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GEOSPATIAL INFORMATION – KEY TO ACHIEVING THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT

I. INTRODUCTION

THE WORLD TODAY is experiencing a deluge of data. Every time one uses that weather app on their smartphone, every time one checks-in to his/her office using the biometrics device, every time a bar-coded product is moved across an assembly line or every time a satellite orbits the imaging or communicating with earth, data is created. Increasingly, this data is being pored over, structured, analyzed and inferred for patterns and insights before a decision is made.

However, this is not a uniform scenario across the world. Developed economies are grappling with an abundance of data while there are parts of globe where data scarcity prevails. This is the paradox of data revolution.

The paradox however is symptomatic of a broader disparity. Those countries/societies experiencing data scarcity are also those that tend to be the most vulnerable, particularly with respect to poverty, gender inequality, conflict and extremism, disasters and climate change. At the same time, the world is on the threshold of immense opportunity – an opportunity of development and bridging the divide that exists among the countries. The United Nations' Millennium Development Goals (MDGs) initiated in 2000 have consolidated several disparate sustainable development initiatives into a common framework and set concrete goals. Consequently, significant progress has been made in a number of areas,

The 17 Sustainable Development Goals and the 169 associated targets promise to achieve sustainable development in its three dimensions – economic, social and environmental – in a balanced way.

though the progress remains uneven, particularly in the least developed and developing countries. Also, many of the MDGs were never fully realized, in particular those related to maternal, newborn, child and reproductive health.

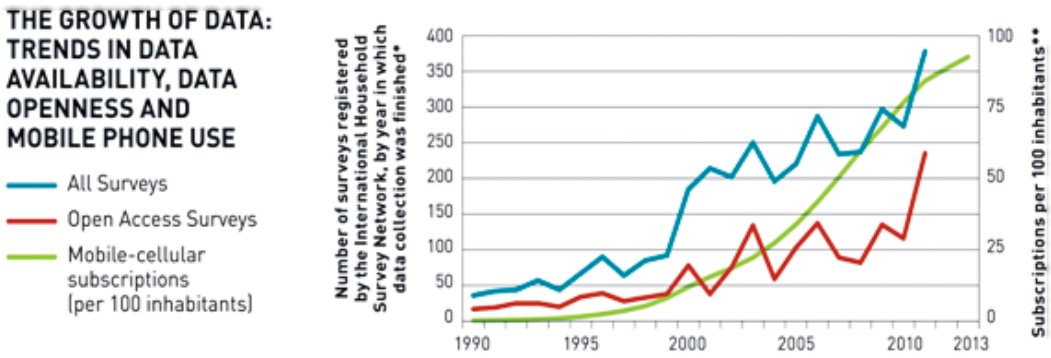
To continue the development strides and to fulfill the vision of MDGs, the United Nations announced the 2030 Agenda for Sustainable Development in September 2015 - an ambitious, integrated, indivisible and transformational global agenda to reach the 'furthest behind first'. The 17 Sustainable Development Goals and the 169 associated targets promise to achieve sustainable development in its three dimensions – economic, social and environmental – in a balanced way. While the agenda itself is global, it takes different national realities into consideration and guides and permits governments to incorporate these Goals and Targets into their national planning processes and strategies as per their priorities.

II. THE DATA PARADOX

The 2030 Agenda, while defining its goals and targets as aspirational and global, recognized the importance of adequate data for the follow-up and review of the progress made in implementing those goals and targets. The basic objective of the 2030 Agenda – that no one is to be left behind – will require quality, accessible, timely and reliable disaggregated data to help with the measurement of the progress and to ensure that no one is left behind. However, the agenda acknowledged that baseline data for several of the targets remains unavailable, indicating that the data paradox is indeed a reality and calls for increased support for strengthening data collection and capacity development in Member States, to develop national and global baselines where they do not yet exist.

Today, data have become bigger, faster, more current and detailed than ever before. Advances in sensor technologies, communications and IT are leading to this exponential increase, adding to the volume and types of data, creating unprecedented possibilities for informing and transforming the society (Figure1). However, inequalities exist in the access to data and information and in the ability to use it. Too many people, organizations and governments, especially in the developing world, are excluded from benefiting from this data revolution because of lack of resources, knowledge, capacity or opportunity. Even in data-rich nations, many organizations have just begun to evolve mechanisms to tap the power of data and analytics for decision-making.

At this juncture, it is critical that civil governments, United Nations and multilateral organizations act to enable a framework to facilitate data to play its full role in the realization of sustainable development by closing the key gaps in access and use of data: between developed and developing countries, between information-rich and information poor people, and between the private and public sectors.



*Source: * International Household Survey Network (http://catalog.ihsn.org/index.php/catalog). For a detailed analysis of global trends in survey data availability, see, e.g., Demombynes and Sandefur (2014), "Costing a Data Revolution," Center for Global Development, Working Paper 383.*

*** World Bank (http://data.worldbank.org/indicator/IT.CEL.SETS.P2), based on data from the International Telecommunication Union (ITU), World Telecommunication/ICT Indicators database*

Figure 1: The Growth of Data: Trends in Data Availability, Data Openness & Mobile Phone Use[1]

Big Data – High on perceived benefits, low on implementation

Understanding the need and significance of data, especially Big Data, for measuring and monitoring of sustainable development goals, the United Nations Statistical Commission set up a Global Working Group on Big Data to examine the use of Big Data for the measurement of indicators of the 2030 Agenda, for various policy applications and for the promotion of capacity building on Big Data issues. The Working Group conducted a survey[2] enquiring about the strategic vision of national statistical offices and their practical experience with Big Data — mobile phone data, satellite imagery and social media data. As many as 93 countries participated in the survey (32 OECD and 61 non-OECD countries).

The working group compiled an inventory of Big Data projects, in which projects were mapped to the sustainable development goals and their targets. The survey revealed that statistical offices consider 'faster, more timely statistics', 'reduction of respondent burden' and 'modernization of the statistical production process' to be the main benefits of using big data, followed by 'new products and services' and 'cost reduction' (Figure 2). While two - thirds of the developing countries consider meeting new demands such as the indicators of the SDGs to be a benefit, only one - third of the OECD countries share that view.

The survey also revealed that 52% of non-OECD countries and 44% of OECD countries have either used or consider using satellite or aerial imagery data specifically. 54% of non-OECD countries and 31% of OECD countries have either used or consider using big data for measuring indicators related to the SDGs.

However, 85% of non-OECD countries and 91% of OECD countries have not yet actively attempted or discussed linking certain Big Data sources for use of deriving certain indicators to measure progress on the SDGs. The survey also points out that countries are in urgent need for 'skills and training for big data', 'quality framework for big data' and 'access to big data'. Another issue in harnessing the potential offered by big data is analytics. This is a completely new area for many countries, especially for government departments working towards sustainable development. It requires the ability to tap into data streams and analyze them on the fly for trends and insights.

This will be a totally new game even for traditional statisticians.

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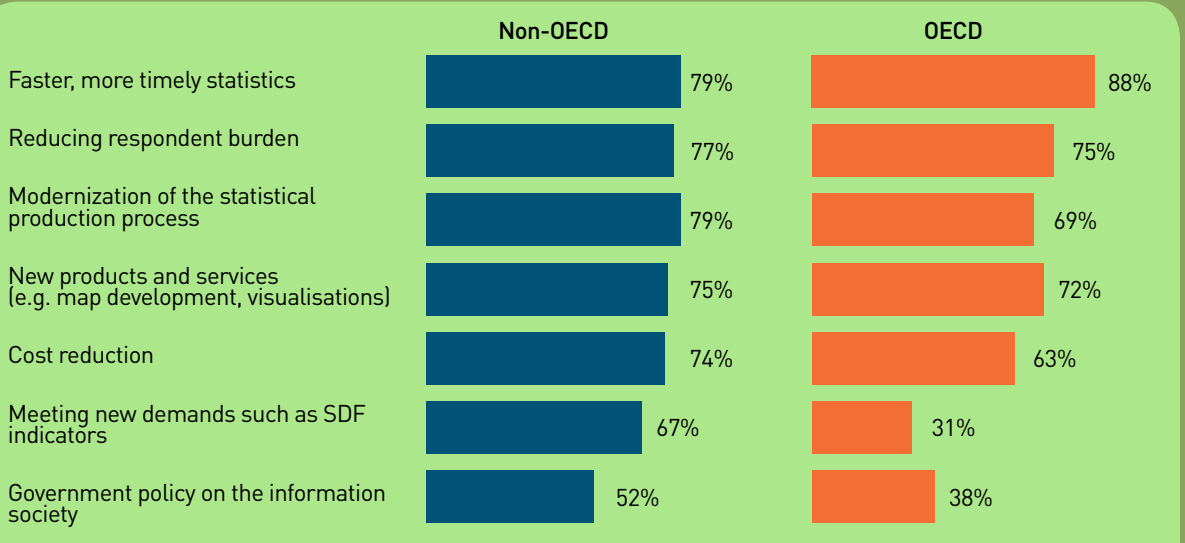

Figure 2: Main Reasons and Business Benefits of using Big Data

III. GEOSPATIAL DATA TO MEASURE & MONTIOR SDGs

While recognizing that each country could use different approaches visions, models and tools available for achieving SDGs based on the national circumstances and priorities, the UN acknowledged the significance and the need forleveraging a wide range of data, including earth observation and geospatial data[3]. It also underscored the need for developing capacities of national statistical offices and data systems, especially in developing and least developed countries, to ensure access to timely, reliable and disaggregated data.

The Agenda committed itself to conducting regular and inclusive reviews of progress at sub-national, national, regional and global levels. It encourages nations to identify and create most suitable mechanisms to build on existing follow-up and review mechanisms at these levels. The Inter-Agency and Expert Group on SDG Indicators developed a list of indicators for the monitoring of the goals and targets at the global level. Further, the Group underscored the significance of integrating geospatial and statistical data as the key requirement for the production of a number of indicators.

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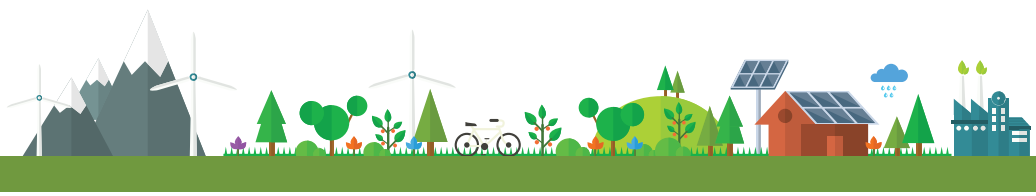
Consider Table 1, for achieving SDG Goal 2.4, the indicator framework mandates countries to periodically monitor and estimate the proportion of agricultural land under such resilient practices. Where are the farms that adopted technology and increased productivity? Where are agricultural yields diminished due to soil degradation? Which areas are more prone to natural disasters or to the effects of climate change? These and many more questions need to be answered to be able to estimate the proportion of agricultural land under productive and sustainable agriculture as the indicator mandates. Until recently, in many of the developing and least developed countries, this monitoring and evaluation was commonly done by manual surveys, which were expensive, logistically challenging and extremely time consuming. Also, these estimates can be inaccurate and unreliable in countries where statistical infrastructure is weak.

Increasingly today, comprehensive and accurate location-based information drawn from high resolution satellite- and aerial-earth observation data are being used, to support such measuring and monitoring outcomes. The use of drones for farm-level observations has reduced the cost and time implications significantly. Collected at local, national and global levels, and supported by IT tools and other best available technologies, earth observation data are playing a critical and insightful role in monitoring the

Table 1:[4]

SDG Goal & Target	Indicators	GA resolution 68/261
2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.	2.4.1 Proportion of agricultural area under productive and sustainable agriculture	SDG indicators should be disaggregated where relevant, by income, sex, age, race, ethnicity, migratory status, disability and geographic location or other characteristics, in accordance with the Fundamental Principles of Official Statistics



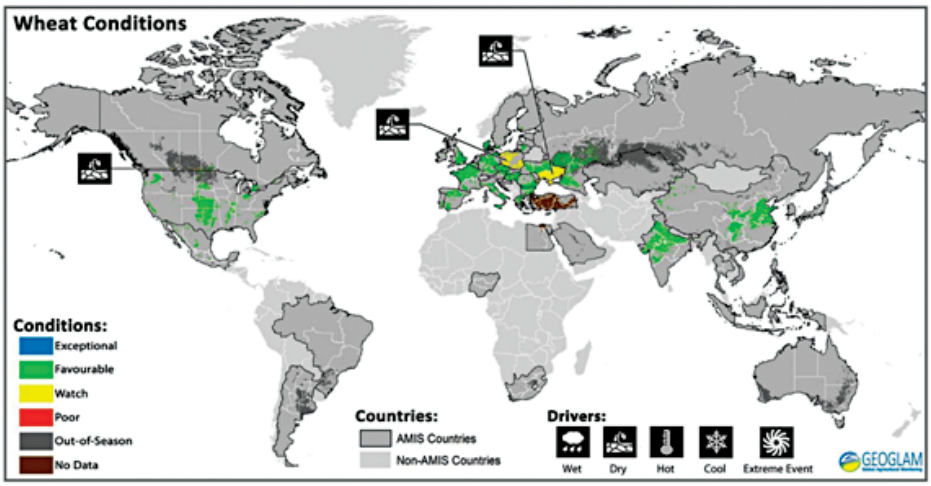


Figure 3: Wheat crop conditions as of Feb 28, 2016 over main growing areas are based upon a combination of national and regional crop analyst inputs along with EO data. Condition information is based upon information as of January 28. Where crops are in other than favourable conditions the climatic drivers responsible for those conditions are displayed. Courtesy: GEOGLAM

targets, tracking the progress and helping countries make mid-term corrections to their Sustainable Development Goals and targets. When combined with demographic and statistical data, these data and analyses can enable nations monitor change over a period of time in a standard format and make decisions.

In agriculture, the Group on Earth Observations (GEO)'s Global Agricultural Monitoring (GEOGLAM) initiative is worth citing. It sends out periodic crop monitor reports, strengthens the international community's capacity to produce and disseminate relevant, timely and accurate forecasts of agricultural production at national, regional and global scales using earth observations, including satellite and ground-based observations[5].

The crop monitor reports provide global crop condition assessments in support of the Agricultural Market Information System (AMIS) market monitoring activities (Figure 3). Both GEOGLAM and AMIS were endorsed by G20 and were tasked to "coordinate satellite monitoring observation systems to enhance crop production projects and weather forecasting data."

Earth observation and geospatial data supports measuring and monitoring of several, if not all, goals and targets set by the 2030 Agenda. Another example is the effective use of EO data to observe land use and land cover changes. Apart from providing a general view of land cover, such data can be used to predict the onset of drought, flooded areas and can best serve as a pre-planning as well as a monitoring and evaluation tool. Consider the example of GlobeLand 30, a global land cover dataset at 30meter resolution for the years 2000 and 2010, developed by the National Administration of Surveying, Mapping and GeoInformation (NASG). The datasets, drawn from Landsat – 4, 5 and 7, MODIS, and Chinese HJ scenes, are organized by 10 major land cover classes and provide essential high resolution land cover and change information freely available for climate change studies, environment monitoring, resource management, sustainable development, and other societal benefit areas (Figure4).

Earth observation can play a positive role in promoting 'environmental' democracy as well. EO data makes environmental harms easier and quicker to trace (e.g. oil spills, forest fires etc) and track and allows empirically grounded and analytically rigorous decision making vis-à-vis sustainable development. This could in turn lead to more accountability and transparency to the policy making and decision making process.

The Rio+20 outcome document, 'The Future We Want', specifically recognizes the importance of "reliable geospatial information" in the areas of national disaster risk reduction strategies and plans (including comprehensive hazard and risk assessments), and for sustainable development, policymaking, programming and project operations[6]. Several initiatives at global and regional level are effectively utilizing geospatial information to combat climate change. The efforts of United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) in promoting the use of earth observation to monitor and track the efforts being put in by various countries in achieving SDGs is noteworthy. UN-SPIDER also promotes the use of space-based data to generate

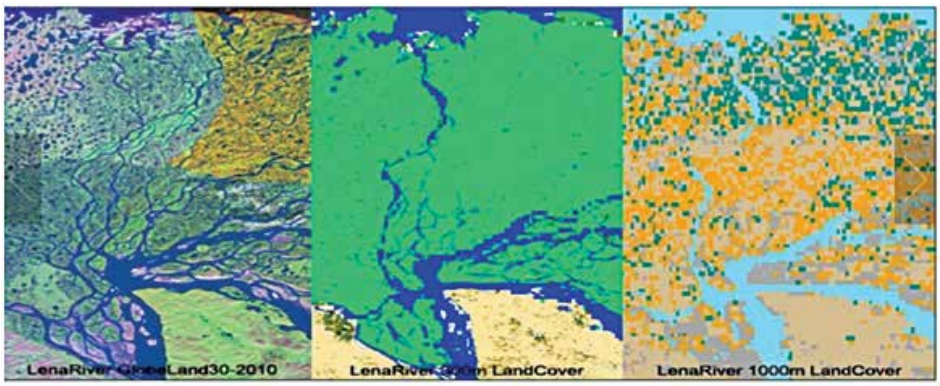


Figure 4: Land Cover image for Lena River, 2010: Extreme Left to Right – GlobeLand30, 300m Land Cover, 1000m LandCover

Source: GlobeLand 30

policy-relevant advice to reduce losses and damages triggered by hydrometeorological phenomena and sea-level rise. In the area of disaster risk reduction and emergency response, UN-SPIDER contributes to the efforts laid down in COP21 in the area of early warning taking note of the launch of the Climate Risk Early Warning Systems (CREWS). CREWS is expected to contribute to one of the seven targets that was established in the Sendai framework for disaster risk reduction and focuses on increasing the availability of and access to multi-hazard early warning systems. In a parallel fashion, UN-SPIDER provides technical advisory support to civil protection agencies world wide in the areas of disaster preparedness and disaster risk assessment.

Figure 5: Satellite images of Aceh province, Indonesia, one week after the tsunami, in January 2005 (left), and 10 years later in December 2014 (right)

Source: UN-SPIDER, Geospatial World

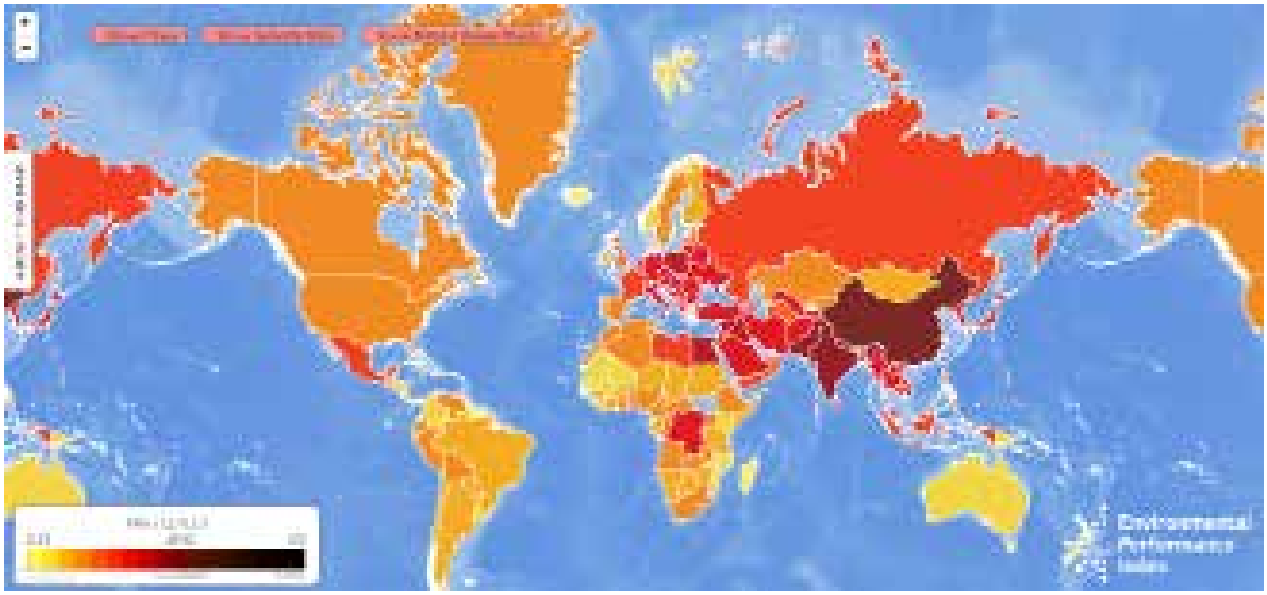


Figure 6: A team of Yale University environmental researchers released a map tool that shows concentrations of fine particulate matter (PM 2.5) across the whole world in pretty astounding detail: each pixel represents a 10-by-10 km square. PM 2.5 is invisible to the human eye but penetrates into blood and organ tissues, and can lead to cardiovascular and respiratory diseases.
Source: http://epi.yale.edu/visuals/airmap/

IV. NEED OF THE HOUR – QUALITY GEOSPATIAL DATA IN SPACE AND TIME

The Millennium Development Goals (MDGs) mobilized support of United Nations Member States to focus on poverty and human wellbeing. The monitoring of MDGs taught us that data are an indispensable element of Sustainable Development Agenda. Despite improvement, critical data especially geospatial data, for development policymaking are still inadequate. Understanding that quality, accessible, timely and reliable disaggregated data will be needed for the success of SDG Agenda, the United Nations agreed to intensify efforts to strengthen statistical capacities in developing countries and least developed countries. Goal 17 explicitly discussed the need to strengthen the means of implementation and revitalize the global partnership for sustainable development[7] as Table 2.

Geospatial professionals, for many years, both individually and collectively, have articulated and stressed the role, need and value of geospatial information, technology and services to the governments and decision makers. According to Greg Scott, Inter-Regional Advisor at UN-GGIM and Prof Abbas Rajabifard, Head of Department of Infrastructure Engineering, University of Melbourne, "Now is the moment in time where we can, and must, elevate and demonstrate our 'geospatial value proposition'. The global geospatial community, particularly through national geospatial information agencies, has a unique opportunity to integrate geospatial information into the global development agenda in a more holistic and sustainable manner, specifically in measuring and

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Table 2 :

SDG Goal & Target	Indicators
Data Monitoring and accountability:	
17.18 By 2020, enhance capacity building to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts.	17.18.1 Proportion of sustainable development indicators produced at the national level with full disaggregation when relevant to the target, in accordance with the Fundamental Principles of Official Statistics. 17.18.2 Number of countries that have national statistical legislation that complies with the Fundamental Principles of Official Statistics.
Multi-stakeholder partnerships	
17.16 Enhance the Global Parnership for Sustainable Development, complemented by multi-stakeholder partnerships that mobilise and share knowledge, expertise, technology and financial resources, to support the achievements of the SDGs in all countries, in particular developing countries. 17.17 Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships.	17.16.1 Number of countries reporting progress in multi-stakeholder development effectiveness monitoring frameworks that support the achievement of the SDGs. 17.17.1 Amount of United States dollars committed to public-private and civil society partnerships.

monitoring the targets and indicators of the SDGs. However, the opportunity brings with it substantial expectation to deliver!"[8]

This is not an easy task as very little is understood regarding the role of geography in sustainable development processes at the inter-governmental level, including how geospatial information can be applied to sustainable development, and how policies can be implemented to bring the two together in a coherent and integrated manner. However, at country level, a few common threads could be identified in line with the SDG Goals and targets that could potentially be useful in many developing countries. These include (and not limited to):

➲ **Creating New Data Avenues:** The 2030 Agenda demands the need for new data acquisition and integration approaches to improve the availability, quality, timeliness and disaggregation of data to support the implementation of the development agenda at all levels. Encouraging new and innovative approaches to EO data creation including small satellites, drones and crowdsourcing will facilitate rapid data creation and access in real and near-real time.

➲ **Open Access to Data:** Opening up archival data, open data access including free access to data is necessary to be able to address the 'furthest behind'.

➲ **Mainstreaming EO:** Earth observation data and analyses are already being used sporadically in various sectors that contribute to sustainable development, including agriculture, climate change, disaster management and monitoring urban change. The need now is to mandate and mainstream the use of earth observation data and tools across the policy continuum, especially for the environment policy. This will augur democratization of EO and will bring a positive spurt in data production, easy and free online access of quality archival / current data, thereby accelerating the uptake and application of EO data closing the gaps highlighted by data paradox.

➲ **Expanding Capacities:** Even where data is available, developing countries are limited in their capacities – IT infrastructure, technology to process and analyze data and human resources. The 2030 Agenda recognizes this roadblock and recommends progressive capacity development mechanisms, which countries need to adopt and step-up their capacities. To this end, governments need to take stock of their existing and expected capacity needs and evolve mechanisms to find strong mission partners to fund and fill the existing gaps.

➲ **Make NSDIs Relevant:** The 2030 Agenda can act as a trigger in revitalizing and making the national spatial data infrastructures (NSDIs), national geospatial information agenciesand/or equivalent apex bodies/mechanisms that exist in many countries relevant to meet the needs of SDGs. This will also build a consensus on the need to integrate the NSDI within national government's development plans. An NSDI strategy that is anchored to sustainable

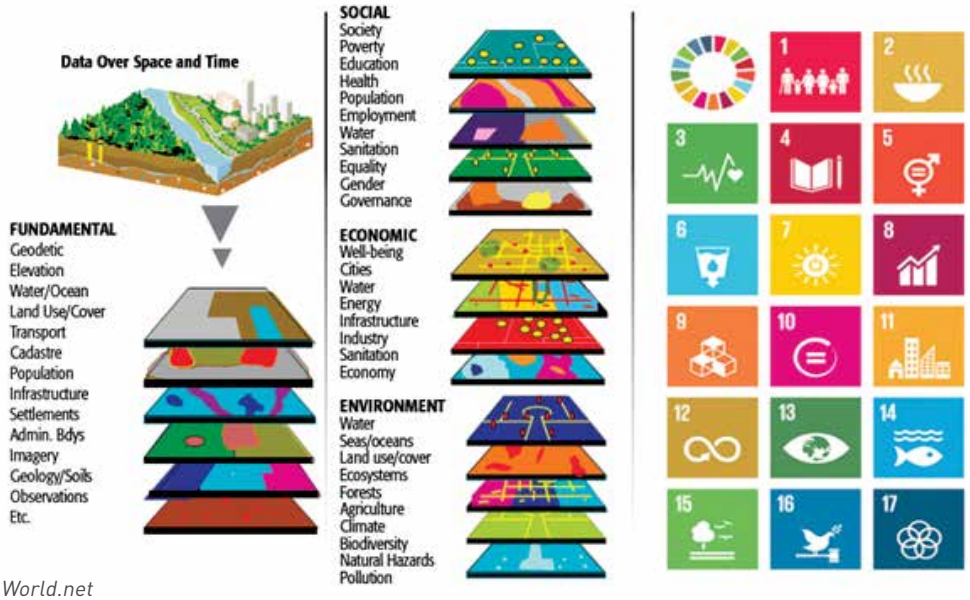

Figure 6: Extending national fundamental data themes to the 17 SDGs and targets by menas of the global indicator framework

Source: UN-GGIM, Geospatial World.net

development, as an overarching theme, would provide an 'information' approach to national policy and implementation. It would also bring the analysis and evidence-base to the process, and thereby a consistent monitoring and reporting framework, that would benefit all areas of government.

It would also benefit to task the NSDIs to work closely with and support the national statistical offices in evolving SDG targets at national level and also in measuring and monitoring the progress of SDGs.

➲ **Collaborative Approach:** Collaborative approaches need to be encouraged to link different data – demographic, statistical, earth observations, environmental and other societal geospatial data together with the one thing they have in common – to geographic location[9]. NSDIs and statistical offices in countries can play a key role in evolving such collaborative mechanisms with the active engagement of geospatial community and other relevant organizations.

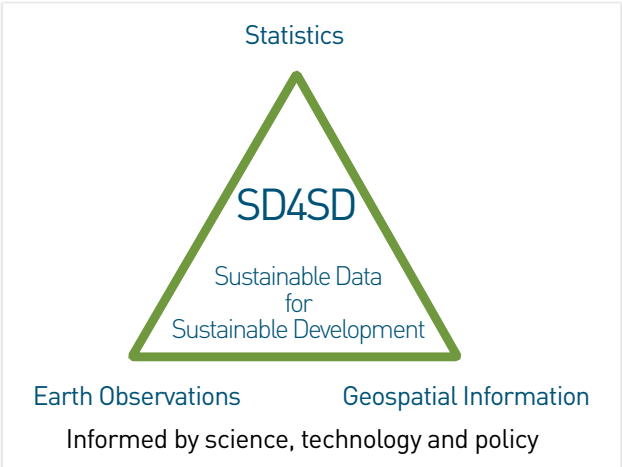

Figure 7: Key areas of data contribution to the global indicator framework

Source: UN-GGIM, Geospatial World.net

➲ **Private Industry Stakeholders:** Significant technology innovation and intellectual capacities developed within the private sector often either do not percolate or see delayed adoption by government entities leading SD activities. Considering that EO industry is taking-off rapidly in private space with cost-effective innovations in sensor technologies, small satellites and drones supported by advancements in IT and data analytics, it is prudent to make private industry an equal stakeholder and partner in policy-making, in evolving regulations and in implementing projects pertaining to SDGs. For example, the Global Partnership for Sustainable Development Data supports data-driven decision-making by initiating more open, new and usable data. It also helps to develop and build support for international principles tying together the data, including sharing and leveraging current, privately held data.

➲ **Geospatial Partnerships:** Evolving partnerships at global, regional and national levels among geospatial entities like UN-GGIM, GEO, CEOS, UN-SPIDER, GCOS, OGC, GSDI, ISPRS etc. For example, The United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) is working closely with the statistical community, at national and global levels, to provide inputs into the processes to develop the global indicator framework with the IAEG-SDGs. Led by Denmark, a task team of 15 countries is providing geospatial inputs.

The Group on Earth Observations' (GEO) initiative GI-18 envisions the organization and realization of the potential of earth observations to advance the 2030 Agenda along with 102 participating organisations. The initiative aims to enable countries and organisations to leverage EO to support the implementation, planning, monitoring, reporting and evaluation of the SDGs and their normative societal benefits. The initiative also serves to advance GEO's strategic engagement with entities at national to international levels[10].

Further, at its recent Ministerial Summit, GEO launched an initiative to expand its partnership with UN-GGIM to build processes, mechanisms and capacity to integrate earth observations with geospatial and statistical information to improve the measuring, monitoring and achievement of the SDGs.

While, these efforts have played and continue to play a key role in developing the geospatial aspects and inputs for the indicator framework, common frameworks also need to be developed from the ground up. We need to create information networks starting at the grassroots level as well and building up to sub-national, national, regional and global levels. There is a lot of work in progress at various levels and there is an imminent need to evolve partnerships for creating common frameworks that directly and indirectly contribute to the success of the Sustainable Development Goals (SDGs).

➲ **Sensitizing Political & Administrative Class:** The success of SDGs hinges heavily on the vision, motivation and commitment of the decision-making fraternity. It is important to sensitize and encourage local political centres and senior administrators to 'own' and 'lead' the geospatial efforts in their respective countries. Without their involvement, much of the data and information derived from it will remain in the ivory tower of 'space research'.

V. CONCLUSION

Data, especially geospatial data, is the basis for evidence-based decision-making, monitoring and accountability and is crucial to the success of the 2030 Agenda. The geospatial community recognizes that location and geography are significantly linked to many, if not all, elements of SDGs. The task before the world geospatial community now is to push the 'geospatial value proposition' envelope to the governments and decision-makers at every level. The United Nations expects that by 2020 nations are able to increase significantly the availability of high-quality, timely and reliable national data that is disaggregated by a number of characteristics and build capacities to utilize the same. This will require collective global and national leadership coupled with pragmatic and appropriate approaches to harness the existing data along with new, reliable and fit-for-purpose data, and integrate the same into the wider sustainable development process, thereby demonstrating the power, functionality and value of data.

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