

## 2020-2022 GEO Work Programme

### GEO Initiative on Land Degradation Neutrality (GEO LDN)

#### 1. Executive Summary

##### 1.1 Overview

In order to halt and reverse the current trends in land degradation, there is an urgent need to enhance national capacities to measure and map degraded lands and identify the most appropriate interventions. The UN Sustainable Development Goal (SDG) Indicator 15.3.1 (“the proportion of land that is degraded over total land area”), for which the United Nations Convention to Combat Desertification (UNCCD) is the custodian agency, utilizes three sub-indicators: land cover, land productivity and carbon stocks, which can be calculated from Earth Observation (EO) and other geospatial information in accordance with the Good Practice Guidance for SDG Indicator 15.3.1.

The UNCCD’s Land Degradation Neutrality (LDN) target-setting and implementation programmes use SDG indicator 15.3.1 and its sub-indicators in a decision support framework to encourage countries to stabilize or reduce their extent of degraded lands through conservation, sustainable management and restoration activities. A coordinated response is needed from the Earth observation (EO) and geospatial community to assist countries and other actors, particularly those with limited EO capacities, to carry out assessments and implement LDN activities.

Increased access to large EO datasets, targeted data products, improved analytical capacity and practical tools are needed to help countries set and implement LDN targets, including to support policy, planning and investment decisions. The data, products, tools, platforms and reporting protocols developed within the GEO LDN Initiative would be accessible in the Global Earth Observation System of Systems (GEOSS) Platform and available for use by other GEO Initiatives, including GEOBON, GEOGLAM and the Earth Observations for Ecosystem Accounting Initiative. The GEO LDN aims to facilitate the provision of space-based information and in situ measurements for improved land management and planning which are fundamentally linked to many other areas of the GEO Work Programme, including its Strategic Plan 2016-2025, and global priorities on sustainable development, climate action and disaster risk reduction.

##### 1.2 Planned Activities

The strategic activities of the GEO LDN Initiative are aimed at:

1. **Building capacity at the country and regional level** to ensure national ownership of EO and *in-situ* measurements will entail the preparation of curriculum and training on the use of new data products and practical tools to support countries in accessing, interpreting and validating this data for (a) UNCCD national reports and action plans which in turn will inform reporting on SDG indicator 15.3.1 at the regional and global level, and (b) land use and spatial planning frameworks required to effectively implement measures to achieve LDN. The curriculum will also include reference to other target monitoring systems and reporting obligations at national level to maximize synergies and avoid duplication of efforts.

2. **Developing minimum data quality standards and protocols** and explore the development of federated collaborative platforms with high computing capacities and big data analytics tools (e.g., EO data cubes) that would allow countries to easily select, access, process, analyze, interpret and quality control large datasets associated with EO and geospatial information.

The GEO LDN Initiative will be global in scope, but may also support regional activities in capacity building, data collection and validation, including activities aligned with other regional GEO Initiatives and priorities. GEO LDN strategic activities will be coordinated via three Working Groups (WGs):

**WG1:** Capacity Building, which will establish networks and facilitate the provision of training,

**WG2:** Data Quality Standards, which will develop minimum data quality standards and specifications for the indicators, and

**WG3:** Data Analytics, which will facilitate and support the development of data products and analytical tools that assist countries and other stakeholders to monitor land degradation.

### **1.3 Points of Contact**

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## **2. Purpose**

### **2.1 Rationale**

As the custodian agency for SDG indicator 15.3.1, the UNCCD utilizes three sub-indicators (i.e., land cover, land productivity and carbon stocks) that rely, to a large extent, on Earth Observations (EO) and geospatial information. A coordinated response from the EO and geospatial community is urgently needed to enhance national capacities to undertake quantitative assessments and corresponding mapping of their degraded lands, as required by the SDG indicator 15.3.1 (“proportion of land that is degraded over total land area”) and by the adoption of Land Degradation Neutrality (LDN) targets under the auspices of the United Nations Convention to Combat Desertification (UNCCD). This would greatly assist countries and other stakeholders at the sub-national level in setting policy, planning and investment priorities among diverse land resource areas.

The GEO LDN Initiative, which involves numerous GEO members and POs, is well-positioned to assist the UNCCD and its 197 contracting parties with the provision and deployment of EO datasets, country support, capacity building and training, and EO tools and platforms so that countries can effectively monitor and report on SDG indicator 15.3.1, but more importantly so that decision-makers have actionable information at their fingertips to make better informed policies and investments. The assets of the GEO community would be utilized specifically to (1) leverage its convening power to turn information into knowledge and package it for user-centric tools, applications and services; (2) identify

existing data and information gaps at national and project levels; (3) mobilize action to reduce these gaps by empowering countries and organizations to strengthen and develop their own capacities through the leveraging of technical assistance and increased access to EO datasets and products; and (4) link to socio-economic and other relevant data through partnerships in order to provide actionable information for decision-making.

## **2.2 Policy Mandate**

In September 2017, the UNCCD's 13th Conference of the Parties (COP.13) adopted various decisions related to SDG indicator 15.3.1, most notably decision 9/COP.13 on "Promotion and strengthening of relationships with other relevant conventions and international organizations, institutions and agencies" which:

*Invites the Group on Earth Observations to support the efforts of Parties to the UNCCD in implementing the Convention by providing space-based information and in situ measurements to assist countries in fulfilling the reporting requirements for Sustainable Development Goal indicator 15.3.1 and fostering data access, national data capacity-building and the development of standards and protocols;*

The UNCCD secretariat, as the custodian agency for SDG indicator 15.3.1, and its resource mobilization institution (the Global Mechanism), as the executing agency for the LDN target setting programme (LDN-TSP), are actively involved with numerous GEO members and Participating Organizations (POs) in capacity building and implementation at the national level. As a result, the overarching terms of reference and good practice guidance for and the expected benefits of the GEO LDN Initiative have already been established.

## **2.3 Planned Outputs of the Initiative**

The key planned outputs of the GEO LDN Initiative are:

1. **Access to space-based information and in situ measurements for the three sub-indicators**, namely, changes in land cover, land productivity and carbon stocks. Effective reporting on SDG indicator 15.3.1 will require the use of multiple types and sources of data, including those generated and used at national and sub-national (local project) levels as well as new sources of data developed outside of national statistical systems, such as global and regional geospatial data sets, including EO data sets. The complementarity, integration and harmonization of available geo-referenced data will help increase the accuracy of change detection in the sub-indicators and significantly reduce the costs of monitoring and reporting on the indicator, while at the same time increasing policy relevance.
2. **Expertise, tools and training to build national capacities:** This includes review and advice on selecting the appropriate data and information that is most applicable to national circumstances. It is vital that the training and technical solutions are practical and self-sustaining and that they address the size and complexity of the data selected for each country. Training on the use of available tools for accessing, processing, analyzing and interpreting data as well as validation techniques would ideally be done in collaboration with National Statistical Offices (NSOs),

specialized agencies and the “main reporting entity” for the indicator. For land use and spatial planning frameworks to implement measures to achieve LDN, the curriculum will also include reference to other target systems and reporting obligations at national level to maximize synergies and avoid duplication of efforts. Regional focus will be used where appropriate.

3. **Minimum data quality standards and protocols for the indicator:** As SDG indicator 15.3.1 relies largely on geospatial information and digital data from various sources, it adheres to ISO 19115-1:2014 which defines the schema required for describing geographic information and services by means of metadata. There is an existing international standard for the sub-indicator on land cover (ISO 19144-2:2012) which includes the Land Cover Meta Language (LCML): a common reference structure used by the System of Environmental-Economic Accounting (SEEA) for the comparison and integration of data for any generic land cover classification system. The international standard for calculating NPP ( $\text{gC}/\text{m}^2/\text{day}$ ) is used for land productivity from remotely-sensed, multi-temporal surface reflectance data, accounting for the global range of climate and vegetation types. This standard was established in 1999 by the U.S. National Aeronautics and Space Administration (NASA) in anticipation of the launch of the Moderate Resolution Imaging Spectroradiometer (MODIS) sensor. For carbon stocks, IPCC (2006) contains the most relevant definitions and standards, especially with regard to reference values applicable for Tier 2 and 3 Greenhouse Gas (GHG) reporting. In this regard, the technical soil infrastructure, data transfer and provision of national reporting data is also standards-based.

#### ***2.4 Intended Users***

The goal of the GEO LDN Initiative is the improved delivery of information, products, tools and services to users by specifically building national and sub-national capacities for capturing, uploading, archiving, sharing, accessing, processing and utilizing data and information in multiple policy contexts. This will target users at the national level responsible for monitoring and reporting, their counterparts in policy and planning in the different land use sectors, and other stakeholders at sub-national level, including local administrations and project managers.

The GEO LDN Initiative will not only serve for reporting (e.g. on indicator 15.3.1), but most importantly will provide countries with critical input for policies and sound decision making for upscaling sustainable land use management and restoration activities. Synergies with other global frameworks/reporting systems (Paris Agreement (NDCs), Sendai, post-2020 global biodiversity framework, REDD+ and other SDG indicators) will support countries in applying integrated cross-sectoral land monitoring systems.

#### ***2.5 Expected Outcomes, Impacts and Beneficiaries***

Halting and reversing land degradation trends will help deliver multiple SDGs, climate action in terms of enhanced carbon sequestration and reduced emissions, and increased resilience to slow onset disasters. Our future economic growth, prosperity and human wellbeing depend upon whether we can achieve a healthy and sustainable balance between our natural and working landscapes. Over 800 million people are estimated to be chronically undernourished, often as a direct consequence of land degradation, declining soil fertility, unsustainable water use, drought and loss of biodiversity. Sustainable land use practices can improve water efficiency and quality in a cost-effective way as well as the restoration of

water-related ecosystems which are essential to mitigate water scarcity. This is an important precondition to achieve access to adequate and equitable sanitation and hygiene for all. By 2030, almost 60 per cent of the world's population will live in urban areas. It is critical to promote integrated spatial development planning approaches to optimize the allocation of land resources that human settlements in urban and peri-urban areas rely upon.

### **3. Background**

The GEO LDN was conceived in response to the decision adopted by the UNCCD's governing body (see policy mandate above) recognizing that making significant progress towards the strategic objectives of the Convention and the 2030 Agenda for Sustainable Development requires strong and effective relationships that can leverage the appropriate synergies with organizations that have overlapping or convergent missions. This includes not only the Rio conventions and other multilateral environmental agreements but also those organizations and institutions focused on issues directly related to sustainable land management, including monitoring and reporting, capacity-building, knowledge and technology transfers, and access to big data.

The GEO LDN Initiative, with its specific policy demand-driven mandate, evolved from a Community Activity into a full-fledged GEO Initiative in November 2018 with the support of numerous GEO members and POs, including financial support from the Government of Germany. The GEO LDN initiative is now supported by countries, organizations and experts with overlapping interests that are represented in the three Working Groups to facilitate assessments of land degradation with the aim of improving ecological and human well-being, thereby also contributing to the "Earth Observations in Service of the 2030 Agenda for Sustainable Development" Initiative.

In 2014-2015, 14 countries participated in the UNCCD's LDN pilot project<sup>1</sup> to implement the target setting approach, including the use of the methodology and data options for reporting on the three sub-indicators. All countries established baselines based on these sub-indicators, either by using national data and/or global default data provided by the UNCCD and its partners. This pilot project demonstrated the importance of upfront technical assistance and country-tailored advisory services for overcoming data analysis challenges and barriers.

Launched in 2016, the LDN-TSP<sup>2</sup> is now supporting 122 participating countries and their national LDN working groups, which are comprised of representatives from key stakeholders across sectors (including ministries, civil society, research, private sector and development partners), in reviewing and validating LDN baselines and targets. While the members of these working groups are diverse in their areas of expertise, there is a need to increase representation from National Statistical Organizations (NSOs) and build more capacity for accessing, processing, interpreting and validating EO data and geospatial information as well as alternative data sources to establish baselines to monitor and report on the

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<sup>1</sup> <http://knowledge.unccd.int/knowledge-products-and-pillars/ldn-target-setting-building-blocks/lessons-learned-14-pilot-4>

<sup>2</sup> <http://www2.unccd.int/actions/ldn-target-setting-programme>

indicator. As of June 2019, over 80 countries<sup>3</sup> participating in the LDN-TSP have established and validated a baseline for the indicator. Several regional and national workshops and meetings have been conducted since 2016, including 5 regional workshops on national reporting completed in May 2018.

The UNCCD COP.13 also endorsed an LDN conceptual framework which underpins a universal methodology for estimating SDG 15.3.1 indicator.<sup>4</sup> At the global level, the UNCCD leads an inter-agency advisory group<sup>5</sup> that has produced Good Practice Guidance<sup>6</sup> for (1) measuring and evaluating changes in each of the three sub-indicators, and (2) estimating and reporting on SDG indicator 15.3.1. The SDG indicator 15.3.1 and its sub-indicators are included in the UNCCD's national reporting for 2018 and every four years thereafter.<sup>7</sup>

As noted above, at least four GEO initiatives and other Community Activities will benefit from the strategic activities undertaken to support the monitoring of SDG indicator 15.3.1 and its sub-indicators. Leadership and engagement in the GEO LDN Initiative will further reinforce GEO's role in global, regional, national and community scale monitoring and expert processes to set standards and specifications for EO land products and related natural resources observations.

## **4. Relationship to Other Activities**

### ***4.1 Linkages to the Sustainable Development Goals***

GEO LDN will assist countries, regions and other stakeholders interested in addressing land degradation and achieving SDG 15, "Life on Land", which is foundational to making progress to many other SDGs. To eradicate extreme poverty or to generate additional income and employment (SDG 1) we must look to healthy and productive land. With a global workforce of over one billion, and as the critical mechanism for alleviating food shortages (SDG 2) agriculture is one of the most important industries to address. The land use sector, with its high concentration of poor people offers some of the most significant opportunities for green growth and prosperity (SDG 8). Models suggest that green investments in the transition to sustainable agriculture could create over 200 million full-time jobs across the food production system in 2050.<sup>8</sup> Poverty reduction (SDG 1) and job creation through sustainable land use is not, however, limited just to agriculture. Land-related activities are also relevant in the broader context of rural development. Examples of poverty reducing and job generating sectors are those related to sustainable forest management, sustainable tourism and clean energy production (SDG 7) as well as ecosystem restoration.

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<sup>3</sup> <http://www2.unccd.int/actions/ldn-target-setting-programme>

<sup>4</sup> [http://www2.unccd.int/sites/default/files/documents/2017-08/LDN\\_CF\\_report\\_web-english.pdf](http://www2.unccd.int/sites/default/files/documents/2017-08/LDN_CF_report_web-english.pdf)

<sup>5</sup> Including the Food and Agriculture Organization of the United Nations (FAO), United Nations Statistics Division (UNSD), United Nations Environment (UNEP), United Nations Framework Convention on Climate Change (UNFCCC) and Convention on Biological Diversity (CBD).

<sup>6</sup> <http://bit.ly/2zMAvK6>

<sup>7</sup> [http://www2.unccd.int/sites/default/files/sessions/documents/2017-09/ICCD\\_CRIC%2816%29\\_L3-1715758E.pdf](http://www2.unccd.int/sites/default/files/sessions/documents/2017-09/ICCD_CRIC%2816%29_L3-1715758E.pdf)

<sup>8</sup> [https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/@publ/documents/publication/wcms\\_181836.pdf](https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/@publ/documents/publication/wcms_181836.pdf)

Land-use decisions also impact on water use (SDG 6), and improving water management goes hand in hand with mitigating or preventing land degradation. Sustainable land use practices that improve water efficiency and quality in a cost-effective way as well as the restoration of water-related ecosystems are essential to mitigate water scarcity. Smart, coordinated land and water management based on spatial planning can provide a cost-effective, long-term solution to water scarcity, drought and pollution. Likewise, while urbanization can improve living conditions, if it is unplanned, it can have adverse effects on people and the environment (SDG 11). Cities and suburbs often encroach on fertile land and, and uncontrolled sprawl can create a vulnerable urban environment prone to natural hazards adjacent to degraded rural and peri-rural landscapes.

In addition, actions to address land degradation have catalyzed partnerships and numerous communities of experts and practitioners to reach agreement and take specific action to address the national reporting requirements under the SDG indicator and other frameworks (SDG 17). This would include close collaboration with the Systems of Environmental-Economic Accounting (SEEA) and the OECD's Green Growth Headline and Core Set of Environmental Indicators.

#### ***4.2 Linkages to the Paris Agreement***

There are many opportunities for the land use sector to actively reduce emissions and sequester carbon in the short to medium term. In agriculture, the potential amount of reduction is estimated at 2.3–6.4 GtCO<sub>2e</sub> per year in 2030. Much of this could be realized through sustainable land management practices such as conservation tillage, combined organic/inorganic fertilizer application or agroforestry and other sustainable approaches and techniques.

The annual rehabilitation and restoration of 12 million hectares of degraded land up to 2030 as envisaged by LDN, can help close the estimated emission gap of 8-11 GtCO<sub>2e</sub> by 3.33 GtCO<sub>2e</sub> in 2030. This is roughly 25 per cent of the emissions gap. In other words, the mitigation potential of this additional land rehabilitation roughly equals 50 per cent of the expected emissions reduction pledges resulting from the Paris Agreement. The improved accuracy of carbon stock estimates would allow for more targeted interventions and better monitoring of Nationally Determined Contributions (NDCs).

#### ***4.3 Linkages to the Sendai Framework***

Natural resource management practices can contribute to the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries. By targeting that part of the population that depends on the land and its provision of ecosystem services, this can reduce the number of people who are vulnerable to disasters, especially those of slow onset.

Land users need timely information about looming disasters, such as drought, and knowledge about how to respond and manage the situation. They need reliable land monitoring systems to fall back on in case of disaster. And they need to know how their land potential and ecosystems function to optimize land use and minimize their vulnerability. By creating timely systems to monitor and communicate land degradation trends, setting up insurance and co-contributory voluntary schemes in the good times and

diversifying their produce, family farmers and small-scale producers can better manage their risks and cope with disaster.

#### ***4.4 Linkages to Other GEO Work Programme Activities***

The GEO LDN initiative has actively reached out to the GFOI, EO4SDGs, CARD4L, and FAO's Global Soil Partnership (GSP) as partners, and to avoid duplication of efforts and to maximize synergies.

Stakeholder mapping was a key exercise during the spring 2019 meeting of the GEO-LDN leads group, and the steering committee is working to engage with as many of these as possible.

The GEO LDN Initiative has worked closely with the EO4SDG team to jointly plan side events for the GEO Ministerial Symposium, support on-line seminars and attend annual meetings. We have also connected with colleagues in a range of African research organizations and will host an LDN focused side event at the AfriGEO Symposium in Nairobi in August 2019. The Central American Integration System (SICA), an institutional framework in the Central America Region covering the States of Costa Rica , El Salvador , Guatemala , Honduras , Nicaragua and Panama, have expressed key interest to join the LDN working groups and support implementation of the GEO LDN agenda in the Central America Region.

The GEO Land Cover (LC) and Land Cover Change (LCC) task, co-led by the GOF-C-GOLD/GFOI land cover at Wageningen University, works to improve the availability and quality of LC and LCC data by helping to convene and coordinate the various sectors of the LC community, including data providers and consumers. The GEOBON, GFOI, GEOGLAM and Earth Observations for Ecosystem Accounting Initiatives are actively participating in global efforts to help classify land cover relevant to the communities served by these initiatives.

CEOS has established a LDN working group to provide liaison functions and foster collaboration of work streams, especially the CEO analysis ready data for land (CARD4L) as it pertains to the data quality standards and data analytics (WG2 and WG3). GFOI has developed method and guidance documents which will be an important reference for LDN data quality standards (WG2). On capacity building (WG1), the GEO LDN Initiative is working closely with the GEO secretariat to develop a work plan based on the experiences and lessons learned from other GEO activities, and to leverage these efforts with other Initiatives, such as SEEA and GEO Wetlands, that have similar approaches to the use of EO data. The LDN Initiative will encourage participation from members of other GEO Initiatives in the LDN Steering Committee as these connections develop.

## **5. Stakeholder Engagement and Capacity Building**

### ***5.1 Operating Environment***

The "end-user community" in the GEO LDN Initiative consists primarily of national governments, relevant line ministries (the main reporting entity for SDG indicator 15.3.1) and their National Statistical Offices (overall responsibility for SDG reporting), and any sub-national entities or specialized agencies that are validating and reporting data for the UNCCD and SDG reporting processes. Advice and expert input from private sector, academia and civil society will also inform progress and priorities. The GEO



LDN Initiative will build upon the national working groups established in the framework of the LDN TSP in 122 countries and, from there, mobilize and strengthen the engagement of other countries.

## ***5.2 Strategy for Engaging Stakeholders and Planned Engagement Activities***

Data, information, guidance, tools, platforms and trainings developed by the GEO LDN Initiative will be tailored to meet the needs of decision-makers for monitoring progress towards a number of global/regional targets and developing initiatives to halt and reverse land degradation and restore degraded land.

### ***5.2.1 Capacity Building for National Reporting***

Regional capacity building workshops to support UNCCD national reporting, which includes the SDG indicator 15.3.1 and sub-indicators, were organized in March to May 2018 under the auspices of the Global Support Programme (“Strengthening UNCCD reporting –enhancing implementation of the UNCCD”) which is funded by the Global Environment Facility (GEF) and executed by the Global Mechanism of the UNCCD. Synergies with other global frameworks/reporting systems were included as a part of the strategic context for the knowledge imparted in these workshops.

These workshops enabled countries to prepare and submit UNCCD national reports by mid to late 2018, which in turn informed SDG reporting on 15.3.1 at the regional and global level in February 2019. The workshops also provided support to countries in accessing, interpreting and validating data for land use planning and spatial planning to implement measures to reach LDN. Workshop participants included UNCCD national focal points, scientific experts, GIS specialists and designated representatives of national statistical offices.

While the GEO LDN Initiative is being formally established according to GEO protocols and procedures, there will be near-term opportunities to follow up on these workshops and provide targeted assistance as well as to advise the UNCCD secretariat as it begins capacity building preparations for the 2021-2022 reporting cycle. The GEO LDN capacity building work plan for 2019-2022 aims to increase the access, coverage and level of confidence in the indicators among national authorities.

### ***5.2.2 Development of Data Quality Standards***

WG 2 has finalized its work plan to develop minimum data quality standards for monitoring and reporting on land degradation (and the sub-indicators) using EO datasets. This will involve hiring a consultant and organizing global consultations. The approach would be to build upon the existing ISO standards for “Good practices framework for combatting land degradation”,<sup>9</sup> the Land Cover Meta Language (LCML)<sup>10</sup> and the international standard for calculating NPP established in 1999 by the U.S.

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<sup>9</sup> <https://www.iso.org/obp/ui/#iso:std:iso:14055:-1:ed-1:v1:en>

<sup>10</sup> <https://www.iso.org/standard/44342.html>

NASA.<sup>11</sup> For carbon stocks, IPCC (2006) contains the most relevant definitions and standards, especially with regard to reference values applicable for Tier 2 and 3 GHG reporting.<sup>12</sup>

In UNCCD decision 22/COP.11, soil organic carbon (SOC) stock was adopted as the metric to be used with the understanding that this metric will be replaced by total terrestrial system carbon stocks, once operational. Information on the distribution of SOC was delivered to the UNCCD by ISRIC World Soil Information as a baseline for the SDG indicator 15.3.1. The SOC product is a remote sensing product, which is derived based on remote sensing data (MODIS) used in combination with machine learning algorithms and historic SOC field observations to derive the prediction of the SOC content and stocks. Future SOC assessments could follow a similar approach based on updated MODIS data and field measurements. WG 2 will also collaborate with the European Space Agency and its World Soils programme.<sup>13</sup>

### *5.2.3 Development of a Federated Data Analytics Platform*

The main mechanisms for developing the science and technologies needed to achieve LDN will be supporting a portfolio of projects at national, regional and/or global scales that address one or more key challenges in mapping LDN, using data and approaches that can be incorporated into a collaborative, federated data analytics platform (“data analytics platform”). The data analytics platform will initially focus on supporting SDG 15.3.1 and LDN monitoring and reporting, but it may also act as a focal point for analytics solutions for a range of other SDGs and global land monitoring initiatives in future.

WG3 will establish an open user community and develop open source tools and methods to calculate SDG 15.3.1 and to support planning, implementation, and monitoring of actions to achieve LDN from EO and other data sources. These tools and methods will be developed using a modular approach, so that tools can evolve as technology and user needs change, and so that the working group can leverage work already conducted under related initiatives (Trends.Earth, openEO, EO4SDG, CEOS, etc.). Together these modular tools will function as the Data Analytics Platform.

Associated tasks will include a review of existing interfaces, codes and computer architectures to identify existing facilities and platforms that might be suitable for housing, or use by, the data analytics platform, and facilitating or supporting one or more research or implementation projects aligned with these objectives.

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<sup>11</sup> Running et al. 1999. MODIS Daily Photosynthesis (PSN) and Annual Net Primary Production (NPP) Product (MOD17): Algorithm Theoretical Basis Document [https://eosps0.gsfc.nasa.gov/sites/default/files/atbd/atbd\\_mod16.pdf](https://eosps0.gsfc.nasa.gov/sites/default/files/atbd/atbd_mod16.pdf)

<sup>12</sup> IPCC. 2006. *ibid*

<sup>13</sup> Space-based EO systems provide a means to support the monitoring of some soil chemical and physical properties, directly or indirectly, through the interaction of radiance fields with the (mainly upper) soil layer as shown by many research projects. However, space-based EO data together with in-situ measurements and modeling are hardly used today in an operational manner by national and international organizations with the mandate to map, monitor and report on soils. This may be related to the lack of adequate, available space-borne EO data (spectral and temporal coverage, restricted data access) as well as the lack of available processing capabilities. With the advent of operational EO systems such as the European Union Copernicus Program (including the high priority Copernicus expansion missions), the free and open EO data policies as well as cloud-based access and processing capabilities (e.g. DIAS) an EO based Soil Monitoring System appears feasible today.

### **5.3 Planned Activities to Engage Stakeholders and Strengthen Capacity**

The GEO LDN Initiative will include actions, including active recruitment of academic, R&D partners and institutions to provide expert input. The value of general Earth science research, data and data analytic techniques will be exploited in ways to both help national governments meet their sustainable development objectives and to demonstrate the translation of R&D into policy and ground-level applications.

The GEO LDN Initiative will assist with the rapid provision and deployment of EO datasets and promote in-country analysis and interpretation of those data sets, thereby ensuring national ownership.<sup>14</sup> The Initiative will leverage the UNCCD reporting mechanism and tools,<sup>15</sup> which provide a practical and harmonized approach to monitoring and reporting beginning in 2018<sup>16</sup> and every four years thereafter.<sup>17</sup> The quantitative assessments and corresponding mapping at the national level, as required by this indicator, would help countries to set policy and planning priorities among diverse land resource areas, in particular:

- to identify hotspots and plan actions of redress, including through the conservation, rehabilitation, restoration and sustainable management of land resources; and
- identify appropriate LDN interventions and assess their likely improvement of the sub-indicators;
- to address emerging pressures to help avoid future land degradation.

## **6. Governance**

### **6.1 Governance Structure**

The GEO LDN Initiative is expected to have the following organizational structure:

- Steering Committee (i.e. 9 members)
- Chair and Vice-chair elected every 3 years
- Possible Secondment(s) to GEO (in Geneva) to act as the secretariat for the Initiative
- Technical Advisory Group (i.e. 15 members, some from outside the GEO community)
- Working Groups (3 to start): capacity building and international standards

The Steering Committee is the main decision-making body, responsible for coordinating GEO LDN Initiative activities. The responsibilities and duties of the Steering Committee are to:

- Provide oversight and strategic direction for the GEO LDN Initiative;
- Promote the aims and objectives of GEO LDN Initiative and expand its profile and prominence;

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<sup>14</sup> United Nations General Assembly. 2015. Transforming our world: the 2030 Agenda for Sustainable Development. Resolution adopted by the General Assembly on 25 September 2015 (A/RES/70/1).

<sup>15</sup> [http://www2.unccd.int/sites/default/files/sessions/documents/2017-08/ICCD\\_CRIC%2816%29\\_INF.1%20-advance.pdf](http://www2.unccd.int/sites/default/files/sessions/documents/2017-08/ICCD_CRIC%2816%29_INF.1%20-advance.pdf)

<sup>16</sup> [http://www2.unccd.int/sites/default/files/sessions/documents/2017-09/ICCD\\_CRIC%2816%29\\_INF.1-1714762E.pdf](http://www2.unccd.int/sites/default/files/sessions/documents/2017-09/ICCD_CRIC%2816%29_INF.1-1714762E.pdf)

<sup>17</sup> [http://www2.unccd.int/sites/default/files/sessions/documents/2017-09/ICCD\\_CRIC%2816%29\\_L3-1715758E.pdf](http://www2.unccd.int/sites/default/files/sessions/documents/2017-09/ICCD_CRIC%2816%29_L3-1715758E.pdf)

- Review and endorse the Implementation Plan and Annual Work Plans of the GEO LDN Initiative;
- Monitor and evaluate institutional effectiveness of the GEO LDN Initiative against aims and objectives outlined in the Implementation and Annual Work Plans;
- Conduct user needs assessment and represent stakeholder interests to the greatest extent possible;
- Provide guidance and support to the GEO LDN Initiative Working Groups and monitor their progress;
- Coordinate the production of deliverables for reporting to the GEO Secretariat;
- Work with the Management and Functional Support Unit to identify new stakeholders that would contribute to and benefit from the GEO LDN Initiative;
- Identify opportunities for collaboration between and among stakeholders;
- Facilitate and coordinate relevant activities and mobilize resources when opportunities arise.

The Steering Committee will, as far as possible, operate by consensus. Decisions requiring a vote will be decided by simple majority of the votes cast. The quorum for a valid vote is participation of one half of the voting members of the Steering Committee. Votes may be held at meetings or by appropriate electronic means. These procedures will apply, for example, to make any changes to the ToR. The Steering Committee will meet in person at least once yearly and via teleconference monthly.

The Steering Committee will consist of the country members, POs, leads (or Co-Leads) of Working Groups and other stakeholders and shareholders, if any. Shareholders, as defined here, are those organizations that contribute resources for the overall coordination of the GEO LDN Initiative (e.g., Management and Functional Support Unit, publications, meetings, events) and/or the production of new tools or services specifically branded as GEO LDN Initiative products. Stakeholders are those organizations that contribute to, or benefit from, the GEO LDN Initiative, and the outputs of the Working Groups, either as a provider or end user. It is anticipated that between one-third and one-half of the Steering Committee will consist of representatives of user communities.

The total number of seats on the Steering Committee will be limited to 12. Members will be elected by the interim or existing Steering Committee, from among the nominations received following an open call. Nominations can be made by stakeholder and shareholder organizations, or members of the GEO community. Self-nominations will be welcome. In their decision, interim or existing Steering Committee members will take into account the contributions of the shareholder organizations being represented, the relevance of the stakeholder organizations being represented, the balance between “providers” and “users”, geographical and developing country representation as well as gender balance.

Steering Committee members will serve a 3-year term with the potential for two one-year extensions (not to exceed 5 years in total). The term may be shortened to two years, for example if a member is serving as a representative of another organization, to align with the term they will serve as official representative (e.g., Chair or Executive Committee member) of that organization.

## **6.2 Key Leadership Positions**

Three Co-Chairs will be elected by the Steering Committee members, and will serve terms of three years, with the potential for two one-year extensions (not to exceed 5 years in total). Exceptions to the 5-year limit are subject to approval by the Steering Committee. The Co-Chairs will lead the discussions of the Steering Committee, oversee the Working Group leads and their work plans, and guide the overall direction and financial resources of the GEO LDN Initiative.

Working Group leads are selected by the Steering Committee and responsible for recruiting members for their working groups. Membership in the working groups is open to all GEO members, POs, and other stakeholders and shareholders. The duties of the Working Group leads are to:

- Identify appropriate individuals to serve on working groups;
- Coordinate outputs from Working Group activities according to a work plan with a timeline for quantifiable and measurable deliverables;
- Contribute to other GEO LDN Initiative deliverables;
- Participate in reviewing GEO LDN Initiative activities and make contributions to the update of the Implementation Plan.

## **6.3 Communications Strategy**

Members of the GEO LDN Initiative, including Steering Committee members, are globally distributed and meetings will primarily be conducted virtually. Meetings will occur in line with milestones in the GEO LDN Initiative workplan, or via email on an approximately monthly frequency at other times. Face-to-face meetings of the Steering Committee will be held at the UNCCD Headquarters in Bonn, Germany and on the margins of GEO Week and other GEO-related events when appropriate.

A website has been established (<https://www.earthobservations.org/activity.php?id=149>) which describes the structure and aims of the Initiative, along with lists of people and institutions who have expressed interest in engaging with it. The Initiative will aim to organize side events at relevant international meetings, including GEO Plenaries and UN events.

## **6.4 Monitoring and Evaluation**

Approximate completion dates have been identified for each of the key outputs and objectives for each Working Group, and progress will be tracked against those dates in the first instance. The Initiative recognizes that, at this time, the Co-Chairs and WG leads contribute to the Initiative on a voluntary basis, and some flexibility around the dates may be required to accommodate changes in circumstances outside of their control.

Metrics may also be used to measure the success of the Initiative. Amongst these, the level and extent of in-kind and financial contribution to the GEO LDN working groups, and the number of individuals joining in-person or virtual meetings and workshops will be recorded.

## **6.5 Risk Management**

There are no substantive technical risks to implementation of GEO LDN Initiative recognizing that securing the financial and in-kind resources needed for producing technical documents, organizing global expert consultations and carrying out capacity building and training remains a serious challenge.

## **7. Resources**

### **7.1 Summary of Resource Requirements**

The implementation of the GEO LDN Initiative currently relies significantly, though not exclusively, on in-kind contributions from existing observing capacities, networks, expertise, staff time, interoperability arrangements and standards, datasets, information systems, user services, projects and capacity building programmes. The Initiative will focus on leveraging existing capacities and streamlining existing programmes and funding schemes for EO land products, platforms and tools to take advantage of multiple, existing or upcoming capacities. These include but are not limited to:

- The Copernicus space segment including the Sentinel series of satellites which for example provide raw data to the European Space Agency's (ESA) Climate Change Initiative on Land Cover (CCI-LC), the various vegetation indices and relevant data layers used to estimate net primary production and land productivity dynamics by the Joint Research Centre of the European Commission
- Other space borne resources from national space agencies collaborating through the Committee on Earth Observation Satellites (CEOS) and other global initiatives;
- In-situ data collection and modelling resources
- Information products from the Copernicus core services for monitoring land, oceans, atmosphere, climate, for security services, emergency response and humanitarian aid;
- Additional processes and products from agencies and organizations such as the European Space Agency (ESA), Conservation International (CI), Organization for Economic Cooperation and Development (OECD), Food and Agriculture Organization of the United Nations (FAO), United Nations Statistics Division (UNSD), etc.
- Research & innovation resources and projects related to geo-spatial information and Earth sciences;
- Other resources, such as data processing capacities, specific data sources, and information technologies for validation and verification made available through the involvement of the commercial sector, such as the google.

But this is not sufficient, the administration and management of the Initiative will rely on staff resourcing contributions (e.g., secondments based at the GEO offices) by the GEO member countries, the European Commission and GEO POs. In addition to these in-kind contributions, further funding of between USD 300,000-500,000 are required for the period 2019-2021 to produce the necessary technical documents, organize global expert consultations and carry out targeted capacity building and training before the next reporting cycle. For the 2021-2022 reporting cycle, the UNCCD will have access

to funding from GEF Global Support Programme as well as voluntary contributions for LDN monitoring and implementation for regional capacity building workshops.

## 7.2 Sufficiency of Resources Contributed

100.000€ have been provided to the Initiative from the German Federal Ministry for Economic Cooperation and Development (BMZ) as a contribution to the GEO trust fund. The German contribution is earmarked for GEO-LDN WG2 on data quality standards. It will be used (a) to recruit a senior consultant who will review existing EO data quality standards, organize a phased global expert consultation with data providers and end-users at national and sub-national level, and based on this elaborate these standards including practical decision trees to guide countries selecting the most appropriate data sets for their specific needs; and (b) to finance a consultation workshop on data quality standards. With this, the funding will contribute significantly to the update of the Good Practice Guidance for SDG indicator 15.3.1.

However, the extent of committed resources is insufficient to meet the ambition outlined in the GEO LDN Terms of Reference and the WG work plans. The lack of in-kind contributions, such as secondments, also remains a serious challenge. Financial and in-kind contributions are vital to achieving the GEO LDN objectives in a number of key areas (Table 1).

*Table 1. Key areas requiring funding and or in-kind support*

Task	Activities	Resources
Operations	<ul style="list-style-type: none"> <li>Two face-to-face meetings of the Steering Committee per year</li> <li>Annual LDN Symposium convening the Steering Committee, and key members of the Technical Advisory and working Groups</li> </ul>	<ul style="list-style-type: none"> <li>Travel, venue hire</li> </ul>
Secretariat	<ul style="list-style-type: none"> <li>Secondment of Secretary to GEO (Geneva)</li> </ul>	<ul style="list-style-type: none"> <li>Salary, relocation</li> </ul>
Capacity building (WG1)	<ul style="list-style-type: none"> <li>Outreach of capacity building networks and services into key regional and local communities</li> <li>Development of training materials and programs</li> </ul>	<ul style="list-style-type: none"> <li>In-kind, networking, travel</li> <li>Consultant fees</li> </ul>
Data quality standards (WG2)	<ul style="list-style-type: none"> <li>Review and define data quality standards for SDG 15.3.1 and LDN</li> <li>Revision of SDG 15.3.1 Good Practice Guidance</li> </ul>	<ul style="list-style-type: none"> <li>Consultant fees</li> </ul>
Data analytics (WG3)	<ul style="list-style-type: none"> <li>Review and define the characteristics of a Federated Data Analytics Platform</li> <li>Implement LDN analytics tools and systems on the Analytics Platform</li> </ul>	<ul style="list-style-type: none"> <li>Consultant fees</li> </ul>

Work plans for each of the Working Groups have been developed to rely as little as possible on sourcing additional funding. Impacts of a lack of additional funding will include reduced potential coordination of activities, through a lack of face-to-face engagement opportunities Steering Committee members and potential project leaders. Achievement of the objectives of the Initiative will then rely more heavily on voluntary efforts from Initiative members.

### ***7.3 Strategy for Mobilizing Additional Resources***

The Steering Committee members have approached a range of national focal points and institutions in search of financial and in-kind support for the Initiative. Steering Committee members will continue to outreach to governments, organizations and funding sources to obtain the resources required. They will also work with the GEO secretariat to explore the possibility of joint fund-raising activities.

The success of WG1 relies strongly on engaging with organizations that have already invested resources in the relevant regions to establish existing communication and implementation networks. In addition, WG1 is engaging with SICA to implement webinars on the assessment and benefits of LDN, and using this a platform to reach out to more potential stakeholders, contributors and funders. Terms of reference for a senior consultant to conduct a review of data quality standards and revise the Good Practice Guidance documents for SDG 15.3.1 have already been prepared for WG2, and the activities of WG3 are closely aligned with activities in a GEF-funded Conservation International project.

The Steering Committee feels that support for the Initiative will increase as the Initiative progresses. In particular, planned activities in each working group, including building networks through seminars and conference presentations, aim to more closely engage with potential collaborators and supporters to align efforts. Finalization of the Work Plans will enable the scope and scale of discrete activities to be identified more finitely, and proposed cost estimations and contract terms can then be included in documents that can be distributed to potential funders.

### ***7.4 Commercial Sector Engagement***

The significance of land degradation as one of the greatest challenges to livelihoods and biodiversity is growing, such as indicated in the recent IPCC report on Climate and Land<sup>18</sup>. Awareness and acceptance of the potential impacts of land degradation is also increasing, and we also expect growth in interest from commercial sector organizations to try and address this challenge.

There are a range of models for engaging with commercial sector enterprises that may apply to the LDN Initiative. Commercial enterprises may benefit directly from funding supplied by a public-good initiative such as LDN operating as a donor. Limited funding is available on these terms to address the objectives of WG2 including revision of the Good Practice Guidance documents for SDG 15.3.1. Additional funding may be available in future, and further contractual engagement of commercial sector organizations will be considered at that time. The commercial sector may also engage with the SDG processes to aim to create value through demonstrating innovation and market leadership, improve efficiency and reduce costs, to improve their reputation in the community or business sectors, and to reduce future risks to

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<sup>18</sup> <https://www.ipcc.ch/report/srccl/>



their enterprises<sup>19</sup>. We believe that the LDN Initiative can demonstrate value to potential commercial sector collaborators in all of these areas.

Commercial organizations have already provided services in support of WG3 including the provision of credits for the use of Amazon Web Services through GEO, and direct engagement towards the development of data analytics services from Conservation International. More support is required to improve the likelihood and sustainability of impacts from WG3, however. Specific support from the commercial sector could greatly benefit the capacity building activities in WG1 by leveraging specific technologies and networks to increase the potential scale and effectiveness of engagement activities.

The LDN Initiative will actively invite participation from the commercial sector in all aspects of its activities including further development of the terms of reference, engagement in internal and public meetings and workshops, and in implementation activities. Engagement will be consistent with the GEO Rules of Engagement with the Public Sector<sup>20</sup> and cognizant when possible of the GEOSS Data Sharing Principles, such as open by default and provision at minimal or no cost.

## 8. Technical Synopsis

### 8.1 Source Data

National data on the three sub-indicators is and can be collected through existing sources (e.g., databases, maps, reports), including participatory inventories on land management systems as well as remote sensing data collected at the national level. Datasets that complement and support existing national indicators, data and information are likely to come from multiple sources, including statistics and estimated data for administrative or national boundaries, ground measurements, Earth observation and geospatial information. A comprehensive inventory of all data sources available for each sub-indicator is contained in the Good Practice Guidance for SDG Indicator 15.3.1. The most accessible and widely used regional and global data sources for each of the sub-indicators are briefly described here.

**1) Land cover and land cover change data** are available in the:

**(1) ESA-CCI-LC,**<sup>21</sup> and Copernicus Global Services. ESA CCI-LC contains annual land cover area data for the period 1992-2015, produced by the Catholic University of Louvain Geomatics as part of the Climate Change Initiative of the European Space Agency (ESA). The Copernicus global climate and land monitoring service will expand this effort to produce annual global land cover data from 2015 onwards as part of an operational service by the European commission (JRC leadership) to produce sustained and stable land cover data until 2030 for SDG reporting processes.

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<sup>19</sup> <https://s3.amazonaws.com/aws-bsdc/SDG-Sectors.pdf>

<sup>20</sup> [http://www.earthobservations.org/documents/GEO\\_Rules\\_of\\_Procedure.pdf](http://www.earthobservations.org/documents/GEO_Rules_of_Procedure.pdf)

<sup>21</sup> <https://www.esa-landcover-cci.org/>

(2) **SEEA-MODIS**,<sup>22</sup> containing annual land cover area data for the period 2001-2012, derived from the International Geosphere-Biosphere Programme (IGBP) type of the MODIS land cover dataset (MCD12Q1).

**2) Land productivity data** represented as vegetation indices (i.e., direct observations), and their derived products are considered the most independent and robust option for the analyses of land productivity, offering the longest consolidated time series and a broad range of operational data sets at different spatial scales. The most accurate and reliable datasets are available in the:

(1) **MODIS data products**,<sup>23</sup> averaged at 1 km pixel resolution, integrated over each calendar year since 2000; and

(2) **Copernicus Global Land Service products**,<sup>24</sup> averaged at 1 km pixel resolution and integrated over each calendar year since 1998.

**3) Soil organic carbon stock data** are available in the:

(1) **Harmonized World Soil Database (HWSD), Version 1.2**,<sup>25</sup> the latest update being the current de facto standard soil grid with a spatial resolution of about 1 km;

(2) WISE30sec database, an interim update of the HWSD v1.2 product;

(3) **SoilGrids250m**,<sup>26</sup> a global 3D soil information system at 250m resolution containing spatial predictions for a selection of soil properties (at six standard depths) including SOC stock ( $t\ ha^{-1}$ );

(4) **GSOC Map**,<sup>27</sup> the Global Soil Organic Carbon Map of the Global Soil Partnership of FAO.

## **8.2 Key Methods**

Improving the availability and suitability of datasets for countries to report on SDG 15.3.1 and LDN is a major focus of the GEO LDN Initiative. In the absence of, to enhance, or as a complement to national data sources, good practice suggests that the data and information derived from global and regional data sets should be interpreted and validated by national authorities. The most common validation approach involves the use of national, sub-national or site-based indicators, data and information to assess the accuracy of the sub-indicators derived from these regional and global data sources. This could include a mixed-methods approach which makes use of multiple sources of information or combines quantitative and qualitative data, including the ground-truthing of remotely sensed data using Google Earth images, field surveys or a combination of both. The regular collection of in situ data is crucial for the validation of the three sub-indicators. Validation is important to allow proper assessment of the accuracy and precision of all three sub-indicators.

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<sup>22</sup> <https://modis.gsfc.nasa.gov/data/dataproduct/mod12.php>

<sup>23</sup> <https://modis.gsfc.nasa.gov/data/dataproduct/mod13.php>

<sup>24</sup> <http://land.copernicus.eu/global/>

<sup>25</sup> <http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/harmonized-world-soil-database-v12/en/>

<sup>26</sup> <https://www.soilgrids.org/>

<sup>27</sup> <http://www.fao.org/global-soil-partnership/pillars-action/4-information-and-data/global-soil-organic-carbon-gsoc-map/en/>

The transformation of data into nationally relevant end products will occur in collaboration with countries through the Capacity Building activities of WG1, and through the products and tools developed in the activities of the Data Analytics working group (WG3). Capacity building activities are planned that will support countries to develop their own national datasets, and includes activities to support image processing, sub-indicator validation and reporting processes. WG3 aims to support the development of improved datasets and analytical tools to simplify and improve the information and tools available for countries to develop and validate national datasets, produced either from global datasets or via other data production processes such as Earth observation or spatial data analysis.

### ***8.3 Scientific or Technical Issues***

The primary scientific challenges are to:

1. Create sub-indicator datasets that best represent national conditions, and
2. Improve the consistency of land degradation assessments between national and local interpretations, and between different datasets representing the same sub-indicator

There is a strong emphasis in the SDG framework on the use of national datasets where possible. Each country has a unique landscape, and a distinctive interpretation of it. Supporting countries to develop National scale products from the global datasets, or to create their own products using image data and field assessment methods, is a strong focus on the Initiative.

There are many interpretations of each of sub-indicators of SDG 15.3.1 available at local, national or global scales, and these may be formulated or interpreted differently, or be based on different base datasets. This creates differences in the representation of the sub-indicators, which ultimately leads to inconsistencies in the extent of degraded land reported using these different datasets. Some of the factors that lead to this situation will be dealt with in WG2 on Data Quality Standards and WG3 on Data Analytics. The science that underpins the sub-indicator analyses will continue to evolve and improve, however, and balancing the consistency and accuracy of the analyses will be an ongoing challenge.

The main technical challenges are to identify the best open source methods to create new data analytics tools, and the best place to house and support them on the web. The range of languages and coding standards, and the number of repositories of data like that needed to assess LDN is very large and growing rapidly. Within the context of this highly dynamic environment, identifying the best environment in which to develop new analytical tools and methods, or the best location to deploy or house the tools can be challenging. Tools developed in WG3 will use the FAIR and Open EO data principles which should maximize the compatibility of these tools now and into the future. One of the early proposed tasks of WG3 is to conduct a review of existing SDG data repositories and analytics hubs to identify the most effective location to house and support data sets and analytical tools in future.

## **9. Data Policy**

### ***9.1 Data Availability***

The GEO LDN Initiative will promote GEO principles and implementation guidelines on data sharing and data management. As a singular new example, this Initiative would be directly engaged and responsive

to various multilateral environmental agreements and global initiatives for reporting on land degradation (and restoration). Data accessibility will be governed by GEOSS Data Sharing Principles, including the development of formats that can be accessed by the GEOSS Platform and hence all GEOSS data users. Although an open distributed model is anticipated, the envisioned access will enhance the holdings of the GEOSS Data CORE. The GEO LDN Initiative will work with the GEO Earth Observations for the SDGs (EO4SDG) Initiative and others to reference this data in data cubes at the national level as they are developed.

### ***9.2 Data Sets Managed by the Initiative***

While the GEO LDN Initiative does not plan to produce new datasets, it will work directly with data providers to explore new data products and analysis ready data that can be accessed directly by end-users or be used in existing tools and data cubes.

### ***9.3 Access to the Outputs of the Initiative***

As a part of the on-going efforts to integrate SDG reporting into the GEOSS Platform, Application Program Interfaces (API's) will be established with the UNCCD secretariat to ensure that reporting data can be accessed through the GEOSS Platform. The GEO and UNCCD secretariats will initiate the necessary consultations to implement this access capability. Specifically, data quality standards and all capacity building materials will be either published or hosted on the GEO and UNCCD Knowledge Hubs and the UNCCD's Capacity Building Marketplace.

### ***9.4 Strategy for Longer-term Preservation of Data and Information***

All data and information generated by the GEO LDN Initiative will be open access. This will be preserved in various formats and reside on various host platforms, such as GEOSS and UNCCD.