Completion Report

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Innovative Data Collection Methods for Agricultural and Rural Statistics

Asian Development Bank

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TA 8369-REG: Innovative Data Collection Methods for Agricultural and Rural Statistics			Revised Amount: N/A	
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Description

Timely and high-quality crop area and production statistics are central to the preparation of development plans for the agricultural sector and for monitoring food security. These data are usually collected using either administrative records or farmer recall surveys, which are prone to significant measurement errors. Recent advances in remote sensing technology hold promise for crop area monitoring and yield estimation but are yet to be fully utilized for policymaking, both within and outside ADB. This Regional Capacity Development Technical Assistance (TA) was conceptualized to promote the use of space/satellite-based technology to estimate paddy rice area and production through a collaboration between ADB and the Japan Aerospace Exploration Agency (JAXA). Four pilot countries—the Lao People's Democratic Republic (Lao PDR), the Philippines, Thailand, and Viet Nam—participated in this project, which was implemented either individually or jointly by the national statistics office (NSO) and the ministry of agriculture (MoA).

Expected Impact, Outcome, and Outputs

The TA's intended impact was more evidence-based policies and programs on food security. The expected outcome was to improve the quality and timeliness of rice crop area and production estimates and forecasts.

The TA's expected outputs were: (i) the development of customized software applications and methodology to estimate paddy rice cultivation area and crop production based on satellite data and in-situ data obtained through crop-cutting experiments at a provincial level for four pilot countries—the Lao PDR, the Philippines, Thailand, and Viet Nam; (ii) training of counterpart staff in the four pilot countries; and (iii) the development of an online training program on the use of satellite data for agricultural and rural statistics.

Delivery of Inputs and Conduct of Activities

A regional Inception Workshop was held in Bangkok, Thailand to kick-off the project activities. Nineteen participants from the implementing agencies of the pilot countries met and discussed the overall objectives of the project, expected outputs, outcomes, project activities, and associated timelines. This was followed by a series of in-country inception workshops to agree on a scope of work, detailed expectations and requirements, and a schedule of in-country project activities.

A specialized consulting firm was hired to develop the customized applications that estimate paddy rice area and production and to train staff in the implementing agencies to use these applications. In addition, international and national consultants were hired to provide technical expertise on a range of topics including remote sensing, development of online course, sampling, and agricultural statistics and field methods. Originally, the TA envisioned the engagement of 32 person-months of international consulting services (firm and individual) and 64 person-months of national consulting services (individual). However, consultancy support for the TA was strengthened through provision of additional inputs, including engagement of specialized expertise on Computer-Assisted Personal Interviewing and advanced geospatial analysis using newer satellite data sources. These topics were not originally part of the TA paper. This brought the total consulting inputs to 58.86 person-months of international consulting services (firm and individual), and 90.86 person-months of national consulting services. All international and national consultants performed satisfactorily, and their work was closely monitored by the Project Officer.

Both in-country and regional dissemination activities were conducted at the end of the project to disseminate the tools, methods, and results at the national and regional level.

Five minor changes in implementation arrangements were approved to make adjustment in the schedule of activities to accommodate a change in the launch date of the satellite that provided the data used in this project, implement additional activities for crop cutting and farmer recall surveys, realign the TA funds to accommodate the services of a copy editor and additional person months for the consultants, and conduct additional training based on the request of the implementing agencies on data fusion and geospatial analysis using alternative satellite data sources.

Evaluation of Outputs and Achievement of Outcome

All the outputs listed in the design and monitoring framework have been achieved.

Firstly, a customized software application known as the Modified International Asian Harvest Monitoring System for Rice (INAHOR-AD) was developed for the pilot countries. The application was based on International Asian Harvest Monitoring System for Rice (INAHOR), a software developed by JAXA for monitoring paddy rice statistics in Japan. It uses radar satellite imagery which can penetrate clouds, thereby allowing for estimation of paddy rice statistics during the rainy season in Southeast Asia. The original version of the software required some programming abilities and was tailored to the varieties of rice found in Japan. The project facilitated the modification of the software to automate many of the pre-processing tasks and allow the users to easily access external programs and applications (i.e. MultiSpecWIN, QGIS) which run on different operating systems. Based on the recommendation of the four pilot countries, modules for (i) inputting boundaries of three geographical levels (province, town or district, and sub-district or village), (ii) random selection of pixels for ground-truthing and crop cutting, and (iii) comparison of results between optical and radar satellite data were also added. Existing modules were also revised to include enhanced navigation facility and other functionalities that (i) identified intermediate stages in rice growth between planting and harvesting stage, (ii) allowed flexibility in utilizing and converting estimates in different units of measures, and (iii) enabled visualization of rice crop growth at different stages. The software was also customized to the language requirements of each country. Right now, three out of four countries have free access to the

satellite data used with this software through special agreements between the countries and JAXA, that ADB helped facilitate. The fourth country is expected to have its agreement by the end of this year.

Two of the methodological research papers have already appeared in the Economics Working Paper (EWP) Series of the ADB: (i) Land Measurement Bias: Comparisons from Global Positioning System, Self-Reports, and Satellite Data; and (ii) Measuring Rice Yield from Space: The Case of Thai Binh, Viet Nam. The first paper has also received a "Revise and Resubmit" in a top field journal in agricultural economics, while the second paper has been accepted by a top field journal in remote sensing—IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing. The third paper on "Area Sampling Frames" is currently being typeset and will appear as part of the EWP series by last quarter of 2018. It was decided that the fourth paper appear as a Special Supplement to ADB's flagship statistical publication, *Key Indicators for Asia and the Pacific 2018*. This publication on *Technological Innovation for Agricultural Statistics* will be released on 5 September 2018. In addition, other communication methods to disseminate the findings of the TA include four ADB blogs (two more upcoming), contribution to Food and Agriculture Organization's (FAO's) newsletter, several presentations at prestigious international conferences/regional meetings, and cross-support to other ADB departments on tools and methods developed in this TA.

Nine training activities and workshops were conducted in each country to introduce staff in the implementing agencies to basic remote sensing concepts and use of multiple software including INAHOR, QGIS, and MapPlus. Additional training activities on field validation techniques, crop cutting methodology, farmer recall, and geospatial analysis using a combination of satellite and field data were also conducted. For Thailand, additional training course on the use of Khon Kaen University (KKU) Rice Crop Growth Model for Estimating Rice Production was organized. For Lao PDR and Viet Nam, two additional training workshops, which went beyond the original scope of the TA were conducted. The first focused on the use of handheld devices for survey data collection instead of paper questionnaires, while the second focused on alternative freely available satellite data sources such as Sentinel 1 and 2 for paddy rice yield estimation. This adds up to a total of 39 training activities and workshops split nearly evenly across the four countries. A total of 73 staff—38 males and 35 females—were trained on various concepts and methodologies during the implementation of the TA and surpassed the initial target of 40 counterpart staff from the implementing agencies. The focus of the project was to target the same staff in the implementing agencies for every training activity to ensure that knowledge transfer is sustained and can be used in the future.

An online training course on the use of satellite data for agricultural and rural statistics was developed and launched. This is ADB's first attempt at developing a Massive Online Open Course (MOOC), made available using the Open edX platform. A total of 84 participants registered for the online training course in the first iteration of the course between March and April 2017. Due to high demand, a second iteration was made available from May to December 2017 for which an additional 60 participants registered. Training materials from this TA have also been made publicly available through a revamp of the pre-existing Community for Agricultural and Rural Statistics (CARS) website. A handbook on the use of remote sensing for agricultural statistics has also been drafted and is currently being copyedited and expected to be released by October 2018.

Overall Assessment and Rating

The TA is assessed as *successful*. The TA is *highly relevant* as the implementing agencies were looking to pilot innovative and cost-effective methods for generating paddy rice statistics alongside capacity building in using new data collection methods. In addition, agreements between JAXA and three out of four pilot countries have been established to allow free access to the satellite data. The fourth country (Lao PDR) is in the negotiation process and is likely to enter an agreement by end of 2018. These agreements along with the capacity built lay a solid foundation for countries to produce more precise paddy rice estimates as frequently as deemed necessary. The TA is *effective* because the existing statistics on paddy rice in all countries can be now validated against satellite-based estimates, leading to an increase in overall data quality. The TA is *highly efficient*, given that all outputs were achieved, including several that go beyond the original scope, at nearly 17% savings in costs. With the agreements for free satellite data use in place, the TA is *likely sustainable* if the pilot countries continue to use the tools developed through this TA to complement and validate results generated from existing methods to compile agricultural statistics.

Major Lessons

Several lessons learned through the course of this TA will be adopted in future TAs. First, the strategic partnership between ADB and JAXA was important for strengthening the capacity of developing member economies in using remote sensing for more timely and better quality agricultural statistics; such strategic partnerships should be considered in future work. Second, the adoption and use of new methodologies would depend on the current capacity and available resources of the agencies. In particular, coordination between major agricultural data producing agencies, namely the NSO and the MoA, needs to be strengthened and the right staff in these agencies need to be targeted for training to achieve a consistent and consolidated set of agricultural statistics. Third, some of the methods implemented have scope for further digitization, and strategic investments need to be made in that direction. For example, digitized plot boundary tracing instead of GPS mapping is now becoming more easily available at very low costs and with better accuracy. These tools should be explored and made available to all countries. Fourth, the availability of freely accessible satellite data has significant impact on the adoption of remote sensing methods into the national statistical system of countries. Finally, online courses, especially MOOC format, are an effective way of reaching out to a wide set of beneficiaries that cannot be accommodated within limited TA resources. Such learning opportunities must be built into future statistics capacity building projects.

Recommendations and Follow-Up Actions

ADB should continue to support NSOs and MoAs on technological innovations for agricultural statistics through systematic scale-up and methodological research. For example, agricultural land ownership records in most developing countries are either poorly maintained or non-existent. Advances in remote sensing can expedite and enhance the development of high quality cadastral maps that form the basis for agricultural surveys. Second, ADB should continue engaging with global initiatives that advocate for the adoption of novel technologies in data collection and management methods. Finally, the remote sensing and GIS tools developed in this TA can be useful for evaluating outcomes/outputs of ADB agricultural loan projects where reliable field data on crop area planted, productivity, intensification are not available.

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