GEOSPATIAL IN ACTION

Data and Insights for the Sustainable Development Goals

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

The General Assembly opens Seventy-first General Debate and holds a brief special segment to mark the first anniversary of the adoption of the 2030 Agenda and the Sustainable Development Goals (SDGs) prior to starting its general debate (2016)
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EXECUTIVE SUMMARY

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 the measuring and monitoring of the Sustainable Development Goals. Geospatial information management and a wide range of data are the science, innovation and technology related to the "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 is both as a facilitator and actor to the 2030 Agenda pledge. Additionally, it is 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 Organization objectives 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 brings together all United Nations entities that work 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 Development 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 an 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. It shows 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. The publication reviews each of the 17 SDGs in sequence to note the specific use of geospatial information and the role of the United Nations entities to provide the data and insights for action for a better world.

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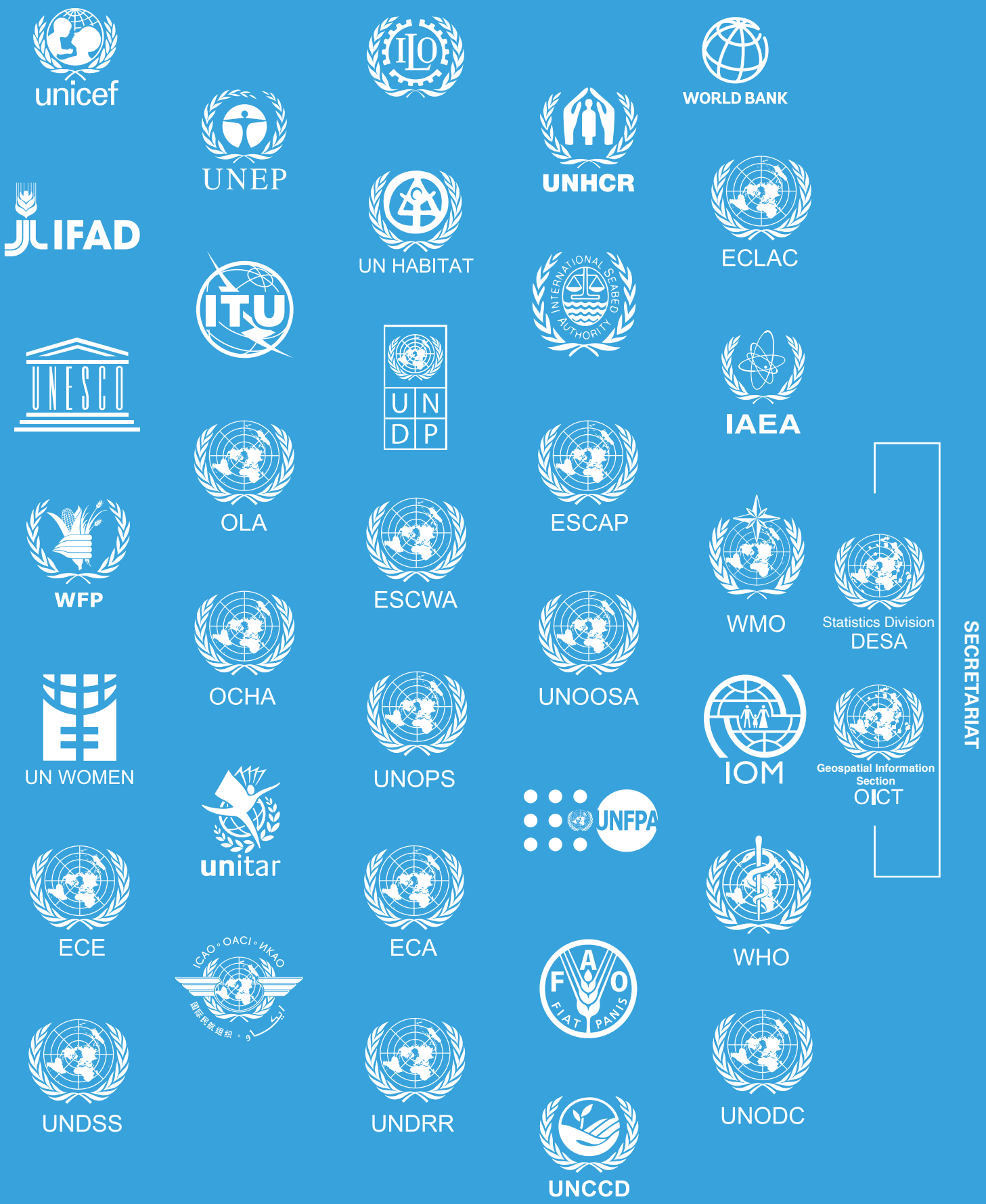
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FOREWORD

Chair of the UN Geospatial Network

We are at an inflection point in History. This is a time for Action. Humanity has never faced a need for such a global call for action. Our interconnected world intertwines the social, economic, and environmental dimensions in such a systemic way that one event happening in one sector crosses over all the others. Similarly, the borderlines from the global, through regional to national and local scales have been flattened. The exploration to its maximum of the potential of Geospatial information and technology is a must and critical contributor to this Call for Action, to contribute to our Common Agenda.

Moreover, we experience times where our lives have been shaken by yet another crisis, a triple crisis of health, with the global pandemic; of conflicts, spreading across and between countries; and of climate change, with raging devastation and threats to our societies. The 2030 Agenda for Sustainable Development is the global call for action for peace and prosperity for people, places and the planet, now and into the future in a global partnership. The 17 Sustainable Development Goals is our common compass that set the directions and priorities for our society, our economy, and our environment.

Geospatial is an enabling set of data, technologies, tools and services which can leverage the true potential of UN system, its Offices, Agencies, Funds and Programmes to effectively deliver their mandates in the nexus of human rights, development, and peace pillars. There has been no better time to abide by Geospatial for a better world, Transforming the Lives of People, Places and Planet.

A very interesting dimension of the current and future use of Geospatial it's the capacity development of organizations, countries and regions for the use and sharing of these data, technologies and services.

This exciting ambition to explore Geospatial to its maximum potential is strongly dependent on skills, competencies, and capacities of People. It is again the Technology, Processes and People paradigm which drives real change. Being Inclusive. Leaving no One Behind!

The geospatial community must rise in a global partnership to address the challenges our world is facing and is likely to face in the future. Member States, international organizations, the private sector, the academia, and the civil society must put their efforts in collective approach.

Much is already ongoing. This publication provides a kaleidoscopic view of the contribution of the UN Geospatial Network entities and their action to provide data and insights for a better world. This movement must be amplified. The progress made by the UN-GGIM in providing essential frameworks for the availability, quality and accessibility of geospatial information is underway. The United Nations Geospatial Network commits to contribute to these frameworks with its best abilities and to amplify their implementation at global, regional and national levels.

Our UN Geospatial Network prepared this publication to showcase what it is contributing to our global Call for Action in the context of the 17 Sustainable Development Goals.

Geospatial for a better world, impacting on People, Places and Planet, here's how… and where.

Alexandre Caldas
United Nations Environment Programme

End poverty in all its forms everywhere

1

1

NO POVERTY

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 a nowcast 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 1), namely the prevalence of poverty in Sub-Saharan Africa.

By 2020, only 47 per cent of the global population was effectively covered by at least one social protection cash benefit, which leaves four billion people unprotected. Knowing and numbering its population is critical for anyone 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.

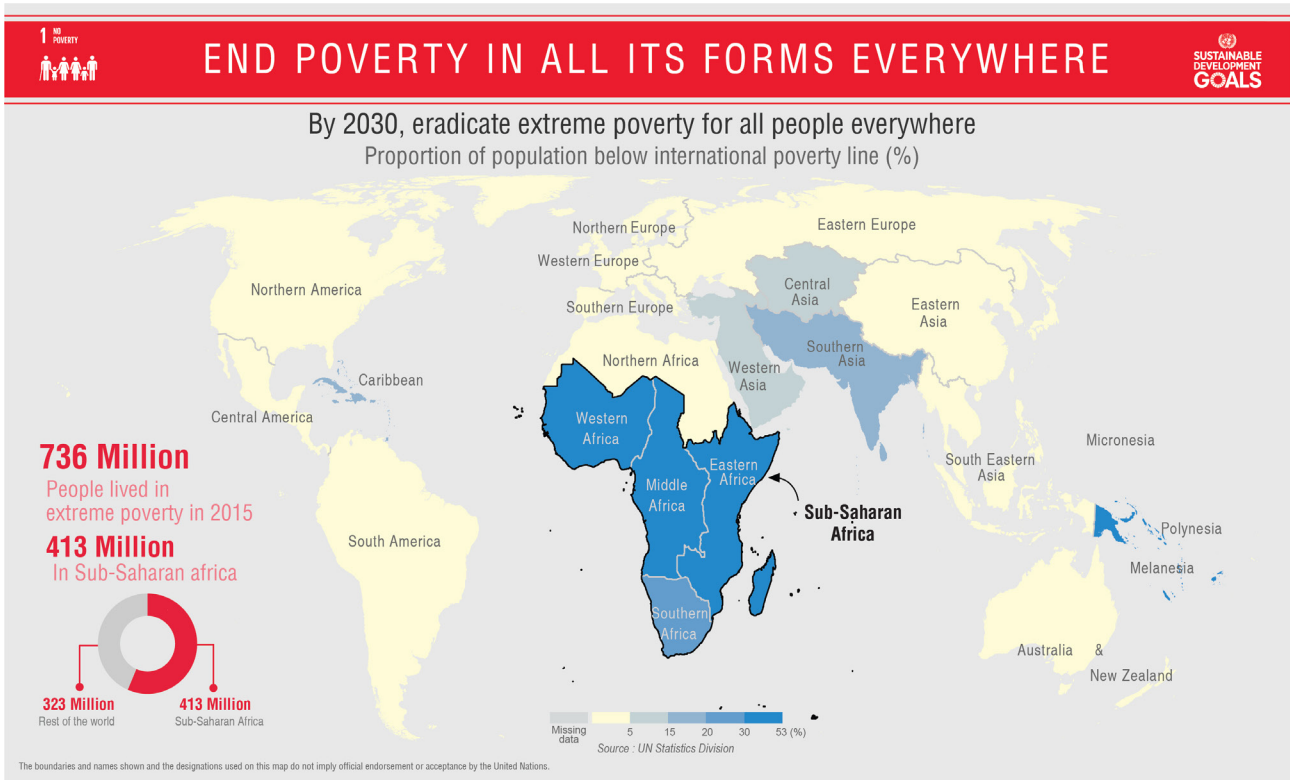


FIGURE 1: Map of the Sustainable Development Goal 1 on "No Poverty" using official SDG indicator. UN Geospatial, 2020

FIGURE 2: Children in the streets, Children are more likely to live in poverty than adults. UNICEF/Halle'n

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 countries and 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.

FIGURE 3: A women and children sitting on wooden chairs in the street. UNDP

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

2

2

ZERO HUNGER

An estimated 25.9 percent of the world population—about two 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 in crop conditions, to mitigate the impact of climate risks, to support farming operations and efficiencies, to monitor land degradation, and to assess the 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.

FIGURE 4: Market woman holding Gblock (a vegetable similar to eggplant) and dried fish. © WFP/Evelyn Fey, 2020

BEFORE 18 June 2019 © Digital Globe 2019

AFTER 29 Apr 2021 © CNES 2021, Distribution Airbus

FIGURE 6: The Asset Impact Monitoring from Space (AIMS) service uses satellite imagery to monitor the changes induced on the landscape by WFP's Food Assistance for Assets (FFA) programmes. The image of vicinity of the village of Zindan, Kabul from 2021 confirms the presence of the stone masonry water reservoir project which is a water harvesting structure built to redirect and store surface water to use for agriculture during the dry season. WFP, 2021

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 is 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 programme. Since its launch in 2017, the programme 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 their impact on food security and agricultural productivity.

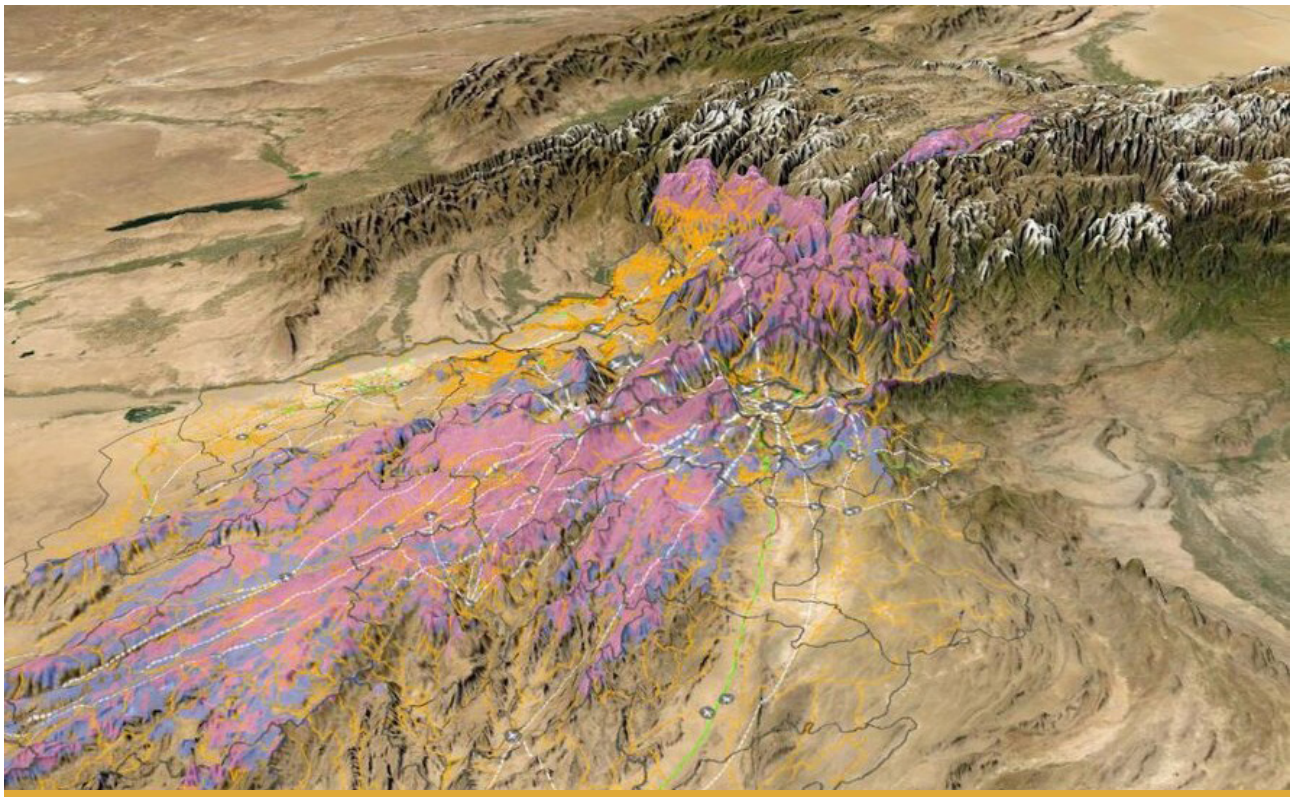


FIGURE 7: 3 Dimensional view of elevation data (SRTM) with road infrastructure and average snow cover providing understanding of physical access constraints for humanitarian aid and in the winter in the North-East of Afghanistan. WFP, 2021

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

3

3

GOOD HEALTH AND WELL-BEING

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: its appearance associated to the proximity of cities and the zoosphere, the region where it appeared to its global spreading pattern around the world in a wave from east to west, or 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) the headquarters and 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.

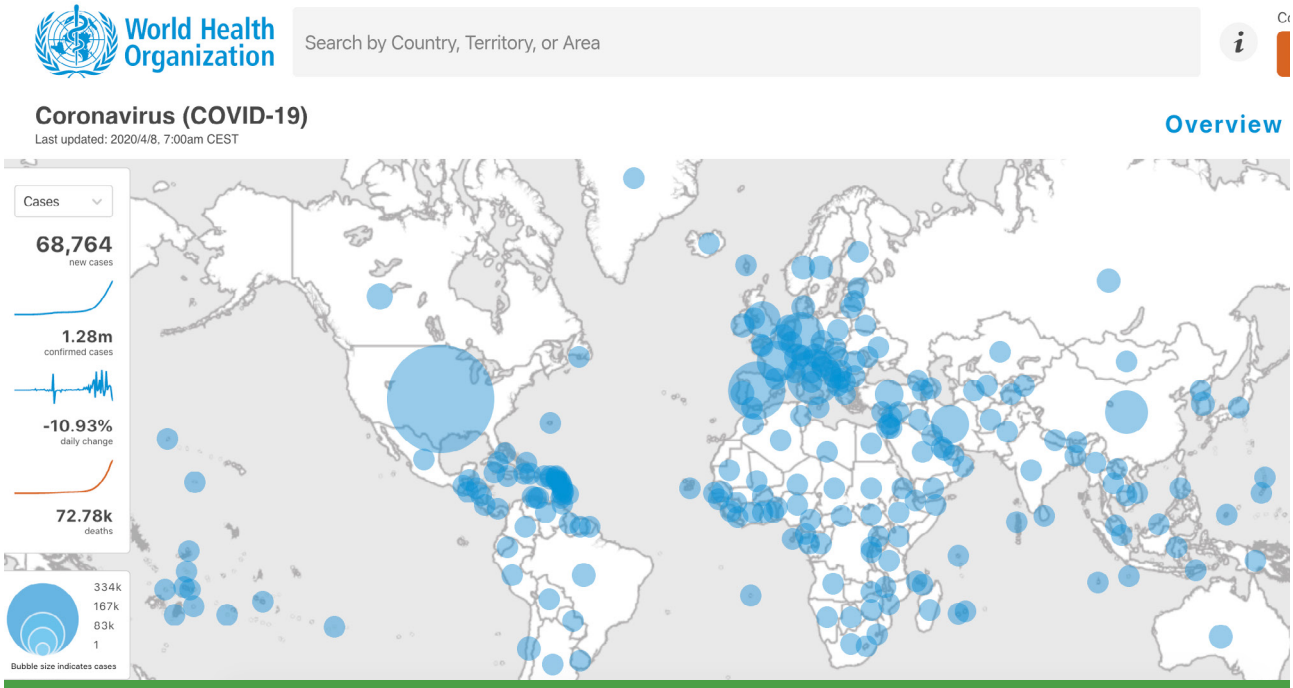


FIGURE 8: COVD-19 dashboard presenting cases worldwide on an interactive map in April 2020. WHO, 2020

FIGURE 9: Scene at Elmhurst Hospital in Queens during COVID-19. UN Photo/Evan Schneider, 2020

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 Sexual and Reproductive Health 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).

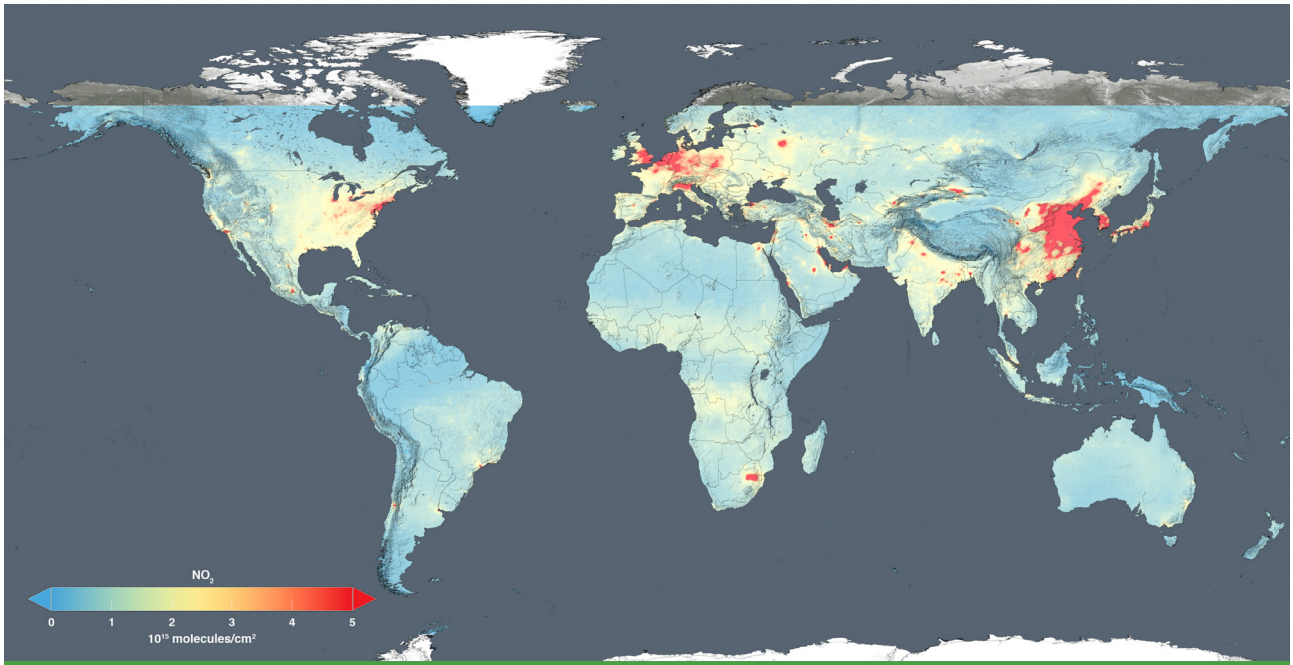


FIGURE 10: Global map showing the concentration of nitrogen dioxide in the troposphere averaged over 2014. © NASA, 2014

0020

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

4

4

QUALITY EDUCATION

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.

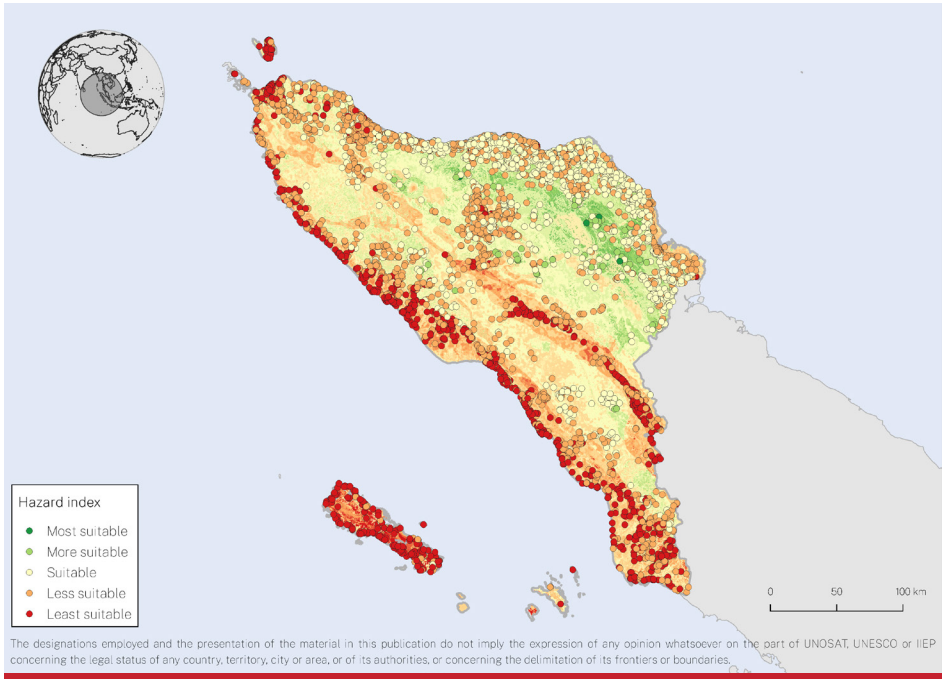


FIGURE 11 Land suitability for educational facilities: Primary schools in Aceh Province, Indonesia. UNESCO-IIEP, 2021 (forthcoming)

FIGURE 12: Aerial view of a school with blue colored corrugated iron roof with children playing on the schoolyard during break located in Namche Bazar, Khumbu, Nepal. Shutterstock/T. Schneider

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 it 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.

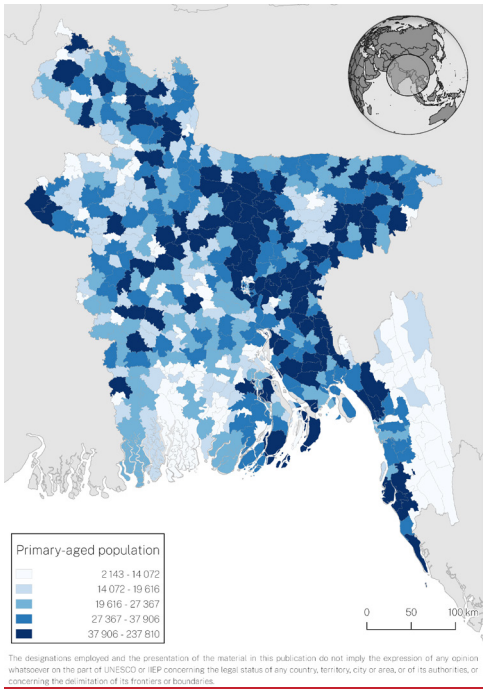


FIGURE 13: Spatialized school-age population: Lower Secondary, Bangladesh, 2019. UNESCO-IIEP, 2020

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 the United Nations Satellite Centre (UNOSAT), 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" on best practices on cartography and to showcase how cartography can support the monitoring of the SDGs. This publication also provides a global showcase on integrating geospatial and statistical data.

0024

Achieve gender equality and empower all women and girls

5

5

GENDER EQUALITY

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".

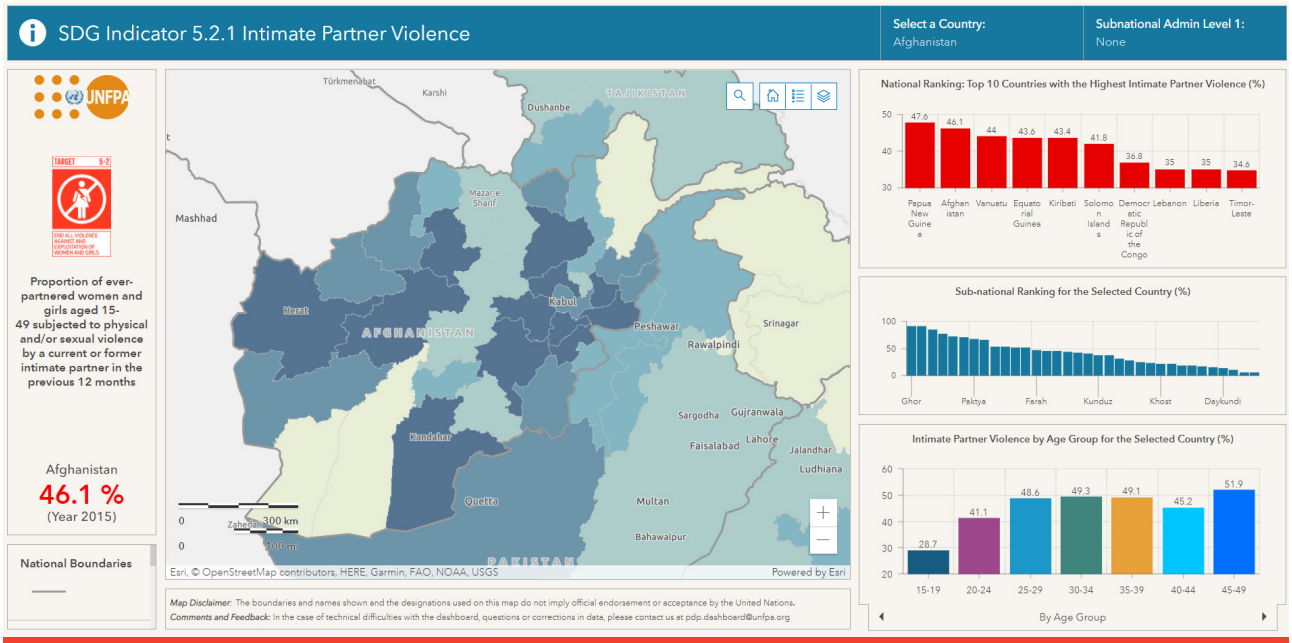


FIGURE 14: Dashboard showing SDG indicator 5.2.1 on Intimate partner violence in Afghanistan. UNFPA, 2021

FIGURE 15: eacekeeper Captain Nampumelelo Nteo, from South Africa, is checking her patrol movement on her Global Positioning System (GPS) and the map after a surveillance and verification mission at Camp Ndromo, Democratic Republic of the Congo (2006). UN Photo/Martine Perret, 2006

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 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.

FIGURE 16: Drones are increasingly used to map flood damage to crops and properties and to provide relief to affected population, here Rhoda Nkhambule holds a drone following a public demonstration of the technology to residents in Thipa village, Kasungu District, Malawi. UNICEF/Brown, 2018

Ensure availability and sustainable management of water and sanitation for all

6

6

CLEAN WATER AND SANITATION

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 WASH response from mapping sanitation infrastructure in refugee camps in Bangladesh (in coordination with the REACH initiative) to assessing impact of hurricanes on WASH facilities in Latin America. In Iraq, the REACH initiative together with the Iraq WASH cluster provided geospatial evidence 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.

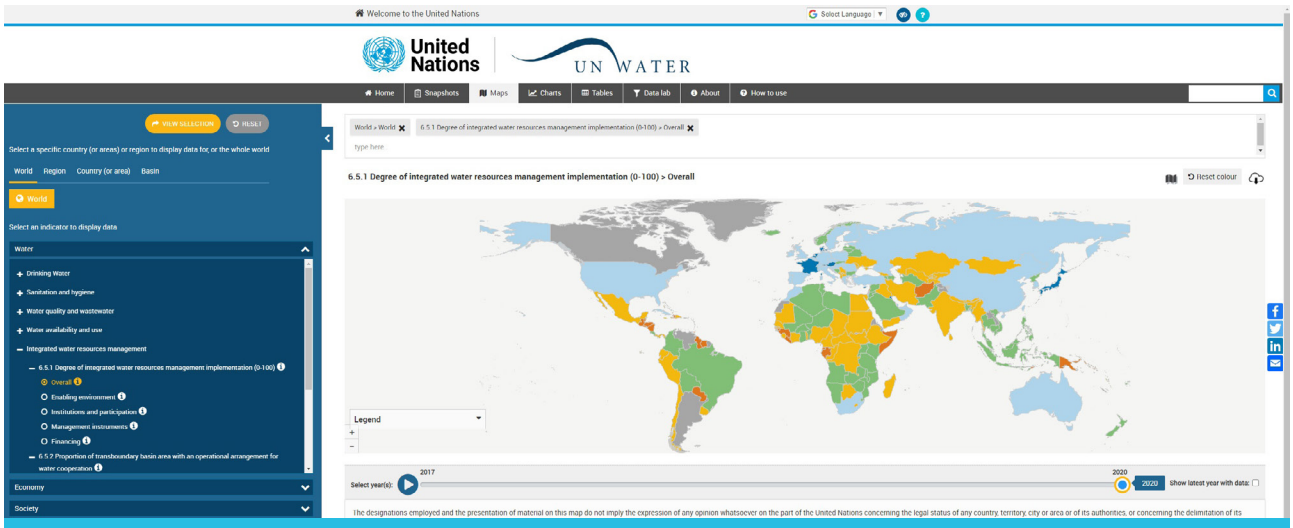


FIGURE 17: UN Water Dashboard showing -19 dashboard presenting indicator 6.5.1 on the degree of integrated water resources management implementation per country. UN Water, 2021

FIGURE 18: In Myanmar, fourth-grade students wash their hands at a community water point in the village of Hnen Ser Kyin, Magway Region. UNICEF/ Gilbertson VII, 2016

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 over 180 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.

FIGURE 19: Satellite image showing the North American Great Lakes in North America. © NASA, 1999

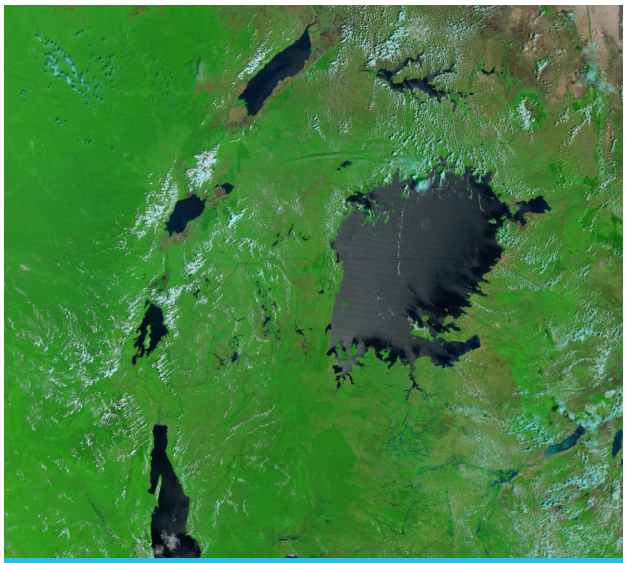
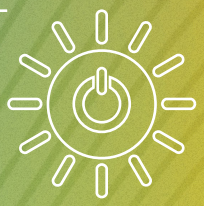


FIGURE 20: Satellite image showing the African Great Lakes. © NASA, 2002



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

7

7

AFFORDABLE AND CLEAN ENERGY

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 (UNDP) 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.

FIGURE 21: Men install solar panels for a hospital in Yemen. UNDP/ 2021

FIGURE 22: Screen capture of the Story map from Map X on small-scale alluvial mining in Colombia: the mapping of El-Bagre-Zaragoza. UNEP, 2020

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 (UNEP) 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.

FIGURE 23: A family in Tarialan, Uvs Province, Mongolia, uses a solar panel to generate power for their ger, a traditional Mongolian tent. UN Photo/ Eskinder Debebe, 2019

Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

8

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 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, rising insecurity and the already tepid economic growth and compounding heightened risks from other factors. As job losses escalate, the International Labour 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 enables reframing of economic policies within countries to consider how the global economy can be rehabilitated.

UN-Habitat and the 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 and its main monuments including the Al-Nouri Mosque and its Al-Hadba Minaret, the Al-Tahera Church and Al-Saa'a Church.

FIGURE 24: The International Labour Organization and UNICEF warn 9 million additional children at risk because of COVID-19 pandemic, child labour is on the rise and work under hazardous and unhealthy conditions as here at a garbage dumping site in Demra, Dhaka. UNICEF/Khan, 2012

FIGURE 25: Aerial view of the surroundings of the Al-Nouri Mosque of Mosul after the destructions in 2018, where geospatial information and technologies are used for damage assessment and planning. UNESCO, 2018

Similarly, the UN Satellite Centre (UNOSAT) – UNITAR, used geospatial information technologies and data to support the efforts of preservation of both cultural and natural sites. Damage to cultural heritage sites is often widely reported, but also hardly accessible and measurable and satellite imagery is often the only source of objective information for areas affected by conflicts. While conducting damage assessments to civilian infrastructure in Syria, related to SDG 16 on Peace, Justice and Strong Institutions, it became evident that there was also wide-spread destruction of cultural heritage sites. With the importance these areas for world history a on the state of cultural heritage in Syria was issued. This report found that over 3 years, 290 cultural heritage locations were affected, and within the 18 areas analyzed, 6 included UNESCO World Heritage Properties as contained in an overall report. The Satellite-based Damage Assessment to Cultural Heritage Sites in Syria provided a detailed perspective to UNESCO on the extent of damage to culturally significant heritage sites in the country by combining the expert assessment of imagery analysts and the background information from archeological experts on heritage sites to create a damage to loss assessment categorization system. The publication on the city of Aleppo for instance is a crucial tool as it provides technical information to plan the restoration and rehabilitation of the city.

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. The UNEP Guidance Manual on Green Economy Policy Assessment suggests the modelling potential of gespatial information in assisting in developing roadmaps.

Another area where the UN is making its segue 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.

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

9

9

INDUSTRY, INNOVATION AND INFRASTRUCTURE

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 25).

Data from 2018 to 2019 shows 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.

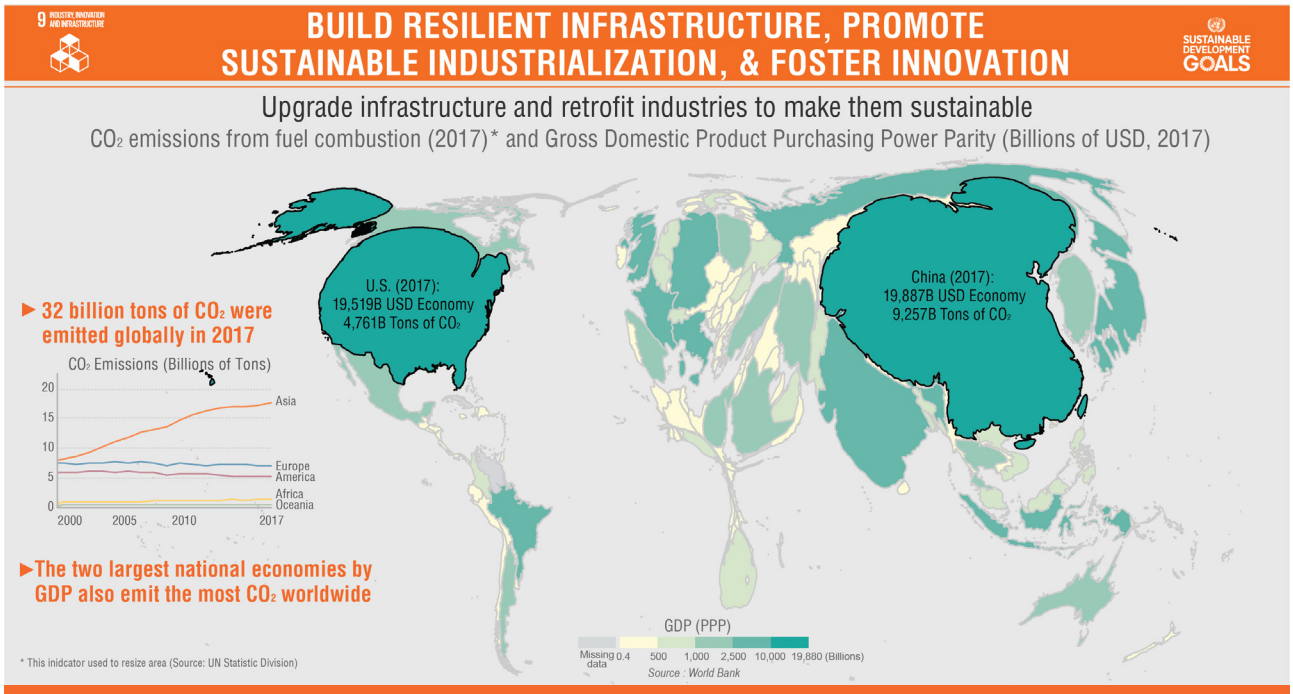


FIGURE 26: World map of the Sustainable Development Goal 9 on using official SDG indicator on CO2 emissions from fuel combustion (2017) and GDP purchasing power parity (Billions of USD, 2017). UN Geospatial, 2020

FIGURE 27: The Copernicus Sentinel-6 Michael Freilich satellite lifted off from the Vandenberg Air Force Base, California, USA. Once in orbit and commissioned, this new mission will take the role of radar altimetry reference mission, continuing the long-term record of measurements of sea-surface height started in 1992. ESA - S. Corvaja, 2020

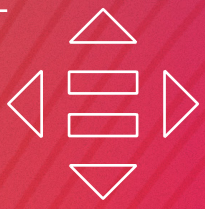
Technology advancements and innovation on Earth observation (EO) bring a new era of accessibility to satellite data, which are increasingly relevant for businesses, governments and civil society at large. The availability of satellites and sensors combined with the technology to process the data, computer-aided 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 a 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.

FIGURE 28: Irene Lasu works as a radio presenter for the UN Mission in South Sudan's Radio Miraya. Peacekeeping radio stations in many countries, are providing critical information during the COVID-19 pandemic. UN Photo/Isaac Alebe Avoro, 2020



Reduce inequality within and among countries

10

10

REDUCED INEQUALITIES

Increasing income disparities and a lack of opportunities, further worsened by the COVID-19 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 approximately 40 per cent 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.

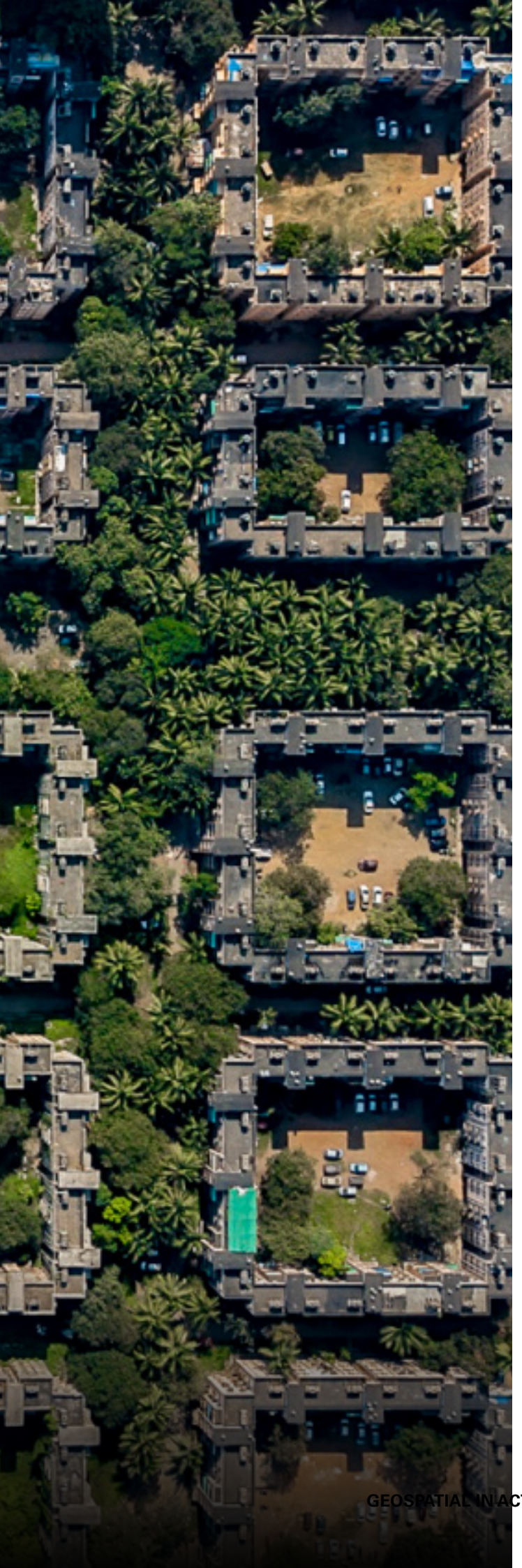
Reliable data on income inequality is not readily available globally and is especially harder to access at a sub-national level. By collecting and mapping existing inequalities with spatially disaggregated data, it is possible to develop tailored policies and strategies to address them. Well-governed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

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.

The Al-Zaatari refugee camp is a settlement in northwestern Jordan, on the border with Syria, that welcomed Syrians fleeing the civil war. Because of its exponential growth, the humanitarian organizations present on the field needed to monitor the status and structure of the camp. Using recent and past satellite imagery, over 20 analyses were conducted by the UN Satellite Centre (UNOSAT) – UNITAR in support to United Nations High Commissioner for Refugees

FIGURE 29: Spatial mapping of Al Zaatari Refugee Camp, Jordan. UNITAR-UNOSAT, 2015

FIGURE 30: Aerial view taken from a drone of slum lines the Mithi River near the National Stock Exchange in Mumbai. The city is home to both a 27-story, $1 billion palace and the largest slum in Asia. © National Geographic/Johnny Miller, 2019



(UNHCR) to best understand and plan its evolution, providing essential maps and hard data on numbers of tents, buildings and locations, as well as remaining available land for new constructions. The analyses are key to inform camp planning, monitoring and management.

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

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. The FAO 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.

Make cities and human settlements inclusive, safe, resilient and sustainable

11

11

SUSTAINABLE CITIES AND COMMUNITIES

We are increasingly living in an urbanized world. Since 2007, more than half the world's population is 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 per cent 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 per cent in 2018.

As with other international global frameworks, the New Urban Agenda by 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 (which collects 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 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.

FIGURE 31: View of the Manhattan skyline and the UN Headquarters from Long Island City, Queens, New York. UN News/Eric Ganz, 2018

FIGURE 32: While Bangkok, which is home to over eight million people, is an example of ongoing efforts being made to increase green spaces to improve city life, it also has a much-valued green haven, which can be seen in the centre of the image.This horseshoe or lung-shaped, green oasis is Bang Kachao and is in the middle of the bustling city. © Copernicus Sentinel, processed by ESA, 2019

Another United Nations entity that monitors the world population trend closely is the United Nations Population Fund (UNFPA). UNFPA 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 the opportunities of geospatial technologies, and how to set them up and sustain their use.

With the increased severity of future hazards due to climate change, strengthening national Disaster Risk Management (DRM) policies and climate resilience are critical for the sustainable development of cities and communities.

Geospatial Information Technologies (GIT) play a key role in understanding the geographic extent and severity of such hazards. In Mozambique, UN Satellite Centre (UNOSAT) – UNITAR's experts have been able for several years to support the National Government and Disaster Management Authorities through satellite imagery analysis and data visualization. The technical backstopping included satellite imagery analysis following major disaster events help the authorities in the field, provision of technical recover training on the Applications of GIT for Operational Planning and Decision Making in Disaster Situations and the development of an operational flood detection method based on Artificial Intelligence (AI) during a complementary awareness raising workshop. The case of Mozambique is one example of a comprehensive approach to strengthening disaster risk management capacities. The provision of innovative technical support hand in hand with capacity development allowed the national authorities and international organizations to learn from experience and increase resilience to hazards, reducing exposure and vulnerability of local communities.

Ensure sustainable consumption and production patterns

12

12

RESPONSIBLE CONSUMPTION AND PRODUCTION

For decades, scientists have been laying out how humanity is driving the three planetary crises: the climate crisis, the biodiversity crisis and the pollution crisis. All are 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 misused 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 the IAEA 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.

FIGURE 33: offee pickers in Timor-Leste. UN Photo/Martine Perret, 2011

FIGURE 34: picture of London, United Kingdom taken by ESA astronaut from the International Space Station at midnight, photographs like this provide vital data about city efficiency and sustainability. Using these pictures and online platforms for citizens to identify cities can support the mapping of energy inefficiencies in urban cities and to urge dimming of the lights. © ESA-NASA/T. Peake, 2016

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.

Take urgent action to combat climate change and its impacts*

13

13

CLIMATE ACTION

With the 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 to increase 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 to 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.

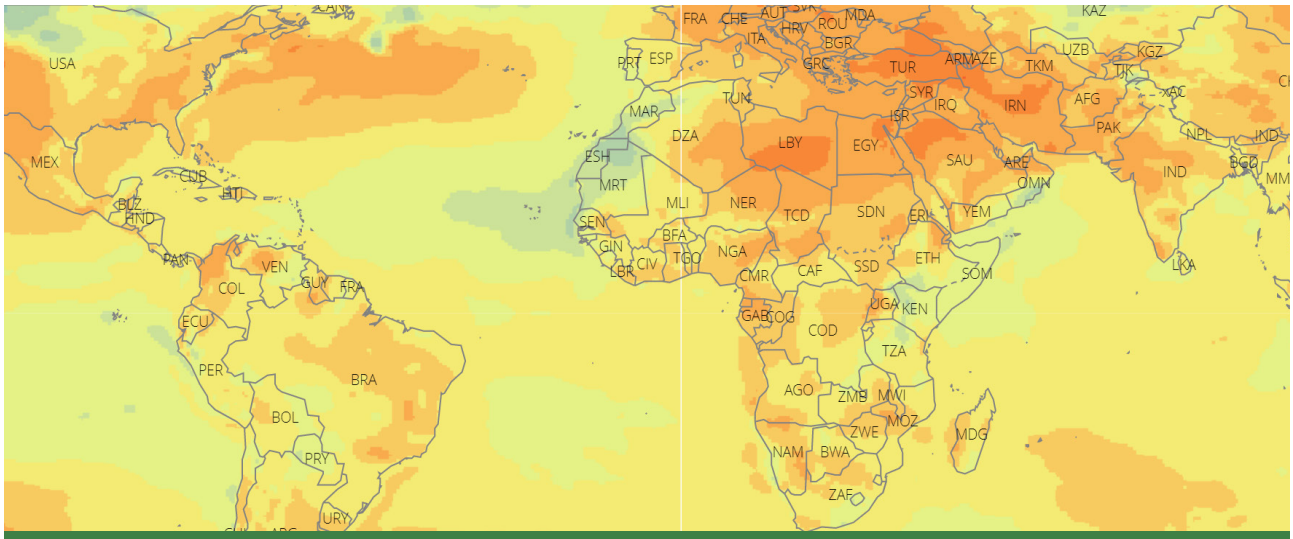


FIGURE 35: Worldwide temperature anomaly. UNDRR, 2021

FIGURE 36: Satellites carry special instruments to measure sea-level rise – but not only. Different instruments can measure different climate variables, from greenhouse gases to melting glaciers, and offer a global view of the state of our planet. © Copernicus Sentinel, processed by ESA, 2017

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, led by the United Nations Satellite Centre (UNOSAT)- UNITAR, 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, enhance access to climate finance, and to reduce the impact of natural hazards. Capacity strengthening activities such as a training course on Geospatial Information Technology applications for climate resilience help 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 UNEP 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.

Conserve and sustainably use the oceans, seas and marine resources for sustainable development

14

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 are 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 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).

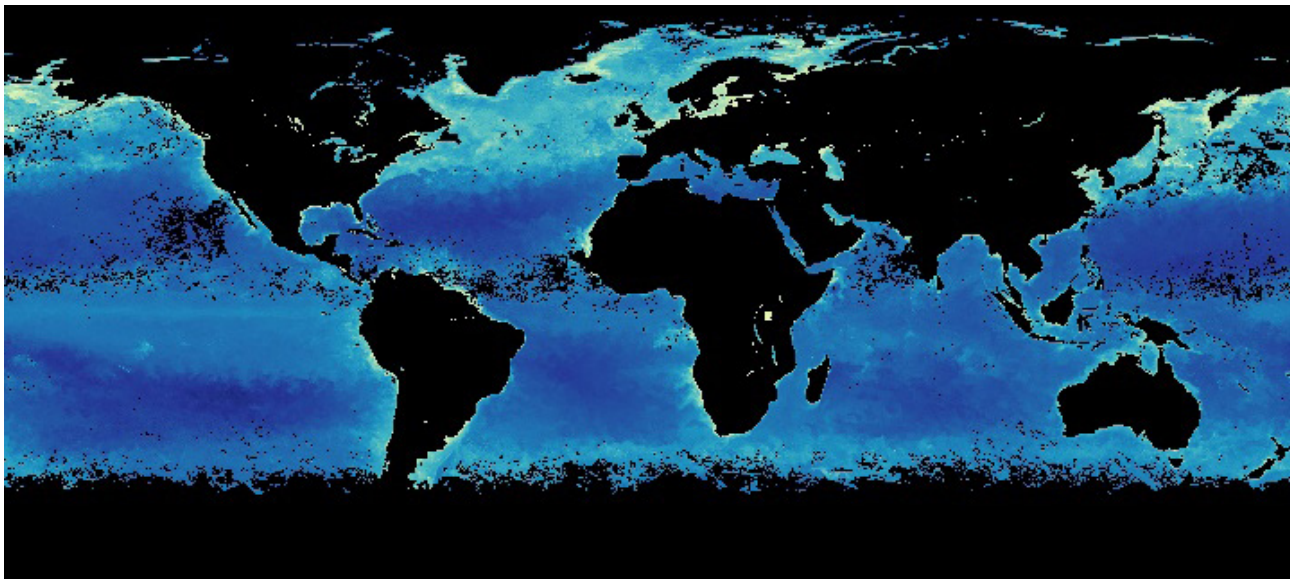


FIGURE 37: Global sea surface chlorophyll concentration. NASA/MODIS, 2019

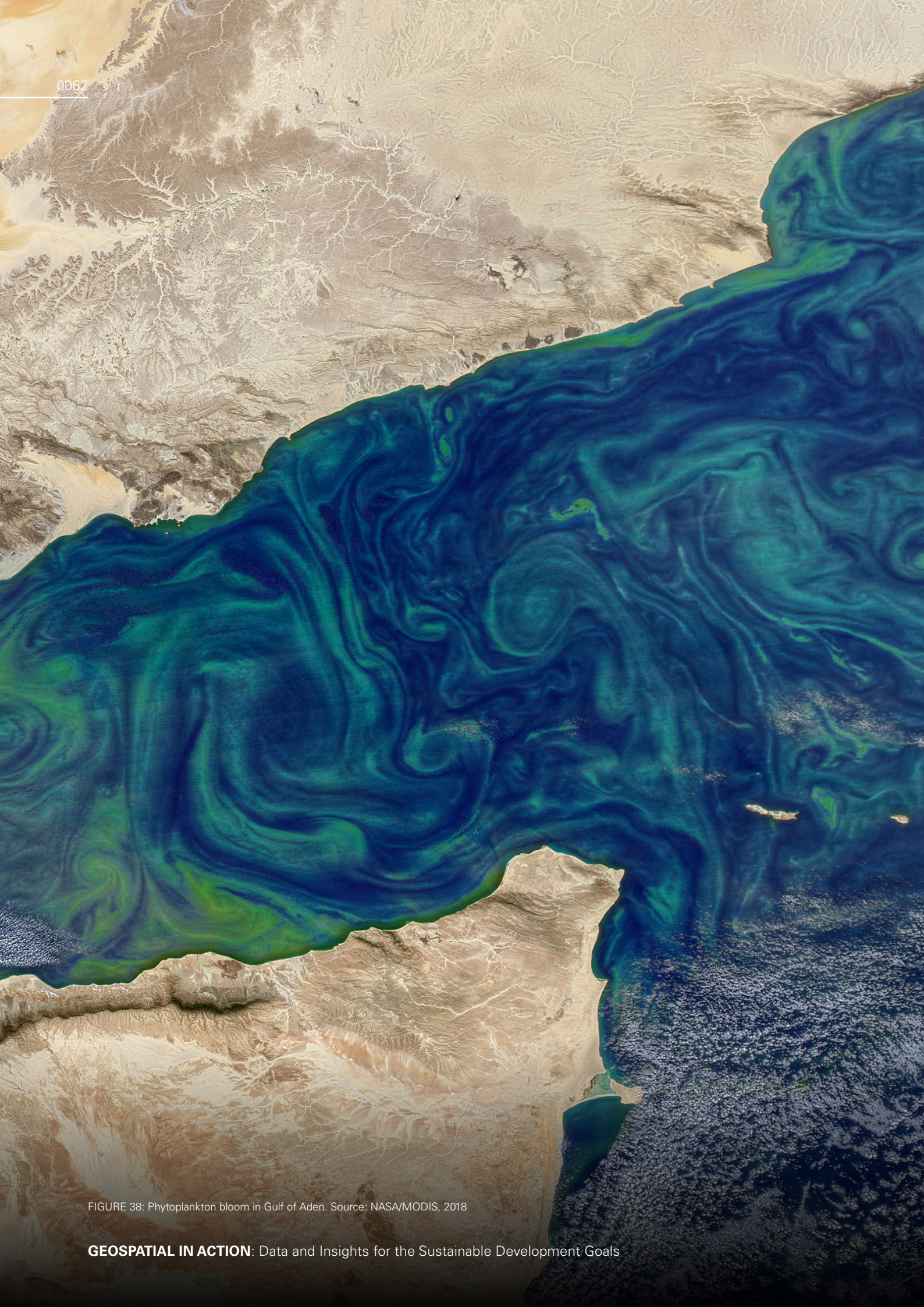


FIGURE 38: Phytoplankton bloom in Gulf of Aden. Source: NASA/MODIS, 2018

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.

Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

15

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 widely accessible such as forest-cover change, species distribution, biodiversity hotspots, human pressures within protected areas and 30 other spatial indicators.

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.

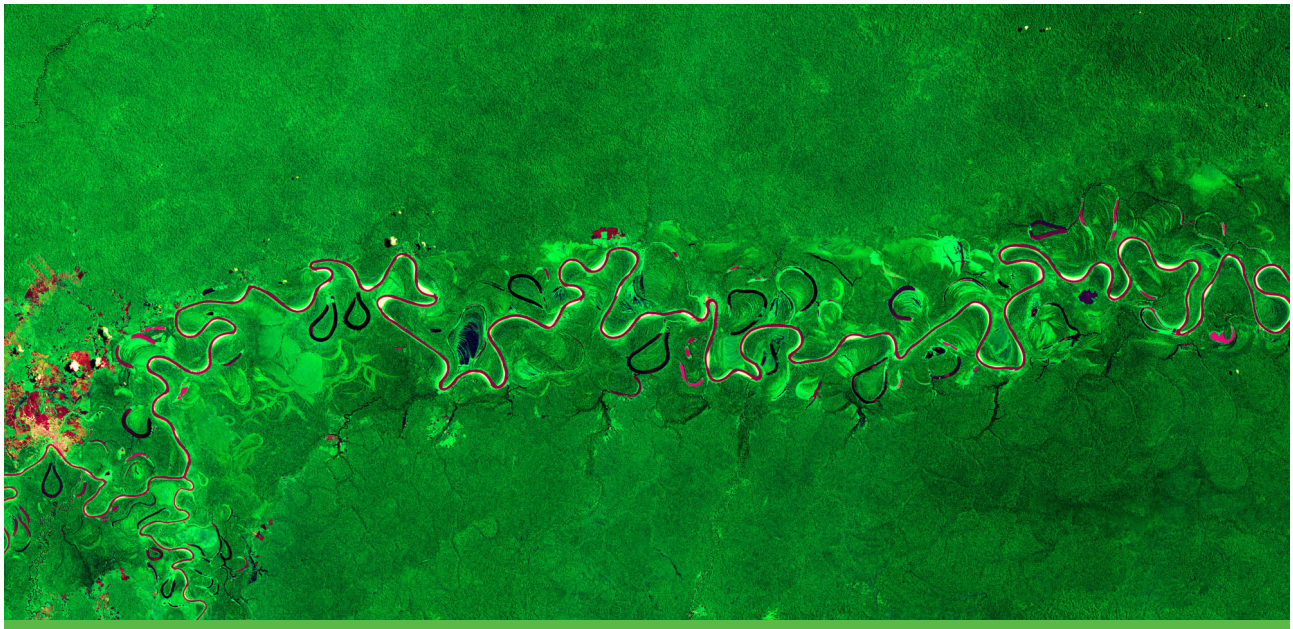


FIGURE 39: The Amazon rainforest is crucial for helping to regulate global warming as the forests absorb millions of tonnes of carbon emissions every year. According to the United Nations, the world is losing 10 million hectares of forest each year, which accounts for 12-20% of the global greenhouse gas emissions that contribute to climate change. © Copernicus Sentinel data (2019), processed by ESA

FIGURE 40: Lungs of the planet. UNEP-WCMC, Unspalsh/Kamenar, 2021

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.

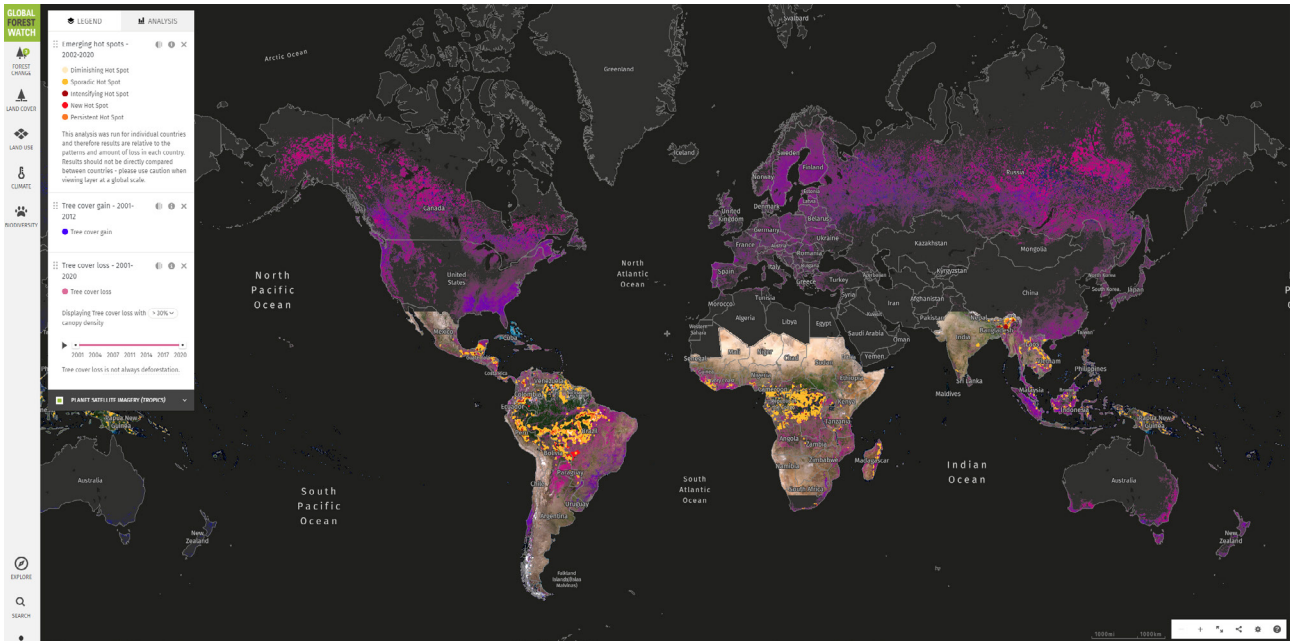


FIGURE 41: Screen capture of the dashboard of showing loss (purple) and emerging hotspots (2002-2020). Global Forest Watch. 2021

Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

16

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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 are 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, the DPPA 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, which 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.

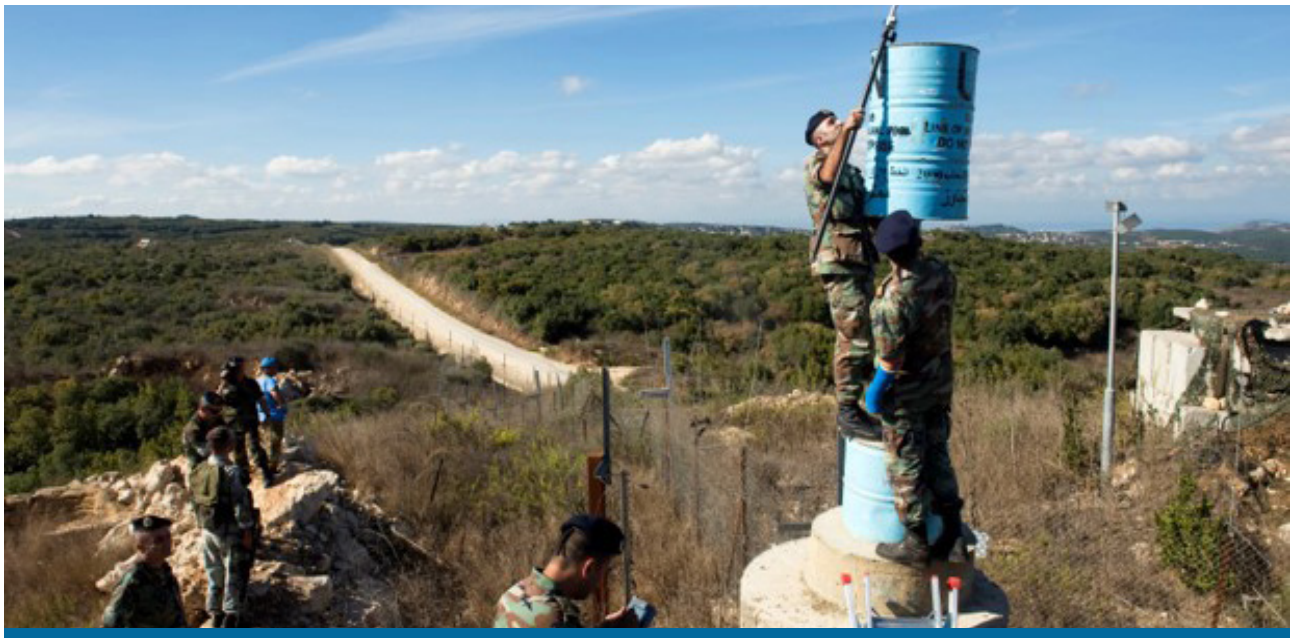

FIGURE 42: Officers of the United Nations Interim Force in Lebanon (UNIFIL) and members of the Lebanese Armed Forces verify the exact position of the Blue Barrel BP-12 in Rumaysh, South Lebanon. Blue Barrels determine the Blue Line, or line of withdrawal, marked between Israel and Lebanon after the pull-out of Israeli forces from South Lebanon in 2000. UN Photo/Pasqual Gorriz, 2010

FIGURE 43: Satellite image of damages, impacts and destroyed building in Gaza on April 2021. © CNES Pléiades, Airbus D&S, 2021

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 a situational awareness platform of Common Operational Geographic Information (COGI) and Mission Operational Geographic Information (MOGI) among mission GIS—such as the United Nations Organization Stabilization Mission in the Democratic Republic of the Congo (MONUSCO), the United Nations Interim Force in Lebanon (UNIFIL), the United Nations Assistance Mission in Somalia (UNSOM), DPO and the 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), which focuses on tackling global issues related to drugs, crime, corruption and terrorism; leverages geospatial technology extensively as illicit activities are often transboundary in nature.

The UNODC Drugs Monitoring Platform (DMP) is a multi-source system that collects, visualizes and shares near real-time data on drug trafficking trends (e.g., over 465,000 geocoded drug seizure data points), using interactive visualizations, aiming to improve 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. The DMP serves as a key information base to help law enforcement agencies across the globe develop effective anti-trafficking measures. Another strength lies in data accessibility through geo-visualization for quick use and interpretation by analysts and other users.

Another area where UNODC extensively applies geospatial technology is in its Illicit Crop Monitoring Programme (ICMP) where it uses remote sensing and GIS for the detection, analysis and visualization of illicit crop cultivation, production and trends monitoring. The argest part of the global supply of heroin from opium poppy and cocaine from coca bush stems from only six countries with high levels of illicit cultivation. Their cultivation and production are driven by a multitude of factors and drivers: lack of livelihood opportunities, limited 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 visualization 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 policymakers in designing and implementing strategies accordingly.

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

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PARTNERSHIPS FOR THE GOALS

At the outset, the 2030 Agenda highlighted its goals through five pillars: People, Planet, Prosperity, Peace and Partnerships. In its preamble, it 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 forge and develop 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 policy references, funds, data, technology transfer, innovation, capacity development, personnel, joint programmes or hosting events.

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.

FIGURE 44: Members of UN Police and the South Sudan Services, working in partnership to secure the country, taking part in a rope pulling competition, hold hands in camaraderie, during celebrations to mark the International Day of Peace. UN Photo, 2011

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 the 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.

Also, drawing from a wide variety of relevant data sources from scientists and other researchers worldwide as well as from its World Development Indicators database, the World Bank developed an Atlas of Sustainable Development Goals that presents interactive storytelling and data visualizations about the 17 Sustainable Development Goals.

FIGURE 45: Seventh Session of the UN Committee of Experts on Global Geospatial Information Management (UN-GGIM) at the UN Headquarters in New York, USA. UN Photo, 2017

CONCLUSION

At the outset, we highlighted the crucial role of reliable global geospatial information to support the 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 they will also help establish the foundation we need to effect the transformation for 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 to plan our future to "Leave no one behind and reach those furthest behind first".

As presented in this publication, the United Nations system is making progress to mainstream the use of geospatial information to fulfill its mandates and act toward the realization of the Sustainable Development Goals. The increased maturity of geospatial information across the United Nations system is evidenced by its continued and growing contribution to providing data and insights, through the data cycle including collection, management, analysis and dissemination. Regarding data collection, the use of Earth observation, geo-enabled surveys, volunteered geospatial information from crowd sourcing or GPS measurements is providing a swelling potential to exploit a wide range of data. The management and analysis of the data using spatial analytics, Artificial Intelligence, threat assessments, and data integration, in particular with statistics, provides for added value products, automated and cross-sectoral insights and understanding on global, regional or local phenomenon.

Finally, the continued use of maps, blooming of web-maps, advent of dashboards and other types of geo-visualization tools and platforms enables to democratize access and usage of geospatial information for decision-makers and the society. Now, through a coherent and interconnected approach, we need to further strengthen our collective access to a wider range of data, using latest technologies and trends, and develop enterprise-level solutions to fully mainstream geospatial information and innovation, across the United Nations system, and beyond for the benefit and capacity development of Member States.

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

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, the UN-GGIM 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.

Data & Technology. 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 the SDGs. The next steps of the Network will be to help provide guidance for geospatial data custodians, as a mechanism to facilitate national capacity development activities by the United Nations system.

People. Finally, 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 Nations 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. Network 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.

In summary, 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 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. The true value of this strengthening can only be fully appreciated when Member States can realize the benefits of stronger frameworks, processes, and partnerships to support their efforts, for a greater impact for people, places and planet.

ACRONYMS

SECRETARIAT

DESA	Department for Economic and Social Affairs
OCHA	Office for the Coordination of Humanitarian Affairs
OICT	Office of Information and Communications Technology
OLA	Office of Legal Affairs
UNDRR	United Nations Office for Disaster Risk Reduction
UNDSS	United Nations Department of Safety and Security
UNODC	United Nations Office on Drugs and Crime
UNOOSA	United Nations Office for Outer Space Affairs

REGIONAL COMMISSIONS

ECA	Economic Commission for Africa
ECE	Economic Commission for Europe
ECLAC	Economic Commission for Latin America & the Caribbean
ESCAP	Economic & Social Commission for Asia and the Pacific
ESCWA	Economic & Social Commission for Western Asia

FUNDS, PROGRAMMES & RESEARCH

UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFPA	United Nations Population Fund
UN Habitat	United Nations Human Settlements Programme
UNICEF	United Nations Children's Fund
WFP	World Food Programme
UNITAR	United Nations Institute for Training and Research
UNHCR	United Nations High Commissioner for Refugees
UNOPS	United Nations Office for Project Services
UN Women	United Nations Entity for Gender Equality & the Empowerment of Women

SPECIALIZED AGENCIES

FAO	Food and Agriculture Organization
ICAO	International Civil Aviation Organization
IFAD	International Fund for Agricultural Development
ILO	International Labour Organization
ITU	International Telecommunication Union
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHO	World Health Organization
WMO	World Meteorological Organization
World Bank	World Bank Group

OTHER RELATED ORGANIZATIONS

IAEA	International Atomic Energy Agency
IOM	International Organization for Migration
ISA	International Seabed Authority
UNCCD	United Nations Convention to Combat Desertification

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UN GEOSPATIAL NETWORK

UNITED NATIONS COMMITTEE OF EXPERTS ON GLOBAL GEOSPATIAL INFORMATION MANAGEMENT

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