Measuring Sustainable Development:
How Can Science Contribute to Realizing the SDGs?

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The *Deutsche Forschungsgemeinschaft* (DFG, German Research Foundation) and the *United Nations University* (UNU) – supported by the German Mission to the UN – are organizing a joint conference on "*Measuring Sustainable Development*" at the German House and UN headquarters in New York City (April 2015). This conference will address the role natural and social science (should) have in realizing the Sustainable Development Goals. Both organizations join their specific areas of expertise in providing an international platform for creating a science/policy interface, where practical knowledge about the post 2015-/SDG process from both the scientific and the policy field will be brought together.

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The aim of this paper is to provide background information to speakers, panelists, and participants about the issues that will be discussed during the DFG/UNU-conference on "Measuring Sustainable Development: How can Science Contribute to Realizing the SDGs?" to be held in April 2015. The first part of the paper provides general background on the political process and examines debates that have arisen around the Post-2015 Agenda and the Sustainable Development Goals (SDGs). The second part covers the themes of each of the conference's four panel sessions. Accordingly, it examines issues related to (1) the selection of adequate indicators, (2) an integrated approach to assessment, (3) the identification and management of synergies and trade-offs, and (4) national and local ownership. All contributions will discuss the role of science in contexts such as these; the conference will develop this issue further in the wrap-up session.

I. General Background: Post-2015 Process, Reports, and Debates

(Marianne Beisheim)

1. The Post-2015 Process and the Sustainable Development Goals

In the period after 2000, the Millennium Declaration of the United Nations (UN) was translated into eight Millennium Development Goals (MDGs), each with measurable and time-bound targets and indicators for monitoring their progress. With the MDGs set to conclude at the end of 2015, governments are in the midst of negotiating an ambitious follow-up agenda, known as the Post-2015 Development Agenda, designed to improve people's lives and protect the planet for future generations. In September 2013, the UN General Assembly decided to merge this MDG follow-up process with the follow-up to the Rio+20 UN Conference on Sustainable Development (UNCSD), where the Member States decided to launch a process to develop a set of sustainable development goals (SDGs). In July 2014, the intergovernmental Open Working Group (OWG), under the mandate of the General Assembly, presented its proposal for 17 SDGs and 169 targets. In September 2014, the General Assembly decided that this proposal was to "be the main basis for integrating sustainable development goals into the post-2015 development agenda".

In December 2014, UN Secretary-General (UNSG) Ban Ki-moon presented his Synthesis Report on the Post-2015 Agenda "The Road to Dignity by 2030: Ending Poverty, Transforming All Lives and Protecting the Planet". It endorsed the OWG's proposal for SDGs and presented the results of extensive consultations along with other key reports, including those of the Intergovernmental Committee of Experts on Sustainable Development Financing (ICESDF) and the Independent Expert Advisory Group on the Data Revolution for

Sustainable Development. This provided the starting point for the final round of intergovernmental negotiations on the Post-2015 Agenda. The President of the General Assembly (PGA) appointed two co-facilitators to lead these negotiations: the Kenyan Permanent Representative, H.E. Mr Macharia Kamau, and the Irish Permanent Representative, H.E. Mr David Donoghue. UN Member States met for an initial stocktaking session (in January) and after that for deliberations on the four elements of the Post-2015 Agenda, namely the Declaration (in February), the SDGs and targets (in March), the means of implementation (to be discussed in April), and follow-up and review (to be discussed in May). In June and July, they will negotiate the outcome document. The UN General Assembly is expected to adopt the Post-2015 Agenda at a summit to be held from 25 to 27 September 2015.

2. Meetings, Reports, and Debates in this particular Context

2.1 Sustainable Development, Responsibilities, Means of Implementation

The UNSG's Synthesis Report proposes six essential elements to help frame and communicate the sustainable development agenda: dignity, people, prosperity, planet, justice, and partnership. The report also argues that the success of the Post-2015 Agenda will depend on community *ownership* and participation, the community seen as including civil society, responsible business, and governments (see II.4). The Post-2015 Agenda will be a *universal* agenda insofar as the SDGs, unlike the MDGs, will apply to *all* countries. Furthermore, it will focus in particular on *transformative* change. While eradicating poverty remains a central goal of the agenda, the current proposal for SDGs also covers issues such as the protection of ecosystems, sustainable consumption and production patterns (SCP), peace and governance, as well as inequality within and between countries. An agenda as broad as this poses many *challenges* at national level in terms of implementation, measurement, monitoring, and accountability. Policy coherence becomes an issue insofar as there is potential for conflicts to arise, especially around trade-offs between short-term development successes on the one hand and long-term sustainability and respect for the planetary boundaries on the other (see II.3 and also Griggs 2013; Kanie et al. 2014; Rockström et al. 2013).

Member States have also struggled to reconcile the need for universal applicability with a desire to allow for national *differentiation*. The Introduction to the report of the Open Working Group asks Member States to translate global goals into national targets, guided by a global level of ambition while, at the same time, taking account of national circumstances. All actors may indeed endorse the need for differentiation and "shared responsibilities", and yet there is considerable disagreement among UN Member States over the precise interpretation of the Rio principle of "common but differentiated responsibilities" (CBDR)

and the obligation that this entails to provide means of implementation (MoI) (Martens 2014). The G77, representing a coalition of developing countries, is adamant that the obligation for industrialized countries to provide funding for the implementation of all SDGs is a logical corollary of this principle. Traditional donor countries, however, point out that the principle of CBDR applies solely to SDGs concerning international environmental public goods (Nobbe 2015).

2.2 Indicators, Monitoring, and the Data Revolution

On 6 March, the UN Statistical Commission (UNSC), which brings together official statisticians from all over the world, endorsed a roadmap for developing an indicator framework (see also section II.1). To support this work, the Bureau of the UNSC produced a technical report, including an initial assessment of proposed provisional indicators, ranking them according to their feasibility, suitability and relevance. Member States discussed this report during the March intergovernmental negotiations on the Post-2015 Agenda. Stefan Schweinfest, Director of the UN Statistics Division, the Secretariat for the UNSC and the UN's designated intergovernmental focal point on the development of all indicators, will present this preliminary proposal at the conference. The UNSC will provide a final proposal in late 2015. It is expected that the final set of indicators will be endorsed by the UNSC in March 2016.

The list of proposed provisional indicators provides approximately two indicators per target, for a total of over 300 targets. The Group of Friends of the Chair (FOC) of the UN Statistical Commission suggested that the "core list" of indicators should be limited to just 100-120 indicators for global monitoring, to avoid seriously overloading the capacities of national statistics communities around the world. This core list could be supplemented by a "much larger indicators architecture", including indicators to be monitored at national, regional, and sectoral levels. This would be compatible with the Sustainable Development Solutions Network (SDSN) report on indicators and the monitoring framework, which calls for a limited set of 100 Global Reporting Indicators plus Complementary National Indicators. The UNSC also endorsed the FOC's suggestion of establishing an Inter-Agency and Expert Group on SDG indicators (IAEG-SDGs), composed of representatives of national statistical systems, with regional and international agencies as observers, to be tasked with fully developing the proposal for the indicators.

While Member States have agreed to mandate this expert group to develop the indicators, they are concerned about certain political issues arising from the choice of indicators. Will actors use the debate over indicators as an opportunity to re-introduce contentious ideas? Will there be respect for national policy space? Which indicators will be used for the MOI targets? Are the indicators easy to understand for the general public? While Member States

themselves have agreed not to negotiate over the indicators, they are keen for the process to be state-led, and want the UNSC to take the lead. Civil society groups are insisting on a transparent and participatory process and call for indicators that do not fall below existing international agreements. Some point to the need to address governance issues and are alert to the danger that they may be neglected on the grounds that they are perceived to be difficult to measure. Experts are concerned about the extent to which the indicators are scientifically robust and SMART (Specific, Measurable, Achievable, Resource-Based, and Time-Bound), and about how best to address inter-linkages (see also II.1 and ICSU 2015, IISD 2015, SDSN 2015, GDI 2015, Beyond 2015). They are also concerned over the feasibility of fully addressing the SDGs and targets with a limited set of indicators, given that some targets address more than one issue and the potential complexity of the issues concerned. Moreover, the aim of the report of the High-Level Panel on the Post-2015 Agenda is clearly to "leave nobody behind". To meet that demand, according to experts and NGOs alike, indicators and data need to be disaggregated – to ensure that disparities and inequities are visible. They also point to the need for suitable statistical capacity building. In general, developing countries will need capacity development support to help them transition from monitoring MDGs to dealing with SDGs. Experts have observed data gaps as a result of omissions and inconsistencies in measuring and monitoring progress. Data needs to be readily available, accessible and reliable. There is also discussion over whether to supplement quantitative measurement with perception-based data. In this context, the data revolution and new information and communication technologies (ICT) in particular may help us achieve this objective (over six billion people now have access to a mobile device). The UNSG's report also calls for an "accountability revolution" to allow information from actors at local level to feed into the international follow-up of the implementation of the SDGs. However, several Member States are hesitant to accept robust and participatory measures for monitoring and review (Beisheim 2015).

2.3 The Role of Science and the Science-Policy Link

The debate on the Post-2015 goals, targets and indicators, and measurement and monitoring lends itself to reflection on the role of science in sustainable development, what science has to offer policy makers, and how the science-policy link could be improved:

- What can we offer in terms of *relevant scientific findings* on environmental, political, economic, and social aspects of monitoring, steering, and motivating sustainable development? Can we identify *emerging* research fields, agendas and questions in this area?
- How, when, and under what conditions does science *interact* with policy and, accordingly, how can we manage the *interplay* between science and policy and contribute to realizing the SDGs? How can the science community be (more) helpful (in implementing the SDGs)? What potential (new) opportunities exist for increased engagement?

The first set of questions will be discussed in the four conference panels with a view to offering decision-makers: insights into the relevance of science-based findings to the development of valid indicators and effective monitoring (II.1); design ideas for solid scientific assessments and evaluations (II.2); suggestions for exploiting synergies and handling trade-offs (II.3); and knowledge about the role of ownership (II.4).

The second issue, the science-policy link, understood as mechanisms whereby scientific research and knowledge can be introduced into policymaking, has been widely debated in both the UN and in academic literature. The Ministerial Declaration of the 2014 UN High-level Political Forum on Sustainable Development (HLPF) states (in para 24) that Ministers have resolved:

> "to strengthen the science-policy interface, including, inter alia, through a global sustainable development report that (…) could provide a strong evidence-based instrument to support policymakers to promote poverty eradication and sustainable development, thereby contributing to the strengthening of ongoing capacity-building for data collection and analysis in developing countries".

The Global Sustainable Development Report (GSDR), a prototype of which was presented at the 2014 HLPF, is thus seen as a central tool in achieving an integrated scientific assessment of the implementation of the SDGs. It aims to adopt an "assessment-of-assessments approach" and to pool the current range of assessments of global sustainable development and perspectives of scientific communities across the globe, and then make the findings available to policy makers. Yet, the scope and methodology of the report needs to be specified in greater detail. The first chapter of the 2015 edition is intended to address the science-policy interface (SPI), with particular focus on the extent to which SDGs are covered by existing international assessments and linkages between the international and national levels. Following a call for contributions by UN DESA, the scientific community has submitted more than 140 Science Briefs, highlighting specific research findings, for the projected GSDR chapter 7 on science issues and solutions. They are now open for public review. Selected briefs are expected to be discussed at the 2015 HLPF.

The UNSG's Scientific Advisory Board (UNSG-SAB) has produced a paper entitled "The Crucial Role of Science for Sustainable Development and the Post-2015 Development Agenda". The SAB notes that science provides "answers that are testable and reproducible", and thus provides the basis for evidence-based policy making. The SAB has opted for an integrated scientific approach, emphasizing the strong interrelationships that exist between different SDGs. They have called, moreover, for a new global research architecture that not only supports interdisciplinary collaboration but also links science with both policy and society, thereby leading to an "enhanced science-policy-society interface". There is, however, no common understanding of what a successful science-policy interface entails. Thus, this discussion would benefit from learning from the experience of established institutions.

Within the Science and Technology Alliance for Global Sustainability (ICSU, ISSC, SDSN, UNU and others), the flagship initiative and scientific consortium Future Earth sees itself as a global platform that will facilitate research collaboration and provide the knowledge needed to support transformation towards sustainability. At a symposium on "Science and the SDGs" in November 2014, the Chair of their Science Committee, Mark Stafford Smith, cited a need for the SDGs to be assessed continuously, using an adaptive process that aims at improving the goals, targets, and indicators and their implementation and monitoring over time. At the same time, participants – scientists and policy makers alike – critically reflected on how scientific advice had to be measured against political feasibility in the process of drafting the SDGs.

This tension is also reflected in the *academic* work that has been written on the science-policy link. One strand of the literature refers to "organized hypocrisy", noting that "talk, decisions and actions" are not always strongly interconnected (Brunsson 2003). While policymakers may call for science-based decision making ("talk"), they may in fact decide and act in very different ways to represent other interests. Krasner (2009) argues that, due to limited capacities, uncertain preferences and mixed motives, fully rational decision-making is a fairly rare phenomenon. Occasionally a policy window may open and allow for new ways of thinking. For this to happen, there must be a willingness to recognize the problem, policy alternatives available, and a political environment that encourages a "taste" for change. It would appear that policymakers are interested not merely in facts but also in arguments, and would preferably like simple and straightforward frameworks that help them make sense of the complex world in which they have to operate (Avey/Desch 2014). While scientists relish pointing out uncertainties in their models, scenarios, predictions or assessments, that derive from incomplete knowledge of the workings of complex systems, policymakers prefer definite answers. Indeed, they tend to be most open to scientific input when they are required to take (potentially costly and unpopular) decisions in situations of high uncertainty. Nevertheless, scientists must find a way to communicate uncertainties openly to ensure that they are neither over- nor underplayed or used as an excuse for inaction but rather understood as an integral part of robust scientific method.

Several authors discuss the role of *consensual* knowledge within the epistemic community (Haas 1992). Others, however, note that what is scientific consensus may not be reflected in the perceptions of either policymakers or the public (Griggs/Kestin 2011). If the scientific community is to bridge this perception gap, it may need to play a more important role in better *communicating* science to policymakers and other stakeholders. Yet others see this more as a role for policy advisors whose job it is to translate academic findings into policy scenarios. How the science-policy interplay is managed varies widely in practical terms, It is also the subject of lively normative debate (Haas/Stevens 2011). Scientific purists opt for a strict *separation* between science and policy, for remaining independent and autonomous

and capable of “speaking truth to power” (ibid). Others believe that the more a scientific discipline is connected, the more influential it will be; they even envisage scientists and policymakers working together to *co-design, co-produce, and co-disseminate* research and results, and produce robust knowledge that is more relevant and useful for policymakers and other stakeholders (Jasanoff 2004; Mauser et al. 2013). Yet others warn that by adopting a middle-of-the-road approach, academic studies might find themselves in the “worst of all possible worlds, neither providing real analytical depth and distance nor escaping from the interests and prejudices of one part of the world” (Hurrell 2011). All sides agree on the relevance of credibility and underscore the procedural design aspects of producing and disseminating scientific findings (Cornell et al. 2013), opting for context-sensitive and pluralist approaches (Engels 2005; Lidskog/Sundqvist 2015) and aiming at mutual exchange rather than a one-way transfer of knowledge.

Finally, debate also exists around the potential implications of a strong normative orientation in science and research towards a solutions-oriented, “transformative” approach (ISSC 2012, WBGU 2011). While some fear a “tyranny of experts” and the loss of openness and pluralism in science (Strohschneider 2014), others do not share these concerns at all and see this kind of research as complementary to pure science (Grunwald 2015).

II. Specific Background on the Panel Topics

1. Indicators and Monitoring (Wilfried Rickels)

1.1 Disputes over Indicators

In the current UN negotiations, Member States have discussed how precisely to measure and monitor the implementation of the SD goals and targets. The UNSC has proposed a preliminary indicator framework (see section I.2.2) for this purpose. Any selection of goals, targets, and indicators is a normative choice and no unambiguous rules govern the selection process (see, for example, Böhringer and Patrick 2007, Krellenberg et al., 2010). While best practice would suggest that the selection process should be conducted in a transparent manner, in reality the vested interests of various stakeholders are rarely absent from the process of selecting goals and targets. This leads to intense negotiations and a final compromise designed to best satisfy the demands of the various interest groups involved. Typically conceptual issues tend to take a back seat. Not surprisingly, the specific choice of goals and targets has been the subject of criticism from various observers and institutions. For example, the ICSU and ISSC report, which focuses specifically on the targets, claims that only 29 percent are scientifically well-founded while 54 percent are deemed to require greater specification and 17 percent may indeed warrant significant revision. The UK Department of International Development finds the overall framework to be excessively detailed and thus unwieldy, with the result that, in their opinion, many proposed targets are either unworkable or unmeasurable. In its defenses, the WWF points out that "it is not the number of goals that matters but what they can deliver. How these are communicated and to which audience is a matter for communication expertise once the goals and targets are agreed." The German Development Institute recently analyzed these various goals, targets, and indicators and commented on them in great detail. Their main criticism is that the different SDGS cover the social, economic, ecological and political dimensions of sustainable development in a rather isolated and fragmented fashion.

However, given the normative character of a framework of this nature, an optimal and/or unanimously supported scientific solution would appear not only to be over-ambitious but downright unrealistic. Nevertheless, it is striking that, in the debate over the current SDG measurement framework, little attention has been devoted to conceptual issues, despite the fact that a more uniform conceptual framework could offer a more optimal outcome without necessitating any significant changes to the currently proposed indicator base.

1.2 Selecting Indicators

Ideally, the *selection of indicators* should start by a determining a large set of potential indicators from which the most appropriate are selected according to well-defined and

broadly accepted methods (see, for example, the Bellagio Principles or Alfsen/Greaker 2007). The selected (headline) indicators should, in particular, reflect policy influence in quantitative terms. The selection of headline indicators should therefore be supported by empirical studies of the historical influence of the indicator on the desired objective, the historical influence of policy measures on the indicator, and correlations between the various indicators (e.g., Schultz et al. 2008). Pintér et al. (2005) and Kopfmüller et al. (2012) argue that if the set of indicators is small, it can be more relevant to decision-makers. For example, in assessing the sustainable development of Santiago de Chile, Kopfmüller et al. (2012) initially discuss 120 indicators, which they whittle down to 12 "headline indicators" to be used to assess the sustainability of the city (headline indicators are intended to provide simple, clear information to guide policy effectively towards sustainable development).

From this point of view, the number of indicators in both the UNSD and SDSN proposals is too large to provide effective guidance for high-level policy recommendations. Such a large set of goals (and even larger set of targets) is unlikely result in a small number of headline indicators which can still attract the attention of decision-makers. It is therefore arguable how effective the proposed framework will be in guiding sustainable development. Obviously, there are situations in which all indicators will improve and these can easily be identified as being instances of exemplary sustainable development. However, in most specific cases, the effects of policy measures on certain goals are contradictory (e.g., job creation versus environmental conservation in certain sectors) and therefore we need to take account of their substitution potential — which may be limited for ecological or technical reasons or due to the fact that social preferences only allow limited substitution (Visbeck et al. 2014). Varying degrees of substitution potential can be seen in the distinction between weak and strong sustainability.

According to scientific criteria, the measurement frameworks currently proposed by the OWG/UNSC/SDSN are designed along the lines of strong sustainability insofar as all indicators have to be maintained at least at current levels (e.g., Dasgupta and Heal 1979) if sustainable development is to be achieved. That would, for example, suggest that in a situation where all indicators but one were to improve (which would be an unlikely success) sustainable development would be deemed not to have been achieved. Policies often affect various indicators in opposite ways, making it practically impossible to provide policy advice based on the indicator set alone, given that no one policy improves all indicators. This argument also underlies the criticism of the German Development Institute when it notes that everybody accepts that no country will be able to achieve all of the goals, with the implication that governments will then chose to focus on less critical goals — leading to an overall process of arbitrary implementation as a potential result.

Sustainable development could, alternatively, be assessed on the basis of some form of aggregate of the various indicators (weighted, for example, by their corresponding shadow

values, see e.g., Arrow et al. 2003). Despite opposition to this approach, both proposals (SDSN and UNSC) contain composite indicators which are based on aggregated normalized indicators. Some of the composite indicators currently included in the proposals are based on the extreme assumption of unlimited substitution possibilities, thereby satisfying a concept merely of weak sustainability (as in the case of the Ocean Health Index as an indicator for SDG 14) (Rickels et al. 2014). It is usually considered critical to apply this concept of weak sustainability, in particular when environmental or social aspects are also included in the objective because, in this context, services derived from machinery and artefacts can, for example, replace natural capital services (e.g., Victor 1991).

Many of the SDGs address complex ecological-economic-human interactions and thus it is crucial to pay attention to the limits to substitution between the various indicators—otherwise development trajectories might be chosen that do not adequately take account of underlying trade-offs (Visbeck et al. 2014). Obviously, weak and strong sustainability represent two extreme cases, while in reality the appropriate level of substitution potential can be expected to lie somewhere between these two extremes and differ in its dependence on the characteristics of the underlying capital stocks to be assessed (Bateman et al. 2011).

Accordingly, from a scientific perspective, the current proposals for the SDG measurement framework would appear in some ways to be inconsistent or even unwise in their use of composite indicators, arguing, on the one hand, for a limited number of indicators while, on the other, opposing (in general) the use of composite indicators. Yet it is possible that the inclusion of meaningful composite indicators could actually supplement the meaning, validity, and policy relevance of the current SDG measurement framework. Seen in this way, composite indexes should not replace the stand-alone indicators but rather be included as additional information. The stand-alone indicators would remain the backbone of reporting and implementation planning, and be measured in their original units without transformation. Additionally, they can be transformed to obtain ratio-scale fully comparable indicators to be used in calculating composite indexes (Ebert and Welsch 2004). These indexes could aggregate the indicators across goals (to measure whether sustainable development has been obtained for a particular goal) and across sustainability dimensions (to measure whether sustainable development has been obtained, for example, in the social dimension). The index itself should be nested (i.e. have various aggregation layers). A nested index with various levels allows for consideration of different substitution possibilities at different levels by first aggregating, for example, indicators with better substitution possibilities (Dovern et al. 2014). Furthermore, this approach could be extended to aggregate all goals or dimensions into one overall index — to assess whether sustainable development has been achieved overall.

1.3 Other Challenges and the Role of Science

Conceptual issues regarding the selection and aggregation of indicators are only some of the challenges facing us in achieving the SDGs and consequently sustainable development. If we are to achieve far-reaching (sustainable) outcomes, we will need properly structured implementation and financing plans at country level — for all and not only selected goals. This too is a matter of resources, but as Homi Kharas nicely put it in a recent post, the question of how much the implementation of the SDGs will cost (and how that compares with the cost of *non*-implementation), cannot be answered without a structured implementation plan.

For this reason, in addition to embarking on a process of reflection with a view to developing an optimal indicator framework for the SDGs, we should expend equal effort on considering implementation and implementation planning issues. We crucially need improved capacities if we are to implement an effective monitoring framework, and that requires timely provision of correct data. Currently, efforts are under way on several fronts to obtain some initial rough numbers for selected goals and targets; however, we still lack more detailed implementation plans at country level with information about budget requirements and possible financial transfers. This kind of detailed information is needed if we are to include national governments and agencies in the overall implementation process. Furthermore, in selecting indicators, we should also consider building on and extending existing frameworks such as the System of National Accounts and the System of Environmental-Economics Accounts (both are used by the World Bank for obtaining information on genuine investment). Given that these existing frameworks are based on sound concepts of sustainable development, the SDG measurement framework can only benefit in validity by using indicators obtained from these data sources. Insofar as further capacity building is concerned, the July 2015 Financing for Development Conference offers a vital opportunity to mobilize the means we need to enable the full indicator framework and a sound baseline to be adopted in time for the first High-Level Political Forum (HLPF) of the SDG era in July 2016.

The scientific community has the potential be more engaged and contribute a scientific perspective to ongoing discussions about the SDG measurement and indicator framework. More specifically, it is possible to envisage deep engagement in two areas: a) first quantitative applications of the preliminary indicators (for specific goals and specific countries) to provide ex-post insights into the extent to which the indicators reflect changes in objectives and the extent to which the indicators have in the past responded to policy intervention; and b) to evaluate the inclusion of composite nested indexes (with limited substitution potentials at the top levels of aggregation) and demonstrate how different assemblies of selected indicators can reflect sustainable development at the aggregated level and whether science-based policy recommendations can be derived therefrom, and, if so, how useful they are likely to be.

2. Assessment and Evaluation (László Pintér)

2.1 The Role of Assessments and Evaluations

SDGs and SDG indicators, universally applicable and covering a full spectrum of sustainability issues, promise to provide important new elements in sustainable development governance in the post-2015 world. *Goal and target-specific evaluation*, using carefully selected indicators, is important for understanding not only the rate and direction of progress, but also for measuring distance to targets. Indicator-based evaluation reports, at the global and at the national level, have been used to monitor progress towards the MDGs. However, while evaluations, narrowly focused on goals, targets and indicators, are important in tracking progress, they are not necessarily *sufficient* by themselves as decision-support instruments, because they may not provide a synthetic perspective on how multiple, interacting forces of change have led – or could lead in the future – to specific outcomes. Evaluation reports have tended to treat the MDGs as if they were planning targets, rather than as expressions of common norms and broad aspirations used to guide and orient policy (Fukuda-Parr et al. 2013). Further, the global MDG evaluation process has not substantively involved stakeholders and policymakers, thereby limiting opportunities for learning or ownership of findings.

While indicator-focused evaluations are important, any attempt to bridge the gap between general aspirations underlying global goals and the specific needs of implementation requires the use of *assessments*. Assessments are designed to bring together science and policy perspectives in analyzing current trends and policy options for the future. It is important to take the role of SDG-related assessment into consideration for several reasons.

First, the SDGs and potential SDG indicators represent a much broader spectrum of aspirations and higher level of complexity in both the underlying issues (e.g., number and diversity of goals and targets, possible combinations of interactions, higher levels of uncertainty) and the policy agendas that SDGs are likely to inspire. Higher complexity also means an increased possibility of interactions between issues that narrowly focused evaluations may easily miss.

Second, stronger emphasis on the MoI calls for analytic tools and products that can act as a bridge between the SDGs as high-level, normative benchmarks and the contextually defined, specific needs of policy planners and implementers. These needs can be broad (how to translate global SDGs into priorities in national strategies or action plans) or narrow and technical (e.g., how policy instruments can be deployed around a specific SDG). They can also be related not only to understanding past progress, but also to translating global goals and targets into contextually meaningful local SDGs with a future orientation, and assessing the risks and opportunities associated with implementation strategies and pathways.

Third, the literature on the effectiveness of science-policy processes makes it clear that participation of stakeholders – involved in SDG implementation at various levels – is a key determinant of effectiveness by underpinning saliency, legitimacy and credibility (Eckley 2001). In contrast with MDG progress reporting which was, at the global level, an expert and statistics-driven exercise, participatory SDG assessment would provide opportunities for co-learning and ultimately buy-in by implementers.

Assessment systems as complementary mechanisms to indicator-specific progress reports and statistical updates can, if properly designed, address these three issues. Assessments come in many forms, and they may play different roles in the various thematic or policy contexts of SDG implementation. Given the scope of the SDGs, *integrated assessments* (IA), defined as "the interdisciplinary process of integrating knowledge from various disciplines and stakeholder groups in order to evaluate a problem situation from a variety of perspectives and provide support for its solution" appear to be particularly suitable (TIAS 2010).

SDG assessments would need to satisfy several *design criteria*, building on a tradition of research focused on the design, tools and methods of IA (e.g., Rotmans 2006, Mitchell et al. 2006, Cash and Clark 2001, Pintér et al. 2012). The term *assessment systems* is used here to indicate that both SDG implementation and assessment processes need to take place at multiple scales and form a distributed network where cross-scale learning and coordination is important (Cash 2000). Examples of such systems already exist in the case of several global assessments with national or regional sub-assessments (e.g., UNEP's Global Environment Outlook (GEO) or UNDP's Human Development Report). Other precedents include large science assessments such as the IPCC's Assessment Reports, the Millennium Ecosystem Assessment, the IPBES and the Global Energy Assessment.

2.2 Assessment Design

Assessment design requires the consideration of many criteria, and some of these that are of particular relevance to SDG assessment are discussed here. They build on the Bellagio Sustainability Assessment and Measurement Principles (Bellagio STAMP), developed by the OECD and the IISD (Pintér et al. 2012; Bakkes 2012).

Conceptual architecture: Any SDG assessment would need to take into account the full scope of agreed goals, targets and indicators at the relevant scale and in context, by structuring the assessment around an analytic framework that enables interlinkages to be recognized and assessed. The framework could build on pre-existing conceptual frameworks used by other assessments, to capture SDGs as a system, and allow both quantitative and qualitative dimensions to be addressed. Quantitative analyses would likely require the use of integrated models capable of representing goals, targets, indicators and their interlinkages as an

integrated system of social, economic, financial, environmental and possibly even governance dimensions (LeBlanc 2014).

Temporal coverage: SDG assessment would need to combine ex-post with ex-ante perspectives. *Ex-post* IA helps understand the pathways and underlying decisions and actions that lead to current baselines. *Ex-ante* analysis is essentially needed for converting SDG aspirations and future targets into strategies, policies and programs. It can build on experience with integrated outlooks that often include the creating of simulations, somewhat akin to a "wind tunnel", to test the implications of policy options. Experience with outlooks ranges from global to national levels and covers a wide range of issues from the economic to the environmental.

Assessment process: While assessments are often best known for their *products*, they are first and foremost an analytic *process*. SDG assessment would need to be a continuous or at least periodic process, and require adequate and stable institutional capacity, as outlined in Bellagio STAMP principle No. 8. A key aspect of the assessment process is the participation of stakeholders and decision-makers, which helps identify policy-relevant issues, construct visions, validate targets, organize transition "arenas" and help select policy options to be tested *ex ante* in future (e.g., Kasemir et al. 2003; Van de Kerkhof and Wieczorek 2005).

Assessment products: SDG assessment could build both on experience with similar products in the past and on new possibilities offered by developments in communication technologies. In addition to periodic assessment reports covering the SDGs overall or in part, continuous monitoring and data streams allow for more frequent or continuous assessment, and better customization of assessment products for the needs of specific audiences. While statistical reports and evaluations of progress *vis-à-vis* targets would form part of the overall assessment package, more in-depth assessment reports could be provided to cater to the needs of decision-makers in specific geographic or thematic contexts. For example, UNEPLive, UNEP's ongoing work to develop a global assessment platform, is also intended to serve as a template for preparing national integrated environmental assessment reports.

Institutional fit of SDG assessment: An IA system of SDG progress and prospects would need to *fit with other elements of the institutional architecture of SDG implementation* mechanisms at both global and sub-global levels. While discussions about the governance mechanisms for SDG implementation are ongoing, at the global level the HLPF is expected to provide oversight, assisted by UN specialized agencies. One of the key instruments of implementation progress tracking and accountability mechanisms will be the Global Sustainable Development Report (see section I.2.3). The prototype of this report has already identified a number of possible design elements for a science-policy reporting and assessment system that would need to match the SDG agenda in terms of structure and ambition. This would provide a suitable home for strategically oriented science-policy

assessment work that goes beyond single indicator-focused evaluation reports. Similar initiatives would be required at the sub-global (national, sector and municipality) level, building on assessment, planning and reporting structures (e.g., integrated development plans, strategic outlooks) where they already exist.

Capacity building and development: While IA processes and institutions similar to what is required for SDG implementation planning and tracking exist, significant further capacity building and development would be required to create more purpose-built and quasi-permanent structures. This applies particularly to developing countries, although many developed countries also lack (or have lost) the required IA and reporting mechanisms, with coordination and management systems, science-policy interface, monitoring, modeling and reporting capacities. Examples of programs to build national and regional capacity for IA approaches exist, such as the training modules for national integrated environmental assessments based on UNEP's GEO (Pintér et al. 2007). However, no readily available capacity building programs exist for the SDGs – they would need to be constructed.

2.3 Role of Science

Building an integrated assessment system that fits both the normative ambitions of the SDGs and the operational needs of SDG implementation will require *scientific input* on multiple fronts. It will also require *new* science and the research required to generate it. Both the social and physical sciences will have to contribute if we are to benefit from better approaches to modeling tightly coupled social-economic-financial-ecological systems, improved monitoring and indicator analysis, participatory construction of integrated policy scenarios and transition pathways, better understanding critical risks and uncertainties and improving the usefulness of assessments for strategy development and governance. One particularly important contribution would be to find ways of making better use of *citizen science* (Kasemir et al. 2003; Kates et al. 2000).

Securing high quality, reliable data, essential for indicator-based SDG reporting, is equally critical for policy- and solution-oriented IA. In its report, the UN Secretary General's Independent Expert Advisory Group on a Data Revolution for Sustainable Development laid out elements for a critical path, calling for a global consensus on principles and standards, sharing technology and innovation, new resources for capacity development, strong leadership in coordination and mobilization and capitalizing on existing potentials.

Bridging the gap between the normative aspirations of the SDGs and the practical needs of SDG implementers will require building institutions and institutional capacities for integrated assessments that transcend in purpose, mechanisms, outputs and utility indicator-based progress reports. A key lesson from the study of global integrated assessments is that they require investment in careful planning to ensure they become an effective and lasting piece of sustainable development governance.

3. Synergies and Tough Choices (Nils aus dem Moore)

3.1 Exploring the Nature of Interlinkages in the SDGs

A central feature of the concept of sustainability is a holistic, systemic perspective that integrates the economic, social and environmental dimensions and prerequisites of human welfare and development. It is the ambition of the Post-2015 process to gear future action at every level towards tackling the challenge of sustainable development as a whole, with the SDGs serving as the central guidance system. Hence, it is a fundamental priority to clarify the relationships between different goals and targets, within and particularly between the three dimensions. From an analytic perspective, individual objectives set at the level of the SDGs can relate to each other in three different ways: They may be *independent* and able to be pursued in isolation; they may be characterized by a *synergetic*, mutually reinforcing relationship; or they may display a *conflicting*, even mutually exclusive relationship.

In practice, however, it is rarely sensible to assume independence: There is ample evidence that failures in one area of sustainable development can quickly undermine progress in other areas. And even if progress on economic, social and environmental objectives is achieved simultaneously, it can be reversed all too easily by poor governance, escalating conflicts and insecurity (SDSN 2013). Therefore, it appears worthwhile to: (i) identify synergies between goals and ways of overcoming obstacles in realizing them; and (ii) identify where objectives may conflict with one another and how to adequately deal with challenges such as these through prioritization and sequencing. The identification of synergies and trade-offs is also inextricably linked with procedural and governance issues.

3.2 Synergies – The Exception or the Rule?

The systemic character of the sustainability approach and the interrelatedness of the three pillars of sustainable development give us grounds to hope that policy action towards the realization of one goal might also lead to advances in the achievement of other objectives. If we want to maximize the positive impacts of political capital and financial resources invested, we might usefully seek out beneficial constellations between goals, targets and the measures that can be taken to achieve them. For example, large synergies may be found in addressing climate change mitigation, energy security, and air pollution simultaneously. It is also claimed that important synergies exist between ensuring food security and restoring agricultural ecosystems; between climate policy and R&D; and between education, R&D, environmental improvements, and economic growth (UN 2014 a).

Opinions differ, however, as to whether synergies are the rule or rather the exception. Evidence suggests that the links between the economic and social pillars of sustainable development are generally positive (Hallegatte et al. 2011). Non-material aspects of quality of life such as health and education tend to rise as levels of per-capita income grow.

Furthermore, the Kuznets curve argument, which posits that social inequality first increases and later decreases during the process of economic development, has been called into question by recent evidence (Milanovic 2010). Even the "big trade-off between equality and efficiency" (Okun 1975) whereby there is an increased likelihood of negative growth effects resulting from policy efforts to redistribute, e.g., through the tax code, has recently been declared to be resolved, at least in the long run: "Countries may find that improving equality may also improve efficiency, understood as more sustainable long-run growth." (Berg/Ostry 2011: 13) However, even in the beneficial context of mutually reinforcing economic and social objectives, the existence of budget constraints regarding time or money alone calls for prioritization and sequencing.

3.3 Trade-offs – More Frequent than Is Readily Acknowledged?

Things are arguably more complicated when it comes to the relationship between the economic and the environmental pillars of sustainability. Even authors that take an optimistic view of the general feasibility of "Green Growth" and the decoupling of economic activities from their unsustainable effects on resources and the environment acknowledge that "economic growth causes environmental degradation – or has for much of the last 250 years" (Hallegatte et al. 2011: 3). It would be misguided to pin one's hopes on the existence of an environmental Kuznets curve (Grossman and Krueger 1991) since only a limited number of local, visible public goods such as air and water quality initially get worse and then improve with greater income. In contrast to flow and local pollutants, critical environmental damages that result from stock (like pesticides) and global pollutants (like greenhouse gases) and the destruction of bio-diversity tend to rise with income.

Furthermore, there is mounting evidence that environmental degradation itself is costly, e.g., through negative impacts on health and ensuing losses of productivity (Croitoru/Sarraf 2010; The Economist 2013; CFR 2014). Less attention is paid to the fact that the world's poorest people live in especially fragile natural environments and that the *local* natural resource base is of prime importance especially for the rural poor (Dasgupta 2009).

The urgency to resolve the trade-off between development and economic growth on the one hand and the need to preserve essential natural resources and life support systems on earth on the other hand has been thrown into sharp relief by the concept of nine "planetary boundaries" (Rockström et al. 2009 a; Rockström et al. 2009 b). It is closely related to neighboring concepts such as "carrying capacity", "sustainable consumption and production", "guardrails", "tipping points" and "footprints". All these approaches make the point that there is a global "adding-up constraint" (Rockström et al. 2013). Attempts to quantify critical thresholds indicate that three boundaries (rate of biodiversity loss, climate change, the global nitrogen cycle) have already been exceeded. Since all boundaries are tightly coupled, the transgression of one puts others also at serious risk.

Against this backdrop, the concept of "Green Growth" (GG) promises to reconcile low-carbon and sustainable development with other valued outcomes, including job creation, poverty alleviation, and high economic growth. The use of environmental assets is generally characterized by market failures, external costs and ill-defined property rights being the most common. Hence, correction of market failures such as these could, in principle, lead to a "win-win situation" that makes growth processes resource efficient, cleaner and more resilient without necessarily causing them to slow down (Hallegatte et al. 2011). Consequently, the suggestion that GG represents a "win-win" option appears in a large number of reports, including reports by OECD (2011), UNEP (2011) and UNESCAP (2013).

Critical appraisals suggest that GG strategies might only be "win-win" in the case of certain micro, project-level interventions, such as the installation of solar panels in poor households. However, in terms of a national development strategy, "GG poses more trade-offs than is readily acknowledged." (Resnick et al. 2012: 215). At country and regional levels, conflicts and obstacles in the way of a shift from current development trajectories to green growth strategies or, in other words, a "sustainable development trajectory" (Rockström et al. 2013) are most likely to arise along two dimensions – short run vs. long run and winners vs. losers. Even if long-term environmental benefits could be sizeable, short-term costs may be perceived as being prohibitively high: "It is difficult to argue against the principle of sustainable development, but there are few incentives to put it into practice when our policies, politics and institutions disproportionately reward the short term." (GSP 2012: 4)

Furthermore, high short-term costs are likely to generate substantial anti-reform coalitions that might include both powerful actors, including political parties, unions, and private sector corporations, as well as the poor. Resnick et al. (2012) argue that these political economy issues are of high importance in both middle-income and extremely poor countries, especially where development strategies rely on the exploitation of comparative advantages that result from favorable agro-ecological conditions, land abundance, or mineral wealth. Notwithstanding these obstacles, the analytical case for green growth is strong since stewardship of the environment is essential to the sustainability of global economic and social progress: "Tackling climate change and fostering sustainable development agendas are two mutually reinforcing sides of the same coin." (UN 2014 b: 14)

3.4 Potential and Limitations of Scientific Support

An essential contribution of science is to provide a knowledge- and evidence-base that enables synergies and trade-offs between goals and targets to be identified. Stakeholder assessments of the proposed SDGs have evaluated whether the three dimensions of sustainability are clearly reflected in each target (WWF International 2014; Beyond 2015; IRF 2015; Stakeholder Forum 2014). However, the identification of interlinkages within the SDGs in terms of their aims and the language used is merely a preliminary step, potentially

indicating where low-hanging fruits might be reaped. Context-specific research is needed if we are to assess what synergies can, in fact, be achieved and the nature of any likely trade-offs. This knowledge would inform decision-makers and help them choose the policy options that can best meet the SDGs at a given location within a defined space of time.

By definition, the challenge to base implementation and monitoring of the SDGs on reliable quantitative information and a solid evidence-base grows with the number of goals, targets and relating indicators that enter the equation. This is also the case for the implementation of the SDGs itself and has motivated calls for a "clear, concise set of objectives": "If nations can simply ignore the imperatives on the grounds that they are too many, too grandiose and too far out of touch with countries' limited resources and ability to effect change, the development goals are in very real danger of failing." (Banerjee/Pande in NYT 2014)

Hence, the more extensive and differentiated the finally adopted SDGs prove to be, the higher the need for policy-makers to prioritize their objectives. This raises a number of related questions: How to *prioritize* objectives in a transparent way? What are the relevant *criteria* to use? How best to design the *process* of prioritizing? Here, science can be most supportive when robust knowledge about causal mechanisms is available. This kind of information can enable a targeted exploitation of interdependencies and goals to be pursued in combination.

However, even readily available solid scientific knowledge does not provide the silver bullet. Since progress may need to be achieved differently in different regions (e.g., poverty alleviation as a priority in one region and prevention of environmental degradation in others), the "right" next step ultimately comes down to a political decision and this is dependent on the consent of the community concerned if there is to be durable implementation. There should therefore be discussion over which particular empirical approaches – surveys, revealed-preference approaches, insights from history, etc. – are most promising if we want to learn about people's actual preferences with respect to various facets of human welfare. Deliberative public participation, in particular, is increasingly hailed as a necessary component of governance and a large number of associated processes have been deployed at local and national levels (see Bäckstrand 2003 for on overview in the realm of environmental policy making). More recently, deliberative approaches have also been used across multiple countries (Andersson/Shahrock 2012), notably to address climate change (Blue 2015).

Finally, the issue of the type of governance needed to realize the SDGs is itself subject to trade-offs that may require tough choices, as exemplified by the following questions: What is the right balance between coordination and decentralized decision-making? How can we enjoy the fruits of close international coordination and yet prepare for unexpected challenges? Related issues of ownership and governance are outlined in the next section.

4. Ownership (Hedda Løkken)

4.1 The Concept of Ownership

The successful implementation of the SDGs arguably depends partly on the existence of a feeling of *ownership* of these goals within national societies. Ownership is increasingly seen as an overarching principle in development studies (Leutner and Müller, 2010). The meaning of the concept, however, is evolving and was put forward for the first time in international development debates with the Paris Declaration on Aid Effectiveness (2005), adopted after the second High Level Forum on Aid Effectiveness. The aim of this declaration was to ensure "more and better" development results, with one of the main ideas behind this being ownership, and more specifically *country ownership*. By this is meant that the leadership of a particular development policy lies with the partner country. It further means that integration of policies into national structures is a precondition for successful results. This concept developed out of the role that traditional donor-driven aid had played in fostering dependency and inequalities between donor and receiver. This definition of ownership used in the Paris Declaration has been highly criticized by NGOs for referring merely to the ownership and ideas of government officials, and making no mention of notions such as Human Rights, inclusion, gender and sustainability. The Accra Agenda for Action (2008), created after the third High Level Forum on Aid Effectiveness, has attempted to respond to these criticisms and broaden the definition of ownership. With the notion of *democratic ownership*, donors commit to work increasingly with all development actors and not only government officials. A criticism that remains, however, is the assumption underlying the concept of ownership that recipient governments are both willing and able to lead development policies. This is not always the case, especially in situations of fragility and conflict. The Busan Partnership for Effective Development Co-operation (2011), adopted after the fourth High Level Forum on Aid Effectiveness, builds upon previous declarations and seeks to further deepen the concept of ownership and foster an inclusive meaning of the term. It argues, for example, that governments should be held to account by their peoples rather than by external actors. If this is to be achieved, it will be important to focus on the transparency of information and exchanges between all stakeholders.

Given the diversity among the large number of states participating in the SDG process – which is geared towards pursuing common, global goals –, we should consider why and how national and local ownership is crucial for successful implementation in each state.

4.2 Considering the National and Local Context

An important issue, noted by the UN Development Group in its discussion of the lessons learnt from the Millennium Development Goals (MDGs), is the need to take local and regional contexts into consideration. The need for ownership of the implementation process

is as relevant in the countries of the Global North as it is for the countries of the Global South. The SDGs should not be a fixed program imposed from outside, but merge into often pre-existing national development plans or sustainability strategies. Scholars and policymakers alike have observed the need to translate global goals into national goals. The case of the MDGs has shown that goals that were within reach in aggregate on the global level, for example with regard to MDG1 on poverty reduction, have not been a feasible proposition for many countries at the national level (Vandemoortele, 2014). Moreover, even if average living standards increase statistically, it still may be the case that many people do not see their living conditions getting better. Thus, any monitoring of the Post-2015 agenda would have to look at every country specifically, disaggregate data and achieve involvement of local actors from all areas of society, both in the implementation plan, and in the follow-up and evaluation of the results of the process.

At local level, this would also require capacity building and innovative thinking. The need for a broad and deep understanding of the needs and challenges facing a particular society calls for scientists to play a role in the implementation of the SDGs, and in particular in Southern research organizations (see European Centre for Development Policy Management). The political independence of research institutions and the local ownership of the research they produce are two major factors in the successful promotion of ownership by research centers. This allows them to remain credible in their local communities while guaranteeing successful national ownership of development projects financed by foreign donors.

4.3 Assuring a Bottom-up, Inclusive and Credible Approach and Process

To achieve ownership, it is necessary to ensure that a bottom-up, inclusive approach is adopted, rather than simply a top-down implementation plan. This raises the challenge of how best to gather the opinions and experiences of the general population. Parallel to intergovernmental negotiations, the UN started what is called "Global Conversations". These "conversations" consist of dialogues with people on the ground, national debates, group activities and other forms of opinion gathering, as well as a large online network, of which the MY World survey is part. This survey was created by the UN and gathers opinions from people worldwide on which six issues, from a list of 17, matter most to them and their families. It is crucial to foster this kind of inclusion and dialogue in the process of drafting the SDGs to create ownership of the results of the process. The UN Development Group, in its comments on the results of the survey, claims that they show people's willingness to be engaged and participate in the shaping of their future. More generally, the global conversations in more than 100 countries show that many countries are capable of encouraging ideas and engagement from civil society and the private sector. However, consultations also have their limitations. For example, in the MY World survey, the issues were already set by the website and access was restricted furthermore to people who knew

about it and had the technical means to participate. Moreover, it would be a considerable challenge to institutionalize participation of this kind as regular process rather than simply a one-off consultation.

In general, it is important that the process around the SDGs does not become a power game, where the biggest powers have the strongest voice. This process has been inclusive and transparent from the very beginning. And this is the way it should be if the objective of the SDGs is to "leave no one behind", as noted, for example, by Amina J. Mohammed, the Secretary-General's Special Adviser on Post-2015 Development Planning. Researchers and NGOs have emphasized the need to operationalize that principle, suggesting that countries should identify their most vulnerable groups and share their disaggregated data and lessons learned at a global summit. "Nothing about us, without us" is the slogan of marginalized social groups in international deliberations about the SDGs. Another relevant issue, arising from the bottom-up, inclusive process, is how best to achieve multi-stakeholder participation.

4.4 Aiming at Multi-stakeholder Participation and Ownership

Scholars underline the need to look beyond the role of state institutions (Frenken et al. 2010), notwithstanding the fact that strong institutions are probably a prerequisite for successful implementation. When there is greater involvement of multiple actors and stakeholders – such as civil society, grassroots organizations and the private sector – the chances of achieving a peaceful and successful development transformation, mainly due to wider general acceptance of the process, are increased. Scholars underscore this argument by pointing to the relationship between a wide participation of various stakeholders and the increased legitimacy of the outcomes (Bäckstrand, 2006). Strong democratic ownership depends upon a wider participation of stakeholders affected by the issues, and also partly responsible for a successful implementation. Legitimacy is equally important in areas of limited statehood (Krasner and Risse, 2014; Beisheim et al., 2014) where activities involving external actors are unlikely to be successful unless local actors regard them as legitimate. Giving the governed a say in decision-making processes is an important prerequisite for local legitimacy of this nature.

Moreover, governments may indeed not always choose policies that bring the most good to the people, but rather those which allow them to be re-elected and remain in power (Faust and Schmitt, 2010). This is another reason to involve non-state stakeholders in discussions about sustainable development: firstly, because these actors can consider the population's needs independent of any political agenda; and secondly, even if political power and opinions naturally change, it still allows for ongoing debate and for issues to be kept on the table. Under these circumstances, transparency is clearly another key issue.

4.5 Assuring Reliable Commitment to the SDGs

If the SDGs are to be reached by the expected deadline of 2030, there needs to be a strong commitment on the part of every participating state towards a more sustainable future for their own country, as well as for other states. This, in turn, poses the question of how this commitment can be achieved in a *reliable* way. Commitment to the SDGs can best be achieved when the people involved, either indirectly through government representation or through direct participation, feel ownership of the process, as well as benefit from the successful achievement of the goals. A credible commitment also involves tackling the root causes of problems instead of simply going for "low-hanging fruits" and "quick-fix" solutions (Fehling et al. 2013, 1117). Building national ownership also involves encouraging long-term investment.

UN documents talk about "shared responsibility", and, in this context, states must agree on the responsibilities incumbent on each participant. If there is to be successful implementation, every participant must trust others to do their part. The real challenge is how to encourage states to take action, through a skillful mix of incentives and monitoring. Experts have underlined the need for national ownership in the monitoring framework of the SDGs. It is their view that monitoring must be country-led, politically backed and resourced, and integrated into the overall national development framework, while also building on existing frameworks. In this context, access to data is crucial in enabling stakeholders in any society to follow the progress of the process towards achieving the goals and see what exactly is being done. For credible and accurate monitoring, perception-based data could possibly make a difference, as it would give people the opportunity to share personal experiences and perceptions of the progress of the SDG implementation process - thereby creating an increased feeling of ownership by people in general.

4.6 The Role of Science

The transparency of the process, the need for broad and active participation, and collection of information on the situation on the ground once again brings us to the essential role of science and researchers in the successful implementation of the SDGs in national contexts. It may be possible to boost ownership of the process by increasing the role of scientists, especially from the Global South. The Southern Voice on Post-MDG International Development, for example, is an open platform contributing to the global dialogue on the Post-2015 goals, by drawing on studies from southern research centers. It is a network of think tanks from Africa, Latin America and Asia, which seeks to address the current "knowledge asymmetry" that exists in the world and include more quality local data from on-the-ground researchers who know the facts and see the needs from a different angle. We vitally need a new kind of global cooperation such as this on scientific and academic levels.

III. Selected Take-Home Messages of the Conference

The international conference on science and the SDGs was organized by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) in collaboration with the United Nations University (UNU) and with the assistance of the Permanent Mission of the Federal Republic of Germany to the United Nations (UN) in New York. It focused on issues of global sustainability and in particular the contribution of science to realizing the sustainable development goals. The two-day meeting brought together more than 60 international experts from all scientific disciplines, from relevant UN institutions, as well as representatives from both political and civil society organizations. The final session took place at the headquarters of the United Nations in an event jointly organized by the Permanent Missions of Brazil and Germany.
Main findings: the contributions of science to realizing the SDGs revolve around four topics and include the following recommendations:

Indicators and Monitoring

- An essential step in realizing the SDGs will be to develop and use a sound and informative indicator framework. This framework can assist member states in tracking progress towards achieving individual SDGs. The framework should be comparable across countries, reward current and future states, take into account underlying trade-offs, and be easy to communicate.
- It may be possible to distill down the number of indicators to a relatively small set of "essential sustainability variables". The basic idea being that each variable/indicator could be applied to more than one target or goal. Keeping the set of indicators small could result in very significant cost savings for the member states, because the smaller the number of indicators, the lower the monitoring costs.
- The indicator framework would need to be suitable and applicable to all countries in order to make developments comparable across countries/regions. It further should be able to aggregate numbers at different spatial levels. In order to get a reasonable sense of the progress that has been achieved, the indicator framework would need to take into account the various current stages of development among countries/regions. Future states of development could be assessed based on this information.
- The added value of evidence-based decision-making can be demonstrated, i.e. incorporating better data and indicators can result in improved policy.
- Building technical capacity around the world and in particular in developing countries is necessary; this includes both the training of scientists and the building of indicator-enabling institutions that are sufficiently strong and transparent, in order to remain politically independent.

Assessment and Evaluation

- To be successful, SDGs need: (i) regular evaluations that provide continuous information to member states and other stakeholders on their progress in reaching goals and targets; and (ii) on-demand assessments that provide needed feedback to member states and other stakeholders on key scientific issues concerning SDGs.
- Assessments need to be multi-level, integrated, transparent, participatory, and consensual in their summaries; their guiding questions need to be framed jointly by

the policy and science communities. The methodology for doing these assessments is readily available from the scientific community.

- Assessments to support SDGs need to "go the extra mile" by assessing inter-linkages and trade-offs embedded within the SDGs, and policy options to transform trade-offs to synergies.
- All underlying assessment data should be made widely available on new digital platforms (e.g. "UNEP Live")

Synergies and Tough Choices

- Synergies as well as trade-offs are always context specific, because there is no robust *ex ante* knowledge of how to exploit synergies or deal with trade-offs. Science can play a pivotal role in the implementation of development goals, in terms of data, analysis, and scenario building, since science is a continuous learning process.
- Short-term vs. long-term trade-offs between goals can be handled by suitable incentives and/or focused temporary support. Other trade-offs should be approached by increased efficiency in the use of resources, often requiring changes in behavior.
- A multi-stage approach to indicator development should be envisioned and explored, from a goal-related to a policy-related indicator framework (five years from now), which should utilize synergies and handle possible trade-offs.

Ownership

- Ownership by countries and other actors will be essential in order to translate global targets into national targets, strategies and policies. Participation of all national stakeholders and participatory monitoring of country-level implementation will be instrumental for achieving local ownership. Beyond that, it is necessary to explore ways to strengthen ownership of SDGs dealing with global common goods.
- The international legal framework for SDGs should have a reinforcing loop to strengthen stakeholders. Frameworks of international law with regard to different societal areas can be used and integrated in national regulations and settings. For example, international conventions on gender and diversity could frame and guide country-specific laws on these issues.
- Efforts should be made to engage local communities and utilize local knowledge as much as possible. The time invested in this will ensure long-lasting ownership of the SDG process at all societal levels, but it also requires building up the necessary capacities for doing so at a large scale.

Conclusion:

Science can make a significant contribution to the SDG process in several ways. First, the implementation of the SDGs can only be evaluated through a meaningful indicator framework, and this framework needs scientific input. Second, science can support the establishment of evidence-based procedures for evaluating the SDGs and tracking progress in their achievement. Third, science is needed for co-designing and carrying out scientific assessments that address key questions arising in the SDG process. Fourth, scientific knowledge is needed for understanding the many inter-linkages and trade-offs embedded in the SDGs and for developing policy options for transforming trade-offs to synergies. In general, science must provide the factual basis for the SDGs.

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Acronyms

CBDR	Common but Differentiated Responsibilities
CEU	Central European University
CFR	Council on Foreign Relations
DFG	Deutsche Forschungsgemeinschaft (German Research Foundation)
FOC	Friends of the Chair Group on Broader Measures of Progress
G77	Group of 77
GDI	German Development Institute (Deutsches Institut für Entwicklungspolitik)
GEO	Global Environment Outlook
GG	Green Growth
GSDR	Global Sustainable Development Report
GSP	High-level Panel on Global Sustainability
HLPF	High-level Political Forum on Sustainable Development
IA	Integrated Assessment(s)
IAEG-SDGs	Inter-Agency and Expert Group on SDG indicators
ICESDF	Intergovernmental Committee of Experts on Sustainable Development Financing
ICSU	International Council for Science
ICT	Information and Communication Technology

IFW	Institut für Weltwirtschaft an der Universität Kiel (Kiel Institute for the World Economy)
IISD	International Institute for Sustainable Development
IPBES	International Panel on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IRF	Independent Research Forum
ISSC	International Social Science Council
MDGs	Millennium Development Goals
MOI	Means of Implementation
NGO	Non-Governmental Organization
NYT	New York Times
OECD	Organisation for Economic Co-operation and Development
OWG	Open Working Group
PGA	President of the General Assembly
RWI	Rheinisch-Westfälisches Institut für Wirtschaftsforschung
SCP	Sustainable Consumption and Production
SDGs	Sustainable Development Goals
SDSN	Sustainable Development Solutions Network
SMART	Specific, Measurable, Achievable, Resource-Based, and Time-Bound
SPI	Science-Policy Interface
SWP	Stiftung Wissenschaft und Politik, German Institute for International and Security Affairs
UN	United Nations
UNCSD	United Nations Conference on Sustainable Development (Rio 2012)
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNSC	United Nations Statistical Commission
UNSD	United Nations Statistics Division
UNSG	United Nations Secretary-General
UNSG-SAB	United Nations Secretary-General's Scientific Advisory Board
UNU	United Nations University
UNU-EHS	United Nations University – Institute for Environment and Human Security
UK	United Kingdom
WBGU	German Advisory Council on Global Change (Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen)
WWF	World Wide Fund for Nature