UN system priorities related to science for sustainable development (SD)

Background paper on items 4 and 5 of the SAB Terms of Reference

Introduction

Sustainable development solutions call for proper scientific identification and assessment in terms of their likely outcomes, in particular because of the complexity of integrated and hybrid systems - including in particular social systems. Sustainable development is both a comprehensive social and a governance challenge. In other words, it entails not just understanding systems, but shaping them. The integrated, transdisciplinary, transformative knowledge required in this regard concerns both science and policy and cannot be assumed to emerge spontaneously. Its elaboration and promotion are themselves a UN system priority.

There are two perspectives for setting priorities related to science for sustainable development (SD):

— Framework conditions: Are science, technology and innovation (STI) systems, globally and/or nationally, adequately prepared to tackle issues of SD effectively? If not, what could the UN system do as a priority to support or encourage change?
— Topics: Which SD topics should science increasingly focus on? What can the UN system do as a priority to support or encourage change?

This background paper will also present some initial analysis pertaining to assessments and digests, planetary boundaries, tipping points and environmental thresholds (item 5 of the SAB Terms of Reference).

National and global contexts of STI generation and sharing

In July 2013, the UN Secretary-General called for “research and innovation (to) become increasingly open, collaborative and international”. International cooperation shapes today the daily work of most scientists in developed countries and a rapidly increasing number of scientists in countries in transition. Repeated assignments abroad and membership in global networks or international advisory bodies are today the norm for many scientists. More and more, these networks and bodies seek to actively engage scientists of developing countries as well; as a result, some kind of ‘global STI’ system is emerging.
However, while a certain degree of ‘internationalization’ can be observed at the regional scale in Europe\(^5\) and in cooperation between Europe, North America, Japan and some other countries, STI decision-making, including priority-setting and funding, is still mainly national in character.

Science agendas are to a considerable extent shaped by funding agencies\(^6\). Globally, R&D funding seems to grow as fast or faster than the economy\(^7\) and while funds targeted at international cooperation efforts seem to be growing substantially, national funding is still dominant. For example, the annual amounts available under the ambitious EU research funding programme *Horizon 2020*\(^8\) are very significant, but amount only to about half of the annual public funds made available for R&D by Germany\(^9\) alone. One of the largest international research laboratories, CERN\(^10\), has an annual budget of about \(\frac{1}{4}\) of the French National Centre for Scientific Research (CNRS)\(^11\). All publicly-funded global research programmes, whether implemented by UNESCO, WMO, ICSU or other entities, typically have budgets at the level of 1 to 10 million Euros. There are currently experiments with joint bilateral funding programmes as well as multilateral funding in the context of IGFA, the International Group of Funding Agencies for Global Change Research, and its Belmont Forum, founded after the Belmont Conference 2009. These new entities provide annual funds of some 10 million Euros.

“Access to the benefits of STI and knowledge is unequally distributed within and among countries and people, and the technological gap between developing and developed countries is persistent”\(^12\). In spite of the growing role for developing countries with technology-intensive policies and industries, most scientists in these countries have almost no possibility to participate in decisions about science agendas, neither at home nor in global cooperation. It has even been observed for the case of health research that “international (...) programmes and donors can distort country research agendas and undermine national research systems”\(^13\).

In the case of many countries, it seems even misleading to use the term ‘STI system’\(^14\). “Some developing countries have not yet established a national STI development plan, while others are working with plans that are out of date”\(^15\). For example, in most African countries, “there is an urgent need to begin weaving all STI programmes and activities into a single national system”\(^16\). In these countries, there are individual scientific institutions and scientists, but there is hardly a ‘system’ or strategic approach to STI yet.

**What framework conditions are needed for STI?**

It is widely acknowledged that in order to flourish economically and socially and to be able to adapt to global change, each country needs its own scientific capacities, both in terms of supplying and of demanding scientific outcomes. To this end, ‘The Future We Want’ highlighted the need for “strengthened national scientific and technological capacities for sustainable development”\(^17\).

Thus, efficient STI systems need to be created, promoted and supported. This has been and continues to be an important task of multilateral agencies such as UNESCO, the World Bank, the UN regional commissions and regional development banks, as well as of bilateral development cooperation\(^18\). Such efforts are geared to build capacities of government officials, public servants and parliamentarians in formulating and implementing STI strategies; this might include setting up a competitive science funding scheme, strengthening institutions and legal frameworks for science, technology and innovation, equipping laboratories, making academic careers more attractive, defining priorities for research, etc. While some initiatives in recent years, e.g. by the G8 or the EU, have led to additional funding for STI policy advice, the scale of support, both by the UN system and through bilateral cooperation, is below the needs of countries.
UN Member States have recently initiated discussions about the role of STI in the post-2015 development agenda. The UN Secretary-General's report to the ECOSOC Annual Ministerial Review in July 2013 mentioned that it is critical to establish "partnerships for strengthening the scientific and engineering capabilities of developing countries. These partnerships will need to be complemented by global and regional cooperation to foster research, product development, technology access, transfer and adaptation, which will be crucial for enabling transformative development." National STI policies and systems will need to be designed within the context of national action plans for sustainable development. Multilateral agencies and bilateral cooperation have the experience and the tools available to initiate without much delay the strengthening of STI systems.

What framework conditions are needed for Science for Sustainable Development?

The debate about the concept of Science for Sustainable Development (SD) equally focuses on the term Sustainability Science, first evoked in the seminal paper Sustainability Science by Kates et. al. in 2001, and the Amsterdam Declaration on Global Change of the same year. For its proponents, SD is not a research topic like any other. To address SD changes effectively, it is not sufficient to provide more funding for research on individual SD topics. Instead such research requires specific enabling framework conditions at scientific institutions and in science policy.

While SD also requires disciplinary research, most questions of Science for SD necessarily require interdisciplinary research, orthogonal to the classical structure of research institutes and university departments, and oriented towards integrated understanding, in particular of human-environment systems and Global Commons. "Like 'agricultural science' and 'health science', sustainability science is a field defined by the problems it addresses rather than by the disciplines it employs." The interdisciplinarity is 'strong' in the sense that it needs integrating disciplines of the natural sciences and the social sciences, which have very different cultures, traditions, structures and methods. It is not enough to work in an interdisciplinary manner among adjacent disciplines, such as physics and chemistry. Many SD research questions also require integrating the humanities and the engineering sciences, again with their very different methods and traditions.

Science for SD also calls for transdisciplinarity. A frequently used definition, different from 'strong interdisciplinarity' demands the inclusion of non-expert knowledge, both in terms of science's epistemic as its institutional organization. In this context, scientists need to reach out to societal stakeholders and communities, including public administration, NGOs and concerned citizens with a view to integrating their knowledge and interests into research design and research implementation (termed co-design and co-implementation). For example, the UNESCO 'World Social Science Report' of 2013 stresses that "scientists [should] work with non-academic knowledge holders to co-design, co-produce and co-implement new knowledge, new priorities and mutual learning processes." Similarly, the 'State of the Planet Declaration' of 2012 underlined that sustainability-oriented research "must integrate across existing research programmes and disciplines, across all domains of research as well as local knowledge systems, across the North and South, and must be co-designed and implemented with input from governments, civil society, research funders, and the private sector." This is related to what Gibbons et al. in 1994 have called mode-2-research. Such transdisciplinarity often is claimed to go hand-in-hand with what is called 'democratization of science'.

Science for SD seems to further entail the need for changes of science systems, a main reason being that most individual research projects will be more complex due to the need of integrating multiple sources of knowledge. There need to be individual incentives to engage in science for SD. This has consequences for funding agencies, their portfolio of 'curiosity-driven' and 'mission-oriented' research and the instruments they use, as well as their
selection and evaluation procedures to account for inter- and transdisciplinary science. There may also be implications for scientific career paths.\textsuperscript{29}.

Other terms sometimes used in the context of Science for SD are \textit{transformation} and \textit{transition}. "In particular, the field seeks to facilitate what the National Research Council [of the US] has called a societal ‘transition toward sustainability’\textsuperscript{30}. The WBGU, a German national scientific advisory body, in 2011 called “for the establishment of a new field of studies, ‘transformation research’, which examines transformation processes and the social preconditions within the scope of planetary boundaries”\textsuperscript{31}. Similarly, the 2013 World Social Science Report was framed by six ‘transformative cornerstones’. A “Sustainability Transitions Research Network” holds annual conferences. What seems to be specific about \textit{Science for SD} is that it is oriented towards societal goals and also towards values\textsuperscript{32}, based on the social and ethical responsibility of science\textsuperscript{33}.

ICSU, ISSC, UNESCO and UNU have in recent years all championed a stronger concept of \textit{Science for SD} and \textit{Sustainability Science}. For example, the ‘Science and Technology Alliance for Global Sustainability’ (‘the Alliance’)\textsuperscript{34} formed by ICSU, ISSC, the Belmont Forum and IGFA, UNEP, UNESCO and UNU, with WMO as observer, has established a new global research programme ‘Future Earth’ with a strong focus on transdisciplinary research.

Beyond inter- and transdisciplinary approaches, more framework conditions are needed for \textit{Science for SD}. There is a need to ensure ethically acceptable, sustainable and socially desirable innovation processes through interactive, transparent and mutually responsive mechanisms between societal actors and innovators. There is also a need to make major changes in the way scientific practices are conducted, including the environment in which scientists operate. Scientists rarely regard their own work in terms of social responsibility. Other framework conditions include instruments, incentives and support for international cooperation, inter-institutional networking, lowering barriers for access to scientific knowledge and publications, as well as being able to set research agendas locally, which also includes issues of local languages. This includes mechanisms that can facilitate the flow of information and ideas amongst the scientific community, policymakers and society at large\textsuperscript{35}.

Strengthening \textit{Science for SD} in this sense will be a major task for the entire science system, at national, regional and global levels. The UN system has a major role to play in this respect; including by providing guidance and supporting governments on integrating science for SD more closely into national STI policies.

\textbf{Which topics of SD need to be addressed better by science?}

A crowd-sourcing platform set up by the UN in 2013 to prepare the ‘Global Sustainable Development Report’\textsuperscript{36} registered 1,115 contributions from scientists around the world who voted on each other’s ideas and contributed a total of 96 issues they would like decision-makers to consider for action as they are currently not well represented on the UN agenda. The top nine issues on the list are: regional natural resource conflicts; the climate–land-energy–water-development nexus; political instability; inequalities; child labor; non-existent or decreasing environmental justice in all countries; youth unemployment; persistence of poverty in poor and also in rich countries; anthropogenic reductions in net primary productivity of biological resources\textsuperscript{37}. Thus a topic that should be addressed by science is the adoption of a framework for defining societal desirability, especially in the context of sustainable development, which is essential for informing and guiding research and innovation towards outcomes that can improve human lives by tackling societal challenges. Indeed, many of these societal challenges are global by nature, and as a consequence, such a framework would have international implications.
The 1992 Rio World Summit had successfully established SD as a broad agenda, encompassing a long list of topics in the form of separate chapters of Agenda 21. Agenda 21 had also devoted an entire chapter to science for sustainable development. Since 1992, the amount and quality of scientific research on these individual SD topics has increased, very often with specific political support, and science has become increasingly integrated into policy efforts to promote and corroborate SD. However, most of this integration has happened ‘topic by topic’: This is to say that the political community and the scientific community working on specific topics such as climate change or biodiversity have improved their mutual integration around specific policy instruments, still resulting in some ‘sectoralization’.

The above-mentioned outcomes of the recent UN crowd-sourcing effort do not correspond to individual topics related to Agenda 21. Indeed it seems that the most important SD tasks ahead, both in terms of need for political action and for additional research, cut across sectors and established political processes. The same is true for concepts such as ‘global challenges’ or ‘grand challenges’, which cut across sectors, disciplines and established processes. As the rise of the concept of Sustainability Science shows, a more integrated picture of SD needs to emerge, which calls also for more and better integrated research. The ‘nexus’ concept, most frequently used to integrate research and action on water, energy, land and food security, is an operationalization of this need for better integration.

The UN system still needs to find proper means of accommodating ‘less vertical’ and more integrated approaches to sustainable development, including their scientific dimensions, ‘vertical’ meaning also through the lenses of distinct mandates and past experiences of individual agencies. The new UN High-level Political Forum on Sustainable Development, the post-2015 development agenda and other processes have the potential of being more integrated, but such integration also necessitates outside support.

Another area of particular relevance is the need to engage the private sector in leveraging science for sustainable development. If there is no effort to try to coordinate the direction of research in the public and private sectors, we might end up with very divergent outcomes in such research – one that is aimed at addressing sustainable development, while another that might sacrifice sustainable development for profit. However, policy should not infringe upon the freedom of scientific research, and thus the question is how this could be achieved in an acceptable and productive manner.

Assessments and digests, particularly on planetary boundaries, tipping points and environmental thresholds?

This topic is well covered in the prototype of the ‘Global Sustainable Development Report’, which is a UN inter-agency effort led by UN DESA and about to be published. The Executive Summary indicates that:

- since the 2000s, assessments have started to widen their scope and to consider ‘co-benefits’, or synergies, and multiple goals. Notable examples are the Millennium Ecosystem Assessment (2005), the International Assessments on Agricultural Science and Technology for Development (2008), and the Global Energy Assessment (2012), etc. In 2012 alone, more than 40,000 authors from 2,200 cities around the world published some 150,000 articles on sustainable development. Most of them focused on specific systems and sectors. The database for the Assessment of Assessments on Oceans contains 1,023 assessments and the one for the Intergovernmental Platform on Biodiversity and Ecosystem Services 182 assessments. For other areas there appear to be no comprehensive, regularly updated databases of assessments.
The landscape of sustainable development assessments is very diverse and it is difficult to make general observations. A handful of prominent international assessments have served as models for new initiatives. The number of assessments and the resources devoted [to different sectors and themes] seems to be proportional to the associated economic stakes. This has made climate change assessments the most proliferating area over the past 20 years.

The IPCC model of intergovernmental scientific assessments has been very influential in shaping more recent assessments that aimed to strengthen the science–policy interface. In fact, IPCC–style assessments have been instituted also at the national level, e.g., in Austria and Hungary. At the same time, the IPCC model of assessment has received criticism from scientists and others.

Transparency, plurality of perspectives and effective participation of scientists from developing countries have been identified as must–haves to ensure global credibility. To make this happen, major efforts are required to support science–capacity in developing countries and to strengthen the institutional mechanisms to support evidence–based policy making everywhere. It was pointed out that 97 per cent of the references in IPCC reports are from Western journals.

UN publications can tap a wider range of knowledge beyond the peer–reviewed, academic literature. They are directly linked to a UN process which facilitates consideration by decision-makers. Diversity of views can provide a wider range of options to decision-makers. Hence overlaps among UN assessment publications do have their benefits, while a loose coordination among assessments and outlooks could benefit decision–makers.

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<th>Link to political process</th>
<th>Participants nominated/ selected by</th>
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The same Report also touches upon tipping points\textsuperscript{44} and planetary boundaries\textsuperscript{45}. In this regard, the report holds that the baseline trajectory is one of excessive materials consumption by 6 billion people in both ‘North’ and ‘South’ which will be at the expense of 3 billion people living in poverty (i.e., less than $2.15 a day), suffering much of the negative consequences of the others’ overconsumption. By its sheer scale, it will have transgressed the majority of ‘planetary boundaries’, heightening the risk of an eventual global ecosystem collapse. Even without a ‘global collapse’, the resulting world in 2050 appears deeply inhabitable insofar as it would deprive billions of people of better lives that are in principle within their reach. The report proposes to design an institutional framework that allows for transparent, independent and participatory monitoring of major sustainability areas and providing adequate feedback to decision-making on areas of global importance.

It is suggested that the SAB in its discussions about assessments etc. focuses on political and conceptual dimensions in order to give guidance to the UN system. Relevant questions could be: Which type of assessments is suitable for which context? Which type of assessments has which political and/or societal and/or scientific impact? Do we need more or rather better integrated assessments? Which SD topics are not appropriately covered due to a (maybe) too ‘vertical’ or sectoral approach?

\begin{table}
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\hline
Model & Type & Description & Collaboration Type & Process Type & Decision-Making Type & Academic, Peer-Reviewed \ 
\hline
Scientific Research Collaborations (_SRC) & Global Energy Assessment & Collaborative scientific collation of scientific knowledge & Informal & Peers & Scientists, Peers & Ad hoc & Descriptive and normative & Academic, peer-reviewed \ 
\hline
Global Environmental Assessment (GEA) & Global Environmental Assessment & Collaborative scientific collation of scientific knowledge & Informal & Peers & Scientists, Peers & Ad hoc & Descriptive and normative & Academic, peer-reviewed \ 
\hline
Millennium Ecosystem Assessment (MEA) & Millennium Ecosystem Assessment & Identification of scientific basis and knowledge gaps for action & Non-governmental & Selected by science panel, endorsed by board & Scientists, Peers & Ad hoc & Descriptive and normative & Academic, peer-reviewed \ 
\hline
Census of Marine Life (CML) & Census of Marine Life; Future Earth & Collaborative scientific research programme & Non-governmental & Peers & Scientists, Peers & Ad hoc & Descriptive & Academic, own \ 
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\end{tabular}
\end{table}

\textsuperscript{1} This paper was drafted by UNESCO and the German National Commission for UNESCO to serve as a background material for the Inaugural Meeting of the Scientific Advisory Board of the UN Secretary-General.

\textsuperscript{2} This Background paper denotes ‘science’ as the creation of new knowledge’ (see UN SG AMR Report, 2013); the terms ‘science’ and ‘research’ are used as simplified shorthand for ‘scientific research’.

\textsuperscript{3} STI ‘systems’ imply STI coordinated policy, strategy and decision-making processes and mechanisms; legal frameworks; implementation mechanisms and institutions; and the means to corroborate them, such as funding mechanisms.


\textsuperscript{5} Particular noteworthy examples are the two “FET flagships” designated in 2013 on graphene and brain research.


\textsuperscript{7} Meulen van der, B. “Science policies as principal-agent games”, Research Policy 27 (1998) 4, 397;

\textsuperscript{8} www.sciencedirect.com/science/article/pii/B9780080448947008782

\textsuperscript{9} Wall Street Journal, Dec 8, 2013, online.wsj.com/news/articles/SB10001424052702303997604579242211359271526; battelle.org/docs/d-funding-forecast/2013_r_d_funding_forecast.pdf?sfvrsn=0

\textsuperscript{10} www.cnrs.fr/fr/organisme/presentation.htm


\textsuperscript{12} www.cern.ch/about/policies-and-figures/budget-overview
COHRED Record Paper 5, “What factors influence national health research agendas in low and middle income countries?”

This does not necessarily rule out that unplanned systems need to be weaker than planned ones.


E.g. www.sideresearch.se/research-cooperation/about-us.aspx or www.bmbf.de/pubRD/Internationalisierungsstrategie-English.pdf

Report of the UN Secretary-General to the 2013 ECOSOC Annual Ministerial Review (cp. above)
www.hks.harvard.edu/var/ezp_site/storage/fckeditor/file/pdfs/centers-programs/centers/cid/publications/faculty/wp213.pdf


www.worldsocialscience.org/activities/world-social-science-report/the-2013-report; In that sense, the World Social Science Report incorporates the ethical notion that critical reflection is not only for specialists, but for each reflexive and critical human being worried about him/herself and his/her environment.


For a recent overview of the debate: www.theguardian.com/science/occams-corner-2013/oct/23/non-scientists-scientific-research-communication; also compare the EU’s activities ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&topicid=1251 and an emerging platform in Germany www.forschungswende.de

Several countries such as the U.S., Japan and several European countries are currently experimenting with a variety of instruments. In the U.S. for example the NSF’s Environmental Sustainability Awards and the calls Science, Engineering and Education for Sustainability (SEES), the Academies’ semiannual Round Table on Science and Technology for Sustainability, the AAAS’ database www.sustainabilityscience.org; in Japan, for example the network Integrated Research System for Sustainability Science I3RS or in Germany the funding programme FONA (also compare epub.wupperinst.org/files/4358/4358_Schniedewind.pdf).

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It is underlined that while this is specific, it is not exclusive, compare the engagement of scientists for peace and against nuclear weapons which has existed for many decades.

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One proven mechanism for such science-policy-society linkage comes from the field of bioethics infrastructures. A key component in most countries is an independent, multidisciplinary and pluralist national bioethics committee, e.g. in France the CCNE, in Germany the Ethikrat and in the U.S. the Presidential Commission for the Study of Bioethical Issues. Such committees provide guidance and advice to policy-makers, and generate public discourse on various issues, including the priority setting for scientific research and, equal access to the fruits of scientific research. UNESCO builds capacities in bioethics focused on these committees.

The elaboration of the Global Sustainable Development Report (GSDR) is a follow up to paragraph 85(k) of the Rio+20 Outcome Document which outlines a number of functions of the High-level political forum. « The high-level forum could: [...] (k) Strengthen the science-policy interface through review of documentation, bringing together dispersed information and assessments, including in the form of a global sustainable development report, building on existing assessments » The ultimate objective of the GSDR is to "strengthen the science-policy interface. The scope is the entire sustainable development agenda at global and regional levels, http://sustainabledevelopment.un.org/index.php?menu=1621 sustainabledevelopment.un.org/content/documents/975GSDR%20Executive%20Summary.pdf
www.sciencemag.org/content/281/5375/336.full
www.millennium-project.org

www.water-energy-food.org
sustainabledevelopment.un.org/content/documents/975GSDR%20Executive%20Summary.pdf

Another catalogue of assessments has been produced in the context of IPBES, which goes beyond biodiversity-related issues: see ipbes.uneapwcmc-004.vm.brightbox.net.