ESCAP Technical Paper
Information and Communications Technology and
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Good Practices for Promoting Regional Cooperation in Space Applications for Sustainable Urban Development, Water Resources Management and Transportation Management

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Abbreviations

ARMAS	Active Road Management Assisted by Satellite
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
DENR	The Philippine Department of Environmental and Natural Resources
DPWH	The Philippine Department of Public Works and Highways
FAO	The United Nations Food and Agricultural Organisation
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information System
GNSS	Global Navigation Satellite Systems
IGS	International GNSS Service
ISRO	Indian Space Research Organization
JAXA	Japan Aerospace Exploration Agency
MDGs	Millennium Development Goals
NOAA	National Oceanic and Atmospheric Administration
OCHA	The United Nations Office for the Coordination of Humanitarian Affairs
RESAP	Regional Space Applications Programme for Sustainable Development
RIMES	Regional Integrated Multi-Hazard Early Warning System for Africa and Asia
RS	Remote Sensing
TEWS	Tsunami Early Warning system
TRMM	Tropical Rainfall Measuring Mission
TSR	Tropical Storm Risk
UAV	Unmanned Aerial Vehicle
UN-GGIM	United Nations initiative on Global Geospatial Information Management
UN-SPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
UNCSD	United Nations Conference on Sustainable Development
UNDAC	United Nations Disaster and Assessment and Coordination
UNEP	United Nations Environment Programme
UNESCO	The United Nations Educational, Scientific and Cultural Organization
UNOOSA	United Nations Office for Outer Space Affairs
USGS	The United States Geological Survey
WMO	World Meteorological Organisation

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1. INTRODUCTION

Science, technology and innovation (STI) is a key driver of sustainable economic growth. Expanding research and development (R&D) in STI is the most efficient way to better understand key global challenges, make a more forward-looking analysis, and devise solutions rooted in a scientific foundation. For example STI can aid in reducing carbon emissions, improving energy efficiency, encouraging climate change resilience, and addressing disaster impacts. Among innovative technologies, space technology and geospatial information system (GIS) applications have emerged as one of the leading technologies that contribute to sustainable economic growth and global development challenges in the Asia Pacific region.

Over the last three decades, space technology applications have gained ground in terms of spread of its usage and the advancement of capabilities associated with said usage. The increasing recognition of the gap between capability and use since the 1990s prompted organizations to launch programs to bridge the gap between providers and users (Wagner, Verhoest, Ludwig, & Tedesco, 2009). The availability of low-cost and readily useable datasets and increasing education and practical research has raised the technological awareness of professionals at both national and local levels every year (Sivanpillai, 2008). The high costs of hiring experts in industrialized countries and the poor physical accessibility of many global regions are boosting the use of Earth observation techniques. Another important driver is preparation for natural disasters and mitigation of the damage" (VTT Technical Research Center, 2014).

The use of space technology has been accelerated by developments in information and communications technology (ICT). Reduced infrastructure cost, improved hardware and broader internet connections increase the accessibility of satellite derived information. With more people getting involved with the study of Space Technology, applications can now go beyond traditional topographic and terrain mapping (Landenberger & Deagen, 2011).

Space technology applications and space-derived information have acted both as an enabler and as a catalyst for global, regional and country efforts in progressing toward internationally agreed Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs) that will form part of United Nations' development agenda beyond 2015. Furthermore, space technology applications and space-derived information serve as effective and innovative tools to support the implementation of MDGs and forthcoming SDGs. They have contributed to the productivity and efficiency of sustainable economic growth and poverty reduction by providing essential information and guidance; sustainable urban development by creating an urban inventory, thematic maps, and queries for identifying most vulnerable urban areas; improved decision making by providing scientific evidence for climate change impact and mitigation measures in inaccessible areas; and contributed to meeting the basic needs of MDGs by providing data to support resource management, transportation, agriculture and disaster risk management. Furthermore, space technology applications and geospatial information such as tele-medicine are indispensable in the fight against infant and maternal mortality, malaria, HIV/AIDS and other diseases identified in the MDGs. Tele-education targeting women can bring quality educational opportunities to the uneducated women and children in even the most remote of villages and also enhances employment opportunities for female professionals (SDG 4).

This paper sets out to show how space technology and geospatial data, combined with non-space derived data such as socio-economic data, can enhance the understanding and observation of global issues. More specifically, this paper discusses how space technology and geospatial data can play an important role in providing valuable information such as trends in climate change, patterns of urbanization, mapping of water resources and GPS in trans-boundary regional transportation. This paper will also show that despite the wide range of benefits associated with the use of space applications, many developing countries in the Asia -Pacific region do not have sufficient access to this important technology, thus depriving them of innovative space-based solutions to both current and future issues.. It is here where regional cooperation can play a vital role in facilitating greater accessibility to space technologies and GIS applications.

The paper at hand is prepared with two objectives in mind: (1) to compile and analyze good practices and lessons learnt in space technology and GIS applications in the areas of sustainable urban development, water resource management, transportation management, as well as regional cooperation on space technology applications; and (2) based on the analysis and findings, to provide policy and technical recommendations on how to optimally use space technology and GIS applications for sustainable development.

2. KEY CONTRIBUTIONS OF SPACE TECHNOLOGY APPLICATIONS TO MDGS AND SDGS

2.1 Contributions to MDGs

The member States of the United Nations announced the Millennium Development Goals (MDGs) at the United Nations Headquarters in New York, in September 2000 as part of its goal to "achieve international co-operation in solving international problems of an economic, social, cultural, or humanitarian character". The MDGs constitute a set of time-bound and measurable goals, targets and indicators for combating poverty, hunger, disease, illiteracy, environmental degradation and discrimination against women. They include inter alia: halving the proportion of people whose income is less than one dollar a day; halving the proportion of people who suffer from hunger; achieving universal primary education and gender equality; reducing under-five mortality by two-thirds; reducing maternal mortality by three-quarters; reversing the spread of HIV/AIDS; and halving the proportion of people without access to safe water. Most of these targets are to be achieved by 2015. In the process of achieving these goals, space technologies and GIS have contributed substantially towards the provision of crucial knowledge and data to inform better decisions regarding how to sustain and improve life on Earth in the overall context of the MDGs (Czar Samiento, 2014).

During the past 10 years, it has been fully recognized that space-referenced information systems, when used appropriately to take into account the differing needs of people, are central to facilitating the achievement of all MDGs. Earth observation data and the convergence of the nature and application of satellite data with airborne data could also be used in the generation of digital elevation models, (DEMs) for mapping. The advances in GIS, associated GIS software, and Global Navigation Satellite Systems (GNSS) have helped to make geospatial information a major source of data for government, commerce and industry. The collective progress in this type of technology is important in eradicating poverty, creating jobs and promoting the achievement of several MDGs.

The Global Earth Observation System of Systems (GEOSS) 10 Year Implementation Plan (Altan, 2009) demonstrated the possible applications in the sectors of develoment as seen in the table 1 below.

Table 1: Areas of Societal Benefit from Earth Observation.

Area	Task Short Title
Agriculture	Data Utilization in Agriculture Forest Mapping and Change Monitoring Training Modules for Agriculture Improving Measurements of Biomass Agricultural Risk Management Operational Agricultural Monitoring System
Biodiversity	Biodiversity Requirements in Earth Observation Capturing Historical Biodiversity Data Biodiversity Observation and Monitoring Network Invasive Species Monitoring System
Climate	Sustained Reprocessing and Reanalysis Efforts Key Climate Data from Satellite Systems Key Terrestrial Observations for Climate GEOSS IPY Contribution Global Ocean Observation System Seamless Weather and Climate Prediction System
Disasters	Seismographic Networks Improvement and Coordination Integration of InSAR Technology Implementation of a Tsunami Early Warning System (TEWS) at Global Level Multi-hazard Zonation and Maps Multi-hazard Approach Definition and Progressive Implementation Use of Satellites for Risk Management Implementation of a Fire Warning System at Global Level Risk Management for Floods
Ecosystems	Ecosystems Integrated Global Carbon Observation (IGCO) Ecosystem Classification

	Regional Networks for Ecosystems Global Ecosystem Observation and Monitoring Network
Energy	Using New Observation Systems for Energy Management of Energy Sources Energy Environmental Impact Monitoring Energy Policy Planning
Health	Forecast Health Hazards Strengthen Observation and Information Systems for Health Environment and Health Monitoring and Modeling Integrated Atmospheric Pollution Monitoring, Modeling and Forecasting
User	Identify Priorities and Synergies between SBAs Pilot Communities of Practice Nowcasting and Forecasting User Applications Millennium Development Goals Environmental Risk Management
Water	Forecast Models for Drought and Water Resource Management In-situ Water Cycle Monitoring Capacity Building Program for Water Resource Management Global Water Quality Monitoring Satellite Water Quantity Measurements and Integration with In-situ Data
Weather	Surface-based Global Observing System for Weather Space-based Global Observing System for Weather THORPEX Interactive Global Grand Ensemble (TIGGE) Numerical Weather-Prediction Capacity Building Data Assimilation for Operational Use Weather Demonstration Project for the Beijing 2008 Olympic Games

Source: The Global Earth Observation System of Systems (GEOSS) 10 Year Implementation Plan (Altan, 2009).

Table 1 above is a comprehensive summary of the potential benefits of GEOSS. It is apparent that GEOSS is therefore a powerful tool in combating poverty (MDG 1), through their contribution to sustained economic growth, enhanced market efficiency, and creation of employment opportunities. For example, the application of space technology in agriculture has the potential to increase food production through better soil management, eco-efficient water resource management and efficient irrigation resulting in high-yield crops with enhanced food value. Projects on space science and technology such as the Famine Early Warning System (FEWS) in Africa help in monitoring and predicting the potential onset of drought-induced famine and provide countermeasures through the use of planned agriculture. Utilization of remote sensing and GNSS techniques improve the precision of agriculture practices and generate jobs for the populace.

Space technology and geospatial information systems have also contributed to combating HIV/AIDS, malaria, and other diseases. Tele-medicine and GIS can aid in much the same way they aid child mortality and maternal health (MDG 4 and 5). Microgravity can greatly help in growing HIV protease inhibitor crystals that, arguably, would help find a potential cure or vaccine. Space technology is also key in tackling the challenges associated with population growth, urbanization, climate change, water crisis, deforestation, biodiversity and energy sources (MDG 7). For example, meteorological and Earth observation satellites provide essential data for hazard mapping, risk assessment, early warning and disaster relief. Similarly, unexpected hazards such as oil spills and wildfires can be monitored and managed using space technology. For instance, a very basic but essential requirement for tackling the problems stemming from unexpected hazards is gathering information on where the problem is located, what is there and how to get there. Existing maps are frequently out-of-date, especially in less developed areas, but satellite images can provide up-to-date information in the case of an emergency.

2.2 Expected Contributions to SDGs

In June 2012, Heads of State and high-level representatives met at Rio de Janeiro, Brazil, for the UNCSD Rio+20. The UNCSD Rio+20 aimed to renew country commitments to both sustainable development and to the promotion of an economically, socially and environmentally sustainable future for our planet, both for present and future generations. To this end, the UNCSD Rio +20 vowed to eradicate poverty, promote sustained economic growth, respect all human rights, protect the environment, enhance gender equality and provide equal opportunities for all. The mutual agreements and resolutions in the conference produced the document “The Future We Want”, which includes the creation of the post-2015 development agenda. Since the UNCSD Rio+20, the United Nations Open Working Group on Sustainable Development Goals has produced 17 proposed sustainable development goals (SDGs) in July 2014 for further consultations among member States and key stakeholders – all of which are set to be achieved by 2030 (United Nations Open Working Group on Sustainable Development Goals, 2014).

The outcome document “The Future We Want” emphasizes the importance of scientific knowledge and technology for sustainable development. In particular, it recognizes that scientific knowledge and evidence-based approaches play an integral part in achieving SDGs. In this regard, applying space science and technology to sustainable