

2nd German Future Earth Summit

Conference Summary Report

Berlin, 28th & 29th
of January 2016

As contribution to

futureearth
research for global sustainability

WCRP
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German Committee
Future Earth

Authors and Co-Authors

Stephan **Bartke** (Helmholtz Centre for Environmental Research - UFZ), Marisa **Beck** (Humboldt-Universität zu Berlin), Lars **Bernard** (Technische Universität Dresden), Claudia R. **Binder** (Ludwig-Maximilians-Universität München), Birgit **Blättel-Mink** (Goethe- Universität Frankfurt), Jan **Börner** (Center for Development Research), Antje **Brock** (Freie Universität Berlin), Roger **Cremades** (Climate Service Center Germany), Martin **David** (Helmholtz Centre for Environmental Research - UFZ), Katrin **Daedlow** (Leibniz Centre for Agricultural Landscape Research), Ruth **Delzeit** (Kiel Institute for the World Economy), Anne **Dombrowski** (Humboldt-Universität zu Berlin), Ines **Dombrowsky** (German Development Institute), Jonas **Eberle** (Friedrich Schiller University Jena), Katharine N. **Farrell** (Humboldt-Universität zu Berlin), Johanna zum **Felde** (Open Knowledge Foundation Germany), Johanna **Ferretti** (Leibniz Centre for Agricultural Landscape Research), Katja **Frieler** (Potsdam Institute for Climate Impact Research), Armin **Grunwald** (KIT - Institute for Technology Assessment and Systems Analysis), Konrad **Hagedorn** (Humboldt-Universität zu Berlin), Uwe **Heinrich** (Leibniz Centre for Agricultural Landscape Research), Katharina **Helming** (Leibniz Centre for Agricultural Landscape Research), Jeremias **Herberg** (Leuphana University of Lüneburg), Katja **Heubach** (Helmholtz Centre for Environmental Research -UFZ), Patrick **Hostert** (Humboldt-Universität zu Berlin), Diana **Hummel** (ISOE - Institute for Social-Ecological Research), Jens **Jetzkowitz** (Philipps-Universität Marburg), David Brian **Kaiser** (Leibniz Centre for Agricultural Landscape Research), Florian **Koch** (Helmholtz Centre for Environmental Research - UFZ), Jürgen **Kopf Müller** (KIT - Institute for Technology Assessment and Systems Analysis), Kerstin **Krellenberg** (Helmholtz Centre for Environmental Research - UFZ), Elmar **Kriegler** (Potsdam Institute for Climate Impact Research), Tobias **Krüger** (Humboldt-Universität zu Berlin), Hermann **Lotze-Campen** (Potsdam Institute for Climate Impact Research), Wolfgang **Lucht** (Potsdam Institute for Climate Impact Research), Alexandra **Lux** (ISOE - Institute for Social-Ecological Research), Simon **Meisch** (Eberhard Karls Universität Tübingen), Nils aus dem **Moore** (Rheinisch- Westfälisches Institut für Wirtschaftsforschung), Lisa **Pettibone** (Museum für Naturkunde Berlin), Franziska **Piontek** (Potsdam Institute for Climate Impact Research), Karen **Pittel** (Ifo Institute), Aranka **Podhora** (Leibniz Centre for Agricultural Landscape Research), Julia **Pongratz** (Max Planck Institute for Meteorology), Thomas **Potthast** (Eberhard Karls Universität Tübingen), Christopher **Reyer** (Potsdam Institute for Climate Impact Research), Anett **Richter** (UFZ / German Centre for Integrative Biodiversity Research), Godela **Rossner** (German Aerospace Center), David **Russell** (Seckenberg Museum Görlitz), Jacob **Schewe** (Potsdam Institute for Climate Impact Research), Bettina **Schmalzbauer** (German Committee Future Earth Secretariat), Jörn **Schmidt** (Kiel University), Christiane **Schmullius** (Friedrich Schiller University Jena), Imme **Scholz** (German Development Institute), Ralf **Seppelt** (Helmholtz Centre for Environmental Research -UFZ), Tuck Fatt **Siew** (Goethe University Frankfurt), Niko **Svoboda** (Leibniz Centre for Agricultural Landscape Research), Kaidi **Tamm** (KIT - Institute for Technology Assessment and System Analysis), Harry **Vereecken** (Forschungszentrum Jülich), Sergio **Villamayor-Tomas** (Humboldt-Universität zu Berlin), Ulli **Vilsmaier** (Leuphana University of Lüneburg), Martin **Visbeck** (GEOMAR Helmholtz Centre for Ocean Research Kiel), Hans Jörg **Vogel** (Helmholtz Centre for Environmental Research - UFZ), Rainer **Walz** (Fraunhofer Institute for Systems and Innovation Research ISI), Lila **Warszawski** (Potsdam Institute for Climate Impact Research), Thomas **Weith** (Leibniz Centre for Agricultural Landscape Research), Martin **Welp** (Eberswalde University for Sustainable Development), Markus **Winkelmann** (KIT - Institute for Technology Assessment and Systems Analysis), Ute **Wollschläger** (Helmholtz Centre for Environmental Research - UFZ)

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German Committee Future Earth & Secretariat
Heilbronner Str. 150
70191 Stuttgart, Germany
Phone: +49 (0) 711 4900 4240
Email: info@dkn-future-earth.de
www.dkn-future-earth.org
twitter.com/dkn_futureearth
#dknsummit16

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German Committee Future Earth Secretariat
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Members German Committee Future Earth

Prof. Dr. François Buscot (2016-2018)

Helmholtz Centre for Environmental Research - UFZ

Prof. Dr. Anita Engels (2016-2018)

University of Hamburg

Prof. Dr. Armin Grunwald (2013-2018)

KIT - Institute for Technology Assessment and Systems Analysis

Prof. Dr. Patrick Hostert (2016-2018)

Humboldt-Universität zu Berlin

Dr. Christiane Joerk (ex-officio)

German Research Foundation

Prof. Dr. Wolfgang Lucht (2013-2018)

Potsdam Institute for Climate Impact Research

Prof. Dr. Karen Pittel (2013-2018)

Ifo Institute - Leibniz Institute for Economic Research at the University of Munich e.V.

Dr. Bettina Schmalzbauer (ex-officio)

German Committee Future Earth Secretariat

Prof. Dr. Christiane Schmullius (2013-2015)

Friedrich Schiller University Jena

Prof. Dr. Martin Visbeck - Chairman - (2013-2018)

GEOMAR Helmholtz Centre for Ocean Research Kiel

Prof. Dr. Volkmar Wolters (2013-2015)

Justus Liebig University Giessen

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German Committee
Future Earth

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Welcome address German Research Foundation

Prof. Shrivastava, Prof. Visbeck, distinguished participants, ladies and gentlemen,

Good morning and many thanks for organising this conference on the very important theme of global change and sustainability research. It really is a great pleasure to welcome you on behalf of the German Research Foundation to the second German Future Earth Summit. It is part of well-established practice that the DFG not only awards grants for research in the various scientific disciplines but also pays close attention to current societal and political developments that might require new ways of thinking or new lines of research. DFG's involvement in Future Earth shows and symbolises really well the specific way the DFG works, namely through "response mode". The DFG operates through the traditional path of research funding while also initiating and promoting new research fields by creating and nurturing a conducive environment for research. This can involve for example, launching strategic funding initiatives or supporting events such as the German Future Earth Summit. This conference is addressing a scientifically exciting and politically very timely and pressing topic – global sustainability research and cross-cutting themes.

The idea of sustainability has become a collective global value and has been turned into a common mission which involves international organisations, governments, non-governmental organisations and other civil society stakeholders. Some of the best examples of developments in the area of sustainability are the World Climate Summit in 2015 and the adoption of the new Sustainable Development Goals (SDGs) by the United Nations in 2015. Sustainable development has also become an important concern for scientists and researchers. Around the world, researchers from many disciplines are working on questions of sustainability and contributing to sustainable development in numerous ways. The importance of contributions made by science to the new post-2015 development agenda was discussed at a high-level conference held at UN headquarters in April 2015 hosted by the German Research Foundation in collaboration with UNU.

I also would like to take the opportunity to remind you of the importance of knowledge-oriented and

curiosity-driven research within the whole process and framework of Future Earth. With regard to the complexity of the challenges that we face, the President of the German Research Foundation, Prof. Strohschneider, pointed out in a recent speech that research should not just be conceptualised as 'predefined problems' and 'predictable solutions'. At the same time, he strongly supports the position of not underestimating the importance of those surprising scholarly insights that we would not have expected, that we did not plan for, that we could not predict. Surprising insights are also what is needed to meet the challenges of sustainable development because they create the real transformative breakthroughs that change the ways we think and act.

So, the point that I would like to make here is that our societies should be committed to not reducing the knowledge options that research can produce for us. Accordingly, I believe we need research systems that can engage in direct problem-solving, but that also leave room for basic curiosity-driven research, that are able to cope with short-term and with long-term perspectives as well as with predictable and with unpredictable developments. We should all take care and take an interest in fostering and nurturing the richness and diversity of approaches, of disciplines, of research fields, and of possible insights that research has to offer. Only then will research be able to produce the innovations that our societies are calling for.

In the context of Future Earth, the DFG offers a wide range of different funding opportunities, some of which will be presented at the research funders section on the second day of the conference. On behalf of the DFG I wish all of us stimulating and fruitful discussions and I look forward to the results of this cross-disciplinary exchange of knowledge.

Thank you very much.

Dr. Christiane Joerk, on behalf of the German Research Foundation (DFG), Head Office



1. Summary and key messages

The year 2015 saw significant political progress in terms of global sustainability. First, the adoption of the Paris Agreement under the United Nations Framework Convention on Climate Change that sets out a global action plan with “holding the increase of the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels” (see UNFCCC FCCC/CP/2015/L.9). Second, the United Nations General Assembly has laid out the 2030 Development Agenda and agreed on a set of 17 Sustainable Development Goals (SDGs). Agenda and goals demonstrates the scale and ambition of an universal agenda that will stimulate action over the next 15 years in areas of critical importance for humanity and the planet (see UN A/RES/70/1 Transforming our world: the 2030 Agenda for Sustainable Development). Finally, the international research platform on global sustainability, Future Earth, operationalised its activities by establishing globally distributed secretariats in France, Canada, USA, Japan and Sweden as well as several regional centres. Additionally, Future Earth and WCRP, the World Climate Research Programme, agreed on a new close partnership that will contribute to the most pressing planetary challenges. In the upcoming months, Future Earth will also reinforce the implementation of Knowledge-Action Networks, which will become the organisational structure for research.

The 2nd German Future Earth Summit was based on these promising developments that continue to stimulate sustainability research both globally and



nationally. The conference was organised by the German Committee Future Earth in close cooperation with the German Future Earth research communities and held in the context of Future Earth and WCRP. It took place on the 28th and 29th January 2016 in Berlin.

About 280 participants from numerous scientific disciplines and several other knowledge domains discussed current developments in the field of global sustainability relating to research practices, organisations and structures in Germany. An expert panel also discussed the role of science in the sustainability debate, the dissemination of research results as well as the funding opportunities in inter- and transdisciplinary research, and higher education schemes.

Plenary panellists included a broad range of experts from several sectors and the German Network of Early Career Scientists in Future Earth also provided key inputs from their perspective. Discussions focussed on issues such as the role of science in society and societal transformations. It was concluded that scientific results can play an important role in decision making if communication channels are well set up. Knowledge exchange between science and decision-makers is much easier when the research agenda is co-designed and the process to scientific findings is co-developed. What particularly emerged from the panel discussions was a sense of the tremendous opportunity to engage in solution-oriented research, particularly in the search for solutions that promote transformative development on regional and local levels. All this is taking place against a very specific backdrop, i.e., the need for science-based information to support the implementation of Sustainable Development Goals. This goes hand in hand with the analysis of nexus problems in the SDG context, greater focus on interdisciplinary and transdisciplinary research, and also the increasing complexity of research. This agenda provides also new challenges and exciting opportunity for today's education and scientific reward system.

The first German Future Earth Summit focussed on three Future Earth research themes: “Dynamic

Planet”, “Global Development” and “Transformation towards Sustainability”. Promising areas of new research were proposed and discussed. To complement the ongoing development of a German perspective on Future Earth research, the second German Future Earth Summit focussed on cross-cutting capabilities to support the research that is needed to achieve the aims of global sustainability. In order to identify thematic priorities for Germany, the conference participants provided input in five parallel sessions, six side events, three special events, eight World Café tables and around 50 posters. Discussions focussed around the conference’s five subtopics: “Observing, monitoring and data systems”, “Earth system modelling and social macrodynamics”, “Metrics and evaluation for human well-being and sustainable development”, “Theory and method development” and “Science-society interface”. Overall, the German Future Earth Summit attracted researchers from many disciplines and a pleasingly large number of early career scientists.

This conference summary report has been prepared in cooperation with the organisers of the sessions, events and World Cafés, and summarises the results of the discussions in each event.

The summit provided input from the scientific community that will assist the work of German Committee Future Earth (DKN). Engagement with the broader scientific community is critical to ensure that the DKN can effectively support interested stakeholders in Future Earth and WCRP objectives. The committee will continue to encourage interdisciplinary dialogue and intensify the exchanges between all relevant sectors (researchers, government, private sector, civil society and funding providers). The German Committee Future Earth will also keep the broader community informed about developments and potential linkages with international sustainability programmes such as Future Earth, WCRP and related activities on data and information (GEO), and assessments (IPCC, IPBES, etc.).

The German Committee Future Earth thanks all participants for their active engagement and for the huge diversity of contributions and looks forward to new initiatives in the field of global sustainability.



Martin Visbeck
Chairman



Bettina Schmalzbauer
Executive Director



THE NEXT STEPS (2016-2018)

In its second term, the German Committee Future Earth will continue to support the self-organisation of the German community through the establishment of working groups.

The German Committee Future Earth will strengthen cooperation with other expert groups and intensify the dialogue with stakeholders on a national scale. This will include facilitating discussion about possible contributions to the Knowledge-Action Networks (established by Future Earth in 2016) and further development of a German perspective on Future Earth research.

The German Committee Future Earth also intends to develop strategic workshops and flagship projects such as “Foresight workshop on science needs in the context of tough choices in implementing SDGs” held in April 2016.

The third German Future Earth Summit will be presumably held in early 2018 with a possible focus on research synthesis and policy interactions.

2. Future Earth & sustainability research in Germany

Future Earth is research initiative on global environmental change and global sustainability. Future Earth supports global partnerships and helps connect also regional or local activities to global programmes in order to identify and communicate possible approaches to achieve global sustainability. Being an open network, Future Earth brings together scientists from the natural sciences, social sciences, humanities and engineering sciences with other knowledge domains (policy, economy, civil society sector) to cooperate, develop synthesis and communicate to the broader public via its platform. The overarching goal is provide the knowledge needed to support transformations towards sustainability. Future Earth seeks to build and connect knowledge to increase impact of research in diverse contexts, to explore new development paths, and to find new ways to accelerate transitions to sustainable development. It is the ambition of the German Committee Future Earth to enable German researchers with a focus on sustainability science to benefit from and create impact in this international network.

Prof. Paul Shrivastava (Executive Director Future Earth) underlined in his talk that Future Earth will support the development of a holistic, integrated, systemic understanding and a set of actions for global sustainable development. This will require comprehensive research priorities that are co-designed in partnership with different knowledge domains to build robust and accepted pathways towards global sustainability. Both fundamental and

solution oriented research will be needed to realise the ambitions of Future Earth. Furthermore, Prof. Martin Visbeck (Chairman German Committee Future Earth) summarised the activities of the growing network in Germany such as the involvement of the German Research Foundation (DFG) and the German Committee Future Earth (DKN) in the scientific and institutional underpinning of sustainable development. The DKN has been active to set agendas, establish working groups, engage with Future Earth international, and support workshops and conferences. Together with the United Nations University, the DFG organised a high-level conference in New York in 2015 to open a forum on how to measure the success of the proposed Sustainable Development Goals and the contribution made by science. The DFG Secretary General Dorothee Dzwonnek pointed out at the conference that "The goal of the DFG-UNU conference has been just to do that, to bring in science and to open a forum of debate for scholars, practitioners, and policy-makers. Conference participants have discussed various concepts and approaches, often passionately, but always with a clear focus on applicability". The conference results laid the foundations for further activities in this field, such as the "Foresight workshop on science needs in the context of tough choices in implementing the new SDG framework". A workshop jointly organised by the German Committee Future Earth in cooperation with the Sustainable Development Solution Network (SDSN) and Future Earth in 2016.



Foresight Workshop

Science needs in the context of tough choices in implementing the new SDG framework

Villa Vigoni, Italy, 18-21 April 2016

Organised by



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“To develop syntheses, synergies and path the way forward on a global level research for global sustainability includes both fundamental and solution-oriented research within the framework of Future Earth and WCRP.”

In Germany, sustainability research has a long-standing tradition linking to applied and fundamental research. Along with our growing knowledge on the complexity of environmental challenges, the need for multi-, inter- and transdisciplinary research came more explicitly into focus about ten years ago. Coordinated and internationally relevant research activities created comprehensive knowledge on coupled human-environment systems related to e.g. climate change, biodiversity loss, ocean acidification, food and fresh water availability, energy security, urban development, and land degradation, as well as nexus-related topics. Today, internationalisation of research, education and institutional frameworks has accordingly become one of the priorities in Germany. However, research communities tend to be most visible in and driven by the natural science affine communities. Considering the pressing global

problems and society's urgent need to mitigate and adapt to global change and to develop towards more sustainable societies, scientific partnerships that support societal transformations towards global sustainability are needed. One of the main goals of the German Future Earth Summit is to connect between diverse communities related to sustainability research to jointly develop a German research perspective within Future Earth. The German Future Earth Summit is therefore a unique opportunity for researchers to exchange ideas and interests and offers the chance to establish completely new collaborations “off the beaten track”.

In 2014, the German Committee Future Earth initiated a national theme-finding process to collect and reflect related research interests of the German communities. This process is still ongoing. The results of the German Future Earth Summits along with those of the different German Committee Future Earth working groups under the umbrella of the German Committee Future Earth (see p. 70) play a crucial role in further development of a German perspective on Future Earth research (current status of discussions see boxes).

Finally, one of the priorities in the next years will be to align national and international research ideas and approaches, particularly in view of the Knowledge-Action Networks (KANs) that are

due to be established. It will hence be of utmost importance to further strengthen the national-global linkages in Future Earth to on the one hand create awareness of German research priorities in the global Future Earth process, and to on the other hand ensure feedback from the global program into the German Future Earth community.

GUIDING QUESTIONS SET 1:

- a) What are the barriers to the implementation of sustainability measures?
- b) How can we feed a world population of 9 to 10 billion people in a sustainable way?
- c) How is sustainability understood in an intercultural context?
- d) What characterises (sustainable) resilient forms of society and how can they be developed?
- e) Where are possible tipping points in the further development of global systems?
- f) What kind of preventive action can be taken against improbable but possible dramatic developments?
- g) Are previous methods of modelling and anticipating possible developments still adequate?
- h) How can the creativity and power of new technologies be exploited for sustainability?

Developing a German perspective of Future Earth research. *The guiding question sets represent the current status of the national theme-finding process that has been initiated in 2014 following the first German Future Earth Summit. This process is still ongoing with the main aim to collect and reflect Future Earth related research interests of the German academic community and stakeholders, and to jointly develop new research priority areas.*

GUIDING QUESTIONS SET 2:

- (prioritising the implementation of Sustainable Development Goals)
- a) Where are the environmental and welfare tipping points and how does the pattern of extreme events change in relation to global and regional change?
 - b) What are the connections between population dynamics and a changing environment?
 - c) How can we ensure access to safe water and sanitation services, sustainable agricultural production, food security and nutrition from land-based resources while preserving ecosystems and biodiversity? How can we ensure access to healthcare systems, education, etc.?
 - d) How can economic growth, industrialisation, infrastructures, energy and climate change be brought into line with environmental stewardship?
 - e) How can we build sustainable cities and human settlements that promote sustainable consumption and production?
 - f) How can we protect and sustainably use marine resources, oceans and seas and other global common resources?
 - g) What governmental structures and societal incentive systems support global partnership for achieving sustainable development?
 - h) How can we provide free and open access to scientific information and infrastructure in support of peaceful and non-violent societies, the rule of law and capable institutions?
 - i) How can we manage environmental crises/ conflicts in the context of building resilience or as an opportunity for transformational change?
 - j) What can we learn from past and present societal and cultural changes for future transformations?

Panel discussion: sustainability research in Germany

The panel discussion was kicked off with a talk by the German Network of Early Career Scientists in Future Earth. The network's spokeswomen, Dr. Sonja Deppisch and Dr. Ruth Delzeit, pointed out the need for a more specific Future Earth research agenda and a clearer perspective of the role of social scientists in Future Earth research. They drew attention to the traditional educational curricula and review systems. These are still strongly disciplinary and unable to cope with higher complexity in inter- and transdisciplinary research. As many issues in the field of global sustainability are nexus problems that have to be explored through a systemic approach that integrates different knowledge domains (e.g. concepts of co-design and co-production of knowledge; Mauser et al., 2013, doi:10.1016/j.cosust.2013.07.001), disciplinary career pathways do not necessarily facilitate inter- and transdisciplinary research. The early career scientists therefore highlighted an **urgent need for structural evolution in the German academic curricula system**; particularly concerning evaluation systems (e.g. measurement of success),

the educational system and career development but also the flexibility and duration of project funding.

In this context, the early career scientists have formulated a set of pressing questions which they presented to the expert panel consisting of: Prof. Dr. Anita Engels (University of Hamburg), Dr. Jörg Mayer-Ries (German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety), Theresia Bauer (Baden-Württemberg Ministry of Science, Research and the Arts), Prof. Dr. Christian Berg (German Association for the Club of Rome), Prof. Dr. h.c. mult. Guy Brasseur (Max Planck Institute for Meteorology).

In the following paragraphs, there is a summary of the panel discussion on academic norms, educational reform and the need for closer cooperation between science and stakeholders in Germany.

After discussing processes and concepts of co-design and co-production in sustainability research, the panellists agreed that inter- and

THE VOICE OF EARLY CAREER SCIENTISTS:

- The Future Earth strategic research agenda calls for a new type of science to support society in its transformation towards sustainability. Are German scientific structures and mechanisms ready to take on an active role or not? What has to be changed in Germany's scientific system?
- How can the structural challenges of inter- and transdisciplinary working between early career scientists be resolved (given that interdisciplinary and transdisciplinary research takes a great deal longer than standard disciplinary research)?
- Science is not sustainable in terms of resources – it follows the logic of growth, which means: even more funding by third parties and even more publications. Does this priority of quantity before quality, of 'short-term research measures' before 'long-term research agendas' really help resolve the challenges of global change? What structural

opportunities do we have to underpin scientific efforts in delivering solutions for sustainability problems?

- What is the role of early career scientists in implementing the Future Earth research agenda?

Dr. Sonja Deppisch & Dr. Ruth Delzeit (Co-spokespersons of the German Network of Early Career Scientists in Future Earth)





“Co-production between science and stakeholders can lead to early failures, but these early failures actually save time and energy in the long run. The issue will be, how do we deal with that?”

trans-disciplinary research cannot be measured against the disciplinary **academic norms**, as the concepts and challenges for individual scientists are completely different. In Germany the academic system could be strengthened to fully support interdisciplinary research, because universities and even research institutes (e.g. the Helmholtz Association or Leibniz Association institutes), whose mission it is to deliver knowledge to society and to support policy formulation, are organised and evaluated in a more disciplinary way. Some structural changes have already occurred that could allow more interdisciplinary thinking in the future (e.g., the creation of research clusters of excellence in Germany). *However, one of the main issues still remains unsolved: How to develop a (fit-for-purpose) scheme for quality evaluation of interdisciplinary science?*

The importance of enhanced **educational system** has also been underlined, where science and research needs to be organised in a more

sustainable way, starting with the school and university systems. An educational reform would allow, for instance, schools to better prepare students for a solution-oriented course of studies and/or the earlier involvement of early career scientists in research projects. Another challenge is the time pressure which does not encourage interdisciplinary consultation and cooperation. Early career scientists, for instance, have to obtain their qualifications extremely quickly (i.e., a PhD in three years). This works against the development of interdisciplinary qualifications which requires much more time because other knowledge domains have to be explored. *The unsolved question is, do we need new quality management approaches in educational systems to better support integrated science in the context of sustainable development?*

Sustainable development will benefit from bringing science closer to private sectors, policy-makers and society. However, establishing and strengthening the cooperation between science, the private sector and civil society in order to advance sustainable development and foster transdisciplinarity will continue to be challenging over the next years due to differences in priorities and timescales. Government also needs to rethink resource mobilisation and the exchange and involvement of the scientific world in decision-making in order to render the transformation towards global sustainability possible. **Government cannot offer solutions but can help to build a framework to make transformation possible.**

“People are globally connected, and live in communities and landscapes, not disciplinary silos.”

Scientists can deliver the knowledge and options for action strategies that will underpin pathways towards sustainable development. From a political point of view there is no overarching top-down arrangement for achieving climate change goals or sustainability goals. Only critical mass in society can trigger the kind of transformation needed to reach these goals. In Germany, energy transformation, for instance, was mainly supported and driven by e.g. small to medium-sized companies and households. Creating trust and willingness to change on a regional/local scale science needs to involve civil society to a greater extent in research on sustainable development and climate change issues. From a scientific point of view researchers have to remain objective. Therefore the challenge will be to find and create acceptable and productive partnerships to develop society-relevant research in collaboration with stakeholders (policy, business sectors, civil society). *A further issue is how to translate research results to many different societal groups? Or more specifically, how can the efficient transfer of knowledge from science to governments be achieved?*



Dialogue forum with DFG, BMBF, European Commission, Robert Bosch Foundation and Mercator Foundation

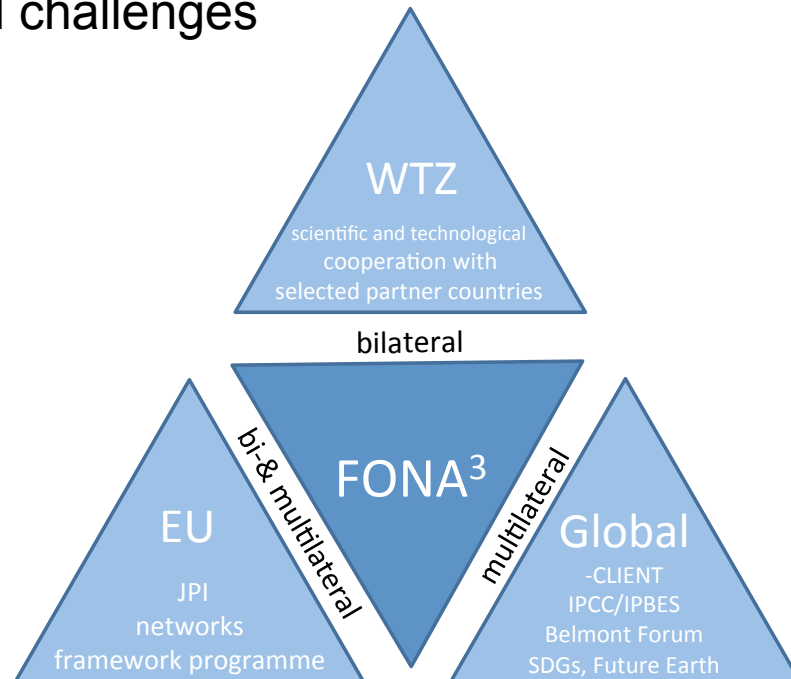
Future Earth is an international research programme for global sustainability that aims at a partnership between the research community and the society. Individual activities and projects are funded and supported by (national) agencies and funders worldwide. Representatives of different German research funding agencies, foundations and the European Commission came together in the dialogue forum to present and discuss possibilities and funding mechanisms with the research community.

“Striving for quality in science goes well along with its societal impact.”

Dr. Wolfgang Rohe (Mercator Foundation) and Dr. Ingrid Wüning Tschol (Robert Bosch Foundation), representatives of the biggest “private” foundations in the field of sustainability in Germany, discussed the opportunities of explorative work in integrated research, the pros and cons of traditional research systems and presented what “private” foundations can offer. In general, foundations have more freedom to evaluate (and employ) scientific excellence beyond traditional evaluation systems. In the “Sustainable Use of Renewable Natural Resources” Junior Professorship programme, for example, the Robert Bosch Stiftung seeks scientists with a proven record of excellence. With its “Next Einstein Forum”, the Robert Bosch Stiftung also aims to integrate and raise the profile of African scientists within the international scientific and research community. With a main focus on “Climate Change” and “Integration” Stiftung Mercator has established a number of institutes such as “The



Facing global challenges



Mercator Institute on Global Commons and Climate Change” or – together with other foundations – “The Expert Council of German Foundations on Integration and Migration”. These and others strive in different ways to combine relevance and excellence. Both foundations highlighted that they welcome open calls for proposals of fellowships, projects, educational programmes, amongst others.

Dr. Volkmar Dietz (German Federal Ministry of Education and Research, BMBF), Dr. Annette Schmidtman (German Research Foundation, DFG) and Dr. Paul Vossen (European Commission, EC) gave talks presenting funding structures and opportunities related to global challenges and programmes such as Future Earth and WCRP.

As sustainable development is a broad concept that involves many issues such as a green economy, city of the future and transformation of the energy system, the BMBF has brought them together as “flagship initiatives” in the third framework programme “Research for Sustainable Development” (FONA³). Additionally “prevention research for sustainability” in FONA³ provides the necessary know-how to overcome various global challenges.

FONA³ is the major research programme in Germany for sustainable development with a focus on (1) relevance (e.g. demand-oriented research), (2) impact (e.g. knowledge transfer, innovative options for actions) and (3) participation (e.g. participatory design of research agenda, involvement of stakeholders in projects). Inter- and transdisciplinarity is a characteristic of most of the funded projects). It was emphasised that cooperation through joint programmes and building partnerships on the European and global level is also needed in order to face global challenges.

Annette Schmidtman introduced the DFG's broad funding spectrum. It is mainly focussed on individual grant programmes and coordinated programmes (e.g. research centres, research training groups, priority programmes). Like the BMBF, the DFG serves all branches of the sciences. The main aim of DFG funding is to foster scientific excellence through competition and the only stipulation is scientific quality. Research has to be investigator driven and present original ideas using innovative methodologies and approaches. Some of the DFG's core activities are the promotion of international research collaborations (e.g. through Belmont Forum), and increasing international visibility and impact of top-class research in Germany. Furthermore, the DFG is heavily engaged in the science-policy dialogue on the role of science in implementing sustainable development goals. An initial conference on the subject was held in 2015 in collaboration with UNU, and in 2016 a scientific follow-up event will be organised by the German Committee Future Earth (in close cooperation with SDSN and Future Earth).

Overview of DFG Funding Programmes

► Individual Grant Programmes

- Research Grants
- Scientific Networks
- Research Fellowships
- Emmy-Noether-Programme
- Heisenberg-Programme
- Reinhart Koselleck Projects

► Coordinated Programmes

- Collaborative Research Centres and CRC/Transregios
- DFG Research Centres
- Research Training Groups
- Priority Programmes
- Research Groups

All DFG programmes include: support for international cooperation e.g. travel expenses, exchanges of personnel, joint workshops, postdoc fellowships ...



DFG



On behalf of the European Commission, Paul Vossen introduced programmes and funding possibilities available from the Horizon2020 programme. He highlighted the EC Commissioner for Science, Technology and Innovation's openness strategy, and its relevance for the Belmont Forum and Future Earth research. Since at least 60% of the overall budget of Horizon2020 will be assigned to sustainable development, the programme is likely to make an essential contribution to implementing Sustainable Development Goals. Efforts to implement the SDGs will therefore considerably benefit from open and result-oriented international cooperation that builds on networks, experience derived from existing initiatives (the Belmont Forum is a good example of this) and a research value chain that includes stakeholders. For example, the Horizon2020 work programme

already includes collaborative research actions such as "Societal transformations towards sustainability" and "Sustainable urban development" that are co-branded by Future Earth and Belmont Forum. There are also many more opportunities such as the ERA-Net Cofund, coordination and support actions funding schemes and Joint Programming Initiatives (JPIs) (on e.g. Agriculture, Food Security and Climate Change, Cultural Heritage and Global Change; Urban Europe; Climate; Water Challenges for a Changing World).

3. Session results cross-cutting Future Earth research capabilities

Research in Future Earth is carried out by its community of international projects around three themes. These are: Dynamic Planet, Global Sustainable Development and Transformation towards Sustainability. These three themes function as broad platforms for strategic and integrated Earth system research under Future Earth. Each theme calls for collaboration across a range of research areas and disciplines. To support and take Future Earth science forward also cross-cutting research capabilities are needed.

The following cross-cutting research capabilities has been discussed at the second German Future Earth Summit:

① Observing, monitoring and data systems

Future Earth research depends on extensive and well administered data for being able to observe changes across scales, to discover unknown relationships, and to drive Earth system models or macro models of society. Since the demand for appropriate information is growing rapidly, innovative observation and data management technologies need to provide a sufficient coverage in space and time for meeting these requirements as well as for optimizing processes and usability. Future Earth will support the emergence of international networks on these issues particularly in areas where the existing ones are still in a premature stage (e.g. biodiversity, governance, social attitudes).

② Earth system modeling and social macrodynamics

Future Earth will depend on access to state of the art Earth system models and integrated assessment models and will contribute to the development of a next generation of improved models that capture dynamics of human-environment interactions,

feedbacks and thresholds in a better way and allow for predictions of risks and changes taking advantage of computing power and skills from a wide range of countries. Although understanding of the Earth system is maturing, challenges remain in knowledge gaps about environmental, biological and social processes and computationally efficient and flexible ways to couple model components to an overall Earth system model. Mathematicians and system analysts play a key role in their improvement and refinement.

③ Metrics and evaluation for human well-being and sustainable development

Future Earth can play a key role in providing scientific advice and expertise to the UN post-Rio+20 and post 2015 processes, including the implementing and monitoring of Sustainable Development Goals (SDGs). The interdisciplinary nature of the SDGs, including environmental, social and economic aspects, means that they will require interdisciplinary knowledge and monitoring during the implementation. Furthermore the global, but regionally and nationally differentiated nature of the SDGs would be complemented well by Future Earth's global coverage with regional and national level interfaces. In order to provide an understandable, extensive view on sustainable development and human well-being, especially with regard to spatial and temporal changes, comparable measures and evaluation procedures are needed. As social aspects in particular are often more difficult to assess and still often underestimated in their interconnections and influences, it is important to close this gap. Future Earth will support efforts to develop systems of metrics to combine representative data in order to make it accessible and processes easier to understand and compare.

④ Theory and method development

In its endeavor to understand the interactions between natural and social systems and to provide fundamental insights into the social, economic, political drivers of behavior as well as institutional adaptations to global change problems, research under Future Earth will need to engage in theoretical debates that draw from a wide range of disciplines. These debates influence research approaches, provide insights and solutions, and encourage or prevent collaboration across disciplines. Our understanding of earth and societal systems is underpinned by basic theories and frameworks of how natural and social systems function and interact. Yet, explanations for individual, societal and political responses to global environmental change often differ fundamentally, generating barriers for

cooperation and integrative results. This is due to the fact that theories and frameworks underlying these explanations draw on a wide range of disciplines from physics, chemistry and biology to anthropology, economics, psychology, sociology or philosophy. The new ideas emerging continuously from or in the combination of these fields often have significant impact on explanations of global environmental and social change. This development is, however, often project-specific and uncoordinated. This session aims at a systematic assessment of the challenges and the framing of integrated research approaches. A specific focus will be on the human response to environmental change from the perspective of natural and social sciences.

⑤ Science-society interface

Future Earth aims to position itself as an international platform for knowledge exchange and transdisciplinary research in order to provide knowledge for societies to face challenges of global environmental change and transition to global sustainability. To accomplish that, stakeholder engagement and a variety of communication possibilities, e.g. science-policy activities and broader science-society interfaces, are seen as a key constituent of Future Earth work.

In research and practice on the various science-society interfaces, different dialogue approaches have evolved, with different interpretations and solutions to resolving the tension between advocacy and providing scientific advice. Effectiveness of approaches varies depending on the topic, interface mechanism, cultural context and relationship between the scientists and policymakers in question. In many cases the role of science can be clearly limited to providing new knowledge and to assess and advise on the consequences of different options. In this situation, scientists comfortably are identified as knowledge brokers but not as issue advocates. In other cases scientists may be expected by both policymakers and the public to advocate more strongly for a course of action. There is no one-size-fits-all solution to this issue, and it will always require careful consideration. One question is also how Future Earth can be policy relevant and most efficient in this rather than being policy prescriptive.

The following chapter provides an overview on all session results.

Session on “Observing, monitoring and data systems”

1

Organisers/Authors:

Lars Bernard (*Technische Universität Dresden*)

Christiane Schullius, Jonas Eberle (*Friedrich Schiller University Jena*)

Patrick Hostert (*Humboldt-Universität zu Berlin*)

Godela Rossner (*German Aerospace Center*)

Harry Vereecken (*Forschungszentrum Jülich*)

The session was divided into two parts:

Sub-session 1 "Infrastructures - quo vadis?"
(Moderation: L. Bernard)

Key questions for sub-session 1: What are the key needs in the coming years from a data infrastructure perspective? For research in Germany? Where are the gaps and where are the opportunities for funding priorities (focus on connecting science to stakeholders)?

Further topics to be considered: Are there fully developed cases of integrated monitoring systems? What can the German community contribute to the establishment of appropriate data systems and tools in the natural and social sciences?

Sub-session 2 "Position of long-term research institutions on sustainable data availability",
(Moderation: H. Vereecken)

Key questions for sub-session 2: Are there fully developed cases of integrated monitoring systems? What can the German community contribute to the establishment of appropriate data systems and tools in the natural and social sciences?

Further topics to be considered: Can we provide good examples for observing and cases of integrated monitoring systems? What are good examples of assimilation schemes for synthesising different data types? How can observational data be compared with output from numerical models? What are the most urgent areas for innovation?

Summary of observations and recommendations

Recurrent themes of arguments: importance of synergies - interoperability - provenance/lineage information - data curation and qualification (cal/val) - incentives - long-term funding
Methodological development & research need:

1. Create **information literacy**: provide best practices and guidance, support capacity-building



online courses, e-learning (link to Belmont Forum), link to citizen science

2. Make **cases for value in monitoring and data infrastructures**: relate to SDGs, increase social sciences usage. Information demand from societal challenges should be the driving factor.

3. **Integrate scientific community and local, state, federal and European authorities for data production and sharing**, because data are very fragmented and no mechanism exists to provide the best use of data and to connect data between institutions.

4. Suggestion: **Future Earth Core Data Set** (examples: a) consequent implementation of INSPIRE, b) open INVECOS data set to scientists - acknowledging all data protection needs - as an exemplary case for integrating data from federal authorities with research).

5. Establish a **baseline integrative observation infrastructure including in-situ data and ways of enabling science to process and deliver information** (e.g. Future Earth working group on how to establish a platform for terrestrial research including data accessibility and monitoring authorities). Good

example for integrated monitoring system: Weather forecast. See also the working group of the "Allianz der Forschungseinrichtungen in Deutschland" which aims to establish a research infrastructure for terrestrial research according to the DFG Strategy Paper: Long-Term Perspectives and Infrastructure in Terrestrial Research in Germany - A Systemic Approach.

6. Establish a **processing infrastructure** that enables researchers to analyse and use big data e.g., from the COPERNICUS programme.

7. More approaches are needed to **link between local and global scales and vice versa**.

Session on “Challenges and future directions in computer modelling of Earth and social systems“

2

Organisers/Authors:

Wolfgang Lucht, Christopher Reyer
(Potsdam Institute for Climate
Impact Research)

Julia Pongratz (Max Planck
Institute for Meteorology)

Ruth Delzeit (Kiel Institute for
the World Economy)

Roger Cremades

(Climate Service Center Germany)

The working group undertook a survey of the state of numerical modelling in the context of Future Earth research topics and challenges. Computer modelling continues to be a central tool for the analysis and assessment of global change and transition pathways to sustainability. The modelling landscape has evolved considerably in the past 15 years: atmosphere-ocean models were developed into more comprehensive Earth System Models (ESMs) and socio-economic integrated assessment models (IAMs) focusing on climate and land use became operational. With the emergence of Future Earth, and with the availability of new methodological and computational resources, a renewed assessment of challenges and future directions in the field of modelling is required. As one participant put it: “We are stuck in the temperature-carbon-GDP story, but people don’t care about temperature and carbon, they care about health and food”.



The session came to two general conclusions:

(A) Established ESM, IAM and impact model evolution face important new challenges in the Future Earth context; they are not yet fully evolved.

(B) There is a substantial but increasingly relevant modelling landscape emerging to fill crucial gaps beyond these established fields, most notably in the fields of multi-sectoral impacts, socio-ecological and macrosocial dynamics modelling.

The workshop arrived at a detailed analysis of achievable insights, required developments and persisting challenges for a next generation of modelling and obstacles to overcoming the challenges. This is a selection of some of these points:

1. Climate and Earth System Dynamics Modelling:

High-resolution modelling on the global scale (more direct link to impacts); progress in simulation of atmospheric and oceanic circulation, oscillations, clouds, more detail in terrestrial and ocean biogeochemistry; links to social and ecological modelling, re-evaluation of interaction with IAMs (consistency of scenario building); improved ensemble selection in multi-model studies based on benchmarking with palaeoclimatic evidence; communication of uncertainties, particularly in the long tails of distributions.

2. Multi-Sectoral Climate Impacts Modelling:

Operationalisation of multi-model intercomparisons; focus on “extremes rather than means” and on impact interactions; improved metrics for measuring impacts; improved process representations – much code dates from the 1990s; integration of regional and global-scale analysis; attribution research; infrastructures and protocols for data sharing

(including field and experimental data); high-resolution data; development of users and user services.

3. Socio-Economic Integrated Assessment Modelling:

inclusion of non-monetary effects, agency, labour markets and social differentiation; integration of material flows, recycling, institutions, distributional effects (differing value of assets for different groups); metrics beyond/in addition to GDP; pathways beyond first-best optimisation; allowing for structural change; transparency about purpose and assumptions; overcoming gatekeeping at journals and in universities.

4. Macrosocial and Socio-Ecological Dynamics Modelling:

Design and development of operational dynamical models; focus on issues of adaptive social and environmental networks, bifurcations/tipping points and their interactions, socio-environmental co-evolution, individual and collective agency with social differentiation and heterogeneous conditions, role of institutions; processing of extreme events in socio-ecological systems; socio-ecological city models; construction of socio-ecological concept models and emulators; links to ESMs and IAMs to increase the complexity of their representation of the social aspects.

A few common challenges emerged across these four modelling realms, such as improved transparency in methods to allow transfer of scientific results to political and societal applications, the need for transdisciplinary understanding, and formulation of a basis for prioritisation.

Session on “Metrics and evaluation for human well-being and sustainable development“

3

Organisers/Authors:

Nils aus dem Moore (*Rheinisch-Westfälisches Institut für Wirtschaftsforschung*)
Martin Visbeck (*GEOMAR Helmholtz Centre for Ocean Research Kiel*) Imme Scholz (*German Development Institute*)

Future Earth can play a key role in providing scientific advice and expertise to the UN post-Rio+20 and post-2015 development agenda, particularly in terms of the implementation and monitoring of the Sustainable Development Goals (SDGs). The three dimensions of these goals, including environmental, social and economic aspects, imply that they will require interdisciplinary knowledge and monitoring during the implementation process. Against this backdrop, 50 participants gathered in the session on “Metrics and evaluation for human well-being and sustainable development”.

Stefan Schweinfest, director of the United Nations Statistics Division, started his opening keynote speech by describing the technical requirements of good indicators. Accordingly, good indicators are solid from a methodological point of view, well-defined and relevant from a user perspective, as well as communicable and comparable all over the world. The second keynote speaker, Guido Schmidt-Traub, executive director of the UN Sustainable Development Solutions Network, pointed out that these conflicting requirements constitute a trade-off between the adequacy and comprehensiveness of indicators on the one hand and their communicability and policy relevance on the other. He also stressed that the selection of indicators in practice is driven, to a large extent, by political considerations.



After three subsequent kick-off talks from different fields of scientific sustainability research by Jan Börner (ZEF – Center for Development Research, University of Bonn), Francesco Burchi (DIE – German Development Institute, Bonn), and Barbara Neumann (‘The Future Ocean’ cluster of excellence, University of Kiel), the audience was split into seven breakout groups. **The most salient issues that were discussed in these groups concerned questions on**

- **how to deal with interlinkages.** Synergies or trade-offs between single indicators most likely affect political decision-making. Participants highlighted the importance of identifying these interlinkages and making them visible.
- the optimal **balance between a global set of SDG indicators and complementary indicators at national or regional levels.** The question was raised as to what extent it is feasible to account for regional and cultural diversity within the SDG indicator framework.
- whether **subjective indicators** should complement the set of objectively measured indicators. It was further discussed to what extent subjective measures can be used appropriately in the context of cross-country comparisons.

- whether information that is generally perceived as being **“unmeasurable” could be important in measuring well-being.** It was suggested that more research should try to capture these unmeasurable factors – which could also include the use of non-quantitative approaches.

Moreover, participants discussed the importance of

- performing **impact evaluations** on the basis of SDG indicators. To know what kind of policy intervention actually works and which does not, was seen as a crucial precondition to using SDG indicators fruitfully to reach SDG targets.
- providing **empirical evidence for the impact of indicators.** Here, the participants embraced a suggestion made by Stefan Schweinfest that SDG indicators would gain acceptance if research produced evidence of their influence on sustainable development. Hence, evidence of the effects of evidence-based policymaking was identified as an important research gap.



Session on “Theory and method development”

Organisers/Authors:

Claudia R. Binder (*Ludwig-Maximilians-Universität München*)
 Karen Pittel (*Ifo Institute*)

Impact statements:

Andreas Ernst (*University of Kassel*)
 Claudia Pahl-Wostl (*University of Osnabrück*) Antje Bruns (*University of Trier*)

The starting point for this session was the challenge faced by Future Earth research relating to the integration of theoretical approaches that draw from a wide range of disciplines. In order to understand the interactions between ecological and social systems and to provide fundamental insights into the social, economic and political drivers of behaviour as well as institutional adaptations to global change problems, debate centring on different theoretical approaches and their interplay is indispensable. In this context, the session specifically focussed on four questions:

- What are the important **preconditions** for integrated theoretical research?
- Are there important **gaps** in existing theoretical approaches that prevent Future Earth research questions from being adequately addressed?

- Can **frameworks** constitute a way to integrate theories from different disciplines?

- How are **human-environmental relationships conceptualised** or framed in natural and social sciences and what are the basic theories behind this framing?

Three impact statements served as an initial input for the discussion among the 30 or so participants. Following the plenary presentations, the above questions were addressed in a World Café. The session concluded with an open discussion in a fishbowl format that specifically included the relevance of these questions for German GEC research, research gaps and funding opportunities.

Participants stressed that they see plurality in research methods as an important precondition for successful interdisciplinary research but that tools are needed to define interfaces between disciplines. Successful cooperation between research partners also relies substantially on unveiling the often hidden assumptions that shape disciplinary understanding of earth and societal systems. These differences in disciplinary understanding of contexts, dynamics and human/societal interrelations were seen as larger barrier to interdisciplinary Future Earth research than specific gaps in existing theoretical approaches. Another key question was whether each research group has to start from scratch when designing and

developing interdisciplinary research or whether there would be some tools to overcome the identified barriers and create increasing added value. Two options were discussed, the first being the development of models, which incrementally become more complex and allows for including knowledge developed in several disciplines. Secondly, the use of frameworks was suggested and further discussed.

As a point of reference for the session, **frameworks** were defined as “a set of assumptions, concepts, values and practices that constitute a way of viewing a specific reality” (Binder et al., 2013). A framework is not a theory but may include components from several theories. Proponents of frameworks argued that by delineating sets of common variables, frameworks can foster a more general understanding of socio-ecological systems that goes beyond the individual project level. Opponents countered that such frameworks would be too general to be of use for specific research questions. They would consequently have to be supplemented by a more context-specific framing, thus thwarting their initial purpose. It was not just the pros and cons of frameworks per se that were

subject to heated debate but also more specific questions (light versus deep frameworks, their degree of flexibility, integration of stakeholders in the development of frameworks etc.). Session participants agreed that dedicating more research efforts to the analysis of the role and design of frameworks could provide substantial added value for inter- and transdisciplinary research in Germany and on an international level.

Regarding the **conceptualisation of human-environmental relationships**, an important challenge identified by the participants was the differences in scales on which different disciplines as well as different research approaches within the same disciplines focus (e.g., long-term versus short-term, local versus global, micro versus macro). Systematic research efforts dedicated to overcoming incompatibilities and inconsistencies caused by these scale differences could make a major contribution to Future Earth.

Session on "Science-society interfaces"

Session report by:

Jeremias Herberg

Organisers:

Armin Grunwald, (*KIT - Institute for Technology Assessment and Systems Analysis*)

Ulli Vilsmaier, Jeremias Herberg

(*Leuphana University of Lüneburg*)

Ralf Seppelt (*Helmholtz Centre for Environmental Research -UFZ*)

The session started with a panel discussion with Mark Lawrence (Managing Scientific Director IASS), Günther Bachmann (Secretary General of the German Council of Sustainable Development) and Klaus Stapf (Deputy Mayor Karlsruhe), moderated by Ulli Vilsmaier. Among themes, the panel discussed:

- good practices of co-design on the local, national and global level,
- the reconciliation of the autonomy and transdisciplinarity of science,
- the meaning of social problems for sustainability

science,

- the difference between policy advice and consultancy on the one hand, and transdisciplinarity on the other.

The panel discussed transdisciplinarity according to four focal points:

Scale: On the level of cities and counties, members of the public can play an active role, but science needs to learn more about how the public thinks. Mutual expectations need to be discussed.

Controversies: The debate that is currently taking place within "GAIA - Ecological Perspectives for Science and Society" was a subject of much controversy. Some emphasised how sustainability studies cannot just be transdisciplinary, but also need to be disciplinary basic research (Bachmann), others pointed out how transdisciplinary research also relies on a set of disciplinary foundations, while scientific methods in turn need to be extended and supplemented by non-scientific methods (Lawrence).

Politics: Sustainability politics itself relies on mutual expectations, which also relate to the skills in which

5

other groups are believed to be competent. This addresses the relationship between science and the public, and in this case exceeds the ecological aspect of sustainability, and also includes the fears and the stability of society at large.

Integration: When asked about future prospects for 2030, Bachmann was hopeful that, by then, civil society will be writing their own national reports separately from governmental reports. Another vision was that, by 2030, policy sectors and departments would no longer be silos but successfully integrated. Lawrence noted that the use of transdisciplinary methods may soon be just as established and legitimate as scientific methods.

The second part of the session was based on eight break-out groups of around seven participants each. Vilsmaier raised four questions that were covered by each one group:

1. Co-design: Where does co-design take place?
2. Co-production: How can equal and cooperative processes of generating knowledge take place while acknowledging different roles?
3. Policy advice: What function can different modes of policy advice fulfil?
4. Mutual learning: What are the most beneficial conditions for promoting an attitude that supports mutual learning and understanding?

1. Co-design

Important insights: Co-design critically addresses the prioritisation of research efforts and thus also relates to long-term funding. Co-design takes place on many levels, be it proposal writing, the grant creation, or the specification of research action on the local and regional level.

Open questions: The participants bemoaned a lack of awareness of the relevance, needs and challenges of co-design.

Critical remarks: The current incentive system in academia substantially hampers the possibility for more co-design as it, for instance, promotes lack of job security for young scholars. The necessary evaluation of co-design practices requires better documentation throughout the process.

Recommendations: Participants stressed that the presupposition of mutual capacities and competences that groups collaborating with one another often have is a fruitful way of carrying out and supporting co-design practices.

2. Co-production

Important insights: Both groups saw various reasons to reflect on the term “co-production”, or to extend it to more complex facets of transdisciplinarity besides collaboration. They discussed how a shared focal point or product helps to better orient cross-group interaction. There is a broad range of roles for scientists, such as trailblazer, knowledge disseminator, moderator, project manager, deflector, to name but a few.

Open questions: The participants stressed that scientific and non-scientific groups need to acknowledge the relevance of each other’s knowledge and capacities. Some participants remarked that the time before and after transdisciplinary encounters is often undervalued. Before, there is a need for a (funded) pre-phase in order to build trust and clarify the undertaking. After, there can and should be a kind of co-implementation that consolidates outcomes in a transdisciplinary way.

Critical remarks: Questions that were raised in the groups addressed the dangers of practising transdisciplinarity as a forced obligation or underestimating the time-consuming efforts of building mutual trust and confidence. In many circumstances there is a need for a third party moderator. One participant remarked that co-production ideally involves co-funding too, that is, financial commitment by all parties involved.

Recommendations: Co-production essentially requires resources, attention and time. Individual and collective training and capacity building also needs further support, possibly with the help of Future Earth.

3. Policy advice/ consultancy

Important insights: The participants approached policy advice as fundamentally conditioned by the apparent institutional embeddedness that frames local scientific practices.

Open questions: The discussion distinguished between science-push and policy-pull. In sustainability, there is more push for political advice and less pull from the side of policymakers.

Critical remarks: Normative questions, e.g., regarding decarbonisation, cannot essentially be discussed in an evidence-based fashion. And if scientific insights are the basis for advisory practices, the best advice may not always come from the most recent research but can also draw from the established status quo in a given field.

Recommendations: The demand for advice often brings time pressure with the result that scientific advice throws up specific facilitation and coordination needs. The participants also demanded



greater transparency in the selection of advisory committees.

4. Mutual learning

Important insights: The two groups gathered good practices from interactive formats such as platforms, dialogue forums, future workshops, regular gatherings, etc. Mutual learning was discussed as an iterative process of group formation that consists of attitudes, conditional contexts and self-evaluation. Contact between heterogeneous groups needs to spring from a shared cause or motive.

Open questions: The term “learning” led to some discussion as to whether transdisciplinary processes tend to target mutual learning of all involved groups, or whether they tend to instigate an open-ended dialogue (“How can we get into conversation?”). Moreover, it is critical to clarify the identity of one’s own group before attempting to formulate cross-group role descriptions.

Critical remarks: Web-based interaction technologies carry particular risks, for instance hampering the creation of mutual trust or jeopardising a certain level of process control.

Recommendations: Learning processes predominantly rely on reflexive and mutual understanding and thus require participants to listen closely to unfamiliar concerns and language.

4. Results community organised events

└ Side Events

1

Integrative urban studies: urban sustainability transformations theme picnic

Organisers/Authors:

Florian Koch, Kerstin Krellenberg,
Martin David (*Helmholtz Centre for
Environmental Research - UFZ*)

In the urban age that we live in, cities are at the forefront of sustainability transformations. This fact is acknowledged in global agreements: the UN's Sustainable Development Goals include for the first time a specific urban goal (number 11), and the Paris Agreement of December 2015 identifies the importance of cities in combatting climate change. Furthermore, urbanisation is mentioned as one major transformation area in the WBGU report on "World in Transition - A Social Contract for Sustainability". In its new report, the WBGU puts the emphasis solely on urbanisation (Humanity on the move: Unlocking the transformative power of cities). In addition, recent national, European and global funding schemes emphasise the importance of urbanisation processes and sustainable cities.

This side event built on these tendencies and put the spotlight on Urban Transformation Studies within the context of an integrated research programme. The event consisted of two major parts:

- 1) input presentations and
- 2) a so-called theme picnic (a moderated discussion session aimed at bringing together different views on transformation studies in/of urban areas from various disciplines and professional outlooks).

The first input presentation by Florian Koch highlighted the complexity of urban sustainability transformations and their relationship to the broader field of urban studies. Kerstin Krellenberg gave a presentation arguing that a systemic view of cities that emphasises the interactions between natural, technical and social functions is needed to achieve



sustainable transformations. The pitfalls of implementing urban sustainability were highlighted by Judith Utz (Deutsches Institut für Urbanistik, DIFU) in her talk on climate protection measures in German cities.

The subsequent discussion focussed on three major questions:

1. How should Urban Transformation Studies be designed?

The participants referred to the need to analyse urban areas in a holistic way, i.e., considering the relationships between city and hinterland as well as different spatial scales (neighbourhood, municipal, metropolitan) and cities in different institutional and demographic contexts. Furthermore, the need for interdisciplinary (combining social, technical and natural sciences) and transdisciplinary (academia, enterprises, civil society) urban studies was emphasised.

2. How can urban studies support the implementation of transformations to sustainability?

The participants argued that implementation issues should play a crucial role in integrated Urban Transformation Studies. Although the role of science

is important, it was noted that sustainability transformations already take place in cities without the support of the scientific community. So the scientific community can now offer its support to already ongoing transformation processes and elaborate implementation recommendations. Co-production should involve civil society, government, local authorities and private enterprises in the development of research agendas for integrative urban studies.

3. How should Urban Transformation Studies be addressed within the framework of the German Future Earth Community (e.g., in a working group on integrative urban studies)?

Due to the importance of cities in sustainable development, the participants agreed on the idea of trying to set up a working group on integrative urban studies within the German Committee Future Earth. It was agreed that the group should focus on the specifics of cities in sustainability transformations: a broad range of actors, a local system interwoven with other spatial levels and the ways in which sustainable transformations can be implemented on a manageable scale in an urban area.

2

Telling stories about sustainable development

A clarification exercise

Organiser/Author:

Jens Jetzkowitz
(*Philipps-Universität Marburg*)

Scientific approaches to sustainable development are widely understood as the antithesis of pretty speeches about visions of sustainability. Moreover, most scientists consider their activity as anti-narrative reasoning. It corresponds to their self-image that the statements they make rely on bare facts and effective analyses and have nothing to do with telling pleasant stories. It rarely occurs to the majority of scientists that their scientific work constantly relates to particular values and worldviews. Although the interpretation of, for example, a regression coefficient presupposes a worldview in which human beings solve a problem by identifying its underlying cause, it seems pointless to discuss this story and other criteria of sensemaking (Karl E. Weick) in the course of daily scientific work.



However, any attempts to transform science and society and move towards sustainability goals ought to reflect on the stories that serve (explicitly or implicitly) as cues or foundations and explore their effects on specific motivational structures. In general, storytelling should not be seen as a contradiction to scientific arguments, but as a precondition, since it is a fundamental human activity in which reported events are connected by meaning.

This side event was conceptualised as an exercise to explore how the question of storytelling should be addressed in sustainability discourse communities. The discussion group of around 15 participants was primed by (1.) an introduction to the issue of storytelling and (2.) by an interpretation of "Avatar", a science fiction film released in December 2009 which suggests a way to tackle the conflict between modern society and nature. The content of both presentations was hotly debated by the participants, proof of the fundamental significance of the issue. At least two different strands of interests were identified. Apart from an academic interest in the interpretation of cultural objects and the function of narratives, it must be noted that there is also an instrumental interest in knowledge relating to how to tell stories about sustainable development. Furthermore, the disagreements on interpretations of specific aspects of the film's narrative show that it is not always easy to arbitrate between these two different strands of interests. While scholars are interested in discussing argumentative viewpoints and positions, practitioners tend to seek advice and communicative strategies.

This exercise has clearly shown the demand for studying storytelling within the sustainable development discourse and for a theory-based and practice-orientated reflection of storytelling. However, any future attempts to do so should be mindful of the diverse interests in the field and should therefore be based on a clear concept on how to integrate these interests. Since each strand can provide inspiration for the other, it does not seem to be appropriate to treat them differently.

Towards a comprehensive future scenario framework for assessing sustainable development strategies

Organisers/Authors:

Hermann Lotze-Campen,
Elmar Kriegler
*(Potsdam Institute for
Climate Impact Research)*
Martin Visbeck
*(GEOMAR Helmholtz Centre
for Ocean Research Kiel)*
Jörn Schmidt *(Kiel University)*
Jan Börner *(Center for
Development Research)*
Ines Dombrowsky, Imme Scholz
(German Development Institute)

The political process of adopting sustainable development goals (SDGs) has reached a turning point with the UN Summit of September 2015 and the 2030 Agenda. However, given the ambitious list of 17 SDGs and 169 policy targets, research has not yet provided comprehensive tools and approaches to analyse interactions, trade-offs, co-benefits and synergies across multiple SDGs in sufficient detail. Moreover, developing strategies to achieve such a complex set of policy goals at different policy levels (from multi-national to sub-national) and across different policy domains (e.g. different government ministries) remains a huge challenge. In order to operationalise comprehensive SDG research, we propose to build on the lessons learned from the IPCC process on climate change impacts, adaptation and mitigation research and policymaking. The climate-related SDG 13 has many interactions with other SDGs, especially energy (SDG 7), but climate impacts may also affect poverty and hunger (SDG 1 and 2), water (SDG 6), marine resources (SDG 14) and economic growth (SDG 8). On the other hand, ambitious climate change mitigation may significantly change production and consumption patterns (SDG 12), urban development and



infrastructure (SDG 9 and 11), and terrestrial ecosystems (SDG 15) with implications for justice and peace (SDG 16).

Presentations: Lessons learned from the scenario process in the Intergovernmental Panel on Climate Change (IPCC) context and potential connections with the SDG framework (E. Kriegler); Sustainable use of marine resources: linking land and oceans (J. Schmidt); Forest conservation: Trade-offs and synergies for sustainable development on the regional scale (J. Börner); Policy coordination for implementing the SDGs: Lessons learnt from integrated water resource management (I. Dombrowsky).

This workshop involved around 40 participants and provided an overview of the Shared Socioeconomic Pathways (SSP) approach, a key element of the new scenario framework developed within the climate research community, and its use for climate policy analysis. Different options were discussed, including how to expand these scenarios in different dimensions, e.g., by explicitly linking land-based processes with oceans, linking global scenarios on climate change mitigation with regional trade-off

analyses on forest conservation, and taking into account experiences from policy coordination in integrated water resource management. As a potential contribution to the Sustainable Development Solutions Network (SDSN) project "The World in 2050", current scenarios could be expanded in a step-wise manner to cover aspects like food and water security, marine ecosystems, health, poverty and global inequality. Trade-offs, synergies and co-benefits between different SDG dimensions need to be emphasised and assessed. However, a focus on poverty and inequality may require adjusted storylines and indicators. With regard to new methodologies, the need for explicit modelling of political decision-making, policy implementation processes and governance systems was expressed. The current SSP scenario framework is in principle open to storyline extensions and new modelling approaches, especially on the regional and national scales. However, consistently linking global-scale scenarios with a sample of more detailed and policy-focussed regional assessments remains a challenge. Future Earth could provide a valuable structural and organisational framework for such a long-term endeavour in global change research.

4

SDGs and the Future Earth research agenda

Perspectives of early career scientists (ECS)

Organisers/Authors:

Ruth Delzeit, Antje Brock,
Simon Meisch (*Spokespersons of
German Network of Early Career
Scientists in Future Earth*)



The side event started off with a round of questions and answers about the work and aim of the ECS network.

The ECS spokespersons of the ESC had prepared a position paper on the Future Earth Research Agenda which was circulated in the ESC network prior to the side event. The group decided to comment on an updated version of the position paper by the end of February.

Due to the large number of other side events running in parallel and obligations of some of the early career scientists in other sessions, it was decided that an additional meeting of ESC will be held this summer in Kiel. The spokespersons will prepare a proposal for a DGF-roundtable discussion. During the side event, participants discussed potential topics for such a roundtable discussion. Several concrete topics were suggested that were considered

broad-ranging enough to attract scientists from different disciplines whilst also relating to the specific role played by ECS. Participants suggested that “Sustainable Development Goals in the Context of Early Career Scientists” would be a suitable topic for such a roundtable.

The speakers will summarise the potential discussion themes and circulate them to the network before submitting them at the next meeting of the German Committee Future Earth in April 2016.

5

Normativity and plurality: how to deal with ethics in Future Earth?

Organiser/Author:

Thomas Potthast (*Eberhard Karls Universität Tübingen*)



Future Earth has been established against a background of global threats to ecosystems and an overall non-sustainable development. It aims to achieve a new way of integrating the sciences and the economic and social spheres in order to contribute to sustainable development (SD) from a global perspective. Thus, Future Earth is embedded in evaluative and normative contexts. This poses peculiarities for the interdisciplinary integration of the natural and social sciences and humanities as well as challenges for transdisciplinary integration. This workshop brought together participants from various backgrounds in the bio- and geosciences, economics and psychology.

1) An initial clarification of terminology was important: “Morals” are individual and/or collective ideas about the morally good individual life (*eudaimonia*) as well as about moral obligations towards others and ourselves (*morals* s. str.). “Ethics” denotes the systematic reflexion of morals (= moral philosophy). In all real world contexts like Future Earth, valuations and judgments are based on both empirical (descriptive) and normative/evaluative (prescriptive) premises: so-called mixed judgements. Hence application-oriented ethics must of necessity integrate knowledge from the natural and social sciences as well as the humanities. “Philosophical” in this context means to very practically reflect on such issues as production, validity claims and implications of both empirical facts and moral norms. Separating moral preferences (i.e. factual moral non-/acceptance) from justified ethical statements (i.e. moral non-/acceptability) is very important to understand differences and a certain tension between social

science vs. philosophical/political approaches to moral issues.

2) The vision statement of Future Earth was analysed with regard to its normative content, comprising the *general ethical justice norm of sustainable development*, *the affirmation of political-legal international norms (most recently: UN Sustainable Development Goals)*, *general epistemological norms regarding inter- and transdisciplinarity*, *instrumental norms of means-ends relationships*, and *methodological-procedural norms*. Hence, research in Future Earth is not neutral, and, as a matter of fact, does not seek to be neutral. Implicit normative attitudes, concepts, practices and objects are to be made transparent and included in an argumentative deliberation.

3) The plurality of values was discussed with regard to the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) conceptual framework. The framework uses three lines of value systems in parallel: consensual values, "Western" values and non-Western value approaches. This exemplifies that there is no such thing like one (ethical) silver bullet. And it is not a question of cultural value relativism ("Anything goes!") but of reaching solutions in different contexts through argumentation that respects different normative orientations - and not simply exporting "Western" value systems. At the same time, regional and global practices that violate universally accepted human rights or are otherwise not ethically justifiable, are to be rejected on the basis of universalist ethical argumentation.

4) Ethical points to consider in Future Earth research means asking for forms of sustainable transformation under conditions of a) cultural plurality *and* b) universal/global obligations, *and* c) conditions of epistemic and moral and cultural uncertainties. In that sense, ethics as moral philosophy in connection with epistemology has a part to play as one methodological perspective of analysis and synthesis in inter- and transdisciplinary approaches for current and future research in Future Earth.



4. Results community organised events

└ World Café

Table 1

What are the impacts of research? Research impact assessment as element of reflexive and socially responsible research.

Organisers/Authors:

Katharina Helming, Katrin Daedlow, Johanna Ferretti, Aranka Podhora (*Leibniz Centre for Agricultural Landscape Research - ZALF*)
Rainer Walz (Fraunhofer Institute for Systems and Innovation Research ISI)
Jürgen Kopfmüller, Markus Winkelmann (*KIT - Institute for Technology Assessment and Systems Analysis*)



In the LeNa project (Guideline for Sustainability Management in Non-University Research Organisations, www.lena-projekt.de), funded by the German Federal Ministry of Education and Research (BMBF), the Fraunhofer-Gesellschaft, the Helmholtz Association and the Leibniz Association are cooperating to develop a joint understanding of sustainability management in non-university research organisations.

Research-specific requirements and contents are being developed in three sub-projects: “Socially Responsible Research”, “Human Resources” and “Construction and Operation”. The discussion at the World Café table was initiated and moderated by the project members involved in the sub-project “Socially Responsible Research” and focussed on introducing impact assessment as a standard element in research processes.

Research impact assessment can be seen as an instrument to facilitate socially responsible research. However, no widely recognised approach to carrying out research impact assessments exists in Germany. At the World Café table, the potential and constraints of such a procedure were discussed and potential



applications in different disciplines were identified. Within those committed, interdisciplinary discussions, the following issues were addressed:

- On what grounds can something be called an “impact” in a specific case?
- How can the challenge of measuring impacts be dealt with (e.g. measuring the effects of delayed impacts)?
- What can be considered as a direct impact of a research project? How can indirect and/or unintended impacts be dealt with?
- How can differences in impact assessments in different disciplines (e.g., in medical research) be dealt with?
- How can the issue of authorship of transdisciplinary results be dealt with? How should transdisciplinary results be formulated to have an impact on scientific as well as (stakeholder-specific) non-scientific discussions?

• How can impacts of research processes be taken into account if there is no funding left for monitoring after the project has ended?

- If research is carried out in third-party countries or intercultural contexts, how can impacts be traced?

The participants of the World Café table attached great importance to considering potential impacts of research processes with regard to sustainable development. They presented numerous examples of impacts from their own research, while remaining focussed on the challenges relating to research impact assessment exercises.

From co-design to co-evolution – What practical knowledge do we need for sustainability science and how can it be co- produced?

Organisers/Authors:

David Brian Kaiser, Thomas Weith
(Leibniz Centre for Agricultural
Landscape Research)

Tuck Fatt Siew
(Goethe University Frankfurt)

Martin Welp (Eberswalde
University for Sustainable
Development)

Background: Co-production of knowledge for sustainability science requires a common grasp of science (natural and social sciences as well as economics) and practice. Knowledge co-production occurs at science-policy/science-practice interfaces, where knowledge from various stakeholder groups is created and integrated. The questions are: (1) what practical knowledge is needed and (2) how can practical knowledge be co-produced at the interfaces?

Goal: Our proposed discussion at the World Café aimed at gaining a better understanding of practical knowledge gaps and needs as well as the methodology used for enabling knowledge co-production. The intention was to use the discussion outcome as a basis for identifying the gaps in and needs of a science-policy-practice interface platform to be used for enhancing communication and knowledge exchange among scientists/researchers and stakeholders.

Results: The participants in the discussion came from diverse professional and disciplinary backgrounds. Most of them were researchers involved in interdisciplinary research focussing on fisheries as well as agricultural, climatic, economic and socio-ecological studies in Germany and





elsewhere, including Africa and China. Other participants included teachers from secondary and tertiary education in Germany and committee members from Future Earth. Some participants raised the issue that it tends to be difficult to define an unknown problem to be addressed in the real world by researchers. Additionally, it is challenging to achieve common understanding of a particular problem and implement a common research agenda together with stakeholders/practitioners. The participants generally believed that these underlying difficulties may be due to the use of different languages and diverse interests in different domains. In response to the first discussion question, the participants spoke of varied practical knowledge that was generated in their research projects for different purposes. For example, in the case of a study on fisheries in Senegal, knowledge that was gained from local fishing populations (including details of their socio-economic situation) was used to support the formulation of a sustainable fisheries policy. The participants cited a broad range of methods for the co-production of knowledge, emphasising the importance of face-to-face meetings and including questionnaire-type surveys and workshops. The application and usefulness of participative modelling methods for enabling knowledge integration was also strongly emphasised. The participants felt that knowledge co-production particularly requires a consideration

of specific socio-cultural settings and the translation of scientific models for practitioners/stakeholders. They also felt that stakeholders need to be involved in iterative processes at eye level and that researchers need to cooperate closely in interactive, multidisciplinary and interdisciplinary settings.

Conclusions: The discussions showed that knowledge co-production is a challenging task that requires researchers and stakeholders to have a holistic and common understanding. A variety of methods are available for enabling knowledge co-production. Most importantly, all researchers and practitioners should co-produce knowledge at eye level throughout all phases: co-design, co-production and co-evolution of knowledge.

Citizen Science als ein Beitrag zur transdisziplinären Wissensproduktion

Organisatoren/Autoren:

Lisa Pettibone (*Museum für Naturkunde Berlin*)
 Diana Hummel, Alexandra Lux (*ISOE – Institut für sozial-ökologische Forschung*)
 Anett Richter (*Helmholtz Zentrum für Umweltforschung - UFZ / German Centre for Integrative Biodiversity Research*)
 Birgit Blättel-Mink (*Goethe-Universität Frankfurt*)
 Katja Heubach (*UFZ Leipzig*)

Die Arbeitsgruppe „Co-design, co-production and co-dissemination“ möchte näher untersuchen, inwieweit die Erfahrungen aus Citizen Science (CS) in der Biodiversitäts- und Umweltforschung als Beispiel für Co-Design und Co-Production genutzt werden können, um Transformationen in Richtung nachhaltiger Entwicklung zu fördern. Am Thementisch wurden Impulse zu partizipativer Forschung gesammelt und diskutiert, um eine Wissensgrundlage für die Arbeitsgruppe zu etablieren. Die meisten DiskutantInnen waren mit dem Konzept von CS wenig vertraut, doch wurde die Diskussion mit persönlichen Beispielen von transdisziplinärer Forschung bereichert. Zunächst wurde das Wissenschaftsverständnis und konkret die Frage nach Gemeinsamkeiten und Unterschieden zwischen CS und anderen partizipativen Ansätzen diskutiert. Hervorgehoben wurde, dass CS möglichst beides umfassen sollte: Die Forschung soll ein Wissen erzeugen, das für BürgerInnen relevant ist, zugleich können BürgerInnen ihr Wissen in die Wissenschaft einbringen. Ähnlichkeiten der CS zu anderen partizipativen Ansätzen bestehen beispielsweise in Formen einer „community-based research“, die stärker in den Sozialwissenschaften zur Anwendung kommen, oder auch zur Emotionsforschung der Psychologie, in der Survey-Methoden angewendet werden. Vielfach werden die Grenzen zwischen Wissenschaft und Gesellschaft durch CS durchlässig; BürgerInnen werden zu Akteuren in der Wissenschaft, z.B. durch die Sammlung und den Austausch von Daten. Die Form der Kooperation bei der Erhebung von Daten ist vor allem aus dem Biodiversitäts- und Monitoringbereich bekannt und CS wird vielfach zunächst mit den Aktivitäten im Naturschutz in Verbindung gebracht. Im Hinblick auf die Beweggründe von BürgerInnen, sich an CS zu beteiligen, wurde auf die Bedeutung der intrinsischen Motivation aufmerksam gemacht, etwa das Bedürfnis, zu einer wissenschaftlichen Unternehmung mit der Bereitstellung gesammelter Daten einen eigenen Beitrag zu leisten. Genauer zu betrachten wäre, unter welchen Bedingungen die Zusammensetzung der Citizen Scientists (z.B. nach Geschlecht, Alter) eine Rolle für die Forschung und Wissensgenerierung spielt. Ein weiterer Diskussionspunkt war das Partizipationsverständnis: Warum wird die





Partizipation von gesellschaftlichen Akteuren in der transdisziplinären Wissensproduktion notwendig? Welchen Einfluss hat diese Begründung auf das Format der Beteiligung? Allgemein ist in der Gesellschaft ein wachsendes Bedürfnis nach Mitsprache und Beteiligung zu beobachten. Partizipation ist insbesondere dann notwendig, wenn es um die Implementierung von Forschungsergebnissen und Akzeptanz geht. Wenn Nachhaltigkeitsforschung ernst genommen wird, ist ein Kontextwissen erforderlich, das z.B. durch CS gewonnen werden kann. Durch neue Formen der BürgerInnen-Beteiligung wird neues Wissen erzeugt. Dies geschieht bereits und neben den bekannten Projekten im Umweltbereich auch in der Geschichtsforschung oder der Planung. In der Regel gehen laut der Diskutierenden die Impulse allerdings von der Wissenschaft aus; umgekehrt ist nur in seltenen Fällen die Initiative von BürgerInnen ausschlaggebend für die Initiierung von Forschung. Im Hinblick auf das Akteursverständnis wurde diskutiert, wer Wissen und für wen produziert, wie unterschiedliche Akteure agieren und welche Machtverhältnisse dabei beachtet werden müssen. Hervorgehoben wurde, dass die Beziehung zwischen WissenschaftlerIn und Citizen Scientists auf Augenhöhe zu gestalten ist; für beide Seiten sollte ein Mehrwert erzeugt werden. Anzustreben sei, dass BürgerInnen nicht nur Daten liefern, sondern auch an der Entwicklung von Forschungsfragen und Hypothesen beteiligt sind. Diskutiert wurde zudem, inwieweit CS vorwiegend von Personen mit höherem Bildungsniveau praktiziert wird und inwiefern sich die Aktivitäten ändern sollten, um einen

breiteren Kreis von BürgerInnen zu erreichen. WissenschaftlerInnen und BürgerInnen verfolgen in der Regel nicht die gleichen Ziele. Daher sind auch die Beteiligungsformate abhängig von den Zielen der Partizipation. Transparenz der Forschung und ihrer Ziele war hier ein wichtiges Stichwort. Genauer zu betrachten wäre, inwieweit kulturelle Unterschiede und soziale und ökonomische Rahmenbedingungen z.B. in Entwicklungsländern spezifische Formen von CS erfordern.

Schließlich wurde das Landschaftsverständnis beleuchtet: Welche Methoden und Ansätze gibt es im Bereich partizipativer Forschung? In welcher Beziehung steht ein Ansatz wie CD zur transdisziplinären Forschung? Welche Methoden sind hier weiterhin wichtig? Als sehr geeignete Methoden wurden insbesondere partizipative Workshops hervorgehoben, die einen intensiven Austausch mit Stakeholdern ermöglichen und von manchen Diskutanten als unerlässlich gesehen wurden. Formen des Dialogs und Wissenstransfers wurden an unterschiedlichen Beispielen betrachtet, z.B. können Daten können gesammelt und z.B. zur Entscheidungsunterstützung (als decision support tools) in Behörden, etwa im Rahmen des Wasserressourcenmanagements verwendet werden. Festgestellt wurde, dass es zwischen CS und transdisziplinärer Forschung Verbindungen gibt, beide jedoch keineswegs gleichzusetzen sind.

Institutional analysis of social-ecological systems

Organisers/Authors:

Konrad Hagedorn, Katharine N. Farrell and Sergio Villamayor-Tomas (*Humboldt-Universität zu Berlin*)

Further information:

www.wins.hu-berlin.de/about-wins



The objective of this World Café table reflects the main focus of the Berlin Workshop in Institutional Analysis of Social-Ecological Systems (WINS), which has been set up to serve as a vehicle for enhancing self-organisation of scholars from different scientific communities engaged in nature-related institutional analysis. WINS starts from the basis that the sustainability of human-environment systems crucially depends on human interactions (individual and collective), guided by institutions (e.g., rules, norms, beliefs) and forms of organisation (structures and modes of governance). At the same time, processes of social construction and deconstruction are crucially conditioned and influenced by attributes of the physical and natural environment. Many different heuristics and languages have been used by different scientific communities to study this, which raises the question of whether and how bridging between these different approaches can be achieved and how communication and collaboration across scientific communities using different analytical frameworks can be stimulated.

WINS' aim with this World Café table was to stimulate thinking and dialogue about the relationships between how institutions are understood and studied by scholars contributing to the inter- and transdisciplinary work of Future Earth. We invited participants to tell us which frameworks they are using and to explore with us whether bridging or bonding should be the guiding principle for developing relationships between their different scientific communities.

Printed copies of Siegwart Lindenberg's definition of framing "...a process of structuring an action situation, ...[which,] in that sense ...governs 'meaning'," from the 2001 Handbook of Sociological Theory, as well images of bridges and bonds and a small wooden model house-frame were provided to make the topic tangible. Each discussion session had a different composition. Some were diverse in



seniority, gender and specialisation; some involved only women, only students or only natural or social scientists. Some sessions were characterised by debate. For example, a firm position in favour of bonding over bridging was strongly advocated in one session, with discussion focussed on the usefulness and robustness of unified comprehensive socio-ecological models. One session was spent mainly discussing the table topic itself, with natural scientists for whom the idea of institutions as a study object was unfamiliar. Another session, with two social scientists, focussed on the issue of policy advice and how nature-related institutional analysis could be bridged with decision-making. There was comparatively little discussion of which frameworks were being used, and a general sense that this was a matter of specialisation and choice. Instead, the main focus of discussion was about whether bridging or bonding relationships were preferable. Many participants focussed on relationships between frameworks, as opposed to relationships between communities. There was a general consensus, with some exceptions, that bridging was a better choice than bonding because it allows for greater flexibility, higher degrees of specialisation and more complete coverage. Several participants took the position that, over time, bridging will lead to bonding. Some found that to be a good thing, while others considered it a potential problem.



Table **5**

Measuring sustainable consumption in the context of the SDGs

Organiser/Author:

Johanna zum Felde
(Open Knowledge Foundation
Germany)

Further information:

www.2030-watch.de

The Open Knowledge Foundation Germany (OKF DE) has published a prototype tool to monitor SDG implementation in Germany. This tool is still an alpha version with regards to choice of indicators, definition of optimum values, design and functionality. The platform of the German Future Earth Summit World Café was used as an opportunity to discuss existing indicators for sustainable consumption and to brainstorm additional ones.

The discussion can be summarised as follows. To assess sustainable consumption there needs to be differentiation between: 1.) defining indicators, 2.) measurement methods and 3.) assessment of the sustainability of a product or process through the definition of a target value. All three steps were perceived as difficult.

It is difficult to define a good indicator as, for example, the proportion of GDP represented by regional products does not mean sustainability per se. Further indicator suggestions were water consumption per capita, food loss, energy consumption, working conditions and the share of regulated products. Data availability was perceived as difficult for many of the proposed indicators. Only a few measuring methods were mentioned, all relating to water, namely life-cycle assessment (from a production perspective, i.e. water and energy) and water quality evaluation. In order to assess sustainability, a target has to be defined to indicate when sustainability has or has not been reached. Country context is therefore important. For example, in the case of water supply there is more rain in some countries than others. The question was also raised as to whether individual indicators have or should have an impact on Germany or other countries as well i.e. the market share for domestic energy consumption

Consumption and production should be seen as two different stages, since sustainable production does not necessarily equal a sustainable product. This would differentiate between enabling, i.e. regulation requiring the marking of bananas in Ecuador, and consumption measurement, i.e. the possibility for consumers to scan barcodes

(providing information on where a product is from and what the ingredients are). Information is the most important aspect. More information than we think exists, but it needs to be made available. Governments should allow consumers to choose at the same time as banning the obviously dangerous.

Finally the World Café participants realised that sustainable consumption is not addressed by a single SDG (12) but is represented in many other SDGs, namely water (SDG 6), energy (SDG 7) and ecosystems (SDGs 14 and 15).



Table 6

Social innovations in energy consumption and production – perceptions, motivations, and change agents

Organisers/Authors:

Working Group German Committee
Future Earth “Strengthening
social-sciences in Future Earth”
and Birgit Blättel-Mink (*Goethe
University Frankfurt*)

The World Café focussed on the impact that changing technologies, political decisions and changing perceptions of the environment might have on social practices. This sometimes leads to social innovations, as can be seen with the German energy transition (Energiewende). As the energy sector is transforming, the lines between passive consumers and active producers are blurring. Consumers become part of the production process, e.g., in the field of solar power. Consumer preference for locally produced green energy not only influences investment decisions made by traditional utility companies but also lead to the creation of new community-based energy providers. Moreover, technological developments offer customers new opportunities to react to developments on energy markets by means of smart metering, new storage technologies, or information technologies for example.

At the World Café we sought to discuss the potential of social innovation for the transition of the German energy system, as well as its contribution to overcoming global challenges in the energy domain. Special attention was given to perceptions, motivations and change agents in the efforts being made to transform societies to more sustainable futures in the energy domain.

The main questions were:

1. What kind of social innovations can be observed in the field of energy production and consumption, and (how) are these new social practices transferable between countries and cultures?





2. What institutional, social and infrastructural conditions are necessary to spark and sustain radical social innovations? What perceptions and motivations drive the process in civil society, industry, and of socio-technical innovators in transformations to sustainable energy use?

Visitors to the World Café provided examples of new social practices in the field of energy provision. A regional initiative of “crowds changing the energy provider” was introduced, where seeking the best provider is a collective, rather than an individual, initiative. Another example from a village in Saxony was reported, where the local authorities, facing empty coffers, initiated “crowd funding” to finance a community wind park. The members of the public who provided the co-funding take a share in profits. A positive side effect of this is that it overcomes the NIMBY problem, at least partially. A third example came from South Africa. The REI4P (Renewable Energy Independent Power Producer Procurement Programme), initiated by the South African Department of Energy, is striving to foster renewable energy through open bids that might come from single communities or companies. The incentive for feeding energy into the national grid being the (re)distribution of profits.

The level on which an action takes place was a major issue in the discussion. Is it useful to foster creative local or regional initiatives, or should there be a comprehensive national regulation scheme embedded in global strategies? What role do single households play in initiating transformation of the energy sector? The German feed-in tariff within the Renewable Energy Act (EEG) as central pillar of the German Energiewende has been identified as inhibiting more than it facilitates energy saving and more sustainable energy use. Economic incentives alone might not foster major behavioural changes.

Bottom-up initiatives have been seen as much more promising: innovative community strategies, as well as corporate initiatives and the collaboration of citizens. Mainly the community level had been seen as promising with single communities being “early-adopters”. It was made clear that in such a case, local problems might function as a powerful initial spark.

Finally, some technical issues, acting as enablers for social innovations, were discussed, including smart metering, a scheme that empowers consumers and turns them into partners in the energy provision system.

Table **7**

Big questions in climate impact science

Organisers/Authors:

Christopher Reyer, Katja Frieler, Lila Warszawski, Jacob Schewe and Franziska Piontek (*Potsdam Institute for Climate Impact Research*)

The impacts of climate change increasingly pose threats to natural and socio-economic systems, endangering the world's transformation towards sustainability. The world's poorest populations, whose basic livelihoods are at risk, are the most vulnerable. Therefore, a better understanding of impacts is crucial in order to create robust knowledge bases for climate negotiations and responsive climate policies.

Despite huge advances, our understanding of climate impacts often remains fragmented, particularly when it comes to cross-sectoral interactions that may amplify or dampen the effects of individual impacts. Furthermore, the difference between impacts at various warming levels is still largely unquantified. The first steps to address this knowledge gap have





been taken in projects such as the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP).

At this World Café table, we wanted to identify the current "Big Questions" in climate impact science, and how they can best be addressed by coordinated, community-driven research programmes. The goal of these discussions was to assess the potential role of the German Future Earth community in addressing these questions, and what concrete steps can be taken to strengthen existing capacities and research efforts. The discussion during the World Café revolved around a few main issues:

1. What risks and costs are likely to arise within a sector or region at different degrees of global mean surface temperature change? Especially between 1.5 and 2°C (after COP 21 in Paris). What are the implications for mitigation and adaptation? How does the rate of warming influence the timing and severity of impacts?

2. What are the most important interactions of impacts across sectors? How can we promote cross-sectoral analyses? How can we quantify the combined impact on society of several interacting impacts?

3. What is the interaction of climate impacts and other changes in nature and society?

4. What are the costs and impacts of adaptation and mitigation measures on other sectors? What are the co-benefits of mitigation and adaptation measures for sustainable development and vice versa?

5. What type of model Improvement is needed to assess future impacts? How should these models be evaluated?

- a. Better capture thresholds and extremes
- b. Include genetic diversity and plasticity
- c. Develop reliable models in new "sectors": health, migration, conflicts

6. How/what can global models learn from regional ones and vice versa?

- a. Upscale adaptation/management and feedback between management and biophysical processes
- b. Top-down (global) modelling vs. bottom-up (regional)

7. Service vs. science: who are the users of "impact science" and how user-oriented should "impact science" be? E.g., adaptation planning, global impact assessments, impact databases for insurers.

Soil research data: interdisciplinary requirements for a national data management system

Organisers/Authors:

Katharina Helming, Uwe Heinrich, Niko Svoboda (*Leibniz-Centre for Agricultural Landscape Research - ZALF*)
 Ute Wollschläger, Hans Jörg Vogel, Stephan Bartke (*Helmholtz Centre for Environmental Research - UFZ*)
 David Russell (*Senckenberg Museum Görlitz*)

Further information:

www.bonares.de

Soils are key resources for food security, biomass provision and the maintenance of ecosystem services and biodiversity. The increasing global demand for food and bio-based products poses challenges for the sustainable utilisation of soils. Climate change, ongoing soil degradation and land taken for urbanisation reinforces the pressure on arable soils to increase productivity while maintaining its carbon sequestration potential and its functionality for water buffering and filtering, microbial transformations and nutrient cycling. Integrated modelling and assessment tools are required to deliver the evidence base for innovative and sustainable soil management practices. However, assessments and models of soil system processes can only be as good as the data on which they are based. Data from long-term monitoring and experimentation are particularly indispensable for identifying changes in geophysical conditions, ground-truth remote sensing, validating data from specific experiments and model simulations, and upscaling findings from local analyses. Sophisticated management and information systems are required to collect, manage and provide high quality, ready-to-use data. However, such systems are costly, time-consuming and require particular expertise. There is also a trade-off between the need for continuity of experimentation following a fixed protocol, and adaptation to emerging research questions. The national, BMBF-funded "BonaRes – Soil as a Sustainable Resource for the Bioeconomy" research programme implements a national data, modelling and assessment system for soil research. It is accompanied by ten integrated research projects, each focussing on specific issues of sustainable soil management.

The World Café identified key requirements of data acquisition, management and provision of soil research data from cross-disciplinary perspective. Key requirements include: (i) highest international standards for meta-data management and data publication options, (ii) up- and down-scaling options of data and model information; (iii) connectivity to policy and practice decision-making.





4. Results community organised events

└ Special Events

Pathways to sustainability: dealing with uncertainty

A special event prior to the German Future Earth Summit 2016 by IRI THESys, Humboldt-Universität zu Berlin

Organiser/Author:

Tobias Krüger, Marisa Beck, Anne Dombrowski
(Humboldt-Universität zu Berlin)

Videos of the talks and discussion are available at:

www.iri-thesys.org/events/videos

Uncertainty creates omnipresent challenges for sustainability research and decision making. Projections of future developments in coupled human-environment systems are always partial and indeterminate because the complex processes of change in these systems are not fully understood and empirical data is scarce. Governance must acknowledge that multiple futures are possible and account for surprises when navigating pathways to sustainability.

What are the implications for the Future Earth community working to identify pathways to a sustainable future? In particular, what theoretical frameworks and methods can help identify, manage and communicate uncertainty in sustainability research? And how can researchers provide effective and meaningful decision-support without unduly simplifying problems or prematurely limiting the range of considered possible futures? A multi-disciplinary audience discussed these and other questions with five expert panelists on the evening before the German Future Earth Summit:

Prof. Andrew Stirling (University of Sussex) – ‘Pathways to Sustainability: responding to uncertainty’ (keynote)

Dr. Armin Haas (Institute for Advanced Sustainability Studies) – ‘Some remarks on uncertainty’

Dr. Sabine Fuss (Mercator Research Institute on Global Commons and Climate Change) – ‘From risk to uncertainty’

Dr. Silke Beck (Helmholtz Research Centre for Environmental Research) – ‘Who speaks for the future of earth?’

Dr. Stefan Bösch (Karlsruhe Institute of Technology) – ‘Risk-knowledge production: Institutionalized knowing about ignorance?’

Photobox of Sustainability developed by the Karlsruhe School of Sustainability

Stakeholder dialogues at the Photobox of Sustainability: giving sustainability a face

Organisers/Authors:

Kaidi Tamm (KIT - Institute for Technology Assessment and System Analysis)

The Photobox of Sustainability is a powerful science-society interface tool exemplifying the diversity of perspectives and giving sustainability a face. Visit the GFES Photobox gallery at www.mensch-und-technik.kit.edu/ksn_fotobox/20160128/index.php

During the first panel discussion at the conference on sustainability research in Germany the question was raised as to whether scientists are also stakeholders. The panel (of scientists) somewhat hesitantly admitted that sometimes scientists can be

considered stakeholders. Defining who is a stakeholder has to do with disciplinary backgrounds and ways the concept is understood, but the issue raised more questions than it answered. Can a researcher, as a trained logical thinker and a human being, remain a neutral observer in the face of the current multifaceted sustainability crisis without to some extent being a stakeholder too?

As transdisciplinary researchers developing cooperative sustainability projects with different interest groups, organisations and students at the Karlsruhe School of Sustainability, we noticed that sustainability often remains an abstract concept for our partners. To help to connect the complex concept with its practical applications, we developed the Photobox of Sustainability. Its components are simple: a chalkboard, a camera, a laptop, wooden walls offering some privacy while still retaining open space, and one or two researchers. By asking what sustainability means on the individual community and professional level, and how transformation towards more sustainable ways of life can take place, the box creates a space for dialogue and encourages reflexion. The unusual format also offers the opportunity to share the answers with a broader public by photographing the message.

At the German Future Earth Summit we asked two questions: what is the individual understanding of



sustainability and how can global sustainability be achieved?

Most answers for the first question relating to people's individual understanding of sustainability had to do with taking responsibility and making change happen. This can be done by using resources, including time, sensibly and sparingly and leaving enough resources for subsequent generations to create a resilient society where nature and humanity support each other. This also involves living viably without discriminating against other people and nature by thinking twice before consuming. Ensuring zero waste and pollution were also mentioned.

Different strategies were proposed as recipes for global sustainability. On the grassroots level, people suggested getting to know your neighbours and discussing with them how to create a good and dignified life for this and future generations and

buying locally. Structural changes such as introducing a circular economy, implementing lifelong sustainability education and awareness raising methods, and rewarding sustainable action while sanctioning unsustainable action were also mentioned.

In addition, there were some pictorial answers with little or no verbal message, depicting for example the interconnectedness and urgency of achieving sustainability. Over the two days Katja Saar and Kaidi Tamm had many insightful, although short (due to time constraints) discussions with participants. What stood out was that the conference audience of sustainability professionals were more cautious with their answers than any other audience so far. Our special thanks go to Bettina Schmalzbauer from German Committee Futur Earth for her excellent support in hosting our special event, and for sharing her vision of sustainability with us.

What does global change look like?

My m² Earth. A collaborative photo project by IRI THESys, Humboldt-Universität zu Berlin

Organiser/Author:

Anne Dombrowski

(Humboldt-Universität zu Berlin)

www.my-m2-earth.org

A photo taken on the margins of the 2nd German Future Earth Summit on 29th January 2016 shows us an area still under construction, an urban wasteland with mechanical diggers in the background and construction site fences in the foreground. A single abandoned brick wall reminds us of what this place once was. What it will end up looking like remains to be seen.

Like the construction site, our whole world is changing, and whether these changes will lead to a sustainable future or not still lies within the realm of the unknown. Even though transformation is a never-ending process with no final result, the present is laying the ground for the future, and this is taking place around us all the time. Within this context, the local and the global are inextricably linked.

Running from 15th October 2015 to 15th March 2016, *My m² Earth* was designed as an ever-expanding online gallery visualising local aspects of global change. Anyone interested in sustainability was welcome to engage in the project by adding their pictures and explanatory notes. What counted here was the photographer's personal view resulting in individual motifs based on everyday experiences.

78 images were submitted by 53 photographers showing visual findings from every continent. Presented as snapshots, documentations or artistic compositions, some seem to come from fieldwork



abroad, others from right on the photographer's doorstep. As anthropogenic change can contain both positive and negative impacts, hopeful and alarming aspects, the images that were submitted focus on a broad range of phenomena such as climate change, biodiversity and agriculture, deforestation and desertification or urbanisation and lifestyle.

The participants, researchers as well as members of the public, were colleagues and friends from the IRI THESys and the Future Earth community, and also from the WWF's and DKK's Massive Open Online Course on climate change, not forgetting the many unnamed participants typical of web-based collaborative projects.

In this sense, photography functions as a visual mediator between scientific and everyday discourse, invites observers to position themselves and offers the possibility to respond to others through images and comments in order to initiate a lively dialogue on the Earth's Future. *My m² Earth* can therefore also be understood as an approach responding to the need for new forms of knowledge production and knowledge exchange within transformation and sustainability research. New research methods and mediation formats including visual approaches are required and can be of profound help when it comes to forging links between different disciplines and between science and society.

Selected images were presented at the 2nd German Future Earth Summit that took place in Berlin from 28th-29th January 2016, and in the near future all the photographs and their accompanying notes will be published in a follow-up publication.

The project was initiated by the Integrative Research Institute on Transformations of Human-Environment Systems (IRI THESys) at the Humboldt-Universität zu Berlin, in cooperation with the German Committee Future Earth.

Winning pictures, from left to right: "The waterway" by Rafael Camargo; taken in Crete - Greece, "Our extended summer." by Margoth González Woge; taken in Donostia, San Sebastián - Spain, "Don't look just at us!" by Rafael Camargo; taken in Sinop, Mato Grosso - Brazil

5. Further information

└ Knowledge-Action Networks, project examples and new initiatives in cooperation with Future Earth

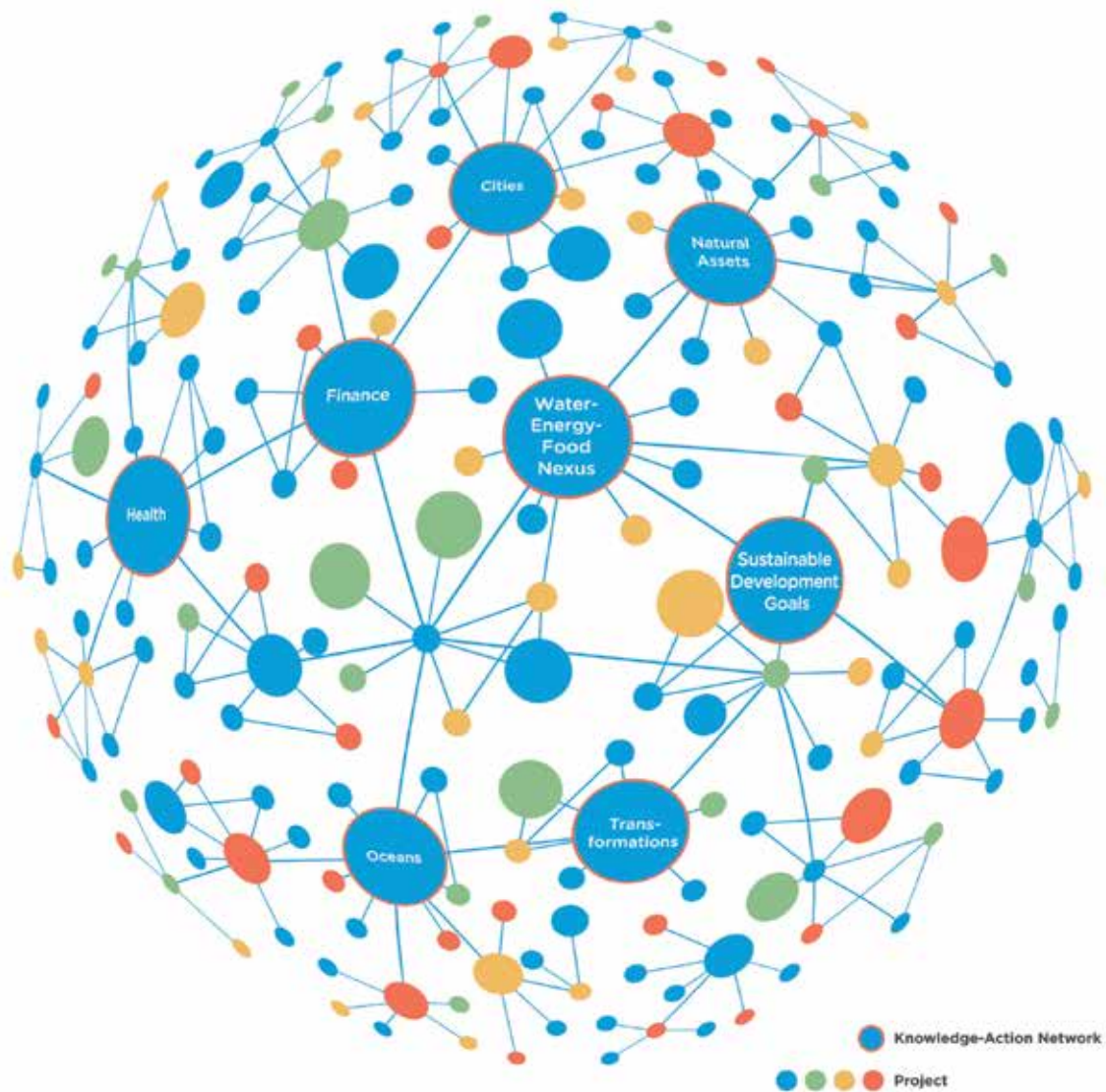
Future Earth's Knowledge Action-Networks (KANs), alongside the projects, are the prime mechanism for delivering the Future Earth research strategy. Knowledge-Action Networks focus on key societal challenges as outlined in the Future Earth 2025 Vision, as well as cross-cutting topics and foster collaboration across different knowledge

domains from research and society. Knowledge-Action Networks build on the large and diverse specialist expertise represented in the Future Earth community, in particular the topic specific Core Projects, Fast-Track-Initiatives and Cluster Activities, as well as the overarching Future Earth Open Network.

Future Earth research projects

Bold - more details in this report (introduced at German Future Earth Summit)

| | | |
|--|--|--|
| AIMES – Analysis, Integration and Modelling of the Earth System | GECHH – Global Environmental Change and Human Health (2006 - 2014) | IRG – Integrated Risk Governance Project |
| bioDiscovery | GLP – Global Land Project | MAIRS – Moonson Asia Integrated Regional Study |
| bioGENESIS | GMBA – Global Mountain Biodiversity Assessment | PAGES – Past Global Changes |
| CCAFS – Climate Change, Agriculture and Food Security (research partner) | IGAC – International Global Atmospheric Chemistry | PECS – Programme on Ecosystem Change and Society |
| ecoSERVICES | IHOPE – Integrated History and Future of People on Earth | SOLAS – Surface Ocean - Lower Atmosphere Study |
| ESG – Earth System Governance | iLEAPS – Integrated Land Ecosystem-Atmosphere Processes Study | UGEC – Urbanization and Global Environmental Change |
| Future Earth Coasts (former LOICZ) | IMBER – Integrated Marine Biogeochemistry and | Water Future – Sustainable Water Future Programme |
| Future Health (former ecoHEALTH) | | |
| GCP – Global Carbon Project | | |



Source: Future Earth

Future Earth Fast-Track-Initiatives and cluster activities

Bold - more details in this report (introduced at German Future Earth Summit)

ArcticSTAR – Solution-orientated, transdisciplinary research for a sustainable Arctic

Bright spots: seeds of a good Anthropocene

Exploring nitrogen in Future Earth

Extreme events and environments - from climate to society (E3S)

Global Biodiversity Monitoring, Prediction & Reporting

Linking Earth system and socio-economic models to predict and manage changes in land use and biodiversity

Liveable urban futures

Scientific Support for IPBES Knowledge Generation

Sustainability for water, energy and food through integrated water information and improved governance

Extreme events and environments from climate to society (E3S)

Contacts:

Kirsten Thonicke (*Potsdam Institute for Climate Impact Research*)
Markus Reichstein, Dorothea Frank (*Max-Planck-Institute for Biogeochemistry Jena*)



Climatic extremes are likely to increase in the future and will affect our ecosystems, economies, societies and human wellbeing. Both, climate change and changes in climate extremes, pose distinct challenges for research and society. The Future Earth initiative E3S Extreme Events and Environments (<http://www.e3s-future-earth.eu>) wants to identify and bring together the different global environmental change scientific communities from social and natural science working on past, contemporary and projected extreme climatic events, and the relevant stakeholder communities from the public and private sector that have to cope with climate extremes. E3S wants to develop and shape research questions such as

- Which are the most relevant climate metrics for extreme impacts on ecosystems and societies?
- To which level of precision do we need to predict extreme impacts as useful support of decisions? At which time scale?
- How do different societies cope with extreme events and how do they govern the related risks and costs?
- What determines the resistance, resilience, and the ability of coupled socio-ecological systems to adapt to extreme events? How does vulnerability influence the capacity to adapt?

We hope for inspiring trans-disciplinary discussions from the fields of natural sciences, economics, politics and governance, psychology, sociology, history and related fields.

Sustainable Water Future Programme

A Scientific, Policy Relevant,
and Solution Oriented Global
Water Research Programme
for Sustainable Development

SUSTAINABLE
WATER
FUTURE
PROGRAMME

Contacts:

Claudia Pahl-Wostl

(University of Osnabrück)

Janos Bogardi *(Bonn University)*

Anik Bhaduri *(Sustainable Water*

Future Programme)

The Sustainable Water Future Program builds on more than a decade of co-ordinated international research of the Global Water Systems Project. The Global Water System Project (GWSP; www.gwsp.org) has operated under the Earth System Science Partnership as one of the joint projects of and its four Global Environmental Change Programmes, coordinating and supporting a broad research agenda to study the complex global water system with its interactions between natural and human components and their feedback processes.

Objective

GWSP has now transitioned into the Sustainable Water Future Programme (SWFP) as a core project of Future Earth. This new programme has a clear objective to generate solutions by facilitating the adoption of science-based evidence into the implementation and monitoring of goals for sustainable development. The Sustainable Water Future Program will also provide the mechanisms and frameworks that facilitate greater cooperation and teamwork across academia, industry and government at the local, national and global scale. This will increase cross-fertilization of ideas and, in particular, much more rapid and effective translation of research outputs through to business outcomes and opportunities.

Thematic Area

The SWFP will be organized under three major thematic areas that resonate with a more solution and action-oriented approach and will dovetail within the Future Earth agenda. These are:

1. Global State of Water: This thematic field produces factual knowledge concerning the global state of water, developing conceptual and methodological innovations to improve analysis and diagnostic capabilities.

2. Governing the Transition: This thematic area concerns the dynamic society-nature interface and interactions at and across different scales in terms of governing the transition towards a sustainable water future.

3. Water as Global Change Agent: This thematic area will explore the water, energy and food security nexus, the water-carbon (energy) link and interfaces with water and health, as well as water biodiversity (ecosystem services) issues.

Key products

Global Water System Assessment: SWFP will establish a future oriented knowledge synthesis and assessment process on the state of global water resources, the Global Water System Assessment. The process will have tangible outputs, organized as a series of Sustainable Water Future Reports and Topical Reports, the content of which will be co-designed by knowledge generators and knowledge implementers.

Water Solution Lab: SWFP will foster new and adaptive planning and water system design principles through interaction between students, researchers, entrepreneurs and community representatives. It will draw on the latest developments from the water sciences and technology, placing them into a planning and design process for water solutions and engaging the private sector with different partners as a combined force for innovation in water solutions lab.

Global Land Project (GLP)

Getting involved:

The GLP is entering an exciting new phase. Beginning January 2016, the Centre for Development and Environment (CDE), University of Bern, was selected to host the GLP International Program Office (IPO) from 2016-2020. Dr. Peter Messerli, Professor and Director of the CDE, joins the GLP as Co-chair of the Scientific Steering Committee and Dr. Andreas Heinimann, CDE Senior Scientist, continues as member of the Scientific Steering Committee. Dr. Ariane de Bremond joins the CDE as senior scientist and GLP Executive Officer. For more information or to get involved you may contact her at ariane.debremond@cde.unibe.ch or glp@cde.unibe.ch.



The Global Land Project (GLP) is an interdisciplinary community of science and practice fostering the study of land systems as the result of human interactions with the natural environment, and co-designing solutions for global sustainability. Land is the nexus of crucial societal and environmental challenges and opportunities regarding food security, access to water, livelihoods, land degradation, biodiversity loss, and climate change. Changes in land systems have large consequences for the local environment and human well-being and are at the same time pervasive factors of global environmental change. Solutions to these challenges must balance complex trade-offs and synergies, and demand multiple paradigms and perspectives.

Research Themes and Priorities

An overarching challenge for land systems research is to connect the improved understanding and empirical data on land systems to the practice and policy that aim to influence and steer how land is used and managed. For the period of 2016-2026, as a network of scientists, institutions, and stakeholders focused on sustaining people, ecologies, and

landscapes, the GLP will build and enhance scientific capacity by identifying core questions, synthesizing research and setting future agendas, creating synergies among researchers and stakeholders, and bridging science and decision making. Priority thematic areas include telecoupling of land use systems, land use and conflict, land-climate interactions, land governance, land change tradeoffs for ecosystem services and biodiversity, and land management systems. We aim to link understanding generated through monitoring, modeling, case study synthesis, gap analysis, and long-term studies of priority thematic areas to support the co-design and co-production of knowledge for policy, practice, and society-at-large.

Linking scientific excellence to societal impact: co-design of land systems research

In 2014, the GLP became a core project of 'Future Earth'. The GLP endeavors to serve as a platform for integration across international programs and networks that address land related issues. Land use change can be seen not only as a consequence and cause of global change but as a solution towards sustainability transformations. In this sense, Land Systems Science (LSS) is more important than ever: many important global change challenges are related to the use of land resources, and many of the Sustainable Development Goals (SDGs) are related to sustainable use of land resources (Verburg et al. 2015). The GLP engages with a wide variety of international programmes, networks, and stakeholders and aims to support translation of knowledge into action.

Authors:

Verburg, P.H., Crossman, N., Ellis, E.C., Heinimann, A., Hostert, P., Mertz, O., Nagendra, H., Sikor, T., Erb, K.-H., Golubiewski, N., Grau, R., Grove, M., Konaté, S., Meyfroidt, P., Parker, D.C., Chowdhury, R.R., Shibata, H., Thomson, A., & Zhen, L. (2016). *Land system science and sustainable development of the earth system: A global land project perspective. Anthropocene (in print)*

Surface Ocean – Lower Atmosphere Study (SOLAS)

Contact: Stefan Konradowitz,
skonradowitz@geomar.de

SOLAS SSC chair: Véronique Garçon,
veronique.garcon@legos.obs-mip.fr



The Surface Ocean – Lower Atmosphere Study (SOLAS) is an international research project that promotes cooperation on research at the air-sea interface, related to transfer of gases, materials, and energy across the interface, and how processes in the surface ocean and lower atmosphere control are affected by these transfers. SOLAS started with an open science meeting held in Germany in 2000, which brought together ocean and atmospheric scientists to identify research priorities for their shared interface. The community of scientists that convened worked through the Scientific Committee on Oceanic Research (SCOR) and the International Geosphere – Biosphere Programme (IGBP) to create a Science Plan and Implementation Strategy for SOLAS. The World Climate Research Programme (WCRP) and the international Commission on Atmospheric Chemistry and Global Pollution (iCACGP) joined as sponsors during the development phase of SOLAS.

The first phase of SOLAS started with the publication of the SOLAS Science Plan and Implementation Strategy in 2004 and continued through 2015. SOLAS asked SCOR, WCRP, and iCACGP for approval of an extension through 2025 and all sponsors agreed, IGBP ended in 2015 and Future Earth agreed to become a new co-sponsor of SOLAS in IGBP's place.

The SOLAS project is unique in connecting the biogeochemical-physical oceanic and atmospheric scientific communities. Thanks to this innovative collaboration over the past decade, the SOLAS community has made important scientific discoveries, while also coming to understand the

critical role of SOLAS science in many aspects of the human realm.

SOLAS will continue to promote international planning and coordination of research and training around the topic of processes in the surface ocean and lower atmosphere during its second phase. The scientific core themes of the second phase of SOLAS are the following:

- **Theme 1:** Greenhouse gases and the oceans
- **Theme 2:** Air sea interface and fluxes of mass and energy
- **Theme 3:** Atmospheric deposition and ocean biogeochemistry
- **Theme 4:** Interconnections between aerosols, clouds and marine ecosystems
- **Theme 5:** Ocean biogeochemical control on atmospheric chemistry

In addition to these five themes, SOLAS will continue to pursue a few crosscutting themes including integrated topics (upwelling systems, polar oceans and sea ice, and coastal waters), a theme focusing on SOLAS science and geoengineering and a theme on SOLAS science and society. With anthropogenic impacts on our earth system becoming increasingly significant SOLAS has taken on the challenge to link earth system science better to societal needs and socio economics.

New, innovative structures will be developed to pursue additional SOLAS priorities in capacity-building and inter-organisational cooperation in more efficient ways. The SOLAS community is committed to finding new ways to further contribute toward constructive solutions of societal concerns. SOLAS will work with other Future Earth projects to co-design interdisciplinary projects related to science policy and sustainability.

Future Earth Core Project Integrated Risk Governance Project (IRG-Project)

Contact: Jochen Hinkel (*Science
Committee Member IRG-Project*)

Chairs: Carlo Jeager, Shi Peijun
Executive Director: Ye Qian



The Integrated Risk Governance Project is a Core Project of Future Earth sharing its goal to provide “the knowledge required for societies in the world to face risks posed by global environmental change and to seize opportunities in a transition to global sustainability” (Future Earth 2015b). IRG-Project will contribute to this goal by expanding and consolidating the knowledge presently available for the purposes of risk management and governance. Specifically, IRG-Project works to identify those situations where opportunities for a sustainability transition can be created and realized precisely by facing the risks of global environmental change. The results are win-win options in risk governance.

Methodologically, the research builds on Ortwin Renn’s (2008) framework for integrated risk governance and Lin Ostrom’s (2012) analysis of governance patterns for common pool resources. One of the most important outcomes of IRG-Project shall be a set of methods that can be used by researchers and practitioners to address specific disaster risks and integrated governance. These include disaster cascade analysis, simulations, social experiments, synthetic populations and stakeholder dialogues.

In the coming years, the work of IRG-Project will be structured by the following five focal research topics.

• **Natural Disasters and Advanced Technologies:** Under this topic IRG-Project will compare regional case studies and further develop its world risk atlas, taking advantage of big data from remote sensing and processing capabilities from high-performance computing. Working closely with UN-ISDR, IRG-Project will help turning good science into good decision making.

• **Coastal Zones and Climate Change:** Integrated risk governance in coastal zones will be a key topic of inquiry for IRG-Project, not least because of the involvement of IPCC Lead Authors on coastal zones and coastal zone experts in The Netherlands, the UK, China and other countries (Hinkel et al. 2015). Studies shall be carried out in cooperation with the Future Earth project LOICZ.

• **Urbanization and Agriculture:** IRG-Project will look at interactions, systemic risks and unintended consequences of the spread of non-sustainable patterns of urban development and the spread of non-sustainable agricultural practices (e.g., biodiversity but also about food safety).

• **Financial Markets and Global Systems:** IRG-Project will look at financial risks in view of similarities and differences with disaster risks in other global systems. A key tool for this purpose will be the notion of consilience (Shi et al, 2014).

• **Green Growth and Integrated Risk Governance:** Humankind as a whole will have to learn to avoid the systemic risks generated by traditional economic growth, but also the risk of misplaced investments aiming at sustainable development. This kind of risk is especially serious with the large-scale investments that will be necessary to create and maintain the critical infrastructures of the future (Flyvbjerg et al. 2003).

Research on these focal topics aims at establishing integrated risk governance as an on-going process of learning how to keep risks in an acceptable domain, including learning from experiences of disaster, relief and reconstruction. The work of IRG-Project in the past years as well as its cooperation with UNISDR make it an ideal platform for this purpose.

IGAC – Facilitating atmospheric chemistry research towards a sustainable world

Contact: Megan Melamed,
megan@igacproject.org



The atmosphere is the integrator of the Earth system. Human emissions of pollutants and long-lived greenhouse gases into the atmosphere have caused dramatic transformations of the planet, altering air quality, climate and nutrient flows in every ecosystem. Understanding the global atmosphere requires an international network of scientists to address these issues.

Acknowledgement of this need led to the formation of IGAC in 1990. IGAC facilitates atmospheric chemistry research towards a sustainable world by fostering community, building capacity, and providing leadership.

Fostering Community

IGAC is an open international community of atmospheric scientists actively collaborating across geographical boundaries and disciplines in order to contribute to addressing the most pressing global change and sustainability issues through scientific research.

Building Capacity

IGAC builds scientific capacity through its national and regional working groups, its early career scientists program, its biennial conferences and facilitation of numerous thematic workshops.

Providing Leadership

IGAC provides intellectual leadership by identifying and fostering activities on current and future areas within atmospheric chemistry research that link emissions, atmospheric processes and atmospheric composition to global change and sustainability issues such as human health, climate, ecosystem and how individual and societal responses feedback onto the core research-led foci of IGAC.

2016 International Year of Global Understanding

Integrated Transdisciplinary Research

Contact: Benno Werlen
(Executive Director of IYGU)



The three most important international science councils, the International Council for Science (ICSU), the International Social Science Council (ISSC) and International Council for Philosophy and Human Sciences (CIPSH) have proclaimed on September 13, 2015 at the World Social Science Forum in Durban the International Year of Global Understanding (IYGU). With this, for the first time in the history of science, all three international science councils are engaging in a joint international project. This engagement is based on new approaches to transdisciplinary research.

Our world faces social, cultural, and economic change, as well as a changing climate. The 2016 IYGU addresses the ways in which we inhabit an increasingly globalized world. How do we transform nature? How do we build new social and political relationships for the emerging global reality? Societies and cultures determine the ways we live with and shape nature. They influence how we perceive the global consequences of our everyday actions. IYGU is aimed at helping to understand what our daily actions mean for the world as a whole in order to overcome global challenges.

Human actions play a key role in creating such worldwide challenges. However, human actions also provide solutions. If social actors know what their day-to-day routines mean for our living conditions, they can take appropriate action. Therefore, the IYGU prompts a transdisciplinary perspective, starting from the logic of everyday actions rather than from traditional scientific disciplines, learning firstly how human actions produce ecological problems and then seeking appropriate science-based solutions. Consequently the IYGU focuses on actual embodied individual human activities performed by each person, each day, everywhere in the world.

IYGU supports agendas for global sustainability research established by the International Council for Science (ICSU) and the International Social Science Council (ISSC). As a bottom-up project it contributes in various ways to the Future Earth program and takes into account the UN Post-2015 Development Agenda.

The IYGU will strengthen collaboration between the natural and social sciences, will identify local actions' global effects, and will empower individuals to change locally to have a global effect.



5. Further information

└ Working groups of the German Committee Future Earth (2015-2017)

Working groups are an important element of the organisational structure of the German Committee Future Earth. Their main objective is to further develop interdisciplinary research related to Future Earth, and to identify research topics of societal relevance and of national interest within the international context.

Furthermore, working groups are encouraged to work with stakeholders to exchange ideas and opinions on new, innovative topics and to learn from different experiences.

Working groups are established by the German research community based on an open call for proposals and run for a maximum of two years. The German Committee Future Earth currently supports the five following working groups:

1**Time period:** 2015 – 2017**Working group spokespersons:**

Birgit Blättel-Mink (Goethe University Frankfurt)
 Lisa Pettibone (Museum für Naturkunde)

Expected output:

handout lessons learnt

Co-design, co-production and co-dissemination in Future Earth: conceptual frame and technical standards

Sustainability science is transdisciplinary, solution-oriented research that seeks to promote and effect a transition towards sustainability by promoting wide-scale societal change. This working group focuses on the detailed processes of such transformative scientific conduct: integrative research through co-design and co-production of knowledge in an interdisciplinary scientific community that includes societal actors (e.g. citizens, administration, enterprises, civil society groups). Taking the example of Citizen Science, the working group will identify the potential and challenges of applying co-design, co-production and co-dissemination in the Future Earth process. In doing so, the working group seeks to advance methods in such research approaches and raise awareness about the transdisciplinary character of sustainability science.

The main objectives of the working group are:

- To analyze the conceptual and practical challenges of transdisciplinary research by utilizing examples from Citizen Science,
- To provide technical support to these approaches in sustainability science, including development of quality standards for selected steps of the transdisciplinary research process, and
- To raise an international debate on the concepts and techniques of co-design, co-production and co-dissemination as complementary facets of transdisciplinary approaches employed in sustainability science.

2**Time period:** 2015 - 2016**Working group spokesperson:**

Hermann Jungkunst (University of Koblenz-Landau)

Expected output:

research article, outlines

Regional disaggregated strategies to foster positive human impact through land-use change

The international scientific discourse on land-use change is dominated by publications on negative human impacts. These warnings are necessary to raise awareness of negative human behaviour and develop policy strategies. But to stimulate the increased involvement of civil societies, an international, interdisciplinary research strategy to transmit positive role models now appears to be essential.

The central aim of this working group is to conceptualise an integrated interdisciplinary approach for evaluating positive human impacts on land-use change, and subsequently assess, measure and describe important points for ecological and social systems. The working group will review patterns of human impacts on land use and work with stakeholders to develop new strategies and new ways of thinking in land-use research.

The working group follows the hypothesis that negative effects of land-use change are based on recent, spatially broad transformation, whereas positive effects are related to long-term cultural landscape development in areas essentially dominated by smallholdings. Starting with reviews filtering the positive effects of land use, the working group will investigate showcases of land use in Europe, the USA and tropical regions such as Brazil and Indonesia. Along with the rethinking of patterns of human impacts on land use, the working group will work with stakeholders to develop new strategies and new ways of thinking in land-use research.

3**Time period:** 2015 - 2017**Working group spokesperson:**Jens Jetzkowitz (*Philipps-Universität Marburg*)**Expected output:**

research article, outlines

The social aspects in socio-ecological models and simulations of sustainability research using the example of social opportunities to reduce meat consumption

What would happen if a compulsory Vegetarian Day were introduced in German canteens? Would free public transport be profitable in cities if it were offset against the maintenance of ecosystem services? What measures for promoting sustainable consumption are likely to be adopted by which lifestyle environments and in what way? Answering these questions requires formalised models of socio-ecological systems to identify the potential of sustainable development and the basic ideas behind it. However, there are still doubts as to whether the characteristics of social systems are appropriately represented in current models and simulations.

Therefore, the working group's objective is to stimulate a methodological discussion on the appropriate representation of social aspects in socio-ecological models and simulations of sustainability research. The working group is based on the premise that social systems are included in a reflexive way in the relevant modelling approaches. Therefore, social systems in modelling approaches follow internal change measures and external steering impulses according to values, standardisations and role structures.

The working group assumes that formalised models of sustainability research are (a) ideally based on (true) assumptions that build on structures of socio-ecological systems and (b) can simulate system behaviour if (significant) data on relevant system structures and processes are available. The working group will also discuss whether knowledge

of a specific socio-ecological system can be accommodated in this system, too.

The working group is approaching these issues in two ways: on the one hand, it is discussing how social aspects are currently included in socio-ecological models and simulations of sustainability research. On the other hand, methodological criteria are being tested and defined using the specific example of meat consumption.

4**Time period:** 2015 - 2017**Working group spokesperson:**Nicolas Brüggemann
(*Forschungszentrum Jülich*)**Coordinator:**Margit von Lützwow (*Scientific Secretariat SKAF (c/o Technical University of Munich)*)**Expected output:**

working paper

Sustainable intensification in agriculture

In order to meet biomass demand in 2050, the 2005 rate of global agricultural production needs to increase by 70-110%. Several options for meeting this target are being discussed, including an expansion of agricultural land, more productive plant species and varieties, efficiency gains in crop and farm management, as well as intensification of agricultural production. However, securing and sustainably increasing crop productivity world-wide requires fundamental innovations with respect to sustainably augmenting resource efficiency of agricultural production, addressing the challenges arising from climate change and a growing world population, and effective strategies for disseminating environmentally friendly socio-ecological solutions on the regional level.

The working group aims to bring together researchers from various disciplines, companies from different agricultural sectors and other stakeholders at federal, regional and local level (in Germany and

abroad), to raise awareness of "sustainable intensification of agricultural production", promote the development of socio-economic solutions on the regional level and identify future research needs.

The new research approaches developed in this context will specifically contribute to increasing the productivity of agricultural land while protecting natural resources and ecosystem services. The new research approaches will also address region-specific conditions and provide solutions on the regional level.

This working group therefore aims to foster societal transformations in the energy domain through smart combinations of social and technical innovations. This will initially involve establishing an inter- and transdisciplinary network of relevant scientists and stakeholders and developing a sound transdisciplinary research perspective for the network's future activities. The working group is adopting two specifications for the social innovation concept. One concerns the domain of innovation, in this case focussing on energy use. The second concerns methodological challenges to capture and model innovation and diffusion.

5

Time period: 2016 - 2017

Working group spokesperson:

Andreas Ernst (*University of Kassel*)
Birgit Blättel-Mink (*Goethe University Frankfurt*)

Expected output:

report, conceptual paper

Integrative social-science concepts for analysing social innovations in energy policy making

Rising awareness of the unsustainable path that societies and economies are currently treading is also triggering the emergence of alternative lifestyle concepts. At the core of this development is social innovation. Social innovation is a concept that covers social movements and collective institutional changes that might give rise to large-scale transformation in living conditions and social, institutional (as well as technical) structures that, in turn, transform lifestyles and organisational behaviour. Both individual as well as societal innovation processes might prove to be important factors in people's willingness to adopt climate policies and support international efforts on climate mitigation and adaptation. Yet, a pressing question is how rapidly and how broadly these new concepts can be adopted. In order to make a difference to current societal and economic development, they will need to reach the mainstream in a relatively short period of time.

German Committee Future Earth
DKN Future Earth Secretariat
Heilbronner Str. 150
70191 Stuttgart, Germany

www.dkn-future-earth.org



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