

The logo of the Asian Development Bank (ADB), consisting of the letters 'ADB' in a white serif font inside a black square.

Technical Assistance Report

Project Number: 54321-001
Knowledge and Support Technical Assistance (KSTA)
December 2020

Empowering Developing Member Countries to Use Multispectral Satellite Images and Artificial Intelligence for Land Use and Coastal Planning

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Asian Development Bank

ABBREVIATIONS

ADB	–	Asian Development Bank
COVID-19	–	coronavirus disease
DMC	–	developing member country
ESA	–	European Space Agency
KARI	–	Korea Aerospace Research Institute
SDCC-DT	–	Digital Technology for Development Unit of the Sustainable Development and Climate Change Department
TA	–	technical assistance

NOTE

In this report, “\$” refers to United States dollars.

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KNOWLEDGE AND SUPPORT TECHNICAL ASSISTANCE AT A GLANCE

1. Basic Data		Project Number: 54321-001
Project Name	Empowering Developing Member Countries to Use Multispectral Satellite Images and Artificial Intelligence for Land Use and Coastal Planning	Department/Division SDCC/SDCC-DT
Nature of Activity Modality	Capacity Development Regular	Executing Agency Asian Development Bank
Country	REG (CAM, TIM, TON, UZB)	
2. Sector	Subsector(s)	ADB Financing (\$ million)
✓ Agriculture, natural resources and rural development	Agriculture research and application	0.13
Water and other urban infrastructure and services	Urban policy, institutional and capacity development	0.13
		Total <u>0.26</u>
3. Operational Priorities		Climate Change Information
✓ Addressing remaining poverty and reducing inequalities		GHG Reductions (tons per annum) 0
✓ Accelerating progress in gender equality		Climate Change impact on the Project Low
✓ Tackling climate change, building climate and disaster resilience, and enhancing environmental sustainability		ADB Financing
✓ Making cities more livable		Adaptation (\$ million) 0.00
✓ Promoting rural development and food security		Mitigation (\$ million) 0.00
✓ Strengthening governance and institutional capacity		Cofinancing
		Adaptation (\$ million) 0.00
		Mitigation (\$ million) 0.00
Sustainable Development Goals		Gender Equity and Mainstreaming
SDG 2.4		Some gender elements (SGE) ✓
SDG 5.b		
SDG 10.2		Poverty Targeting
SDG 11.3		General Intervention on Poverty ✓
SDG 12.8		
4. Risk Categorization Low		
5. Safeguard Categorization Safeguard Policy Statement does not apply		
6. Financing		
Modality and Sources		Amount (\$ million)
ADB		0.25
Knowledge and Support technical assistance: Technical Assistance Special Fund		0.25
Cofinancing		0.80
High Level Technology Fund (Full ADB Administration)		0.30
Republic of Korea e-Asia and Knowledge Partnership Fund (Full ADB Administration)		0.50
Counterpart		0.00
None		0.00
Total		1.05
Currency of ADB Financing: US Dollar		

I. INTRODUCTION

1. The knowledge and support technical assistance (TA) will support developing member countries (DMCs) of the Asian Development Bank (ADB) in using artificial intelligence, satellite imagery, and Earth observation solutions for project planning and implementation. The TA will cover the development of cloud-based platforms to process satellite data and produce models on land use management and coastal planning as well as capacity building programs for relevant agencies. The TA will prioritize solutions to address DMC institutional constraints linked to the lack of awareness on the available effective technologies, insufficient regulatory processes, or limited dissemination of best practices. It will prove that technical capacity in the DMCs can be easily improved, and the cost–benefit ratio is more favorable than other solutions. These solutions will be for land use management and coastal planning in Cambodia, development of a sustainable coffee sector in Timor-Leste, optimization of cropping systems in Uzbekistan, and land use planning in Tonga.

2. Strategy 2030 recognizes the promotion of innovative technology as a guiding principle and aims to “seek ways to promote the use of advanced technologies across its operations and provide capacity building support to DMCs.”¹ Earth observation is one such advanced tool. The use of satellite-based Earth observation products has advanced significantly since 2010 in the past decade for a broad range of uses, including environmental and disaster risk management, urban planning and land management, and knowledge-intensive agriculture. These innovative solutions cut across the operational priorities, specifically (i) tackling climate change, building climate and disaster resilience, and enhancing environmental sustainability (OP3); (ii) making cities more livable (OP4); (iii) promoting rural development and food security (OP5); and (iv) strengthening governance and institutional capacity (OP6).

3. The TA is included in the 2020 Management-approved results-based work plan of the Sustainable Development and Climate Change Department.²

II. ISSUES

4. ADB stopped project site visits because of the coronavirus disease (COVID-19) pandemic, even in conflict-affected situations, hindering more effective project design, implementation, and monitoring. This highlights the usefulness of satellite imagery, which allows virtual visits to sites that cannot be easily accessed or studied to plan or implement interventions. However, DMCs often are unable to use free and open multispectral satellite data systematically and unable to leverage the technology to improve nationwide planning and make decisions based on up-to-date and accurate information. DMC capacity to access and process such free and open raw datasets is also limited or fragmented. Further, there is rampant institutional absence of national guidelines and support structures that promote the use of processed satellite data. Some DMCs also have limited awareness of the cost–benefit advantages of new technologies demonstrated locally.

5. This TA aims to reduce the technology gaps for cloud-based processing; raise awareness of the need for local guidelines; and provide a cost–benefit analysis of using artificial intelligence, satellite imagery, and Earth observation solutions compared with traditional practices.

¹ ADB. 2018. *Strategy 2030: Achieving a Prosperous, Inclusive, Resilient, and Sustainable Asia and the Pacific*. Manila. p. 11.

² The TA first appeared in the business opportunities section of ADB’s website on 12 October 2020.

6. Satellites provide nonintrusive, objective, and consistent historic and projected data.³ The technology is also rapidly evolving. New multispectral imagery is now available, and the frequency and resolution of image captures have increased, significantly expanding potential uses. DMCs can improve the accuracy of land use models and reduce the cost of land surveys by transitioning to Earth observation-based solutions. In addition, Earth observation can provide reliable data when actual field surveys are difficult to conduct because of COVID-19 pandemic-related travel restrictions or in cases of conflict. Satellites are also among the few free and open data sources that systematically monitor land use.

7. Combined with artificial intelligence, satellite imagery is driving a global revolution in land management. Much of the new and improved imagery is available as a free and open resource from space agencies such as the European Space Agency (ESA). Artificial intelligence has also advanced rapidly, and artificial intelligence-based image recognition models can automatically identify land features and uses with high accuracy. Satellite technology with artificial intelligence-based image processing can enable ADB DMCs to avoid traditional data gathering and analysis solutions that are often too expensive and complex. DMCs are well-positioned to take advantage of Earth observation solutions, given their lack of historical investments in land management infrastructure. However, some DMCs have limited technical capability or inadequate information technology systems to perform the technical processing required for these solutions. Because some platforms do not offer training for DMCs, this TA will build DMC capacity to implement these Earth observation solutions.

8. In response to DMC demand for Earth observation-based interventions, the TA aims to create artificial intelligence solutions using open data from space agencies, such as ESA, the Japan Aerospace Exploration Agency, and the Korea Aerospace Research Institute (KARI); and academic institutions, such as the University of Tokyo. The TA will focus on processing Earth observation-based image data to create sustainable and replicable solutions for decision makers. The Sustainable Development and Climate Change Department's Digital Technology for Development Unit (SDCC-DT) has provided considerable support through TA, integrating relevant data into planning and implementation. For example, Indonesia's Ministry of National Development Planning, National Institute of Aeronautics and Space, Ministry of Public Works and Housing, and Geological Service housed in the Ministry of Energy and Natural Resources used two cloud-based interferometric processing platforms, the Geohazards Exploitation Platform⁴ and Rheticus,⁵ in project preparation activities for the reconstruction of Palu in Central Sulawesi and for the management of water resources in Java.⁶

9. To achieve the TA objectives, ADB will collaborate with government agencies that can sustain the operational use of these cloud-based solutions. This approach is based on the experience in Indonesia, where cloud processing is being used to optimize the implementation of water security, flood risk, and post-tsunami reconstruction projects. SDCC-DT will regularly consult with DMCs and operations departments on the most appropriate technology. This TA focuses on land use management and coastal planning in Cambodia, development of a sustainable coffee sector in Timor-Leste, optimization of cropping systems in Uzbekistan, and

³ ADB. 2017. *Earth Observation for a Transforming Asia and the Pacific: A Portfolio of Twelve Earth Observation Projects Supporting Asian Development Bank Activities*. Manila.

⁴ [Geohazards Exploitation Platform](#). The platform allows external users to employ Earth observation data by combining fast data access, cloud processing facilities, and intuitive data analysis tools.

⁵ Planetek Italia. [Rheticus](#). Rheticus is a cloud-based geographic information service platform that provides land monitoring data upon user request.

⁶ ADB. [Indonesia: Emergency Assistance for Rehabilitation and Reconstruction](#); and ADB. [Indonesia: Enhanced Water Security Investment Project](#).

land use planning in Tonga because these require frequent satellite acquisitions and features that are difficult to map using traditional image processing or geographic information systems. To address future use of the cloud-based platform, this TA will foster integration into DMC systems or create sustainable customized links with tools created by ESA and other partners.

10. The TA will build on previous ADB projects where satellite imagery has been used to develop and pilot-test land use solutions. These include activities organized for Emergency Assistance for Reconstruction and Rehabilitation in Indonesia, where initial support was provided under ESA's Earth Observation for Sustainable Development Disaster Risk Reduction project and delivered the first damage assessment in the country and monthly land and infrastructure motion analytics.⁷ It will also build on the work for an upcoming project in Cambodia on monitoring coastal and marine fisheries and associated ecosystems using artificial intelligence to detect oceanfront gradients associated with water upwelling. Earth observation technology will be used to monitor the health of coastal mangrove ecosystems that serve as a nursery for marine life. The TA will also build on a grant in Timor-Leste,⁸ in which artificial intelligence is used to identify coffee plantations from optical multispectral satellite images. For this project, multispectral imagery accurately identified coffee plantations under a forest canopy, reducing the need for physical surveys in hard-to-reach mountainous terrain. Once the model is created and validated, it can be used to monitor national coffee production for economic and agricultural planning.

11. **ADB's value addition.** ADB's value addition would be leveraging partnerships with ESA and the University of Tokyo, and upcoming collaborations with the Japan Aerospace Exploration Agency and KARI to provide the most appropriate Earth observation-based solutions to the DMCs, including historical data, satellite images, and modeling and forecasting methodologies. ADB resources may also be used for storage and dissemination.⁹ ADB is in a unique position to provide state-of-the-art solutions to DMCs, with their varying needs, from these agencies. Working directly with the DMCs, ADB can identify applicable solutions for small and remote Pacific islands, landlocked countries in Central Asia, or archipelagos in Southeast Asia.

III. THE TECHNICAL ASSISTANCE

A. Impact and Outcome

12. The TA is aligned with the following impact: use of advanced technologies in land use planning and natural resources management increased.¹⁰ The TA will have the following outcome: capacity of DMCs to use free and open multispectral satellite data improved.¹¹

B. Outputs, Methods, and Activities

13. **Output 1: Cloud-based platforms operationalized.** The TA will support the use of state-of-the-art, machine learning techniques to process terabytes of free and open satellite data from

⁷ ADB. [Indonesia: Emergency Assistance for Rehabilitation and Reconstruction](#); and ESA. [Earth Observation for Sustainable Development Disaster Risk Reduction](#). The ESA initiative supports the uptake of Earth observation-derived information in sustainable development. It comprises knowledge development, capacity building, and skills transfer, which were done in coordination with ADB and the World Bank.

⁸ ADB. 2020. [Timor-Leste: Coffee and Agroforestry Livelihood Improvement Project](#).

⁹ One of these is the Spatial Data Analysis Explorer, an interactive geospatial cloud-based platform that has satellite maps and datasets for ADB projects. Similar solutions will be evaluated in consultation with the Southeast Asia Department's Urban Development and Water Division project team for the Southeast Asia Urban Services Facility.

¹⁰ ADB. 2018. *Strategy 2030: Achieving a Prosperous, Inclusive, Resilient, and Sustainable Asia and the Pacific*. Manila.

¹¹ The design and monitoring framework is in Appendix 1.

sensors at different spatial resolutions.¹² This includes technical cooperation with KARI to access its marine information service based on Cheollian 2B.¹³ ESA will integrate Sentinel-3¹⁴ and Cheollian 2B multispectral data and make available artificial intelligence expertise to process data into a coastal marine water monitoring processing chain. This will allow using available datasets to support areas such as agroforestry and sustainable coastal fisheries. Consultations with relevant users will be conducted to test different use-case scenarios and decide on the most appropriate cloud-based solution.

14. Output 2: Integration of Earth observation technology solutions into projects supported. The TA will support mainstreaming of Earth observation technology to produce maps (e.g., land use, land cover, marine environment, and coffee plantation). Similar solutions can be replicated in other sectors and DMCs. This output will use KARI's Cheollian 2B and other available tools from space agencies such as ESA, integrate satellite data in the cloud, and validate results with DMCs.

15. Output 3: Knowledge in adopting Earth observation-based solutions improved. The TA will support hosting the artificial intelligence model, processing imagery, connecting to free and open data archives, and storing results in a cloud-based platform with a user-friendly interface to foster uptake in DMCs that lack major investments in local information technology infrastructure. User training sessions will be organized, and knowledge products will be disseminated.

16. On-site training will also be conducted, as necessary and as permitted by local COVID-19 directives. A sizable portion of the capacity building training will be delivered remotely during the first year of activities. DMCs not targeted by this TA will be invited to join the virtual training. To provide efficient virtual training, an enhanced methodology will be designed and will consist of highly structured training modules, including on building a virtual community and providing tangible values for inclusion in participants' working practices.

C. Cost and Financing

17. The TA is estimated to cost \$1,050,000, of which (i) \$250,000 will be financed on a grant basis by ADB's Technical Assistance Special Fund (TASF 6), (ii) \$500,000 will be financed on a grant basis by the Republic of Korea e-Asia and Knowledge Partnership Fund and administered by ADB, and (iii) \$300,000 will be financed on a grant basis by the High-Level Technology Fund¹⁵ and administered by ADB. Civil works, the purchase of large equipment, permanent staffing costs, and the hiring of staff consultants are not eligible for funding under the e-Asia and Knowledge Partnership Fund. Consulting services, goods, and works for project identification, development, and implementation (including surveys, conferences, seminars, workshops, travel, per diem, remuneration, resource persons, reports, communications, publications, pilot activities, capacity development, and research and policy advice) are eligible under the High-Level Technology Fund. The key expenditure items are listed in Appendix 2.

¹² Ensuing artificial intelligence models will be considered ADB property.

¹³ KARI. [Geostationary Korea Multi Purpose Satellite \(GEO-KOMPSAT, Cheollian\)](#). GEO-KOMPSAT-2B or Cheollian 2B is KARI's geostationary orbit multifunction satellite that can observe environmental pollutants and monitor marine conditions.

¹⁴ ESA. [Sentinel-3](#). Sentinel-3 is ESA's low-orbit, moderate-sized satellite. Its main objective is to measure sea surface topography, sea and land use surface temperature, and ocean and land surface color with high accuracy and reliability to support ocean forecasting systems, environmental monitoring, and climate monitoring.

¹⁵ Financing partner: the Government of Japan.

D. Implementation Arrangements

18. ADB, through SDCC-DT, will administer the TA and will be the executing agency. SDCC-DT will implement the TA from January 2021 to December 2023. It will report to the Thematic Advisory Service Cluster on TA progress and consult with relevant sector and thematic groups and operations departments during implementation. SDCC-DT will carry out TA administration and supervision, and will be accountable for the outputs. SDCC-DT will obtain government concurrence before any country activity is conducted.

19. Implementation arrangements are summarized in the table.

Implementation Arrangements			
Aspects	Arrangements		
Indicative implementation period	January 2021–December 2023		
Executing agency	ADB through SDCC-DT		
Implementing agency	ADB through SDCC-DT		
Consultants	To be selected and engaged by ADB		
	Individual: individual consultant selection	International expertise (42 person-months)	\$852,840
Disbursement	Disbursement of TA resources will follow ADB's <i>Technical Assistance Disbursement Handbook</i> (2020, as amended from time to time).		

ADB = Asian Development Bank, TA = technical assistance, SDCC-DT = Digital Technology for Development Unit of the Sustainable Development and Climate Change Department.

Source: Asian Development Bank.

20. **Consulting services.** ADB will engage the consultants following the ADB Procurement Policy (2017, as amended from time to time) and its associated project administration instructions and/or staff instructions.¹⁶ ADB will consider lump-sum payments and output-based contracts for consulting services, where appropriate. The TA will require 42 person-months of international individual consulting services. The consultants will procure and process data and/or satellite imagery, as appropriate.

21. **Social media and websites.** The cloud-based platforms included in output 1 will use DMC systems and ADB platforms (e.g., ADB.org), as applicable.

IV. THE PRESIDENT'S DECISION

22. The President, acting under the authority delegated by the Board, has approved (i) the Asian Development Bank (ADB) administering a portion of technical assistance not exceeding the equivalent of \$500,000 to be financed on a grant basis by the Republic of Korea e-Asia and Knowledge Partnership Fund, (ii) ADB administering a portion of technical assistance not exceeding the equivalent of \$300,000 to be financed on a grant basis by the High-Level Technology Fund, and (iii) ADB providing the balance not exceeding the equivalent of \$250,000 on a grant basis for Empowering Developing Member Countries to Use Multispectral Satellite Images and Artificial Intelligence for Land Use and Coastal Planning, and hereby reports this action to the Board.

¹⁶ Terms of Reference for Consultants (accessible from the list of linked documents in Appendix 3).

DESIGN AND MONITORING FRAMEWORK

Impact the TA is Aligned with Use of advanced technologies in land use planning and natural resources management increased (Strategy 2030) ^a			
Results Chain	Performance Indicators with Targets and Baselines	Data Sources and Reporting Mechanisms	Risks
Outcome Capacity of DMCs to use free and open multispectral satellite data improved	By 2023, six ADB projects using Earth observation cloud-based technology implemented (2019 baseline: 0)	Final aide-mémoire and quarterly project progress reports	DMC investment priorities on using multispectral data in their projects change.
Outputs 1. Cloud-based platforms operationalized 2. Integration of Earth observation technology solutions into projects supported 3. Knowledge in adopting Earth observation-based solutions improved	1a. By 2021, two optimized cloud-based platforms made available (2019 baseline: 0) 2a. By 2022, two projects using multitemporal satellite data processed and made available through simple download for the user's workspace in the cloud (2019 baseline: 0) 3a. By 2023, 40 government officials, 40% of whom are women, confirmed increased knowledge on Earth observation-based solutions (2019 baseline: 0) 3b. By 2023, two knowledge products, including how-to guides on using Earth observation technology, published (2019 baseline: 0)	1. Cloud-based platforms, Quarterly progress reports, workshop proceedings 2. Quarterly project progress reports, processed data 3a. Workshop proceedings, post-workshop surveys 3b. Knowledge products published online and disseminated	Uncertainty because of the COVID-19 pandemic restricts DMCs' ability to support TA activities. The raw multispectral data satellite is not available in sufficient amount because of cloud cover.
Key Activities with Milestones			
<p>1. Cloud-based platforms operationalized</p> <p>1.1 Conduct consultations with prospective users to scope different use-case scenarios (Q1 2021)</p> <p>1.2 Develop a user technical requirements document (Q2 2021)</p> <p>1.3 Prepare a detailed technical note on foreseen institutional impact (Q3 2021)</p> <p>1.4 Select and adopt cloud-based solutions among those available in SDCC-DT (Q2 2023)</p> <p>2. Integration of Earth observation technology solutions into projects supported</p> <p>2.1 Codesign with KARI the use of GEO-KOMPSAT integrated with Sentinel 3 multispectral data (Q4 2021)</p> <p>2.2 Integrate satellite data catalogs in the cloud and conduct an operational test of the artificial intelligence engines (Q1 2022)</p> <p>2.3 Test artificial intelligence results for selected projects (Q2 2022)</p> <p>2.4 Validate the results with direct engagement of ADB and DMC stakeholders (Q2 2022)</p>			

3. Knowledge in adopting Earth observation-based solutions improved

- 3.1 Prepare training materials (Q3 2022)
- 3.2 Deliver training modules 1 and 2 for selected DMCs (Q4 2022)
- 3.3 Evaluate and assess direct engagement of ADB and DMCs stakeholders (Q1 2023)
- 3.4 Adopt corrective actions and improvements (Q1 2023)
- 3.5 Deliver training modules 3 and 4 for selected DMCs (Q1 2023)
- 3.6 Deliver training modules 5 and 6 for selected DMCs (Q2 2023)
- 3.7 Submit final reporting, user manuals, and long-term sustainability documents (Q3 2023)

TA Management Activities

Prepare and submit concise monthly reports (Q3 2023)
Organize 2-day annual progress review in DMCs, and final review and final workshop at the ADB headquarters (Q2 2023)

Inputs

ADB: \$250,000
Republic of Korea e-Asia and Knowledge Partnership Fund: \$500,000
High-Level Technology Fund: \$300,000

Assumptions for Partner Financing

Not Applicable

ADB = Asian Development Bank, COVID-19 = coronavirus disease, DMC = developing member country, GEO-KOMPSAT = Geostationary Korea Multi Purpose Satellite, KARI = Korea Aerospace Research Institute, Q = quarter, SDCC-DT = Digital Technology for Development Unit of the Sustainable Development and Climate Change Department, TA = technical assistance.

^a ADB. 2018. *Strategy 2030: Achieving a Prosperous, Inclusive, Resilient, and Sustainable Asia and the Pacific*. Manila. Source: Asian Development Bank.

COST ESTIMATES AND FINANCING PLAN
(\$'000)

Item	Amount
A. Asian Development Bank^a	
1. Consultants	
a. Remuneration and per diem: international consultants	224.00
b. Out-of-pocket expenditures: reports and communications	3.50
2. Contingencies	22.50
Subtotal (A)	250.00
B. Republic of Korea e-Asia and Knowledge Partnership Fund^b	
1. Consultants	
a. Remuneration and per diem: international consultants	377.80
b. Out-of-pocket expenditures: international travel	30.00
2. Training, seminars, workshops, forums, and conferences ^c	54.00
3. Contingencies	38.20
Subtotal (B)	500.00
C. High-Level Technology Fund^d	
1. Consultants	
a. Remuneration and per diem: international consultants	251.04
b. Out-of-pocket expenditures	
i. International travel	20.00
ii. Reports and communications	15.00
2. Contingencies	13.96
Subtotal (C)	300.00
Total	1,050.00

Note: The technical assistance is estimated to cost \$1.05 million, of which contributions from the Asian Development Bank, Republic of Korea e-Asia and Knowledge Partnership Fund, and the High-Level Technology Fund are presented in the table.

^a Financed by the Asian Development Bank's Technical Assistance Special Fund (TASF 6).

^b Administered by the Asian Development Bank.

^c Includes the cost of Asian Development Bank staff travel as resource persons and tokens for any resource persons.

^d Financing partner: the Government of Japan. Administered by the Asian Development Bank.

Source: Asian Development Bank estimates.

LIST OF LINKED DOCUMENTS

<http://www.adb.org/Documents/LinkedDocs/?id=54321-001-TARreport>

1. Terms of Reference for Consultants