5. Knowledge for action

5.1 Improved data and greater knowledge enable better and more effective actions and solutions in more places

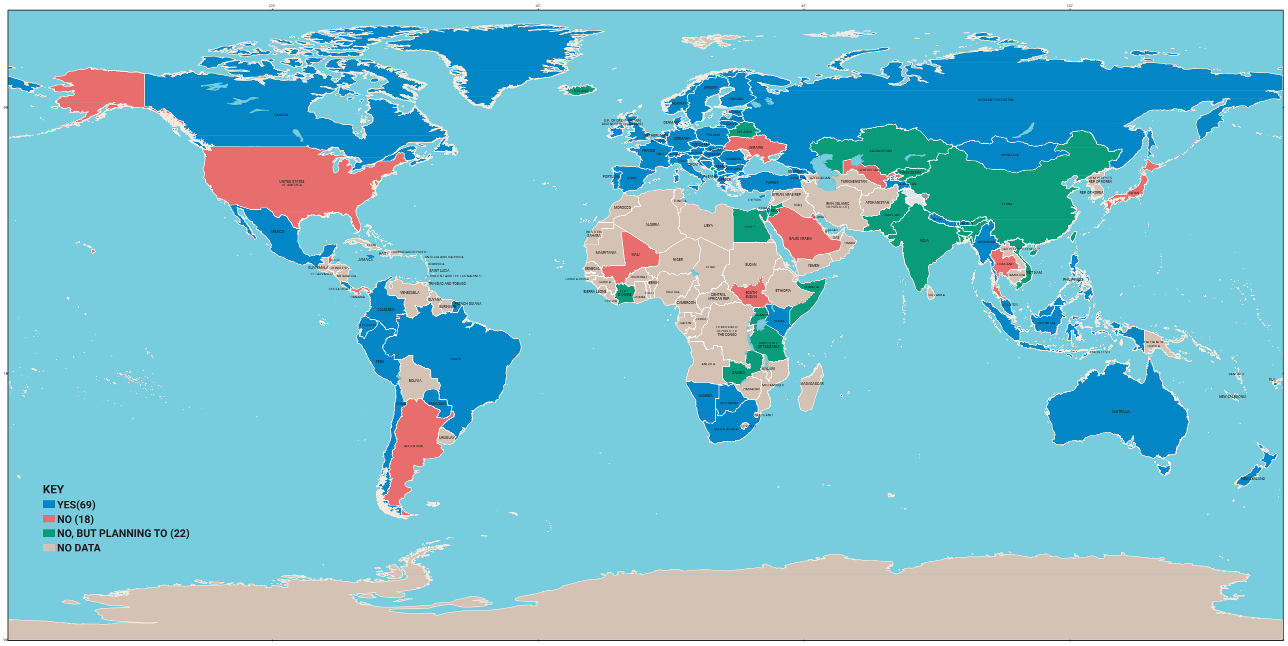
Though actions must be undertaken on the basis of the knowledge already at hand, the world needs openly accessible data, information, analysis, knowledge and science to better inform and guide what needs to be done to achieve sustainability across all environmental dimensions (*established but incomplete*). Achieving the Sustainable Development Goals, multilateral environmental agreements, internationally agreed environmental goals and science-based targets will require an integrated approach that considers linkage across different environmental and non-environmental components, building upon disaggregated data generation and incorporating traditional knowledge and citizen science. Achievement of the Sustainable Development Goals and targets needs to be followed up upon and reviewed, using the global indicators, complemented by indicators at the national and regional levels, and work is needed to develop the baselines for those targets for which national and global baseline data do not yet exist. Integrated data and analysis can prioritize needs, shape effective policies and strengthen monitoring and evaluation outcomes. {3.1, 25.1}

Advances in collecting official statistics and other evidence that feed into geographic information systems for environmental monitoring and accounting have expanded knowledge, while highlighting data gaps in every environmental domain (*well established*). Such gaps limit our capacity to formulate and implement policy solutions. More data will assist in linking people with the environment. Time series data is vitally important in that regard, as it forms the basis for monitoring change. Regular standardized data collection can be translated into statistics and indicators that highlight vulnerabilities within and between communities. Disaggregated data that captures information by gender, ethnicity, race, income, age and geographic region identify critical differences and promote effective policy design. {3.5, 3.7}

In addition to filling knowledge gaps with new data, enormous gains can be made from consolidating, curating, harmonizing and increasing open access to existing data which are widely dispersed and cannot be easily combined or compared (*well established*). Common frameworks, initiatives and political will are needed to merge data sources and make better use of what is available. In that context, the Framework for the Development of Environment Statistics, the System of Environmental-Economic Accounting and the System of National Accounts are robust consensus statistical frameworks and methodological approaches that could be broadly adopted (see figure SPM.9). Rationalizing both existing and newly collected data is essential for the development of indicators. {3.3}

Whether an indicator can be measured by Earth observation is a major factor in data availability (*well established*). A revolution in the quality and cost-effectiveness of Earth observation data means that indicators that can be measured remotely have far greater spatial coverage than those that cannot. For example, satellites can estimate deforestation and land use change with increasing accuracy, but cannot monitor all aspects of subsurface ocean environments. Data are particularly sparse for biodiversity, which is measured mostly by in situ observation and genetic analysis. Some freshwater components, such as groundwater and water use, are also data-deficient due to measurement challenges. The dichotomy in the volume of remotely sensed data versus in

Figure SPM.9. Extent of adoption of the System of Environmental-Economic Accounting



Source: United Nations (2018).

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situ data will inevitably grow as Earth observation technologies improve. {3.4}

More inclusive and open access to data will assist in achieving equity, transparency and best use of data for sustainability and development (*established but incomplete*). The "open data" movement has gained significant traction in recent years, working towards data being freely available to all. Education is a key component of access and countries should be forward-thinking in building capacity to analyse and interpret environmental data. For many measures, there is a strong imbalance in data access between developed and developing countries. That contributes to global differences in the ability of nations to understand the environment, its implications for human health and the use of environmental data for socioeconomic gain. {25.2.2}

5.2 Opportunities from emerging data sources and the Earth-human systems modelling revolution

Emerging data sources, such as Earth observation and Earth-human systems models, when combined with socioeconomic data and contextual analysis, can enable better policy decisions towards achieving the Sustainable Development Goals and multilateral environmental agreements (*established but incomplete*). "Big data", generated through new approaches and technologies, is emerging as a valuable resource which can inform environmental assessment processes. Evolving artificial intelligence and technological analytics, including algorithms, programming and mechanical methods, can advance evidence-based information for decision-making, forming part of what some refer to as the "fourth industrial revolution". There is enormous potential for advancing environmental knowledge if big data can be effectively harnessed and interrogated. Stronger collaboration between the public and private sectors, especially large corporations involved in big data collection, are critical for promoting economically viable and equitable solutions. Protocols for big data use are continually being developed and refined, but the extreme pace at which big data is evolving creates the potential for misinterpretation and misuse, raising issues of ethics, privacy and protection, for which urgent policy attention is required. {25.1.2}

Future sensor technology should allow detailed data disaggregation of spatial and demographic information (*established but incomplete*). A combination of satellites and airborne and ground-based networks can help to monitor developments and impact at the local, regional and global levels in near-real time. The resulting data and information, together with rapidly emerging digital infrastructure, can enable rapid response to changing circumstances. Realizing those benefits, however, depends on appropriate governance and national circumstances for data collection, processing, curation and use, along with combining environmental data with context-relevant socioeconomic information. {25.1.2}

While Earth observation is the primary contributor to remotely-sensed big data, citizen science enables timely, cost-effective collation of in situ data from dispersed sources (*well established*). When coupled with emerging technologies, such as smart sensors, mobile devices and web applications, citizen science enables the collection and analysis of large volumes of geographically-referenced data to inform and support decision-making, educate the public about environmental issues and enhance public participation. There are, however, significant challenges in ensuring that citizen science data are of appropriate quality, representative, can be soundly analysed and that results are effectively disseminated. {25.1.1}

Traditional knowledge is a globally underutilized resource which can complement science-based knowledge (*well established*). In 2007, the United Nations Declaration on the Rights of Indigenous Peoples helped indigenous peoples to document, revive and strengthen their knowledge, but capacity-building is needed to develop practices for managing the collection of information and the integration of traditional knowledge with other knowledge systems. Collaborative work between traditional knowledge holders, academia and Governments has led to innovative processes, procedures and tools for data generation, and knowledge production and enrichment, which can help in understanding and caring for the environment. {25.1.3}

Importantly, data gaps will be an ongoing reality for the foreseeable future and should not delay urgent action (*well established*). Decision-makers at all levels cannot wait for new data before acting, but should implement evidence-based management from current knowledge, then be adaptive and responsive as new knowledge becomes available. Governments and society need to embrace the evolving data landscape, facilitate the development of new information technology skills and adopt a holistic approach in utilizing both existing and emerging data and knowledge tools. {25.2.4}

International cooperation and sharing of data and information resulting from observational networks on Earth and in space are key to success (*well established*). Continued investment in education and training of the next generation of experts and decision-makers is essential for maintaining the pace of progress on the multigenerational challenges associated with the "Healthy Planet, Healthy People" theme of GEO-6. {25.3}

5.3 The way forward

The sixth Global Environmental Outlook has set out many of the challenges and opportunities faced by the world today, moving forward from today to 2030 and beyond that to 2050. The ongoing revolution in data and knowledge of all types at the local, national and multinational levels offers an opportunity to increase our capacity to address environmental and governance challenges and accelerate progress. Most important is the need to take bold, urgent, sustainable and inclusive action that integrates environmental, economic and social activity on pathways to achieve the Sustainable Development Goals, multilateral environmental agreements, internationally agreed environmental goals and other science-based targets.

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