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APEC Capacity Building Workshop on Climate-Smart Agriculture by Using Geospatial Data and Earth Science Technology

APEC Policy Partnership for Science, Technology and Innovation

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1. Introduction

The workshop promoted a concept of climate-smart agriculture among policy makers and stakeholders in order to support the economic growth, social capital asset and human well-being of the people and deepen the spirit of community in the Asia Pacific to build on and complement the work of other relevant regional and global institutions for the climate-smart agriculture. The innovation sharing was in special techniques with solid methodology and demonstrates basic concept, case studies and implements the new approaches to transform traditional agriculture to be 'smart' within the region. APEC member economies were encouraged to join the project. The participants were encouraged to share new approaches to solving climate extreme issues on agricultural management and acknowledge innovative technological applications as well as having opportunity to participate in the project via knowledge transfer from prominent international experts so that the climate change issue, being considerable obstacles for agricultural cultivation, can be solved by space based intelligent technologies for human wellbeing, economic stability and mitigate carbon emission.

Between 14 - 17 March 2022, the workshop, hosted by Geo-Informatics and Space Technology Development Agency (GISTDA) at GISTDA Training Center, Bang Khen, Bangkok Thailand for operating online Conference Platform, had been arranged in the virtual format and was attended by of 57 participants from 1 3 economies: Australia; Brunei Darussalam; Chile; China; Indonesia; Japan; Malaysia; the Philippines; the Russian Federation; Thailand; Myanmar; Lao PDR; and Cambodia and from 22 organisations in public sector, institutions and private agencies. The event aimed to enhance capacity building in Climate-Smart Agriculture by applying geospatial technology in order to foster proactive cooperation network on efficient smart agriculture management for achieving sustainable development and climate resilience for APEC economies. The programme was run by ZOOM and the virtual learning platform, which were the channels for the virtual conference platform for presenting, communicating and discussion.

2. Climate-Smart Agriculture and Best Practices

In the current time, climate challenges result to variable seasonal weather; decreased productivities; plant diseases; and reduced biodiversity of ecosystem. Therefore, intelligent technologies are essential to be applied under extreme climate challenge conditions. The session presented achieved best practices and opened the floor for discussion.

2.1 Space and Geo-Informatics for Climate-Smart Agriculture

Presented by Pakorn Petchprayoon PhD, Director, GISTDA

The speaker showed the overview issues derived from climate change, and conveyed the applications of Geo-Informatics technology for supporting issue solutions on flood and drought. The issues are immense effects to agricultural productivity. Earth Observation satellites deliver images that can be applied for flood and drought management. The images can be depicted as maps and information in figures, graphs or tables which support decision making, planning, monitoring and management under implementation of stakeholders.

Thailand's space agency, GISTDA, has developed the agricultural systematic monitoring to support the government and local agricultural authorities. The tools: satellite images and ground station – in-situ measurement, are integrated to generate analytical information, and deliver information through the modules of CropWatch (Crop area estimation), CropHealth (Crop stress) CropMed (Weather and Climate), and CropBarn (yield prediction).

In sum up to answer the questions from the participants, both optical and SAR remote sensing systems as well as crop calendar are applied for monitoring crop areas. For crop yields' prediction, the key indicators are Vegetation Index and actual yields; 1-year model prediction can predict yields if there are sufficient information of productivity, but model, including more than 1-year yields, information, generate higher accuracy of the results.

2.2 Global Crop Pest and Disease Habitat Monitoring and Risk Forecasting

Presented by Prof. Huang Wenjiang, Aerospace Information Research Institute, Chinese Academy of Sciences, China

The increase of vegetation pests and diseases resulting from climate change brings about heavy reduction of yields and grain quality globally. Therefore, urgent prevention is essential to ensure food security and stability in the regions. The speaker informed that the reduction of crop productivity caused by pest and disease is more than 10 per cent globally. Remote sensing plays significant role in supporting dynamic monitoring and forecasting of pests and diseases occur in vegetation, because of its high spatial resolution and hundred bands (hyperspectral).

Disease and pest will be affected by crop growth conditions and environmental factors, such as crop leaf area index, crop cover conditions, and rainfall conditions, such as land surface temperature and soil moisture content. For example, in places with high temperature and high soil moisture content, the disease will be serious, whereas in the condition of drought, the pest will be more serious.

In cases of small or medium-sized plantations, the monitoring and forecasting techniques, based on remote sensing application, can also be analysed. We can use remote sensing to monitor the crop growth conditions (such as leaf area index, land coverage, leaf chlorophyll content), the soil moisture and land surface temperature can also be retrieved from remote sensing and in-situ survey and ground sensors. By inputting parameters including crop growth and environmental and with multi-temporal monitoring, we can distinguish the different stress conditions.

2.3 Water Security for Agriculture by Applying Intelligent Technology

Presented by Dr N.R. Patel Indian Institute of Remote Sensing and Centre for Space Science and Technology Education in Asia Pacific

The agricultural sector remains the biggest consumer of global freshwater resources; irrigation land is responsible for 69 per cent of global water withdrawal. By 2050, global demand on water for agriculture will be increased by 20 - 30 percentages as being critical to plant growth and major factor of large yield gaps; the challenge is extreme climate resulting to vulnerability on agriculture. Therefore, water security is crucial for accessing sufficient quantities of clean water to maintain adequate standards of food and goods production, proper sanitation, and sustainable health care.

In India, Geo-Informatics Technology is applied to manage food/water security by using geospatial information. India-Water Resources Information System (India-WRIS) is generated for being a single widow solution for comprehensive, authoritative, and consistent data as well as being information of India's water resources in a standardized domestic GIS framework for planning, development and management of water resources in the economy.

For the case study of the India, the system can be a prototype to other economies for applying intelligent technologies, based on geospatial data, for agricultural management of each economy depending on one's own context.

2.4 Agricultural Monitoring using Multiple Earth Observation Satellites under the APRSAF/SAFE Project

Presented by Shinichi Sobue, PhD, ALOS-2 Project Manager; and Kei Oyoshi, PhD, Associate Senior Researcher, Japan Aerospace Exploration Agency (JAXA)

The presentation delivered information about Asian Rice Crop Estimation & Monitoring (Asia-RiCE) which is the work of an ad hoc team of stakeholders with an interest in the development of an Asia-RiCE component for the GEO Global Agricultural Monitoring (GEOGLAM) initiative. Asia-RiCE seeks to contribute to domestic and regional information system by engaging Meteo Dat, Earth Observation Data, and In-situ Data as well as statistical information. The programme is led by JAXA and the National Centre for Space Studies (CNES) with more than 20 Asian space agencies and Ministries of Agriculture with international organisations to strengthen rice crop monitoring ability by using remote sensing, which is a component for GEOGLAM. GEOGLAM was endorsed by the G20 Summit, and aims to enhance regional and global agricultural production (wheat, maize, soybean, and rice) estimates through the use of Earth Observations. JAXA has developed earth observation data and information systems and delivered those data and information to domestic, regional and international partners' data and information systems for promoting agriculture applications of earth observation technology. JAXA has initiated various projects related to agriculture not only for Asian economies but also for the Asia-Pacific region.

2.5 Assessment of drought impact on rice production in Asia using satellite remote sensing and dissemination with web-GIS

Presented by Prof. Wataru Takeushi, University of Tokyo

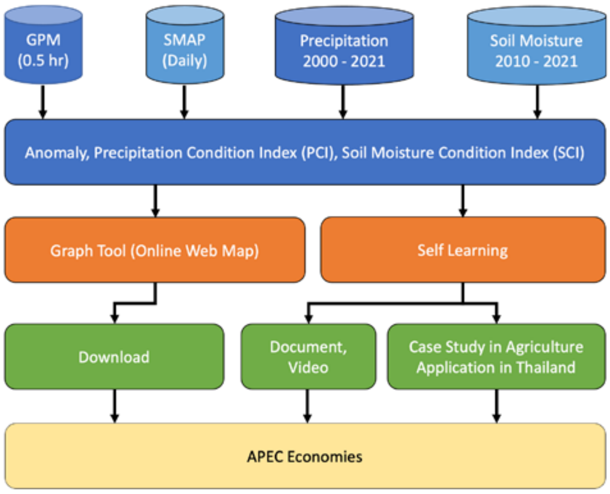
The contents included agricultural drought monitoring in Asia Pacific region; Green House Gas monitoring from rice paddy fields; air pollution mapping with Remote Sensing and portable sensors; and deep learning application for urban morphology. The case studies, based on Earth Observation technology applications, were shown and demonstrated techniques of Geo-Informatics Technology.

The presentation illustrated that agricultural management needs state-of-art technology to be tools for leveraging cultivation and productivity under extreme climate conditions.

3. Climate-Smart Agriculture Learning Platform

Presented by Asst Prof. Dr Soravis Supavetch, Lecturer, Faculty of Engineering, Kasetsart University

The Climate-Smart Agriculture platform is both automatic satellite data processing (climate-related dataset) system and a learning platform for self-learning. The Global Precipitation Measurement (GPM) and Soil Moisture Active & Passive (SMAP) data available for download from this website are the preprocessed product supporting the platform's project (GISTDA and APEC cooperation). The framework below explains the platform components or the structure of the system.



During the workshop, there was practical session; the participants had opportunity to process geospatial data to generate maps, under instruction by the expert, for supporting decision making, planning, and monitoring on agricultural management. The learning materials are available at https://geoserver.varunatech.co/smartagri/. On the platforms, users can request username and password to process data of oneself economy by sending request email to artsa@gistda.or.th.

4. Feedback

The overall feedback illustrated that the participants satisfied the workshop arrangement because they could gain much knowledge in agricultural management by applying space based intelligent technology which is beneficial to each economy under current extreme climate. Furthermore, extending duration of workshop and training were requested by the respondents because the technical parts were needed practical time and under instruction by the instructors. In the part of “Expected thematic areas of Training and Workshop in the future or feasibility of cooperation”, the respondents delivered requesting related the workshop by applying the state-of-art technology on climate-smart agricultural management in other dimensions such as hydrology and agrometeorology focusing on both theoretical concept and practices, especially in data processing training. In the future, the project can be extended to prediction phase which can deliver geospatial information to support intelligent agricultural management towards APEC economies in order to mitigate risk and stabilise food security in the region. In the future, the capacity building activities, especially technical training, are planned to be held in physical format for directly instruction by the experts as well as extending international networks; and approach to other dimension of agricultural management such as flooding and crop health.

5. Conclusion and Recommendations

In conclusion, Climate Smart Agriculture is a vital approach to food security; adaptation; and mitigation, by applying synergic technologies to operate agricultural management under extreme climate. Obviously, the best practice sessions and the virtual platform illustrated that research scholars have been developing space-based innovations, models and platforms for transforming agricultural development intelligently. The deliverables are beneficial to policy makers, technicians end users for planning, monitoring and analysing of cultivation in order to sustainably increase agricultural productivity and incomes as well as adapting and building resilience to climate change. However, there are many economies which face with shortage of technological approach resulting to face with vulnerability in livelihood and food availability.

In the way forward, ASEAN Research and Training Center for Space Technology and Applications (ARTSA), which is pushed forward by GISTDA – a space agency in Thailand, can be a platform to bridge scientific community with global networks and stakeholders by delivering capacity building activities and supporting joint research towards APEC economies and other regions for approaching state-of-art tools for Climate-Smart agricultural management.