THE SDGs GEOSPATIAL ROADMAP

SUSTAINABLE DEVELOPMENT GOALS

SDGs GEOSPATIAL ROADMAP


SDGs
GEOSPATIAL
ROADMAP

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EXECUTIVE **SUMMARY**

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2020 was intended to be a milestone for global sustainable development. Twenty years on from the inception of the Millennium Development Goals and five years into the SDGs, regardless of the present global situation, the transformational vision and new data requirements called for to realise the 2030 Agenda, has not been fully realised. The extent of this challenge has been underestimated and is further amplified by gaps and an unequal distribution of the foundational geospatial data, leadership, knowledge, and innovation which all countries need. While technologies are evolving at a rapid pace, the commensurate capabilities, skills, and opportunities in the developing countries are not, and countries are being left behind. This is a gap that must be bridged; this SDGs Geospatial Roadmap provides simple and actionable guidance to the Inter-Agency and Expert Group on the SDGs, Member States and Custodian Agencies to bridge this gap and realise the innovation potential that using geospatial information and its associated technologies can bring to the SDGs.

GEOSPATIAL ROADMAP

This SDGs Geospatial Roadmap has been developed collaboratively as a strategic information and communications mechanism that 'builds the bridge' and understanding between the statistical and geospatial actors working within the Global Indicator Framework. The vision of the SDG Geospatial Roadmap is to see geospatial and location-based information being recognised and accepted as official data for the SDGs and their global indicators. This vision expands on the recommendation of the IAEG-SDG's Working Group on Geospatial Information (WGGI) that, while official statistics are the foundation on which the SDGs are built, the SDGs cannot be fully realised using official statistics alone particularly when they are not produced in sufficient quality, detail and frequency. In fact, the SDGs are highly dependent on the understanding of geographic location, necessitating the inclusion and use of geospatial information, Earth observations and other forms of location-based data.

Therefore, **the SDGs Geospatial Roadmap is a living resource that helps communicate, guide and enhance the awareness of geospatial information, Earth observations, and related data sources, products, and enabling tools and methods, to inform and support the implementation of the SDGs, according to national circumstances.** It achieves this through three phases that detail how and why geospatial information is needed, and how it can be applied, to support countries in their national implementations of the SDGs. In highlighting available resources, existing global geospatial frameworks and novel innovative approaches, the SDGs Geospatial Roadmap is supported by a series of **Key Actions, Case Studies and supporting guidance** for each phase that recommend the unique value proposition and opportunity that geospatial information can and does provide, and identifies what needs to be done, when, why, and by whom. Therefore, the Roadmap contextualises the opportunity for geospatial information to meet the challenge of the SDGs.

INTRODUCTION

INTRODUCTION

In July 2017 the General Assembly, in its resolution 71/313, adopted the Global Indicator Framework for the 17 SDGs and 169 targets of the 2030 Agenda for Sustainable Development, as developed by the IAEG-SDGs. The Global Indicator Framework was earlier agreed upon by the Statistical Commission at its forty-eighth session, held in March 2017. The resolution stressed that official statistics and data from national statistical systems constitute the basis needed for the Global Indicator Framework and recommended that national statistical systems explore ways to integrate new data sources into their systems to satisfy new data needs of the 2030 Agenda. In line with the requirements of the 2030 Agenda, the SDG indicators should be disaggregated, where relevant, by income, sex, age, race, ethnicity, migratory status, disability and geographic location, or other characteristics, following the Fundamental Principles of Official Statistics.

What is Geospatial Information?

Geospatial information is a nation's 'digital currency' for evidence-based decision-making. It is a critical component of a national infrastructure and knowledge economy that provides a nation's blueprint of what happens where, and the means to integrate a wide variety of government services that contribute to economic growth, national security, sustainable and equitable social development, environmental sustainability and national prosperity. In providing the integrative platform for all digital data that has a location dimension to it, all countries must leverage their national geospatial information system to enable informed national development and decision-making.

Yet, as of 2021 we have not yet achieved the transformation progress needed to attain the SDGs. As the reporting requirements of the 2030 Agenda add an extra layer of work to National Statistical Offices (NSOs), at a time when many are already facing ever higher pressures caused by national and global reporting frameworks. Further, while official statistics are the foundation on which the SDGs are built, they cannot be fully realised using official statistics alone. The SDGs are highly dependent on geospatial information and Earth observations (EO) as the primary data for relating people to their location and place, and to measure 'where' progress is, or is not being made, particularly at 'disaggregated' sub-national and local levels.

The Working Group on Geospatial Information (WGGI) of the Inter-Agency and Expert Group on the SDG indicators was established to directly support and complement the ongoing work of the IAEG-SDGs and its implementation of the Global Indicator Framework, where the **geospatial data acquisition, integration and statistical disaggregation** is most needed.

What are Earth Observations?

Earth Observations (EO) are an all-encompassing term for planetary scale, space-borne, airborne and in-situ observations of the Earth's surface. EO data is borderless, impartial and inclusive for all. It is also a crucial data source for many of the SDG indicators describing the environmental aspects of the planet. Designed for planetary-scale coverage, satellite EO has some key characteristics which make it an indispensable source of data for a number of SDG indicators and a supporting source of data for many others. However, while the data has a potential global coverage, there are significant demands for the consummate skills and resources to fully realise its potential.

The SDGs Geospatial Roadmap aims to communicate the value of the support already provided to the IAEG-SDGs, UN custodian agencies, and Member States, providing practical guidance for the use of geospatial information for the measurement and monitoring of the SDGs, and elaborates on the vision to see geospatial and location-based information being recognised and accepted as official data for the SDGs and their global indicators, providing practical guidance which enables its mainstreaming at any level of development. It achieves this through demonstrating how to 'build the bridge' between the statistical and geospatial actors working within the Global Indicator Framework, through three phases:

PHASE 1:	PHASE 2:	PHASE 3:
Prepare and Plan	**Design, Development and Testing**	**Producing, measuring, monitoring and reporting geospatially enabled SDG indicators**

The SDGs Geospatial Roadmap is addressed to NSOs who are primarily responsible for the implementation of the various frameworks that enable for the integration of data across the national data ecosystem; an ecosystem that extends beyond the NSO, but which the NSO is a key actor. This can include the National Geospatial Information Agency (NGIA), the national (or regional) space agency, custodian agencies of the United Nations System and other stakeholders within the data community. Significantly, innovations within the geospatial information and EO communities, and their enabling technologies, can be leveraged to transform the measurement, monitoring and production of indicators to support the 'leapfrogging' of countries that currently lag behind.

This roadmap was developed from the collaborative work of the members of the WGGI, from the design of the structure to its content, which results from a broad process of qualitative consultation with the statistical institutes of the member countries, seeking to understand the deep and diverse problems in this subject, and of custodian agencies and experts for the co-creation of a set of guidelines that seek to address the main difficulties.

Many of the challenges recognized do not have a clear, obvious and immediate solution, this is particularly acute for those challenges in the area of governance. The SDGs Geospatial Roadmap aims to be an interactive living resource, which invites the statistical, data and geospatial information communities to contribute with new resources, services and examples of best practices, as they emerge, which will be added to the Roadmap's Storymap.

What is disaggregation by Geographic Location?

The ability to disaggregate SDG indicators where relevant, into thematic areas related to age, gender, economic status, and income is a key tenet of the "leave no one behind" philosophy of the 2030 agenda. While the initial development of the Global Indicator Framework largely constituted a statistical data approach, the need for 'disaggregation by geographic location' is now well recognised to ensure that no one is left behind. Development is no longer only knowing about 'people' as national aggregations, but also their 'place' and their environment, and consequently their geographic location at a subnational level. Ensuring that data are more spatially-explicit and can be disaggregated spatially at sub-national level, (e.g. by administrative or functional units such as urban/rural areas or basins/sub-basins) is key to the 2030 agenda since it allows to augment national statistical data by providing an additional level of spatial granularity of the indicators for more informed decisions within countries.

How to Use the SDGs Geospatial Roadmap

The SDGs Geospatial Roadmap brings together the collective experience of the WGGI, incorporating case studies and national examples, specific resources and tools, and highlights further areas for exploration and consideration and those that work to address global challenges.

Each Phase is composed by a contextual introduction, lists of resources, and Key Actions, which are simple actions that can be undertaken to establish/strengthen national capacity in using geospatial information for the SDGs.
In alignment with the three main areas of influence of the Integrated Geospatial Information Framework (IGIF) - see annex 1 -, the Roadmap contextualises along the areas of governance, technology, and people. The interconnected nature of these areas means that actions to use geospatial information for the SDGs are interlinked, offering many opportunities to develop and strengthen capacity.

Importantly, countries are urged to recognise that while using geospatial information may be innovative given the national environment, this experimental approach is shared by all countries, regardless of their current capability or capabilities. In developing this Roadmap, perspectives were provided from stating that they were operating at the cutting edge of innovation to acknowledging that often basic equipment (including computers, internet, and electricity) and skills were not available or were previously established but were not sustained.

As such, the Key Actions are also intended to be milestones for 'checking in' on progress. The rapid pace of innovation within the global geospatial information community means that the data we have today, in terms of quality (in its many dimensions), resolution and other attributes will be better tomorrow. Accordingly, the Roadmap can be used as a tool to help countries identify what they need to start to use geospatial information, or for strengthening existing capacities.

Key Actions

A Key Action is millestone for countries to enact to work towards the strengthening their use of geospatial information for the SDGs. They will be distilled in a box, with the main, text elaborating why these actions are key.

Each phase details:
1. A context and descriptive of the main problems expressed by a representation of the sector.
2. A table of Key Actions.
3. Orientations towards annexes, attached documents or URL to external resources.
Depending on the status of your country, some of the resources will be more appropriate in the present than others that could be considered useful for future phases.

PHASE 1: **PREPARE AND PLAN**

PHASE 1: **PREPARE AND PLAN**

The Phase 1 of the SDGs Geospatial Roadmap, Prepare and Plan, focuses on providing key actions to establish a basis from which to use geospatial information for the SDGs. The 2030 Agenda, its Goals, Targets and the actual Global Indicator Framework are built upon the recognition that future sustainable development strategies must be inclusive, with universal respect for equality and non-discrimination, transformative for people and planet and importantly evidence-based and data-driven. The acquisition and maintenance of the data needed to fulfill these objectives are often conducted at a national level by a variety of agencies, primarily NSOs and NGIAs, but includes many others within a national data ecosystem. From these data, two elements should be considered:

- *The production, measurement, and monitoring of indicators*
- *The disaggregation of these indicators by geographic location and other characteristics*

But, the complex nature of this process means that for many countries, the intensive requirements of the SDGs cannot always be achieved due to several reasons: lack of access, coordination and sharing of data within the national data ecosystem, missing data, incomplete coverage, inconsistent reference system, inaccurate or a lack of authoritative data, and absence of updating policy, among many other issues.

The availability of new technologies and approaches can both be a positive driver, or serve to increase perceived complexity. However, it must be noted that geospatial information and its associated enabling technologies offer one of the best ways for innovation in the areas of statistics and data science, and to enable the augmentation of national statistics where needed. Geospatially enabling the existing national data ecosystem will help countries more comprehensively meet the requirements for producing, measuring, monitoring and reporting the SDGs. But there is a consummate lack of geospatial information management skills, analysis, and methodologies, which in itself limits countries to identify needs and solutions. So, where to start?

The starting point is to recognise that the needs of the SDGs are not to be considered in isolation. The data needs of the SDGs are the same data needs that empower national decision-making or progress towards other complementary global agendas. Yet, while each country makes progress towards the SDGs, it is crucial to articulate and recognise the value that all elements of the national ecosystem can bring to the SDGs, and vice-versa. When leveraging the transformational potential of geospatial information, this includes bringing together NGIAs, Cadastral and National Space Agencies, Urban Development and other national institutions that are the knowledge centres and geospatial information producers.

Now is the time for NSOs and other agencies producing official statistics to recognise that the gaps in their statistical production processes can be significantly augmented and improved through the appropriate use of non-conventional methodologies and data. These new insights allow for concrete advances in the analysis of national economics, gender equity issues, poverty, environmental factors and other domains, as detailed and exemplified in the Box 2.

Key Actions

1. Establish a National Committee to coordinate SDGs, composed of all relevant agencies (inc. NGIA, NSO, Space Agency, etc.).

2. Use the Global Fundamental Geospatial Data Themes to identify your national data capacity and highlight potential data gaps.

3. Work towards the implementation of guiding Frameworks, like the Integrated Geospatial Information Framework, the Global Statistical Geospatial Framework and the Generic Statistical Business Process Model.

4. Assess available Skills a rid Technological capacity, leverage regional platforms, establish partnerships with academia and the private sector to bridge gaps.

[Key Action 1] Accordingly, form a National SDGs Committee to help coordinate the production of the SDGs. Many countries have established these communities, but this is not yet universal. In this National Committee which holistically considers the SDGs, there should be a subcommittee focused solely on the coordination and use of geospatial information. This National SDGs Committee will help with coordination for the SDGs, while strengthening interlinkages at the national level. The National SDGs Committee should be led by a high-level and effective communicator, ultimately, ensuring that all decision-makers are aware that the needs of the SDGs are the needs of national development.
Box 1 details as an example how Ireland and Colombia have established governance arrangements according to their national circumstances.

[Key Action 2] Often, national data ecosystems can be fragmented, for several reasons challenges the integration of data - underscoring the importance of interoperability of data. It should be expected that there will be gaps that remain in the national data ecosystem and that gaps are not exclusive to one singular country. As such, regardless of your existing data circumstances, identify what data is available for the SDGs and what sorts of data are needed to evaluate progress towards the SDGs. A useful framework for 'filling in the data gaps' are the 14 Global Fundamental Geospatial Data Themes. These offer a basis for understanding the various data needed for the production, measurement, monitoring and disaggregation by geographic location of the Global Indicator Framework. Especially in countries where access to technology, software and skills are not as strong as in others, the themes offer a simple template to evaluate national data capacity and availability, as a basis that will enable the development of a strategy, prioritization, and baseline for indicators production.

Conversely, at the global level and also aligned with the 14 Themes, are the **WGGI's reports on "Global and Complementary Geospatial Data for SDGs"** and "**Land Cover Datasets for SDGs**". These resources identify specific sources of geospatial data, often data that is freely available at no-cost at the point of delivery - "open data". These offer an entry point for countries to access the data, technology and skills available outside the national context. In this context, EO offers the largest opportunity to transform and augment national efforts to use geospatial information for the SDGs. In addition, when data is non-existent or insufficient, methods that use non-conventional data or analysis can be employed to complement traditional approaches. Box 2 provides further context on how to establish a framework to introduce non-conventional data and methods within the measurement strategy.

[Key Action 3] Therefore, when establishing the data baseline to produce indicators, a useful starting point is to **determine the availability of the 14 themes at the national level**; potential gaps at the national level could be resolved at the regional level (discussed in Phase 2). But, it is not the sole resource available to help with elevating national capacity for using geospatial information for the SDGs. Here, **three guiding frameworks, the IGIF, GSGF and GSBPM can combine to enable the use of geospatial information for the SDGs**. The three guiding frameworks individually and collectively support the NSO (GSBPM), the NGIA (IGIF), and the bridge between them (GSGF). The outputs and inputs to each of these frameworks are the data of the Global Fundamental Geospatial Data Themes.

Key Frameworks

- Integrated Geospatial Information Framework.
- Global Statistical Geospatial Framework.
- Generic Statistical Business Process Model.

[Key Action 4] The needs for developing technological capacity for using geospatial information will differ across countries - in the process of developing this Roadmap, discussions with Member States highlighted the vast differences in their capacities, some reported difficulties with access to basic computing, internet connectivity and software, other countries reported low capacity in using geospatial information and EO for producing, measuring and monitoring SDGs, while others raised structural difficulties, including lack of institutions needed to coordinate across diverse data producers.

Establishing an enabling environment for geospatial information to empower the SDGs is the primary outcome of implementing global geospatial frameworks like the IGIF, GSGF and the Global Fundamental Geospatial Data Themes (see Annex 1 for the elaboration of these frameworks). These frameworks help strengthen the national capacity to use geospatial information, yet, their strategic pathways, principles or themes cannot be realised unless there is a consummate level of development in the capacity for integration of statistical and geospatial information, technology and people.

There are many technological systems and approaches for the management of SDG indicators, but one is recommended by both the Statistical Commission and the Committee of Experts on Global Geospatial Information Management (UN-GGIM), the Federated System for the SDGs (FIS4SDGs). The FIS4SDGs provides a complete enabling environment for national and international reporting for the integration of SDGs. It offers countries a basis from which to establish capability and readiness. Moreover, while nationally owned and implemented, it enables dissemination and interoperably within the national and global SDGs ecosystem. Several countries of varying capacities have implemented the FIS4SDGs, demonstrating its applicability to guarantee the standardized management of SDGs indicators, regardless of the data or methodology used in their production and will help assist countries with the technology components of all Phases of this Roadmap.

Throughout discussions with countries, custodian agencies and experts, it was repeatedly observed that despite significant investments to develop skills in countries that lag furthest behind, there is an inherent fragility in the sustainment of capacity, knowledge and skills. While regional and global cooperation, events and workshops can help to build local teams of experts, persistent capacity and skills still need to be maintained. Therefore, the Roadmap recommends that the National SDGs Committee establishes a national baseline of technical/skills capacity. Strategic Pathway 8: "Capacity and Education" of the IGIF is accompanied by a detailed Annex, containing tools which enable countries to conduct a Capacity Needs Assessment, highlights common components of a 'capacity development and education strategy', and other assessment tools.

Key Framework

The Global Fundamental Geospatial Data Themes

Key Technology

The Federated Information System for the SDGs (FIS4SDGs)

The FIS4SDGs, an initiative led by DESA's Statistics Division, in partnership with Esri, that leverages state-of-the-art web technologies and services to improve the integration, accessibility and usability of official statistics, geospatial information, and other sources of data, including from outside the official statistical system, to support decision makers at the local, national, regional and global levels in achieving the 2030 Agenda.

The FIS4SDGs creates an enabling environment for the national and international reporting and the integration and analysis of SDG data and statistics across a system of federated data hubs, thus strengthening the capacity of national statistical and geospatial information systems to respond to the data needs of decision and policy makers, and their international partners, at the country level. Based on the principle of national ownership, where the National Statistical System implements internationally agreed standards around the production and dissemination of data and statistics, in line with country-specific priorities and ongoing capacity building efforts.

The federated architecture supports an interoperable data ecosystem enabling independent global and national SDG Data Hubs can publish and share with each other, authoritative SDG data and information on a common platform, enabling users to not only access the data they need when they need it, but also ensure the traceability and accountability of the data, which is maintained at its source.

Box 1: *Ireland and Colombia's Governance Story*

COLOMBIA

In February 2015, Colombia took decisive steps forward in the implementation and fulfilment of the shared vision of the 2030 Agenda. Through the creation of Colombia's High-Level Commission for the preparation and effective implementation of the 2030 Agenda and its SDGs, there is a significant national commitment to strengthen the interlinkages across the Colombia government and incorporate all relevant institutions and stakeholders for the 2030 Agenda, including its Statistical and Geospatial Agencies. The High-level Commission's Technical Secretariat is provided by the National Planning Department, the technical advisory body to the President, and the technical committee reports to this body. Subsequently, in March 2018, the public policy document "CONPES 3918 of 2018 Strategy for the implementation of the SDGs in Colombia" was approved.

This document provides the roadmap that the country will follow, with the aim of realising the 2030 Agenda and defines the scheme for monitoring and reporting progress in the implementation of the SDGs in Colombia, which included prioritising 180 indicators based on national development needs.

The definition of the indicators was carried out through workshops and roundtables with the participation of more than 200 people from 44 national government entities. To guarantee the visualization and reporting of progress, the national entities must annually report to the National Administrative Department of Statistics (DANE) information corresponding to the indicators, in its capacity as coordinator and regulator of Colombia's National Statistical System. Once DANE verifies the quality and timeliness of the data, they are uploaded to a national SDG platform which consolidates and disseminates all relevant information related to Colombia's reporting of the SDGs. Additionally, DANE in collaboration with the technical secretariat of the IAEG-SDGs, led by the country teams of UNFPA and FAO, worked together to produce the resource "Guide to measuring and reporting on the global indicators in the United Nations Sustainable Development Cooperation Framework" (1). The Guide is a key national tool to assist in the identification and bridging of data gaps for monitoring the 2030 Agenda. The actions described within it contribute towards measuring the global development agenda of the SDGs, but is also a key element for compliance with national development priorities, as identified by the provisions of CONPES 3918.

IRELAND

Ireland's National Agencies for Statistics (Central Statistics Office – CSO) and Mapping (Ordnance Survey Ireland – OSi) have a long-established working relationship, formalised through an Annual Memorandum of Understanding (MoU). This MoU was prompted by two events in 2017: 1. An invitation to join the UN's Federated Information System for the Sustainable Development Goals (FIS4SDGs) initiative; and, 2. The publication by the Conference of European Statisticians (CES) of a Road Map on Statistics for SDGs. From the basis this MoU provides, the CSO and OSi continue their collaboration with the goal to develop and deploy a new approach for the national measurement and monitoring of the 231 SDGs Indicators using geographic information systems, thereby realising the geospatial potential of statistical data.

A joint OSi/CSO SDG team, with Esri Ireland as the technical partner, was formed and quickly developed Ireland's HUB for SDG. This data is disseminated and hosted on the OSis GeoHive web portal, where interested parties can openly access, visualise and download data, and consume data through open, and standardised web APIs. In parallel, the CSO also developed a series of statistical SDG publications. A group of nationally focused electronic publications are designed to inform Ireland's SDGs Voluntary National Reports (2).

Governance is central to the success of work undertaken by the OSi/CSO. Weekly meetings are held by the OSi/CSO team; at the same time, the CSO has established a national SDG Indicators Data Governance Board, consisting of various stakeholders from Government Departments and Agencies, which meets on a quarterly basis to identify sources of data needed to support the national Indicators.

(1) This resource is available in Spanish and English
(2) https://www.cso.ie/en/statistics/unsustainabledevelopmentgoals/

There is also a UN SDG Senior Government Officials Group, chaired by the Government Department with national responsibility for the implementation of Agenda 2030, of which both the CSO and OSi are invited members. Further, the work of the OSi/CSO SDG team is guided by overarching global statistical and geospatial frameworks, including the IGIF, GSBPM, and the GSGF. Annex 1 provides a "Frameworks Explainer" to highlight how to optimise the usage of global geospatial frameworks for the SDGs.

Box 2: *Embracing non-conventional methods and data to bridge data gaps*

What can we call non-conventional methods and data?

Non-conventional methods can be defined as new and innovative ways of evaluating and testing programs and assessing different forms of data and data collection that, in part or in whole, do not correspond to traditional and officially recognized and certified methods, statistics and data sources. They can be scientific processes that mix mixed sources, including or not official ones, can modify, adapt officially used statistical methods, make use of innovative processes such as Artificial Intelligence, and integrate data from various origins, not produced or validated by public agencies, such as satellite images, or data from social networks or mobile telephony.

Citizen Science

Some non-conventional methodologies integrate the participation of citizens at various stages. We can differentiate between Crowdsourcing and Citizen Science, where crowdsourcing is the practice of obtaining information or input into a task or project by enlisting the services of a large number of people. Whereas, Citizen Science encompasses action within data management including classification, analysis, and validation (for example through people's participation in an artificial intelligence process), leading to insights, assessments or scientific research and knowledge production. There is already significant work that has been undertaken to identify how Citizen Science can benefit the production, measurement and monitoring of SDG indicators (3), with several cases of countries using Citizen Science and other non-conventional methods to make progress towards the SDGs. Looking forward, Citizen Science has a vast opportunity to reduce the wide inequality in production, measurement and monitoring that exists today between countries and provide countries with trusted and actionable data.
To fully embrace the potential of citizen science and other non-conventional methods, shared Networks can be joined, such as the WeObserve SDGs and Citizen Science Community of Practice led by the International Institute for Applied Systems Analysis and the EO4SDG initiative of the Group on Earth Observations (GEO) and other spaces where methods, cases and resources are shared.

(3) Fraisl Dilek, Jillian Campbell, Linda See, Uta Wehn, Jessica Wardlaw, Margaret Gold, Inian Moorthy et al. "Mapping citizen science contributions to the UN sustainable development goals." Sustainability Science 15, no. 6 (2020): 1735-1751;
Examples shown as a storymap: **cutt.ly/PQoizUS**

GHANA

Ghana's NSO has used data from processes that integrate Citizen Science to measure various indicators. The vast coastline of the country provides an immense challenge to monitor progress towards SDG 14.1.1 (a) Index of coastal eutrophication; and (b) plastic debris density. SDG 14.1.1 on marine litter is crucial to understand how the human footprint is impacting the natural environment, informing national policy, and for building consumer awareness of issues related to the use of plastics. The monitoring of these effects is challenged by the scale of this phenomenon, but Ghana is taking pioneering steps to use Citizen Science to complement conventional data sources primarily through using data cards and the Clean Swell mobile application to enable citizens to record data pertaining to the location, weight of debris collected, type of waste. Further information can be found here: Towards measuring SDG 14.1.1 in Ghana.

MEXICO

The National Institute of Statistics and Geography (INEGI), Mexico´s combined NSO and NGIA, progressively established a Data Science Laboratory (LCiD) under its "Research" pillar. The development of competencies for the use of non-conventional methods and data, data science in general, and the methodological improvement of their integration into official statistics require a long-term institutional effort for their maintenance and progress.

To make this possible, INEGI has established a permanent structure and mechanisms to ensure that such data meet quality standards, and additionally, to give a precise and formal mandate to the laboratory to preserve this initiative from changes in administration and operational dynamics. The Data Science Laboratory brings together staff to foster their involvement in innovative projects with cross-pollination from specialists across its departments. This approach provides a platform to develop skills and capabilities within its staff, while enabling a fertile environment for innovation and testing. Ultimately, this enables INEGI to collaborate and mainstream novel research from its academic partners and develop the necessary infrastructure, to augment its traditional statistical production process with non-conventional methods and Citizen Science to produce, measure, and monitor SDG indicators.

In the case of the project "Women's access to care services and economic empowerment", a non-conventional method has been developed using automatic learning processes to classify the official national database of economic units (DENUE) in a comprehensive way, in order to understand which provide a Care service and which is their target population, to finally calculate geospatially the proximity of women to these via the road network, and the relationship it has with their participation in the economy. This unconventional method for an unofficial indicator provides a deeper understanding of a national concern. It can be seen through this storymap: cutt.ly/VQorWQE.

PHASE 2:
DESIGN, DEVELOPMENT AND TESTING

PHASE 2: **DESIGN, DEVELOPMENT AND TESTING**

By building on the foundation established by Phase 1, Phase 2: "Design, Development and Testing" identifies resources that help with assessing and deciding on which data, methods, gaps, issues, and actions to implement to use geospatial information in the SDGs. With 17 Goals, 169 Targets and 231 unique Indicators, and need to to measure progress for those who are vulnerable or in vulnerable situations, even in 2021, six years after the proclamation of its ambitious global vision, the overarching data needs, means of production, methodologies of measurement, and mechanisms of dissemination are not yet fully matured. Successive decisions of the Statistical Commissionon the need to have disaggregated statistics and the need to 'develop the necessary statistical standards and tools and build capacity on disaggregated data', including using geospatial location, including its decisions 47/101, 48/101, 49/101, 50/101, 51/101). Moreover, significant progress in the Global Indicator Framework has been made in these six years, this is perhaps best highlighted in the agreement of IAEG-SDGs to the Statistical Commission in 2021 acknowledging that there are only Tier I and II indicators. While there are no longer any Tier III indicators (i.e: currently there are no longer any indicators without an internationally established methodology or standard), out of the 231 indicators, 130 are tier I indicators (4), 97 are tier II indicators (5) and 4 relate to multiple tiers (with different components of the indicator classified in different tiers). Further, supporting the construction of the indicators are 531 data series, which includes time series data and data disaggregated by various characteristics, including by sex, age, and other relevant characteristics.

The interconnected nature of the SDGs means the involvement of agencies from across the national ecosystem, including environmental, agricultural, and cadastral agencies. Therefore, the roadmap recommends high-level commitment to an open discussion across the national ecosystem that supports the sharing of institutional challenges in the management of geospatial information for the SDGs, identifies indicators based on national priorities, and then seeks a shared commitment to bridging these gaps and the selection of indicators that are of specific focus to the national context.

Key Actions

1. Identify key sources to prioritize data needs.
2. Prioritise Focus Indicators based on national circumstances and priorities.
3. Commit to convening workshops to promote the sharing of kwnowledge and experiences.
4. Convene workshops with SDG Custodians to confirm appropriate data, methods and coordinate development support.
5. Collaborate with regional and global entities to leverage available capacity.

(4) Tier I: Indicator is conceptually clear, has an internationally established methodology and standards are available, and data are regularly produced by countries for at least 50 per cent of countries and of the population in every region where the indicator is relevant.
(5) Tier II: Indicator is conceptually clear, has an internationally established methodology and standards are available, but data are not regularly produced by countries.

[Key Action 1] While some indicators need local data all the way down to street and address level, others could benefit from a more regional/global data approach, or a combination of these two approaches could be applied. Further, with there still being extensive work ongoing by the SDGs Custodian Agencies in defining the metadata and methodological needs of the indicators, combined with the need for national capacity development to produce indicators, geospatial information has the potential to enable transformational at all levels, supporting not just the SDGs, but other developmental priorities within the national ecosystem, including the ambition of the 2030 Agenda of leaving no one behind.

To assist with highlighting if and how geospatial information can be used for the production, measurement and monitoring of indicators the "Short List" and "List of Indicators" are invaluable for supporting the design and development of what sources of geospatial information are needed. Specifically, the "List of Indicators'' identifies which indicators are capable of being produced, measured or monitored using geospatial information, and the dimensions of disaggregation. Box 3 elaborates on how to identify, and prioritise using Disaggregation by Geographic Location and other characteristics, further contextualising how and why the IGIF's Strategic Pathway 4: "Data" should be implemented. To support this implementation, Strategic Pathway 4 comprises of several annexed resources and templates (including documents on how to conduct Gap Analyses and establish Data Governance Roles and Responsibilities).

Key Resources

- The Short List
- The List of Indicators
- Integrated Geospatial Information Framework: Strategic Pathway 4: Data

[Key Action 2] Following the prioritisation of indicators, there is a need to prioritise and identify what data countries need. Nationally, geospatial information can be evaluated and provided by the stakeholders of the National SDGs Committee. The "SDGs Assessment Matrix" (See Annex 4), as a practical tool for countries to identify responsibilities, needed data and metadata, and agreed modalities of production.

Assessment Tool

The SDGs Assessment Matrix is a questionnaire, set up by a Regional UN-GGIM Committee, for supporting the identification of priority ranking in the analysis of the indicators. Each line of the matrix is one indicator contained in the "Short list" or in the "List of Indicators". The assessment is based on questions aimed at:

The SDGs Assessment Matrix:

- Identity how a country is reporting and how on specific indicators.
- Identify actual and expected level of usage of geospatial information.
- Evaluate the availability of national methodologies.
- Identify Country level of interest on the indicators.

[Key Action 3] Alongside dialogue in the national context, countries are urged **to engage stakeholders at the regional level**, through the regional committees of UN-GGIM, UN Regional Commissions and other regional organisations. As countries in the same region often have similar arrangements and levels of capacity, there is the potential for a high degree of sharing data, lessons learned and collaborative development of methodologies as well as tools. Given the global nature and availability of data sources, countries could also explore ways to work collaboratively to procure tools and platforms that might otherwise be unattainable in isolation. Exemplifying the potential support available at the regional level is the support provided by FAO and **Digital Earth Africa**. DE Africa offers countries with an operational data infrastructure which makes current and historical, analysis-ready satellite data freely available and openly accessible for the continent, with FAO collaborating with DE Africa to produce land cover and crop type maps.

Food and Agriculture Organization

FAO, is building capacity in countries in producing national land cover and crop type maps, in-line with the Global Fundamental Geospatial Data Themes to underpin the computation of several land based SDG indicators.

Digital Earth Africa

Digital Earth Africa aims to provide a routine, reliable and operational service, using Earth observations to deliver decision-ready products enabling policy makers, scientists, the private sector and civil society to address social, environmental and economic changes on the continent and develop an ecosystem for innovation across sectors. It achieves this by processing openly accessible and freely available data to produce decision-ready products.
www.digitalearthafrica.org
Given the replicability and open source of this service, Digital Earth Americas and Digital Earth Pacific have seen value and are now being implemented.

Globally, there are numerous data sources available providing topographic maps, EO, digital elevation models (DEMs) and several other sources of geospatial information available for the SDGs. To help chart a path and demystify what sources of (global) data can be used, two key resources developed by WGGI can be used, the "**Global and Complementary (Non-authoritative) Geospatial Data for SDGs**" and "**Specifications of land cover datasets for SDG indicator monitoring**".

Key Resources

- Global and complementary geospatial data for SDGs.
- Land cover datasets for SDGs.

Regardless of where the geospatial information originates, irrespective of whether data is drawn from the national, regional or global level, the actions to enable its use for the SDGs are broadly similar. By transforming raw data into decision-ready products through involving the relevant national actors, the ability to inform policy and action can be realised while the barriers of capability and cost are reduced.

[Key Action 4] Following the prioritisation of indicators and the identification of suitable data, there is a need to **identify appropriate methodologies to develop indicators.** Workshops with SDG Custodians are a useful first step with testing methodologies of production, but liaising with other countries in the region in a systematic manner is another mechanism that can help confirm appropriate data, methods and coordinate development support. These mutual efforts should be articulated into national discussions on how to further establish the technical environment around the SDGs, dependent on existing national capability and capabilities.

From establishing geospatial and location-based information as official data for the SDGs and their global indicators, technological change is the sole constant. As a trend, as we develop new technologies new opportunities will become available, by embracing a forward-looking approach to using geospatial information for the SDGs, countries can take advantage of these novel data sources, regardless of whether these data sources are considered innovative. For example, the Landsat programme was initiated in 1972, and since then its sensors and ability to deliver 'better' data has consistently evolved. Now, both privately-owned or state-run constellations provide a variety of data including orthoimagery. Another example is the Demographic and Health Surveys (DHS) Program. First initiated in 1984, it has been used for decades to collect, analyze, and disseminate data on the well-being of women and children. The DHS programme is often used as the primary source of data for the Global Indicator Framework. In recent years the DHS has added geographic information in all surveyed countries, which has enabled researchers and policy makers to assess the impact of location on health and other well-being outcomes and is increasingly being used to improve accessibility of health services, including family planning interventions. Case study analysis shows how these data are used to monitor the SDGs from the gender perspective (Box 3). With the guiding notion of the SDGs being one where progress towards the SDGs is "country-owned and country-led", it is advised that **when considering geospatial information, regardless of how innovative or technically mature it may seem, its ability to transform decision-making is limited, if a country does not wish to, or cannot commit to, using geospatial information.**

[Key Action 5] The encompassing nature of the SDGs, should not be placed on the shoulders of the few within the national context. Efforts for staff **to foster collaboration with their counterparts in other agencies and ministries, and peers in other countries should be enacted**. By promoting the participation of staff at all levels, the ability for sharing knowledge and socialising innovation can be realised. In highlighting resources that assist with the Design, Development and Testing of geospatial information for the SDGs, understanding that the SDGs are reported nationally, but the challenge of developing appropriate methodologies is a global problem, and one shared by all 193 countries. Through dialogue, nationally and globally, gaps can be identified and barriers overcome.

Box 3: *Disaggregation by Geographic Location: Using geography and disaggregated data to ensure no-one is left behind*

Our geography and 'location' can be a strong predictor of development outcomes: correlations between living in rural areas, high rates of poverty, remote areas with poor infrastructure, access to basic facilities, conflict zones or informal settlements, with risks of disadvantage, gender, ethnic and cultural aspects, among other individual characteristics, can be verified thanks to the geographical location. This is commonly observed for women and girls, who are doubly disadvantaged by the existing factor of location and the threat of gender-based discrimination.

As a guiding principle, the IAEG-SDGs agreed that indicators in the global monitoring framework should be disaggregated, where relevant, by "income, sex, age, race, ethnicity, migratory status, disability and geographic location, or other characteristics". Indeed, indicators should cover specific groups of the population often overlooked such as women and girls. Despite this broad principle recognizing the need for disaggregation by sex and other characteristics, explicit references to women and girls and gender equality are not consistently made across the Global Indicator Framework. This is further compounded by the need for data that are disaggregated by geographic location. These data are essential to monitoring progress over time and space, on the commitment to "leave no one behind".

Importantly, many countries can use the capacities that they have already developed to produce statistics that can be both disaggregated by the dimensions of the SDGs and also by geographic location. Using data from Demographic and Health Surveys, for example, can help in identifying spatial inequalities between women and men and among distinct groups of women and girls. In Colombia, analysis of the 2015 DHS showed that 99.7% of women in the richest quintile live in urban settings, while 88.2% of the poorest live in rural areas. Women and girls from the richest urban households fared far better than women and girls from the poorest rural households in key SDG related outcomes. Among the rural poorest, indigenous and Afro-Colombian women and girls lag far behind the non-ethnically affiliated majority across key dimensions such as child marriage, adolescent birth rates, skilled attendance at birth and education. Indigenous women and girls also fared worst in access to household level assets, including improved drinking water, clean fuel and housing.

The 2030 Agenda calls for the universal achievement of the SDGs whereby the well-being of everyone in society is assured, most especially that of the furthest behind. From a monitoring perspective, this means accounting for the progress of everyone, everywhere. Doing so will require going beyond national averages to assess at local level the outcomes of different groups of women and girls who, because of entrenched forms of discrimination, are often the most disadvantaged in society. Intersecting inequalities based on gender and other characteristics including ethnicity, geography and wealth result in a form of disadvantage that is acute and uniquely felt by women who stand at these intersections. Multi-level disaggregation of data, including by sex and geographic location brings out these inequalities and is hence critical for identifying the furthest behind. From a policy point of view, such data can inform context-specific development strategies that are inclusive of all. As an example of how geographic and sex disaggregation can be established, please see Colombia's Storymap on : shorturl.at/vxyS9.

Box 4: *Selecting geospatial information and its methodologies to produce, measure and monitor indicators*

1. USE GEOSPATIAL INFORMATION WHEN AVAILABLE

Where it is the recommended data source, **efforts should be made to use geospatial information**. If not, it can be selected to complement other data sources, bridge gaps, or add information and coverage. Time series with data of EO can be useful when matching data to reporting timeframes. When data is presented in an intuitive manner that engenders better understanding, this will lead to better and more informed policy and decision-making. A useful resource is the List of Indicators, which identifies the various dimensions of how geospatial information can be used (see Box 3).

2. DEFINE SOURCES AND DETERMINE CORRECT INTEGRATION METHOD

Where available, it is preferable to utilise **national data**, where it can suit the national context better, providing greater and more relevant thematic detail, and has been produced and validated by national experts. **Global datasets** can also be advantageous, as these existing datasets can provide an almost immediate assessment of an indicator's status. Further, key global datasets have guidance and case studies that can guide its correct use and integration for national level estimation and reporting.

3. IDENTIFY THE APPROPRIATE ASPECTS OF A DATASET

Several attributes factors should be considered when selecting geospatial information. For example, when wanting to develop a Digital Earth Model, then using a cadastral database would perhaps not be the first place to start. Similarly, to conduct analysis in a specific time-frame, data will be needed for that time period. Aspects to consider when selecting a dataset include: Thematic match – match of classes in the dataset with the indicator methodology; Spatial resolution – providing sufficient detail, while being manageable to process; Temporal coverage – the match to the reporting timeframe; Temporal extent-continuity to 2030; Availability of accuracy information – required to assess its suitability.

4. IDENTIFY RELEVANT ACTIONS ON THE DATA SELECTED

Where possible, geospatial information should be validated at the geographic level in which it is being used. This will help For this, local ground or reference data should be of a higher quality than the dataset itself. **Harmonising data** will also be required where geospatial data is replacing or complimenting another data source; however, extensive methodological guidance is available (e.g. for Land Cover). National campaigns may be required to acquire, process, and analyze geospatial information.

PHASE 3:
PRODUCING, MEASURING, MONITORING AND REPORTING GEOSPATIALLY ENABLED SDG INDICATORS

PHASE 3: **PRODUCING, MEASURING,MONITORING AND REPORTING GEOSPATIALLY ENABLED SDG INDICATORS**

Phase 3: Producing, measuring, monitoring and reporting geospatially enabled SDG indicators starts with identifying key actions that support the process from producing an indicator, through to its dissemination and reporting. This Phases' Key Actions highlight how to continually monitor progress against the indicator and support the publication and dissemination of metadata, and suggest an iterative return to the methodological definitions of the measurement that the country performs.

Phase 3 is particularly important as through building on the foundation established in the previous Phases, the ability to produce and report, and measure and monitor, SDG indicators will be realised. Once data, attributes and methodologies are gathered and selected and indicators prioritized, the structure in charge of technical development should be established depending on the institutional and data ecosystem, to guarantee the best conditions for the continuous access to inputs and for the analysis, and to achieve the continuity and correct frequency in term of engagement and responsibility on the reporting effort. Roles, timing and scheduling, as well as the method for reporting might be planned and committed.

Key Actions

1. Develop and enact an SDGs Dissemination Strategy
2. Implement a suitable SDGs data management and dissemination platform (ie. the FIS4SDGs), or develop on open standards, software and principles systems
3. Promote a culture of storytelling with existing data and highlight existing data gaps
4. Establish a publication calendar, identify institutional areas responsible for monitoring the indicators
5. Publish metadata and continually update the list of prioritised indicators, including sources of information used

[Key Action 1] The disparity in how countries are reporting against the SDGs, highlights how decision-making in many countries is not sufficiently based on findings resulting from analysis of data, public data or transparent methods. From establishing a National SDGs Committee and developing an inclusive environment for design, development and testing of geospatial information for the SDGs, the next step is to develop and publish a dissemination strategy, focused on the national environment and its decision-making needs. The development of this strategy should be led by the National SDGs Committee, and linked to national issues and development priorities. This will further emphasise that developing capacity to attain the goals and targets of the SDGs are the same needs for national development.

[Key Action 2] The technological capacity that provides this enabling environment is often seen as the primary challenge, yet once the challenge of accessibility to equipment and internet connectivity are resolved, there are several technologies available, many which are focused solely on the needs of the SDGs. Throughout the development of this Roadmap, countries repeatedly mentioned the challenge of accessibility to data and technology. However, these challenges can be resolved through dialog with regional and global actors, with the provision of technical assistance and capacity development that ensue. Workshops and meetings at the beginning of the entire process or at any point, bringing together peers, Custodian agencies and development actors, can help foster dialogue on developing strategic action and support the coordination of resources to mitigate these gaps.

Tools such as the Federated System for the SDGs, as well as National SDG Data Hubs, help with bridging the technology divide, not only for the dissemination of results associated with the SDGs, but also to guarantee the standardized management of geospatial information, and geospatially enabled indicators. Further, the potential to reflect information at different levels of disaggregation, global and local, means that these tools and platforms are oriented to different types of users and facilitate both decision-making and focused actions that guarantee compliance with the Goals and targets of the 2030 Agenda.

Ultimately, while the consummarate actions within the areas of Governance and Technology crucially underpin the ability of countries to use geospatial information for the SDGs, it is the ability to communicate, develop and skill the people within the relevant agencies and ministries to fully mainstream and effect the transformation that we collectively need.

The development of skills at the national level are needed for technological autonomy, use and development of software and solutions, in the domains of the data production, the measurement, and reporting, with ideal integration of statistical and geospatial data. Individual indicators should be reported and disaggregated by geographic location, not just at the national level, but at the smallest sub-national level possible to engender positive decision-making.

[Key Action 3] Storytelling is a vital method used to communicate to various stakeholders, whether national or global, the public or national agencies the importance of the 2030 Agenda, and the importance of integrating indicators into local policy. Telling stories generates an attractive shared understanding and thus lay the foundation for a constructive dialogue with the different national stakeholders and global partners with whom to collaborate in the different stages of implementing the SDGs Geospatial Roadmap. An efficient and pervasive means to help tell stories are Storymaps.

Storymaps are an interactive communication tool which integrates text, interactive maps, and other mechanisms to interactively visualise data, triggered and animated as the reader navigates through the Storymap. In embedding interactive maps, the user can interact with the underlying data and what the data represents in a relatively simple manner, this could include interrogating and analysing the data through advanced analytics, such as zonal statistics or proximity analysis, which may be beyond a reader's technical proficiency, yet would help inform their decision-making. Box 6 communicates the principles and technologies used to develop Storymaps. In helping further entrenching the use of geospatial information within the national context, communicating the "how", it can also help others within our global community, regardless of their capacity to make progress.

Key Resource

- Compilation of tools and resources for data disaggregation

- Storymaps collate various modalities to communicate organized knowledge and a narrative in an interactive and engaging manner. A storymap can contain web maps, text, photos, and other multimedia to helps users comprehend concepts. Storymaps serve as useful to foster public engagement and have been extensively used by journalists, scientific institutes, and media organizations and to communicate the SDGs.

→ Principles on Storymaps (Box 6)

[Key Action 4] This Action leverages the cumulative efforts of established capacities developed by the previous Key Actions, and Phases to develop institutional capacity to go beyond the production and dissemination of SDG indicators, but to strengthen national capacity for their measurement and monitoring. From the burgeoning landscape established by the SDGs Assessment Matrix, the agencies responsible for the underlying data, methodologies and producing the indicators should have been identified.

Within this national statistical system, national ministries and agencies should also have the ability to 'action' the data; producing and reporting indicators is one step, but informed policy- and **decision-making is the ultimate aim of the SDGs**. Through the constant production and dissemination of indicators, the ability to monitor and measure progress, identify where progress is, and is not being made can be realised. This will help further promote the trust and uptake of data. Accordingly, it is recommended to **incorporate information pertaining to the use of geospatial information within the National Data Publication Calendar (6), indicating the source(s) of geospatial information, levels of geographic disaggregation, national custodian institution(s) responsible for the indicator's production, institutions who will consume the emanating data, and other relevant pieces of information** deemed important, based on national priorities.

[Key Action 5] This Action urges that countries **take proactive steps to publishing metadata and information relating to the prioritisation of indicators**. This will help further enfranchise and socialise decisions made regarding the production and dissemination of indicators, but also their measurement and monitoring. In realising the vision of geospatial and location-based information being recognised and accepted as official data for the SDGs and their global indicators, the use of geospatial information will be mainstreamed.

This will require a broad agreement to use geospatial information in producing, measuring, monitoring and reporting geospatially enabled SDG indicators. Metadata and methodologies of how data is transformed into an indicator are as important as the data themselves. As the use of geospatial information is in nascent stages of use, notwithstanding its potential to transform how countries reach the shared-vision of the 2030 Agenda, there are still opportunities for development.

One such development will be **to articulate guidance on how to review and validate indicators using geospatial information.** While a significant number of indicators can only be produced by geospatial information alone, almost all indicators would benefit from its use in its production, measurement or monitoring. At a minimum, all indicators produced should be geospatially enabled to allow for disaggregation by geographic location at sub-national levels, where possible. In turn, the consistent production will allow for progressive measurement and monitoring at these levels of geography. Another would be **to expand on existing resources, such as the Global and Complementary Geospatial Data for the SDGs report and identify agreed minimum validation criteria or common parameters that SDG Custodian Agencies could use to validate the effectiveness of Earth observations through its metadata.**

As an example, Box 5 highlights the end-to-end process in using geospatial information for an indicator, from production to reporting. Box 5 illuminates the example process for calculating indicators 6.6.1 and 15.4.2 providing examples at both the national and global level, through integrating geospatial information, EO and other forms of official data. Further, these two cases highlight that with increased quality of the underlying EO, in both elements of optical resolution and temporal accuracy, the enablement of monitoring at increasingly finer geographic areas becomes possible.

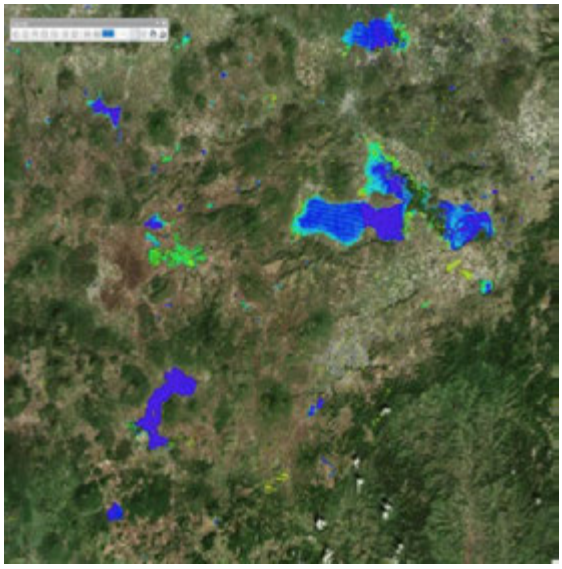
(6) As an exemple, see Mexico's National Publication Calendar : **cutt.ly/lQdMY6R**

Box 5a: *Mexico's Methodology for calculating SDG 6.6.1*

Water-related ecosystems provide important social and economic benefits to societies, such as provision of drinking water and sanitation, recreational opportunities, maintenance of aquatic habitats to support biodiversity and fishery industries, water for key sectors such as energy and agriculture, and regulation of water flows. The SDG indicator 6.6.1: 'Change in the extent of water-related ecosystems over time' (SDG Target 6.6: 'protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes') informs on the trends in the ecosystem assets. The INEGI has developed a guide to support the measurement of continental open waters changes in time.

To calculate this indicator, two processes have been conducted in order to distinguish and generate spatial extent data on open water and vegetated wetlands. Earth observations have permitted the accurate calculation of the geographic extent of lakes, rivers, estuaries and artificial waterbodies from year to year, and then monitor extent of vegetated wetlands by using datasets such as land cover, elevation, vegetation cover and soil moisture. The data generated on open water has been further distinguished into lakes, rivers and estuaries versus artificial waterbodies, while vegetated wetlands and artificial waterbodies were excluded to prevent duplication of estimations.

Two datasets have been used: the National dataset of water bodies scale 1:50 000, which define national water bodies coverage from the national topographic dataset edited over Spot satellite images; and the National coverage of Water Observations from Space (WOfS) 2015 which allowed the calculation of the spatial extent of open water bodies in Mexico for 2015 from the USGS Landsat 4, 5, 7 and 8 satellite imagery archive.



INEGI, National water bodies scale 1:50 000 (Area: 44 798 Ha).

2015 Mexican WOfS (Area: 40 315.40 Ha)

Box 5b: *The end to end process for SDG 15.4.2*

SDG indicator 15.4.2, the Mountain Green Cover Index (MGCI), is particularly relevant to the geospatial community, as it can be entirely measured using geospatial information, primarily from EO sources. A land-based indicator, the MGCI is officially defined as the ratio of green vegetated area over the total mountainous area. This indicator can be constructed by two fundamental geospatial data sources, a map of Land Cover and a (Digital) Elevation Model.

Nationally in Japan, high-resolution land use and land cover data are produced by the Japan Aerospace Exploration Agency (JAXA) and the Fundamental Geospatial Data/high-resolution DEM 10m resolution is produced by the Geospatial Information Authority of Japan (GSI). In this context, the Japanese working group on validation of methods of using observation data for SDG indicators, established under Japan's Ministry of International Affairs and Communications, has used such national data to estimate MGCI. Their findings confirm that higher resolution national datasets allow for more accurate measurement of the indicator, this especially acute in countries with a small geographic area or complex topography.

While the use of national data can often be available at higher spatial and thematic resolutions, the vital role of standardized, globally available, geospatial information cannot be understated. As these global datasets have the potential to fill national data gaps, if the required data is not available or nationally produced.
Globally, FAO, as the custodian agency for the MGCI, has supported countries in the reporting process for this indicator in 2021 through the development of a new methodology, based on using EO data and techniques (7). This methodology allows countries to compute their MGCI estimates using either global land cover maps (such as from European Space Agency (ESA) Climate Change Initiative) and a Global Elevation Model (such as the United States Geological Survey's "GTOPO" dataset) or nationally produced datasets, if available. This approach, developed in consultation with countries, has been used by FAO to compute national and subnational MGCI estimates globally which have been shared with countries for validation in compliance with the SDG reporting process. Further, both ESA and GTOPO data are available as assets on Google Earth Engine, making the FAO methodology ready-to-go for any country at literally zero implementing cost. Broadly, there are three trends are advancing the ability of countries to produce and measure MGCI:

1. At the indicator level, FAO is supporting the refinement of the indicator definition. This is already under way and will be soon adopted. Such an improvement will allow the indicator to be more sensitive to the vegetation types, and hence be more correlated to the ecological functions and ecosystem health of mountains;

2. At the national level, EOs are progressively being more absorbed into national monitoring systems, and countries are starting to produce their own annual land cover maps and elevation models; and,

3. At the global data level, there is a clear trend over the last decade in increasing spatial and temporal resolution of the products. In 2021 the World Cover project coordinated by the will deliver the first global land cover map at 10 meters resolution. Microsoft and Esri have delivered their first global land cover map in 2020 using Sentinel 2 data.

(7) De Simone, L., Navarro, D., Gennari, P., Pekkarinen, A., & de Lamo, J. (2021). Using Standardized Time Series Land Cover Maps to Monitor the SDG Indicator "Mountain Green Cover Index" and Assess Its Sensitivity to Vegetation Dynamics. ISPRS International Journal of Geo-Information, 10(7), 427.

The future for improving the national monitoring of the SDG 15.4.2 is promising, driven by the intersection of methodological improvement and the availability of better national, and global geospatial information.

Box 6: *Storymaps - Communicating the SDGs using Geospatial Information*

Storytelling is the art of telling a story using attractive and effective didactical resources, from any format and media, in an organized and hierarchical way, accompanying the reader through a set of narrative elements. The geographical story map has similar intentions, focused on cartographic and infographic expression. A certain level of interaction is implicit, which allows the reader to navigate freely although with a guideline, creating the feeling of a personalized experience. It integrates maps, legends, text, photos, and other multimedia contents and provides functionality, such as swipe, pop-ups, and time sliders, that helps users explore its content. They serve as a great tool for public engagement because they can easily be shared. They are being widely used by journalists, scientific institutes, and media organizations to convey their point lucidly, make the story more interactive, easy-to-comprehend, and reach more readership.

Storytelling is based on criteria such as fluency, clarity, visual appeal, didactics, emotion. Attracting and maintaining the interest of a broad readership can be accomplished with some of these tips:

- Writing as short and clear as possible
- Catchy, contextualized phrases as titles and section headings
- The story map is then developed into different parts responding to the thread
- Visual logic adapted to the reader's gaze: from a corner of the screen to another
- To facilitate understanding, the story might be linear, from a starting point A to an arrival Z
- Major arguments, results and conclusion visually highlighted and differentiated
- Open towards new perspectives, new questions, or other applications
- Sources, credits, links to reference works

Different tools exist to create storymaps, both proprietary and open source, allowing for various visual alternatives, more or less elaborate, more or less interactive. The tools examples below don't need any coding skill.

Proprietary:
Interactive pages: Esri Storymaps - Microsoft Sway - Pudding - Storycrafter.
Tools with free versions: Mapbox - Infogram - Tableau Public - etc.
Interactive visualizations (tools with free versions): Flourish - DataWrapper

Opensource: StorymapsJS - TimeMapper

Some examples are provided of storymaps made by member states and organizations, in relation to the SDGs measurement, with a geospatial approach:

Multidimensional poverty measurement (Goal 1): cutt.ly/yQoqMz6
Water Quality in Belize using Satellite Imagery (Goals 14, 15): cutt.ly/mQoiLVt
Mountain Green Cover Index (Goal 15): cutt.ly/pQoi1Mg

It is important to stress that while geospatial information is unequally applied by countries in their journey towards attaining the SDGs, the role of official statistics will change. **Geospatial information is the missing component that will enable the robust transformation of official statistics and it must be embraced for us to achieve the shared vision of the 2030 Agenda.** The complementary nature of geospatial information means for many, the impact of using geospatial information will not be fully understood. But, there are several resources discussed within this Roadmap that can be used to transform a country's governance, technological capability and staffing to meet the challenge of the SDGs. This will be a constantly moving target, which will be consistently improved by the consumerate development and accessibility to novel technology, methodologies and approaches. The gulf between our current abilities and the future that we want is still large, but we can and must **take proactive steps to bridge the geospatial digital divide and take the bold and transformative steps which are urgently needed to shift the world onto a sustainable and resilient path.**

SUMMARY AND **CALL TO ACTION**

SUMMARY AND **CALL TO ACTION**

Implementing the SDGs Geospatial Roadmap will enable countries to better harness geospatial information for the measurement, monitoring and reporting of geospatially related indicators. Further, this will help countries disaggregate indicators by geographic location and combine with data disaggregated by income, sex, age and others to help inform the measurement, monitoring and production of indicators, which in turn will assist countries with making decisions informed by data. While it is already recognised that integration of these forms of data is a critical driver that enables the implementation of the SDGs, this cannot be achieved through statistics alone in part due to the interconnected and interrelated nature of the SDGs.

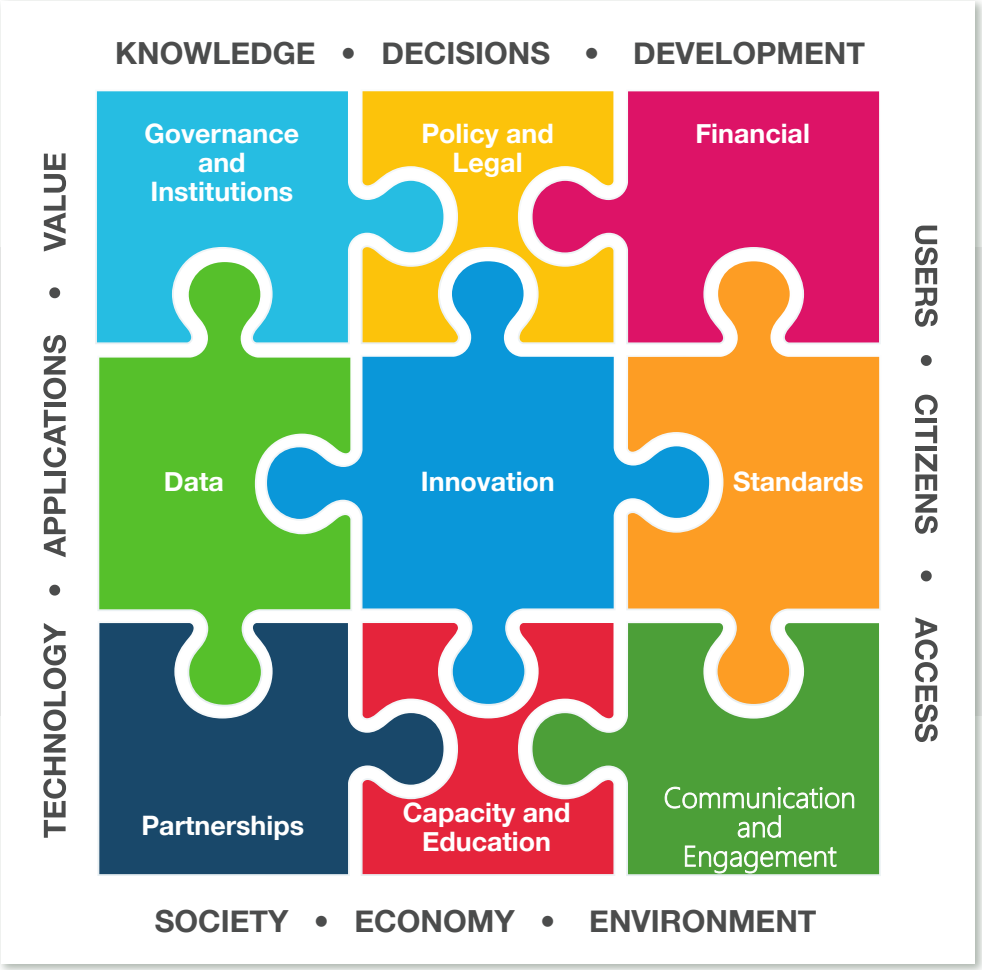
Unfortunately, the call of Goal 17 to "enhance capacity-building support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts" by 2020 was not met. However, we collectively have the tools and mechanisms that will enable the production and dissemination of high-quality, timely and reliable data within our grasp.

At the foundation of this is geospatial information; from adding value to all other disaggregation to providing the key mechanism which will enable the full realisation of the overarching principle of the 2030 Agenda for Sustainable Development, namely to leave no-one behind and to reach those furthest behind first. Geographic information is the key (and broadly missing) component that can highlight groups which are currently lagging behind, whether through disaggregation of income, sex, age, race, ethnicity, migratory status, disability or other characteristics relevant in national contexts. In sum, geospatial information provides the basis to integrate and analyse these forms of data, inform decision-making, and enable the 'where' needed for action and this Roadmap is the starting point to enable the IAEG-SDGs, custodian agencies and member states to fully harness geospatial information for the SDGs, and in turn, this Roadmap calls for geospatial and location-based information to now be recognised and accepted as official data for the SDGs alongside official statistics.

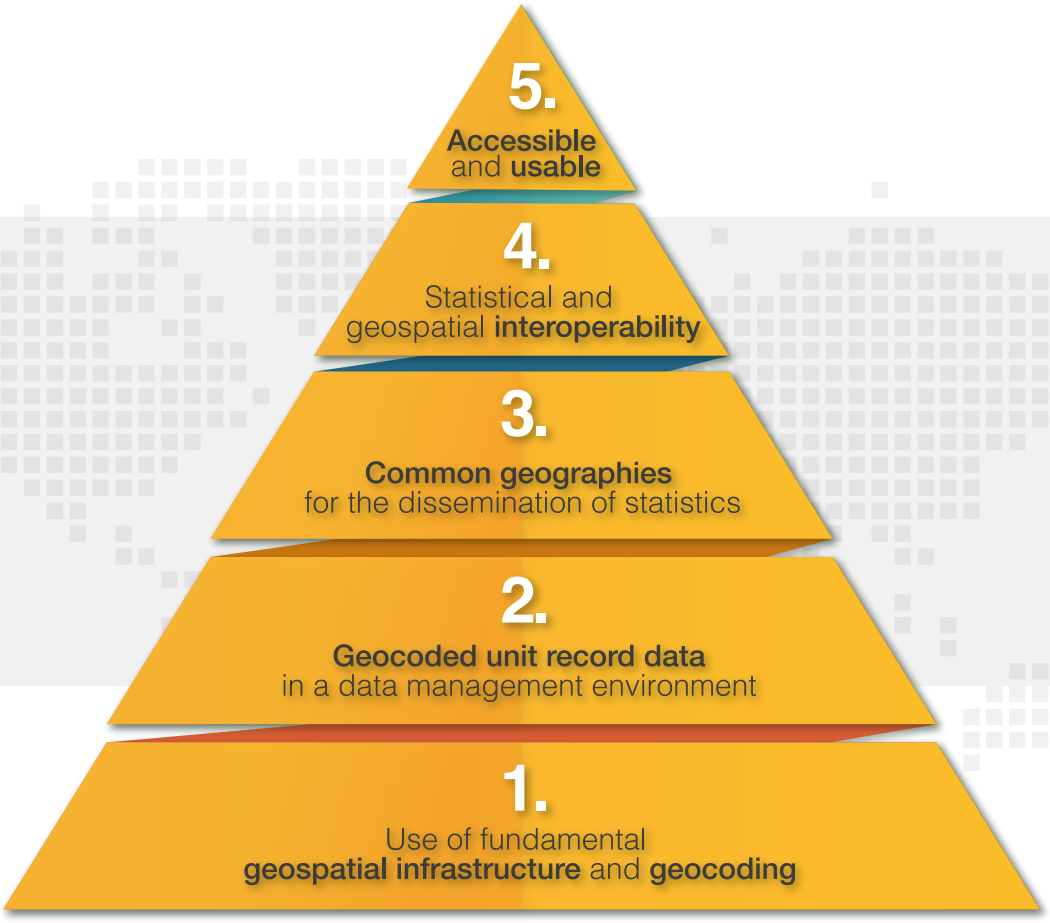
ANNEXES

1. FRAMEWORKS **EXPLAINER**

The Integrated Geospatial Information Framework (IGIF) comprises three parts as separate, but connected, documents: Part 1 is an Overarching Strategic Framework; Part 2 is an Implementation Guide; and, Part 3 is a Country-level Action Plan. The IGIF sets the context of 'why' geospatial information management needs to be strengthened and why it is a critical element of national social, economic and environmental development. It focuses on the role of geospatial information in the digital age and how that information is integral to government functions at all levels.



The Global Statistical Geospatial Framework (GSGF) is a high-level principles-based framework that enables a range of data to be integrated from both the geospatial and statistical communities and that, through the application of its five principles and supporting key elements, permits the production of harmonised, standardised and integrated, geospatially enabled statistical data to facilitate data-driven decision-making. The resulting data can then be integrated with statistical, geospatial, and other information to inform and facilitate data-driven and evidence-based decision making to support local, sub-national, national, regional, and global development priorities and agendas.



The Generic Statistical Business Process Model (GSBPM) describes and defines the set of business processes needed to produce official statistics. It provides a standard framework and harmonised terminology to help statistical organisations to modernise their statistical production processes, as well as to share methods and components. The GSBPM can also be used for integrating data and metadata standards, as a template for process documentation, for harmonising statistical computing infrastructures, and to provide a framework for process quality assessment and improvement

The Global Fundamental Geospatial Data Themes are 14 themes considered fundamental to strengthening a country' s geospatial information infrastructure. They range from Addresses to Physical Infrastructure and are "fundamental data sets are the minimum primary sets of data that cannot be derived from other data sets, and that are required to spatially represent phenomena, objects, or themes important for the realisation of economic, social, and environmental benefits consistently across Africa at the local, national, sub-regional and regional levels" . Significantly, the 14 Themes were developed in direct response to the data needs of the SDGs. Implementing the 14 Themes is a first step towards realising the data ecosystem and help provide a framework for integrating different forms of data. This data can come from a variety of stakeholders, commonly the NSO and NGIA, but there will be others, especially if using EO. In effect, to enable the integration of data, a bridge must first be built between the NSO and the NGIA, this sets the stage for providing high-quality, timely and reliable data for the measurement, monitoring and production of indicators.

2. THE WGGI

The WGGI was established by the IAEG-SDGs at its 3rd meeting in Mexico City in April 2016. The primary objectives of the WGGI are to 1) ensure that, from a statistical and geographic location perspective, the key principle of the 2030 Agenda for Sustainable Development, to leave no one behind, is achieved via the Global Indicator Framework, and that everyone can be counted; and 2) provide expertise and advice to the IAEG-SDGs and the larger statistical community as to how geospatial information, EO and other new sources of data can reliably and consistently contribute to the Global Indicator Framework to support the implementation of the SDGs.

In its first three years of work, the WGGI set a number of tasks to achieve, primarily related to providing expertise, advice, and strategic guidance to the IAEG-SDGs and the wider statistical community on how geospatial information, EO and other new data sources can reliably and consistently contribute to the production of indicators.

In July 2019, the IAEG-SDGs updated the Terms of Reference of the WGGI to align to the emerging needs of the IAEG-SDGs, and to achieve a greater working relationship, synergy and coordination between the statistical and geospatial information communities. With a revised membership and updated modalities, the WGGI developed its draft 2020-2021 Work Plan at its 6th meeting in Mexico City in March 2020, a key element being the development of an 'SDGs Geospatial Roadmap'. UN-GGIM, at its tenth session in August 2010, subsequently endorsed the final Work Plan, and further 'welcomed the development and future dissemination of the Geospatial Roadmap for the Sustainable Development Goals as a means to support Member States towards improving the application of geospatial information and EO for the production of indicators.' Between the summers of 2020 and 2021, this Geospatial Roadmap was developed in several stages of collaborative work, integrating the general reflections on the context on which the Roadmap should be based, and the development of the guide from which to develop the content to through an extensive phase of consultation by groups, from the member states and members of the IAEG-SDGs, the representatives of custodial agencies, and experts in the subject in order to reflect in a comprehensive and broad way both the needs and the diverse resources that exist or could be developed for the effort to monitor indicators and goals in the countries.

3. PROCESS OF DEVELOPMENT

Since 2016, the WGGI has provided expertise and advice to the IAEG-SDGs, custodian agencies and the broader statistical community as to how geospatial data, EO and other new data sources can reliably and consistently contribute to the production and dissemination of the indicators. This Roadmap is now developed to articulate the vision "to see geospatial, and location-based information being recognised and accepted as official data for the SDGs and includes key strategic messages and facts" an essential action emanating from the WGGI's 6th meeting in Mexico City , noted in decision 10/105 of UN-GGIM and other fora. The WGGI has developed the SDGs Geospatial Roadmap through several dedicated meetings and conversations with Member States of the WGGI and IAEG-SDGs, followed by extensive consultations with all members of the WGGI, IAEG-SDGs

At its eighth session in August 2018, UN-GGIM, in making decision 8/110, noted the importance and crucial role of the WGGI in engaging with national Governments, and acknowledged that geospatial information and EO were not yet sufficiently leveraged in statistical production processes. Further, UN-GGIM advised that the WGGI continue to develop and provide expert advice and guidance on the application of geospatial information and its management to achieve national development priorities and the global targets of the SDGs, and that the WGGI do so with a degree of urgency while ensuring the robustness of the advice and guidance provided. At its tenth session in August 2020, UN-GGIM, in making decision 10/105, the Committee welcomed the development and future dissemination of the SDGs Geospatial Roadmap as a means of supporting Member States in improving the application of geospatial information and EO for the production of indicators, and of fostering the development of "story-telling" mechanisms to better visualize, communicate, promote and disseminate information about progress in the work of the working group as widely as possible through real-world examples and case studies. Further, Statistical Commission Decision 52/101 encouraged the IAEG-SDGs to further incorporate data innovation in its work, including the integration of geospatial information and statistics for the 2030 Agenda for Sustainable Development.

In implementing the mandate provided by the Statistical Commission and cognisant of UN-GGIM's decisions in this area, the IAEG-SDGs' WGGI undertook a significant period of engagement among its members through written submissions and informal conversations with IAEG-SDGs and WGGI Member States, SDG Custodian Agencies and invited experts (such as Regional Commission, Academia and the EO community) to develop this SDGs Geospatial Roadmap.

4. THE SDGs ASSESSMENT MATRIX

The matrix is a questionnaire that supports the identification of priority ranking in the analysis of the indicators. It consists of an excel file where each row represents an indicator, and contains questions to understand if and how a country is reporting on specific indicators, the actual and expected level of usage of geospatial information, the availability of national methodologies and the level of interest on the indicators.

This is the current structure of the SDGs Assessment Matrix:

1. Country or agency's name

2. Which organisation is responsible for this indicator?

3. Is your country already reporting on this indicator?
   - 3.1 If yes, at what level of a) geographic disaggregation and b) frequency?
   - 3.2 If no, why not?

4. Is this indicator also part of your national SDG strategy?

5. Do you use or plan to use the method set out in the UN metadata to calculate the indicator, or an alternative method adapted to your national situation?

6. Does the current method used by you entail direct use of geospatial data? (Direct use means that geospatial information of any sort is part of the actual calculation of the indicator. In surveys/sample surveys geospatial information can be indirectly part of the underlying design)
   - 6.1 If yes, please indicate if Geospatial data or EO derived data are used
   - 6.2 If the indicator is spatially disaggregated, this is operated by using administrative borders or geostatistical units?
   - 6.3 Please indicate if free of charge or commercial data are used
   - 6.4 If no, do you believe that revising/changing your national or the UN method to include geospatial information would significantly improve or add value to the indicator?

7. Do you have a methodology or methodological proposals to share?

8. Rank indicator according to your institution priority

THE SDGs GEOSPATIAL ROADMAP

SDGs GEOSPATIAL ROADMAP

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