (HAII), Thailand

ThaiWater
M o b i l e   A p p l i c a t i o n

The application is available on both iOS and Android platform.

 App Store   ▷ Google Play

Abstract:

ThaiWater Mobile Application, designed and developed by Hydro and Agro Informatics Institute (HAII), simplifies the real-time information derived from the comprehensive www.thaiwater.net web-based platform and visualizes water and weather situation in Thailand into an easy to understand format. The application is an extension of the National Hydroinformatics and Climate Data Center (NHC) for public access on mobile platform aiming at self-awareness on water and weather situation monitoring. Information on ThaiWater application includes rainfall, water level, dam level, storm tracking, forecasting, and country-wide water situation. The users can also report the situation and share with others via this application. The favorite location can also be set for convenient use.

Application of tools and technologies:

» Mobile technology
» Internet
» Visualization

Applying Remote Sensing Technology in flood forecasting and warning systems in Viet Nam

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The National Centre for Hydro-Meteorological Forecastings (NCHMF), Viet Nam

The National Centre for Hydro-Meteorological Forecastings (NCHMF) is a public-profitable organization which belongs to the National Hydro-Meteorological Service (HMS), Ministry of Natural Resources and Environment (MONRE). NCHMF is Vietnams weather and climate authority, responsible for protecting life, property, and national security.

Abstract:

This presentation aims to share knowledge and experiences on improving flood forecasting and warning systems through satellite-based technology and information and communication technology.

System Overview

»*Target Area :*
the Red River basin in Vietnam
»*Pilot area :*
Ha Hoa District in Phu Tho Province
»*System Configuration (figure1) :*
overview of the flood forecasting and warning systems on the Red River basin

Application of tools and technologies:

» GSMaP Calibration
» The Water and Energy Budget based Distributed Hydrological Model (WEB-DHM)
» Web-GIS
» SMS for flood early warning dissemination
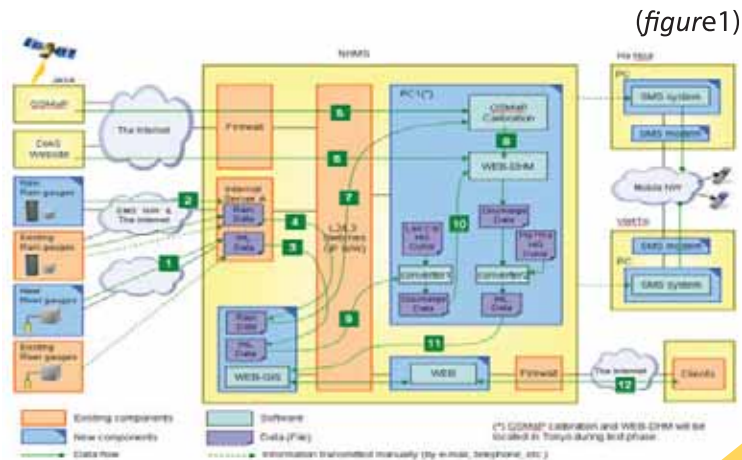
(*figure*1)

Information flow

» GSMaP data is obtained from JAXA server to the PC in NHMS via the internet.
» Rain data from rain gauges is transmitted to NHMS via SMS and the internet and stowed in the internal server.
» Water Level data from river gauges is transmitted to NHMS via some kind of media and stowed in the internal server.
» Rain data and Water Level data are transferred from the internal server A to WEB-GIS server.
» GSMaP Calibration obtains Rain data from WEB-GIS server.
» Calibrated GSMaP data is transferred to WEB-DHM.
» Discharge data output from WEB-DHM is converted to water level data by converter-2 software.
» SMS messages are generated by SMS systems in Ha Hoa or Viet Tri.
» WEB-GIS server presents rain data, water level data and prediction of water level to clients of government officers via web access.

FRDM: Managing flood and drought in Malaysia

Morni Mamat
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💼 ***Fire and Rescue Department of Malaysia (FRDM), Malaysia***

Fire and Rescue Department of Malaysia is the main organization in rescue work in Malaysia. Operation Division is the back bone to Fire and Rescue of Malaysia to handle flood and drought. All 13,000 fire fighters are well trained to handle such disaster at any circumstances, supported by strong logistic equipments and rescue apparatus such as Mi-17-IV helicopter.

Abstract:

Pre-incident planning and response time procedure is most important thing to be considered during flood and drought occurred. There for, FRDM has co-operate with other government agencies to mitigate risk and lost when it happen. Information gathering is the critical element while disaster happens. Latest application may help rescue team to mobilize rescuer and logistic to the site as soon as possible in order to reduce life lost.

Remote area may become time obstacle to the rescue team reach the place in time. Community Fire Team and Volunteer Fire Fighters in that particular area are considered as response time to the FRDM. Head of the village in the community will relay the message to the FRDM request help to curb the disaster. In grey area that cannot be reached by cellular telephone or government inter radio network (GIRN) satellite phone is one of the option to solve the problem

NEPTUNE Singapore's coastal water quality monitoring and prediction system

Serene Tay
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Hydroinformatics Institute (H2I), Singapore

The Hydroinformatics Institute (H2I) was established in June 2014 with the purpose of developing, executing and managing specialist consultancy projects in the fields of monitoring, hydrodynamic modelling, water quality modelling and operational management systems. The team from H2I has extensive experience in research and specialist consultancy projects in Singapore, including numerical modelling using SOBEK and Delft3D and the setup and maintenance of integrated modelling systems and operational management systems at PUB and NEA

Abstract:

NEPTUNE is an operational management system for Singapore coastal water quality monitoring and prediction initiated and managed by National Environment Agency (NEA), Singapore. NEPTUNE integrates hydrodynamics and water quality modelling using eight specially outfitted buoys that act as miniature labs. The buoys continuously collect data on pollutants, including oil and nutrients, and send live updates to the authorities on how these could spread. They also monitor coastal waters for other abnormalities. The high resolution 3D models, which have more than 36,000 active grid cells, capture the complex tidal interac-

tions in the Singapore and Johor Straits, allowing NEA to predict the impact of coastal incidents in the marine environment. This has bearing on marine ecosystems, including corals, mangroves and other living organisms, and industries like aquaculture and tourism. Since 2014, H2i has been responsible for the maintenance of NEPTUNE system for NEA.

Application of tools and technologies:

» Operation Management System
» Delft-FEWS
» Delft3D modelling software
» WFlow hydrological model

References

http://www.h2i.sg/project-neptune/

Implementation of Integrated Water Resource Management in Malaysia

Chiam Shiun Shu
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Department of Irrigation and Drainage Malaysia (DID), Malaysia

The Department of Irrigation and Drainage Malaysia (DID), Ministry of Natural Resource & Environment (NRE) aims to lead the Engineering Expertise Services and National Water Resources Management. Its mission to provide engineering expertise services and water resources management including river management, coastal and manage flood and drought in holistic way to improve citizens life in the context of water security and environment sustainability. Today, the DID's duties encompass:

- » River Basin Management and Coastal Zone
- » Water Resources Management and Hydrology
- » Special Projects
- » Flood Management
- » Eco-friendly Drainage

Abstract:

Due to effect of the El Niño, La Niña effect and climate change, Malaysia has faced more frequent flood and drought. Malaysia government have adopted the Integrated Water Resource Management (IWRM) concept to manage our water resources. IWRM is a process, which deals with re-allocating water, allocation of financial resources, and in the implementation of environmental goals. The

"National Water Balance Management System (NAWABS)" and "National Flood Forecasting and Warning Program (PRAB)" have been developed as a management instruments. Both of the modelling systems can give a very comprehensive output results. **NAWABS system** can provide 9 outputs including "Water Accounting", "Water Availability", "Water Demand Options", "Water Prioritization and demand management options", "Water Allocation", Water Quality", "Water Storing and releasing during high and low flows", "Water Resources Index (WRI) and Drought index (DI)" and "Water Auditing". It also provides 2-month water balance forecast, 2-week drought warning. While, **PRAB program** gives 7-day flood forecasting and 2-day flood warning.

With the strategy to "live with floods", accurate forecasting is an important tools in reducing vulnerabilities and flood risk. As a result, effective water management requires consideration of water status, involvement in land use matters and linkage to authorities dealing with land, forests, minerals and other such related resource or activity sectors. Malaysia is committed to conserve and manage its water resources to ensure adequate and safe water for all.

STEP-A : Indonesian Contribution to the First Step in Assessing and Increasing School Disaster Preparedness

— *Irina Rafliana*
(irina_rafliana@hotmail.com)

### Indonesian Institute of Sciences (LIPI), Indonesia

Organizations involved in this Web and Mobile Application are LIPI, UNESCO IOTIC, UNDP, BPPT, National Secretariat for Safe School (SMAB) and many others. This demonstration will be presented by LIPI (Indonesian Institute of Sciences). LIPI is the leading national research institution in Indonesia, with experiences in DRR research in area of geological and water-related hazards, public education and science communication.

Abstract:

The 26 December 2004 Indian Ocean tsunami showed significant impacts of fatalities and infrastructure damages. Communities including schools were utterly unprepared. It became important to understand the level of preparedness for appropriate interventions in future. In 2006, LIPI and UNESCO supported by UNISDR developed a tool to assess the tsunami preparedness level of schools based on five parameters; 1).Policy, 2).Knowledge, 3).Preparedness and Response Plan, 4).Early Warning System, and 5).Resource Mobilisation Capacity. More than 200 schools in 10 provinces in Indonesia have been assessed using this tool. With support from UNDP Regional programme and the Government of Japan, the initial web based application was improved to a convenient mobile-based application; both are now called "STEP-A". Focusing on earthquake and tsunami risk and potentially other types of hazards, it will be promoted in 18 countries across Asia-Pacific. This presentation will demonstrate the use of STEP-A in schools in Bali, Mentawai and Aceh, Indonesia.

Application of tools and technologies:

STEP-A for Android
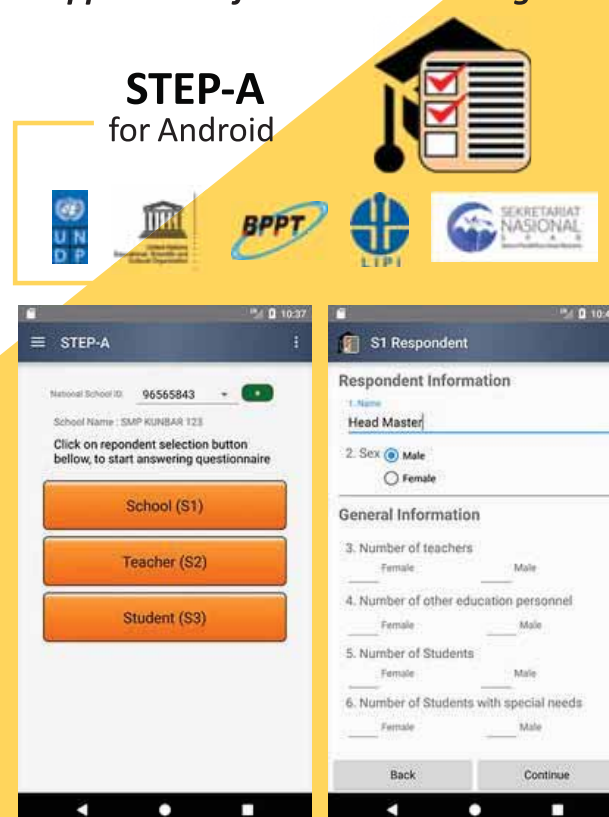
A big data software system to support state authorities to response to disaster, flood and drought preparedness and prevention and water operation

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Institute of Information Technology, Vietnam Academy of Science and Technology ,Viet Nam

Institute of Information Technology (IoIT) is a preeminent and leading research institution in the area of Information and Communication Technology in Vietnam. IoIT, established in 1976, is one of 30 national member institutes of Vietnam Academy of Science and Technology. Notable achievements of IOIT includes assembling the first PC in Vietnam (1979) and the first organization to introduce Internet to Vietnam (early 1990s).

Abstract:

Information technology plays a crucial role to a variety of applications, including response to disaster, flood and drought preparedness and prevention and water operation. Big data has been rising as a hot topic in information technology and the fourth industrial revolution. In this talk, a big data based system, aimed at supporting state agencies in charge of those areas and improve their administrations/performances effectively, is presented. Key functions and state-of-the art techniques integrated to develop this software system are described along with different usage scenarios regarding how state authorities are benefited from this system.

Application of tools and technologies:

» **Big data technologies:**
Hadoop, MapReduce, MongoDB, ElasticSearch, Spark, etc.

» **Natural language processing (NLP):**
text clustering, POS tagging, text summarization, etc.

» **Machine learning:**
deep learning, R, GATE, Weka, KNIME, etc.

Nationwide Network of Hydrometeorological Sensors and Supporting Technologies to Gather, Process, and Deliver Data for Disaster Mitigation and Response in the Philippines

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Advanced Science and Technology Institute (DOST-ASTI), Department of Science and Technology, Republic of the Philippines

DOST-ASTI is a Philippine government agency that is mandated to conduct scientific research and development in the fields of information and communication technology and microelectronics. The institute complements the Philippines' endeavor in science with intensive activities in computer and information technologies. Among its project is the development and deployment of monitoring sensors nationwide, the establishment of high speed connectivity thru a national Research and Education Network, creation of a high performance computing and data archiving facility, and the development of the country's first satellite, DIWATA-1.

ASTI STATIONS NETWORK FLOW

Abstract:

The presentation shows activities of the Philippines thru the use of locally developed technology to mitigate and respond to weather-related disasters. Thru DOST-ASTI, more than 2,000 hydrometeorological stations have been deployed to gather relevant data at predetermined intervals. These data are transmitted to a central repository using cellular network which covers most of the country. The data are distributed thru a high speed network to users who generate value by inputting the data into models and algorithms to generate forecasts and support decision-making. Computing and storage facilities are also available to ensure that data are properly kept for future use. The data are also presented in a website that is accessible to stakeholders. Satellite imagery are also available to complement sensor data. Community warning systems will also be installed to issue timely warnings to the public. In this presentation, the Philippines illustrates the use of multiple technologies to gather, process, distribute, and store data for use in disaster mitigation and other applications.

Role of SCHOOLS in solving environmental problems in the community

Weeraphong Phimsarn
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Mattayom Suwitserianusorn School, Bangkok, Thailand

Abstract:

Although schools in Thailand are established within the community to educate local people, education cannot response to the changing environment within the community accordingly. Mattayom Suwitserianusorn School foresees the importance of integrated education which will improve life and social well-being within the community. The school has managed to learn with the community, companies and Utokapat Foundation by joint design and integrated all the subjects in the school. The integrated knowledge will help students develop skills and create over 50 new products and innovation to solve problems within the community.

Application of tools and technologies:

Human-power water turbine to add more oxygen into the canal

Semi-automatic system water hyacinth collecting machine

Weather tracker

Framework:

Students

1
» understand local context
» identify environmental problems
» analytical skill
» design solutions

2
Teachers give advice and recommendations

3
Local experts support and suggest by using local wisdom

4
Learning process / integrated study skill

5
New innovation

Space technology application for disaster management in Vietnam

An Quang Hung
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Disaster Management Policy and Technology Center (DMPTC) , Viet Nam

Disaster Management Policy and Technology Center (DMPTC) is under the Viet Nam Disaster Management Authority (VNDMA) – belong to Ministry of Agricultural and Rural Development of Vietnam (MARD). DMPTC has functions which are supporting, implementation of State Management and specific Task in Natural Disaster Prevention, Mitigation and Climate Change Adaptation across the country.
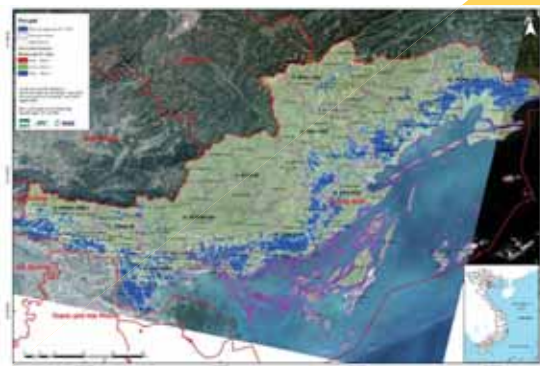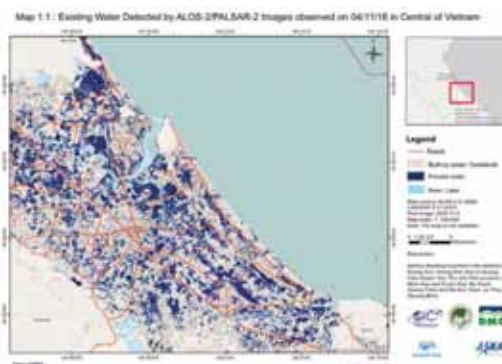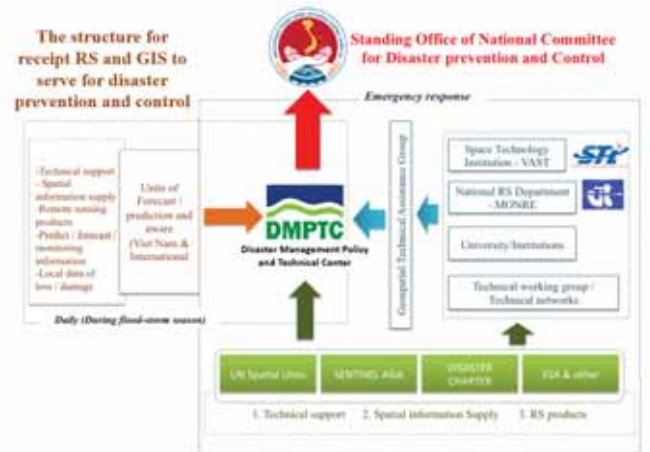
Abstract:

Disaster Management Policy and Technology Center (DMPTC) started to apply space technology and Remote sensing for disaster management from 2013. We tried to connect the government agency with the technical organization in national and international to make technical support for disaster activities in Vietnam. We have pilot for quick assessment flood situation in Quang Ninh in 2015 using SAR images from Sentinel 1. The second pilot was made the drought map for drought situation in Highland and North center of Vietnam in 2016. The two pilot result also gives the potential for using remote sensing and GIS to support for disaster management activities in Vietnam.
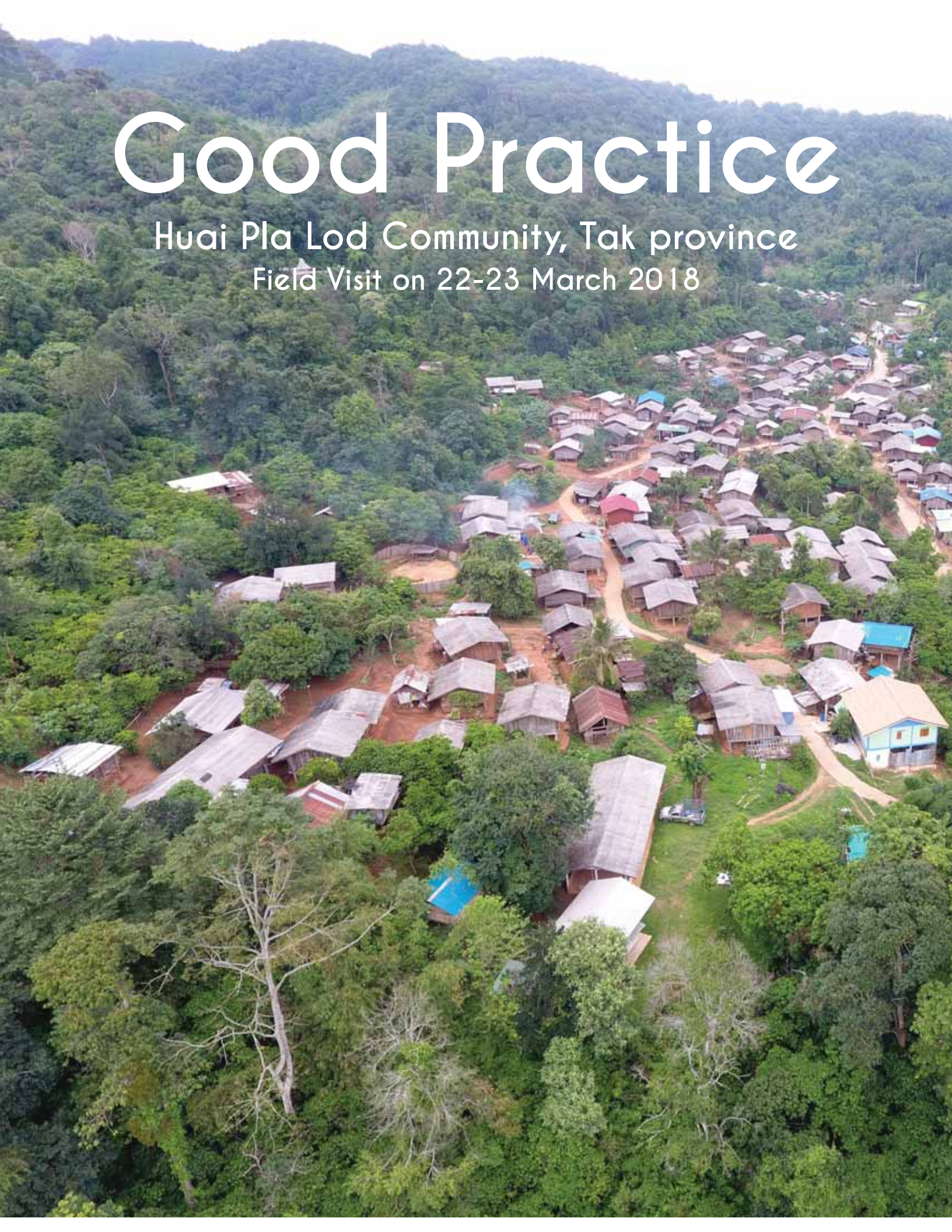
Application of tools and technologies:

» Flooding maps base on satellite images
» Drought maps base on satellite images

Good Practice

Huai Pla Lod Community, Tak province
Field Visit on 22-23 March 2018

Community-based Water Resource Management Huai Pla Lod community

General information of Huai Pla Lod community 🌱

» Location: Dan Mae Lamao sub-district, Mae Sod district, Tak province

» Population: 1,013 people in 255 households of Black Muser hill tribe people

» Area: 36.69 km² in west Salween river East of Ping river and Moei River basins

Land use

0.62 km² (1.7%) **of agriculture** (389.55 Rai)

0.54 km² (1.49%) **of habitat** (340.38 Rai)

0.59 km² (1.62%) **of graveyard** (370 Rai)

5.85 km² (15.97%) **of farming** (3,655.44 Rai)

26.46 km² (72.22%) **for agroforestry** (16,534.48 Rai)

1.84 km² (5.01%) **of forest preservation** (1,148.12 Rai)

0.56 km² (1.53%) **of Public area** (351.44 Rai)

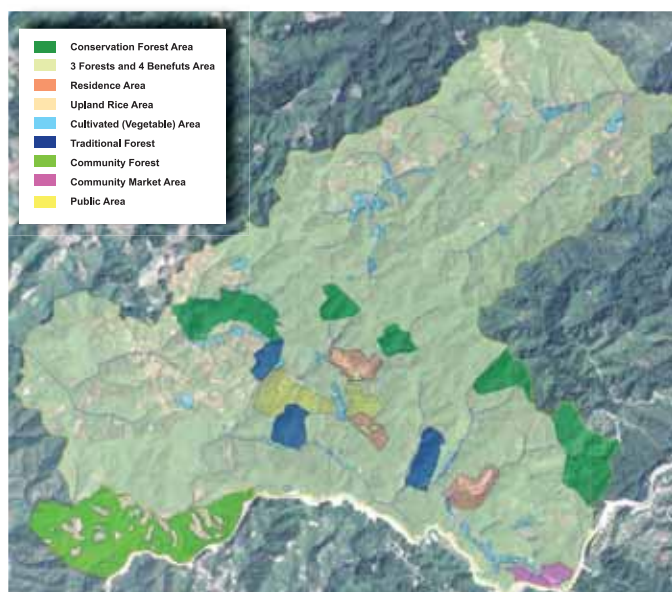0.17 km² (0.46%) **of Local market** (105.77 Rai)

Success factors

» Build local capacity to apply science and technology for integrated natural resource management: soil, water and forest.

» Strengthen Public-Private and People (Community) Partnership (PPPP)

Challenges

» In the past, the Black Muser people in the community did not value the forest. They lived by growing opium, practiced mono crop and shifting cultivation. So, they suffered from deforestation, barren soil and regular drought. People disputed over water for consumption and agriculture production.

» January 1974, H.M. the King Bhumibol visited Huai Pla Lod and nearby communities. He gave advice to the villagers to conserve the forest by applying "3 Forest and 4 Benefits (Agroforestry)" concept, e.g. change in cultivation product from opium to other economic crops such as coffee.

» In 1981, the Huai Pla Lod community area was reclaimed by Taksin Maharat National Park. Musers realized that they need to restore the forest otherwise their land would be expropriated. However, despite community afforestation efforts, people still suffered from lack of water, soil degradation and insufficient income.

Conservation Forest Area
3 Forests and 4 Benefits Area
Residence Area
Upland Rice Area
Cultivated (Vegetable) Area
Traditional Forest
Community Forest
Community Market Area
Public Area

Achievements

» Yearlong income earning from local agricultural products such as Arabica coffee, bamboo shoot, Indian gooseberry, and Chayote.

» Optimum use of every drop of water: Water from protecting watershed area have been used for consumption in 225 households, generating hydropower electricity, 3 kilowatts, for street light, and then reuse the water for agriculture in downstream area, area of 0.62 km^2. Muser market for selling local agricultural products without middleman.

» Income earn from the market approximately 20,000 – 35,000 baht per month per household. The cash-flow within the community around 14.4 million baht per year.

Approaches

» Upstream forest rehabilitation and Community Water Resources Management (CWRM) by built over 400 check dams to increase absorption of water by the forest

» S&T application for water resource management and water balance analysis

» Zoning for community forest and conservation forest

» Change agricultural pattern and create crop calendar:
    Community changed their agricultural pattern by using crop calendar and utilized the concept of Agroforestry and Sustainable Forest Rehabilitation to restored the forest and maintain the balance of the nature while planting trees for household use and cultivating agricultural products for food and income.

S&T for development

» Global Positioning System (GPS) to map water resources, water infrastructure, and community's zoning.

» Water balance analysis and crop calendar.

» Check dam system and impounding dam to increase water storage.

» Development of upstream forest conservation framework and regulations.

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