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Chapter 7: Conclusions and recommendations

Authors

Dr. Erica Gaddis, University of Utah

Reviewers

Brennan Van Dyke, UNEP; Hally Blanchard, UNEP; Joseph E. Flotemersch, U.S. Environmental Protection Agency; Ludgarde Coppens, UNEP; Maria Schade, UN-Water; Susan Mutebi-Richards, UNEP; Ting Tang, International Institute for Applied Systems Analysis

This report focuses on evaluating interlinkages and trends between major global drivers and marine and freshwater indicators within the SDG indicator framework. Although the progress made in relation to the 92 environment-related SDG indicators is presented, the overall progress towards attaining the SDG targets is not, as those findings are reported elsewhere (for instance (UN 2022b)). This work represents a major step forward in using analytical methods to explore well-known and lesser-known interlinkages between water indicators and other environmental, social and economic factors.

7.1 Progress on environmental SDG indicators

Global analysis of the progress of the 92 environment-related SDG indicators indicates an improvement in data availability. A total of 59 per cent of the 92 environment-related SDG indicators have sufficient data to analyse, compared with 42 per cent in 2020 and 32 per cent in 2018 (UNEP 2021b; UNEP 2019c).

While more indicators have sufficient data for analysing progress, the number of both indicators showing positive and negative or little change has increased. Among the SDG environment-related indicators, 38 per cent show positive change indicating environmental improvement, an increase from 28 per cent reported in the previous report (UNEP 2021b). In parallel, 21 per cent of SDG environment-related indicators are showing negative or little change, an increase from 14 per cent reported for 2020.

Global policy discussions benefit not only from improved data availability for SDG indicators but also from new analytical approaches to understanding the underlying linkages and drivers of indicator trends. This report represents one new analytical approach that has the potential to contribute to a more policy-relevant integrated analysis. The relationships explored in this report provide a global-scale confirmation of relationships between SDGs and their indicators that have been explored at smaller scales elsewhere. Further, the analysis has helped identify critical gaps in indicator data and challenges with disaggregated data that ought to be resolved to achieve more meaningful policy analyses in the future.

7.2 Integrating SDG indicators: Piloting new analytical approaches through water data and indicator

Global assessments of water resources have always been challenged by the availability of global data sets that can provide meaningful trends of changes in both freshwater- and marine-related ecosystems. It has been even more difficult to link the state and trends of water-related ecosystems to policy interventions at all scales using data-driven and scientifically defensible methods.

The international community accepted the challenge of increasing the consistency, scientific defensibility and policy relevance of environmental data to inform global trends and policy through the development of the SDG indicator framework. This report represents one of the first attempts to identify statistically based interlinkages between environmental, social and economic drivers and freshwater- and marine-related ecosystem indicators.

This undertaking has exposed the need for even better and more innovative approaches to developing global data sets and to refining global water indicators. Of the 22 freshwater and marine indicators included in the SDG framework, five have been classified as representing change to ecosystems (two for freshwater and three for marine). These indicators represent the heart of the analysis presented in this report. However, only one indicator for each of the marine and freshwater trends had sufficient data to conduct a linkage analysis with other indicator data sets, so the indicator that was used to evaluate change in the freshwater ecosystem was “change in the extent of water-related ecosystems over time” (SDG indicator 6.6.1) for which 22 data points were available. In the marine environment, the index of coastal eutrophication and floating plastic debris density (SDG indicator 14.1.1) was assessed through the single sub-indicator of chlorophyll-a deviations with 17 data points available.

The challenge of analysing SDG indicators due to a lack of data cuts across the environment-related SDG indicators set as mentioned above. Data tracking gender equality and the inclusion of vulnerable groups in water management and governance are not available. The linkages between water and gender need to be addressed, as women’s gender roles often mean that they interact with natural resources, especially in developing countries. Understanding these inextricable linkages can lead to the formulation of gender-responsive plans, policies and strategies in line with international frameworks and agreements. Monitoring and tracking such data ensure that all key stakeholders are involved and such an inclusive approach is more likely to lead to environmental sustainability while contributing to the environmental SDGs as well as cross-cutting SDGs such as SDG 5.

Thus, a key conclusion from this report is the need to bolster data collection for other environment-related indicators and to re-evaluate the suitability of the current indicator methodologies to parse true change in the environment from data and methodological artefacts.

7.3 Key findings: Global freshwater-related ecosystems

Freshwater-related ecosystems continue to be degraded at an alarming rate. Estimates of over 85 per cent of wetlands have been lost over the past 300 years, and the effect on other freshwater ecosystems is accelerating (UN 2022b). This is despite 62 per cent of indicators indicating a positive change at the global scale representing the 22 freshwater-related indicators including ecosystems and human uses and activities.

The analysis presented in Chapter 4 of this report indicates that land conservation indicators are tightly linked to freshwater-related ecosystem status, emphasizing the importance of land management practices in supporting healthy lakes, streams and wetlands. The analysis also identified a strong negative relationship between GNI per capita and the extent of freshwater area. Economic activity continues to have a direct impact on the degradation of freshwater systems. This emphasizes the need to carefully evaluate the optimal locations for water-intensive industries and to place value on the services provided by healthy freshwater-related ecosystems.

The analysis also identified the impact on freshwater resources of developing drinking water infrastructure without attention to water-use efficiencies. At the global level, all state of human well-being indicators were negatively related to freshwater area both seasonally and as annual minimums and maximums. Experts deduce that this could be related to the role that freshwater plays in supporting public health and economic prosperity. Many jobs are found in water-intensive sectors such as energy production, manufacturing and agriculture, creating a strong link between human well-being and freshwater resources. Investments in new water infrastructure should focus on developing water resources for human use in ways that provide a sustainable supply of clean water without causing irreversible harm to freshwater streams. Further, infrastructure investments should include provision for both drinking water and proper treatment of wastewater especially in urban settings and be linked to the circular economy. Water is uniquely positioned to become circular if proper infrastructure is designed to improve efficiency, water reuse (especially in the energy and mining sectors), the integration of grey water into urban landscapes and improved agricultural water sustainability.

Some linkages between freshwater indicators and other SDG indicators do not have a certain causal mechanism. For example, a decline in the status of species listed as threatened by extinction appears to be related to improvements in freshwater area. However, additional investigation would be needed to determine if this link is more than an artefact of the data and/or analysis methods and what underlying mechanisms may be at play.

7.4 Key findings: Marine-related ecosystems

Stresses on marine-related ecosystems are well documented both in scope and magnitude. Increased plastic pollution, eutrophication and overfishing (including from illegal, unregulated and unreported sources) as well as climate-driven increases in water temperature and acidification all continue to degrade the health of coastal and other marine-related ecosystems (UN 2022b).

In 2017, 2.4 billion people lived in areas within 100 km of the coast (UN 2017), and recent assessments estimate that only around 16 per cent of global coastal regions are ecologically intact, while 48 per cent are heavily affected by human activities and 84 per cent of countries had more than 50 per cent of their coastal regions degraded (Williams et al. 2022).

The analysis summarized in Chapter 5 attempted to link the eutrophication component of marine-related ecosystem status to various potential drivers. The strongest positive linkage was found between the proportion of population living in an urban area and increased chlorophyll-a deviations. This finding is consistent with the literature documenting eutrophication of coastal areas that receive effluents from large cities or are linked to large riverine inputs of freshwater and nutrients draining large areas of agricultural and urban land uses.

Unfortunately, the aggregation of the chlorophyll-a data makes linkages difficult to detect, and so, although the analytical approach has merit and the linkages are generally consistent with the literature, no new conclusions can be made about coastal eutrophication and catchment-based human activities at the global scale. Disaggregation of data to a catchment scale, rather than a national one, would be necessary for exploring new relationships in this arena.

7.5 Importance of scale: Global versus national findings

A unique aspect of the analysis presented in this report is the inclusion of both global- and national-level linkages. This approach provides an opportunity to verify global linkages with national case studies, which also helps explore the impact of data aggregation on the ability to detect meaningful linkages between indicators. Each of the countries included in this report have more data on water resources, which can help explore the soundness of the linkages discovered through the global-level analysis.

Indicators related to conservation efforts were the most consistently positively linked to freshwater-related ecosystem indicators at both the global and national scales. This includes measures of terrestrial, mountain and freshwater KBAs. Further, indicators related to urbanization and drinking water infrastructure were also closely linked with freshwater-related ecosystem area at both scales. GNI per capita was also negatively linked with freshwater-related ecosystem outcomes at both the global and national levels. These findings emphasize the importance of policies related to conservation, water infrastructure and the mitigation of impacts associated with economic activity in protecting freshwater-related ecosystems.

Interestingly, linkages between water-use efficiency indicators and freshwater-related ecosystems were found at the national level but were not identified in the global-level analysis. The predominance in Colombia and Mongolia of the relationship between water-use efficiency and water resource indicators might suggest that, in these countries, water management strategies are not sufficient to decouple economic activities from resource use, even though this relationship has not been found at the global level.

Regarding the impact of freshwater-related ecosystems on the state of human well-being, the statistical analysis has identified different direct drivers and socioeconomic and environmental factors for global compared with national settings. Only at the national level were lakes and rivers seasonal areas directly linked with proportion of population accessing basic drinking water services and GNI per capita.

Unfortunately, no national-level analyses were possible for the marine-related ecosystem indicators, so a comparison cannot be made between the global and national levels.

The various positive and negative relationships identified between the state of the ecosystem, direct drivers of change, state of human well-being and socioeconomic and environmental factors highlighted the importance of considering the impact of indirectly related factors. While some impacting factors are common for global and national settings, identifying other national factors considered to have synergies or trade-offs with freshwater-related ecosystems is imperative to be able to formulate targeted policies and interventions to protect freshwater-related ecosystems.

While some linkages were detected at both the global and national scales, others were only identified at the more granular national scale. While global-level trends are critical to assessing overall progress in achieving the SDGs, the importance of also evaluating indicators at the national scale, as demonstrated in this report, will provide a more comprehensive and actionable interpretation of key linkages.

Data and indicators are key for informed decision-making and policy design to know how realistic options are, what inconsistencies might result from decisions, how the cost of such inconsistencies can be mitigated and how trade-offs can be explained. The SDG indicator framework represents a critical advancement towards international goals in increasing the consistency, scientific defensibility and policy relevance of environmental data to inform global trends and policies at all scales. National, subnational and international perspectives should be integrated to ensure policy coherence. Considering that most environmental policies, including water policy, are developed at the national or subnational scale, it is crucial that the successes of the SDG indicator framework be translated into disaggregated data that can inform subnational policies while maintaining compatibility at the global scale.

7.6 Policy recommendations

This report represents the first attempt to use statistical tools to link a broad suite of SDG indicators representing socioeconomic, environmental and human well-being indicators with freshwater- and marine-related ecosystems status. Generally, the strongest linkages are supported by other literature and provide more robust support for policies that integrate land and water conservation, ensure suitable water infrastructure in urban areas, provide mitigation of pollution and address impacts from water withdrawals associated with economic activity. These policies broadly cross the targets identified in SDG 6, SDG 14 and SDG 15 (UNESCO and UN-Water 2020; UNEP 2019d).

Integrated water resources management is an optimal policy response to water resources and ecosystems. This requires the incorporation of scientific analysis of the most relevant external drivers of ecosystem and resource issues and a comprehensive planning approach used in integrated water resources management, in addition to the traditional approach which focuses on stakeholder input. This is critical to achieving policy coherence and recommendations that are both policy relevant but also scientifically defensible. This concept is well represented in SDG target 17.14, which highlights the importance of mechanisms to enhance policy coherence in sustainable development.

Sustainable development and the 2030 Agenda can only be achieved through an all-sectoral approach. Its interlinked nature calls for policy coherence for sustainable development through an integrated approach to ensure the production of complementary policies and avoidance of trade-offs.

7.7 Data and indicator recommendations

Measuring the progress of the 92 environment-related SDG indicators generally evaluated trends but did not assess their magnitude or progress towards meeting targets identified for specific indicators. Although this report provides statistical support for a suite of policy recommendations that have been outlined elsewhere (UNESCO and UN-Water 2020; UNEP 2019d), the analytical approach outlined herein also exposes some of the critical data gaps on water-related ecosystems and has challenged the suitability of some indicators to detect meaningful change in the health of freshwater- and marine-related ecosystems.

The freshwater-related ecosystem assessment was limited to linkages between various metrics of the area of freshwater within each country. While these data sets benefit from the ability to provide consistent measurement using remote sensing across the globe, they are limited in their ability to measure the water quality, volume or ecosystem health of waterbodies. There may be opportunities to further utilize citizen science, satellite imagery or low-cost in situ monitoring to produce measures of water quality and/or volume for reservoirs, lakes and even aquifers. The standardization of water data across agencies that currently collect and publish this information is a major hurdle that will need to be addressed to make good use of existing robust data sets. Currently, citizen science contributes to the monitoring of five SDG indicators (i.e., SDG 14.1.1b on marine litter or SDG 6.3.2 on water quality) with a potential to directly or, through supplementary information, contribute to 76 indicators (Fraisl et al. 2020).

There is also a clear need to continue to scale up consistent water quality monitoring that can be used to inform national- and global-level assessments. Reliable water quality monitoring data are required to assess the status and trends of water quality for human and ecosystem health as well as to inform policymakers in taking appropriate decisions conducive to water resource protection and restoration, both in terms of waterbodies and water-related ecosystems. However, during the 2017 data drive, only 52 Member States reported on their ambient water quality, and some of the submissions contained very few data points (UN-Water 2018a).

Data availability limited the analysis of marine-related ecosystems. Data on plastic debris density (SDG 14.1.1b) was unavailable and time-series data were not yet available for another state of the marine-related ecosystem indicator. Although data availability for SDG 14 has improved, the current availability of data does not provide an understanding robust enough to statistically support policy formulation. Although chlorophyll-a data were available to evaluate coastal eutrophication, the aggregation of chlorophyll-a data to the country level means that the aggregate value may or may not reflect changes for a particular river system (or group of river systems) depending on the size and geography of individual countries. Interpreting the indicator becomes more difficult as the length of the coastline increases, making it a serious challenge for large countries. Disaggregation of chlorophyll-a data at the subnational level (major river basins) is needed to provide a better understanding about the drivers of coastal eutrophication globally. Future revisions of the indicator methodology for coastal eutrophication are recommended to evaluate alternative spatial boundaries for aggregation that represent catchment-scale linkages and/or natural boundaries associated with ecosystem type and function rather than national boundaries.

The statistical model used in this report confirmed many known linkages between freshwater- and marine-related ecosystems and variable drivers. It also identified several new linkages that cannot be easily explained with the existing literature. While authors attempt to postulate potential mechanisms for these linkages, further investigations are needed to identify whether there are covariates or drivers that may help to develop new innovative policies to protect freshwater- and marine-related ecosystems.

As the SDG indicator framework continues to undergo review and revision especially in preparation of the post-2030 Agenda, this report demonstrates the importance of incorporating more ecologically relevant spatial groupings. Catchment-based or ecosystem-based aggregations may provide more insight into the ecological dimension of many of the linkages identified in this report. However, methods and tools used are expected to be concomitantly developed to facilitate actionable use of data by policymakers working within political or geographical boundaries. Further, although remote sensing has provided comprehensive data for the analysis of global trends, there are some clear drawbacks of relying solely on a remote sensing approach. Other methodologies and data are necessary to understand underlying trends in freshwater-related ecosystem health and water quality that cannot be measured with remote sensing.

Finally, the challenges associated to the analysis of economic-socio-environmental interlinkages for freshwater- and marine-related ecosystems exist across the environmental dimension of the SDGs, particularly as related to the lack of sufficient data and the need for additional disaggregated data. An effort to deploy novel sources of data and to assess their reliability and consequent value to policy formulation is critical to the goal of developing science-based action to achieve sustainable development.