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Use of digital technology and geospatial information systems to enhance resilience and promote sustainable development

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Note by the secretariat

Summary

Advances in digital technologies and innovations in data processing, integration, and delivery play a critical role in scaling up the application of geospatial information services for sustainable development in Asia and the Pacific. The present document contains a brief review of emerging trends in the region and of efforts made by the secretariat of the Economic and Social Commission for Asia and the Pacific (ESCAP) and by ESCAP members and associate members to build capacities for space applications based on geospatial information and digital technologies. It also highlights examples of applications from the South-East Asia subregion that fall under the six priority thematic areas identified in the Asia-Pacific Plan of Action on Space Applications for Sustainable Development (2018–2030).

In preparation for the Fourth Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific, which will be held on 26 October 2022 and be co-organized with the Government of Indonesia, the Committee on Information and Communications Technology, Science, Technology and Innovation is invited to consider the issues raised in the present document and make recommendations to guide the future work of the secretariat to make progress during the second phase of implementation of the Plan of Action (2022–2026). The Committee is also invited to make recommendations on how to scale up regional action and to submit those recommendations for further deliberation and consideration at the Ministerial Conference.

* ESCAP/CICTSTI/2022/L.1.

I. Regional needs to facilitate the adoption of digital technologies and geospatial information systems

1. With over 4,500 satellites in orbit, increasing public and private investments and an expanding range of applications for accelerating the achievement of the Sustainable Development Goals, interest in the space sector has never been greater. In Asia and the Pacific, the use of geospatial information and the development of innovative applications are increasing, as having the ability to leverage digital technologies is critical for providing Governments, businesses, communities and citizens with timely, reliable and high-quality geospatial information that will empower them to make evidence-based decisions.

2. Digital technologies include: (a) cognitive digital technologies, which rely on the application of advanced analytics, machine learning and artificial intelligence approaches to develop insight; (b) cloud-based digital technologies, which are characterized by the on-demand availability of computer system resources, especially software, data storage and computing power; (c) the Internet of things, a term for physical objects with sensors, processing ability, software and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks; (d) blockchain technology, which is a system of digital, distributed ledgers of transactions comprising a database of information with an append-only structure governed by a network of computers instead of by a central party; (e) big data, i.e. increasingly large volumes of more varied data transmitted at ever-greater speed; and (f) fast Internet, a term used to refer to next-generation connectivity networks, as exemplified by fifth-generation (5G) wireless networks, that provide speed and capacity at fundamentally different levels from their predecessors. Combined with geospatial information, these digital technologies have been supporting efforts to enhance resilience and promote sustainable development in Asia and the Pacific, mainly by observing planet Earth through a higher-resolution lens, using multiple sensors and higher frequencies, so that development interventions can be better targeted and their impacts tracked.

3. The members and associate members of the Economic and Social Commission for Asia and the Pacific (ESCAP) have recognized the benefits of applying geospatial information in such sectors as education, food security, agriculture, energy, disaster risk reduction and resilience-building. At the Third Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific, held in 2018, participants adopted the Asia-Pacific Plan of Action on Space Applications for Sustainable Development (2018–2030)[1] as a means of promoting the use of geospatial information and space technologies, as well as their applications. The first phase of implementation of the Plan of Action (2018–2022) resulted in the application of a wide range of space technologies in the six priority thematic areas identified in the Plan of Action, namely: (a) disaster risk reduction and resilience; (b) management of natural resources; (c) connectivity for the 2030 Agenda for Sustainable Development; (d) social development; (e) energy; and (f) climate change. An evaluation of the first phase of implementation is under way; the findings and recommendations of that evaluation will be presented at the Fourth Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific, to be held in Jakarta and online on 26 October 2022.

[1] ESCAP/75/10/Add.2.

4. The Fourth Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific is expected to result in agreement on regional cooperation mechanisms to accelerate the implementation of the Plan of Action during the second phase (2022–2026). At its twenty-fifth session, in 2021, the Intergovernmental Consultative Committee on the Regional Space Applications Programme for Sustainable Development [2] proposed "Space+ for our Earth and future" as the guiding theme of the second phase, with a view to widening the scope of geospatial technologies and digital technologies adopted for sustainable development beyond the traditional approaches by: (a) leveraging innovations in digital technologies; (b) engaging end users across multiple sectors, including youth and the private sector; (c) managing data and information more effectively through unique products and services; and (d) strengthening implementation by increasing collaboration with global and regional stakeholders.

II. Emerging good practices in the implementation of the Plan of Action

5. The Plan of Action contains 188 actions and suggestions for how to implement them, including through research, knowledge-sharing, capacity-building, technical support, intergovernmental discussions and the exchange of information on regional practices. These actions are grouped into the above-mentioned six priority thematic areas. Several cross-cutting issues have also been identified in the Plan of Action. Moreover, the long-standing Regional Space Applications Programme for Sustainable Development has been enabling the rapid delivery of ongoing work and new programmes in support of the implementation of the Plan of Action. Highlights of the efforts made by the secretariat in this respect are provided below.

6. Members and associate members have requested that capacity-building for space applications based on geospatial information and digital technologies be prioritized across all sectors during the Plan of Action's implementation.[3] Through enhanced regional cooperation, the secretariat has facilitated access to timely geospatial information, expertise and resources by promoting knowledge-sharing and good practices.

7. Since 2021, the secretariat has been building the pan-Asia partnership for geospatial air pollution information. Through this project, the secretariat aims to enhance the capacity of participating member States to access and utilize space-derived data and applications for air pollution monitoring and management. The project is implemented, in cooperation with the National Institute of Environmental Research of the Republic of Korea and other partners, to validate satellite data from the Geostationary Environment Monitoring Spectrometer by integrating data from surface-based spectrometers (for example, those that are part of the Pandora Spectrometer System) and undertaking a series of capacity-building programmes with the aim of promoting the use of comprehensive metadata for effective air pollution monitoring and mitigation. In addition, the project aims to promote a regional action-oriented dialogue on air pollution. These capacity-building efforts also address technical issues related to the operation of Pandora instruments by developing a national decision-making support tool using remote sensing and

[2] Additional information is available at www.unescap.org/events/2021/25th-session-intergovernmental-consultative-committee-icc-regional-space-applications.

[3] See ESCAP/75/10/Add.2, paras. 25 and 27 (c).

other information for some countries and scaling up existing air pollution models for other countries. The project covers 13 countries in the region.

8. The secretariat has been working on integrating geospatial information and digital technologies to support local government decision-making by ensuring access to the correct information at critical times. Specifically, the secretariat collaborates with regional partners to develop a standard data format and platform to capture, store, display, query and analyse geospatial information and cross-sectoral statistical data simultaneously to support evidence-based decision-making.

9. Since 2021, the secretariat has supported the Governments of Indonesia and Thailand in using integrated spatio-temporal data for monitoring progress in achieving the Sustainable Development Goals at the local level, also with the technical support of experts from the National Geomatics Center of China. This project contributes to the priorities set out in the regional road map for implementing the 2030 Agenda for Sustainable Development in Asia and the Pacific[4] and is therefore focused on the commitment to leave no one behind, on disaster risk reduction and resilience and on the management of natural resources. The project is aimed specifically at supporting the Sustainable Development Goals monitoring and reporting centres in Makassar and Bandung, Indonesia, and the city government of Songkhla, Thailand. The primary stakeholders in these centres are the end users in local city governments, who own non-georeferenced sectoral data and statistics but who have a limited capacity to integrate sectoral data into satellite-derived data for timely situational analyses and decision-making. This project, which is aimed at bridging the gap between service providers and users in the Asia-Pacific region, is being implemented with the support of the Statistics Division, the United Nations Geospatial Network and the United Nations Satellite Centre. All good practices and lessons learned will be shared with other countries through ESCAP platforms, the Regional Space Applications Programme for Sustainable Development and knowledge products such as the Asia-Pacific SDG Gateway and the biennial compendiums of geospatial practices for sustainable development in Asia and the Pacific,[5] among others.

10. Space applications can be employed to optimize the processes of collecting official statistics and compiling novel statistical products, which national statistical organizations without access to such applications have been unable to do. A land monitoring project for Central Asia being implemented with the support of experts from the Russian Federation has demonstrated how geospatial technology and statistics intersect. Government officials from the five Central Asian States participating in the project have been receiving guidance and training on using national- and province-level satellite imagery. Owing to the coronavirus disease (COVID-19) pandemic, the modality for delivering the training programme has had to be redesigned. ESCAP has delivered 24 online seminars based on best practices for online learning, which have been interspersed with assignments and brainstorming sessions. As a result, the target audience has indicated a heightened capacity to use open-source mapping and programming tools to compile land statistics in the format put forth by the System of Environmental-Economic Accounting.

[4] E/ESCAP/73/31, annex II.

[5] The first such compendium, which was published in 2020, is available at www.unescap.org/publications/geospatial-practices-sustainable-development-asia-and-pacific-2020-compendium. A second compendium will be published in 2022.

11. Modern remote sensing methods make it possible to warn of incipient wildfires. The secretariat is harnessing satellite-derived wildfire data in two ways: firstly, by connecting vulnerable States with States possessing timely fire hotspot data; and, secondly, by conducting statistical analyses of wildfire seasonality, spatial distribution and proximity to infrastructure and dwellings. This twofold approach was taken when the secretariat facilitated the provision of wildfire data from the Russian Federation to relevant stakeholders in Kyrgyzstan. Also in Kyrgyzstan, where drought remains a significant issue and is monitored mostly from the ground, the secretariat is taking measures through the implementation of a Central Asia drought information system. As an initial step, an assessment of institutional and technical needs for drought monitoring will be developed with the United Nations Satellite Centre, as part of a larger capacity-building effort being carried out with support from experts from the Russian Federation and other States.

12. Since 2020, the secretariat has supported several countries in South Asia and South-East Asia to develop cognitive systems to monitor floods and carry out damage assessments. However, many members and associate members still lack the capacity to configure cognitive systems using geospatial information and map flood hotspots and risks. Since early 2022, the secretariat has been building the capacity of several members and associate members by jointly developing and using open-source and easy-to-use cognitive models to produce flood hotspot data and risk maps.

13. In addition, to support the activities identified under the marine and ocean pollution sub-theme of the Plan of Action, the secretariat has been helping to address coastal erosion in Indonesia and Thailand by developing a digital tool to visualize the evolution of coastal erosion over the past three decades. The digital tool uses big data available as analysis-ready data stored on cloud platforms to map changes in the shoreline. In addition, the secretariat has collaborated with the National Research and Innovation Agency of Indonesia to enhance the capacity of national decision makers to use geospatial information and the cloud for evaluating and monitoring the water networks in Bandung; it has also collaborated with university-based centres of excellence focused on the Sustainable Development Goals to do the same in Makassar.

14. Within the overall framework set out by the Secretary-General in his report entitled "Our Common Agenda",[6] ESCAP, in its resolution 78/1, resolved to listen to and work with youth, to ensure their meaningful engagement. ESCAP is supporting efforts to build the capacity of young professionals in countries in the Asia-Pacific region to use integrated geospatial information for mitigating disaster risk, monitoring crops and droughts for food security, mapping the COVID-19 pandemic and monitoring air pollution.

15. In March 2022, the secretariat, in collaboration with the Geo-Informatics and Space Technology Development Agency, the Association of Southeast Asian Nations (ASEAN) Research and Training Center for Space Technology and Applications, Multi-GNSS Asia and the United Nations Satellite Centre, organized the first youth forum on the innovative use of geospatial information for resilient and sustainable development.[7] Over 90 young professionals, researchers and students from Asia and the Pacific attended the forum. As travel restrictions start to ease, the secretariat plans to

[6] A/75/982.

[7] See www.unescap.org/events/2022/youth-forum-space-applications-and-space-initiative.

organize a number of follow-up subregional and thematic forums. Furthermore, the secretariat has sponsored the attendance of six young professionals from developing countries, four of whom were women, to attend the twenty-fifth post-graduate course in remote sensing and geographic information systems (GIS) at the Centre for Space Science and Technology Education in Asia and the Pacific, in Dehradun, India. In May 2022, in collaboration with the Asian Disaster Preparedness Center, the secretariat organized an online training session on applying satellite remote sensing to air quality monitoring. Fifty-five young professionals from nine developing countries, 22 of whom were women, attended.

16. The Plan of Action includes several issues relevant to the COVID-19 pandemic. For example, it contains requests for the secretariat and member States to take the following actions: (a) to research how global navigation and communications satellite systems can be used to minimize the spread of epidemics; (b) to promote regional cooperation by leveraging existing mechanisms to share data and exchange expertise (including on big data analytics) to contain the present and future spread of disease and epidemics; (c) to develop the capacity to map health risk hotspots using geospatial information and big data; and (d) to research solutions (including telehealth and telemedicine solutions and pandemic monitoring and management) using space technology applications to improve the capacity in vulnerable countries to prepare for, mitigate and respond to emergency health situations. In line with these actions and responses to the COVID-19 pandemic and its ensuing socioeconomic crisis, the secretariat is encouraging, at the regional level, the sharing of georeferenced big data and analyses of geospatial and temporal interlinkages with a view to improving understanding of the risk correlations between COVID-19 and socioeconomic areas such as health, finance, connectivity, education, energy and safety.

III. Building on present trends for the future and recommendations

17. The region has made considerable progress on the effective use of geospatial information and digital technologies to support the achievement of the Sustainable Development Goals. However, the least developed and most vulnerable countries in the region still have unfulfilled data needs, which means that there is insufficient capacity to map disaster-related risks and improve disaster mitigation and preparedness procedures. To address these data and capacity needs, members and associate members may need to scale up regional cooperative programmes during the second phase of implementation of the Plan of Action (2022–2026). For example, through its Regional Space Applications Programme for Sustainable Development, ESCAP could facilitate the establishment of a coalition of space-faring States willing to provide high-resolution satellite imagery and big Earth data analytical tools for consistent and timely ex-ante natural disaster risk monitoring and reduction, with a focus on countries with special needs.

18. The Internet of things and geospatial information are becoming increasingly intertwined. Sensors are becoming smaller and cheaper, allowing devices like the new generation of smartphones to be fitted with light detection and ranging systems. The increasing popularity of 5G and satellite Internet networks will enable users to transfer geospatial data from millions of sensors to the cloud, where they can be processed to gain more relevant insights that can, in turn, enhance resilience and promote sustainable development. A digital twin depicts in virtual form the real world of tangible items, processes, connections and actions. Natural and constructed surroundings can be digitally

duplicated, and a wide range of digital models can be seamlessly integrated using geospatial technology.

19. The concept of smart cities and transportation systems too is growing exponentially. An increasing number of automobile manufacturers will be placing their driverless vehicles on the road during the next 5 to 10 years. To support these systems, high-quality maps are being developed to expand the field of vision of onboard sensors and provide assistance in adverse weather conditions; connected and autonomous vehicles will be equipped with sensors and artificial intelligence algorithms. In addition to being used for smart cities and transportation systems, these high-quality maps will help to develop more resilient cities.

20. For example, during the COVID-19 pandemic, the National Parks Board of Singapore launched the SafeDistance@Parks application to allow members of the public to check visitor levels in major parks, gardens and other natural areas. In addition, the Singapore Land Authority has developed Virtual Singapore, a dynamic three-dimensional city model and collaborative data platform including three-dimensional maps of Singapore. The Virtual Singapore platform will enable users from different sectors to develop sophisticated tools and applications for test-bedding concepts and services, planning and decision-making, and conducting research on technologies to solve emerging and complex challenges for Singapore.

21. In the Philippines, the Department of Science and Technology uses geospatial information, the cloud, the Internet of things, the fast Internet and big data to manage the risk of disasters. Initiatives include: using data from Filipino-made microsatellites and nanosatellites for hazard mapping; and assessing environmental conditions using on-the-ground Internet of things-based stations to prepare for potential disasters. In addition, a multi-agency initiative led by the Philippine Institute of Volcanology and Seismology has been developed to make scientific data available for public use. The main purpose of this initiative is to rapidly generate hazard and risk assessments. In addition, the Universal Structural Health Evaluation and Recording System is being developed by Mapúa University in Manila to monitor the structural integrity of infrastructure, mainly buildings and bridges, by determining their resistance to strong earthquakes.

22. Thailand is developing an integrated climate observing system and online database of essential climate variables for both Thailand and other States members of ASEAN. The data is derived from satellite and Internet of things-based ground stations. The essential climate variables will have a higher temporal and spatial resolution for Thailand and ASEAN than the currently available datasets. The online database will allow all sectors, including the Government and the private sector, to access, without limits, data that can be used to forecast climate change and anticipate its impacts on society, the economy and the environment. In addition, the Geo-Informatics and Space Technology Development Agency in Thailand has developed, in collaboration with government organizations and educational institutions, a geospatial data service platform for the management of fine particulate matter. The aerosol data retrieved from the Japanese Himawari satellite and weather stations of the Thai Meteorological Department are analysed and updated hourly on the platform.

23. The Viet Nam Disaster Management Authority has developed a robust multi-hazard early warning system called the Viet Nam Disaster Monitoring System that uses the fast Internet and the Internet of things to enable real-time and near-real-time monitoring of hydro-meteorological and reservoir-related

data. To complement the System, the Authority has also developed a disaster monitoring application to allow users to access alerts and information products and perform various data analyses.

24. The Government of Timor-Leste has undertaken a programme with the Melbourne Energy Institute in Australia to improve professional, technical and administrative capabilities of human resources personnel working in the disaster management sector. As part of the programme, individuals working in disaster management will be trained to collect geospatial information and analyse it using cloud-based cognitive models to map geophysical hazards. They will also be trained to detect and mitigate earthquake-related hazards and risks, for which a national Internet of things-based seismograph network will be installed. That network will be critical for the future economic development in key industries, e.g. the petroleum sector, by providing access to data and ensuring real-time data collection.

25. Looking forward, in order to further mainstream the adoption of geospatial information applications, it will be increasingly important to adopt an end-user-centric approach. The end user, who is not necessarily a geospatial expert, will need to be empowered to derive valuable insights from data without having to learn the technicalities of analysis. In addition, scaling up the application of geospatial information in multiple sectors will increasingly depend on the involvement of a range of stakeholders, including the private sector and youth. To enable this broad stakeholder outreach, to further innovate and to contribute to the achievement of the Sustainable Development Goals, the development of user-friendly and easily accessible GIS portals and services tailored to the specific needs of end users will become a major imperative for the geospatial community.

26. Since 2018, ESCAP members and associate members have worked together to implement various initiatives on integrating geospatial information to build greater resilience in the future. Based on the lessons learned and the best practices that have been identified, members and associate members may wish to scale up the integration of geospatial information, starting with pilot countries during the second phase of implementation of the Plan of Action (2022–2026), under the theme “Space+ for our Earth and future”. Such a scaling-up exercise will help address the underutilization and integration of geospatial data in Asia and the Pacific.

IV. Issues for consideration by the Committee

27. The Committee on Information and Communications Technology, Science, Technology and Innovation may wish to discuss the above recommendations and submit them for further consideration at the Fourth Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific, to be held in Jakarta and online on 26 October 2022.

28. To guide the secretariat’s current and future work, the Committee may also wish to consider how to increase access to and better leverage digital technologies and innovations to further strengthen the contribution of space applications to the achievement of the Sustainable Development Goals as envisioned in the Plan of Action, mindful also of the growing use of geospatial information and digital technologies in the region and the potential development of new and innovative applications.