futurearth
research for global sustainability

**Draft**

# Executive Summary and Overview of the Transition Team report on the initial design of Future Earth

## Executive Summary

**The need for a step change in Earth system research**

Human activities are altering the Earth system with significant impacts on the environment at the local, regional and global scale. Changes in the Earth's climate and loss of biodiversity are undermining improvements in human wellbeing and poverty alleviation. The challenge of achieving a transition to global sustainability is urgent given the potentially catastrophic and irreversible implications for human societies. On one hand, this is a threat to human prosperity on Earth, on the other hand, it provides incentives to exploit and develop new opportunities for innovation that supports sustainable development.

Future Earth is a 10-year international research programme launched in June 2012, at the UN Conference on Sustainable Development (Rio+20) that will provide critical knowledge required for societies to face the challenges posed by global environmental change and to identify opportunities for a transition to global sustainability.

Future Earth will answer fundamental questions about how and why the global environment is changing, what are likely future changes, what are risks and implications for human development

and the diversity of life on Earth, and what the opportunities are to reduce risks and vulnerabilities, enhance resilience and innovation, and implement transformations to prosperous and equitable futures.

Future Earth will deliver science of the highest quality, integrating, as necessary, different disciplines from the natural and social sciences (including economic, legal and behavioural research), engineering and humanities. It will be co-designed and co-produced by academics, governments, business and civil society from all regions of the world, encompass bottom-up ideas from the wide scientific community, be solution-oriented, and inclusive of existing international Global Environmental Change projects and related research activities.

**Connecting research and responses to societal challenges**

Future Earth will address issues critical to poverty alleviation and development such as food, water, energy, health, and human security and the nexus between these areas and the over-arching imperative of achieving global sustainability. It will provide and integrate new insights in areas such as governance, tipping points, natural capital, the sustainable use and conservation of biodiversity, lifestyles, ethics and values. It will explore the economic implications of inaction and action and options for technological and social transformations towards a low-carbon future. Future Earth will explore new research frontiers and establish new ways to produce research in a more integrated and solutions-oriented way.

Recent foresight exercises on the challenges facing Earth system research converged on the need for a step change[1] in both the conduct and support of such research. More disciplines and knowledge fields need to be engaged, bringing together both disciplinary and interdisciplinary excellence. Close collaboration between the scientific community and stakeholders across the public, private and voluntary sectors to encourage scientific innovation and address policy needs is essential. More financial support for these collaborations is required. Together, these changes will help realise a new 'social contract' between science and society to accelerate the delivery of the knowledge that society needs to address pressing environmental changes (Lubchenco 1998, ICSU 2011).

At the Rio+20 UN Conference on Sustainable Development in June, 2012, governments agreed to develop a set of Sustainable Development Goals (SDGs) that will integrate environment and development goals for all nations. Future Earth will provide integrative scientific knowledge needed to underpin the SDGs and sustainable development more broadly.

Future Earth will build upon and integrate the existing Global Environmental Change (GEC) Programmes – the World Climate Research Programme (WCRP), the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme (IHDP), DIVERSITAS – biodiversity science, and the Earth System Partnership (ESSP). It will also have to expand significantly beyond the existing global networks and engage new institutions and researchers. It must ensure research excellence by being open and inclusive, attracting the brightest minds from a

[1] "Towards a 10 year Earth System Research initiative for Global Sustainability - A joint statement of intent from the Belmont Forum1, ICSU2 and the ISSC" 2011 http://www.icsu.org/general-assembly/programme/general-assembly/documentation-for-delegates/30th-general-assembly-file-of-documents/8-earth-system-sustainability-initiative.pdf

broad range of disciplines and countries.

The research and complementary capacity building and outreach activities of Future Earth will be co-designed by the broad community of researchers (including natural and social sciences, engineering and humanities) in partnership with governments and business and other stakeholders, in order to close the gap between environmental research and policies and practices. Future Earth will deliver a step-change in making the research more useful and accessible for decision-makers.

**The conceptual framework**

The conceptual framework for Future Earth (Figure 1), which will guide the formulation of research themes and projects, recognises that humanity is an integral part of the dynamics and interactions of the Earth System and that this has important implications for global sustainability. It recognises that many of those socio-environmental interactions occur across different spatial and temporal dimensions.

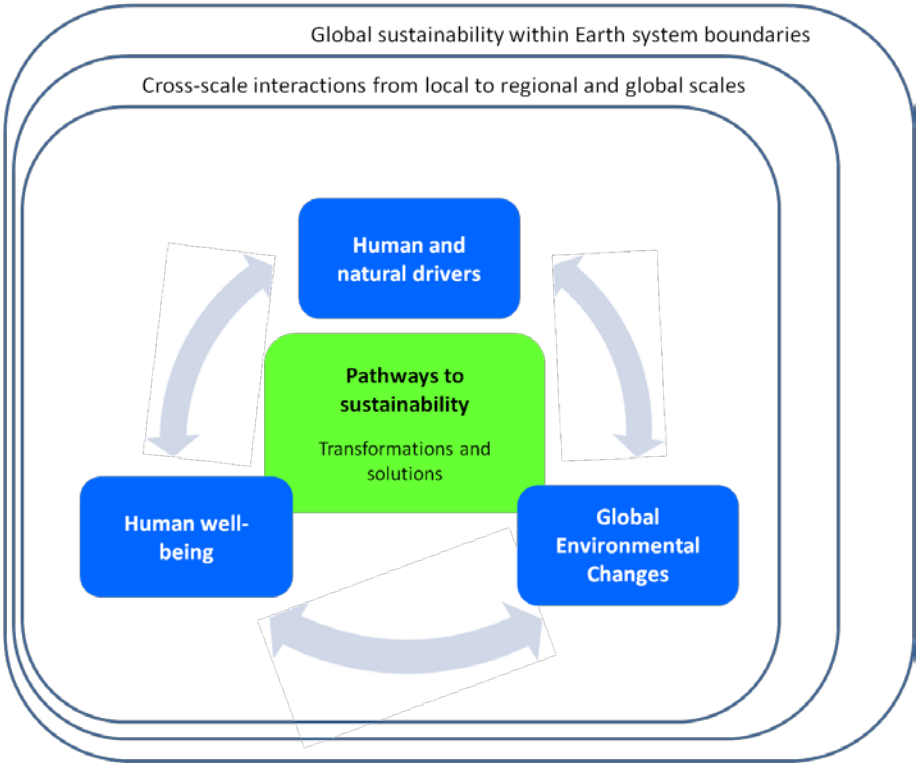


**Figure 1: Schematics of the Future earth conceptual framework**

The conceptual framework illustrates the fundamental interconnections between natural and human drivers of change, the resulting environmental changes and their implications for human well-being. These interactions take place across a range of time and spatial scales, and are bounded by the limits of what the Earth system can provide. It emphasises the challenge of understanding and exploring avenues for human development within Earth system boundaries. This fundamental, holistic, understanding is the basis for developing transformative pathways and solutions for global sustainability.

**The initial research themes**

The conceptual framework guides Future Earth research towards addressing key research challenges, expressed as a set of three broad and integrated research themes:

(i) **Dynamic Planet** - understanding how planet Earth is changing due to natural phenomena and human activities. The emphasis will be on observing, explaining, understanding, projecting Earth environmental and societal trends, drivers and processes and their interactions as well as anticipating global thresholds and risks. Building on existing knowledge, there will be a particular focus on interactions between social and environmental changes across scales

(ii) **Global Development** - providing the knowledge for addressing the most pressing needs of humanity including sustainable, secure and fair stewardship of food, water, biodiversity, energy, materials, and other ecosystem functions and services. The emphasis of this Future Earth research theme will be on understanding the impacts of human activities and environmental change on the health and well-being of people and societies and on the interactions of global environmental change and development.

(iii) **Transformations toward Sustainability** – providing the knowledge for transformation toward a sustainable future: understanding transformation processes and options, assessing how these relate to human values and behaviour, emerging technologies, and economic development pathways, and evaluating strategies for governing and managing the global environment across sectors and scales. The emphasis of Future Earth research will be on solution-oriented science that enables fundamental societal transitions to global sustainability. It will explore what institutional, economic, social, technological and behavioural changes can enable effective steps towards global sustainability and how these changes might best be implemented.

These research themes will be the main priorities for Future Earth research.

**Cross-cutting capabilities**

Addressing the proposed integrated research themes will depend on progress in and access to a number of core capabilities including observing systems, Earth system models, theoretical developments, data management systems and research infrastructures. Future Earth will also support and deliver scoping and synthesis activities, communication and engagement, capacity development and education, and effective interactions at the science-policy interface. These capabilities are essential to advance the integrated science of global environmental change and translate it into useful knowledge for decision making and sustainable development. Many of these capabilities lie beyond the boundaries of the Future Earth initiative per se, residing in national and international infrastructures, training programmes, and disciplines. It will be important that Future Earth works in partnership with the providers of these capabilities for mutual benefit.

**The governance structure**

The governance structure of Future Earth (Figure 2) embraces the concepts of co-design and co-production.

The Science and Technology Alliance for Global Sustainability is responsible for establishing Future Earth and will promote and support its development as the programme's sponsors. Its members consist of the International Council for Science (ICSU), the International Social Science Council (ISSC), the Belmont Forum of funding agencies, the United Nations Educational, Scientific, and Cultural Organization (UNESCO), the United Nations Environment Programme (UNEP), the United Nations University (UNU), and the World Meteorological Organization (WMO) as an observer. Future Earth is led by a Governing Council, and supported by two advisory bodies: an engagement committee and a science committee.

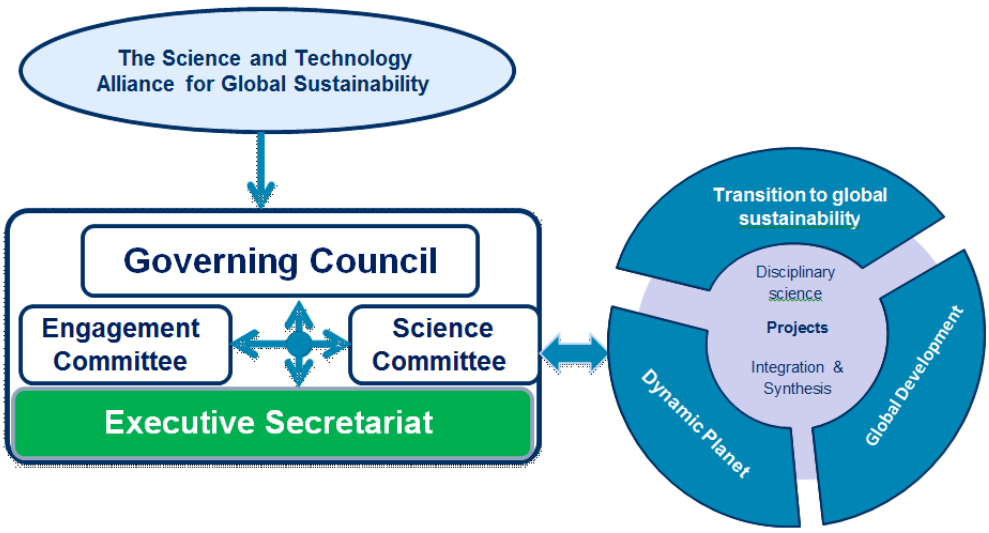


**Figure 2: Schematics of the organisational structure of Future Earth**

The Governing Council and its subsidiary bodies will, as appropriate, involve representatives from the full range of stakeholder communities (academia, funders, governments, international organisations and science assessments, development groups, business and industry, civil society, and the media).

The Governing Council is the ultimate decision-making body and is responsible for setting Future Earth's strategic direction and policies. The science committee will provide scientific guidance, ensure scientific quality and guide the development of new projects. The engagement committee will provide leadership and strategic guidance on involving stakeholders throughout the entire research process from co-design to dissemination, ensuring that Future Earth produces the knowledge society needs. The Executive Secretariat will perform the day-to-day management of Future Earth, ensuring the coordination across themes, projects, regions and committees, and liaising with key stakeholders. It is expected that the secretariat will be regionally distributed. The development of National Future Earth committees will also be actively encouraged.

**Towards a funding strategy**

Future Earth will require both innovative funding mechanisms and enhancement of existing support. The success of the programme will depend on continued support for essential disciplinary research and infrastructures and a substantial strengthening of the funding bases for trans-disciplinary

research and coordination activities. The Alliance will work with the Governing Council and Future Earth secretariat to secure new and enhanced sources of funding. Already the Belmont Forum has launched in 2012 a new open and flexible process to support international collaborative research actions through annual multi-lateral calls. Members of the Belmont Forum and of the International Group of Funding Agencies for global change research (IGFA), will need to proactively engage with other funders at national and regional levels to create adequate support. Strengthened engagement with development donors, the private sector and philanthropic foundations will be part of a diversified Future Earth funding strategy.

**Towards a new model of Communications and Engagement**

Future Earth will position itself as a lead provider of independent and innovative research on global sustainability. It will provide a vibrant, dynamic platform that encourages dialogue, accelerates knowledge exchange, and catalyses innovation. Future Earth will develop a comprehensive flexible communications strategy to engage all relevant users, at regional and global level, working with regional partners to engage locally, combining the traditional top-down expert information sharing approach with more inclusive iterative dialogue and exploratory participatory and bottom-up approaches. New social media and web technologies provide exciting opportunities and the expertise to take full advantage of these must be embedded in the Future Earth secretariat.

**Education and capacity building**

Future Earth will partner with programmes and networks that already work in the educational sector to ensure rapid dissemination of research findings and their implications for global sustainability to support formal science education at all levels. The identification of effective partners is critical to the success of Future Earth in the complex arena of formal education, with its diversity of local and national mechanisms, cultures and languages. The strengthening of existing partnerships with networks of science and technology centres also provides a valuable mechanism for contributing to the 'informal' education sector.

Future Earth has identified capacity building as a basic principle of all its activities and will adopt a multi-tiered approach to scientific capacity building, with both dedicated capacity building actions and capacity building embedded across all its activities and projects. Dedicated capacity building actions will include building a strong international network of scientists committed to international interdisciplinary and trans-disciplinary research, a particular focus on early-career scientists and the development of institutional capacity. There will be a strong emphasis working on enhancing science capacity in lesser developed countries, with regional partners playing an important role.

# 1. Overview

## 1.1. Why Future Earth?

Human activities are altering the Earth system in ways that threaten well-being and development (Steffen et al., 2004; Steffen et al., 2011). We have entered a new geological epoch, the Anthropocene (Crutzen 2002; Zalasiewicz et al., 2010), in which our activities significantly impact many global processes in the Earth system, and together with natural variations, are leading to dangerous global environmental changes. There is growing evidence that a transformation to global sustainability is necessary to secure global prosperity in the future, and this will require important shifts in governance and development paradigms (Galaz et al., 2012; Kanie et al., 2012). Human knowledge and ingenuity in an increasingly interconnected world offer many possibilities for innovation to respond to these changes and to create new opportunities for individuals, communities, firms and countries to thrive (WBGU, 2011).

Global environmental changes have regional and local impacts, undermining natural resources and ecosystem services. The cross-scale interactions between human activities, large scale changes in the Earth system, and local impacts have important implications for human development and create many of the sustainability challenges facing society. Evidence increasingly suggests that global sustainability is a prerequisite for human wellbeing at local as well as global scales (IPCC 2007; UNEP 2012a; MA, 2005). Failure to move towards global sustainability will likely cause more global environmental changes, with their consequent regional and local impacts, such as flooding, drought, land use change, biodiversity loss and sea-level rise. Prosperity is likely to be limited to those that can afford to adapt while others could suffer disproportionately. However, in today's globally connected world, local conditions and crises can magnify across scales and societies with effects on perceptions, mobility, trade, economics and political stability. Knowledge-based solutions are needed to provide food, water, and energy security for all, and to allow humanity not just to survive, but to thrive, as we resolve the sustainability challenges of economic development, demographic change, climate change and the loss of biodiversity.

The terms sustainability and sustainable development have become common currency in the international science and policy community. The most frequently cited definition of sustainable development is that of the Brundtland Commission that in 1987 wrote that "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs". For many scholars and practitioners there are three pillars of sustainability: environmental (or ecological), social, and economic with others seeing sustainable development as based in a respect for nature, human rights, and economic justice. The 2012 report of the High-level panel on global sustainability wrote "sustainable development is fundamentally about recognizing, understanding and acting on interconnections — above all those between the economy, society and the natural environment. Sustainable development is about seeing the whole picture — such as the critical links between food, water, land and energy. And it is about ensuring that our actions today are consistent with where we want to go tomorrow" (Bruntland, 1987; Brown et al. 1987; GSP, UN, 2012).

The challenge of achieving a transition to global sustainability is not only large in scale - it is also urgent. There is growing evidence that the climate is changing and critical environmental services are degrading, and that there are risks of crossing critical tipping points in the Earth system. These changes can have potentially catastrophic and irreversible implications for human societies (Lenton et al., 2008; Schellnhuber 2009; Rockström et al., 2009). There are also many important, unanswered questions relating to the global environmental change, sustainability and the basic functioning of the Earth system that need to be addressed.

Evidence to date indicates that little progress is being made towards sustainability. For example, UNEP's recently published Global Environmental Outlook-5 (2012a) assesses the state of the environment in different regions, for different sectors and for the world as a whole, and concludes that we are not moving towards sustainability, with only 3 of 90 indicators showing significant improvement. Development indicators have shown some improvement, yet about a billion people remain poor and hungry (UNMDG, 2012) and many more experience chronic threats to their livelihoods, health, and well-being.

At Rio+20, the nations of the world agreed to develop Sustainable Development Goals that integrate environmental and development indicators to set targets for the future, and discussed other options and opportunities for environmental stewardship and equitable development. There are calls for science to provide the knowledge base for these and other efforts to build a sustainable, just and prosperous future for current and future generations. *The Future We Want*, as the outcome document of the Rio+20 UN Conference on Sustainable Development, provides a clear statement in this direction:

> *"We recognize the important contribution of the scientific and technological community to sustainable development. We are committed to working with and fostering collaboration among academic, scientific and technological community, in particular in developing countries, to close the technological gap between developing and developed countries, strengthen the science-policy interface as well as to foster international research collaboration on sustainable development". (Paragraph 48)*

Future Earth can play a key role in providing scientific advice and expertise to the United Nations post-Rio+20 and post 2015 processes, including the definition and monitoring of Sustainable Development Goals, a UN 'high level political forum' on sustainable development, the science-policy interface within UNEP, and ongoing assessment processes such as the IPCC.

The international research community has a number of organisations and networks that promote international science coordination and collaboration to understand the causes and consequences of global environmental change. Notably, these include the existing Global Environmental Change programmes – the World Climate Research Programme (WCRP), the International Geosphere-Biosphere Programme (IGBP), DIVERSITAS, and the International Human Dimensions Programme (IHDP). Together with their numerous research projects, these programmes have delivered essential advances in understanding global environmental change and they have created important networks of researchers and connections to decision makers.

In 2001 the global change research programmes (WCRP, IGBP, IHDP and DIVERSITAS) issued the Amsterdam Declaration on Global Change calling for a new system of global environmental science that would draw upon the disciplinary base of global change science and integrate across disciplines, environment and development, natural and social sciences, and international boundaries[2]. They jointly established the Earth System Science Partnership (ESSP). A 2008 review of the ESSP recommended stronger engagement with policy and development, greater scientific focus and more resources, a greater commitment to an integrated approach to global environmental change and governance options that included a consolidated secretariat or a fusion of the parent programmes.[3] Subsequent reviews of individual programmes confirmed the need for change. ICSU and ISSC then initiated a wide consultation to explore options for a holistic strategy for earth system research. The report of this Earth System Visioning process for the next decade of Earth system research (ICSU/ISSC, 2010) identified grand challenges that addressed the intersection of global environmental change and sustainable development. These challenges included forecasting future environmental changes and their consequences, enhancing observations, anticipating disruptive change, changing behaviour, and encouraging innovation for sustainability (Reid et al, 2010).

The Visioning process called for both disciplinary and interdisciplinary research, and new partnerships between researchers, research funders and users to coordinate and co-design research. At the same time a consortium of research funders issued the Belmont Challenge with the goal of delivering knowledge needed for action to avoid and adapt to detrimental environmental change including extreme hazardous events. They identified priorities that included the assessment of risks, impacts and vulnerabilities, advanced observing systems and environmental information services, interaction of social and natural sciences and effective international coordination (Belmont Forum 2011).

The potential and urgency of a coordinated scientific and societal response to global environmental change was highlighted at the 2012 Planet under Pressure conference, organized by the global environmental change programmes. The conference declaration called for a new approach to research that is more integrative, international and solutions oriented; reaching across existing research programmes and disciplines, north and south, and with input from governments, civil society, local knowledge, research funders and the private sector (Planet under Pressure 2012). This call was echoed in the Rio+20 declaration and the UN Secretary General's Global Sustainability Panel report with the latter calling for a major global scientific initiative to strengthen the interface between policy and science (UNCSD 2012; UNEP 2012b).

## 1.2. What is Future Earth?

Future Earth is the response to calls for international, integrated, collaborative and solutions-oriented research to respond to the urgent challenges of global environmental change and sustainable development.

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[2] The Amsterdam Declaration on Global Change 2001, see http://www.essp.org/index.php?id=41.

[3] ICSU-IGFA Review of the Earth System Science Partnership 2008, see http://www.icsu.org/publications/reports-and-reviews/essp-review.

Future Earth is conceived as a 10-year programme that builds upon Earth system science and brings together global environmental change researchers to further develop interdisciplinary collaborations that address critical questions. Future Earth will develop research to better understand changing natural and social systems; observe, analyse and model the dynamics of change and especially human-environment interactions; provide knowledge and warnings of risks, opportunities and dangers; and define and assess strategies for responding to change, including through the development of innovative solutions. It provides the opportunity for scientists from within and outside existing international programmes, projects and initiatives to work together under a unifying framework.

The following questions represent some of the sustainability challenges where Future Earth research is expected to make a major contribution:

- How can freshwater, clean air, and food be sustainably secured for the world population today and in the future?
- How can governance be adapted to promote global sustainability?
- What risks is humanity now facing as global growth and development place unprecedented pressures on ecosystems? What are the risks of crossing tipping points with serious implications for human societies, and the functioning of the Earth system, and the diversity of life on earth?
- How can the world economy and industries be transformed to stimulate innovation processes that foster global sustainability?
- In a rapidly urbanizing world, how can cities be designed to sustain a high quality of life for more people, and have a sustainable global footprint that considers the human and natural resources they draw on?
- How can humanity succeed in a rapid global transition to a low-carbon economy that secures energy access for all?
- How can societies adapt to the social and ecological consequences of a warming world, and what are the barriers, limits and opportunities to adaptation?
- How can the integrity, diversity and functioning of ecological and evolutionary systems be sustained so as to sustain life on earth and ecosystem services, and to equitably enhance human health and well-being?
- What lifestyles, ethics and values are conducive to environmental stewardship and human welfare and how might these contribute to support a positive transition to global sustainability?
- How does global environmental change affect poverty and development, and how can the world alleviate poverty and create rewarding livelihoods which help achieve global sustainability?

There are many areas where Earth system research can contribute to better understanding these challenges and help identify solutions. For example, observing, documenting and forecasting the dynamics and interactions of Earth system components, including social elements, will provide the knowledge needed to assess the state of the planet, understand the risks and opportunities in where we may be heading, and explore alternative scenarios for the future. Understanding the

relationships between biological diversity and ecosystem function will play a critical role in sustaining the services provided by nature (e.g. healthy soils, clean water, fresh air, genetic variation). Evaluating the potential and risks of new technologies can identify new options for human development and environmental restoration. Analysing the effectiveness of different response options to environmental change, and identifying the longer term social transformations associated with the responses, will help identify pathways to sustainability.

### 1.3. What is the added value of Future Earth?

**Future Earth** intends to add value to existing research activities by emphasising:

*Co-design of research and activities:* Future Earth aims to close the gap between environmental research and current policies and practices. Future Earth invites the broad community of researchers working within the natural and social sciences, engineering and the humanities to engage in developing knowledge that is co-designed with those who use research in governments, business, and civil society. Such co-design means that the overarching research questions are articulated through deliberative dialogues among researchers and other stakeholder groups to enhance the utility, transparency, and saliency of the research. This approach embraces the concept of a new 'social contract' between science and society (Lubchenco 1998, ICSU 2011).

*International and regional emphasis:* Future Earth prioritises research that requires international cooperation to succeed because the research and solutions are difficult to implement at the national level only. In this context, it will include national or locally placed and comparative research that has international implications. Future Earth must be inclusive, involving researchers from countries around the world and building capacity where needed, especially in the least developed countries. Future Earth recognizes the added value of regional research collaborations where common questions, challenges, projects and solutions are best designed and implemented within and between clusters of countries and among researchers that share common problems, regional concerns, and cultural perspectives.

*Decision support and improved communication:* Future Earth intends to deliver a step change in making research more useful and accessible for decisions and solutions that can be made by governments, business and civil society regarding environmental change and sustainable development. In addition to the principle of co-design, this means that Future Earth should develop best practices in integrating user needs and understanding of the research, making research accessible to all parties, communicating risks and uncertainty, developing and diffusing useful tools for applying knowledge, resolving conflicts, respecting and including local knowledge and supporting innovation.

*Support for intergovernmental assessments:* Future Earth will also respond to the research needs identified by major global and sectoral assessments such as the Intergovernmental Panel on Climate Change (IPCC 2007), the Millennium Ecosystem Assessment (2005), and the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD, McIntyre et al 2009). The new Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), the Assessment of Assessments (AOA) on the oceans, and the emerging process to develop Sustainable Development Goals (SDGs) provide other important opportunities for researchers to contribute and

collaborate through the mechanisms and networks of Future Earth. Alliances with major international agencies that regularly provide reports on environment and development, such as WMO, UNEP and UNESCO, provide opportunities to ensure that Future Earth research responds to and informs stakeholder needs for up to date information and indicators of high scientific quality.

In the wake of Rio+20, Future Earth can enhance the contribution of the scientific community to sustainable development by increasing scientific collaboration between countries, disciplines and sectors. It should provide the basis for a more effective interface between science and policy (see Annex 2 for further details).

### 1.4. Key principles of Future Earth research and governance

Future Earth will be guided by the strategic research framework set out in this document and its research will operate according to the following principles. Future Earth will:

- *Promote scientific excellence:* An overarching element to these key principles is Future Earth's commitment to support science of the highest quality.
- *Linking earth systems research to global sustainability:* Future Earth does not encompass all environment and development research but focuses on integrated earth systems research and global sustainability.
- *Be international in scope*: Future Earth focuses on areas where international research co-ordination is needed.
- *Promote integration*: Future Earth should draw on expertise in natural and social science, as well as engineering, the humanities and professions such as planning and law.
- *Encourage co-design* and co-production: the research agenda and programmes should be co-designed and, where possible, co-produced by researchers in collaboration with various stakeholders in governments, industry and business, international organisations, and civil society.
- *Be bottom-up driven*: the Future Earth approach will emphasize the importance of 'bottom-up' ideas from the research community and other stakeholders in designing the projects that respond to sustainability challenges.
- *Provide solution-oriented knowledge*: Future Earth will provide foresight of changes and risks, evaluating the effectiveness of responses and providing a knowledge base for new innovations and policies.
- *Be inclusive*: Future Earth will include existing international Global Environmental Change programmes and projects and related trans-national and national activities in a framework that strengthens existing endeavours and provides new opportunities. Attention will be given to regional engagement, geographic and gender balance, capacity building and networking.
- *Be responsive and innovative*: The governance and organisational structure for Future Earth must be fit-for-purpose, leave room for adaptation as the programme develops, and especially enable step-changes in the delivery of research for sustainability.

- *Be sensitive to Future Earth's own environmental footprint*: Special consideration will be given to the environmental impacts resulting from the implementation of Future Earth. For instance, greenhouse emissions related to operations (travel for meetings etc.) will be tracked and minimised wherever possible.

### *1.4.1. Building Future Earth's approach to co-design*

One of the most innovative and challenging aspects of Future Earth is the idea of co-design and co-production of relevant knowledge. This requires an active involvement of researchers and stakeholders during the entire research process. Such co-design is also endorsed by the UN Conference on Sustainable Development (Rio+20, June 2012) in its 'Future we want' document (United Nations 2012). This document clearly states the importance of enhanced involvement of stakeholders.

Integrating global environmental change issues with development and sustainability issues involves many complexities and uncertainties and must incorporate understanding of societal norms, values and perspectives (Kates 2011). Under such conditions, science has up-to-now tended to provide mainly understanding but not answers or comprehensive solutions (e.g. Funtowicz and Ravetz 1990, Klein 2004b). Co-design is one way to address this, and it has already shown its value and utility in fields where science and policy meet. Experiences with co-design and co-production of knowledge are discussed at length in the scientific literature (e.g. Alcamo et al. 1996, Lemos and Morehouse 2005, Scholz et al. 2006, de la Vega-Leinert et al. 2008, Pohl 2008, Brown et al. 2010, Scholz 2011, Lang et al. 2012). In development research participatory approaches are common (e.g. Chambers 2002) and in science-policy research different dialogue approaches have evolved (e.g. van den Hove 2007). Co-designed and co-produced research is also sometimes referred to as 'transdisciplinary' (e.g. Klein 2004a and b).

Co-design and co-production of knowledge include various steps where both researchers and other stakeholders are involved but to different extents and with different responsibilities (Figure 1). Whilst researchers are responsible for the scientific methodologies, the definition of the research questions and the dissemination of results are done jointly. Co-design and co-production also recognises that researchers, information and models are now based in many different types of organisation and the great benefits from research collaborations between, for example, universities, NGOs, and the private sector. One of the main challenges is how to build trust among all stakeholders, and to ensure continuous engagement. The challenges of co-design and particularly co-production are not underestimated by the Transition Team, and it is recognised that the programme will need to support the research community and stakeholders to develop and share the necessary skills. It is also recognised that the focus for this way of working should be on where the research and stakeholder community feel that it will bring the greatest benefits.

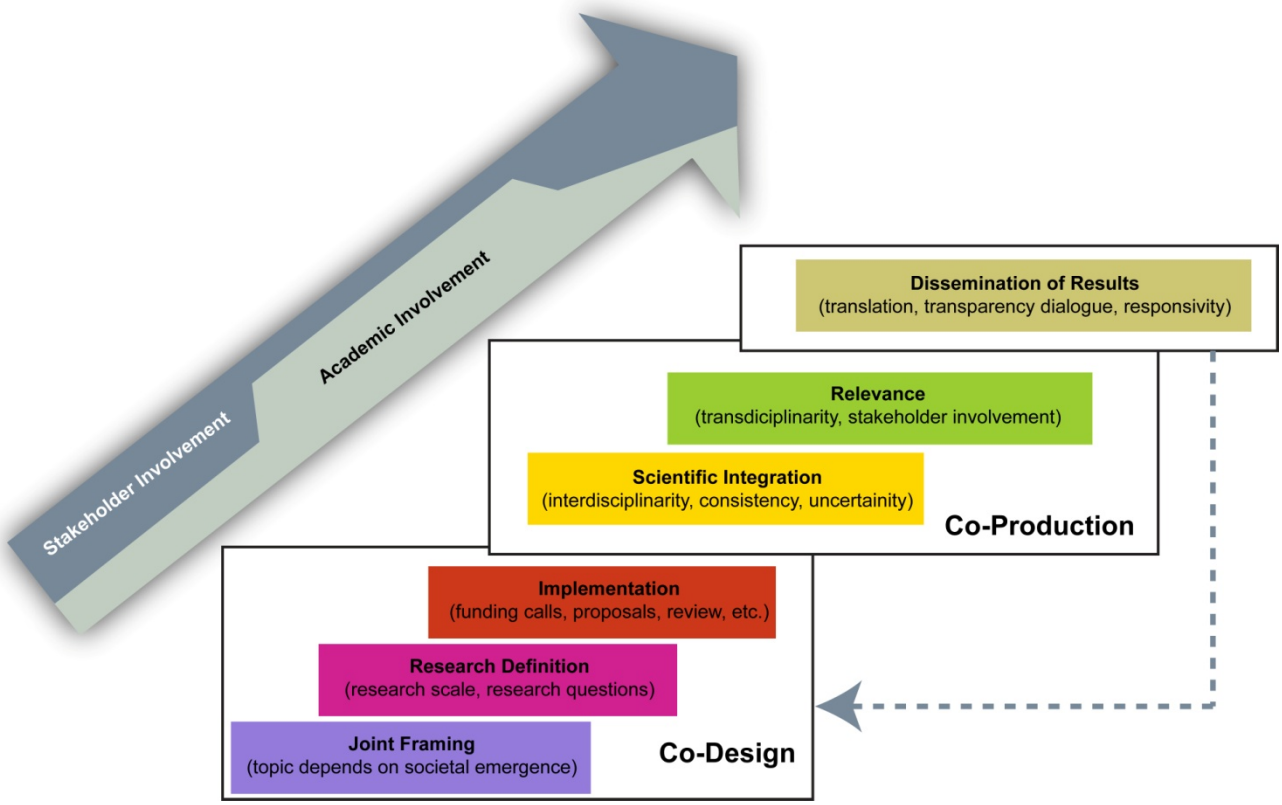


**Figure 1: Steps and involvement in co-design and co-production of scientific knowledge**[4]

### *1.4.2 Future Earth major stakeholder groups*

The major stakeholder groups identified so far as relevant to Future Earth are shown in Figure 2.

[4] Mauser W, Klepper G, Rice M, Schmalzbauer BS, Hackmann H, Leemans R, Moore H: Transdisciplinary global change research: the co-creation of knowledge for sustainability. Current Opinion on Environmental Sustainability 2013, (Submitted)


**Figure 2: Future Earth's main stakeholder groups**

The stakeholder communities that could potentially be interested in Future Earth knowledge are heterogeneous. It is therefore difficult to unambiguously classify them into distinct groups. However, eight major categories of stakeholders can be distinguished:

- *Academic Research*: This essential stakeholder group includes individual scientists, research institutes and universities, who provide both the scientific knowledge necessary to accomplish the ambitions of Future Earth, as well as scientific expertise, methodology and innovation. Individual researchers and their students, and internationally oriented research institutes should all be able to contribute to and benefit from Future Earth.
- *Science-policy interfaces*: Organisations at the interface between science and policy assess the status of scientific evidence and 'translate' it into policy-relevant information. These include integrated assessments such as the Ozone Assessment, IPCC, the Millennium Assessment, and more recently, IPBES. They also include a variety of other 'boundary' organisations and structures such as the Sustainable Development Solutions Network. There are also other bodies that undertake this role.
- *Research Funders*: National research funding organisations are important catalysts of innovative disciplinary and interdisciplinary research. They are often relatively independent parts of governments or private foundations. Funders support peer-reviewed research projects and research infrastructures. They also support the training and career development of researchers and work with them to inspire young people and engage the wider public with research. Some trans-national research funders, most notably the European Commission, play a similar role at the regional level. Funders are important stakeholders as intermediaries between researchers, governments, and other stakeholders.
- *Governments (national, regional and international)*: Governments are responsible for managing and balancing the short and long-term well-being of their citizens, business, environments and resources. Governments operate at many different levels (e.g.

municipalities, states, nations and internationally). Future Earth should work at supra national and international levels and work with regional partners to support more local needs. Key stakeholders include the various UN-organisations and programmes, and the international conventions such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD).

- *Development groups*: Some of these organisations (e.g. World Bank) focus on promoting social and economic development in less developed countries. Others play a role in amplifying the voices of the poorest people in the decisions that affect their lives, improving development effectiveness and sustainability and holding governments and policymakers to account. Many organisations (see e.g. http://www.devdir.org ) share in such development work, including civil society organisations, academic and research institutions, governments, faith-based organisations, indigenous peoples' movements, foundations and the private sector.
- *Business and industry*: This sector supports the majority of the world's research and development and is a critical group of stakeholders to be engaged in Future Earth. There are many different industry sub-sectors with different interests, including: primary and secondary productive industries (e.g. mining, manufacturing, agriculture and construction), a wide variety of financial, health and other services and consultancies, and consumer focused business such as retail and media. Some industry organisations (e.g. the World-Business Council for Sustainable Development - WBCSD) do cover a broad range of interests and could potentially represent these in Future Earth at the global level.
- *Civil society*: These are groups organised independently from governments and governmental institutions. Civil society groups have organised themselves to represent their interests with governments or other influential actors. The non-governmental organisations (NGOs) have nowadays taken over some roles that traditionally have been the responsibility of local or national governments. NGOs have also been instrumental in national and international policy negotiations and in producing research reports. All these accomplishments increase the relevance of these actors to Future Earth. Civil society in this document includes indigenous communities, recognising the important knowledge that these groups can offer and the important role they can play in Future Earth.
- *Media*: Media here refers to communication intermediaries and organisations that use both traditional and electronic means to gather and distribute information, and are central to the broader influence of any network or concern - scientific, corporate, financial, cultural, industrial, political or technological. The media represent a fast changing landscape, which will continue to evolve rapidly during the lifetime of Future Earth. It is not just an outlet for communication, but also a stakeholder group that does its own research and can help broker messages between the local and global scales and different stakeholders.

### 1.5. The Science and Technology Alliance for Global Sustainability

Future Earth is a programme of the Science and Technology Alliance for Global Sustainability. The 'Alliance' is an international partnership based on a shared commitment to address the needs of global sustainability through the application of science and technology. The Alliance vision is: a sustainable world where decision-making is informed by the best available scientific evidence, and in which its mission is to encourage and facilitate the co-design, co-production and co-delivery of

knowledge with relevant stakeholders in order to address and create solution pathways for global sustainability problems. Future Earth is the Alliance's first initiative.

The Alliance operates as an informal body comprising stakeholders from the research and education community, research funders, operational service providers and users. The present members include:

- International Council for Science (ICSU)
- International Social Science Council (ISSC)
- Belmont Forum / IGFA (groups of major research funders)
- UN Educational Scientific and Cultural Organisation (UNESCO)
- UN Environment Programme (UNEP)
- UN University (UNU)
- World Meteorological Organization (WMO) as an observer.

Other organizations have also expressed interest in joining the Alliance as Future Earth moves into an implementation phase.

More generally, the Alliance partners collaborate on:

- Promoting and monitoring the vitality of the international science, technology and innovation system
- Marshalling resources needed to support a successful Future Earth programme
- Incentivizing the cooperation of natural, social (including economic and behavioural), engineering and human sciences in developing integrated solution pathways.
- Fostering the use of science, technology and innovation in equitable, sustainable decision making and practice at all levels, taking into account environmental, societal, cultural and geographic diversity.