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Research Report

Post 2015: getting down to the nitty-gritty: measuring the state of the environment

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Post 2015: Getting Down to the Nitty-Gritty: Measuring the State of the Environment

Summary

Hitherto human development has happened at the expense of biodiversity loss, degradation of ecosystems and climate change. Therefore, development-related environmental challenges such as the degradation of ecosystems are expected to become much more important in the post-2015 development agenda. Integrating changes in environmental quality into the – yet to be defined – master plan of development implies that goals are defined and progress towards these goals is measured. Such measurement requires available and reliable data on adequate environmental indicators.

Environmental indicators are the crucial source of information as regards the state of the environment in quantitative terms. But measuring the state of the environment and the changes occurring within it is challenging for conceptual and practical reasons: first, environmental quality is a complex, multidimensional phenomenon. High or low environmental quality is the result of a combination of factors related to several environmental spheres – air, water and land – as well as cross-cutting issues such as biodiversity. In order to measure the multidimensional environmental quality, one ideally needs data on air quality, water quantity and quality, soil quality and biodiversity. Second, the conceptual challenges of measuring environmental quality are related to the decisions about what to measure and how to measure it; selecting appropriate environmental indicators is difficult and vividly debated. Third, another challenge is the selection of indicators that are adequate for both the situation in developed as well as developing

countries. Fourth, limited financial and human capital represents additional constraints for reliable and available data for developing countries. Hence, the availability and quality of data remain poor in a large number of countries.

Allowing for human development without compromising natural resources is the future key challenge. The integration of development-related environmental objectives into the post-2015 development agenda requires an indicator set in order to measure progress towards these objectives. After establishing the baseline, periodic measurements of the indicator set would be needed for monitoring damages over time. The problem is that environmental data is scarce, scattered and of poor quality for many key environmental indicators, particularly in developing countries. Therefore, the quality and availability of environmental data needs to be improved for all countries. While geographic coverage and coverage across years needs to be improved for existing indicators, more efforts are needed to gather data for additional key indicators. It is also recommendable to measure environmental indicators at lower levels rather than just at the national level.

For the post-2015 development agenda, a core set of indicators should be defined that (1) adequately captures the location's environmental circumstances, (2) is measured concordantly with international standards and (3) is conducted on a regular basis in order to assess changes over time. This also requires investments in know-how and infrastructure for data gathering and data processing.

Environmental indicators need to be included in the post-2015 development agenda

Human development has mainly happened at the expense of the depletion of natural resources, with noticeable environmental impact. Climate change, biodiversity loss and the degradation of ecosystems threaten current and future possibilities for human development. Particularly in developing countries, many citizens are very vulnerable and sensitive to environmental degradation because they earn their living from agriculture, for instance, or live in densely populated urban slums.

These development-related environmental challenges will most likely play a much more prominent role in the new – yet to be defined – post-2015 development agenda than in the Millennium Development Goals (MDGs). The MDGs list “ensure environmental sustainability” as a goal but are missing specific targets and indicators to measure that. They are instead more strongly associated with goals directed at social development. Three simple but important arguments underpin the necessity to integrate the ecological dimension into the future development agenda: the integrity of the environment is a prerequisite for socio-economic development, human well-being depends on good environmental quality and an intact environment has intrinsic values (UNEP 2013).

The report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda (UN 2013) recommends that each goal and target should be specific, measurable, attainable, relevant and time-bound (SMART). The request for measurability includes that credible and internationally comparable indicators, metrics and data are used that are subject to monitoring. Including the changes occurring within the environment in the new development agenda requires defining goals and targets and measuring the progress towards them by tracking changes over time.

Measuring the state of the environment is challenging

Measuring the state of the environment and the changes occurring within it is not a trivial task at all. The state of the environment is difficult to compare across countries because of the highly diverse native conditions. Countries differ in terms of environmental conditions, their endowment with natural resources as well as their size. How can one compare the tropical rainforest in Brazil with the desert in Namibia? The difficulty is that environmental indicators can be very context-specific. For instance, a low level of biodiversity in a tropical rainforest has much more severe implications than the same low level of biodiversity in a dry savannah. Two fundamental decisions for measuring the state of the environment are: What should be measured and how should it be measured (including which variables and individual indicators should be employed)?

Focusing on human-environment interactions, appropriate environmental indicators link the state of the environment to human well-being, such as water quality that describes the condition of a body of water in relation to

human needs. In fact, there is a lively debate about which indicators characterise good environmental conditions. Among other things, selecting appropriate indicators for water and soil quality is extremely difficult – not least due to the number of variables to be considered (e.g. see the long list for classifying the ecological status of water in Annex V of the European Water Framework Directive). To complicate matters, the same environmental aspect may be measured in various ways. For instance, biodiversity can be measured in terms of stock of selected, particularly important species, or by the number of listed endangered species. Also, the relevant boundaries of an environmental process do not necessarily coincide with the administrative boundaries of countries. Hence, the adequate spatial unit of analysis differs depending on the issue at hand, and it is thus not always useful to aggregate data at the national level – which, however, is likely to be the reference level for reporting progress in the post-2015 development agenda.

Measuring the state of the environment is even more challenging in developing countries. Limited financial means, know-how and infrastructure to gather and process data lead to a limited reliability and availability of data in many developing countries. But internationally comparable data is a necessary condition to track the status of the environment and the changes occurring within it from a comparative perspective at the national, regional and global levels. Despite improvements in data quality, insufficient information on environmental data and monitoring remain a problem. The availability and quality of data remain poor in a large number of countries. If they exist at all, data are often scattered across many public and private sources and are difficult to gather and compare globally. Data availability is geographically unbalanced in almost all thematic areas. Data is less available in developing countries, with data fragmentation being even greater at sub-national levels.

An additional challenge for selecting environmental indicators is that they must adequately reflect the situation in both developed and developing countries – given that the post-2015 goals are supposed to be universal. As the level of development varies so strongly, indicators differ in importance, and different indicators may be suitable in each case. For instance, soil degradation is a challenge in rural areas with subsistence agriculture, whereas chemicals and waste pose a problem in densely populated urban areas – particularly for poor people. Other issues are universally applicable. For instance, freshwater and marine ecosystems as ultimate places to sink pollutants are very sensitive indicators for the environmental impact of human activities.

Available information on the state of the environment is limited

Measuring the state of the environment is crucial, given the interdependent relationship between development and the environment. Changes within the environment are perceptible in different ways, and one ideally needs information on air quality, water quantity and quality, soil quality and biodiversity, both at the local and global levels.

Environmental indicators, environmental indicator sets and environmental composite indicators are the available sources of information on the state of the environment at the global level – with environmental indicators serving as the basis for the other two.

Environmental indicators, such as sulphur dioxide emissions, biochemical oxygen demand or the extent of forest, quantify a single dimension of the state of the environment in numerical scores. The coverage across countries and across years of environmental data varies from excellent to fragmentary, depending on the indicator. Table 1 lists a selection of environmental indicators that are theoretically relevant and for which data is available, although with restrictions. Indicators with excellent coverage are “carbon dioxide emissions” with time-series data from 1990 to 2007 for 215 countries, or “particulate matter” with time-series data from 1990 to 2010 for 210 countries. Other indicators with similar comprehensive coverage are “extent of forest” and “marine and terrestrial protected areas”. A comprehensively available indicator such as “nitrogen fertilisers” comprises the years 2002 till 2010, but only for 71 countries world-wide. Yet, the available data for indicators such as “annual water withdrawals” is more sporadic with data for several years, but not necessarily subsequent years or the same years across countries. Indicators such as “marine dissolved oxygen” or “fish stocks overexploited” are not publicly accessible and therefore not readily available as a dataset.

	Indicators at local level	Indicators at global level
Air quality	Nitrogen oxide emissions (NO _x), ¹ Sulphur dioxide emissions (SO ₂), ¹ Particulate matter ²	Carbon dioxide (CO ₂), methane (CH ₄), nitrous oxide emissions (N ₂ O) ¹
Water quantity and quality	Annual water withdrawals as % of renewable water resources, ³ Biochemical oxygen demand, nitrate, electrical conductance ⁴	Marine dissolved oxygen ⁵
Soil quality	Nitrogen fertilisers ³	----
Biodiversity	Extent of forest, ³ Marine and terrestrial protected areas ¹	Marine trophic index, ⁶ Fish stocks overexploited ⁶
Sources: 1) United Nations Statistics Division; 2) World Bank; 3) Food and Agriculture Organization; 4) Global Environment Monitoring System (GEMS) Water Programme; 5) GEOMAR; 6) Sea around us Project		

Environmental indicator sets list many individual environmental indicators such as UNSD environmental indicators. It is a compilation of 10 indicator themes with relatively good quality and geographic coverage from a wide range of data sources. This implies that the country- and time-coverage is not uniform but depends on the indicator.

Environmental composite indicators (or indices) are able to measure the state of the environment in its multiple dimensions. They aggregate several weighted environmental indicators into a composite indicator, with the weights expressing the theoretical importance of each indicator. They can convey highly condensed information and facilitate the representation of the multidimensional concept of environmental quality, but they pose theoretical and conceptual challenges. As they measure environmental conditions at a particular point in time at the national level, the score reflects the country average. If initial conditions are controlled for in composing the index, cross-country comparison is possible. If environmental conditions are measured repeatedly, relative changes over time within a country and between countries can be assessed.

Among the limited initiatives to construct an environmental composite indicator, the Environmental Performance Index (EPI) is the best composite environmental indicator currently available that satisfies the following criteria: it (1) measures a relevant aspect at the country level, (2) quantifies the aspect in numerical scores at the national level, (3) is accessible on the internet in English, (4) uses a transparent methodology and (5) covers several developed and developing countries. The EPI measures country performance against absolute targets in environmental health (the protection of human health from environmental harm) and ecosystem vitality (ecosystem protection and resource management) (Hsu et al. 2014). The dimension of ecosystem vitality is the source of information for the environmental status, including water resources, agriculture, forests, fisheries, biodiversity and habitat, as well as climate and energy. The latest iteration, the EPI 2014, ranks 178 countries in total, of which 128 countries are developing countries, as defined by income. It benchmarks each country's performance with respect to environmental targets, established from treaties or other internationally agreed-upon goals, standards set by international organisations, leading national regulatory requirements, expert judgement and ranges of values observed in the data. A proximity-to-target score is calculated for each country and each indicator, which quantifies the gap between a country's current result and the target. The EPI explicitly accounts for varying natural resource endowments, physical characteristics and geography between countries such as landlocked or desert countries. Strict criteria for data selection (relevance, performance orientation, established scientific methodology, data quality, time series availability, completeness) are used to assess whether a dataset is adequate to measure performance on pressing environmental concerns. These high data standards improve the quality of the composite indicator and are recommendable from a statistical perspective.

What will be needed for the post-2015 development agenda?

Integrating development-related environmental objectives into the post-2015 development agenda – with the aim to monitor progress towards these objectives – requires their operationalisation into an indicator set. An indicator set would compile data on environmental indicators deemed as relevant for environmental quality. For a comprehensive picture, data on air quality, water quantity and quality, soil quality and biodiversity would be needed. The indicator set would need to be measured periodically for monitoring changes over time; the initial measurement would establish the baseline, if progress is to be assessed against the year 2015 for instance.

For the purpose of the post-2015 development agenda, it is not necessary and not recommendable to aggregate this data into an overall environmental composite indicator (or to use parts of – or the entire – EPI). Such a composite indicator would reflect a country's performance with respect to all objectives. This exercise would require weights to be defined for each indicator, expressing the theoretical importance of an individual indicator. Yet, even if all indicators were weighted equally – in order to reflect their equal importance – their statistical importance would not be equal.

Environmental indicators, in general, allow countries to assess their status and, if measured regularly, to examine changes over time with regard to one sphere of environmental quality. Environmental data, however, is scarce, scattered and of poor quality for many key environmental indicators – even more so in developing countries. Yet, if

the post-2015 development agenda is to include SMART goals and targets with respect to the environment, the following necessary improvements will need to be implemented:

- The quality and availability of environmental data at the national level needs to be improved for all countries. Such data is needed to measure the baseline and the progress towards the goal.
- Geographic coverage and coverage across years needs to be improved for existing indicators.
- In addition, more efforts are needed to gather data for key environmental issues such as freshwater quality, wetlands loss, agricultural soil quality and degradation, desertification, or chemicals and waste.
- Wherever and whenever feasible, it is recommendable to measure environmental indicators at finer units than at the national level in order to yield a more fine-grained picture, as developments in urban areas, for instance, can be very different from those in rural areas.

In order to produce internationally comparable and reliable environmental data in light of the post-2015 development agenda, a core set of environmental indicators should be defined that (1) adequately captures the environmental circumstances *in situ*, (2) is measured concordantly with international standards and (3) is measured on a regular basis in order to assess changes over time.

This requires investments in know-how and infrastructure for data gathering and data processing, which highlights the fact that the new development agenda also needs sound financing as a backbone.

Literature

- Hsu, A. et al. (2014): The 2014 Environmental Performance Index, New Haven, CT: Yale Center for Environmental Law and Policy
- UN (United Nations) (2013): A new global partnership : eradicate poverty and transform economies through sustainable development, the report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda, New York: UN
- UNEP (United Nations Environment Programme) (2013): Embedding the environment in Sustainable Development Goals, Nairobi: UNEP (Discussion Paper 1)

For a detailed discussion on environmental composite indicators, please refer to:

- Stepping, K. M. K. (2013): Challenges for measuring the state of the environment in developing countries, Bonn: DIE (Discussion Paper 25)

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