SCIENCE FOR NATURE AND PEOPLE project on MAKING ECOSYSTEMS COUNT IN THE SUSTAINABLE DEVELOPMENT GOALS

Report from the MEASURING NATURAL CAPITAL workshop

6-10 October 2014, NCEAS, Santa Barbara, USA
SNAP project on Making Ecosystems Count in the Sustainable Development Goals
Measuring Natural Capital workshop, 6-10 Oct 2014
Workshop Report, FINAL 2014-11-18

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Photo on front cover: SNAP Measuring Natural Capital workshop participants at NCEAS, Santa Barbara, on 9 October 2014. Credit: Ginger Gillquist / NCEAS.

Acknowledgements
We would like to thank all Measuring Natural Capital workshop participants for their hard work and engagement at the workshop that resulted in the workshop outputs presented in this report.
### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>CCAFS</td>
<td>Climate Change, Agriculture and Food Security</td>
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<tr>
<td>CIAT</td>
<td>International Center for Tropical Agriculture</td>
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<td>CIFOR</td>
<td>Center for International Forestry Research</td>
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<td>CRP</td>
<td>CGIAR Research Program</td>
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<td>DESA</td>
<td>(United Nations) Department of Economic and Social Affairs</td>
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<td>GEO-BON</td>
<td>Group on Earth Observations – Biodiversity Observation Network</td>
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<td>IFPRI</td>
<td>International Food Policy Research Institute</td>
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<td>InVEST</td>
<td>Integrated Valuation of Ecosystem Services and Trade-offs</td>
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<td>ISPC</td>
<td>Independent Science Partnership Council</td>
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<td>MDG</td>
<td>Millennium Development Goal</td>
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<td>NCEAS</td>
<td>National Center for Ecological Analysis and Synthesis</td>
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<td>PIM</td>
<td>Policies, Institutions and People (CRP)</td>
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<td>RIOS</td>
<td>Resource Investment Optimization System</td>
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<td>SDG</td>
<td>Sustainable Development Goal</td>
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<td>SDSN</td>
<td>Sustainable Development Solutions Network</td>
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<td>SEEA</td>
<td>System of Environmental-Economic Accounting</td>
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<td>SNAP</td>
<td>Science for Nature and People</td>
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<td>SNAP MEC WG</td>
<td>Science for Nature and People Making Ecosystems Count Working Group</td>
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<tr>
<td>UN</td>
<td>United Nations</td>
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<td>WLE</td>
<td>Water, Land and Ecosystems (CRP)</td>
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Executive Summary

The Measuring Natural Capital workshop brought together a diverse and highly qualified team of experts on ecosystem services, national-level indicators, rural development, sustainability and resilience. Participants were selected to provide a breadth of experience and expertise from scientific and policy communities and attendees included representatives from the United Nations Monitoring and Evaluation office; United Nations Social and Economic Assessment departments; Stockholm Resilience Centre; four CGIAR research centers - Bioversity International, International Center for Tropical Agriculture, Center for International Forestry Research, and International Food Policy Research Institute; and several organisations actively collecting, analyzing or modelling data on ecosystem services - the Natural Capital Project and Vital Signs. Susan Abs, from Eclipse Environmental Consulting Ltd., facilitated the workshop, which was held in Santa Barbara at the National Center for Ecological Analysis and Synthesis, who co-lead the Science for Nature and People initiative.

The primary objective of the four and a half day workshop was to define and characterise a tentative set of natural resource and ecosystem service-based indicators for planning and monitoring progress towards meeting the Sustainable Development Goals (SDGs). Participants worked hard to achieve this objective through a series of presentations, varied group activities and focused plenary discussions. The working group successfully identified over 60 potential indicators, narrowing the list down to 17 indicators the group considered strong candidates for inclusion as SDG indicators. More detailed analysis of these 17 indicators is now underway.

Sessions over the week were very varied and included: presentations on the Sustainable Development Goal planning process, the Vital Signs initiative, and the United Nations System of Environment-Economic Accounting; discussions on natural resource management outcomes; and a stimulating introduction and debate on operationalising resilience. The week also included a number of focus groups to identify natural resource and ecosystem service-based indicators for case study decision-making processes, and guided and informal discussions on the role of science in the SDG process and wider policy arena. Feedback from workshop participants was generally positive, particularly regarding the energy and engagement of the group, intellectual caliber of discussions, and flexibility of organizers. Suggestions for improvement mainly referred to the need for greater clarity on workshop and project goals; the need for more discussion time; and minor improvements to the venue. These suggestions will be used to strengthen subsequent workshops and phases in the project.

Outputs from the week will form the basis of a preliminary set of indicators to be suggested by the working group for inclusion in the SDGs. Indicators identified at the workshop will be reviewed and strengthened over the next few months to derive a more detailed set of natural resource and ecosystem service-based indicators. These will feed into the next two phases of the project on designing a set of decision-making tools for large-scale infrastructure development planning, and consulting with scientific, national and international policy experts to improve the usefulness and usability of our indicators and decision-making tool.
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1. SNAP Working Group on Making Ecosystems Count in the Sustainable Development Goals

1.1 Introduction

Managed landscapes are the backbone of food production and local-livelihoods, but are also key providers of life-sustaining ecosystem services and important harbors of biodiversity. Today many of these landscapes are themselves under threat of severe degradation from high rates of poverty and over-dependence of local economies on natural systems, putting both people and biodiversity at risk. Despite our undeniable reliance on these landscapes, their conservation value from both an environmental and human development perspective is often poorly appreciated and even more poorly measured. Conservationists have been challenged to re-prioritize protection efforts to these vital landscapes but currently lack the tools needed to measure and track widespread changes in these systems, as many of the ecosystem services are “invisible” in current monitoring systems.

As conservation and sustainable development agendas move ahead, the SNAP working group on *Making Ecosystems Count in the Sustainable Development Goals (SNAP MEC WG)* aims to develop and validate a critical set of measurable natural resource and ecosystem service-based indicators for planning and monitoring country-level progress towards meeting the Sustainable Development Goals (SDGs), which can be used to guide natural resource management decisions at the national-level. The SNAP MEC WG focuses on indicators that are grounded in ecosystem science and which highlight the contribution of ecosystem services to achieving well-being outcomes; that include novel evaluation measures, and; that are specifically formulated to be of practical relevance to policy makers faced with making difficult decisions on large scale development opportunities and their impact on livelihoods, present and future.

This SNAP MEC WG is led by Bioversity International and supported by the National Centre for Ecological Analysis and Synthesis (NCEAS), The Nature Conservancy, and the CGIAR research programs on Water, Land and Ecosystems (WLE) and Policies, Institutions and Markets (PIM), as well as in-kind contributions from participating institutes covering staff time associated with the initiative. This working group is a communication point between four CGIAR research programs (CRPs): Climate Change Adaptation and Food Security (CCAFS), Forest Trees and Agroforestry (FTA), Policies, Institutions and Markets (PIM), and Water Land and Ecosystems (WLE). Each of these CRPs has a strong emphasis on co-design of research with local partners and stakeholders supporting the needs of government institutions.

1.2 Objectives

The overarching objective of the SNAP MEC WG is to:

- Develop a set of SDG-relevant natural resource and ecosystem service-based indicators to assist countries in monitoring their progress towards achieving the SDGs.
The secondary objectives are to:

- Design and validate a decision-making tool linked to these indicators that can inform national-level infrastructure development decisions; and
- Inform the development of CGIAR’s strategic results framework.

We aim to derive a set of SDG-relevant indicators that capture major dimensions of ecosystem and ecosystem service change and which demonstrate the links between ecosystems and human and economic well-being, paying specific attention to effects of ecosystem change on livelihoods, food security, and health. The aim is for these indicators to be usable at a national-level to monitor progress towards the SDGs. To support this, our intention is to design a decision-making toolset that illuminates trade-offs between different large-scale infrastructure development and management options in the context of achieving the SDGs. This work will involve several CGIAR centres and the findings are intended to guide the development of CGIAR’s strategic results framework.

1.3 Anticipated Outputs and Outcomes

Five main project outputs are anticipated:

1. A database of existing natural resource and ecosystem service-based indicators potentially relevant to the SDGs;
2. A set of SDG-critical natural resource and ecosystem service-based indicators described in a consistent and comparable format;
3. A decision-making toolkit tested on two to three large-scale infrastructure developments where impacts are measured using indicators described in (2);
4. Supporting materials to ensure the decision-making toolkit is openly accessible and usable; and
5. At least two publishable papers; one describing the decision-making tools and uses, the second assessing the relevance of ecosystem service science to the SDGs.

Through these outputs, we intend to achieve the following outcomes:

1. Inform / influence the metrics and indicators used for the SDGs;
2. Provide an infrastructure development decision-making toolkit to national level stakeholders that can be used to channel infrastructure planning and investment decisions towards attaining the SDGs; and
3. Inform those infrastructure investment decisions selected as pilot studies for the project;
4. Influence CGIAR’s development of natural resource management indicators to track impacts of research on natural resource management and development outcomes;
5. Improve science-policy knowledge exchange by building relationships between CGIAR and public and private sector organisations involved in infrastructure development decisions in Africa.
1.4 **Approach**

To deliver the outputs and outcomes detailed above, the working group activities will follow five main phases:

**Phase 1:** Evaluate existing natural resource and ecosystem service-based indicators and derive a draft set of critical natural resource and ecosystem service-based indicators linked to the SDGs;

**Phase 2:** Design a blueprint for a large-scale infrastructure decision analysis tool whose outputs can be assessed using the draft indicator set derived in Phase 1;

**Phase 3:** Consult with scientific, national and international policy experts on outputs from Phase 1 and 2;

**Phase 4:** Revise and strengthen the indicator set and decision-making tool based on consultation comments received in Phase 3, and pilot test the tool on real-world infrastructure development decisions;

**Phase 5:** Work with scientific, national and international policy experts to assess and improve usability of decision analysis tool outputs.

Figure 1 shows the working group structure, comprising four core team members whose work will be informed and strengthened by science and policy experts through a series of focused workshops.

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**Figure 1:** SNAP Making Ecosystems Count Working Group structure

The **workshop series** will bring together scientists working on ecosystem service metrics and valuation, national and international level policy makers reporting on progress or accountable for achieving the SDGs, and national stakeholders involved in making decisions on large-scale development interventions. These workshops will flow logically into one another and the stakeholder consultation period, to inform key project outputs and help the group achieve anticipated outcomes (see Figure 2). A timeline for the overall project and key milestones is provided in Section 1.5.
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Figure 2: Flow of workshop series inputs, outputs and outcomes over the project lifespan

- Background on SDG process and current indicators
- Outlines of ES-based monitoring systems (Vital Signs, SEEA)
- Potential investment decisions

**Workshop 1: Making Ecosystems Count**
- Draft NR / ES-based indicator set
- Outline of decision-making tool
- Strategy for stakeholder consultation

**Stakeholder Consultation Period**
- Analysis of feedback on usability and relevance of NR / ES-based indicator set and of decision-making tool

**Commentary on Science in the SDGs**
- NR/ES indicator database
- Propose SDG-relevant indicators to SDSN

**Workshop 2: Developing a decision-making toolkit**
- Refined tools and draft supporting materials
- Analysis of usability and usefulness of tool outputs for three case study interventions

**Preliminary modelling tools**
- Analysis of usability and usefulness of tool and outputs for three case studies
- Improvements of tool and tool outputs to aid interpretation of results
- Suite of supporting materials to ensure tool is usable and user-friendly

**Workshop 3: Visualization and usability**
- Complete draft version of decision-making toolkit
- Draft supporting materials to aid use of tool (e.g. guidance for use)

**Decision-making tool for channeling development investments towards achieving the SDGs**
## 1.5 Project timeline

### 2014

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<th>No.</th>
<th>Task</th>
<th>Start</th>
<th>End</th>
</tr>
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<td>1</td>
<td>Evaluate existing NR/ES based indicators</td>
<td>8/1/14</td>
<td>11/21/14</td>
</tr>
<tr>
<td>2</td>
<td>Design draft infrastructure decision toolset</td>
<td>10/13/14</td>
<td>12/5/14</td>
</tr>
<tr>
<td>3</td>
<td>Consultation on infrastructure decision toolset analysis and outputs</td>
<td>11/7/14</td>
<td>3/13/15</td>
</tr>
<tr>
<td>4</td>
<td>Revise infrastructure decision-making toolset design and outputs</td>
<td>3/2/15</td>
<td>4/24/15</td>
</tr>
<tr>
<td>5</td>
<td>Improve usability of decision-making tools</td>
<td>2/1/15</td>
<td>5/31/15</td>
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### 2015

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<td>2/1/15</td>
<td>5/31/15</td>
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2. Framing the Measuring Natural Capital workshop

2.1 Workshop Purpose

To help meet the overarching project objective, the **primary objective** of the first workshop on Measuring Natural Capital was to:

- Define and characterise a tentative set of natural resource-based indicators for planning and monitoring progress towards meeting the SDGs.

The secondary objective was to explore which of these indicators would be useful for informing large-scale infrastructure planning and investment decisions.

The **expected outputs** of the workshop were:

1. Workshop Report - capturing the discussions, methods and outputs of the workshop and a time bound work plan for future work in the project.
2. Consultation Report - to be used as a basis for the consultation with policy-makers, NGOs and technical advisors on the draft indicator set in October-December 2014.

2.2 Participants

A total of 19 participants attended the workshop, including the workshop facilitator. A full list of participants who attended the workshop and their contact details is provided in Annex 7.1.

Participants were selected to provide a breadth of experience and expertise from scientific and policy communities relevant to the SDGs and ecosystem service research. Attendees included representatives from the United Nations Monitoring and Evaluation and Social and Economic Assessment departments; a scientist from the Stockholm Resilience Centre; researchers from four CGIAR research centres - Bioversity International, CIAT, CIFOR, and IFPRI; and several organisations actively collecting and modelling data on ecosystem services – the Natural Capital Project and Vital Signs. Individuals who were invited but sent apologies include scientists from several other organisations, notably GEOBON, The Nature Conservancy, Wetlands International, and the CCAFS and ICRAF CGIAR research centres, and representatives from several policy orientated organisations including the Niger Basin Initiative, FAO, and the World Bank. Susan Abs, from Eclipse Environmental Consulting Ltd., facilitated the workshop.

The workshop was held in Santa Barbara at NCEAS, who co-lead the SNAP initiative.

2.3 Agenda

In order to achieve the workshop objectives and outputs, the workshop sessions aimed to enable the group to:

- Understand the SDG setting and reporting process;
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- Explore the status and role of science in deriving and using indicators;
- Identify and characterize SDG-relevant natural resource and ecosystem service-based indicators;
- Assess novel environmental indicators and identify those that relate to several of the SDGs;
- Select a critical set of SDG-relevant natural resource and ecosystem service-based indicators including for use as part of an infrastructure decision-making tool; and
- Plan the next steps for the project.

Activities over the five days were arranged to meet these aims and achieve the workshop objectives. A mix of presentations, discussions, interactive activities and group work were used to ensure variety and keep participants engaged. A copy of the final agenda is provided in Annex 7.2.
3. Results of the workshop

This section synthesizes the workshop presentations, discussions, questions posed and responses offered by participants, and any outputs produced, in relation to the aims of the workshop. All presentations are available on request from the core project team.

3.1 Introduction

To open the workshop, Frank Davis (NCEAS) welcomed participants to NCEAS and introduced the objective of SNAP. Fabrice DeClerck (Bioversity International) followed by giving an overview of the specific SNAP MEC WG objectives and the anticipated outputs for the Measuring Natural Capital workshop, namely to derive a critical set of SDG-relevant indicators. With that, we were underway!

3.2 Understanding the SDG setting and reporting process

Two presentations were delivered on day one of the workshop – by Sylvia Wood (Columbia University and Bioversity International) and Julian Chow (United Nations Department for Social and Economic Affairs) - aimed at elucidating the process by which the Sustainable Development Goals are derived and reported on at the United Nations (UN), to help the group understand the role of indicators in planning for and monitoring progress towards attaining the SDGs.

Sylvia explained that a tentative set of 17 SDGs, along with 169 targets and over 100 indicators for monitoring these targets, are being reviewed and negotiated within the UN from now until September 2015. To build on lessons learned from attempts to monitor progress towards Millennium Development Goals (MDGs), the SDGs are expected to be more data-driven to help overcome data collection challenges. Sylvia highlighted that national efforts to meet the SDGs are guided by what countries must report on, therefore, if we can help to ensure countries are using a strong indicator set – underpinned by reliable data - this will help them meet the goals.

The importance of good data for monitoring purposes was echoed by Julian, who described the approach by which monitoring for the SDGs is likely be conducted. Monitoring is still under discussion but is likely to follow the process used under the MDGs and be coordinated by government-led specialist committees who will integrate the SDGs into National Development Plans. National Statistics Offices are likely to play a critical role in obtaining and updating the data needed to monitor progress. Ensuring data availability, quality and comparability is essential. Julian highlighted the importance of countries taking national ownership for the SDGs through integrating the goals into national policies and fostering inter-agency and cross-stakeholder engagement.

Julian went on to explain the System of Environmental-Economic Accounting (SEEA) developed by DESA to facilitate integrated social, economic and environmental national-level accounting. The SEEA provides a central framework for environmental accounting that was adopted as a national standard by the UN statistical commission in 2012. A key point of interest to this SNAP MEC WG is that the SEEA system links ecosystem assets and well-being through ecosystem services.
3.3 The status and role of science on natural resource and ecosystem services for deriving and using indicators

Several presentations and group exercises aimed to provide participants with an insight to and stimulate thinking about how we might draw on the broad range of techniques used and organisations involved in measuring and monitoring natural resources / ecosystem services.

Becky Chaplin-Kramer (Natural Capital Project) introduced two ecosystem service assessment tools: the Integrated Valuation of Ecosystem Services and Trade-offs (InVEST) and Resource Investment Optimisation System (RIOS). The two programs work in tandem, where RIOS is used to generate alternate ecosystem service-based scenarios and InVEST generates spatially explicit maps of these ecosystem services and their provision levels. These include a growing list of services, e.g. water quantity available for irrigation, drinking water and hydropower. The values are calculated according to the specific use value and can be compared against other means of ensuring service provision, including built infrastructure. Becky highlighted that ecosystem service modeling typically focuses on ecosystem service supply (biophysical processes and structures that generate ecosystem services), but a supply of ecosystem services only provides a service when it reaches people. Becky proposed that assessing the outcomes of ecosystem service flows is something we can contribute to the SDG indicators; identifying who benefits, who loses, and where an intervention could be effective. Participants discussed the fact that there is a lot at stake if models are inaccurate, and therefore there might be value in characterizing indicators used in any decision-making according to the accuracy of the associated model.

Becky also gave a brief introduction to the GEO-BON Ecosystem Service working group, explaining that this group works to track global changes in ecosystem services and cross-regional trade-offs in services. She highlighted that part of GEO-BON’s work focuses on exploring the quantitative relationship between ecosystem services and poverty alleviation using existing national datasets e.g. emerging research by Patti Balvanera.

Data collection and access for decision-making in the development context was discussed by Sandy Andelman, who introduced participants to work carried out by Vital Signs. Vital Signs seek to integrate multi-source and multi-scale datasets (e.g. agricultural, livelihoods and conservation data) to monitor changing environmental and livelihood conditions to enable more informed development at lower costs. Working with Ushahidi and CrisisNET, they provide tools for mobilizing and harmonizing existing datasets, and they advocate the use of protocols for collecting and integrating data for decision support. Sandy stressed that while scientists typically prefer the idea of having many indicators and metrics for decision-support, consultation conducted by Vital Signs has showed that the policy sector, private sector and NGOs want only a few high level indicators, perhaps with additional indicators for further information. Sandy went on to explain that visualization of indicators is very complicated and depends on the medium through which data will be viewed (e.g. on a cellphone, or a tablet) and thus should be done with care and in consultation with those planning to use the information provided.

A presentation by James Stevenson (CGIAR Independent Science Partnership Council, or ISPC) shifted the focus of the discussion towards monitoring the impact of natural resource management
research outcomes on development outcomes. The ISPC takes a two-pronged approach to this task, first studying the impact of research outcomes (e.g. influence on forest policy decision-making process) on natural research management and therefore on outcomes for natural resources (e.g. reduction in deforestation), and second identifying the outcomes themselves and tracing back to identify drivers of change and enabling conditions within natural resource management in order to determine how these drivers were influenced by research outcomes. James explained that this work is important for demonstrating the value of different CGIAR research activities and therefore influencing future research and funding priorities (as could similarly be the case for national-level monitoring efforts related to the SDGs). A sizeable challenge relevant for this working group is the high level of uncertainty in existing methods for linking natural resource management changes to actual impacts on natural resources (and the benefits they provide to people).

Sandra Corsi (Bioversity International) followed with a presentation on assessing the impact of natural resource management research-for-development. First, Sandra explained the main differences between impact assessment for research, development and research-for-development. She proposed that impact assessment of research relies on measurable outcomes assessed with counterfactual analyses to prove impact, whereas most development interventions are assessed by identifying contributory causes and rely on a theory of change to assess impact. In impact assessment for research-for-development, the type of impact depends on the extent to which the intervention under assessment is research-oriented or development-oriented, with key challenges being: (i) the methodological plurality of current and past CGIAR’s interventions; and (ii) the impossibility of retroactively adopting a statistical approach for impact assessment where the intervention did not follow such an approach.

Next, Sandra presented an early attempt to develop a natural resource management results framework for research-for-development interventions. The underlying hypotheses of the framework are: (i) a comprehensive definition of sustainability is needed; (ii) each intervention needs to report on all areas of sustainability; and (iii) indicators associated with each sustainability dimension are required. When all conditions are met, data will create a convincing narrative and will capture potential inter-sector tradeoffs. Sandra suggested indicators associated with each sustainability dimension need to be calibrated for each locality, but should be based on comparable data and scoring methods to allow cross-case comparisons. In plenary, participants discussed (i) the difficulty of carrying out impact assessment analyses for interventions conducted in the absence of experimental designs, and (ii) the complexity of devising a scoring method.

Alongside these presentations, to collect ideas about which gaps in science were most important for this working group, participants responded individually as part of a group interview exercise to the question: What are the critical gaps in existing natural resource-based indicators, metrics and data?

Data availability, collection and harmonization in line with reporting time-lines were highlighted, with participants recognizing that data gaps and poor quality data can undermine the usefulness of an indicator to decision-makers at the national and global level. Participants proposed that there is a need for indicators to be based on a standard for data collection that ensures adequate accuracy without
making data collection impractical (i.e. enabling remotely sensed data use where possible). Participants agreed that there is a noticeable gap in data and metrics pertaining to cultural ecosystem services, which may be due to the difficulty in finding quantifiable and comparable data for this type of ecosystem benefit. The group discussed the importance of capacity building for overcoming these gaps, and of more effectively communicating why natural resources matter.

There was consensus among workshop participants that one substantive challenge for deriving a SDG-relevant indicator set lies in finding cross-cutting indicators; that provide information relevant to multiple goals or aspects of well-being. The group agreed that ascertaining indicators for tipping points in a system would be highly valuable, to provide early warning signs for decision-makers of changes to ecosystems and human well-being. This theme was continued in a discussion on resilience and a group debate on critical thresholds (see section 3.6).

3.4 Identifying SDG-relevant natural resource and ecosystem service-based indicators

Small group work, individual work, and plenary discussions started on day 1 of the workshop to identify what constitutes an SDG-relevant natural resource or ecosystem service-based indicator. These were complimented with two brainstorming sessions to identify potential candidates for our critical indicator set.

Participants worked to address the following questions:

- How can natural resource-based indicators and metrics guide decision-making?
- How far can natural resource-based indicators be linked to social and economic well-being?
- Who are the targeted end users of these indicators, and how can we help ensure they use them?
- Which SDGs and other country-level goals will our indicators help monitor progress towards?
- What type and level of indicators will we consider?
- What criteria will we use for indicator selection?

The following sections summaries the conclusions reached by participants over the week in response to these questions.

How can natural resource-based indicators and metrics guide decision-making?

A key point raised by participants in response to this question is that natural resource / ecosystem service-based indicators can make trade-offs between activities and ecosystem services more visible, allowing for prioritization of activities and adaptive management of natural resources. Participants thought that time-series use of these indicators may help identify thresholds or risks posed by specific approaches, and make it easier to assign accountability to decision-makers for their actions. They agreed that a critical advantage of using a standard set of indicators and metrics across countries is that this provides a common language for discussion and comparison at a global level. On the flip-
side decision-makers may focus on changes in indicators rather than outcomes, meaning that poor indicators can foster poor decision-making.

Who are the targeted end users of these indicators, and how can we help ensure they use them?

The group decided that potential end-users of SDG-relevant indicators are likely to include national governments (e.g. agriculture, environment, infrastructure, planners), the global funding community, researchers, local governments and their stakeholders, regional scale bodies, NGOs, and global bodies linked to international conventions.

A significant barrier to use of these indicators is the targets associated with the SDGs and specifically if these do not lend themselves to measurement, as is currently the case for many of the targets. The group agreed we could increase the likelihood of our indicators being taken up by:

- making the indicators clear and easy to understand and use;
- demonstrating their use, especially through a decision-support tool;
- ensuring each indicator is well-documented with agreed standards for use;
- co-developing indicators with end-users;
- deriving indicators that are adaptable to local contexts;
- ensuring a clear link between indicators and benefits to people (i.e. income, jobs);
- assuring that any datasets required for use of an indicator are attainable by end-users, including building capacity to this end where needed; and
- striving to identify an unbiased set of indicators.

Which SDGs and other country-level goals will our indicators help monitor progress towards?

Participants reviewed the SDGs and their associated targets and indicators and identified the SDGs for which they thought natural resource or ecosystem service-based indicators could be most useful. These were:

- SDG1: End poverty in all its forms everywhere
- SDG2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
- SDG3: Ensure healthy lives and promote well-being for all at all ages
- SDG5: Achieve gender equality and empower all women and girls
- SDG6: Ensure availability and sustainable management of water and sanitation for all
- SDG7: Ensure access to affordable, reliable, sustainable and modern energy for all
- SDG11 (possibly): Make cities and human settlements inclusive, safe, resilient and sustainable
- SDG12: Ensure sustainable consumption and production patterns
- SDG13: Take urgent action to combat climate change and its impacts
- SDG14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development
• SDG15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

A question was raised regarding how the workshop participants might best use their expertise to add value to the SDG indicator set. The group decided that goals 2, 3, 6, 7, 15 were both highly relevant for natural resource or ecosystem service-based indicators and well-aligned to the participants’ range of expertise in terrestrial and particularly agricultural systems. **It was therefore decided that these five SDGs would be the main focus of discussions over the course of the workshop**, although participants agreed that we might ultimately want an indicator set mapping onto all SDGs. The participants also discussed the project focus of considering how environmental goals (particularly SDG15) contribute to social and economic goals. As such, much of the discussion during the week revolved around how SDG 15 contributes to achieving SDG 2, 3, 6 and 7 as mediated by ecosystems services.

**What type and level of indicators will we consider?**

Participants agreed that the type of indicators that the group could consider was very broad, ranging from soil-quality, to water supply, to biodiversity, and that each type of indicator will need to be fully defined in our final indicator set as these can hold different meanings for different audiences. On discussing what constitutes an “ecosystem service-based” indicator, it became clear that the conception of “ecosystem service-based indicator” and “natural resource-based indicator” differed across the group. Participants discussed the following preliminary definitions:

- A **natural resource-based indicator** is one that measures natural resource stocks or condition, e.g. ha above-ground biomass;
- An **ecosystem service-based indicator** is one that measures human well-being as mitigated by an ecosystem service, e.g. % energy usage derived from biofuel.

At least one participant raised the point that it could be important to distinguish between indicators for ecosystem change and those for an ecosystem service, such as to link with terminology in accounting approaches (stocks, flows) or ecosystem service science (supply, service, benefit). **General consensus from participants was that this distinction would be important**, agreeing that it is not very helpful for development if the provision of ecosystem services is increasing but the benefits are not reaching people. Another participant pointed out we should refer to the potential for well-being as a way of more precisely differentiating service supply and delivery. The group discussed the idea that indicators for ecosystem service supply could either be measures of the provision of a service (e.g. food yield, carbon sequestration rate) or measures of anthropogenic inputs as service replacement (e.g. fertilizer application replacing soil fertility services). No consensus was reached on how best to measure ecosystem service delivery (and benefits). **Participants agreed that further work will be needed post-workshop to iron out the above definitions** and in particular improve the definition of an ecosystem service-based indicator to better capture the idea of ecosystem service flows.
There was some debate around whether we should be seeking natural resource based indicators, as per the stated workshop objective, or ecosystem service-based indicators. Most participants were of the opinion that the latter type – with a general understanding that these are indicators that measure ecosystem service flows - hold greater potential to be cross-cutting and novel, and are therefore more likely to appeal and gain traction as alternatives to the currently proposed SDG indicator set. The group decided that we should seek to identify both natural resource and ecosystem service-based indicators.

What criteria will we use for indicator selection?

Participants discussed the characteristics of a good quality indicator, starting with a review of the criteria for robust SDG indicators proposed by SDSN. Sarah Jones (Bioversity International) described alternative criteria for good quality indicators proposed by CIFOR, indicating several gaps in SDSN’s criteria list. Over two group breakout sessions and a plenary discussion, participants tentatively proposed the following criteria for indicator selection, with consensus that these criteria will need further review before adoption by the working group:

1. Clear, straight-forward and intuitive
2. Consensus based (in line with international standards); unambiguously defined and constructed; methodically sound
3. Broadly consistent with systems-based information (i.e. in FAO system); constructed from well-established data sources (may require capacity building for key variables); measurable and feasible to collect (e.g. affordable)
4. Disaggregated and scalable
5. Universal
6. Managed by a designated organization
7. Existence of a baseline (now or soon)
8. Fit for purpose; outcome orientated (e.g. policy in place versus behavior change)
9. Sensitive to incremental change
10. Have major influence on uptake of ecosystem service and resilience approaches.

The group discussed the value of including a criteria pertaining to the position of an indicator on the causal pathway between action (implementing change) and outcome (achievement of a goal), most likely incorporated into criterion 8. Participants discussed the problems around this because of gaps in scientific knowledge; what research could be done in order to make those causal links? The discussion concluded that there is a strong case for research that more clearly demonstrates the link between ecosystem service provision and human well-being.

How far can natural resource based indicators are linked to social and economic well-being?

This question was posed to stimulate thinking around how a set of environmental-based indicators might underpin social and economic indicators used to monitor progress towards achieving the SDGs.
One participant raised the point that jurisdictional boundaries – typically used in social and economic data analysis – do not always provide a suitable boundary for monitoring ecosystem services, since these are often trans-boundary, creating a data comparison issue. Workshop participants discussed the potential for measures such as natural resource depletion to provide an indication of future well-being, but thought that existing measures lack credibility and therefore influence, e.g. quality of life index. There was consensus across the group that monitoring distributional effects - mapping the flow of natural resources / ecosystem services and their benefits to people across space and time – is both difficult and very important for linking natural resources to human well-being, since trade-offs will arise between beneficiaries (social groups).

**Brainstorming indicators**

Several rounds of group-work focused on generating indicators we might include in our critical indicator set.

First, to help understand the ways in which this working group could add value to the SDG indicators, participants worked in small groups to review the indicators already proposed under SDG15 and identify gaps and potential replacement opportunities. The groups concluded that the current set of indicators for SDG15 is largely inadequate and incomplete (e.g. the focus on red list species is too narrow). There was a noticeable gap in indicators demonstrate links between natural resources and human well-being – such as through ecosystem service concepts, meaning there is an opportunity for this group to suggest such indicators. Indicators under SDG6 were similarly assessed as lacking elements of ecosystem services.

Participants’ initial ideas on how indicators for SDG15 could be improved were:

- Extend the existing measures to indicate the capacity of each to provide a service
- Include a measure of land degradation;
- Include a measure of soil quality; and
- Include a measure of soil microbial diversity, since this is a good indicator for soil-related ecosystem services.

Second, participants worked in groups of four to five to brainstorm suitable indicators for SDGs 2, 3, 6, and 7 to emphasis the functional relationship between ecosystems and the services they provide. Participants referred to indicators used for the Aichi targets and existing SDG indicators and considered what indicators would be useful for monitoring these four SDGs, how they might be measured, and how they could be characterized using the criteria developed earlier in the workshop. The results of this work was a set of approximately 30 indicators that were not already in the SDGs and that were potentially good candidates for inclusion under one of SDG 2, 3, 6 or 7, with several indicators thought to be relevant for several SDGs (e.g. human trophic level was deemed relevant to SDG 2, 3 and 12).
SNAP project on Making Ecosystems Count in the Sustainable Development Goals
Measuring Natural Capital workshop, 6-10 Oct 2014
Workshop Report, FINAL 2014-11-18

Next, participants were introduced to three case studies where development decisions are under consideration: management of the FOMI hydropower dam; design of a SACGOT sugar plantation; and planning small catchment system locations in the Volta Basin.

First, Justin Johnson (University of Minnesota / Bioversity International / The Nature Conservancy / Natural Capital Project) introduced participants to the development context surrounding the FOMI dam, a planned hydropower plant development in the Niger basin. Justin explained that changes to the flow regime are one way in which ecosystem services would be affected by the development, and decision-making could be better informed by an analysis to see what hydropower design and management techniques would help maintain services by mimicking natural flows, managing pulse flows, or mitigating ecosystem service losses. A stylized representation of three different scenarios that could result from differing flow regimes chosen for the dam was presented (see Figure 3), where each scenario would produce a different sized inundation zone of the Inner Niger Delta.

Second, Evan Girvetz (CIAT) presented on the Southern Agricultural Growth Corridor of Tanzania (SAGCOT), explaining that this area is the target of major agricultural development and decisions will relate to the locations (within specified sub-regions), design and management of these developments and their associated components, such as road infrastructure, housing and irrigation systems.

Third, Fabrice DeClerck introduced a project led by Bioversity International to identify optimal locations for small water catchment systems across the northern Volta basin. Fabrice explained that decisions on the location of these systems will be made to maximize crop for drop from irrigated agriculture, and an analysis of the impacts on and trade-offs for ecosystem service flows to agriculture and other sectors would inform the decision-making.

Participants worked in small groups over two separate sessions to brainstorm potential natural resource and ecosystem service-based indicators for guiding decision-making in these three case study contexts. Table 1 presents the results of this work.

<table>
<thead>
<tr>
<th>Context</th>
<th>Ecosystem service</th>
<th>Indicator</th>
</tr>
</thead>
</table>

Figure 3: Scenarios for altering the flow regime of the Fomi dam
<table>
<thead>
<tr>
<th>Context</th>
<th>Ecosystem service</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOMI dam focusing on decisions about management of flow regime, grid expansion, mitigation of ecosystem service losses</td>
<td>Water quantity</td>
<td>Rainwater capture, Groundwater table, Irrigation water available</td>
</tr>
<tr>
<td></td>
<td>Water quality</td>
<td>An index variable measuring toxic metals, nitrogen, etc. Nutrient / sediment load in watercourse above and below the dam</td>
</tr>
<tr>
<td></td>
<td>Flood regulation</td>
<td>Discharge rate, Low/high water variance</td>
</tr>
<tr>
<td></td>
<td>Food</td>
<td>Fish stocks, Species diversity index, Change in extent and type of aquatic habitat</td>
</tr>
<tr>
<td></td>
<td>Biofuel (possible reduction in pressure on biofuel as a result of hydropower)</td>
<td>Change in above ground biomass</td>
</tr>
<tr>
<td></td>
<td>Passage by river</td>
<td>Number of navigable vessels passing through identified points</td>
</tr>
<tr>
<td></td>
<td>Soil quality</td>
<td>Salinization, Soil quality health index (soil organic matter, carbon / nitrogen / phosphorous content)</td>
</tr>
<tr>
<td>SAGCOT focusing on decisions about location, farm type, design specifics (e.g. road, contract farming, cropping systems), management</td>
<td>Water supply, including allocation for difficult uses and beneficiaries, and temporal / spatial variations</td>
<td>River levels, Groundwater levels</td>
</tr>
<tr>
<td></td>
<td>Water quality</td>
<td>% of population at risk of flooding (can it be related to flood control service of different land cover / land-use types?)</td>
</tr>
<tr>
<td></td>
<td>Soil fertility</td>
<td>Soil organic carbon levels</td>
</tr>
<tr>
<td></td>
<td>Carbon sequestration</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Food</td>
<td>Yield disaggregated by area in/out of plantation, Area under cultivation per crop variety, Change in nutrition from changes to agro-biodiversity, wild food products</td>
</tr>
<tr>
<td></td>
<td>Eco-tourism and recreational services</td>
<td>Protected area extent</td>
</tr>
<tr>
<td></td>
<td>Cultural value of land</td>
<td>Number of people displaced from land that has high cultural value for individual (Masai herders)</td>
</tr>
<tr>
<td></td>
<td>Disease control</td>
<td>Incidence of malaria / diarrhea, Changes in disease vectors</td>
</tr>
<tr>
<td></td>
<td>Pollination</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Pest control</td>
<td>Bird populations (but questionable metric)</td>
</tr>
<tr>
<td>Volta basin small catchment systems focusing on decisions about system location</td>
<td>Water quantity</td>
<td>Water use efficiency</td>
</tr>
<tr>
<td></td>
<td>Soil quality</td>
<td>Soil organic carbon</td>
</tr>
<tr>
<td></td>
<td>Food</td>
<td>Dietary diversity, e.g. nutritional functional diversity, human trophic levels, food</td>
</tr>
</tbody>
</table>
In plenary, participants discussed the importance of thinking about the longer-term context for each of the case studies (e.g. effect of climate change) and thought that it would be good to incorporate this into indicators used for decision-making.

3.5 Assessing novel and cross-cutting elements of SDG-relevant indicators

Line Gordon (Stockholm Resilience Centre) gave a captivating presentation on the concepts of resilience thinking and planning to help participants understand and explore how resilience might be used to strengthen SDG-relevant indicators. Line summarized the rapid environmental and consumption changes of the Anthropocene and proposed that there is growing evidence of systems approaching tipping points creating regime shifts, which can fundamentally change ecosystem service flows. When change happens rapidly and people are not prepared for the new state, this can cause a rapid loss of well-being; but equally lack of change is a problem when people are living in a resilience but undesirable system state (e.g. in poverty). Line proposed the following definition:

- **Resilience** is the capacity of a system – be it an individual, a forest, a city, or an economy – to deal with change and continue to develop.

Line emphasized that resilience is not a goal in itself, but about making other goals resilient. She suggested there are **five ways in which resilience is being operationalized that might be relevant to our SDG-relevant indicator set:**

- Drawing on the seven principles for applying resilience to ecosystem services proposed by Biggs et al. (2012);
- Conducting resilience assessments, described in more detail in the Resilience Alliance assessment workbook;
- Detecting early warning signs of thresholds and tipping points;
• Applying adaptive management, as described in Biggs and Rogers (2003) and Folke et al. (2005);
• Deriving metrics and indicators for resilience, as proposed in Béné (2013) and Speranza et al. (2014).

This introduction to resilience was followed by a debate (see Figure 4) designed to stimulate ideas on the usefulness of thresholds for indicators as one way of incorporating resilience into our indicator set, and more specifically how these thresholds can / should be derived.

Participants were split into two debating teams and a judging panel and debated the question: “Setting critical thresholds for the SDGs should only be achieved through social processes (as opposed to through science)”. Key points arising from this lively debate include:

• Concern that we lack of scientifically robust thresholds relating to ecosystem service supply and use;
• Recognition that, for national level action, global thresholds need to be translated into national-level thresholds and this is not straight-forward;
• Acknowledgement that social processes are rarely able to handle uncertainty;
• Concern that socially derived thresholds can be politically motivated;
• Agreement that science is a socially mediated process so however robust the thresholds are for the SDGs, without buy-in from society, these thresholds will have limited use;
• Recognition that purely science-derived thresholds are not possible in areas with lack of long-term or detailed data and that there is a space for expert opinion to help guide this process; and
• Implementation of scientifically derived targets (on their own) usually fails; these need to be contextualized.

Overall, participants agreed that science is critical for providing robust information on which to set thresholds, but social processes are fundamental to the setting and application of these thresholds. The group thought it is imperative that we seek to understand what more can be done to integrate scientific knowledge into social processes where we know this knowledge could be important.

3.6 Relating indicators to an infrastructure decision-making tool

Conceptual framework for a decision-making tool

Justin Johnson described a modeling framework for the project’s infrastructure development decision-making tool. The objectives of the modeling exercise were to show how natural resource and ecosystem service-based indicators can be evaluated in a three-part framework: scenario generation, service provision and indicator valuation. Justin proposed two contact points at which the modeling framework can be used to inform the SDG indicator discussion: inform initial discussions with SDSN; and, apply the modeling framework to the three case studies to show how natural resource and ecosystem service-based indicators can be implemented in specific investment contexts.
The three components of the decision-making tool are shown in Figure 5.

Justin explained that the first step, scenario development, would be the process of engaging stakeholders in order for us to understand which intervention options are feasible and to explore how different implementations of the investment decisions will affect future land-use (or other datasets). The second model component, estimating the change in ecosystem function, natural resource level or ecosystem service provision, would be estimated with existing models, such as InVEST. Finally, the resulting level of ecosystem service provision from each scenario would be assessed using the SDG-relevant indicators developed by this group. Once finished, the idea is that the modeling tool could be re-run with differing parameters to test for resiliency.

The three case studies introduced to the group earlier in the week were used to discuss the modelling framework in more detail. Participants worked in small groups to identify which ecosystem services would be most relevant (i.e. affected by the proposed infrastructure) for decisions presented in each case study, and how indicators identified over the week could be used to monitor these services. Participants then discussed how these indicators could be used as part of a decision-making tool, using the conceptual framework presented by the workshop organizers.

**Discussion on the decision-making tool concept**
Justin Johnson (see Figure 6) explained that the aim for the decision-making tool is to present outputs in a way that will show trade-offs between indicators – and therefore SDGs – for different scenarios, and attempt to incorporate resilience ideas such as by identifying critical thresholds for indicator values. If the tool could be set up to work as envisaged, participants agreed that it could be a very useful product for decision-makers.

Suggestions from participants for tool improvement were:

- Check whether indicators at a national level would always be relevant for a large-scale investment, i.e. would indicators be sensitive enough to capture change due to the infrastructure development;
- Ensure it is clear that our outputs measure progress towards achieving the SDGs under different scenarios, rather than only provide an assessment of ecosystem services, which many other models can already do;
- Design model so that outputs plug into an economic valuation tool so that we can illustrate cross-sectorial trade-offs;
- Seek to identify what our indicators can add to those already in use in national-level decision-making processes (e.g. in national 5-year development plans); and
- Link our model to the environmental impact assessment process, since most large-scale infrastructure decisions will undergo this type of assessment, and similarly explore how we can link our tool to cumulative assessments and strategic environmental assessments.
3.7 Selecting a critical set of SDG-relevant natural resource and ecosystem service-based indicators

Sylvia Wood explained that the SDSN is seeking to ensure there are no more than 100 core indicators for the SDGs and therefore any new indicators proposed by this working group will ideally need to be proposed as alternatives or revisions to indicators currently in the list. Through a mixture of discussions in plenary and small group-work, participants worked to narrow down the range of indicators proposed over the week and identify a critical set of ecosystem service indicators that were:

- Complementary to one another;
- Relevant to and usable by policy-makers; and
- Build on existing initiatives to measure and monitor natural capital and ecosystem change.

All of the indicators suggested over the week were gathered into a database by the organizers and participants worked in groups to characterize these indicators (using the criteria list presented in part 3.5) and select those that might be suitable for inclusion in a critical natural resource / ecosystem service-based indicator set for the SDGs. A dot voting (color-coded system of “keep it”, “drop it”, or “not sure”) exercise and group discussion of the results was used to decide which indicators could potentially be proposed immediately for inclusion in the SDGs. The full list of indicators considered in the dot voting exercise is as follows, arranged in order of decreasing number of “keep it” votes and increasing number of “drop it” votes:

1. Soil organic carbon
2. Area of hypoxia and eutrophied zones
3. SEEA water productivity indicator
4. Environmental flows and groundwater supplies
5. River fragmentation and flow regulation index
6. Change in agro-biodiversity
7. Land cover conversion
8. % riparian flows maintained
9. Nitrogen use efficiency
10. Wild commodities index
11. Nutrient and sediment levels in water
12. Habitat fragmentation index
13. Water quality for biodiversity index
14. Pollination
15. Human trophic level
16. % renewable electricity
17. % of electrified households on/off grid.

Participants agreed that the first four indicators on the list were likely to be good candidates for inclusion in the SDG indicator list. These indicators were considered by participants as good candidates mainly because of their cross-cutting or novelty value. For example, soil organic carbon was considered resilience relevant (slow variable), while land cover conversion was thought to be applicable to all
biomes and to build on systems thinking. The lowest priority was given to indicators that were thought to be too difficult to measure (e.g. % electrified households on/off grid) or had questionable usefulness above existing indicators (e.g. human trophic level).

### 3.8 Planning the next steps for the project

A group discussion, guided by Susan Abs, was held to collate participant thoughts and expertise on how to plan and conduct the consultation on our indicator set and decision-making tool. Highlights of the suggestions provided are:

- Check there is buy-in from stakeholders for our indicators and decision-making tool – are they relevant, useful, and applicable (e.g. data access issues)?
- Demonstrate any modelling tools with examples;
- Find out what the existing decision-making process is and whether there are already instruments in place to maximize benefits from ecosystem service trade-offs;
- Get advice on improving our decision-making tool and see who might help us promote this tool;
- Seek to understand stakeholder needs to enable countries to meet the SDGs and ask how we can meet these needs - find out where stakeholders think we can have an impact;
- Conduct a two-tiered consultation (and ideally three consultation periods), one relevant to specific investments and one relevant to national level technical groups accountable or whose work is relevant to the SDGs; and
- Piggy back on events that are already happening, e.g. via SAGCOT, Vital Signs, IPBES, organized training workshops on the SDGs (e.g. by UNDP).

Participants moved onto discuss how to take forward the research ideas emerging from the workshop to potentially publish. Two central ideas emerged and **it was agreed that these will be taken forward by the participants over the next few months:**

- Assess the status of the science-policy interface around the SDGs and identify routes for science to better integrate into SDG-relevant policy processes; and
- Test and report on the effectiveness of the decision-making tool designed by the group.

### 3.9 Closure

The workshop was closed by Fabrice DeClerck who gave a summary of the week’s achievements and a big thank you to participants and organizers for an engaging and productive week. Participants were invited to complete a workshop evaluation form and results of the feedback from this and through the week are presented in Section 4.
4. Feedback from participants

Participants were invited to provide short feedback on the workshop sessions at the end of each day on slips of paper and more detailed feedback at the end of the workshop on an evaluation form.

A selection of the feedback received during the workshop is provided below. We have selected comments with the aim of capturing the spectrum of feedback received over the course of the week. Feedback was provided anonymously and therefore participant names are not indicated.

Positive feedback

- “Resilience presentation was excellent.”
- “Energetic, engaged group of participants.”
- “Intellectual strengths of participants [and] participative nature of the group.”
- “I really enjoyed the group – I think we worked together well. It was great having structure but being flexible as needed to adjust. I think we ended up in a good place.”
- “Focused leadership.”
- “Great flexibility of the organizers.”
- “Good structure and flow.”
- “Open and inclusive.”
- “Debate worked well to stimulate thinking”
- “People really bringing their best ideas to the conversations”

Suggestions for improvements

- “I feel like the group is tasked with achieving related but somewhat disparate outcomes – SDGs, SRF and project level [goals]. It would be helpful to know if there are more/less important aspects among and within these.”
- “Are we trying to do too much?”
- “Pre-meeting communication and greater clarity on objectives could probably have made the workshop even more productive.”
- “Focus more on the key indicators.”
- “The debate was fun, but I’m not sure if it added to developing a set of indicators. I think we need more time for in-depth discussion to reduce, refine and really define the indicator list.”
- “Group should avoid appearing ideological and decide steps objectively.”
- “Not clear which activities lead to which outputs.”
- “Some type of review (done by organizers) of previous indicator discussions.”
- “It would be useful to have an assessment of data availability and gaps.”
- “More participants from beneficiary stakeholder [groups].”
- “Agenda pretty jam-packed. A little less presentation; more discussion.”
- “Provide microphone and shorten the duration of the workshop.”
- “Need better aircon – really noisy.”
Fourteen of the nineteen participants completed and returned the end-of-workshop evaluation form (provided in Annex 7.3).

Encouragingly, participants consistently gave most workshop sessions a high rating (value 4 or 5). The sessions on *The Proposed SDGs* on Day 1 and *An Introduction to Resilience* on Day 3 received the highest rating (value 5) from more than half of the survey respondents. Several other sessions received high ratings from all respondents, such as *Introduction to Vital Signs* on Day 1, the *FOMI dam investment* and *SAGCOT - Sugar Plantation* on Day 2, and *An Overview of the Scenario Analysis* session on Day 4. This indicates that participants considered a range of sessions over the week to have been well-executed and relevant; welcome positive feedback for the presenters and organizers. In contrast, several workshop sessions were considered of limited value by some participants, receiving value ratings of 1 or 2 from one or more respondents. However, no single session received low ratings (level 1 or 2) from more than three respondents, and all sessions were rated highly (level 4 or 5) by at least four respondents. This is most likely a reflection of the wide range of interests, perspectives and expertise at the workshop. It seems fair to conclude that although satisfaction between sessions varied, all of the week’s sessions were valuable to the group as a whole.

With respect to organization, logistics and communication around the workshop, responses suggest that some participants were dissatisfied with the clarity of goals, objectives and outputs, and two participants indicate that the pre-workshop communication did not meet their expectations. This is also reflected in participant responses to evaluation form questions (discussed below). However, it is heartening to note that all respondents rated the *Degree to which all participants could voice their views* at level 4 or 5, inferring the workshop successfully created an open space for discussion. Respondents similarly rated the *Facilitation* highly (level 4 or 5 by 11 respondents), suggesting the activities undertaken by the organizing team and particularly the facilitator to help maintain flow and achieve outputs through the week were appreciated. The evaluation responses and several feedback comments indicate that participants considered the air-conditioning system sub-optimal – probably due to the noisiness of the system making it impractical to keep the system operating during plenary – and thought the room itself was not ideal; several respondents commented that room was too small.

Participant answers to questions at the end of the evaluation form, and feedback provided daily through the week, give a good indication of overall participant satisfaction with the workshop and helpful advice for strengthening the project going forward. Feedback was generally positive, particularly regarding the atmosphere and energy in the group; intellectual content of discussions; adaptations made to the workshop sessions in reaction to participant suggestions through the week; and the variety of formats used for the sessions. It is clear that several respondents thought the workshop and project objectives were unclear (although comments indicate that this became clearer over the course of the week) and that having three seemingly disparate project objectives was confusing. Several participants commented that there was not enough time for discussion and that there is a need for the project tasks to be more explicitly linked to each other and to anticipated outputs. We discuss this further in the Conclusions and Recommendations section.
5. Conclusion and Recommendations

Workshop participants made significant progress towards a critical set of natural resource and ecosystem service-based indicators for the SDGs. Participants derived strong initial criteria against which to assess these indicators, which will be reviewed further by the core working group team and during stakeholder consultation. Over 60 SDG-relevant indicators linking natural resources with human well-being were suggested over the course of the workshop, with a tentative list of 17 indicators put forward by the end of the week. More detailed analysis of these 17 is now underway.

Overall, participants agreed there are significant gaps in the current list of indicators for the SDGs proposed by SDSN, regarding cross-cutting indicators that provide information on ecosystem services that is relevant to multiple aspects of well-being, which this working group can help to fill. The working group recognized that indicators for distributional effects of development decisions – the flow of ecosystem service benefits to different groups of people over space and time – would be highly valuable to decision-makers, but further work is needed by the group to identify such indicators.

Several recommendations emerged from the workshop and through feedback from participants for improving the project design and ensuring project objectives are achieved, which the SNAP MEC working group will attempt to address these over the coming months.

Recommendation 1: Demonstrate the link between the multiple project objectives and clarify how specific activities will connect to achieve the anticipated outputs and outcomes.

This recommendation is based on feedback from participants. The lack of clarity and seeming disconnect between the objectives for the project could be a function of poor communication on the part of the organizing committee, or an indication that the project objectives should be reviewed and perhaps scaled down. Although the organizers had defined overall workshop objectives and communicated these to the group in advance in the pre-workshop reading material and during the introduction to the workshop, the workshop would have benefited from a more in-depth discussion early in the week to clarify these objectives and more explicitly define outputs and anticipated outcomes of the workshop and the project as a whole. The core team will ensure adequate time is made for this at future workshops. More immediately, the core team is reviewing the project objectives and workflow to ensure that anticipated outputs are reasonable and achievable, and will revise these based on this review.

Recommendation 2: Clarify definitions for key terms, including clearly differentiating natural resource and ecosystem service based indicators, and indicators measuring ecosystem service supply versus those measuring ecosystem service use or benefit.

Discussions early in the workshop demonstrated the need for precisely defined terminology when discussing indicators. The working group will continue discussions and seek consensus on definitions of key terms prior to the consultation phase of the project.
Recommendation 3: Conduct a wide review of existing natural resource / ecosystem service-based indicators in order to re-evaluate and strengthen our suggested indicator set.

Feedback from participants and discussions within the workshop made it clear that the project would benefit from a comprehensive review of existing indicators. This review is already underway and will be used to inform selection of indicators that the working group proposes for inclusion in the SDG indicator set.

Recommendation 4: Strengthen our criteria for indicator selection.

The working group established initial criteria for indicator selection with consensus that these required further work. The core team will undertake a review of potential alternative criteria and use this to suggest final revisions to our criteria, seeking consensus from the working group on any changes.

Recommendation 5: Revise our project timeline to ensure there is adequate time for a full and fruitful consultation with policy stakeholders and scientific experts.

Discussions on next steps for the project illustrated the importance of allowing sufficient time for consultation on the indicators and decision tools we will propose. The core team has revised the project timeline as shown in Section 1.5, allowing more time to prepare for and conduct the consultation than was previously envisaged.
6. References


7. Annexes

7.1 Participant Contact Details

Table 2: Workshop participant list and contact details

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abs, Susan (Facilitator)</td>
<td>Eclipse Environmental Consulting</td>
<td><a href="mailto:susanabs@shaw.ca">susanabs@shaw.ca</a></td>
</tr>
<tr>
<td>Andelman, Sandy</td>
<td>Vital Signs</td>
<td><a href="mailto:sandelman@conservation.org">sandelman@conservation.org</a></td>
</tr>
<tr>
<td>Belcher, Brian</td>
<td>CIFOR</td>
<td><a href="mailto:Brian.Belcher@RoyalRoads.ca">Brian.Belcher@RoyalRoads.ca</a></td>
</tr>
<tr>
<td>Brooks, Karen</td>
<td>IFPRI (PIM)</td>
<td><a href="mailto:K.Brooks@cgiar.org">K.Brooks@cgiar.org</a></td>
</tr>
<tr>
<td>Chaplin-Kramer, Becky</td>
<td>Natural Capital Project</td>
<td><a href="mailto:bchaplin@stanford.edu">bchaplin@stanford.edu</a></td>
</tr>
<tr>
<td>Chow, Julian</td>
<td>UN DESA</td>
<td><a href="mailto:chowj@un.org">chowj@un.org</a></td>
</tr>
<tr>
<td>Corsi, Sandra</td>
<td>Bioversity (PIM)</td>
<td><a href="mailto:sandra.corsi@gmail.com">sandra.corsi@gmail.com</a></td>
</tr>
<tr>
<td>DeClerck, Fabrice</td>
<td>Bioversity (WLE)</td>
<td><a href="mailto:f.declerck@cgiar.org">f.declerck@cgiar.org</a></td>
</tr>
<tr>
<td>Dulloo, Ehsan</td>
<td>Bioversity (PIM)</td>
<td><a href="mailto:e.dulloo@cgiar.org">e.dulloo@cgiar.org</a></td>
</tr>
<tr>
<td>Girvetz, Evan H.</td>
<td>CIAT (WLE)</td>
<td><a href="mailto:egirvetz@cgiar.org">egirvetz@cgiar.org</a></td>
</tr>
<tr>
<td>Gordon, Line</td>
<td>Stockholm Resilience Center</td>
<td><a href="mailto:line.gordon@stockholmresilience.su.se">line.gordon@stockholmresilience.su.se</a></td>
</tr>
<tr>
<td>Johnson, Justin</td>
<td>TNC/ICE/Bioversity (WLE)</td>
<td><a href="mailto:jandrewjohnson@gmail.com">jandrewjohnson@gmail.com</a></td>
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<tr>
<td>Jones, Sarah</td>
<td>Bioversity (WLE)</td>
<td><a href="mailto:s.jones@cgiar.org">s.jones@cgiar.org</a></td>
</tr>
<tr>
<td>Kappel, Carrie</td>
<td>NCEAS</td>
<td><a href="mailto:kappel@nceas.ucsb.edu">kappel@nceas.ucsb.edu</a></td>
</tr>
<tr>
<td>Mandle, Lisa</td>
<td>Natural Capital Project</td>
<td><a href="mailto:lmandle@stanford.edu">lmandle@stanford.edu</a></td>
</tr>
<tr>
<td>Nemser, Bennett</td>
<td>UN M&amp;E Unit</td>
<td><a href="mailto:bnemser@gmail.com">bnemser@gmail.com</a></td>
</tr>
<tr>
<td>Regmi, Anita</td>
<td>Bioversity (Economic Advisor to Research Director)</td>
<td><a href="mailto:anita.regmi@cgiar.org">anita.regmi@cgiar.org</a></td>
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<tr>
<td>Wood, Sylvia</td>
<td>Columbia Univ. / Bioversity (WLE)</td>
<td><a href="mailto:sylvia.wood@cgiar.org">sylvia.wood@cgiar.org</a></td>
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<tr>
<td>Zhang, Wei</td>
<td>IFPRI (WLE)</td>
<td><a href="mailto:W.Zhang@cgiar.org">W.Zhang@cgiar.org</a></td>
</tr>
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### Workshop Agenda

**MEASURING NATURAL CAPITAL WORKSHOP**  
6-10 October 2014, NCEAS, Santa Barbara, USA  
PARTICIPANT AGENDA

<table>
<thead>
<tr>
<th>Day</th>
<th>Theme</th>
<th>Sessions</th>
</tr>
</thead>
</table>
| Mon | Setting the stage for measuring natural capital | 09:00 - Introductions; **NCEAS rep and Susan Abs**  
09:40 - Goals and objectives for the project and workshop; **Fabrice DeClerck**  
10:10 - The proposed SDGs, their indicators, and the SDG decision-making process; **Sylvia Wood**  
11:00 - BREAK  
11:20 - In-country monitoring; **Julian Chow**  
11:50 - Target SDGs and criteria for indicator selection  
12:30 – LUNCH  
13:30 - Target SDGs and criteria for indicator selection (cont.)  
14:00 - Measuring natural resources and modelling ecosystem service flows; **Becky Chaplin-Kramer**  
14:45 – An introduction to Vital Signs; **Sandy Andelman**  
15:30 – BREAK  
15:50 - Strengths and weaknesses of existing approaches to measuring natural resources and ecosystem services  
17:15 – Review of objectives and outputs; **Susan Abs**  
17:30 – END |
| Tues | Measuring natural capital in rural landscapes | 09:00 – Recap on progress; **Susan Abs**  
09:05 – Outcomes of NRM research; **James Stevenson**  
09:25 – Linking natural resource metrics to CGIAR system-level outcomes for an integrated approach to NRM monitoring; **Ehsan Dulloo and Sandra Corsi**  
10:20 - BREAK  
10:45 - Framing the week – **Fabrice DeClerck**  
11:00 – Finding good quality ES based indicators  
12:00 – Placing decisions in context – FOMI dam; **Justin Johnson**  
12:20 – LUNCH  
13:35 – Placing decisions in context – SAGCOT; **Evan Girvetz**  
13:55 – Placing decisions in context – Volta basin; **Fabrice DeClerck**  
14:15 - Using ES-based indicators to guide decision-making  
15:30 – BREAK  
15:50 - Deriving a set of ES-based indicators  
17:15 – Review of objectives and outputs; **Susan Abs**  
17:30 – END  
**18:30 – Wine and Cheese Reception** |
<p>| Wed | Resilience | 09:00 – Recap on progress; <strong>Susan Abs</strong> |</p>
<table>
<thead>
<tr>
<th>Day</th>
<th>Theme</th>
<th>Sessions</th>
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<tbody>
<tr>
<td></td>
<td>for sustainable development</td>
<td>09:05 - Resilience for development; <strong>Line Gordon</strong>&lt;br&gt;10:00 – Critical thresholds debate&lt;br&gt;10:40 - BREAK&lt;br&gt;11:00 - Critical thresholds debate&lt;br&gt;12:30 – LUNCH&lt;br&gt;13:30 - Define a tentative set of natural resource based indicators&lt;br&gt;15:30 – BREAK&lt;br&gt;15:50 – Define a tentative set of natural resource based indicators&lt;br&gt;17:15 – Review of objectives and outputs; <strong>Susan Abs</strong>&lt;br&gt;17:30 – END</td>
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<tr>
<td>Thurs</td>
<td>Indicator refinement and testing</td>
<td>09:00 – Recap on progress; <strong>Susan Abs</strong>&lt;br&gt;09:05 – Criteria testing and refinement; <strong>Sarah Jones</strong>&lt;br&gt;10:20 – Selecting critical indicators; <strong>Sylvia Wood</strong>&lt;br&gt;10:40 – BREAK&lt;br&gt;11:00 – Selecting critical indicators; <strong>Sylvia Wood</strong>&lt;br&gt;12:30 – LUNCH&lt;br&gt;13:45 – An overview of the scenario analysis process; <strong>Justin Johnson</strong>&lt;br&gt;14:15 – Scenario analysis group discussion&lt;br&gt;15:40 – BREAK&lt;br&gt;16:00 – Designing the consultation process; <strong>Susan Abs</strong>&lt;br&gt;17:15 – Review of objectives and outputs; <strong>Susan Abs</strong>&lt;br&gt;17:30 – END&lt;br&gt;18:30 – <strong>Volleyball Game</strong></td>
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<tr>
<td>Fri</td>
<td>Planning the next steps</td>
<td>09:00 – Recap on progress; <strong>Susan Abs</strong>&lt;br&gt;09:05 – Scenario analysis&lt;br&gt;10:20 – Resilience measures&lt;br&gt;10:50 – BREAK&lt;br&gt;11:10 – Voting on indicators&lt;br&gt;11:30 - Next steps&lt;br&gt;12:00 – Review of objectives and outputs for the week; <strong>Susan Abs</strong>&lt;br&gt;12:15 - Closing remarks; <strong>Fabrice DeClerck</strong></td>
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</table>
7.3 **Participant Evaluation Form**

A blank copy of the evaluation form was distributed to participants for completion on the last day of the workshop and circulated post-workshop to those four participants who were not present on the last day.

### SNAP Workshop: Measuring Natural Capital
NCEAS, 6-10 October, 2014
PARTICIPANT EVALUATION FORM

| Please rate the value of these sessions to you: | Low | 2 | 3 | 4 | 5 |
| SESSION OR TOPIC | | | | | |
| **DAY 1 – Monday** | | | | | |
| Workshop goals and objectives (Fabrice DeClerck) | | | | | |
| The proposed SDGs (Sylvia Wood) | | | | | |
| In-country monitoring (Julian Chow) | | | | | |
| Break-out groups on priority SDG goals, indicator selection criteria, indicator type/level (circle your group) | | | | | |
| Modelling natural capital (Becky Chaplin-Kramer) | | | | | |
| Introduction to Vital Signs (Sandy Andelman) | | | | | |
| Group interview with four key questions for the week | | | | | |
| **Day 2 – Tuesday** | | | | | |
| Outcomes of CGIAR NRM research (James Stevenson) | | | | | |
| CGIAR framework for NRM impact assessment (Sandra Corsi) | | | | | |
| Framing the week (Fabrice DeClerck) | | | | | |
| FOMI dam investment (Justin Johnson) | | | | | |
| SACGOT – sugar plantation (Evan Girvetz) | | | | | |
| Volta basin small dam scheme (Fabrice DeClerck) | | | | | |
| Applying indicators to case studies | | | | | |
| Discussion on good ES based indicators | | | | | |
| **Day 3 – Wednesday** | | | | | |
| An introduction to resilience (Line Gordon) | | | | | |
| Critical thresholds debate | | | | | |
Break-out sessions on SDG-based indicator development

### Day 4 – Thursday

- Criteria testing and refinement (Sarah Jones)
- Selecting awesome indicators (Sylvia Wood)
- An overview of the scenario analysis process (Justin Johnson)
- Planning the consultation process

### Day 5 – Friday

- Scenario analysis
- Resilience measures
- Next steps

<table>
<thead>
<tr>
<th>Please rate the workshop on the following topics:</th>
<th>Low</th>
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<th>High</th>
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<tr>
<td>Pre-meeting communications</td>
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<td>Clarity of goals, objectives &amp; outputs</td>
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<td>Degree to which goals, objectives &amp; outputs were achieved</td>
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<td>Logistics: room, A-V, collaboration site</td>
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<td>Refreshments: breaks &amp; lunches</td>
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<td>Degree to which all participants could voice their views</td>
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<td>Degree to which workshop will have value for your work</td>
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<td>Overall level of interest in workshop</td>
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<td>Facilitation</td>
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</table>

1. Do you have any comments on specific sessions?

2. What are the 2-3 greatest strengths of this workshop?

3. What were the 2-3 things which could have been improved?