GEOSPATIAL IN ACTION

Data and Insights for the Sustainable Development Goals

UN GEOSPATIAL NETWORK
UNITED NATIONS COMMITTEE OF EXPERTS ON GLOBAL GEOSPATIAL INFORMATION MANAGEMENT

INSIDE COVER

Prepared by the United Nations Geospatial Network of the

Committee of Experts on Global Geospatial Information Management

Foreword

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared objective for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership.

The 2030 Agenda recognizes the crucial role in providing reliable global geospatial information to support measuring and monitoring the Sustainable Development Goals. Geospatial information management and a wide range of data are the science, innovation and technology related to "where", or location information. This has been critical for humanity since the dawn of time to understand our world, our societies and to plan our future. The role of the United Nations both as a facilitator and actor to the 2030 Agenda pledge is also the guarantor to the aim to "Leave no one behind." The United Nations covers a wide spectrum of entities and activities at the interface of science, policy and society, including operations and actions on the ground.

Geospatial information, data, technologies and services can bring value for better decisions. It can deliver stronger support to people, places and planet, and it can address the Organizational priorities as set out in the United Nations Charter as well as in global agendas as brought to the forefront of our world's priorities by the 2030 Agenda.

The United Nations Geospatial Network, the inter-agency mechanism that bring together all United Nations entities working on enabling the Organization with geospatial information, was created under the intergovernmental process of the Committee of Experts on Global Geospatial Information Management (UN-GGIM). The frameworks and guidance developed by UN-GGIM are powerful enablers. They further enable synergies and activities of the Network so the United Nations can bring to bear the benefits of geospatial data and information for the Sustainable Developments Goals, amongst a wider range of data presented in the Secretary-General's Data Strategy.

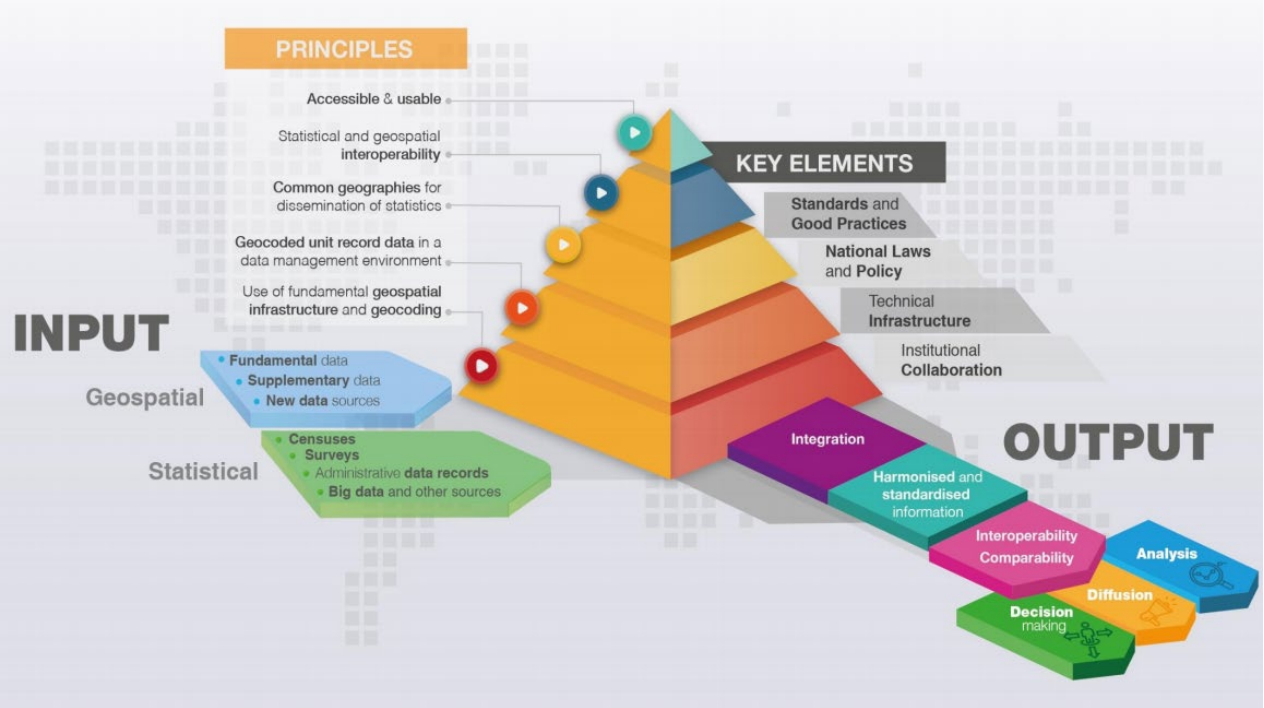
Data, and geospatial data, provide the evidence required for smarter and more effective decisions for a greater impact in moments that matter most. The Blueprint, the strategic document of the UN Geospatial Network established priorities and activities for the geospatial community of the United Nations and to bring value and enhanced, stronger contribution to the forefront to advance and address the challenges of the SDGs in close collaboration with Member States and other partners.

This publication is the demonstration of the breadth and wealth of their contributions, the importance of geospatial information to the Organization and how it underpins all decision-making; supporting its mandates and actions; providing key information in moments that matter most, in the context of the SDGs, for a greater impact to the benefit of people, places and planet.

Geospatial for a better world, here's how… and *where*.

01 - End poverty in all its forms everywhere

After a decline from 15.7 per cent in 2010 to 10.0 per cent in 2015, the pace of reduction of extreme poverty slowed further, with nowcast a rate of 8.2 per cent in 2019. The pandemic is reversing this trend. The data and indicators for the SDGs and the volume of value entries for all indicators can be overwhelming. Going through these entries to absorb, analyze and establish relationships between entries can be overwhelming; using geospatial data visualization and maps help in synthesizing and visualizing the complex data provided through the indicators. As promoted in the Global Statistical and Geospatial Framework, the integration of geospatial information and statistics provides the ability to rapidly identify patterns and specific areas with most poverty based on the International Labour Organization indicator 1.1.1 (Proportion of Population Living Below the International Poverty Line). The statistical indicators can also be integrated through aggregated geographic sub-regions to help identify major trends on this goal (Figure X), namely the prevalence of poverty in Sub-Saharan Africa.



By 2020, only 47 per cent of the global population were effectively covered by at least one social protection cash benefit, which leaves 4 billion people unprotected. Knowing its population is a critical component for anyone in a country who needs to evaluate its poverty levels. The United Nations Population Fund supports the production of estimates at a high-spatial-resolution level through modelling based on geospatial data inputs. For example, while conducting its fifth population and housing census in 2019, Burkina Faso faced security challenges in some parts of the country due to terrorism attacks. So, it was not possible to send enumerators, which led to an incomplete population enumeration. A geospatial population modelling was developed to estimate the population in 38 municipalities out of 368 and to produce a 100x100 meter gridded population for all in the country. Many Burkina Faso institutions have been trained to use this gridded population. With these population grids and subnational statistics, spatial inequalities and regions in poverty can be readily identified. Some agencies, such as the World Food Programme have also established food insecurity indexes based on common geographies to identify priority areas.

The triple threat of COVID-19, conflict and climate change makes the global goal of ending poverty by 2030 beyond reach unless immediate and substantial policy actions are implemented. The Regional Drought Mechanism, the flagship programme of the Economic and Social Commission for Asia and the

Pacific (ESCAP), provides a tailored and customized toolbox of data, products and services. The toolbox supports countries in building their capacity to apply Earth observation for managing drought risk, ultimately building resilience to drought. Timely and free access to space-based data and tailored capacity building is provided to countries in the region to support evidence-based decisions in response to drought, with the direct support from three regional service nodes in China, India and Thailand as well as other cooperation partners. CropWatch Cloud brings universal access to a cloud-based crop-monitoring platform, providing an agroclimatic, agronomic information service through cooperation among ESCAP, Aerospace Information Research Institute of the Chinese Academy of Sciences, and relevant governmental agencies of Cambodia, Myanmar, Thailand and the Lao People's Democratic Republic.

War affected countries and areas affected by terrorism, non-state armed groups or other forms of violence significantly contribute to the aggravation of poverty. Geospatial information and analytics provide situational awareness to Peace and Security operations as spatially enabled incident reporting and Unmanned Aerial Vehicles can provide increased insights on spatial patterns of violence and highly affected areas. These patterns can then be countered by putting geospatial data in the decision process for action. Poverty is the result of multi-sectoral challenges and, therefore, finds its root causes in several of the other SDGs.

02 - End hunger, achieve food security and improved nutrition and promote sustainable agriculture

An estimated 25.9 percent of the world population—about 2 billion people—were affected by moderate or severe food insecurity in 2019, an increase from 22.4 per cent in 2015. The fastest rise was in Latin America and the Caribbean although the highest levels were found in sub-Saharan Africa. Millions of people around the world are teetering on the brink of starvation. These are men, women and children whose lives would be lost within days or weeks if the humanitarian community is not able to provide life-saving food assistance. The COVID-19 pandemic has intensified the vulnerabilities and inadequacies of global food systems, which could add hundreds of millions more people to the chronically undernourished, making the goal of ending hunger a more distant reach.

Geospatial information is critical in addressing the tremendous needs and challenges of feeding the world population. Geospatial information and Earth observation are key in providing insights to evaluate changes of crops conditions, to mitigate climate risks impact, to support farming operations and efficiencies, to monitor land degradation and to assess impact on livelihoods. The issue of world hunger requires sound and timely evidence-based geospatial data for decision-makers and farmers alike to create and maintain secure and sustainable food systems for feeding populations. Geospatial data, methods and tools help to identify and monitor natural resource use and propose adequate relevant information for policy and actions to provide food for all.

The Food and Agriculture Organization helps countries implement appropriate geospatial solutions that can assist their efforts to create sustainable food systems. Geospatial information and Earth observation can help to support the generation of robust data and guide sustainable agricultural development. New, quick and simple solutions are developed for improved disaggregated crop statistics for countries, using remote sensing and geospatial technologies. The Global Agro-Ecological Zones is both a methodology for assessing global land resources and a spatial database. The geospatial database covers five thematic areas: land and water resources; agro-climatic resources, suitability and potential yields for crops/land utilization; downscaled actual yields and production of main crop commodities; and yield and production gaps. This global methodology and resource are also supporting national capacity development.

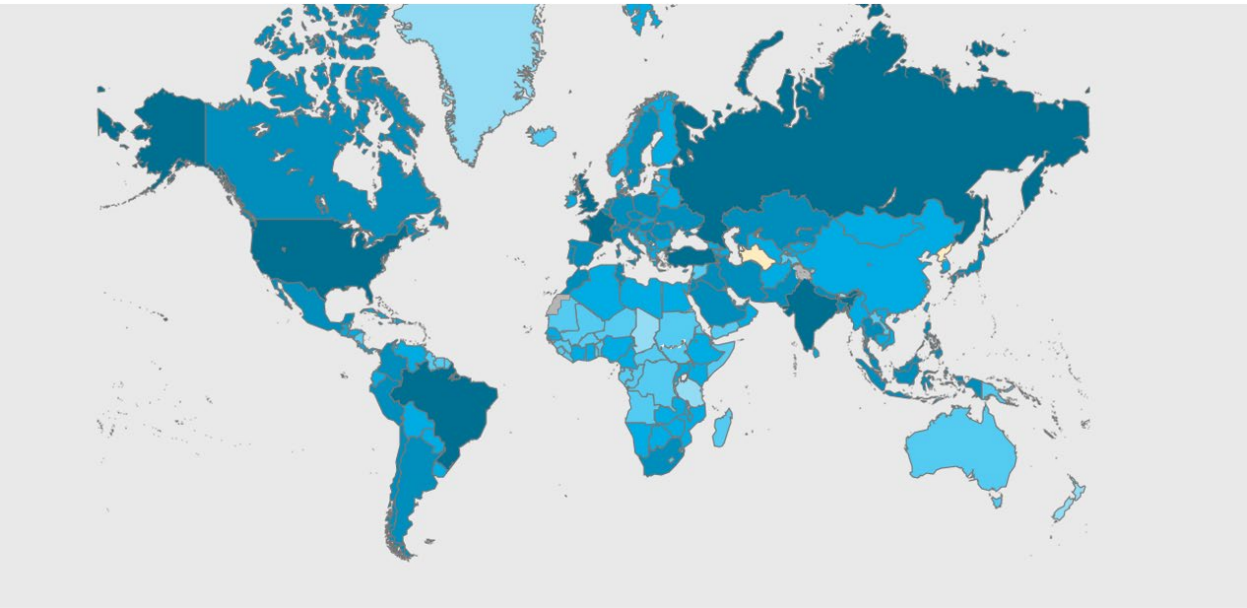
Geospatial information and technology are critical for surge operations in bringing food supplies to populations affected by disasters or crises and for monitoring systems. The World Food Programme (WFP) uses geospatial analytics for the design of new rural developments such as in Yemen when on-site visits are not possible. The combination of geospatial datasets helps determine the social, environmental and climate vulnerabilities of over 4,000 villages. It additionally helps identify intervention areas and preliminary intervention options to improve the livelihoods of 26,000 poor households. The AIMS satellite programme of WFP monitors and evaluates changes in the landscape induced by the Food Assistance for Assets programmes. Since its launch in 2017, it has monitored 1,500 assets across 18 countries. These programmes engage communities in the construction and rehabilitation of assets that stabilize and restore landscapes, reduce hardships on women and girls, reduce disaster risk, increase food production, and strengthen and diversify livelihoods—directly contributing to many SGDs.

The International Fund for Agricultural Development uses geospatial methodologies, tools, and data to support decision-making in the formulation of its country strategies, and throughout its project investment cycle, that aim to reduce poverty and hunger in rural areas. Geospatial analysis supports identifying vulnerable areas, targeting poor rural communities, analyzing climatic hazards and impacts as well as assessing the state of natural resources. The Fund relies on using freely available global and national datasets including population estimates, social-economic and nutritional data, accessibility to urban centres, environmental datasets, climate data on rainfall and temperature, land cover and land use maps, etc. The Fund also collects geospatial information from its funded projects (e.g., locations of beneficiary households, infrastructure locations, and/or areas under improved management) and uses it to evaluate impacts on food security and agricultural productivity.

03 - Ensure healthy lives and promote well-being for all at all ages

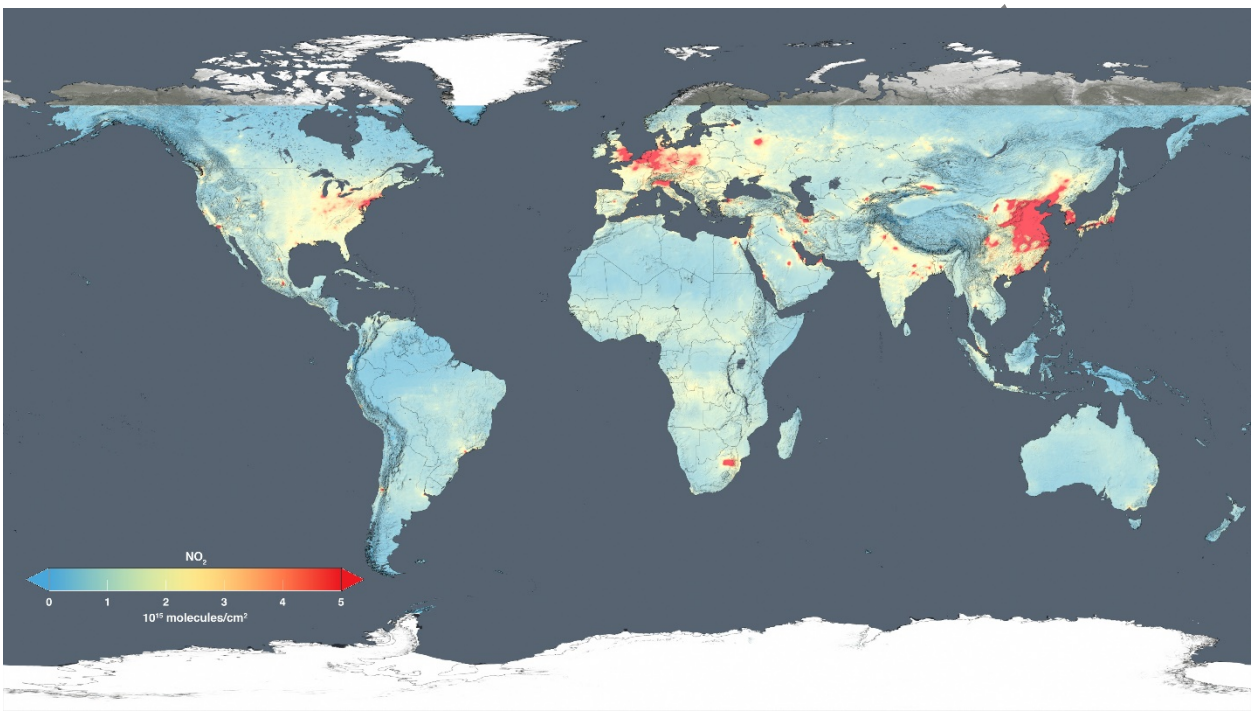
Before the COVID-19 pandemic, progress had been made in many health areas including improving maternal and children health, increasing immunization coverage and reducing communicable diseases albeit not fast enough to meet the SDG 3 targets by 2030. The disruption caused by the pandemic has now halted or even reversed the progress made. Allegedly, one of the first geospatial applications was health when in 1854, John Snow demonstrated the correlation of a cholera outbreak to contaminated water pumps. Using geospatial representation and analysis for public health planning enable timely and reliable decisions that can save lives.

The COVID-19 crisis is inherently associated with geospatial location: from its appearance associated to the proximity of cities and the zoosphere, from the region where it appeared to its global spreading pattern around the world in a wave from east to west, or from the importance of social—or geographical—distancing of two metres between individuals. In the context of prevention, understanding the spatial patterns of diseases indeed can save lives if timely, as spreading factors can then be addressed focusing on priority areas. For the response, the World Health Organization (WHO) regional centres have been leveraging geospatial technologies for vaccine distribution planning, monitoring and evaluation. Since the onset of the pandemic in January 2020, WHO regional offices have been deploying geo-enabled programmes to ensure equitable access to COVID-19 responses. Geospatial information provides a common operating framework to answer questions around equity and resource allocation and coverage. Without such data, we cannot ensure universal health coverage for COVID-19 treatment or vaccine distribution. In broader terms, WHO is using geospatial information for global health and medical applications and to find disease clusters and their possible causes, to improve deployment for emergency services and to determine if an area is being served adequately by health services. Lastly, many countries could benefit from capacity development as they lack the benefits of geospatial information systems to strengthen their health information system and related responses or actions.



A recent survey shows that substantial disruptions persist over one year into the pandemic, with about 90 per cent of countries still reporting one or more disruptions to essential health services. Among the most extensively affected health services are those for mental, neurological and substance-use disorders; neglected tropical diseases; tuberculosis; HIV and hepatitis B and C; cancer screening; services for other noncommunicable diseases including hypertension and diabetes; family planning and contraception; urgent dental care; malnutrition; immunization and malaria.

The development of small area estimation to disaggregate indicators by geography is important as recent advances in geospatial modelling tools have been shown to provide significant benefit to governments and agencies by allowing higher-resolution predictions of defined indicators. The United Nations Population Fund (UNFPA) has been supporting countries on generating case studies to strengthen the national capacity to implement a Small Area Estimate approach of combining censuses with survey data to produce model-based estimates of key indicators that are routinely collected in surveys but not in censuses. Indicators have been focused on Indicator 3.7.1 related to family planning indicators (e.g., contraceptive prevalence rate, unmet need for family planning, demand satisfied for family planning). UNFPA uses population and health services data to map the current coverage of each component of essential SRH services, including Emergency Obstetric and Newborn Care (EmONC), at a sub-national level. This supports the achievement toward the targets to reduce the global maternal mortality ratio (SDG 3.1), end AIDS (SDG 3.3), ensure universal access to sexual and reproductive health-care services, including for family planning (SDG 3.7), and to achieve universal health coverage (SDG 3.8).

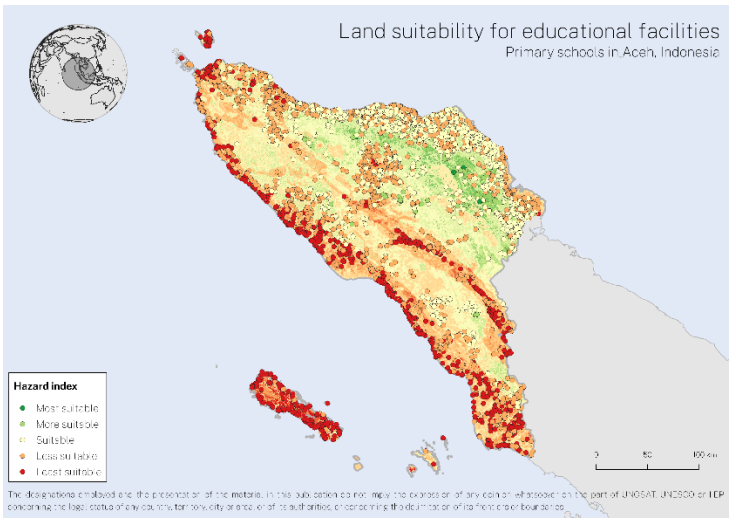


04 Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

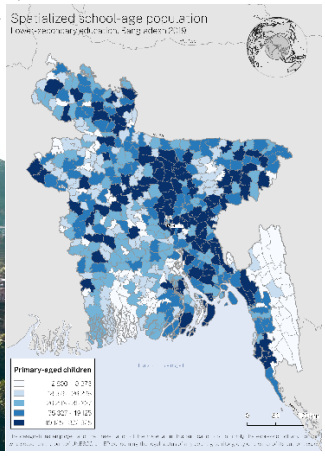
It is estimated that an additional 101 million children and youth (from grades 1 to 9) fell below the minimum reading proficiency level due to COVID-19 in 2020, wiping out the education gains achieved over the last 20 years. Recovery could occur by 2024, but only if exceptional efforts are devoted to the task. To help achieve inclusive and equitable education, geospatial data, tools and analysis can support decision-makers, Ministries of Education and academia to increase educational access and coverage. Further, as a subject, bringing geospatial knowledge and learning to all is an opportunity for developing new services, competencies and opportunities. Access to education in this field should be mainstreamed so it is not a niche for specialists but the wider use of society.

From 2018 to 2019, almost 300 million out of 520 million rural dwellers still lack good access to roads in 25 countries in Africa, Asia, South America, Central Asia and the Middle East. A Rural Access Index was updated using a spatial method. The indicator 9.1.1 on the "Proportion of the rural population who live within 2 km of an all-season road" is the quintessential example of the necessity and use of geospatial analysis. The availability of a worldwide geospatial data network to calculate such an indicator needs to be prioritized and be standardized globally along with consistent methodology for scaling up.

Geospatial information and analysis can also support the planning of schools, inspection, and accessibility to education. The United Nations Educational, Scientific and Cultural Organization (UNESCO) focuses on capacity development and on promoting consultative, inclusive and participatory processes where national ownership is systematically pursued, encouraged and enhanced. Several tools and methodologies have been designed to provide customized and responsive educational offerings. The programme on resilient site classification informs the location of new educational facilities, and helps to prioritize the maintenance, refurbishment, or relocation of the existing infrastructure; the isochrone-based catchment areas support the better understanding and evaluation of travel time and travel distance; the geographically-weighted regression model aims to design targeted educational policies; and the spatialized school-age population estimates at the micro level help to better assess the location of children and youth to provide educational opportunities.



Connecting schools to the internet would be indispensable to bridge the digital divide. Accurate information on school locations and internet connectivity are not often readily available. Project Connect, a joint initiative by the United Nations Children's Emergency Fund (UNICEF) and the International Telecommunication Union (ITU) (part of giga connect) aims to build a global database of school locations and connectivity using Artificial Intelligence (AI) models with training and validation from governments, open-source and crowd-sourced platforms. AI models have been applied to extract useful insights from satellite imagery. For Colombia, Honduras, Sierra Leone, Niger, Rwanda, Kenya and Kazakhstan, more than 23,000 unmapped schools were detected with approximately 90 per cent overall accuracy. Further research is required to successfully scale up in other parts of the world. An open source data sharing platform will soon be made available to join the wider effort to reduce inequalities and promote child well-being.

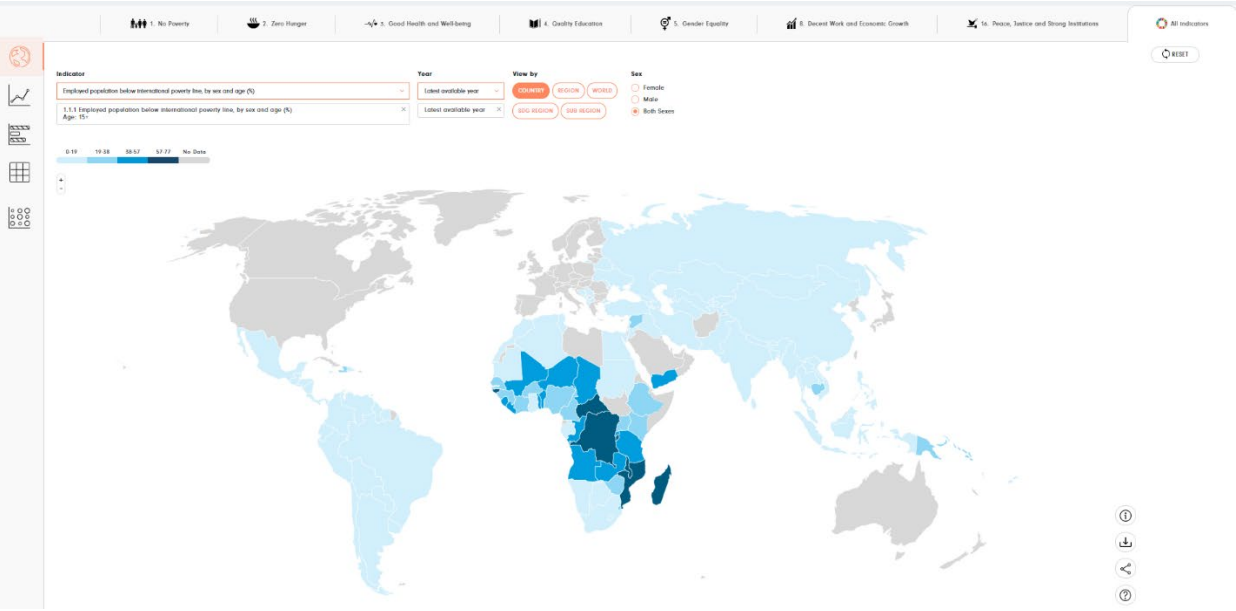


For quality education and raising awareness, promoting the use of geospatial information for solving societal challenges is also part of the mission of the United Nations. The UNESCO OPERANDUM Geospatial Information Knowledge Platform (GeoIKP) and the RURITAGE rural landscape mapping aim to promote education on geospatial information. Further, the United Nations Institute for Training and Research (UNITAR), through its United Nations Satellite Centre, developed web-based and self-paced online courses on "Geospatial Information Technology in Fragile Contexts", with a focus on remote sensing and analysis. The UN Geospatial Information Section prepared a free and open educational publication entitled "Mapping for a Sustainable World " with the aim to bring theory, best practices, conventions, and methods on cartography; and to showcase the interaction of how cartography can support the monitoring of the SDGs. This publication also provides a global showcase on integrating geospatial and statistical data.

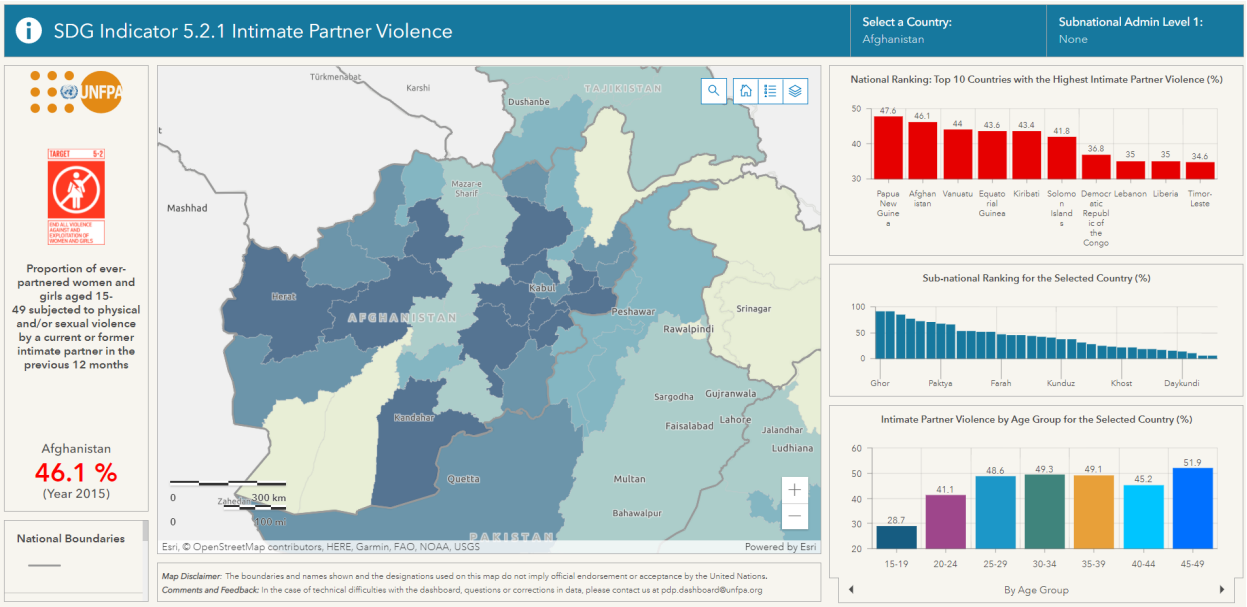
05 Achieve gender equality and empower all women and girls

Gender equality is a fundamental human right embedded in the United Nations Charter, calling for equal rights of men and women and of nations large and small. In the context of the Sustainable Development Goals, without considering the issue of gender equality, true sustainable development will not be achieved. Before the COVID-19 pandemic, full gender equality remained unreached. While women account for 70 per cent of health and social workers and are on the front lines of combating the coronavirus they also bear additional household burdens, spending three times as many hours in unpaid domestic and care work as men. They are also under increased risk of violence, whether it be physical, sexual or psychological, as cases of domestic violence have increased by 30 per cent in some countries.

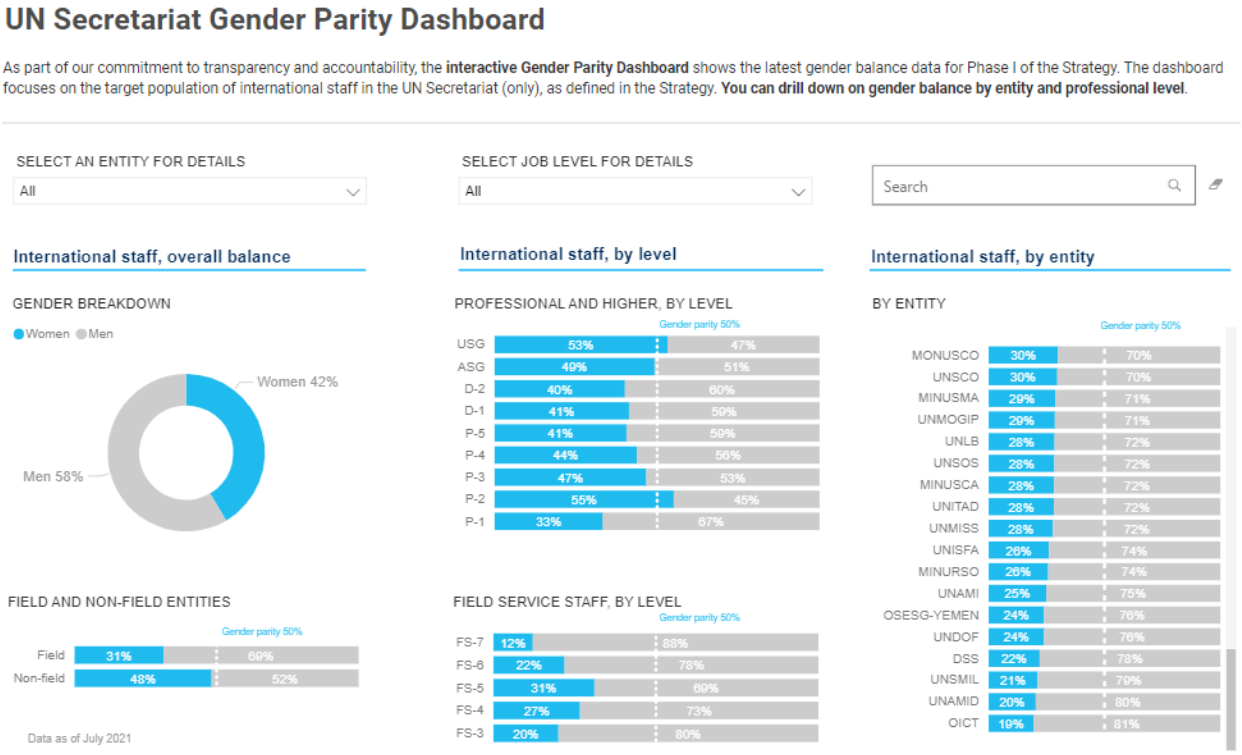
The entity that puts women's and girls' issues at the forefront in the Organization is UN Women. There are 53 gender-specific indicators across the SDG framework but only 12 of the 53 gender-specific indicators have data regularly produced. Given this data gap reality, the "Making Every Woman and Girl Count" programme (Women Count) was launched in 2016 where in 10 countries over four regions, official SDG indicators and geospatial data were brought together to produce cutting-edge research and analysis to make the most disadvantaged groups of women and girls visible. The work carried out in Pakistan showed multidimensional well-being based on location and ethnicity, and it highlights the interdependence in policy-making and decision-making to achieve the ultimate goal of the SDGs, "Leave no one behind".



The United Nations Population Fund (UNFPA) developed a geospatial dashboard on Intimate Partner Violence (IPV), featuring national data for 119 countries, sub-national data and disaggregated data on IPV by age, place of residence, employment, education and household wealth. The dashboard shows that young women face the greatest risk of IPV. It displays trends in sub-regions and sub-groups, enabling policymakers, advocates, service providers and journalists to better target their efforts. Ultimately, the dashboard is useful for everyone acting to end gender-based violence, including activists and other key players.



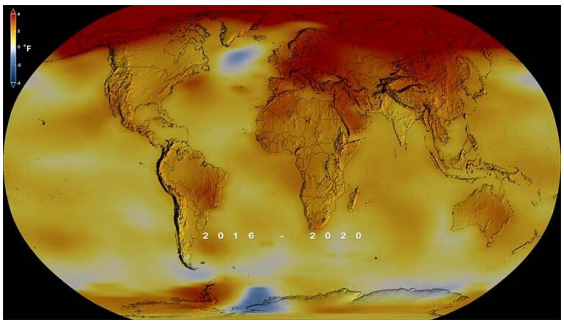
As part of gender equality mainstreaming, a priority set for the Organization, the United Nations Geospatial Network through its entities has conducted activities and events to both raise awareness and contribute to gender balance in the profession as well as prepared geospatial interfaces and analytical tools to address and monitor gender equality topics.



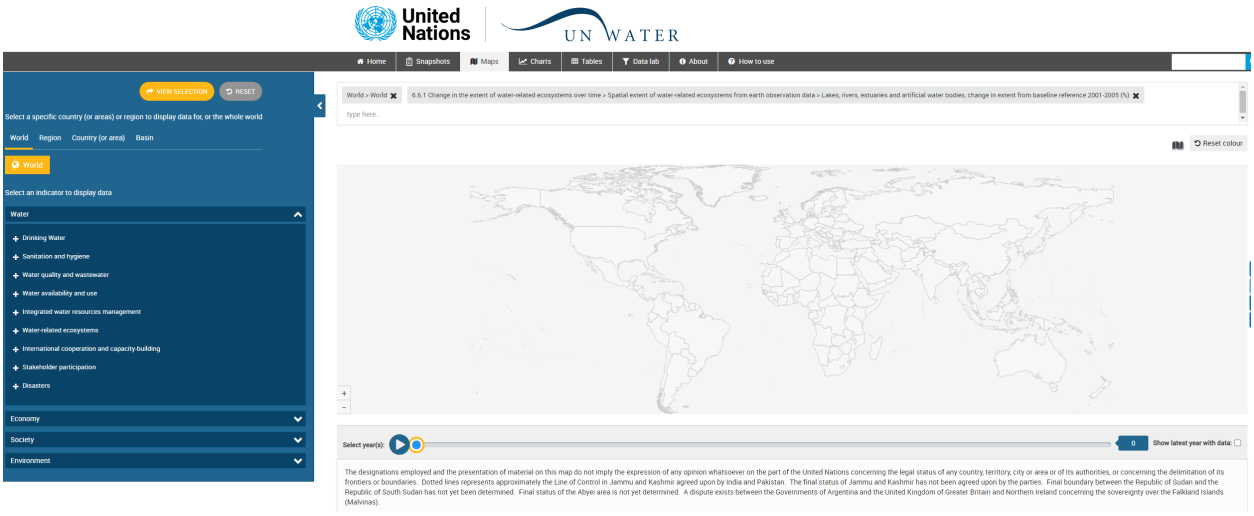
Organizations such as the World Food Programme (WFP), the work of which orients towards emergency and disaster response, collects large volumes of geospatial data related to vulnerability as it is critical to have preparedness towards Disaster Risk Reduction. Noting that vulnerability is also gender-based, an Integrated Contact Analysis (ICA) method will allow geographical targeting with better preparedness to combat gender-based vulnerability.

06 Ensure availability and sustainable management of water and sanitation for all

Water and sanitation are at the core of sustainable development as they underpin poverty reduction, economic growth and environmental sustainability. Overexploitation, pollution and climate change have led to severe water stress across the world. In 2017, 2.2 billion people lacked access to safely managed drinking water while 4.2 billion people lacked safely managed sanitation. Water scarcity could displace 700 million people by 2030. Recognizing this growing challenge, the United Nations General Assembly launched the Water Action Decade, on 22 March 2018, to mobilize action to help transform how we manage water. In the global pandemic environment, 3 billion people lack basic hand washing facilities at home when it has become widely known that handwashing is one of the effective methods suggested for COVID-19 prevention.



Within the Organization, United Nations Water (UN-Water) coordinates the efforts of UN entities and international organizations that work on water and sanitation issues as over 30 UN organizations carry out relevant programmes, reflecting that water issues run across all main focus areas of the Organization. UN-Water is currently designing and building a UN-Water SDG6 Data Portal, a dashboard to integrate the global status of water-related issues. The platform uses geo-visualization methods to communicate the latest status in a visually effective way.



The global water, sanitation and hygiene (WASH) cluster has effectively used geospatial technology to inform the WAS response from mapping sanitation infrastructure in refugee camps in Bangladesh (in coordination with REACH initiative) to assessing impact of hurricanes on WASH facilities in Latin America. In Iraq, REACH initiative together with the Iraq WASH cluster provided a detailed evidence-base on needs, access to and functionality of WASH services and infrastructure, through remote sensing studies carried out in 2020 that identified longer-term challenges to durable WASH solutions, such as a volatile water supply, water shortages, pollution and flooding. This raises a new set of cross-sectoral issues with implications for WASH interventions.


The Food and Agricultural Organization (FAO) of the United Nations has a global information system on water resources and agricultural water management known as AQUASTAT, which provides over180 variables and indicators by country from 1960. From the SDG framework perspective, achieving food security while using water resources in a sustainable manner is a major challenge, but monitoring water productivity through open-access remotely sensed derived data (WaPOR) is a way to increase water use efficiency and crop yield, and therefore its water productivity. In this regard, concepts of water accountability are increasingly adopted by countries, and Earth observation information is able to substantiate the challenges they are facing at their national and local context, as seen in selected case studies presented in online geospatial web services.

Combining specialized geospatial tools and methods such as remote sensing technology and geophysical survey, one can identify potential drilling locations for productive and sustainable wells. Continuous monitoring ensures protection and effective groundwater management with long-term systematic measurements of water levels. The Field Missions in the Peace and Security Pillar have deployed this service in order to avoid depleting the already strained water resources in post-conflict environments, and providing such tools allows the Field Missions to garner support and acceptance in often hostile environments.

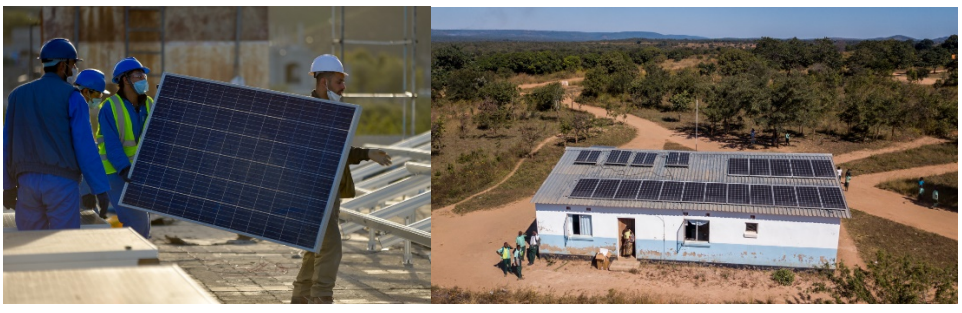
07 Ensure access to affordable, reliable, sustainable and modern energy for all

Despite significant progress over the last decade on improving access to electricity, increasing the use of renewable energy in the electricity sectors, and improving energy efficiency; the world is still short of achieving affordable, reliable, sustainable and modern energy for all.

Yet there are ever-growing opportunities to use a variety of alternate sources of energy, harnessing renewable energy resources such as solar, wind power, tides and waves, hydro-power or geothermal. Most of these energies are tied to the geospatial characteristics such as the location of currents, sunshine intensity, topography, altitude, orientation and intensity of winds. Optimizing the location of these energies can be done using geospatial data and analysis, and can solve problems such as interpolation, potential estimation, and optimal location analysis of renewable energy. Geospatial analysis can also be used to design an optimal pipeline network for oil and gas transportation or when evaluating risks in mining. Likewise the electrification planning process must consider the geographical characteristics of the resources as well as the spatial dimension of social and economic drivers of energy demand in order to find the most optimal energy access solution, using parameters such as population density, power plant location, road access and existing networks.

The United Nations Development Programme highlighted the potential of these renewable energies, in particular for Africa as one of the most richly endowed regions with the highest global surface solar radiation. Yet the continent's share of the world's generated solar energy is less than 1 per cent. This analysis based on the continent can be further refined to identify optimal sites for building solar plants and tap into these opportunities. Due to the geographic landscape of African countries, particularly rural communities, access to the national grid is very difficult and expensive. Cost-effective renewable energy such as solar panels or plants, therefore, becomes the most effective solution to rural and local electrification in Africa. The geospatial analysis of the irradiance co-developed by the World Bank shows the photovoltaic electricity potential and in particular one of the highest potentials over Africa.

The United Nations Environment Programme developed a technical background document and remote sensing analysis techniques to support national and regional artisanal and small-scale mining (ASGM). The programme contributes to the evaluation of the influence of mining on the aquatic environment, and on the benefits and challenges of using remote sensing technologies and in-situ environmental monitoring of mercury in water, sediment and selected biota. The programme also suggests a strategy and methods for ASGM site-identification and prioritization as well as environmental sampling, chemical analysis and data-treatment in support of the study's objectives.



8 Decent work and economic growth

Sustained and inclusive economic growth can drive progress, create decent jobs for all and improve living standards. COVID-19 has disrupted billions of lives and endangered the global economy. The International Monetary Fund (IMF) expects a global recession worse than in 2009. The economic and financial shocks associated with COVID-19 are extensive - disruptions to industrial production, falling commodity prices, financial market volatility, and rising insecurity, the already tepid economic growth and compounding heightened risks from other factors. As job losses escalate, the International Labor Organization (ILO) estimates that nearly half of the global workforce is at risk of losing their livelihoods.

Analysing spatio-temporal relationships of the above mentioned economic activities and its workforce, it enables reframing of economic policies within countries to consider how the global economy can be rehabilitated.

UN-Habitat and United Nations Educational, Scientific and Cultural Organization (UNESCO) jointly presented the Initial Planning Framework for the Reconstruction of Mosul, offering perspectives on how to 'Build Back Better' the city for the people of Mosul and sharing the process of urban rehabilitation efforts through the Mosul Portal. The programme used extensively geospatial information, mapping and aerial imagery for the evaluation of damage and impact of destruction to the city buildings.

Due to the global pandemic, another area which has seen a shift in global community is the use of use of digital technologies and this was framed as an example of the Employment-Intensive Investment Programme's (EIIP) during the planning, implementation, monitoring and closure/evaluation phases of a project cycle where GIS is employed widely to effectively manage its resources.

One industry that is heavily impacted is the tourism industry. Prior to the global pandemic, from the context of sustainable tourism, the United Nations World Tourism Organization (UNWTO) organized a series of workshops where they provided live demonstrations of spatial analysis, use of satellite images and building data dashboards to support more transparent and timely communication and decision-making.

Another area of sustainable growth will need to come through activities related to green economy initiatives. Several UN entities collectively are addressing the gaps and opportunities in the future. UN Environment (UNEP)'s Guidance Manual on Green Economy Policy Assessment suggests the modelling potential of GIS in assisting in developing Roadmaps.

Another area where the UN is making its segway is in the area of Employment, Decent work for all social protection. The Department of Economic and Social Affairs (DESA) has been responsible in garnering the support of Member States on the Convention on the Rights of Persons with Disabilities (CRPD) and has over the years been monitoring the latest status through a geovisualization product.

09 Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation

The COVID-19 pandemic has hit the manufacturing and transport industries hard, causing job losses and declining incomes for workers in these sectors. Small-scale industries have been severely affected by the pandemic, and many continue to face existential challenges. Geospatial data and analysis allow decision-makers to monitor infrastructure, to support the planning of new investments and to evaluate industrialization impacts. Using the Sustainable Development Goals indicators and geospatial data visualization techniques can support the global understanding of the impact and challenges to "retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes" (Target 9.4) and, for instance, monitor worldwide industrialization impact using carbon dioxide (CO2) emissions (Indicator 9.4.1, Figure X).

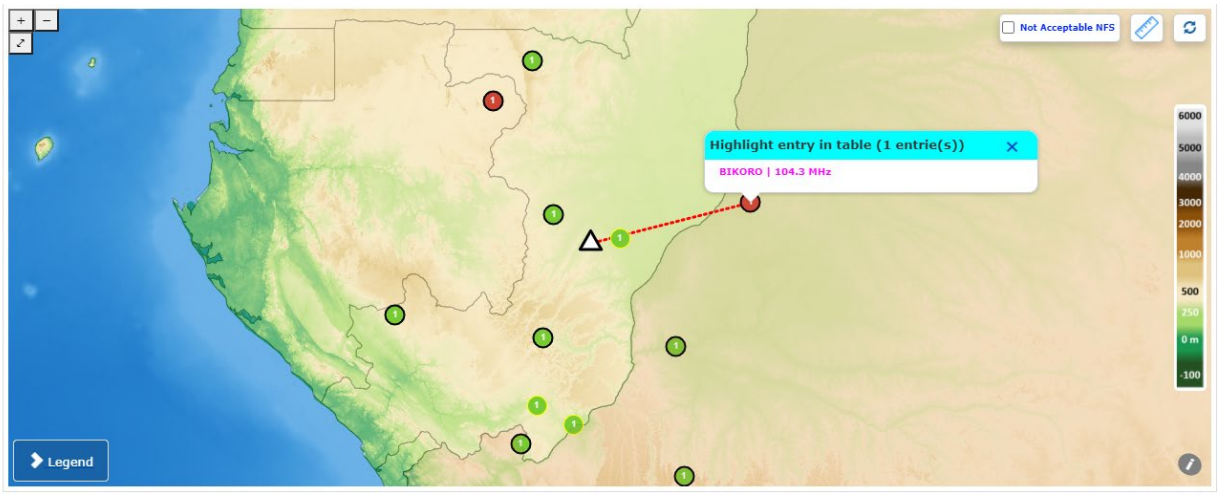
Data from 2018 to 2019 show almost 300 million out of 520 million rural dwellers still lack good access to roads in the 25 countries in Africa, Asia, South America, Central Asia and the Middle East where the Rural Access Index was updated using a spatial method. This indicator 9.1.1 on the "Proportion of the rural population who live within 2 km of an all-season road" is the quintessential example of the necessity and use of geospatial data and analysis in support of monitoring achievements related to the SDGs. The indicator is related to road networks, which is one of the fundamental geospatial data themes and the geospatial calculations of proximity to these geographic objects. The availability of a worldwide geospatial data network to calculate such an indicator needs to be available and standardized globally as well as defining agreeable methods and algorithms to perform these calculations consistently across regions is required.

Technology advancements and innovation on Earth observation (EO) bring a new era of accessibility to satellite data, which are increasingly relevant for businesses, governments and civil society at large. The availability of satellites and sensors combined with the technology to process the data, computer-aided analysis and Artificial Intelligence now provide insights on global-scale economic, social, environmental and industrial processes. The democratization of these technologies is ongoing in the United Nations, yet the availability of data and the insights from EO can be further amplified for operations and capacity development so they can be available to decision-makers and for mandated activities.

For example, radio systems are still of paramount importance to the world and even more so for developing countries as broadcast radio goes where newer technologies do not. It is an extremely effective way of delivering information in rural and remote areas where information can educate and save lives in emergency situations. FM (frequency modulation) radio remains a key information and communications technology service, delivering immense social-economic value. Yet, in many countries, the expansion of FM radio is hampered by lack of FM frequencies. The ITU, in cooperation with the African Telecommunications Union, is currently assisting 53 African countries to identify new frequencies for FM broadcasting in Africa.

Software tools have been developed and deployed by the ITU to assist administrations of countries to identify the most suitable frequency channels for each station to avoid interference. A web map application

tool allows users to visualize the location of FM stations and to understand if those stations are compatible with each other or generate unacceptable levels of interference. The interference is calculated in the backend with a compatibility analysis software implementing a path-general propagation model (no terrain). As geospatial data is instrumental to determine if some of the identified interference would be mitigated by favorable terrain or other physical factors, the application allows users to perform calculations on the fly using a path-specific propagation model (consuming SRTM3, land/sea and atmospheric refractivity data) and to display the correlation of the field strength and terrain data.



Excel

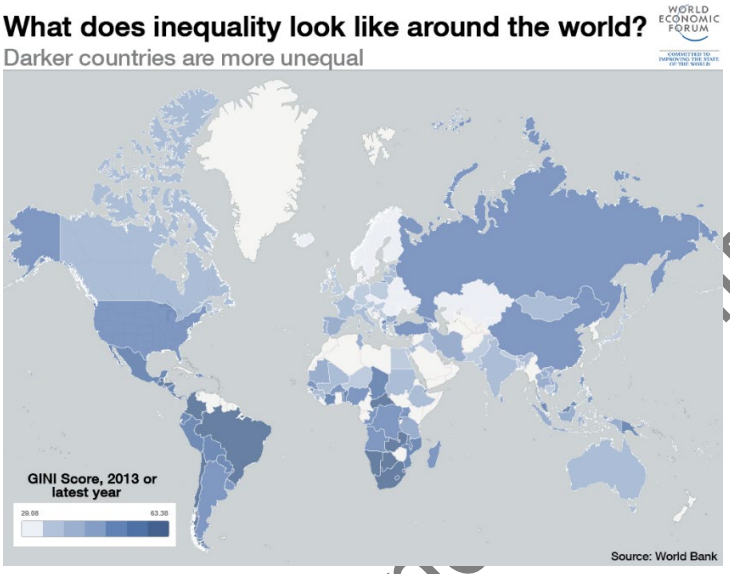
Assign ID	Adm	Intent	Stn Cls	Assigned Frequency (MHz)	Polar	Site Name	Total Distance	Cold Sea Path (Km)	Warm Sea Path (Km)	Super refractivity Path (Km)	ERP (dBW)	Azimuth (deg)	Protection Ratio (dB)	NFS (dB(µV/m))	Coord.
084045334	COD	RECORDED	BC	104.3	H	BIKORO	300	0	0	0	50	255.7	25	59.27	---
084042900	GAB	RECORDED	BC	104.3	H	MEKAMBO	314	0	0	0	50	145.8	25	57.94	---
4570	COG	ADD	BC	104.1	V	OYO	55	0	0	0	30	260.2	25	52.01	---
084108898	GAB	RECORDED	BC	104.2	V	MALINGA	377	0	0	0	47	69.9	37	50.77	---
084046024	COD	RECORDED	BC	104.4	H	MUSHIE	243	0	0	0	50	320.2	7	46.95	---
4509	COG	ADD	BC	104.2	H	NGAMANZAMBALA	310	0	0	0	27	18.3	37	44.73	---

10 Reduced Inequalities

Increasing income disparities and a lack of opportunities, further worsened by the covid19 pandemic, in today's world inequalities have widened and deepened. Gender, ethnicity, race, place of origin, and socio-economic status largely determine the opportunities one can get. A study by the United Nations Institute for Development Economics Research found that the richest 1 percent of world adults, individuals worth at least $514,512, owned ~40% percent of the world's household wealth, a total greater than the wealth of the world's poorest 95 percent, those adults worth under $150,145.

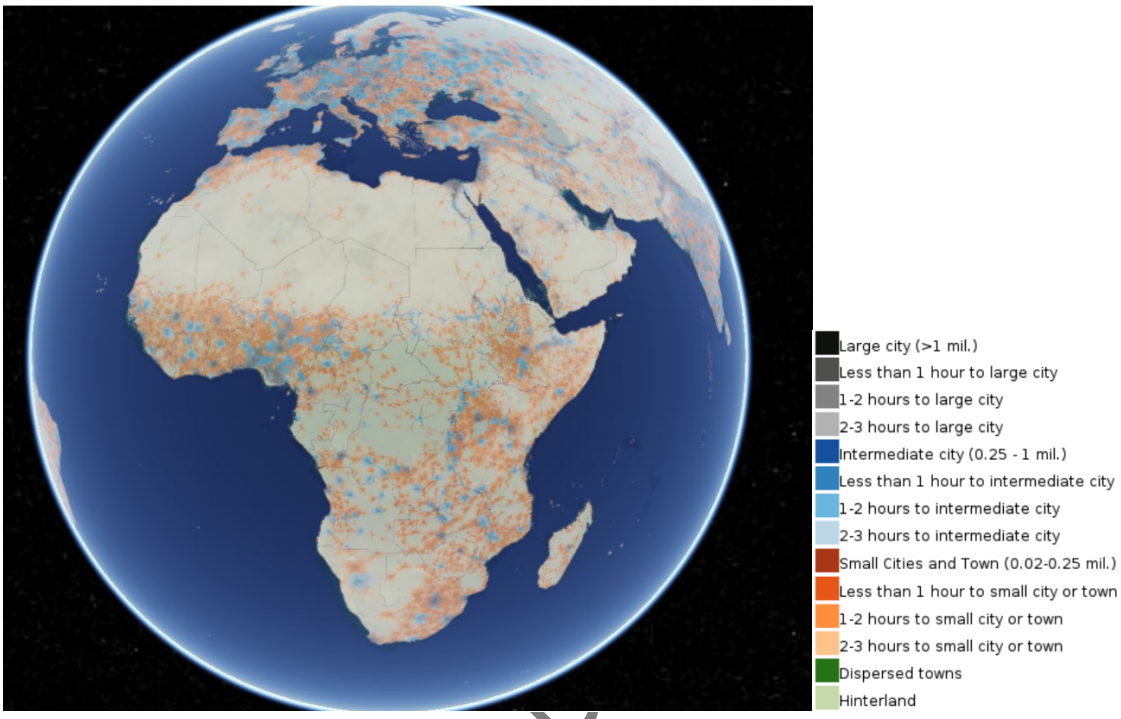
Reliable data on income inequality is not readily available globally, and especially harder to access at a sub-national level. By collecting and mapping existing inequalities with spatially disaggregated data, it is possible to develop tailored policies and strategies to address them. Well governed spatial data helps to quantify as well as visualize the extent of inequality and support inclusion and equity.

Using primary household data, the World bank maps the Gini index that has systematically captured inequality across the world at national level.



Refugees around the world face significant challenges in getting equal opportunities. Mapping the location of camps and identifying physical and environmental access constraints greatly aid in creating opportunities. UNHCR regularly employs geospatial story-telling tools both for analysis as well as advocacy. Satellite based mapping of refugee camps have enabled the ability of UN agencies to frequently monitor and identify access to basic needs such as WASH facilities, schools and health centers.

Rising inequality in income is also associated with growing spatial disparities and can lead to the concentration of poverty in certain areas, which is associated with lower relative mobility. Spatial inequalities can be extreme between urban and rural areas. FAO's Global Urban-Rural Catchment Areas (URCA), a raster dataset maps urban locations through seven agglomerations and rural locations based on travel time to urban centers.



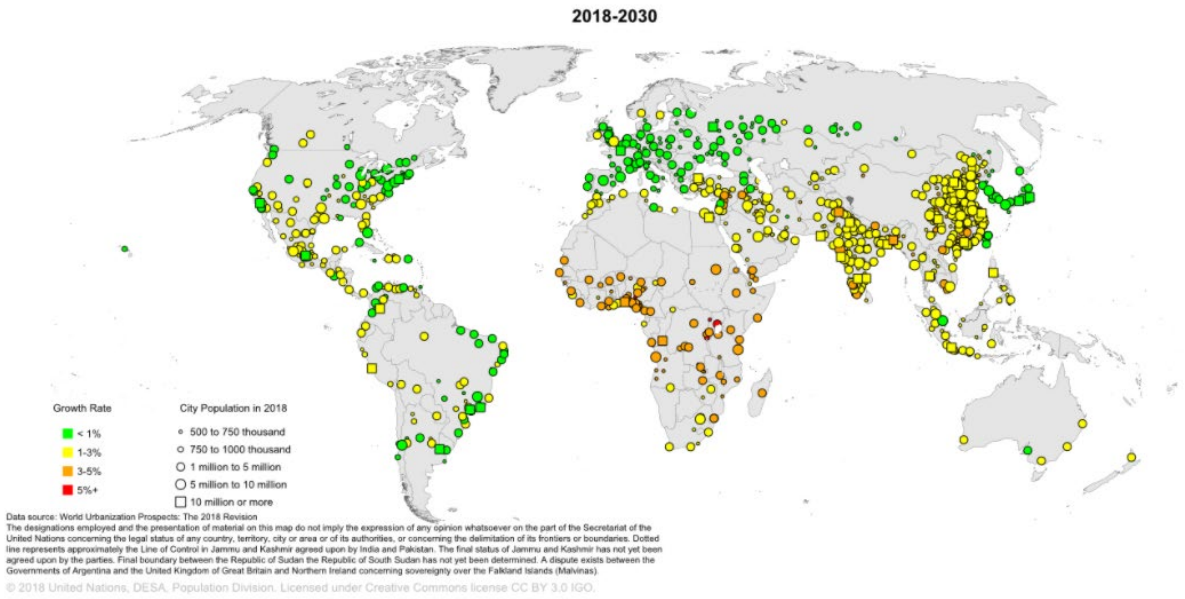
11 Sustainable Cities and Communities

We are increasingly living in an urbanized world as since 2007, more than half the world's population are living in cities, and that share is projected to rise to 60 per cent by 2030. Cities and metropolitan areas are powerhouses of economic growth—contributing about 60 percent of global GDP. Rapid urbanization is resulting in a growing number of slum dwellers, inadequate and overburdened infrastructure and services (such as waste collection and water and sanitation systems, roads and transport), worsening air pollution and unplanned urban sprawl. The share of urban population living in slums rose to 24% in 2018.

As with other international global frameworks, the New Urban Agenda by the UN-Habitat shares the global urban vision and sets the principles of global urban policy framework as urbanization can be a powerful tool for sustainable development.

The impact of COVID-19 is most devastating in poor and densely populated urban areas, especially for the one billion people living in informal settlements and slums worldwide, where overcrowding also makes it difficult to follow recommended measures such as social distancing and self-isolation.

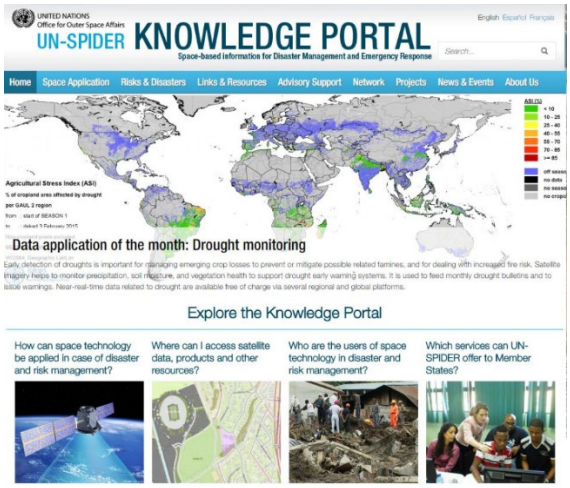
The Population Division of the Department of Economic and Social Affairs who collect the official United Nations population estimates and urbanization projection have been collecting, curating and sharing these data from the 1950s as World Population Prospects and World Urbanization Prospects, and supplement their information with statistical and geovisualization products. Their maps are used widely throughout the United Nations and by many international organizations, research centres, academic researchers and the media.



Another UN entity who monitors the world population trend closely is the United Nations Population Fund (UNFPA) who has deployed a World Population Dashboard to communicate the different aspects of the population ranging from Maternal and Newborn Health, Family Planning, Education, Fertility, Life Expectancy and Harmful Practices.

As part of awareness, UN-Habitat has been promoting geospatial technology as an urban management tool at the local government level and published a Handbook to serve as an introductory guide and to raise awareness on opportunities of geospatial technologies and how to set them up and sustain their use. From the perspectives of building sustainable communities, through Community Mapping initiatives, they bring the youth closer to their communities and their living environment. Use of GPS, imagery maps are introduced in these initiatives and many other international development agencies

have programmes such as Missing Maps and YouthMappers. Similar initiatives are carried out by the United Nations Office for Outer Space Affairs (UNOOSA) through their UN-SPIDER programme.



12 Ensure sustainable consumption and production patterns

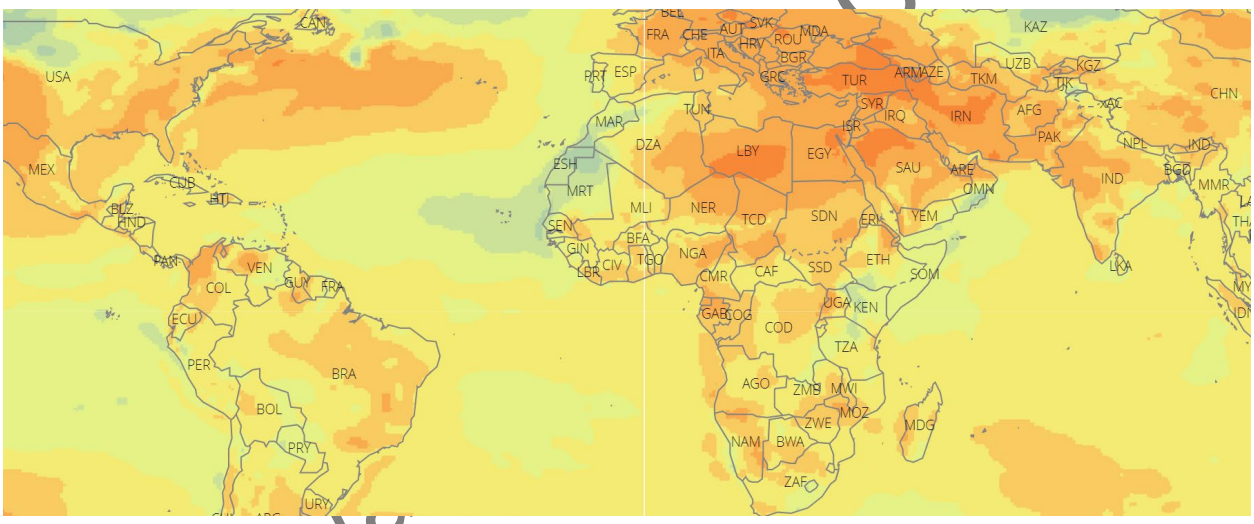
For decades, scientists have been laying out how humanity is driving the three planetary crisis: the climate crisis, the biodiversity crisis, and the pollution crisis, all linked to unsustainable production and consumption. Changes in consumption and production patterns can help promote decoupling of economic growth and human well-being from resource use and environmental impacts.

Nuclear technology represents both opportunities for new energy and threats in the disposal of nuclear waste. The International Atomic Energy Agency (IAEA) is the world's centre for cooperation in the nuclear field and seeks to promote the safe, secure and peaceful use of nuclear technologies. Every nuclear country must take responsibility for the management of used nuclear fuel and disposal of nuclear waste. It works to promote the safe, secure and peaceful use of nuclear technologies. As part of its mission, the IAEA is mandated to independently verify that nuclear facilities are not mis-used and that nuclear material is not diverted from peaceful uses. Geospatial activities play an important role in the fulfilment of this mandate. The IAEA has steadily developed its capability to collect and analyze information available from open sources, including satellite imagery. Together with the information resulting from other safeguarding activities, particularly in the field, this information contributes to IAEA's assessment of the correctness and completeness of the declarations made by national governments. Commercial satellite imagery enables the IAEA to monitor sites of interest, including those that are difficult to access, for physical or security reasons, or when access is impossible under challenging circumstances. Commercial satellite imagery is routinely used in the following safeguarding activities: to verify the accuracy and completeness of information supplied by governments; to assist in the planning of in-field and inspection activities, providing inspectors with insights into and an understanding of a facility infrastructure; to detect changes and monitor activities at nuclear fuel cycle-related sites; to identify possible undeclared activities. These activities also relate to Goal 16 on Peace, Justice and Strong Institutions.

13 - Take urgent action to combat climate change and its impacts

With fast-moving effects of climate change, natural hazards are not only increasing in numbers but also intensifying. Understanding and addressing the impacts of climate change are the most pressing and urgent issues of our times. Geospatial technology plays a central role in studying Earth systems by mapping expensive data to illustrate complex situations and to offer evidence-based solutions. This enabling technology allows the user to collect and analyze data to better understand why and where hazards happened and to anticipate future occurrences, providing tangible solutions not only to prepare, respond and recover but also in increasing the climate resilience of vulnerable communities.

Climate risk is a major driver and amplifier of disaster losses and failed development. Risk reduction processes have multiple connections with climate change mitigation, adaptation and vulnerability reduction. United Nations Office for Disaster Risk Reduction (UNDRR) Global Assessment Reports rely on geospatial data and analysis to better advocate for Disaster Risk Reduction measures globally. Emergent climate-related risks will alter most of our current risk metrics, and it is crucial to accurately collect, analyze and visualize data for advocacy and inform policies.



The World Meteorological Organization (WMO) Global Climate Observing System (GCOS) regularly assesses the status of global climate observations of the atmosphere, land and ocean. GCOS heavily relies on Earth observation systems to track the diverse climate indicators.

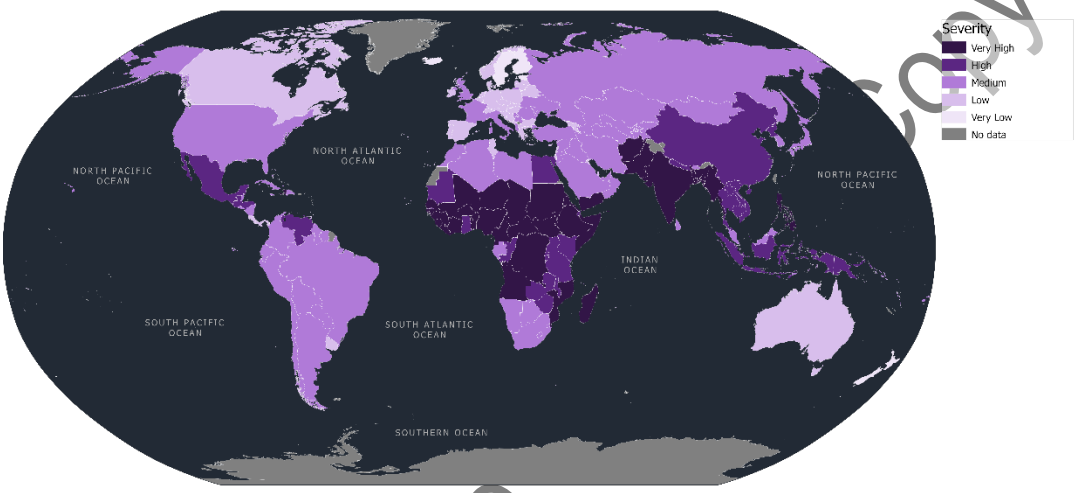
The United Nations Office for Outer Space Affairs (UNOOSA) advocates and promotes the added value of space applications for climate change mitigation and adaptation through several initiatives. The United Nations/Austria Symposium on Space Applications for Climate Action brought together the space community to effectively address the specific space applications and use cases in the realm of climate change. Through the Youth4Climate initiative, UNOOSA provided space for younger generations to research and propose novel geospatial solutions to address the impacts of climate change

Small island nations are on the frontline of climate change's devastating impacts. The *CommonSensing* project of the United Nations Institute for Training and Research - United Nations Satellite Centre (UNITAR-UNOSAT) brings web-based geospatial solutions to the national and local stakeholders in Fiji, Vanuatu and the Solomon Islands. Using a wide range of satellite imagery and data, the project aims to strengthen national and regional climate action policies, and to reduce the impact of natural

hazards. Capacity strengthening activities such as a training course on *Geospatial Information Technology applications for climate resilience* helps to translate theoretical knowledge and raw data into actionable intelligence for policy-making and action on the ground.

Agriculture practices need to adapt to changing climatic conditions. The Food and Agriculture Organization of the United Nations (FAO) uses geospatial technology to compare future climatic conditions with current baseline information on suitability and yield, which enables them to assess the impact of climate on the performance of land utilization types.

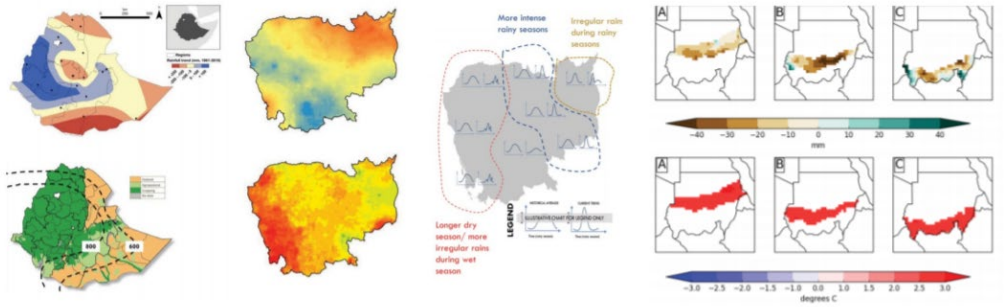
UNICEF utilizes geospatial technology to estimate the Children's Climate & Environment Risk Index (CCRI) using approximately 60 different indicators. CCRI aims to capture children's exposure to climate-related and environmental shocks and stresses. Spatial analysis helps to visualize children's exposure and vulnerability to the impacts of climate change, in order to help prioritize action for those most at risk and ultimately ensure children live in a safe, clean and sustainable world.



The UN Environmental Programme / Global Resource Information Database-Geneva (UNEP/GRID-Geneva) has made available fundamental core geospatial data sets such as modelled hazards that have formed the basis for climate change impact analysis. Combining hazard data with exposure and vulnerability, it is possible to accurately estimate the spatial distribution of climate risks, at sub-national, national and regional levels. Part of its Risk Informed Response project, UNICEF Somalia has undertaken climate change impact analysis using GRID data to better inform long term programme planning and improve preparedness.

Food security climate analysis conducted by the UN World Food Programme (WFP) utilizes a wide range of geospatial data and methodologies to better understand the impact of climate change. Long-term trend analysis helps build the Integrated Context Analysis that is used to plan and design resilience programmes. Climate risk analysis such as community-based adaptation activities, forecast based financing, early warning systems and longer-term climate projections are used to assist host governments to design climate or food security policies and plans.

Geospatial risk analysis is an indispensable tool to enable United Nations entities to effectively address the varying, widespread impacts of climate change.

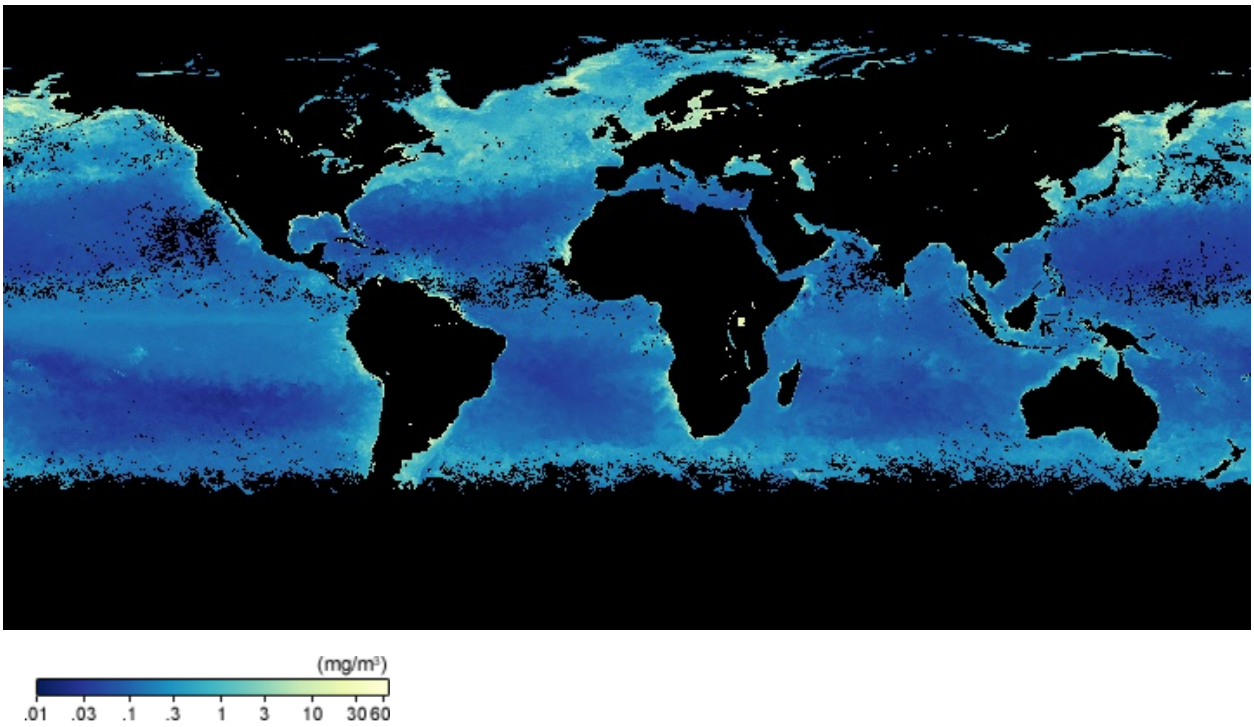


A snapshot of various WFP climate and food security analyses that have been undertaken around the world, and which are summarised in How Climate Drives Hunger. Image 1 shows historical rainfall and livelihood data in Ethiopia; image 2 shows climate variability trends in the onset of the rainy season in Cambodia; image3 shows projected climate changes in Sudan's annual average rainfall and temperature.

14 - Life below water

The oceans cover more than 70 per cent of the surface of our planet and play a key role in supporting life on Earth. They are the most diverse and important ecosystem, contributing to global and regional elemental cycling and regulating the climate. The ocean provides natural resources including food, materials, substances and energy. Marine protected areas contribute to poverty reduction by increasing fish catches and income, creating new jobs, improving health, and empowering women. Increasing levels of debris in the world's seas and oceans is having a major and growing economic impact.

Oceans, seas and other marine resources are essential to human well-being and social and economic development worldwide. Their conservation and sustainable use are central to achieving the 2030 Agenda, especially for Small Island Developing States. Marine resources are particularly important for people living in coastal communities, who represented 37 per cent of the world's population in 2010. Oceans provide livelihoods, subsistence and benefits from fisheries, tourism and other sectors. They also help regulate the global ecosystem by absorbing heat and carbon dioxide (CO2) from the atmosphere. However, oceans and coastal areas are extremely vulnerable to environmental degradation, overfishing, climate change and pollution.



The United Nations Environment Programme (UNEP) is working to develop a coherent approach to measuring the ocean condition and the drivers, pressures, impacts and responses. This is through promoting the measurement of the ocean SDGs where UNEP is the custodian. Through working to develop an approach for better ocean accounts, they published a Global Manual on SDG 14.1.1, 14.2.1 and 14.5.1. This manual also provides details related to how the SDGs align with the Regional Seas, starting with the baseline mapping of Integrated Coastal Zone Management (ICZM).

Globally available data from Earth observations and modelling are used to index coastal eutrophication and plastic-debris density along with national data. Earth observations data and models are extensively used to collect and map sub-indicators such as chlorophyll-a concentrations that are available daily from the NOAA Multi-Sensor VIIRS satellites.

Monitoring ecological parameters in addition to ecosystem-based management or protected areas is useful to inform the effectiveness of management practices. Understanding the state of biodiversity, water quality, habitat quality, ecosystem health and other ecological parameters can reveal disturbances in ocean health that may have otherwise been overlooked. These disturbances can then be addressed in future management and planning. One example includes continuous monitoring of sea surface temperature.

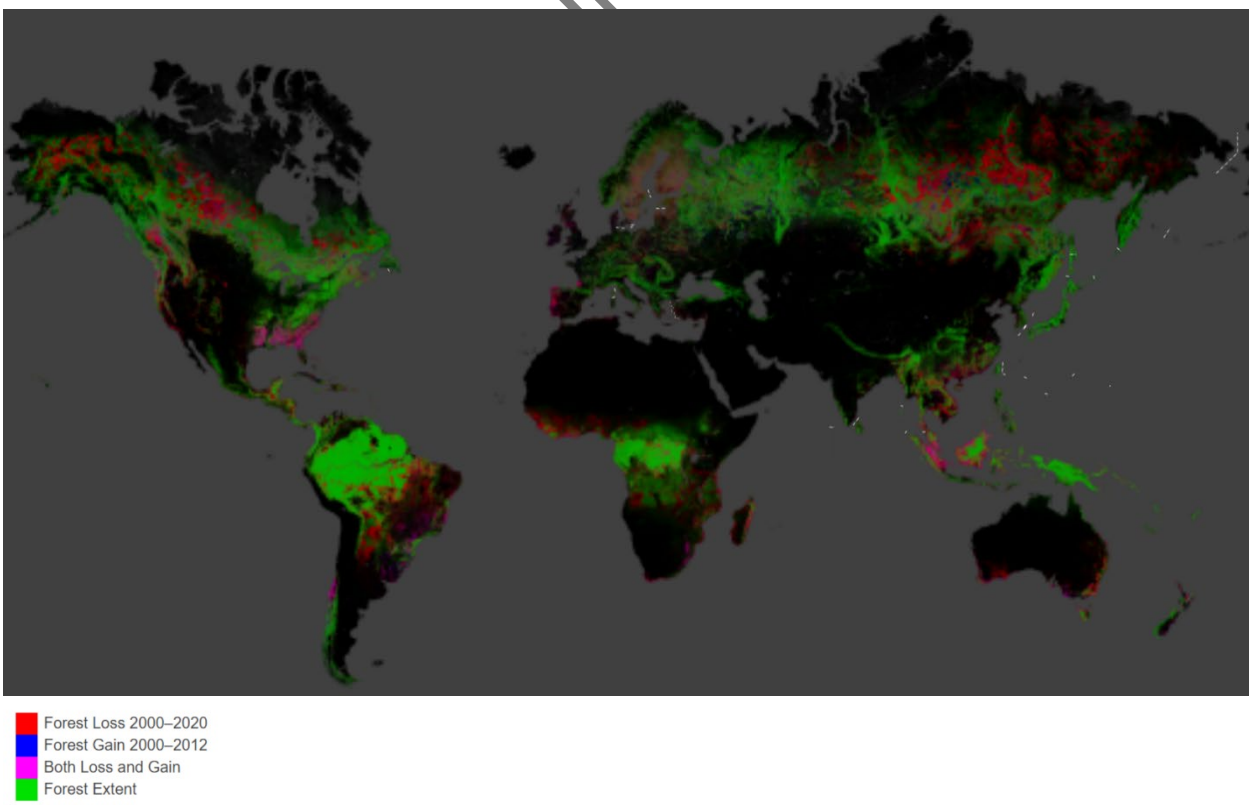
A new machine learning model developed by UNEP and Google aims to create a tool that can generate a detailed and accurate view of the plastic pollution problem in the Mekong River and beyond, and contribute to the development of a plastic leakage hotspot map. The map can then be used by local and national governments to determine how to target policies and resources to prevent plastic leaking into waterways.

15 – Life on Land

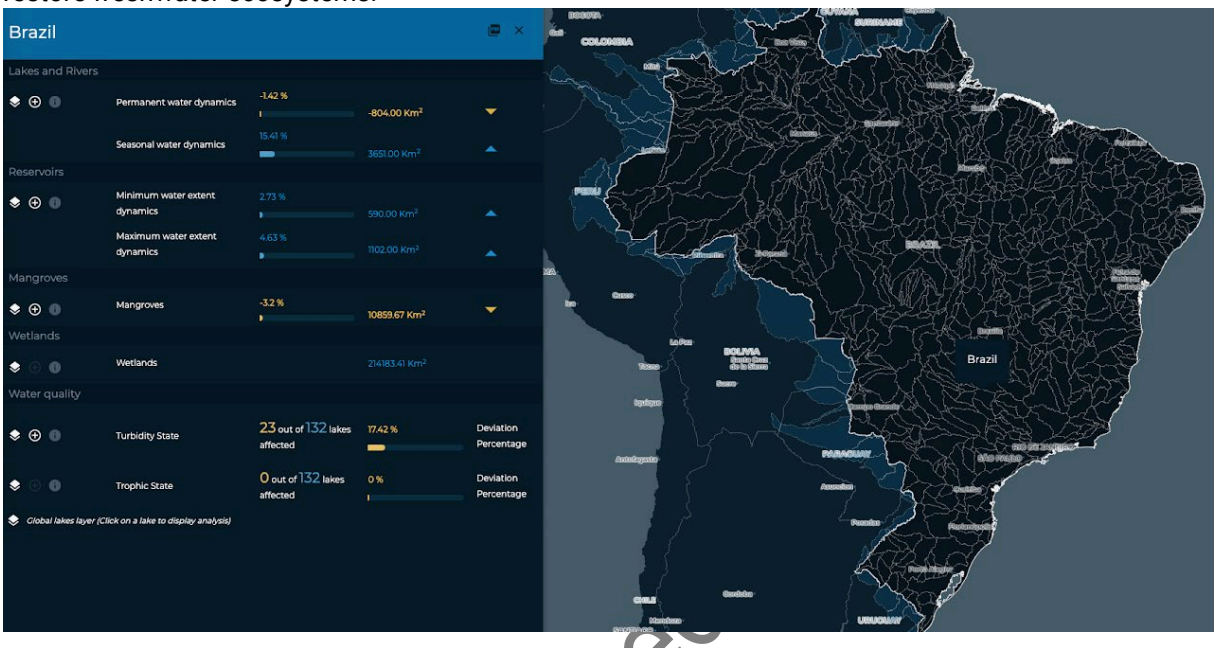
Preserving diverse forms of life on land requires targeted efforts to protect, restore and promote the conservation and sustainable use of terrestrial and other ecosystems. Goal 15 focuses specifically on managing forests sustainably, halting and reversing land and natural habitat degradation, successfully combating desertification, and stopping biodiversity loss. All these efforts combined aim to ensure that the benefits of land-based ecosystems, including sustainable livelihoods, will be enjoyed for generations to come.

Illegal mining and logging destroy vast swaths of protected areas. These areas are often hard to reach on the ground and often expensive and dangerous to track new or abandoned operations for local governments. With support of remote sensing tools, big data analysis and mapping; it is possible to plan and implement restoration activities. MapX is an online, open-source geospatial platform, backed by the neutrality of the United Nations, that makes the results available in easy-to-understand maps. The platform uses summary story maps, to outline the interlinkages between the environment, conflict and natural resources. The MapX mission is to increase global environmental transparency by making the best available data such as forest-cover change, species distribution, biodiversity hotspots, human pressures within protected areas and 30 other spatial indicators widely accessible.

Conflicting interests and competition over land and resources have been major driving forces of forest conversion, with increasing pressure due to population growth, degradation of lands, economic interests and, not least, the impact of climate change. The FAO Global Land Cover - SHARE (GLC-SHARE) integrates the high accuracy land cover information obtained at national level by local mapping agencies and/or national projects with the best synthesis of global satellite-based, but less validated, datasets in areas where no better national data are available. Mapping land cover allows for assessment and monitoring of terrestrial ecosystems and changes within them, which are crucial to the sustainable management of natural resources, environmental protection, food security and humanitarian programmes.



Geospatial technology also plays a central role in identifying important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type. UNEP together with partners created the Freshwater Ecosystems Explorer: an accurate, up-to-date, high-resolution geospatial data visualization platform depicting the extent to which freshwater ecosystems change over time. This tool can help decision-makers understand the dynamic ecosystem changes and drive action to protect and restore freshwater ecosystems.



UNEP works together with the National Aeronautics and Space Administration (NASA) on the Global Learning and Observations to Benefit the Environment (GLOBE), an international science and education programme that provides students and the public worldwide with the opportunity to participate in data collection and the scientific process, and to contribute meaningfully to our understanding of the Earth system and global environment.

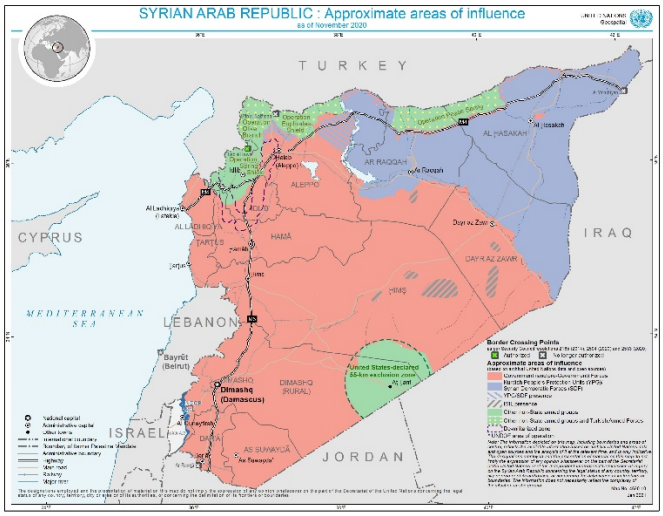
While ensuring national ownership and retaining the flexibility for countries to use their national data, the UN Convention to Combat Desertification (UNCCD) has outlined a standardized approach for reporting on SDG Indicator 15.3.1 using geospatial information, which focuses primarily on the use of three sub-Indicators: Land Cover and Land Cover Change; Land Productivity; and Carbon Stocks above and below ground. The GEO Land Degradation Neutrality (GEO LDN) Initiative was launched in 2018 to enhance national capacities to use geospatial information to map and measure the extent of degraded lands and effectively report on SDG Indicator 15.3.1. GEO is well-placed to assist the UNCCD and its contracting parties with the rapid provision and deployment of EO datasets, in-country capacity building and training, along with guidance on the use and development of EO tools and platforms.

16 Peace, Justice and Strong Institutions

Conflict, insecurity, weak institutions and limited access to justice remain a great threat to sustainable development. Every day, 100 civilians are killed in armed conflicts despite the protection under international law. The number of people fleeing war, persecution and conflict exceeded 79.5 million in 2019, the highest level recorded. The global pandemic of COVID-19 further exacerbated and threatened global peace and security.

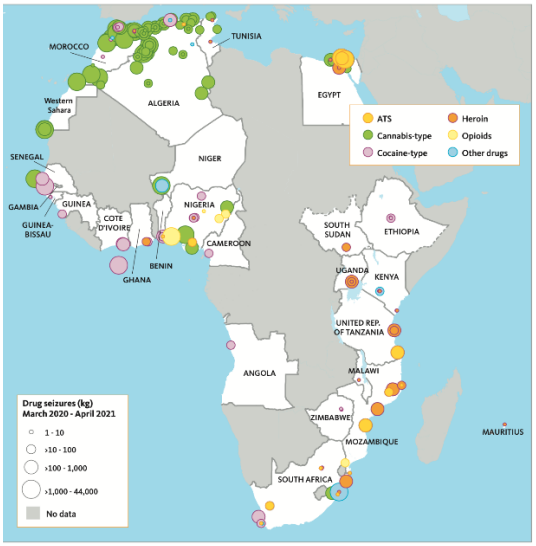
The Department of Political and Peacebuilding Affairs (DPPA) applies earth observation and imagery intelligence to support the work of the Security Council through the Sanctions Committees and Panels of Experts to investigate, research and monitor the implementation of sanctions. Geospatial information and intelligence is used to provide evidentiary support to experts on non-proliferation, threats and security, nuclear issues, armed groups, natural resources, humanitarian and human rights violations. To provide innovative monitoring approaches, DPPA's Innovation Cell and its technical partners worked on a pilot project applying earth observation analysis to advance water security-related forecasting. By examining supply-and demand-side water changes throughout history and creating a model to estimate future trends against conflict risk indicators, the methodology bolsters water-related conflict prediction.

A similar line of work is carried out by the Office of Independent International Commission of Inquiry on the Syrian Arab Republic who reports to the United Nations Human Rights Council. In their 2021 report, they used geovisualization products to effectively communicate the spatio-temporal changes of the approximate areas of influence of the different groups and their human rights violation dimensions.



Following the Security Council resolutions and mandates, the Department of Peace Operations (DPO) deploys peacekeeping missions around the world, and for many field missions, deployment of Geographic Information Systems (GIS) is a given, especially following the recommendation in the Brahimi report: Report of the Panel on United Nations Peace Operations (2000) and the Report of the High-Level Independent Panel on Peace Operations (HIPPO) (2015). Successful deployment of situational awareness platform of Common Operational Geographic Information (COGI) and Mission Operational Geographic Information (MOGI) amongst the Mission GIS such as United Nations Organization Stabilization Mission in the Democratic Republic of the Congo (MONUSCO), United Nations Interim Force in Lebanon (UNIFIL), United Nations Assistance Mission in Somalia (UNSOM), DPO and Office of Information and Communication Technology (OICT) identified the value of integrating the diverse mission mandate and operational requirements into one platform to provide a common operational picture. Currently, a situational awareness platform, Unite Aware, is being piloted in the United Nations Multidimensional Integrated Stabilization Mission in Central African Republic (MINUSCA) for future enterprise level deployment.

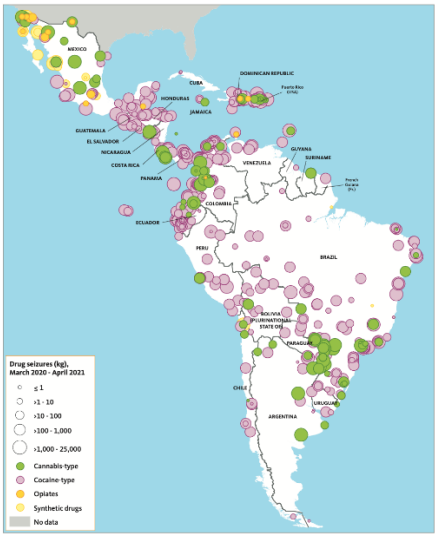
Illicit activities are intertwined with development issues as they often emerge in an environment where there are weak institutions. The United Nations Office on Drugs and Crime (UNODC) who focuses on tackling global issues related to drugs, crime, corruption and terrorism leverages geospatial technology extensively as illicit activities are often transboundary in nature.



Source: UNODC, Drugs Monitoring Platform.

Note: The figure is based on information from significant individual seizures, which constitutes an opportunistically determined subset of all relevant seizures.

The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.



Source: UNODC, Drugs Monitoring Platform.

Note: Opiate seizures of Ecuador are omitted because of limited data availability. The figure is based on information from significant individual seizures, which constitutes an opportunistically determined subset of all relevant seizures. Grey areas in the maps denote countries excluded from the specific analysis or an absence of data points.

The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

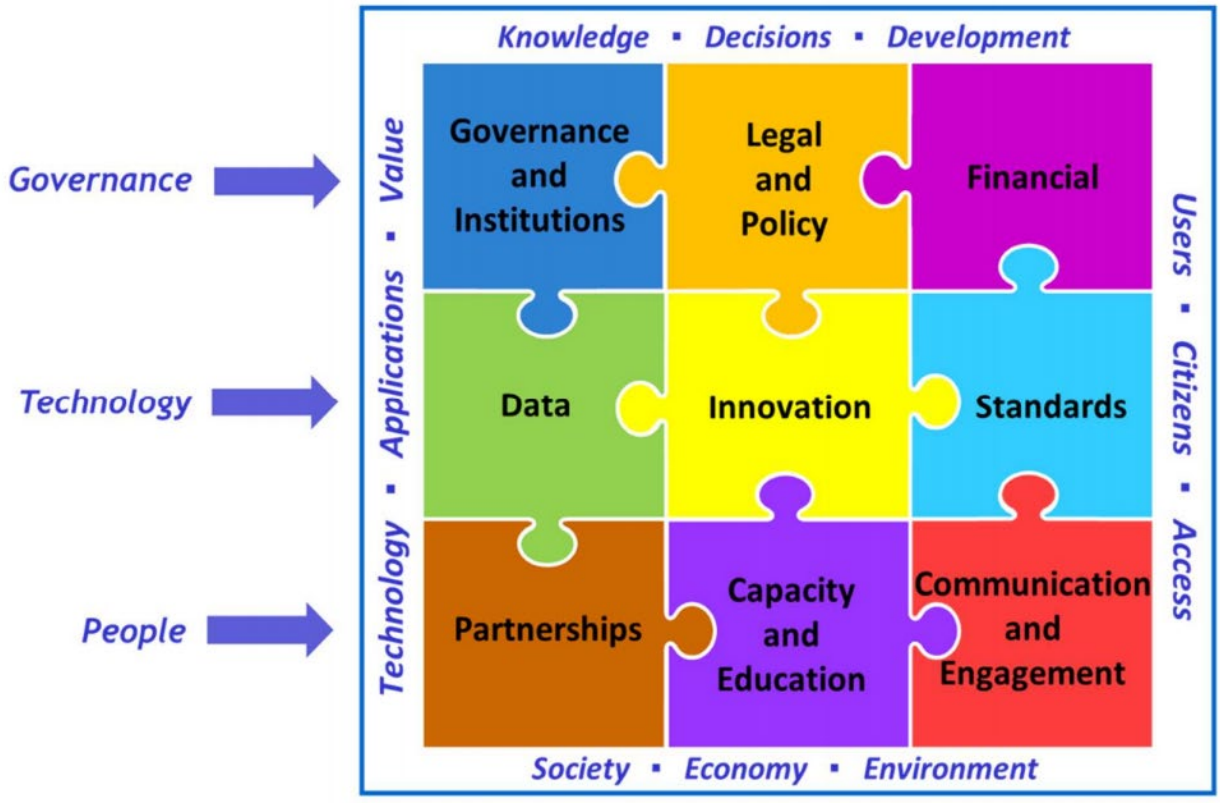
The UNODC Drugs Monitoring Platform (DMP) is a multi-source system which collects, visualize and shares near real-time data on drug trafficking trends (e.g. over 450,000 geocoded drug seizure data points) using interactive visualizations, improving early warning drug threat identification for law enforcement and analysts. The platform has proved to be particularly useful in monitoring the impact of the COVID-19 pandemic on drug trafficking, as the ongoing health crisis has triggered requests for new and timely data for improving knowledge and monitoring unprecedented trends, thus highlighting the need for and value of "real-time" data. DMP serves as a key information base to help law enforcement agencies across the globe to develop effective anti-trafficking measures. Another strength lies in the data accessibility through geo-visualization for quick use and interpretation by analysts and other users.

Another area where UNODC extensively applied geospatial technology is in their Illicit Crop Monitoring Programme (ICMP) where they use Remote Sensing and GIS to monitor illicit crop cultivation and estimate illicit production. The global supply of heroin from opium poppy and cocaine from coca bush stems from only six countries with high levels of illicit cultivation. Its cultivation and production are driven by a multitude of factors and drivers; lack of livelihood opportunities, access to licit employment or education and the absence of basic facilities (e.g. clean water and health care). Conversely, illicit drug production has been linked to conflict financing, increased insecurity, environmental damage, and a weak rule of law, all of which potentially threaten sustainable development along all its dimensions. ICMP uses geospatial technology for the detection, analysis and visualisation of illicit crop cultivation, production and trends monitoring. By providing technical support to Member States to better understand the drivers and the impact of illicit crop cultivation at a spatially disaggregated level, it guides policy makers in designing and implementing strategies accordingly.

17 - Strengthen the means of implementation and revitalize the global partnership for sustainable development

At the outset, the 2030 Agenda highlighted its goals through five pillars: People, Planet, Prosperity, Peace and Partnerships and in its preamble invited “all countries and all stakeholders, acting in collaborative partnership” to implement the Sustainable Development Goals. Partnerships enable respective entities of the United Nations to have forged and are developing stronger partnerships to maximize potential from resources, avoid redundant or overlapping investments, exploit synergies and introduce a culture of sharing.

The Integrated Geospatial Information Framework developed by UN-GGIM also highlights the importance of partnerships for Member States to establish effective cross-sector and interdisciplinary cooperation including with the private sector, academia, geospatial societies and international organizations. The objective is to create and sustain the value of geospatial information through a culture based on trusted partnerships and strategic alliances that recognize common needs and aspirations.



Respective entities of the United Nations Geospatial Network have developed, throughout time, strategic partnerships and alliances, with a wide range of actors to advance the value of geospatial information for the mandates of the Organization and for the benefit of Member States.

First and foremost, partnerships have been established with Member States in the form of in-kind contributions in the form of funds, personnel, data, technology transfer, capacity development, joint programmes, hosting of events or policy references. For example, the Hand-in-Hand initiative in FAO prioritizes countries where national capacities and international support are the most limited or where operational challenges, including natural- or man-made crises, are the greatest.

Geospatial societies are also unique in contributing through their expertise and insights to the mandates of the United Nations. Successful partnerships require partners who are attuned to each other’s visions

and roles where missions align. UN Geospatial and the International Cartographic Association are both committed to building awareness of how maps can be used for decision-making. They raise awareness on global agendas and collaborate on a publication on how cartography can help better understand, share and communicate through mapping the Sustainable Development Goals.

Various institutes and academia contributed to the development of methods, tools, data or analysis in collaboration with, for example, UNFPA, FAO, UNESCO or the United Nations Secretariat. The contribution by the international Standards Developing Organizations is also a key factor for success in developing and propagating further standards and methods.

Most entities of the United Nations also established systems contracts and partnerships with Earth observation providers, software companies and professional services. The United Nations Secretariat established systems contracts that are available for the wider United Nations system and avoid redundant work. Similarly, UNICEF developed a long-term agreement with six professional services companies to increase its readiness to address geospatial requirements and fill the gap. In-kind contributions from the private sector can be obtained to gain relevant knowledge, expertise, technologies, research and development or innovation. Public Earth observation conglomerates and government-led programmes such as NASA and European Space Agency (ESA) are also engaged with specific United Nations programmes and mandates.

Finally, under an overall framework, the contribution of civil society can tremendously benefit from the availability of geospatial information, where geospatial data is scarce, and voluntary geospatial information and crowdsourced data can support the mandates of the Organization. WFP and UN Geospatial have put in place two programmes to use and leverage open-source geospatial data, the Humanitarian Topographic Atlas and the UN Mappers to increase contributions from civil society to create geospatial data, which is in turn beneficial for on-the-ground operations in countries and for the wider geospatial community.

Conclusion

At the outset we highlighted the crucial role of reliable global geospatial information to support measurement and monitoring needed to achieve the shared vision and ambition of the 2030 Agenda for Sustainable Development. The use of geospatial information and its enabling technologies will not only serve to strengthen the management of data, knowledge and evidence needed to make policy- and informed decisions for the betterment of our people and planet, but will also help establish the foundation we need to effect the transformation for by the Secretary-General's Data Strategy. The science, innovation and technology related to geographic location, the 'where' component, contributes to better understanding our people, places and planet, and plan our future to "Leave no one behind, and reach those furthest behind first".

As discussed in this document, the United Nations system is making positive progress to mainstream geospatial information, including Earth observations, to fulfill its mandates and effect action in the context of the Sustainable Development Goals. The increased maturity of geospatial information across the United Nations system is evidenced by the continued and growing use of maps, data, spatial analytics and threat assessments to make decisions. Alongside this growing maturity, there has been a dramatic increase in the use of thematic dashboards, deployment of Earth observations, and interest in harnessing new tools and methods including using Artificial Intelligence, all fostered by the integrative ability of geospatial information. Now, in solidarity we need to strengthen our collective access to a wider range of data and develop enterprise-level solutions to fully mainstream geospatial information, across the United Nations system.

Despite these successes and ever-expanding possibilities of harnessing geospatial information and technology for people, places and planet, the Geospatial Network will seek to strengthen its activities along three major areas:

Governance. The United Nations, with Member States, is in a unique position to understand challenges and facilitate their resolve in the accessibility, interoperability, and availability of geospatial data across national contexts. The interactions and definition of custodianships in national and global context can support the wider availability, homogeneity, and universality of geospatial data for their use and related access. Principally, UN-GGIM's Integrated Geospatial Information Framework and Licensing Geospatial information are key guiding documents for the Network to help strengthen geospatial information within the United Nations system.

People. The sectoral approach of the United Nations somehow favors a silo-based approach on the collection, curation, standardization, and dissemination of geospatial data. Through its efforts, the United Nations Geospatial Network is advocating that the United System follows the "collect once, use many times" mantra. This will require the promotion and awareness-raising of one of the strengths of the United Nations system, it's people. The Network's members offer a unique opportunity to help bring the frameworks, standards, and norms developed by UN-GGIM to the working level within Member States, as they are ultimately responsible for many of the underlying geospatial data that is needed for any sectoral analysis and the disaggregation of data to understand local dynamics. Through strengthening this mechanism of coordination and coherence, we can not only strengthen the geospatial capacity of the United Nations system, but also bolster efforts to strengthen geospatial information in Member States.

Data and Technology. Finally, developing the capacity and availability of geospatial data, and the enabling technologies around the data, will support the mainstreaming of integration and capacity development. The Network recognizes the global fundamental geospatial data themes as key guiding documents for the United Nations in organizing their activities and critical framework and 'trading language' for the wider geospatial community. Further, the Global Statistical and Geospatial Framework provides the principles for a better integration, while applicable in national context the GSGF is also guiding for both the Geospatial and Statistical community within the United Nations system and ultimately will help with connecting and integrating global data to monitor SDGs. The Network's next steps will be to help provide guidance for geospatial data custodians, as a mechanism to facilitate national capacity development activities by the United Nations system.

In sum, the United Nations Geospatial Network is cognizant of its progress and achievements, and those of its constituent entities, as presented in this publication. The challenges and opportunities ahead for strengthening the United Nations system's geospatial governance, people, and data and technology present an optimistic and achievable future that can be practically realized. The Secretary-General's Data Strategy is an important guiding document for the Geospatial Network to help promote the strengthening of the coordination and coherence of geospatial information across and within its constituent members and the United Nations system. However, the true value of this strengthening can only be fully appreciated when Member States can realize the benefits of stronger partnerships, processes and frameworks to support their efforts, for a greater impact for people, places and planet.

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