Messages

from the

International Workshop

on

Resilience as Requirement for Sustainable Development

A contribution to tackle the Earth crises

On March 28 to 30, 2012, a group of 47 scientists, representatives from regulatory agencies, NGOs, businesses and from media assembled in Wildbad-Kreuth, Germany, to explore whether and to what extent the resilience theory is applicable to sustainable development in general and in particular to finding solutions to tackle global warming, resource limitation, loss of biodiversity and human well being.

Sponsored by

Priority recommendations

- The resilience theory is likely to provide a sound basis of the development of powerful strategies to drive sustainable development. In order to keep the Earth System resilient, efforts must be made to sustain its auto-regulative capacity.
- The resilience of societies and their economies should be strengthened through robust decisions in response to global changes.
- The triade formed by the three major sub-systems, nature, society and economy should be considered the dominant expression of the Anthropocene period. Resilience of this triade is considered the most important precondition for sustainable development and its longevity.
- To foster the auto-regulative capacity of the triade it is of crucial importance to strengthen its ability to continuously change and adapt to the ever changing site-specific ambient conditions. Continuous re-orientation of the triade must replace conservation of the *status quo*.
- Since the site-specific conditions, capacities and limits vary a mix of local, regional and global, centralized and de-centralized approaches towards resilience and, thus, sustainability is to be favored over approaches focusing on global governance alone.
- Existing energy regimes should be transitioned across a variety of energy sources and technologies, adapting energy systems to local circumstances and de-centralizing energy production.
- The vulnerability of complex societal systems (urban agglomerations, communication and mobility infrastructures, industrial societies) to climate change needs to be better understood. It is insufficient to base vulnerability assessments predominantly on statistics of national GDP per capita.
- Resilience of tropical and boreal forests is to be valued not only because of their capacity to sequester carbon, but even more so because of their capacity to regulate the hydrological cycle.
- Water, energy, natural resources, agricultural land, forests and wetlands must all be considered, and treated, as vital common goods.
- Technology is an important anthropogenic means to support resilience, but technology based remediation and control systems must be resilient themselves. Rebound effects must be considered when choosing technology as a means to strengthen resilience of marine and terrestrial systems.
- Efforts to maintain the resilience of the eco-social triade must be communicated at the earliest stage of decision making in order to reach consensus that the proposed development strategies serve the self-interest of the region and its inhabitants and natural environment.
- To better understand and manage the complexity of the relevant eco-social systems within our societies, new inter- and transdisciplinary approaches and methods are required. Efforts must be undertaken to extend the knowledge of qualitative and quantitative dynamic network models and analysis of human-environment systems, in order to find leverage points for effective intervention, and transfer such insights into practice.

Motivation

The workshop was held in response to the results gained during an earlier workshop on "Earth System Engineering: The art of dealing wisely with the planet Earth", held in 2008 at Wildbad-Kreuth. Four major Earth crises were indentified – crises that endanger the persistence of the life enabling conditions on Earth. Global warming and the resulting climate change need to be tackled simultaneously with "loss of ecosystem functions", "unequal distribution and subsequent deficiency of vital resources such as air, water, food and energy", and "decay of conditions that keep economies as well as societies stable". It was agreed that measures to solve the four Earth crises must be derived within sustainability guidelines. Small meetings held after the first Wildbad-Kreuth workshop led to the hypothesis that the resilience theory expresses the potential of developing readily understandable and thus broadly acceptable measures toward a sustainable solution of the Earth crises.

Resilience theory in brief

The Stockholm Resilience Centre considers a system resilient as long as it is capable to continually change and adapt while remaining within the thresholds set by any natural or man-made regime. As Lovelock´s Gaia theory suggests life on Earth has demonstrated over billions of years its capacity to proactively respond to ambient changes, maintain its integrity and remain resilient, subsequently. Likewise, anthropogenic systems must change and adapt to ongoing variations of ambient conditions in order to qualify for remaining resilient. Should a system not be able (or willing) to orient itself to the contemporary ambient conditions it runs the risk of becoming vulnerable, getting extinct or be driven into a region governed by an alien regime. If the latter happens, the system transforms into a different entity, one that may be valued as negative or positive depending on the judgment of the observer and the parties affected. In short, the readiness to accept continuous re-orientation keeps a system resilient, whereas conservation of the *status quo* makes a system vulnerable, and bears immense risks.

Format of the workshop

Prior to the meeting in Wildbad-Kreuth the participants were expected to send written statements to be distributed for comments and recommendations. Thus, the need for oral presentations during the workshop was minimized, and the time for in-depth discussion sessions in plenum and in break-out groups was maximized. Four break-out groups were built focused on the topics: climate change and energy demand (1), water and food (2), ecosystems (3), and society and economy (4). Intermediate results gained during the break-out group sessions were presented and discussed in plenum for getting feedbacks from the other groups.

Messages from the break-out groups

<u>Climate change and energy demand</u>

The combustion of fossil fuels during the industrial era has become a major disturbance of the global environment unprecedented in the human history. It contributed significantly to the observed unfavorable changes of climate and ecosystems that are currently occurring on a global scale. Existing energy regimes of industrialized countries are unsustainable and must be transformed.

Existing energy regimes of industrialized countries are unsustainable and must be transformed. Without a clear pathway to sustainable energy regimes, the Millennium Development Goals are obviously in conflict with targets to reduce GHG emissions. As long as economic growth is dependent on greater amounts of energy consumption based on fossil fuels, sustainable development cannot effectively proceed. The resilience of the climate system is greatly related to human populations, their numbers and their consumer lifestyles. While it is desirable that wealth will be shared more equally among developed and developing countries in the future, it is unlikely that this goal can be achieved in a sustainable way as long as economic growth is

considered the key to development, and greater wealth the key to stop the growth of human populations. Energy regimes need to be transformed in the first instance and carbon emissions must be reversed to remove excess carbon from the atmosphere.

It is crucial for industrialized countries to better understand their vulnerability as well as the adaptability of complex social structures and networks to climate change in order to be able to make robust decisions towards self-protection. For the greatest part of history on Earth, *homo sapiens* has lived in small groups and adapted culturally to climate change. Its cultural capacity to create new ecologic niches has enabled spread about all landmasses on the globe. Human adaptability created a great variety of cultures making humankind as a whole extremely resilient to changes in the global ecosystem. Today, as a global society emerges, mass extinction of species is paralleled by a loss of cultural diversity. This raises serious concerns about the human capacity to adapt to global change in future.

Water and food

Water and food supply systems have a unique role since they are vital for human survival and for societal developments. Unlike other commodities water and food have no substitutes although food sources and supplies are much more varied than those of water. Water and food, including fertile, unpolluted soil, can be considered common goods that benefit whole humanity. The productivity of these systems must be protected. Value of water and food must be fully and appropriately reflected in the economic systems (tiered pricing – "some for free or at low cost, pay for more"). Currently, water and food values are biased worldwide by direct and indirect subsidies. Full accounting (but not necessarily full-cost pricing) of water and food that includes externalities (such as pollution) would provide more socially resilient systems of production, distribution and consumption. This issue may be especially important in the growing energy-water-food nexus. Biofuel production competes for water and land with direct human needs and biofuels are often supported by their own subsidies. If not managed properly, expansion of biofuel production may decrease the resilience of water and food system because they are pushed toward monoculture plantations.

Water supply and sanitation systems are typically local in scale with a few regional examples (California, Australia). In contrast, food supply systems vary from extremely localized (farming for individual needs) to completely globalized complex networks. Thus, it is likely that resilience enhancing may take different forms for water and food. Multi-scale systems are likely to be more resilient and can be applied to the water and food sector (e.g., distributed water reclamation versus large scale centralized treatment, small urban garden farming versus agro-business) although the range of scalable solutions will be smaller for water supply than for food. Redundancy and lower extraction ratios (ratios of actual use of water or actual food consumed to their respective maximum potential availabilities) should be beneficial for resiliency although these approaches may make systems less efficient with respect to energy and other resources but less fragile, presumably.

Oceans play a special role in water and food systems. They are not only the source of fresh water in the hydrologic cycle and climate regulator but also a final receptacle for pollutants (e.g., plastic garbage, nutrients, pesticides, sediments, radio-nuclides). Thus, degraded ocean environments indicate possibly even more severe problems on land. Many people feel emotional attraction to the oceans and a slogan "Do not trash the ocean" might resonate well as a focal point of awareness-raising campaign.

Ecosystems

Sizeable natural ecosystems are needed as reference points to study the sensitivity of ecosystems with respect to anthropogenic influences and impacts. Human intervention has resulted, mainly due to a long agricultural and forest tradition, in a world-wide disturbance of the functioning of natural aquatic and terrestrial ecosystems. On a major part of the Earth's surface natural ecosystems have been replaced by artificial biological systems to provide food and biomass to human society. Such systems lack resilience that is inherent to natural ecosystems; by human intervention they can be maintained in a short-term quasi-resilient state only. At the same time there still remain vast ecosystems on Earth, including boreal and tropical forests and some regions of the open ocean, that, while disturbed by humans to a varying degree, still operate in the natural regime, retain much of their integrity and resilience and continue to provide particular regional and global environmental services, including the regulation of the terrestrial water cycle. Disruption of these last frontiers of resilience by uninformed human intervention is dangerous but a common practice. Modern clear-cutting of boreal forests in Eurasia is a striking example of this. Governmental institutions are called upon exercising responsibility for the common. Another example is the misinterpretation of the links between biodiversity and resilience. Research has to be undertaken to not only consider the conservation of rare target species but to better integrate ecological functions and to simultaneously consider producers, consumers and reducers as the three principal functional groups of ecosystems.

It is important to make decision makers as well as the public aware that our contemporary knowledge is by far insufficient to fully replace the auto-regulative capacity of ecosystems by technology. It is beyond human competence to continuously change and adapt ecosystems to changing climatic conditions and anthropogenic land-use strategies, and thus keep ecosystems resilient. Neglecting intrinsic natural auto-regulation services is very likely to lead eventually to destabilization of ecosystems, and with it societies and economies. Ecosystems provide the green space for the human well being. Taking responsibility for ecosystems is greatly facilitated by having a personal relationship with nature. We need innovative methods to deliver information about the importance of fully functioning ecosystems to the society (from childhood on) and to let the public participate on protection work.

Society and economy

Contemporary economies are driven by economic growth. Following the growth paradigm we tend to forget, however, that within the eco-social triade economic activity has no ends in itself but should serve the needs of the society being a part of the ecosystem. Consequently, the economy should be directed to the well-being of people and to the functioning of ecosystems rather than to quantitative growth for the sake of growing. Among others, human well being relies on educational achievements, health, easy access to fresh water, clean air and healthy food, safe neighborhood, physical and/or virtual mobility and intact nature.

Transformation from growth to well being driven economies requires the ability and willingness of stakeholders to change and adapt. Key issues include, but are not limited to the distribution of income, knowledge, as well as the successful management of global commons. Uneven distribution of income and wealth and unequal access to resources affect the resilience of the Earth System directly. While instability in the growth dynamics is a major factor affecting ecological sustainability, even stable and high growth rate is no guarantee of guarding resilience. It would be important to identify the region and context specific factors impinging on this process and plan for interventions at different levels. Demography, resources, economic growth and societal structure should be considered as key the drivers, and local, regional and global aspects may be taken to define spatial levels of articulation of concerns and of intervention.

Considerable research is required to better understand the interaction of drivers and levels and of the interdependence among the drivers and levels. It is necessary to identify indicators pertaining to climate change vulnerability and resilience of the Earth System, and quantify economic and social changes taking

place across countries, including policies and strategies of intervention. The work may be started on a pilot basis for Asian countries, for instance, and may gradually be expanded to other regions.

Urgent research tasks and questions

- How to identify and which are the most effective points of leverage and drivers to alter complex eco-social systems towards higher resilience and sustainable growth?
- Taking the world economy as such a main driver, ways to internalize external effects while de-coupling economic growth from resource degradation should be found; thus, developing a functioning world carbon market must be of utmost importance to self-regulate economies.
- How do sustainable energy regimes interact with local and regional environments, and how can they be set up in a most resilient manner?
- In which way and to what extent are complex social structures and infrastructures in urban areas and industrial structures vulnerable to climate change? What are the feedbacks of climate change in these structures?
- In what way does the loss of cultural diversity, caused by globalization, affect human adaptability to climate change and global environmental change in general?
- If re-orientation and innovation are accepted as major driving forces of continuous change and adaptation, which methods are to be generated and deployed that provide knowledge based orientation? Which methods and strategies are to be developed and implemented to optimize a two-way science-society knowledge transfer?
- What are appropriate measures to quantify the integrity of local and global water and food supply systems?
- How to manage optimal level food supply from oceans, while the resilience of marine systems remains secured?
- How to quantify the "value" of natural and human-influenced ecosystems?
- How to effectively fit protected ecosystem into human land-use structures? Can the "diversity of land-use concept" serve as a framework to integrate different ecosystem functions on the regional scale? How can global commons effectively be managed at local, regional and global scale?
- What exactly is the importance of biodiversity with respect to resilience of anthropogenic ecosystems? What are the links between biodiversity, the environment and its functions? What role do producers, consumers and reducers play in the context?
- Under which conditions are extinction of native organisms and intrusion of alien organisms into an anthropogenic ecosystem a threat or sign of auto-regulation?
- How can an economic system based on growth be transferred into a system serving for the well-being of people?

Authors

Friedrich Barth, Werner Bauer, Eva Bachthaler, Franz Bischof, Josef Bugl, Elena Davydova, Patrick Dewilde, Timi Ecimovic, Ludgera Ewers, Ulrike Feigl, Helmut Fluhrer, Kristina Frey, Jürgen Geist, Martin Grambow, Dr. Hartmut Grassl, Wolfgang Haber, Slav Hermanowicz,Victor Gorshkov, Gökce Iyicil, Jörg Imberger, Tara Chandra Kandpal, Claudia Klüppelberg, Amitabh Kundu, Eva Lang, Anton Lerf, Claus-Peter Lieckfeld, Tobias Luthe, Anastassia Makarieva, Franz Mauelshagen, Hamish McGowan, Chin Man Mok, Diego I. Murguia, Ulrike Potzel, Armin Reller, Axel Schaffer, Rudolf Schreiber, Helga Schubert, Yong Hui Song, Leena Srivastava, Rao Surampalli, Orhan Uslu, Tom Vereijken, Norbert Vogt, Michael von Hauff, Gisela Wachinger, Raoul Weiler, Peter A. Wilderer