WATER, SOIL AND WASTE
DRESDEN NEXUS CONFERENCE
DNC 2017 | SDGs & NEXUS APPROACH: Monitoring and Implementation

CONFERENCE REPORT

STATE OF THE NEXUS APPROACH 2017

MULTIFUNCTIONAL LAND-USE SYSTEMS AND RESOURCES MANAGEMENT IN RESILIENT CITIES

UNITED NATIONS UNIVERSITY
UNU-FLORES
Institute for Integrated Management of Material Fluxes and of Resources

TECHNISCHE UNIVERSITÄT DRESDEN

Leibniz Institute of Ecological Urban and Regional Development

DNC2017 CONFERENCE REPORT

STATE OF THE NEXUS APPROACH 2017: MULTIFUNCTIONAL LAND-USE SYSTEMS AND RESOURCES MANAGEMENT IN RESILIENT CITIES

17–19 May 2017
Dresden

Convening Organisations

UNITED NATIONS UNIVERSITY
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FOREWORD

It is our firm belief that the Nexus Approach, by considering interconnected resources and resource flows in a balanced way and taking into account the intertwined nature of research and implementation, is a crucial tool for sustainable development and adapting to global change. Fully understanding that this is not just another management concept or a purely academic endeavour, it was and is our intention to move discussions on the Nexus Approach forward by bringing together a diverse group of researchers and practitioners from different sectors, countries, and disciplines. We also believe that true progress is only possible through continued exchange across these groups. Thus, we have joined forces to provide a platform for the growing community of actors dealing with integrated resources management by applying and implementing a Nexus Approach – the Dresden Nexus Conference (DNC).

We are pleased and proud to report that the second installation of this biennial conference attracted 425 participants from 50 countries over three days (17–19 May 2017). This success is clearly connected to the attractive and inspirational conference programme developed by a wide network of key actors in the international nexus community. The organisation of DNC2017 is built on the proven partnership between three Dresden-based institutions: the United Nations University Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES), the Technische Universität Dresden (TU Dresden), and the Leibniz Institute of Ecological Urban and Regional Development (IOER), which banded together to collectively benefit from their expertise and networks. For UNU-FLORES, DNC is a strategic tool to fulfil various aspects of its mandate, in particular with regard to policy-relevant research to serve the United Nations system and its Member States. For TU Dresden, one of 11 'Universities of Excellence' in Germany, contributing to DNC fits perfectly into its institutional strategy as a synergetic university by fostering internationalisation and providing a showcase for sustainability in research and teaching, in particular in its interdisciplinary research priority area 'Energy, Mobility and Environment'. For the IOER, a think tank addressing the scientific basis for the sustainable development of cities and regions in the national and international context, DNC likewise is a strategic tool to support its mission and mandate.

This strategy was already a success for the inaugural DNC in 2015, but only over time, through experience and with feedback from participants, can the Dresden Nexus Conference come into its full potential. Thus, drawing heavily on the review of participants of DNC2015 and thematic input from partners, the focus in 2017 shifted to the more applied aspects of monitoring and implementation. Since DNC2015 we have seen the adoption of the Sustainable Development Goals (SDGs), the Paris Agreement on Climate Change, the Sendai Framework for Disaster Risk Reduction, and the New Urban Agenda. In response to these developments, two very timely topics were chosen for the programme: **Multifunctional Land-Use Systems** and **Resources Management in Resilient Cities**.

Our aim, however, was not only to improve the substantive dimension of the conference, but also the structural approach in terms of increasing participatory elements, gender balance, and facilitating rigorous debate and exchange. This is reflected in our decision to limit the number of presentations per session, to extend the time for poster sessions, and to introduce a poster

competition[1]. We also included a World Café, which was particularly well-received for its success in inspiring more direct discussion and debate amongst participants. Finally, to make the Nexus Approach more practical and tangible we introduced programme items that appealed to other senses and experiences. These included two case study panel discussions as well as various side events, including a gaming session and several excursions that showcased nexus-relevant local projects and sites. In the Conference Wrap-Up – to ensure we would have fruitful feedback to draw on for DNC2019 – we asked four key listeners from different sectors to provide feedback on the success and possible limitations of the conference.

The relevance and timeliness of the debates and knowledge shared during DNC2017 go far beyond the entities and individuals who were able to physically attend the conference. Thus, an important dimension of our activities to advance a Nexus Approach to the management of environmental resources is the consolidation and dissemination of the content shared at the conference. Emerging from DNC2017, this biennial report *State of the Nexus Approach* offers a cross-section of the most recent and innovative nexus-oriented initiatives in the field of sustainable management of environmental resources.

We would like to take this opportunity to thank all partners involved in the preparation of DNC, members of the International Scientific Advisory Committee, members of the Organizing Committee, session conveners, panellists, moderators, keynote speakers, key listeners, oral and poster presenters, exhibitors, organisers of side events and excursions, and all participants. It was the commitment of all of them that made DNC2017 possible and ultimately a success. Finally, we also would like to thank the Deutsche Forschungsgemeinschaft (DFG) for the significant financial support.

Reza Ardakanian
Director, UNU-FLORES

Karl-Heinz Feger
Dean, Faculty of Environmental Sciences, TU Dresden

Bernhard Müller
Director, Leibniz Institute of Ecological Urban and Regional Development

[1] All participants received a ballot, offering the opportunity to select the three best posters participating in the competition (only early career scientists). The three winning posters are highlighted by a symbol in their respective session report.

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Conceptual preparations for the Dresden Nexus Conference 2017 (DNC2017) started soon after DNC2015. This iterative process between the inaugural organisers and collaborators, many of whom continued their involvement through participation in the International Scientific Advisory Committee, led to the following substantive concept of DNC2017.

INTRODUCTION

CONFERENCE CONCEPT

Background

Building on the success of the inaugural Dresden Nexus Conference (DNC) in March 2015, DNC2017 brought together researchers and implementers, such as policy- and decision makers, from universities, national and international organisations, UN organisations, ministries and governmental agencies, as well as individual researchers, stakeholders from the private sector, and civil society from around the world under the theme **"Sustainable Development Goals and the Nexus Approach: Monitoring and Implementation"**.

The Nexus Approach to the sustainable management of water, soil, and waste emphasises the interrelatedness of these three resources along with the cycle of research to implementation and monitoring. DNC2015, under the umbrella "Global Change, Sustainable Development Goals and the Nexus Approach", focused on the challenges posed by different aspects of global change (climate change, urbanisation, population growth) on environmental resources management and how a Nexus Approach may help to cope with them. There was overall consensus among participants of DNC2015 that applying a Nexus Approach is key for the sustainable use of environmental resources under conditions of global change. It will, therefore, be instrumental for achieving the Sustainable Development Goals (SDGs), which will frame the international development agenda for the next 13 years.

While the importance of the Nexus Approach for achieving the SDGs can be deduced rather straightforwardly from conceptual considerations, the more complex question remains *how* to adopt and implement it. With the adoption of the SDGs in autumn 2015 the overall targets related to resources management are clear. Many of the SDGs are interrelated, which already points to the need for a Nexus Approach. Furthermore, the management of environmental resources is of particular relevance for Goal 2 (*End hunger, achieve food security and improved nutrition and promote sustainable agriculture*), Goal 6 (*Ensure access to water and sanitation for all*), Goal 7 (*Ensure access to affordable, reliable, sustainable and modern energy for all*) and Goal 11 (*Make cities inclusive, safe, resilient and sustainable*). A common theme and potentially strong integrator is therefore the need for monitoring strategies reflecting the Nexus Approach and the SDGs. These strategies and the respective data are crucial to be able to evaluate any advance towards sustainable environmental resources management and achieving SDGs and have to be a decisive component of policies and guidelines for the implementation of integrated management approaches.

Objectives and Theme

Given that sustainable resources management will be mandatory for United Nations Member States in the context of SDGs, DNC2017 focused on the contributions of a Nexus Approach to the sustainable management of water, soil, and waste. The main objective was to showcase nexus-oriented research and case studies demonstrating the link between research and policy/implementation. Strengthening that link requires looking in depth at monitoring and implementation strategies. DNC2017 thus addressed issues related to data requirements as well as data quality and efficient data management, strengthening of monitoring programmes and of feedback loops to resources management. Moreover, DNC2017 dealt with governance frameworks for integrated resources management, and incentives for resource recovery and efficiency among others, facilitating the implementation of sustainable environmental resources management strategies.

DNC2017 considered examples and case studies addressing monitoring and implementation strategies targeting research, education, and advocacy (or any combination thereof), all of which are essential for advancing a Nexus Approach. Nexus-oriented research, policy-oriented and transdisciplinary in nature, addresses critical knowledge gaps, making use of environmental monitoring data from various sources. Since the implementation of nexus-oriented policies requires a nexus mindset, education (mainly at postgraduate level) and advocacy are equally important as research to ensure the sustainability of monitoring and implementation strategies.

At DNC2017 issues related to monitoring and implementation strategies were specified and addressed both for rural as well as urban and peri-urban systems. In particular, we considered

- Multifunctional Land-Use Systems, and
- Resources Management in Resilient Cities.

These systems are perfectly suited to demonstrate the close link between the Nexus Approach to the sustainable management of environmental resources and the related SDGs. With multifunctional land-use systems we refer mainly to resources management in rural areas and respective ecosystem services, while acknowledging the close relation to the second system considered, cities. Within both systems it is required to discuss ways how to achieve SDG 2 (*End hunger, achieve food security and improved nutrition and promote sustainable agriculture*), 6 (*Ensure access to water and sanitation for all*) and 7 (*Ensure access to affordable, reliable, sustainable and modern energy for all*), while SDG 11 (*Make cities inclusive, safe, resilient and sustainable*) explicitly addresses the urban setting. Discussing ways how the application of a Nexus Approach may help to achieve these SDGs implies focusing on monitoring and implementation strategies, while considering research, education, and advocacy as outlined above.

Expected Outcomes

Addressing issues related to monitoring and implementation strategies for a Nexus Approach in multifunctional land-use systems and for resources management in resilient cities as explained above, DNC2017 aimed to

- showcase the state of the art of adopting a Nexus Approach to the management of water, soil, and waste;
- provide scientific evidence for – and quantification of – benefits from applying a Nexus Approach to management of water, soil, and waste resources, including the identification of required data, information, and indicators;
- identify knowledge gaps and priorities for research, education, and policy advice related to the integrated management of water, soil, and waste;
- identify needed individual and institutional capacities and appropriate strategies for implementation of a Nexus Approach, including creating incentives and removing barriers to unlock the potential of a green economy.

To see full-length videos of plenary sessions, watch the **Dresden Nexus Conference playlist** on UNU-FLORES YouTube channel.

DNC2017 Presentations have been compiled and made available online at dresden-nexus-conference.org/2017/publications/presentations.

PROGRAMME AT A GLANCE

In order to make the programme of DNC2017 attractive for a diverse range of participants, two different main themes – Multifunctional Land-use Systems and Resources Management in Resilient Cities – were discussed across two days. On both Day 1 and Day 2, participants had the opportunity to attend a keynote speech and several sessions on both themes. Two panel discussions were held during the conference, one addressing each theme. Please note that this report, different from the conference programme, is structured according to themes and does not reflect the chronological sequence of the conference.

Day 1 | Wednesday, 17 May 2017

9:00–10:30 **Plenary**	**OPENING CEREMONY** – with high-level representatives of SMWK and BMZ **Keynote Speeches (Q & A Session)** – Jerome Delli Priscoli | Nicola Fohrer
10:30–11:00	**COFFEE BREAK**
11:00–12:30 **Parallel Sessions**	**A.1** (Main Auditorium) | **B.1** (Small Auditorium) | **B.2** (Lecture Hall) | **X.1** (Seminar Room 9)
12:30–14:00	**LUNCH**
14:00–15:30 **Parallel Sessions**	**A.3** (Main Auditorium) | **A.2** (Small Auditorium) | **B.5** (Lecture Hall) | **X.2** (Seminar Room 9)
15:30–16:30	**POSTER SESSION AND COFFEE BREAK** (Mezzanine Floor Gallery and Meeting Area)
16:30–18:00 **Plenary**	**PANEL DISCUSSION** | on Case Studies implementing the Nexus Approach in Resilient Cities
18:30–20:30	**WELCOME RECEPTION** (Dresden City Hall, Ballroom)

Day 2 | Thursday, 18 May 2017

9:00 – 10:00 **Plenary**	**KEYNOTE SPEECHES (Q & A Session)** – Eugenie Birch | Luca Montanarella
10:00 – 10:30	**COFFEE BREAK**
10:30 – 12:00 **Parallel Sessions**	**A.5** (Main Auditorium) | **A.4** (Small Auditorium) | **X.3** (Lecture Hall) | **B.4** (Seminar Room 9)
12:00 – 13:30	**LUNCH**
13:30 – 15:00 **Parallel Sessions**	**A.6** (Main Auditorium) | **X.4** (Small Auditorium) | **B.6** (Lecture Hall) | **B.3** (Seminar Room 9)
15:00 – 16:00	**POSTER SESSION AND COFFEE BREAK** (Mezzanine Floor Gallery and Meeting Area)
16:00 – 17:30 **Plenary**	**PANEL DISCUSSION** | on Case Studies implementing the Nexus Approach with Multifunctional Land-Use Sytems
18:30	**GAMING SESSION** | Water-Energy Nexus Game (Martha-Fraenkel Hall)

Day 3 | Friday, 19 May 2017

9:00 – 10:00 **Plenary**	**KEYNOTE SPEECHES (Q & A Session)** – Stefan Uhlenbrook | Stefan Bringezu
10:00 – 11:00	**WORLD CAFÉ** (Main Auditorium)
11:00 – 11:30	**COFFEE BREAK**
11:30 – 13:00 **Plenary**	**CONFERENCE WRAP-UP** – János Bogárdi | H.E. Ambassador Csaba Korösi | Birguy Lamizana-Diallo | Kwang Kook Park **CLOSING REMARKS** – Jakob Rhyner | Hans Georg Krauthäuser | Bernhard Müller
14:00	**EXCURSIONS**

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WELCOMING REMARKS

Remarks in the Opening Ceremony

Uwe Gaul, State Secretary, Saxon State Ministry for Higher Education, Research and the Arts

His Excellency Körösi, Ambassador of Hungary,

Professor Rhyner, Mr. Maennel,
Professor Ardakanian,

Ladies and gentlemen,

I am pleased to be able to open the 2017 Dresden Nexus Conference today. Dr Stange, State Minister, would have very much liked to do this herself. She values the work that UNU-FLORES does, and views the 2030 Agenda for Sustainable Development as one of the key international agreements that will require time, patience, and commitment to implement — but for which all this will be worth it. Consequently, she regrets even more that scheduling issues mean that she is unable to attend in person. However, she has asked me to pass on her very best wishes, and to say that she hopes you gather a lot of new insights, make a lot of new contacts, and have a pleasant stay in the city of Dresden.

A few days ago I read a headline that stated: "The fossil empire strikes back". It made me aware once again that nobody can rest on their laurels – and it also made me rather sad, too. However, it does fit with the developments that we are currently witnessing, across various locations and in connection with very different people. The root of this lies in the fact that globalisation is viewed as something which is threatening and uncontrollable. People with a weakness for simple solutions, whether actual or hypothetical, know immediately what should be done: just get rid of globalisation, shut the door, leave globalisation out in the cold, ignore it, and carry on as before. If only life, and the world, were so simple.

So, let's not indulge in any illusions, and instead let's look for real solutions to ensure that our world is somewhere where our children, and our children's children, can live. Let's think about the future, and make it a reality! The 2017 Dresden Nexus Conference has an important contribution to make to this.

In itself, the 2030 Agenda for Sustainable Development is a very impressive paper, featuring five key messages and 17 strategic sustainability goals. The key messages relate to people, the planet, prosperity, peace, and partnership. The strategic sustainability goals are organised accordingly. However, the actual key message – and, by extension, the manifested insight offered by the 2030 Agenda – is much broader in scope. It is the insight that an economic model that is

purely focused on growth cannot ensure a golden future for us. This chance will only arise from the use of a model based on sustainability and equality. I know that lots of people, including those of you here in this hall, have recognised this too. And that is why you are working to pave the way for this kind of model, step by step.

The sustainability goals mentioned before are, of course, highly diverse. Some bear their message in their titles, such as, for example, Goal 1: No Poverty, or Goal 2: Zero Hunger, while others are clearly more abstract, such as Goal 9: Innovation and Infrastructure or Goal 15: Life on Land. However, they all have numerous facets which are, in turn, the focus of a broad range of international activities, campaigns, and projects. Nevertheless, what they have in common is that the greatest successes can be achieved when they are approached together and collaboratively. An interdisciplinary approach is often needed to recognise interdependencies and take them into account, for one thing. For another, this is also necessary for developing fresh or additional approaches to solutions.

UNU-FLORES itself focuses on the Nexus Approach to promoting the sustainable management of water, soil, and waste. In doing so, this Nexus Approach takes into account the complex interplay between the various global resources, and aims to increase efficiency in the usage of water, soil, and waste. This holistic approach has to be reflected in research, and also in the development of individual and institutional capacities. It also needs to function across sectors and disciplines.

In the few years since its establishment, UNU-FLORES has succeeded in establishing itself as the major name in the field of promoting the sustainable management of water, soil, and waste. Meanwhile, UNU-FLORES has spread its commitment to its activities and projects around the globe.

The Dresden Nexus Conference sees UNU-FLORES work in collaboration with the Technische Universität Dresden and the Leibniz Institute of Ecological Urban and Regional Development to play an important role in pushing forward this Nexus Approach. This year, the topics of *Multifunctional Land-Use Systems* and *Resource Management in Ecologically Stable Cities (Resilient Cities)* are at the forefront. With regard to the 2030 Agenda, five of the 17 sustainability goals are primarily at the centre of our attention.

I would be happy if, at the end of this three-day conference, all the participants could travel home having gained new insights, helpful ideas, new contacts, and even more energy and enthusiasm for their important tasks. To this end, I hope you enjoy the interesting lectures, stimulating discussions, and enriching trips to neighbouring areas. You will realise that the vast majority of the population of Saxony supports cosmopolitanism, tolerance, and the absolute equality of minorities and people from any background. We are ready to take responsibility: not just on a regional level, but across our borders. I am happy that most of our citizens view internationalisation as an opportunity, and are making use of it. This is because we all stand to benefit when our knowledge and actions lead to innovations and development that help ensure prosperity, peace, and the long-term sustainability of the materials necessary for life.

Thank you for listening.

Detlef Klein, Senior-Advisor of the Water-Energy-Food Nexus Unit at GIZ, German Federal Ministry for Economic Cooperation and Development

Federal Ministry for Economic Cooperation and Development

On behalf of Tania Rödiger-Vorwerk, Deputy Director General, German Federal Ministry for Economic Cooperation and Development (BMZ)

Dear Mr Gaul, Mr Maennel, Mr Priscoli, and Professor Fohrer,

Dear participants and colleagues,

Thank you for the opportunity to welcome you on behalf of the Federal Ministry of Economic Cooperation and Development to the 2017 Dresden Nexus Conference. Unfortunately, Mrs Rödiger-Vorwerk could not be here herself today due to some developments that needed her immediate attention. It is now my honour to address and welcome you here on her behalf.

Germany has actively promoted the Water-Energy-Food Nexus approach since the Bonn2011 Nexus Conference, which was hosted under the patronage of Chancellor Merkel. That conference was an important milestone in bringing the nexus perspective to the international development and science agenda. Since then, Germany has brought the Water-Energy-Food-Security Nexus forward based on three pillars (1) Knowledge management and cooperation, (2) Regional dialogues, and (3) Nexus mainstreaming.

First, knowledge management and cooperation. With the 2011 Nexus Conference, the German Government established the Nexus Resource Platform, an online platform that provides information on research and development projects, conferences, workshops, and articles relating to nexus activities worldwide. With this platform, we hope to support discussion, knowledge exchange, and research in the nexus community. I am also happy that the launch of the Nexus Observatory will take place this afternoon, a result of the collaboration between German Development Cooperation and UNU-FLORES. The Nexus Observatory will further support co- working and knowledge exchange at the level of data analysis.

Since the Bonn Nexus Conference, the Nexus Approach has gained ground and is now commonly used at the international level. It has helped to show the importance of understanding interdependencies, such as those in the Sustainable Development Goals.

To move beyond the conceptual level, it is, however, necessary to improve monitoring and implementation of nexus approaches, which will be the subject of discussions in the next days. Improving monitoring processes requires usage of new data sources and modification of existing ones. For instance, combining household survey data with data from regulators, suppliers, and agricultural producers could lead to a more comprehensive data base. Germany is supporting various initiatives that work towards establishing a common monitoring methodology that allows us to evaluate our progress towards achieving the Sustainable Development Goals.

Second, regional dialogues. In 2014 BMZ initiated the Regional Nexus Dialogues that intend to strengthen political processes in the MENA region and Latin America. The European Commission has also joined the initiative and scaled up efforts in West Africa and Central Asia.

By bridging the traditional divisions between sectors and stakeholders, we aim to meet increasing demands for water, energy, and food. German Development Cooperation strongly supports the increased recognition of linkages among sectors at policy, programme, and project levels.

Connecting different sectors is also key to the 2030 Agenda for Sustainable Development. Many parts of the world, including Europe, have scarce water and land resources and must simultaneously deal with the challenge of limiting their greenhouse gas emissions. Cooperative resource management that takes the nexus perspective into account is becoming increasingly important.

Third, nexus mainstreaming. The nexus concept has come a long way since Bonn and is becoming increasingly mainstreamed in various programmes of different sectors. For example, the nexus is anchored in the new BMZ water sector strategy which has a stand-alone Nexus annex. I would like to use the next few minutes to outline a few examples of our work across the globe with nexus relevance.

For example, in Mongolia we are implementing an energy efficiency project as part of the 'Urban Nexus in Asian Cities' Programme. By implementing waste to energy infrastructure and promoting the use of renewable energies in the waste and wastewater departments, 30% of carbon emissions can be saved. By looking at resource management through intra- or even inter-municipal nexus task forces, we sustainably address the pressures that are put on growing cities.

Through capacity development measures and staff directly supporting different city departments, we aim to achieve more than just writing another study or just running another workshop, and aim to increase integrated urban planning. This Mongolian example is only a small part of our approach to implementing the Nexus Approach in our urban development programmes.

We also brought Germany's experiences with the Urban Nexus into the Habitat III process on Housing and Sustainable Urban Development. I'm happy to say that the nexus perspective is now anchored as a guiding principle for cross-sectorial solutions in the New Urban Agenda, which was adopted at the Habitat III conference in Quito last year.

Another example is the work of the International Water Stewardship Programme in Zambia. Through improved collaboration with the agricultural and environmental sector, we have reached about 78,000 people. These people profit from improved ecosystem services, as we effectively put protection measures for the local water source in place. This also allowed the local bottling plant to remain in operation, thereby saving hundreds of jobs. Analysing challenges and solutions in a holistic, cross-sectoral manner and not in thematic silos allows us to walk off the beaten path and develop new, innovative solutions and partnerships.

With this in mind, I am delighted to welcome you to the 2017 Dresden Nexus Conference, in the hope that the next three days will be full of stimulating discussions and solutions on how we can collaborate to tackle future challenges.

I wish you every success in your discussions and thank you for your attention.

Remarks at the Welcome Reception

Detlef Sittel, Deputy Mayor, City of Dresden

Dear Prof. Ardakanian, Dear Prof. Feger,
Dear Prof. Müller,

Presidents, Directors, and Rectors,

Dear participants of the conference,
Ladies and gentlemen,

It is my great pleasure to welcome you to Dresden – and to the city hall – on behalf of our mayor Dirk Hilbert.

Some of you were no doubt also here for the first Dresden Nexus Conference in March 2015. The conclusion reached by that meeting was that the integrated management of natural resources such as water, soil, and waste – the so-called Nexus Approach – is decisive for attainment of the Sustainable Development Goals. At this conference, you are now discussing the concrete strategies which are necessary for sustainable development. What is the City of Dresden doing to support this?

Let's take Goal 7 of the Agenda 2030, for example, "Access to affordable, reliable, sustainable and modern energy for all." Without energy, there can be no development. This poses a great challenge for the global community: Worldwide energy consumption must be reduced, and we must make more intensive use of renewable energy sources.

Our wastewater utility company – Stadtentwässerung Dresden – has been working very actively on this question for many years. For example, a turbine was installed in the discharge from our wastewater treatment plant to the River Elbe, and makes use of the six-metre height difference for power generation. Solar panels on the roof over the rain overflow also produce electricity. As a result, the wastewater treatment plant will soon be operating without additional energy inputs. Other factors which make this possible are energy-saving measures and the co-processing of bio-waste in the sludge treatment section.

If you are interested in further information, I can recommend Friday's excursion, which will take you to the wastewater utility company. One goal which is very important for cities is Goal 11: "To make cities and human settlements inclusive, safe, resilient and sustainable." To this end, we applied to join the "City of the Future" project of the Federal Ministry of Education and Research – and we were also successful. The aim is to develop an integrated and sustainable "Vision 2030+" for Dresden. This is then to be implemented in real labs, in other words, designated areas of the public space, where it can be tested in practice.

And let's not forget Goal 13, which calls for "action to combat climate change and its impacts." Climate protection is a cross-sectional task which involves many areas of public activity. Climate protection can only be realised if all the different actors, with their different possibilities for action and influence, work together. Dresden has thus adopted an "Integrated Energy and Climate Protection Concept Dresden 2030". This shows where there is potential, and which measures are necessary for ecological and socially compatible development. The climate protection concept is being implemented under the motto "Energy for climate – Dresden is switching." The target is not only to reduce greenhouse gases, but also to limit the costs for energy consumers. In this way, the city is meeting a promise it gave in 1994 as a member of the Climate Alliance, and is making a contribution to climate protection at global level.

Ladies and gentlemen,

The Agenda 2030, with its 17 goals, is an ambitious commitment, but at the same time also an urgently necessary one for us all. The core of the agenda, the catalogue of 17 Sustainable Development Goals, has for the first time addressed all three dimensions of sustainability – social, environmental, and economic.

Such ideas are not completely new, however. Over 100 years ago, for example, the Englishman Ebenezer Howard decided to do something to overcome the poor living and working conditions in big cities. He devised a model for planned urban development: The "garden city". The first garden city in Germany was developed in Dresden in 1909: Today's city district of Hellerau is one of the most important witnesses to the international "garden city movement". The idea of a social community was here paired with the ideal of living in a natural setting.

A residential community with both small homes and larger houses, as well as shops, a school, and a festival hall, was built in the immediate neighbourhood of the "Dresdner Werkstätten" furniture workshops. The working conditions there were good. There were many windows, for example, so that the craftsmen could work in natural light.

One highly modern aspect, which is still sustainable and efficient by today's standards, was the use of wood waste: Sawdust and small pieces of wood were extracted via pipes under the centre courtyard, into a bunker on the opposite side. When necessary, this waste was fed to the central power plant under the clock tower, and used to produce heating for the workshops and electricity for the whole of Hellerau.

Hellerau has continued such ideas through to today – with a solar installation on the roof of the historical workshop building. The special thing about this is that it is a community power generating project: Citizens whose homes do not have a suitable roof for solar panels can here lease a section of roof to operate a solar system of their own. The installation produces enough electricity to supply 10 households.

If you are staying in Dresden for a little longer, I can recommend a visit to the garden city Hellerau. You can even support sustainable local transport by taking tram line number 8! On this note, I wish you an inspiring evening with interesting discussions, and a successful conference.

Thank you.


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MULTIFUNCTIONAL LAND-USE SYSTEMS

KEYNOTE SPEECHES

"Multifunctional Landscapes: Assessing the Interconnectedness of Water, Food, and Biodiversity"

Nicola Fohrer
Director, Institute for Natural Resource Conservation, Christian-Albrechts-Universität zu Kiel

Typically, landscapes are clearly multifunctional, providing various types of services affecting virtually every aspect of life. Within these landscapes, water resources in particular are under pressure, being affected by multiple stressors and all dimensions of global change. And, of course, water within landscapes is closely interrelated with food and biodiversity. To understand and ultimately manage these relations and the interaction of key drivers, landscape processes and feedback mechanisms, an integrated and interdisciplinary modelling approach is required.

Some examples may illustrate these interactions and provide some indication how to address the outlined challenges. First, land-use change induced by energy demand and its impact on water resources has been studied using the case of the Three Gorges Dam in China. The building of this huge reservoir was a response to increased energy demands, but also addressed flood prevention and navigation. The resulting land-use changes, due to resettlement of lost agricultural land and urban areas, potentially could increase erosion and landslides in the catchment, which would imply a high risk of eutrophication in the reservoir. The occuring land-use changes were studied using a combined approach: field-mapping of landscape changes based on geo-tagged fotos, farmer interviews asking about agricultural practises, and analysis of land-use maps obtained from satellite images. The results of these studies show that cropland was partly converted to forest and orange orchards, showing a move from home self-subsistance to market fruits. As a result, the sediment yield was, contrary to expectations, cleary reduced.

In a second example the linkage of land use, water, and biodiversity was assessed in the Changjiang River, China. Here, we asked what happens if we also consider biodiversity in the analysis of the previous case study? Regarding water, besides hydrology also hydrobiological data were added to the analysis.

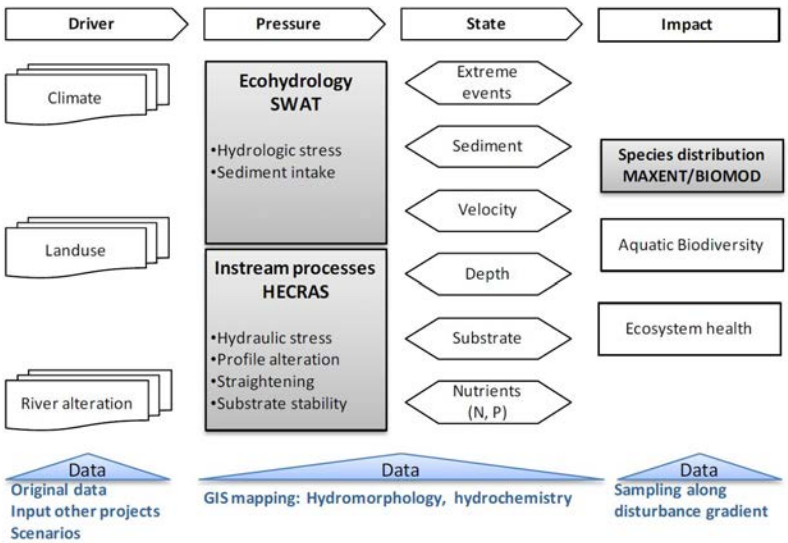

Figure A.1: Considering aquatic habitat properties in integrated river basin management - an ecohydrological modelling approach. Kiesel et al. 2010.

This integrated approach enabled a joined hydrobiological and hydrological assessment (Fig. A.1). The assessment demonstrated how the spatio-temporal variations in hydraulic variables shape the distribution of key species (macroinvertebrates) in this river system.

A third example dealt with water-related ecosystem services in the northern Siberian Lowlands. The main question posed here was, what would happen to ecosystem services (provisioning, regulating, cultural) if projected temperature increase affects snow melt, the key hydrological driver in this area. The interdisciplinary methodological framework resulted in an indicator-based assessment of several ecosystem services. It revealed that water flow regulation is the key service in this landscape, because water flow is the dominating factor for agriculture.

In conclusion, with regard to the interconnectedness of water, food, and biodiversity the impact of land-use change/climate change on water balance components is relatively well understood, despite data scarcity or non-stationarity. Progress has been made in linking hydrology and hydraulics to model aquatic biodiversity as a function of global change. It has also been made in depicting spatially and temporally distributed ecosystem services. However, more research is still required when it comes to considering multiple landscape functions/services for multi-goal optimization (e.g., agricultural yield, water quantity & quality, biodiversity, income) as a stakeholder driven process.

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"The Importance of Sustainable Soil Management within Multifunctional Land-Use Systems for Achieving the SDGs"

Luca Montanarella

Action Leader, European Commission – Joint Research Centre, Institute for Environment and Sustainability

Sustainable Soil Management (SSM) is rapidly emerging as the way forward for protecting the limited soil resources of our planet. The recently approved Voluntary Guidelines for Sustainable Soil Management (VGSSM) by the FAO Council provide the necessary guidance and support practices that can help national authorities to move towards a more sustainable approach to the available soil resources. A strong endorsement of the central role of soils has also been received by the recently approved Sustainable Development Goals (SDGs) that include specific reference to the important role of soils for achieving food security (Goal 2), healthy living conditions (Goal 3), and a land degradation neutral world (Goal 15) by 2030.

Given the current rates of soil degradation, there will be the need for a rapid implementation of the VGSSM if we want to realistically achieve these goals by 2030. Of crucial importance for the success or failure in achieving the SDGs will be the implementation of an effective indicator system allowing for measuring in an objective way. The development of a Global Soil Information System within the Global Soil Partnership (GSP) will allow assessing the status and trends of global soil resources and effectively reporting with special regards to implementation rates of sustainable soil management practices. Equally important will be the mobilisation of resources for the necessary capacity building and training efforts in less developed countries, especially in Africa.

Among scientists there is a distinction between soil and land. Soil is what is in the vertical dimension of the land. In the soil there is an ecosystem living under the so-called land. The living ecosystem of soil justifies why we need to consider the multifunctional view of European soils (ecosystem function). The seven functions are: (1) biomass production (including in agriculture and forestry); (2) storing, filtering, and transforming nutrients, substances, and water; (3) biodiversity pool, such as habitats, species, and genes; (4) physical and cultural environment for humans and human activities; (5) source of raw materials; (6) acting as carbon pool; (7) archive of geological and archaeological heritage.

According to the Food and Agriculture Organization of the United Nations (FAO), at the global level, soil provides for approximatively 95% of food. But what is the state of soil in terms of quality?

Target 2.4 of SDG2 uses as indicator (2.4.1) the proportion of agricultural area under productive and sustainable agriculture. To produce food you need soil but the available fertile soil for food production is between 13 and 18% of earth lands. That is the reason why we wanted to find indicators of soil quality. The quality of food you produce is important; so there is a good connection between soil contamination and food quality. The European Commission - Joint Research Centre (JRC) developed the Agri-environmental indicator for soil quality, providing a way to look at soil quality in Europe.

Addressing Target 3.9 (By 2030, *substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination)*, JRC published a science report for environmental policy on soil contamination. Moreover, collaboration with China gave rise to the Sino-EU Panel on Land and Soil (SEPLS). SEPLS is a scientific body with a goal to provide decision makers in Europe and China with a clear scientific view on the current state of land and soil resources and potential environmental and socioeconomic consequences of their future utilisation patterns and the threat to soil resources base of food security in China and Europe.

There is a trilemma in land-use policies, that of: ecological security, urban development, and food security (Fig. A.2). JRC also published "Threats to the soil resource base of food security in China and Europe" where it explains the risks related to the unsustainable use of soil.

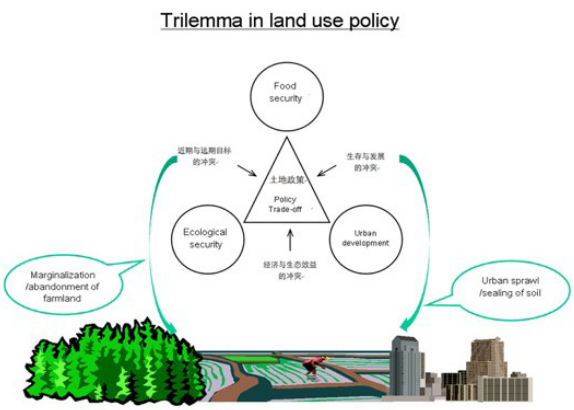

Figure A.2: "Threats to the Soil Resource Base of Food Security." Toth and Li 2013

A framework for monitoring and reporting on SDG target 15.3 bases the target on the proportion of degraded land. This proportion differs from country to country. But how do we measure land degradation? There is a huge debate on how to connect land degradation and restoration assessment to the other SDGs. So far no agreements have been made on a common index.

Land degradation and restoration is a cross-cutting theme across various policy areas. If we want to make progress, we need to act on the ground. Voluntary frameworks that are not legally binding are good tools to achieve sustainable soil management (SSM), which is to be achieved by 2030!

SSM is associated with the following characteristics: minimal rates of soil erosion by water and wind; soil structure is not degraded (e.g., soil compaction) and provides a stable physical context for movement of air, water, and heat, as well as root growth; sufficient surface cover (e.g., from growing plants, plant residues, etc.) is present to protect the soil; store of soil organic matter is stable or increasing and ideally close to the optimal level for the local environment; availability and flows of nutrients are appropriate to maintain or improve soil fertility and productivity, and to reduce their losses to the environment; soil salinisation, sodification, and alkalinisation are minimal; water (e.g., from precipitation and supplementary water sources such as irrigation) is efficiently infiltrated and stored to meet the requirements of plants and ensure the drainage of any excess; contaminants are below toxic levels, i.e. those which would cause harm to plants, animals, humans, and the environment; soil biodiversity provides a full range of biological functions; soil management systems for producing food, feed, fuel, timber, and fibre rely on optimised and safe use of inputs; and soil sealing is minimised through responsible land-use planning.

Guidelines for SSM exists and are to: minimise soil erosion; enhance soil organic matter content; foster soil nutrient balance and cycles; prevent, minimise, and mitigate soil salinisation; prevent and minimise soil contamination; prevent and minimise soil acidification; preserve and enhance soil biodiversity; minimise soil sealing; prevent and mitigate soil compaction; improve soil water management.

Soil is a cross-cutting theme between food security, climate change, desertification, and biodiversity. Global soil partnership (GSP) is one loop linking the different institutions connected to nexus solutions. Indeed FAO sees GSP as the facilitators for the establishment of such a partnership, which will serve not only FAO's needs, particularly in relation to food security, but also the needs of other Conventions and international agreements. One of the key roles of the GSP will be to develop synergies between the various multilateral environmental agreements while maintaining the focus on food security. Assuring enough food production while mitigating and adapting to climate change will be the main focus of the GSP.

At the same time the GSP will closely collaborate with the Convention on Biological Diversity (CBD) and UN Convention to Combat Desertification (UNCCD) assuring that soil biodiversity and fragile ecosystems in dry lands are preserved for future generations. Acting as well as a science and technology platform for soil research it will closely link with the main scientific advisory bodies of the three Rio conventions, like International Panel on Climate Change (IPCC), Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), and the Committee on Science and Technology (CST) of UNCCD. The proposed establishment of the Intergovernmental Panel on Land and Soil aims exactly to fill the existing gap in policy-relevant scientific advice for issues related to land and soils within the various Conventions.

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PARALLEL SESSIONS

A.1 Wastewater Reuse in Nexus Perspective: Environmental, Economic, and Societal Opportunities

Conveners: Birguy Lamizana (UNEP), Ines Dombrowsky (DIE), and Tamara Avellan (United Nations University (UNU-FLORES)), Stefan Ulhenbrook (WWAP UNESCO), Florian Thevenon (Waterlex), Janis Von Koerber (University of Applied Sciences Magdeburg), Oliver Maass (Leibniz Institute for Agricultural Engineering and Bioeconomy), Matti Hanisch (BORDA Germany)

In the context of water scarcity, galloping urbanisation, and population growth, the use of non-conventional water has become a must. The reuse of wastewater in multifunctional land-use systems may improve soil productivity, enhance food and non-food value chains, and generate income. This should be an interesting option particularly in urban to peri-urban transition zones where wastewater infrastructure is lacking or poorly developed, while agricultural land use is playing a role (mainly for smallholder farmers). In this approach the wastewater is treated in a target-oriented manner to be used for irrigation and nutrient supply of the respective land use, considering health and environmental aspects.

The World Water Development Report *Wastewater, the Untapped Resource* presented by Stefan Uhlenbrook provided direction and guidance of how this can be done by highlighting the critical role of wastewater management for vibrant economies, employment, and the maintenance of healthy environments. As water availability decreases, wastewater represents an alternative yet reliable source of water, particularly in a circular economy. Wastewater use can generate business opportunities and enhance food and water security, thus alleviating poverty. However, to increase treatment and use of wastewater, investments in infrastructure and appropriate technologies are needed. Ensuring the development of human and institutional capacity is also essential. Stakeholders need to be aware that financing, operating, and maintaining infrastructures for wastewater treatment provide long-term social, economic, and environmental benefits that may outweigh costs. Raising awareness on the benefits of wastewater treatment and use is the first step of a change in attitude towards wastewater. Yet, legislation and regulation may help enterprises, institutions, and individuals to see wastewater as a resource.

Examples of wastewater legislation from six countries (Argentina, Austria, Finland, Jordan, Singapore, and South Africa) and contrasting scenarios were provided by Florian Thevenon. These examples pointed out the need to take into account the human rights standards (the right to water and sanitation, the right to housing, the right to food, and the right to a healthy environment) that governments must respect, protect and fulfil; but also the cross-linkages with a range of other issues, such as the water, energy, and food nexus in promoting good practices in wastewater treatment and reuse. These sectors have to be taken into consideration in order to produce a comprehensive, efficient, and sustainable wastewater management legal framework, through an integrated and holistic approach. Further, the examples also highlighted that when good policies, laws, and regulations are in place their implementation makes a great difference in sustainable wastewater management.

An economic perspective on wastewater reuse was provided by Janis von Körber, reporting on development of industrial settlements with reuse of water in Iran. The Eco-Industrial Parks (EIP) concept is based on efficient resource sharing to reduce waste and to optimise water use, supported by cooperation. One of the EIPs to be developed in Central Iran is located in Isfahan, in the catchment of Zayandeh Rud, and part of the Integrated Water Management project "IWRM in Isfahan". In the project a methodology was developed for the quantification of industrial water use based on a nexus-oriented approach. The scenarios considered a high inter-industrial water reuse without additional water supply for the connected water fluxes.

An example of wastewater reuse in Germany, presented by Oliver Maaß, also focused on economic benefits. Reusing wastewater in agriculture may help and could reduce costs and lead to increased added value particularly in arid and nutrient-poor areas. Benefits were assessed by comparing the costs of wastewater irrigation and sludge application with conventional disposal options, as well as comparing the costs of irrigation and fertilisation with treated wastewater to groundwater irrigation and mineral fertilisation. The added value was calculated by ascertaining the remunerations received by the stakeholders in the various value chains. The results indicate that the reuse of wastewater and sludge results in: (a) the development of linked regional value chains; (b) lower costs of wastewater treatment and sludge disposal; (c) higher profitability and added value in crop production; and (d) a high share (77%) of regional added value. However, the results also show that the reuse of wastewater and sludge within linked value chains can restrict actors and lead to crowding out effects on the added value.

The presentation by Tamara Avellan highlighted how constructed wetlands can be a tool for the Nexus Approach. Using wetlands to treat wastewater addresses at least three major elements in sustainability: water and sanitation, energy, and greenhouse gas (GHG) emissions. Sustainable use of resources is a key element in achieving the Sustainable Development Goals (SDGs). Of the 17 SDGs, at least two are relevant to the integrated use of constructed wetlands: SDG 6 (*Ensure access to water and sanitation for all)* and SDG 7 *(Affordable and clean energy*).

The final speaker, Matti Hanisch, elaborated on how to effectively and safely recover the nutrients present in human waste/wastewater while simultaneously mitigating the risks through locally available solutions. Agriculture in India is facing deep crisis due to deficient rainfall and increasing cost of inputs. Use of wastewater and human waste in agriculture has become an inevitable option for farmers to sustain in farming. Best practice examples were associated with crop planning, appropriate irrigation methods, and other safety measures for farmers and consumers. Evidence was provided on how future scaling-up of nutrient recovery from waste/wastewater can improve soil health with economic benefits and positive environmental externalities.

Besides directly contributing to food and energy security, presentations in this session showed that (i) a target-oriented reuse of wastewater can contribute to sustaining soil fertility and soil-related ecosystem services; (ii) using wastewater in this way provides opportunities to enhance the value chain of wastewater-derived products (food crops, energy crops, energy from wastewater, etc.). Finally, (iii) it was demonstrated that reusing wastewater addresses major issues of the Sustainable Development Goals (SDGs), particularly SDG 1, 2, 6, 7, 13, and 15. An enabling environment (e.g., laws and legal frameworks, and technology) is needed for wastewater reuse in the Nexus Approach.

Taking these issues into consideration, the following take-home messages resulted from the sessions:

- Wastewater is a critical resource in a circular economy.
- Wastewater management is of high complexity and its implementation requires institutional stakeholders, lawyers, but also transboundary collaboration when needed.
- Wastewater recycling in industries leads to higher resource efficiency and increased economic benefits.
- Wastewater reuse within linked value chains leads to increased added value but changes in the distribution of added value and restrictions for farmers should be taken into account.
- Constructed wetlands are critical for pre-treatment of wastewater especially in developing economies.
- Regulatory measures have to be implemented to increase the acceptance of the safe use of wastewater and make farmers implement the safe use of treated wastewater.

Oral Presentations:

Wastewater As a Resource in a Circular Economy
Stefan Uhlenbrook (UNESCO WWAP, Italy); Engin Koncagul (UNESCO WWAP, Italy); Angela Renata Cordeiro Ortigara (UNESCO WWAP, Italy); Richard Connor (UNESCO WWAP, Italy)

The Importance of Laws and Legal Frameworks to Provide Norms and Guidelines in Support of Effective and Sustainable Wastewater Management
Florian Thevenon (WaterLex, Switzerland); Rose Osinde Alabaster (WaterLex, Switzerland); Viktoria Mohos Naray (WaterLex, Switzerland); Lenka Kruckova (WaterLex, Switzerland)

Nexus-Oriented Approach for Sharing Water Resources: Development of Eco-industrial Parks in the Catchment of Zayandeh Rud River, Iran
Janis Von Koerber (University of Applied Sciences Magdeburg, Germany); Wolf Raber (inter 3 - Institute for Resource Management, Germany)

Added-Value from the Nexus of Wastewater Treatment, Crop Production, and the Generation of Bioenergy: A Case Study on Using Wastewater and Sludge in Crop Production in Braunschweig (Germany)
Oliver Maaß (Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB), Germany); Philipp Grundmann (Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB), Germany)

Constructed Wetlands in the Water-Energy-Waste Nexus
Tamara Avellán (United Nations University (UNU-FLORES), Germany); Paul Gremillion (Northern Arizona University, United States); Fabio Masi (IRIDRA, Italy)

Sustainable and Safe Use of Wastewater and Human Waste in Food Production in Peri-Urban Areas of Karnataka, India
Girija Ramakrishna (Consortium for DEWATS Dissemination (CDD Society), India); Matti Hanisch (BORDA, Germany)

Poster Presentations:

A.1.1 Wastewater Reuse Potential in Africa
Martina Flörke (University of Kassel, Germany); Joseph Alcamo (University of Kassel, Germany)

A.1.2 DEWATS Effluent Reuse in South Africa: Technical, Agricultural, and Social Reception
Bjoern Pietruschka (University of KwaZulu-Natal, South Africa); William Musazura (University of KwaZulu-Natal, South Africa); Andrew Okem (University of KwaZulu-Natal, South Africa); Alfred Odindoity (University of KwaZulu-Natal, South Africa); Christopher Buckley (University of KwaZulu-Natal, South Africa)

A.1.3 Using Duckweed for Nutrient Recovery and As a Polishing Step for DEWATS Effluents
Bjoern Pietruschka (University of KwaZulu-Natal, South Africa); Shola Oyawoye (University of KwaZulu-Natal, South Africa); Jesse Scolavino (California state Polytechnic University Pomona, United States); Monica Palomo (California state Polytechnic University Pomona, United States); Natalie Mladenov (San Diego State University, United States); Alfred Odindoity (University of KwaZulu-Natal, South Africa); Christopher Buckley (University of KwaZulu-Natal, South Africa)

A.1.5 Economic Valuation of Wastewater Reuse in Agriculture in Nairobi
Avinandan Taron (Tata Institute of Social Sciences, (TISS), India); Solomie Gebrezgabher (International Water Management Institute, Ghana); Sena Amewu (International Water Management Institute, Ghana)

A.1.6 The Need for Sustainable Sludge Management and Enhanced Policies in Latin America and the Caribbean
Serena Caucci (United Nations University (UNU-FLORES), Germany); Tamara Avellan (United Nations University (UNU-FLORES), Germany); Rosa Maria Miglio Toledo De Rodriguez (Universidad nacional agraria la molina UNALM, Peru); Nicolas Rezzano Tizze (Universidad de la República, Uruguay); Hiroshan Hettiarachchi (United Nations University (UNU-FLORES), Germany)

A.1.7 Use of Treated Wastewater in Aquifer Recharge: The Long-Term Impact on Crop and Soil Health
Serena Caucci (United Nations University (UNU-FLORES), Germany); Tamara Avellan (United Nations University (UNU-FLORES), Germany); Olfa Majoub (National Research Institute for Rural Engineering, Water, and Forestry, Tunisia); Julie Lions(Bureau de Recherches Geologique Minieres, France); Andreas Antoniou(International Groundwater Resources Assessment Center (IGRAC), Netherlands); Hiroshan Hettiarachchi (United Nations University (UNU-FLORES), Germany)

A.2 Resource Recovery and Reuse in Multifunctional Land-Use Systems

Conveners: Manzoor Qadir (United Nations University (UNU-INWEH)), Katharina Felgenhauer (IWMI), Sarantuyaa Zandaryaa (UNESCO)

With increasing research-based evidence, a range of once apparently considered wastes have been found to be valuable resources with multiple uses and benefits including provision of ecosystem services. While considering multifunctional land-use systems, this session addressed resource recovery and reuse from the liquid waste streams and solid wastes. While sharing details of the functional examples of resource recovery and reuse in multifunctional land-use systems, the session presentations addressed two key questions: What are major roadblocks in resource recovery from certain so-called wastes for use in multifunctional land-use systems? What catalysts can fast-track the paradigm shift towards resource recovery and reuse rather than continuing disposal or poorly managed applications leading to environmental and health implications?

In his setting-the-scene presentation, Manzoor Qadir used the waste hierarchy concept for wastes and resources for planned resource recovery and reuse. Katharina Felgenhauer addressed the potential role of applied research in achieving waste-based resource recovery and reuse at landscape level. This presentation addressed key constraints to such resource recovery as technical (limited access to suitable low-cost technologies), commercial (constrained value chains, business models, and financing mechanisms), and institutional (insufficient capacity for cross-sectoral collaboration). These constraints can be overcome through refining technologies through drying, enrichment, co-composting, and palletisation of excreta-based fertilisers; enabling commercialisation through market assessment, business planning, and operationalisation; supporting institutions through involving donors, investment and financial institutions, relevant public and private sector, and end-users; and creating opportunities through transfer and adaptation of technologies, development of value chains and marketing, and capacity development for public-private collaboration. The presentation from Sarantuyaa Zandaryaa addressed key elements of best policy and technology practices related to water reuse and resource recovery. While addressing the challenge of paradigm shift from 'disposal' to 'reuse and resource recovery', this presentation emphasised the needed shift from informal, unplanned uses of untreated or partially treated wastewater to planned, safe, and fit-for-purpose use of wastewater along with functional examples, such as direct potable water reuse in Windhoek, Namibia; phosphorus recovery from wastewater for commercial opportunities; energy recovery from wastewater in Japan; and heat recovery from waste streams in Switzerland.

Bastian Piltz addressed nutrient recovery from human urine in decentralised sanitation systems. The presentation emphasised on using stately measures in managing wastewater and recommended suitability analysis of fertilisers produced and establishment of demonstration pilot-scale sites. Matti Hanisch addressed the operational opportunities of increasing food production through sanitation interventions and reuse of treated waste in agriculture. The associated challenges were scale issues, limited quality control measures, and institutional limitations with low interest in sustaining interventions. Muhammad Saqib presented the case of producing food, forage, and energy salt-affected environments through using salt-tolerant plant species and developing food and feed processing systems, and harnessing renewable energy from halophytes.

Based on the functional examples presented and follow-up discussions with the presenters and audience, the findings of this session are important for a range of ecosystems, particularly dry areas of the world where freshwater scarcity, water quality deterioration, and land degradation may compromise the achievement of sustainable development goals, specifically SDG 2 addressing sustainable agriculture and food security; SDG 6 ensuring water and sanitation for all; SDG 12 promoting sustainable production and consumption; SDG 13 on combating climate change; SDG 14 on conserving and sustainably using the oceans, seas, and marine resources; and SDG 15 on reversing land degradation. Eradicating extreme poverty and meeting the SDGs without adequately addressing such underperforming land and water resources is highly unlikely.

On the journey to sustainable development, there is a need to use innovative approaches in transforming wastes into resources to harness economic, social, societal, health, and environmental benefits. Therefore, to justify disposing any material, the four options – *prevention, minimisation, reuse, and recycling* – must be reviewed first and shown to be technically impractical or disproportionately expensive before disposal is considered as an option in waste management.

Oral Presentations:

Potential of Resource Recovery and Reuse in Multifunctional Land-Use Systems
Manzoor Qadir (United Nations University (UNU-INWEH), Canada)

The Need for Applied Research in Achieving Waste-Based Resource Recovery and Reuse at Landscape Level
Katharina Felgenhauer (International Water Management Institute (IWMI), Ghana); Josiane Nikiema (International Water Management Institute (IWMI), Ghana); Pay Drechsel (International Water Management Institute (IWMI), Sri Lanka); Olufunke Cofie (International Water Management Institute (IWMI), Ghana)

Water Reuse and Resource Recovery: Best Policy and Technology Practices
Sarantuya Zandaryaa (UNESCO Division of Water Sciences, France)

Nutrient Recovery from Human Urine in Decentralised Sanitation
Bastian Piltz (University of Cologne, Germany); Michael Melkonian (University of Cologne, Germany)

Sustainable Sanitation Systems: Increasing Food Production Through Sanitation Interventions and Reuse of Treated Waste in Agriculture
Tanvi Sahni (Consortium for DEWATS Dissemination (CDD Society), India);
Matti Hanisch (BORDA, Germany)

Plants4Salt: Food, Forage, and Energy Production from Salt-Affected Soils Using Halophytes
Muhammad Saqib (Justus-Liebig-Universität Gießen, Germany)

Poster Presentations:

A.2.1 Global Warming Reduction by Use of Multifunctional Sanitation System in Kibera, Kenya
James Raude (Jomo Kenyatta University of Agriculture and Technology, Kenya); Gerryshom Munala (Jomo Kenyatta University of Agriculture and Technology, Kenya)

A.2.2 Nutrient Recovery for Use in Agriculture: Economic Valuation of Decentralized Compost Business Model in Nairobi
Solomie Gebrezgabher (International Water Management Institute (IWMI), Ghana); Avinandan Taron (Tata Institute of Social Sciences, (TISS), India); Sena Amewu (International Water Management Institute (IWMI), Ghana)

A.2.3 Material Flow Analysis of Biomass and Waste Flows in Smallholder Farming Systems in the Kagera-Region, Tanzania
Anika Reetsch (United Nations University (UNU-FLORES), TU Dresden, Germany); Karl-Heinz Feger (TU Dresden, Germany); Kai Schwärzel (United Nations University (UNU-FLORES), Germany); Christina Dornack (TU Dresden, Germany); Gerald Kapp (TU Dresden, Germany); Ariane Krause (TU Berlin, Germany)

A.2.5 Effect of Building Material Substitutes in Multifunctional Land-Use Systems in India
Regine Ortlepp (Leibniz Institute of Ecological Urban and Regional Development, Germany)

A.3 Roles of Multifunctional Reservoirs in the SDG Agenda

Conveners: Danka Thalmeinerova (Global Water Partnership), Angela Klauschen (Global Water Partnership), Richard Taylor (International Hydropower Association), Dipak Gyawali (Nepal Water Conservation Foundation), Tanor Meissa Dieng (African Network for Basin Organizations)

Addressing water scarcity through the lens of climate change brings up the need for more water storage. Water reservoirs are celebrated as a clean and renewable source of energy and an appropriate solution for increased food production. These aspects are strongly echoed in the SDG agenda and it is anticipated that governments will plan for more development of reservoirs, especially in the areas of a high water storage potential yet to be exploited. The session aimed to explore new pathways for optimising services provided by multifunctional reservoirs that are scrutinised against key impacts. These include ecosystem degradation, social conflicts regarding resettlement of people, and optimal trade-offs between competing water uses. Finally, the transboundary aspects often add more turbulence to the conflict. Five case studies from Nepal, Eastern Africa, Brazil, Sardinia, and Poland provided a snapshot of diverse hydrological conditions under which multifunctional reservoirs are managed and operated or under planning, putting particular emphasis on governance.

The session started with a general perspective on multipurpose reservoirs provided by Dipak Gyavali. He argued that while it is recognised that dams have high social and environmental impacts, transboundary and national discourse on water resources development has not been constructively addressed. Siloed agencies have failed to adopt the nexus and to design reservoirs as genuine multipurpose enterprises. Indeed, these reservoirs especially in the global south including South Asia provide multiple benefits of flood control, irrigation, water supply, navigation, fisheries, tourism, and hydropower. But most agencies have pushed for single irrigation or hydropower projects, ignoring and undervaluing further benefits or only recognising them as add-ons. This allowed some

beneficiaries to be free-riders and others to bear the full costs. More unfortunately, projects that should have gotten political support have self-inflicted political opposition upon themselves. The nexus sees interdisciplinarity as the key to a robust multi-stakeholder approved water governance. Allocation (win-lose) could be replaced with profitable trade-offs (win-win). It would argue against a multidisciplinary committee approach, but a broader constructive engagement of different social solidarities – between hydro developers, hydro critics, and hydro managers.

An example of different governance arrangements for hydropower projects (HPP) in Africa was provided by Ines Dombrovsky. In order to finance regional projects, development banks have encouraged public-private partnerships (PPP). This raises the question which governance arrangements ensure that regional HPP are financially viable and at the same time environmentally and socially sustainable. The study finds that in the case of the existing Ruzizi II HPP, a public project company owned by the three governments involved was not able to recover costs and a cross-default situation occurred. Furthermore, irregularities took place in compensating project-affected population. In order to avoid these problems and to raise required funds, Ruzizi III envisions a PPP. However, making the project viable for the private sector under politically risky conditions proves challenging, not least in terms of tariffs, and provisions for addressing negative environmental effects are subject to private sector uptake. In the case of Rusumo Falls, the plant will be publicly owned and privately operated. This arrangement provides for lower tariffs and less complex negotiations and greater country control over dealing with social and environmental effects, but may be more prone to political interference.

The examples from Africa demonstrate that hydropower is often the driver for multipurpose reservoirs, which was further elaborated on by Maria Ubierna Aparicio. She emphasised that hydropower can contribute to the needs of the modern world by generating renewable electricity, providing energy storage to match supply with demand, supporting the greater role of other renewables through firming capacity, and system quality by the control of frequency and voltage in the power system. Multipurpose reservoirs can also provide for activities such as navigation, fisheries, recreation, and (most recently) other forms of renewable energy generation. The stored water can regulate flows for downstream uses, such as: water supply, irrigation, flood control environmental management, and pollution control. None of these benefits will be realised unless projects are built in the right place and in the right way. Stakeholder involvement is essential early in the planning and preparation stages, and management plans need to be cross-examined prior to decision-making. Tools exist for measuring sustainability performance of the planning, preparation, implementation, and operation stages, preparation, implementation, and operation stages.

The two next presentations provided specific examples and challenges of reservoir management and water allocation: Clecio Barbosa Souza Júnior, reported on a case from Brazil, where the multifunctionality of water is guaranteed by law. The São Francisco River features three large reservoirs — built 30 to 50 years ago under the premise of regulating flows for hydropower and controlling floods. However, the law stipulates the multiple uses paradigm in a participatory and decentralised way. So far, only few rules are laid down. Studying the newly introduced watershed committee's functioning revealed that established institutions still need to update their routines to the new paradigm, not leaving this task to the committee alone, which deliberates but not finally decides. A hydro-economic model attempted an economics-driven allocation. An eco-hydrologic model run different flow regimes under climate change scenarios and suggested that integrating water and wind power is one means to reconcile water and energy demands while also accounting for ecological flow. This calls for a multi-criteria approach, currently started, which opens the arena for different stakeholders in order to make demands and reasoning of users and the environment more transparent.

A study presented by Janez Susnik aimed at assessing the resilience and vulnerability of Sardinian reservoirs under climate projections, and investigates potential conflicts among key economic sectors for water resources from multipurpose dams. Long-term water availability in the largest Sardinian dams was estimated for current and future climates using a reservoir water balance accounting for demand from multiple sectors (agriculture, tourism, domestic use). Projections of water budgets were simulated under two Representative Concentration Pathways (RCP) scenarios. Irrigation requirements of economically relevant crops and possible changes in irrigated areas and policies were assessed by modelling tools. Results show that reservoir vulnerability increases by increasing evapotranspiration processes, erratic water availability and increased demand, leading to diminishing water levels for some reservoirs. Identified sustainable strategies focus on integrated management of reservoir systems and optimal allocation amongst water user sectors.

In the final presentation Mikolaj Piniewski widened the scope beyond reservoirs and demonstrated that natural small water retention measures (NSWRM) could provide alternative water storage and can have significant positive effects on solving environmental problems such as hydrological extremes, nutrient transport, and decreased biodiversity. Within the framework of the River Basin Management Plans first a valorisation method should be developed for identifying locations in a river basin where NSWRM are needed, based on multi-criteria analysis. Second, new methods and tools should be developed for river basin authorities to evaluate the cumulative effectiveness of the system of NSWRMs at river basin scale. In the third step, we should provide decision makers with policy options and cost analysis for implementation of NSWRMs. Tools need to be developed, which will prove (or not) that with the certain scale of retention measures in the landscape we can get the benefit for better water resources in the river basin.

Key messages are:

- The Nexus Approach can be achieved either by charisma of enlightened leadership or because of disasters; while nexus thinking is very natural at the farmer's level, administration and organisational governance is characterised by silo decisions.
- Technological questions on dam designs dominate over the social and economic impacts; the Nexus Approach should not be limited to technical innovative solutions and sectors' trade-offs. This approach might mask a bigger debate around resource inequality and access.
- Natural water retention measures should be seen as part of river basin management plans and should be considered by planners in all related sectors: water, energy, food production, and ecosystem protection.

Oral Presentations:

Can Multipurpose Reservoirs Change the Water Discourse?
Dipak Gyawali (Nepal Water Conservation Foundation, Nepal)

Governance Arrangements for Regional Hydropower on Shared Rivers: The African Ruzizi Cascade and Rusumo Falls Projects
Ines Dombrowsky (German Development Institute (DIE), Germany)

The Role of Hydropower As a Driver for Multipurpose Reservoirs
Richard Taylor (International Hydropower Association, United Kingdom); María Ubierna Aparicio (International Hydropower Association, United Kingdom)

Towards a Fair and Just Distribution of Water in a Semiarid Reservoir Region
Marianna Siegmund-Schultze (Berlin Institute of Technology (TUB), Germany); Johann Köppel (Berlin Institute of Technology (TUB), Germany); Hagen Koch (Potsdam Institute for Climate Impact Research (PIK), Germany); Márcia M. G. Alcoforado de Morais (Universidade Federal de Pernambuco (UFPE), Brazil); Verena Rodorff (Berlin Institute of Technology (TUB), Germany); Clécio Barbosa Souza Júnior (Berlin Institute of Technology (TUB), Germany)

Water-Food-Energy Nexus and Climate Change for Multipurpose Reservoirs in Sardinia
Sara Masia (University of Sassari, Italy); Janez Susnik (UNESCO-IHE, Netherlands); Simone Mereu (CMCC Foundation, Italy); Donatella Spano (University of Sassari, Italy); Serena Marras (University of Sassari, Italy); Antonio Trabucco(CMCC Foundation, Italy); Maria Blanco (Universidad Politécnica de Madrid, Spain); Andrea Virdis (Sardinian Regional Water Authority (ENAS), Italy)

Can We Use Natural Small Water Retention Measures As a Tool to Optimize Services Provided By Water Systems?
Tomasz Okruszko (Warsaw University of Life Sciences, Poland); Anja Potokar (Limnos. Ltd., Slovenia); Ignacy Kardel (Warsaw University of Life Sciences, Poland); Janos Feher (Global Water Partnership Central and Eastern Europe, Hungary); Richard Muller (Global Water Partnership Central and Eastern Europe, Slovakia); Sabina Bokal (Global Water Partnership Central and Eastern Europe, Slovenia); Tomas Orfanus (Institute of Hydrology, Slovak Academy of Sciences, Slovakia); Mikolaj Piniewski (Warsaw University of Life Sciences, Poland)

Poster Presentations:

A.3.1 Optimal management of multi-purpose multi-reservoir systems under global change conditions
Niels Schütze (TU Dresden, Germany); Ruben Müller (Büro für Angewandte Hydrologie, Germany); Henok Yirgu Gebretsadik (Water Works Design and Supervision Enterprise, Ethiopia)

A.3.3 Generating Multifunctional Historical Data for Improved Management of Reservoirs
Joseph Sang (Jomo Kenyatta University of Agriculture and Technology, Kenya); Caroline Maina (Egerton University, Kenya)

A.3.4 The Negative Effect of Cyanobacteria on the Multiple Functions of Water Reservoirs
Kristin Zoschke (TU Dresden, Germany); Hilmar Börnick (TU Dresden, Germany); Eckhard Worch (TU Dresden, Germany)

A.4 Water and Soil-Related Ecosystem Services Provided by Forests and Agroforestry Systems

Conveners: Aster Gebrekirstos (World Agroforestry Centre), Yanhui Wang (International Union of Forest Research Organizations (IUFRO)), Karl-Heinz Feger (Technische Universität Dresden), Kai Schwärzel (United Nations University (UNU-FLORES))

This session was aimed at providing a platform for presenting and discussing multifunctional landscape analysis approaches by introducing the decision analysis methods in the context of nexus thinking and considering SDG targets in land-use planning with a focus on the management of forest and agroforestry ecosystems. The presented results were expected to support the development of decision making in the face of multiple risks and uncertainties.

Xiaoping Zhang presented "Response of Runoff and Sediment Yields to Land-Use/Cover Change on the Loess Plateau, China". After giving the background on severe soil erosion and soil conservation projects, the reduction of sediment and annual water yield in some representative watersheds was illustrated, and then explained with the understanding of eco-hydrological processes based on plot-scale studies. Finally, she concluded that natural vegetation is generally better than artificial ones for controlling soil erosion with low water cost.

Lulu Zhang questioned if the long-term strategy to increase forests and build terraces and check-dams is adequate to ensure both soil- and water-related ecosystem services. The impact of water yield reduction was separated among individual measures. She concluded that the single-function focused land policy (e.g., afforestation for erosion control) creates imbalanced soil- and water-related ecosystem services in dryland areas, and it is necessary to shift towards more transdisciplinary management for balancing different service demands.

The ecosystem services of water retention, water purification, carbon sequestration, food product supply (grain, vegetables, livestock), and per person GDP as an indicator of human wellbeing in the Miyun Research watershed in Beijing were presented by Xiaoyan Wang. Based on model results some possible management modes were suggested.

Hosea Mwangi reported on the "Impact of Agroforestry on Hydrological Ecosystem Services in the Transboundary Mara River Basin, East Africa". After listing the negative hydrological consequences of deforestation in Kenya, the SWAT model was used to simulate the hydrological impact of agroforestry. It was found that both the surface flow, peak flow, and annual flow were reduced in proportion to agroforestry size and tree cover. Then he suggested that agroforestry should be implemented on upstream headwater sub-watershed.

This session highlighted the necessity of multifunctional land-use/landscape management for solving the competition of some services supplied by forest/agroforestry ecosystems. While the principles of a Nexus Approach for managing soil-water-related services could clearly be deduced from the presented studies, more detailed techniques and investigations are required for a comprehensive assessment and evaluation of adopting such an approach in agroforestry systems. This session was successful in promoting nexus thinking and future studies and practices of multifunctional management of forest and agroforestry ecosystems with the consideration of SDG targets.

Oral Presentations:

A Case Study of Responses of Runoff and Sediment Yields to Different Land Covers on Slope Plots of the Loess Plateau, China
Xiaoping Zhang (Institute of Soil and Water Conservation, Northwest Agricultural and Forestry University, China)

Harmonising Ecosystem Services in Dryland By Multifunctional Land Use
Lulu Zhang (United Nations University (UNU-FLORES), Germany);
Kai Schwärzel (UNU-FLORES, Germany)

Ecosystem Services and Residents Well-being in the Miyun Reservoir, Beijing, China
Xiaoyan Wang (Capital Normal University, China); Shujiang Pang (Capital Normal University, China); Juying Fu (Capital Normal University, China); Fangyuan Li (Capital Normal University, China)

Impact of Agroforestry on Hydrological Ecosystem Services in the Transboundary Mara River Basin, East Africa
Hosea Mwangi (Jomo Kenyatta University of Agriculture and Technology, Kenya); Stefan Julich (TU Dresden, Germany); Sopan Patil (Bangor University, United Kingdom); Morag McDonald (Bangor University, United Kingdom); Karl-Heinz Feger (TU Dresden, Germany)

Poster Presentations:

A.4.1 Study on Carbon Exchange Characteristics of Larix gmelinii Forest in China
Bing Wang (Inner Mongolia Agricultural University, China); Xiaomei Li (Inner Mongolia Agricultural University, China); Qiuliang Zhang (Inner Mongolia Agricultural University, China)

A.4.2 Anthropogenic Development of Soils in Drained and Farmed River Valleys
Beata Labaz (Wroclaw University of Environmental and Life Sciences, Institute of Soil Sciences and Environmental Protection, Poland); Cezary Kabala (Wroclaw University of Environmental and Life Sciences, Institute of Soil Sciences and Environmental Protection, Poland)

A.4.3 The Surface Cover and Soil Hydrological Characteristics of Three Alpine Shrubs in Eastern Qilian Mountains
Zhao Jinmei (Gansu Agriculture University, China); Ma Rui (Gansu Agriculture University, China)

A.4.4 Rural Resources (including Forestry) in the Local Development of Low Carbon Economy: A Case Study of Poland
Paweł Wisniewski (University of Gdańsk, Poland)

A.4.5 Coupled Spatial Patterns of Vegetation Leaf Area Dynamics and Drought Variability in a Multifunctional Land-Use Watershed, Northwestern China
Cen Pan (Nanjing University of Information Science & Technology, China); Lu Hao (Nanjing University of Information Science & Technology, China)

A.4.6 Water-Use Patterns of Contrasting Perennial Tree Communities in the Rocky Mountainous Semiarid Ecosystems in North China
Jia Guodong (Beijing Forestry University, China); Xinxiao Yu (Beijing Forestry University, China)

A.4.7 The Contribution of Climate Variability and Land-Use and Land-Cover Changes on Water Flow Dynamics in the Taita Hills, Kenya

Rose Adhiambo Akombo (Kenyatta University, Kenya); Stefan Julich (TU Dresden, Institute of Soil Science and Site Ecology, Germany); Karl-Heinz Feger (TU Dresden, Germany); Joseph Sang (Jomo Kenyatta University of Agriculture and Technology, Kenya)

A.4.8 Characteristics of Throughfall Under Berberis diaphana Shrub

Ma Rui (Gansu Agriculture University, China); Zhao Jinmei (Gansu Agriculture University, China)

A.5 Tools, Data, and Instruments for Management of Environmental Resources

Conveners: Rabi Mohtar (Texas A&M University), Stephan Hülsmann (United Nations University (UNU-FLORES)), Rüdiger Schaldach (CESR)

Exploring the interlinkages between resources and advancing an integrated management approach requires integrated modelling tools. For implementing such tools there is a pressing need for better disciplinary and interdisciplinary data (see session A.6). Models to simulate and forecast the pools, fluxes, and status (quality) of environmental resources exist. However, new modelling frameworks building on these models and tools are emerging, highlighting the interfaces, interactions, and fluxes between resources (e.g., soil-water), systems (e.g., pedosphere-atmosphere), and sectors (e.g., water, energy, food). The aim of this session was to (i) define data and data gaps in the resources nexus in support of integrative modelling tools, and (ii) showcase and explore models and model structures to help understand the interlinkages between environmental resources.

Following a brief introduction to the Nexus Approach and how it builds on disciplinary work to bring synergy across the sectors and stakeholders, the session started with "A Guiding Framework for Modelling the Water-Energy-Food Nexus" presented by Bassel Daher. He highlighted the need for a common nexus philosophy and common platform(s), but different tools and approaches according to the specific nexus problem addressed. Exemplified by various nexus hotspots it was shown that they all have different trade-offs and critical questions and decision makers (with specific interests, preferences, and capacity), which differ across sectors and scales. A 7-point guideline addressing these issues (system definition, scale, critical question, data, assessment, stakeholders, and communication/stakeholder involvement) should be helpful to define the most suitable modelling approach – while no simple cookbook method is available. A major challenge of nexus modelling is providing decision makers with clear, simple, yet comprehensive answers. It is important to account not only for physical resource interactions and trade-offs, but also to capture the interactions among different players and stakeholders governing those resources.

A practical example of applying a Nexus Approach to assess expected changes in water, land, and energy resources and resource use was provided by Adnan Degirmencioglu for the Gediz Basin, Turkey. The goal was to determine the water and energy trade-offs to the food production and the development of forward-looking scenarios that ensure the optimal use of these resources. The author concluded that crop pattern in the region is an effective parameter for land allocation and water demand. Changes in the crop pattern in the future may cause a shift toward more water need and/or land allocation. Results indicate that self-sufficiency and sustainability in the basin will worsen in the long term as compared to the year 2014. The reduction in land as a consequence of urbanisation and water scarcity due to climate change are inevitable but in order to keep sustainability at the same level, varieties that are resistant to drought should be selected while some new farming practices such as direct planting and employing drip irrigation systems in production should be considered seriously.

The issue of water needs for agriculture was taken up by Christopher Jung who argued that an integrated view on water and land resources is required to quantify potentials and limitations of irrigated crop production and identify trade-offs between SDGs. Doing so requires respective tools. Building on existing models, the aim of the presented study was to address the issue at a global scale by coupling the land-use model LandSHIFT and the water model WaterGAP. First results – based on global maps of irrigated areas and climate as well as socioeconomic scenarios – indicate region-specific shifts in the percentage of irrigated areas, an expansion being expected in many parts of Europe and Asia.

Moving to groundwater, Catalin Stefan presented a web-based tool and modelling framework, which allows for performing diagnostic analysis of aquifers and assessment of managed aquifer recharge (MAR) implementation potential. The tool helps plan and optimise MAR schemes and promote sustainable water management. It does help in the development of stakeholders' capacities as well as improve academic training for students and professionals, allowing various model complexities through web-based implementation of combinations of open-source tools. A socioeconomic perspective on groundwater use was provided by Felix Sebastian Riera reporting about a study in Argentina. He concluded that the General Irrigation Department is a major player in water policy and that the water organisations are clear about resource administration but are lagging in terms of quality programmes. Energy policies may improve targeting beneficiaries and slowly update to full-electricity pricing. Subsidising energy alters incentives for responsible water use to the worse. Further studies focusing on assessment of water use, management, and efficiency in agricultural production are needed to fully evaluate the environmental impacts of ground water exploitation.

The final presentation by Desirée Dörr introduced a statistical approach to analyse development pathways according to the relation between living conditions and environmental impact. The study found differences and inequalities in this relation between industrialised countries, transition countries, and developing countries. High living conditions depict higher environmental impacts and transitions towards higher living conditions observed tend to exhibit higher environmental impacts under business as usual. Further research is required to assess how climate change and fulfilment of SDGs will affect the development typologies.

Considering also the poster presentations, the session provided a comprehensive perspective on how to address the challenge of nexus modelling by using a common conceptual framework to either develop new tools or – supported by several contributions – to make use of existing tools, but upgrade, couple, and combine them as required for specific nexus hotspots.

Oral Presentations:

A Guiding Framework for Modelling the Water-Energy-Food Nexus
Bassel Daher (Texas A&M University, United States); Rabi Mohtar (Texas A&M University, United States); Sanghyun Lee (Texas A&M University, United States); Amjad Assi (Texas A&M University, United States)

Strategic Planning of Natural Resources: Water, Energy, and Food (WEF) Nexus Approach for the Gediz Basin, Turkey
Adnan Degirmencioglu (Ege University Izmir, Turkey); Rabi Mohtar (Texas A&M University, United States); Bassel Daher (Texas A&M University, United States); Gülden Özgünaltay Ertugrul Ahi Evran University, Turkey); Sanghyun Lee (Texas A&M University, United States)

Implementation of an Irrigation Submodel in the Global Land-Use Model LandSHIFT
Christopher Jung (CESR, Germany)

Web-Based Modelling Framework for Planning and Assessment of Managed Aquifer Recharge Applications
Catalin Stefan (TU Dresden, Germany); Ralf Junghanns (TU Dresden, Germany); Aybulat Fatkhutdinov (TU Dresden, Germany); Jana Ringleb (TU Dresden, Germany); Jana Sallwey (TU Dresden, Germany)

Political Economy of Energy Subsidies for Groundwater Irrigation in Mendoza, Argentina
Felix Sebastian Riera (Georg-August-Universität Göttingen, Germany); Bernhard Brümmer (Georg-August-Universität Göttingen, Germany)

Global Development Typologies and Pathways: How Far Are We from Sustainable Development?
Desirée Dörr (Potsdam Institute for Climate Impact Research (PIK), Germany); Prajal Pradhan (Potsdam Institute for Climate Impact Research (PIK), Germany); Carsten Walther (Potsdam Institute for Climate Impact Research (PIK), Germany); Jürgen Kropp (Potsdam Institute for Climate Impact Research (PIK), Germany)

Poster Presentations:

A.5.1 Nexus Tools Platform: Facilitating the Selection of Suitable Nexus Tools
Stephan Hülsmann (United Nations University (UNU-FLORES), Germany); Theresa Mannschatz (United Nations University (UNU-FLORES), Germany)

A.5.2 Numerical modeling for forecasting availability of woody biomass for energetic purposes. A regional case study in Mexico
Ulises Flores (Albert-Ludwigs-Universität Freiburg, Germany); Dirk Jäger (Albert-Ludwigs-Universität Freiburg, Germany)

3rd poster prize

A.5.3 Soil properties related to the water cycle change by land-use: How to consider it in modelling?
Parvathy Chandrasekhar (United Nations University (UNU-FLORES), Germany); Janis Kreiselmeier (United Nations University (UNU-FLORES), Germany); Andreas Schwen (BOKU Wien, Austria); Stefan Julich (TU Dresden, Germany); Karl-Heinz Feger (TU Dresden, Germany); Kai Schwärzel (United Nations University (UNU-FLORES), Germany)

A.5.4 Modelling the impact of global food trade on water, lands, and energy security using WEF Nexus Approach
Sanghyun Lee (Texas A&M University, United States); Rabi Mohtar (Texas A&M University, United States); Bassel Daher (Texas A&M University, United States); Amjad Assi (Texas A&M University, United States); Adnan Degirmencioglu (Ege University/Department of Agricultural Machinery, Turkey); Jin-yong Choi (Seoul National University, Korea, Republic of); Aiko Endo (Research institute for humanity and nature, Japan); Makoto Taniguchi (Research institute for humanity and nature, Japan)

A.5.5 The Need for Concepts of Integration and for Interdisciplinary and Interdepartmental Communication Shown by the Example of Ecological Hygiene
Lucas Dengel (EcoPro, India)

A.5.6 Management of Mineral Resource Extraction in Hoa Binh Province: A Contribution to Sustainable Development in Vietnam (MAREX)
Bernhard Müller (Leibniz-Institut für ökologische Raumentwicklung (IÖR), Germany); Paulina Schiappacasse (TU Dresden, Germany); Peter Wirth (Leibniz-Institut für ökologische Raumentwicklung (IÖR), Germany); Georg Schiller (Leibniz-Institut für ökologische Raumentwicklung (IÖR), Germany); Thinh Nguyen Xuan (TU Dortmund, Germany); Klaus Oswald (C&E Consulting and Engineering GmbH, Chemnitz, Germany)

A.5.7 Comparison of Two fAPAR Remote Sensing Methods for Estimating Gross Primary Production
Pedro Gómez-Giráldez (IFAPA, Spain); Héctor Nieto (CSIC, Spanish Council for Scientific Research, Spain); Ana Andreu (United Nations University (UNU-FLORES), Germany); Elisabet Carpintero (IFAPA, Spain); María Patrocinio González Dugo (IFAPA, Spain); Pablo Zarco-Tejada (CSIC, Spanish Council for Scientific Research, Spain)

A.5.8 Environmental Efficiency and Economic Valuation of Groundwater Use in Mendoza, Argentina
Felix Sebastian Riera (Georg-August-Universität Göttingen, Germany)

A.5.9 A Simple "Bucket Model" Calculation to Evaluate the Potential of Surface Water Retention Ponds in Improving Ecosystem Services on a Holding in Spain: A Case Study
Immo Fiebrig (Coventry University, United Kingdom); Marco Van De Wiel (Coventry University, United Kingdom)

A.5.10 Modelling Soil Moisture and Extent of Inundation for Flood Recession Agriculture
Ibrahima Niane (Société Nationale d'Aménagement et d'Exploitation des terres du Delta du Fleuve Sénégal et des vallées du Fleuve Sénégal et de la Falémé (SAED/Senegal - West Africa), Senegal)

A.5.11 Addressing Climate-Related Data Scarcity in Sub-Saharan Africa (SSA): An Integrative Approach
Solomon Hailu Gebrechorkos (United Nations University (UNU-FLORES), Germany); Stephan Hülsmann (United Nations University (UNU-FLORES), Germany); Ana Andreu (United Nations University (UNU-FLORES), Germany); Christian Bernhofer (TU Dresden, Germany)

A.5.12 Political Economy of Water-Energy Nexus in Iran: The Role of Energy Subsidy on Groundwater Pumping for Irrigation
Tinoush Jamali Jaghdani (Georg-August Universität Göttingen, Germany); Bernhard Brümmer (Georg-August Universität Göttingen, Germany)

A.5.14 Dresden Technology Portal: Your Access to Research Infrastructure and Know-How
Enrico Kluge (TU Dresden, Germany)

A.6 Monitoring and Assessment of Resource Use in Multifunctional Land-Use Systems

Conveners: Rüdiger Schaldach (University of Kassel), Cezary Kabala (Wroclaw University of Environmental and Life Sciences), Elias T. Ayuk (United Nations University (UNU-INRA))

The session had two main objectives: first, to discuss innovative scientific approaches for the effective long-term monitoring and assessment of natural resources use and environmental impacts in multifunctional land-use systems at different spatial scale levels; second to present case studies that can serve as good practice examples for the successful implementation and application of such monitoring/assessment systems.

During the session, five presentations were given. The presentation by Rebekka Hüfner addressed the first objective of the session and elaborated on how simulation models can contribute to monitoring of resource use in multifunctional land-use systems. Examples included the application for the selection of monitoring sites for water quality analysis, the calculation of ecological footprints, and last but not least, the identification of potential "hot spot" regions. The last application was illustrated by the identification of biophysically suitable regions for afforestation in the REDD+ context and potential conflicts with other land uses (e.g., food production). Here the presenter highlighted the potential of analysing trade-offs between different sustainable development goals.

The following two talks were directed at the second objective of the session; case studies from Vietnam and Cameroon were presented. The Vietnam case study focused on the monitoring of environmental impacts by the extraction of mineral resources in the Hoa Binh province. The presenter Haniyeh Ebrahimi Salari showed spatially explicit results from monitoring the effects of mining on air, soil, and water quality. For this purpose, advanced GIS-based analyses techniques were applied. It became clear that mining is an important economic factor for the region but that this benefit is contradicted by massive environmental impacts, again illustrating potential conflicts between different sustainable development goals. Additionally, it was highlighted that there is a need for a comprehensive (nexus-oriented) monitoring to provide information for the development of strategies that aim at reducing damages of natural ecosystems and humans.

The objective of the Cameroon case study, presented by Dorothe Yong Nje was to determine the benefits of soil conservation practices on hydroelectric power generation at the lake Lagdo located in the northern part of the country, using the damage function approach. The first step of the analysis was to estimate the physical effect of environmental change on soil erosion considering different land management practices. In the second step, the quantitative link between lake sedimentation and its effects on the storage capacity of the reservoir was established. Finally, the economic value of the impact was determined. The results show that the loss of direct storage capacity of the reservoir due to sedimentation increased the costs of electricity production. Measures to reduce soil erosion include payments to landowners as powerful incentives for promoting environmentally-friendly land-use practices that help to sustain ecosystem services (PES). The study illustrated very well the demand for a Nexus Approach looking at interdependencies, in this case between the agricultural and energy sectors.

The final two presentations concentrated on land-use change in Germany. Johanna Fick showed results from the CC-LandStraD project that identified management options for sustainable land use and climate mitigation. She highlighted that despite ambitious sustainability goals, areas for infrastructure and settlement are still expanding (mainly at the cost of agricultural

land). Moreover, especially agriculture contributes a significant share to national greenhouse gas emissions. Using the RAUMIS model, different land-use related mitigation options were analysed. Measures include rewetting of organic soils, enhancing the efficiency of mineral and organic fertilisers, and the retirement of land from agricultural production (afforestation, set-aside). Especially in the discussion it became clear that location-dependent combinations of measures considering regional factors are necessary.

The presentation given by Gotthard Meinel highlighted the importance of monitoring systems to track the ongoing land-use change worldwide. Relevant processes in Germany that contradict national sustainability and climate goals include loss and degradation of soil, lack of brownfield recycling, and further expansion of settlements. A new monitoring system that is based on topographic geo-data sets in combination with cadastre maps for buildings was presented. It focuses on settlements and open space to describe the sustainability of current and past land-use change in Germany. The results show that settlement and traffic are rising while agricultural areas are decreasing. The built up area are higher in Western Germany when compared to the east. However, building ground area per inhabitant is higher in the east. Further, the monitoring system can visualise soil sealing and flood risk areas. The presenter points out that a better understanding of complex land-use processes requires the combination of different analytical tools and data sources. Finally, long-term monitoring was identified as a key method to support policies and planning processes aiming at reaching the sustainable development goals.

Oral Presentations:

Assessing REDD+ and Competing Land-Use Objectives
Rebekka Hüfner (Center for Environmental Systems Research (CESR), Germany)

Monitoring of the Extraction of Mineral Resources and Its Environmental Impacts: Case Study of Hoa Binh, Vietnam
Nguyen Xuan Thinh (TU Dortmund, Germany); Haniyeh Ebrahimi Salari (TU Dortmund, Germany); Esther Bradel (TU Dortmund, Germany)

Sustainable Land Use and Climate Mitigation: Management Options and Enhanced Knowledge (Cross-Sectoral, Inter-, and Transdisciplinary Research Findings for Germany)
Johanna Fick (Thuenen Institute, Germany); Sarah Baum (Thünen Institute, Federal Research Institute for Rural Areas, Germany); Rene Dechow (Thünen Institute, Federal Research Institute for Rural Areas, Germany); Peter Kreins (Thünen Institute, Federal Research Institute for Rural Areas, Germany); Martin Henseler (Thünen Institute / EDEHN - Equipe d'Economie Le Havre Normandie, Université du Havre, Germany); Jesko Hirschfeld (Institute for Ecological Economy Research (IÖW), Germany); Julian Sagebiel (Institute for Ecological Economy Research (IÖW), Germany)

Evaluation of Environmental Services Associated with Multifunctional Land-Use Systems in the Watershed of Lake Lagdo, Cameroon
Dorothe Yong Nje (United Nations University (UNU-INRA), Ghana); Elias Ayuk (United Nations University (UNU-INRA), Ghana)

Monitoring of Land-Use Development: Methodological Problems and Solutions in Germany
Gotthard Meinel (TU Dresden, IOER, Germany)

Poster Presentations:

A.6.2 Monitoring of South African Savanna's Water Use and Water Stress Using Earth Observation Data

Ana Andreu (United Nations University (UNU-FLORES), Germany); Timothy Dube (School of Agriculture, Earth & Environmental Science, University of KwaZulu Natal, South Africa); Héctor Nieto (IAS, CSIC, Spain); Azwitamisi Eric Mudau (Earth Observation Research Group, Natural Resources and Environment, CSIR, South Africa); Radoslaw Guzinski (ESRIN D/EOP-SEP, European Space Agency, Italy); Eva Muthoni Kimonye (Pan African University Institute of Water and Energy Sciences(PAUWES), Algeria); María Patrocinio González Dugo (IFAPA, Spain); Abel Ramoelo (Earth Observation Research Group, Natural Resources and Environment, CSIR, South Africa); Stephan Hülsmann (United Nations University (UNU-FLORES), Germany)

A.6.3 Monitoring of Soil Quality and Land Management in the Surrounding of Large Copper Ore Tailings Impoundment in SW Poland

Cezary Kabala (Wroclaw University of Environmental and Life Sciences, Poland); Bernard Galka (Wroclaw University of Environmental and Life Sciences, Poland); Pawel Jezierski (Wroclaw University of Environmental and Life Sciences, Poland)

A.6.4 Vulnerability of the electricity supply sector to climate change in the River Niger Basin

Oluwabamise Lanre Afolabi (International Climate Protection Fellow with Alexander von Humboldt Stiftung, Germany); Stephan Hülsmann (United Nations University (UNU-FLORES), Germany); Tolulope Omotoso (Purdue University, United States); Rabi Mohtar (Texas A&M University, United States)

A.6.5 Characterising the Intensity and Dynamics of Land-Use Change in the Mara River Basin, East Africa

Padia Lariu (TU Dresden, Germany); Hosea M. Mwangi (TU Dresden, CAWR, Germany); Stefan Julich (TU Dresden, CAWR, Germany); Sopan Patil (Bangor University, United Kingdom); Morag McDonald (Bangor University, United Kingdom); Karl-Heinz Feger (TU Dresden, CAWR, Germany)

A.6.6 The Impact of Stakeholders' participation in the Mapping and Valuation of Ecosystem Services in the Eastern Region of Ghana

Ngozi Stewart (United Nations University (UNU-INRA), Ghana); Kwabena Asuboateng (United Nations University (UNU-INRA), Ghana)

2nd poster prize

A.6.7 Surface Water Quality Monitoring Optimization: Integrating Scientific Evidences to Legal Perspectives

Thuy Hoang Nguyen (United Nations University (UNU-FLORES), Germany); Hiroshan Hettiarachchi (United Nations University (UNU-FLORES), Germany); Björn Helm (TU Dresden, Germany); Serena Caucci (United Nations University (UNU-FLORES), Germany); Peter Krebs (TU Dresden, Germany); Christina Dornack (TU Dresden, Germany)

A.6.9 Transfer of Knowledge As a Conservation Tool: Managing Biodiversity and Traditional Farming in a Multifunctional Spanish Ecosystem (Dehesa). LIFE+bioDehesa

Antonia Belén Caño Vergara (IFAPA, Spain); Pedro Gómez-Giráldez (IFAPA, Spain); Alma María García Moreno (IFAPA, Spain); Ana Andreu (United Nations University (UNU-FLORES), Germany); María Patrocinio González Dugo (IFAPA, Spain)

A.6.11 Soil Quality Indexing: Tool for Assessing Soil Degradation of Land-Use and Soil Management Systems in Mai-Negus Catchment, Northern Ethiopia

Gebreyesus Brhane Tesfahunegn (United Nations University (UNU-INRA), Ghana)

A.6.12 Sustainable and Inclusive Decisions on Field Traffic Will Help to Enhance Knowledge on Optimizing Soil Functions

Kirstin Marx (Johann Heinrich von Thünen Institute, Germany); Johanna Fick (Johann Heinrich von Thünen Institute, Germany); Marco Lorenz (Johann Heinrich von Thünen Institute, Germany); Stefan Stiene (German Research Center for Artificial Intelligence, Germany); Sebastian Stock (German Research Center for Artificial Intelligence, Germany); Rainer Duttmann (Christian-Albrechts-Universität zu Kiel, Germany)

A.6.13 Thank you for Bee-ing There - Bee Pollination Increases Yield and Quality of Cash Crops in Burkina Faso, West Africa

Katharina Stein (University of Wuerzburg, Germany); Drissa Coulibaly (Université Nangui Abrogoua, Cote D'Ivoire); Dethardt Goetze (University of Rostock, Germany); Stefan Porembski (University of Rostock, Germany); André Lindner (Centre for International Postgraduate Studies of Environmental Management - CIPSEM, Germany); Souleymane Konaté (Université Nangui Abrogoua, Cote D'Ivoire); K. Eduard Linsenmair (University of Wuerzburg, Germany)

PANEL DISCUSSION

Moderator: Nicola Fohrer (Kiel University)
Panellists: Yanhui Wang (Chinese Academy of Forestry), Ngo Trung Hai (Vietnam Institute for Urban and Rural Planning), John Gathenya (Jomo Kenyatta University)
Commenters: Rattan Lal (Ohio State University), Ania Grobicki (Ramsar Convention)

The main goal of the panel discussions was to use case studies to provide DNC participants with a more tangible and concise understanding of the implementation of a Nexus Approach. In particular, it should take on the more theoretical discussion of the keynote speech and synthesise the more specific discussions in the parallel sessions through examples. For both main themes of DNC2017, Resources Management in Resilient Cities and Multifunctional Land-use Systems, a set of three case studies were presented, which together should provide a comprehensive example of how a Nexus Approach can be developed and (at least partly) be implemented in different regional and political contexts. Two experts representing respectively the scientific/monitoring and governance/implementation perspectives were involved in the subsequent panel discussion to widen the view and facilitate generating some general conclusions and lessons learnt.

Case study presenters were asked to provide a brief overview of the case, highlighting:

- what kind of project and measures have been put in place and
- for what purpose (addressing which problems in relation to SDGs);
- how this has been done in terms of stakeholder involvement,
- how progress is monitored (both concerning the implementation of measures as well as their success with respect to the quality, quantity, and sustainable use of resources),
- what kind of governance challenges have been faced during implementation and how they were addressed.

The main points to be discussed during the panel after the brief introduction of cases were:

- Do presented cases represent suitable examples for the application of a Nexus Approach?
- Is monitoring of resource use and matter fluxes addressed adequately?
- Do they contribute to achieving SDGs in respective countries?
- Which lessons can be learned for implementation of integrated resources management?

Case 1: China

"Multifunctional Approach to Balance the Impacts of Soil Erosion Control and Water Yield Reduction by Large Scale Afforestation in the Dry Loess Plateau Region of Northwest China"

Yanhui Wang, *Head of the Department of Forest Hydrology and Integrated Water and Soil Management at the Chinese Academy of Forestry*

Brief Description of Project/Case[2]

Dryland areas include arid, semi-arid, and semi-humid areas; they occupy about 50% of the global land surface and are often sensitive and prone to land-use changes because of the shortage of water and vegetation cover. The Loess Plateau region in Northern China is one of such regions. Centuries of overuse or improper management resulted in degenerated ecosystems, severe soil erosion and desertification, and thus poor local economy. To control erosion, various large-scale soil conservation programmes, especially afforestation, have been implemented by the central government since the 1950s. These programmes have been quite successful in terms of restoring forest/vegetation and reducing soil erosion, but reduced the water yield and aggravated the regional water scarcity. The predicted climate change, the warming, has exacerbated this situation. A more water-saving planning and management are urgently required for balancing soil erosion control and water supply security, and thus to enhance the overall services through a multifunctional land-use in the Loess Plateau region. Finding nexus solutions to ensure full use of all ecosystem services requires in-depth analysis and understanding of the water-soil nexus. The studies conducted now allow informing a decision process for improved management considering site-specific properties and factors.

Geographic Location

The study region is the Loess Plateau of northern China, with a semi-arid or semi-humid climate, sparse forest coverage, severe soil erosion, an increasing water use conflict because of the inherent water shortage, warming climate, and a fast-growing water demand.

Nexus Orientation

Despite decades of efforts, an integrated approach underlining synergy in environmental resources and socio-economy is still lacking. To increase resource use efficiency and promote the multitude of shared benefits between human and environment, the nexus, namely the interrelationships, interactions, interdependencies, and trade-offs among resources (e.g., soil and water), services (e.g., erosion control, water yield, timber production, carbon sequestration, biodiversity protection, etc.) and sectors (e.g., agriculture, forestry, and industry) have to be taken

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[2] Feng, Xiaoming, Bojie Fu, Shilong Piao, Shuai Wang, Philippe Ciais, Zhenzhong Zeng, Yihe Lu, et al. 2016. "Revegetation in China´s Loess Plateau Is Approaching Sustainable Water Resource Limits." *Nature Clim. Change* 6(11):1019–22.

Zhang, Lulu, Christian Podlasly, Karl-Heinz Feger, Yanhui Wang, and Kai Schwärzel. 2015. "Different Land Management Measures and Climate Change Impacts on the Runoff – A Simple Empirical Method Derived in a Mesoscale Catchment on the Loess Plateau." *Journal of Arid Environments* 120 (September):42–50. doi:10.1016/j.jaridenv.2015.04.005.

into consideration before a policy decision is made. An enabling policy requires merging the planning and management of different natural resources and their supplied ecosystem services in a spatiotemporal balanced range, in which both environment and society, upstream and downstream can profit, and sustainable regional development can be supported.

SDG Orientation

Several SDGs (e.g., Goals 1, 2, 6, 7, 12, 13, 14, and 15) are intrinsically linked to the planning and management for the sustainable use of natural resources, such as land, water, and biodiversity, through support of good governance. This implies that there is a need to shape more sustainable land-use systems on local, regional, and global scales to address the pressing issues for the process of sustainable development. The existing environmental resources management strategy aggravating China's problems undermine its ability to achieve the SDGs and it thus needs to adapt a more sustainable concept of development.

Stakeholder Involvement

Many different stakeholders are involved in afforestation projects (e.g., in the Grain for Green project). A more detailed grouping and interrelation understanding based on their loss/benefit can help a balanced decision and management. However, the stakeholder grouping and interrelation has been oversimplified, by dividing into government and local farmers. Government, as the active policymaker, is more interested in the ecological benefits such as erosion control, carbon sequestration, forest area increase, while farmers, as passive implementers, are more interested in the shorter-term economic benefit. Local farmers heavily take part in afforestation programmes due to their attractive compensation (payment for services) from government for their converted forestland from slope farmland. However, not enough attention was paid to the different afforestation impacts and services demand of (other) different stakeholders, for example, the competitive water users of different sectors and locations. More efficient engagement of different stakeholders is required.

Monitoring/Implementation Orientation

Different techniques were used or can be used to monitor the implementation and impacts of afforestation projects on the Loess Plateau. For example, forest area, forest growth, forest quality, forest cover, and its seasonal dynamics (e.g., canopy leaf area index) were monitored by remote sensing, field inventory system, and long-term studies. The public involvement and associated socioeconomic changes are monitored using statistical data provided by local administration. The reduced soil erosion and water yield were estimated through different approaches at different spatial scales, such as erosion and runoff plot observation, catchment sediment yield, and river discharge calculation based on gauging station observation and model simulation. So far, the impact assessments focus more on so-called benefits evaluation, such as reduced soil erosion and increased carbon sequestration, but considered less the competitive influences/trade-offs on other services at varying scales. An overall evaluation of impacts on natural resources and society is still lacking.

Governance Challenges

How are soil and water resources and the main ecosystem services influenced by the forest quality, quantity, and spatial distribution? How do the main services interact and how does their interrelation vary with site condition, spatial and temporal scales, and the services demanded by society? How to evaluate and predict competitive services? How to arrive at a balanced decision for optimal and multifunctional use of natural resources? How to design and implement ecosystem services payment for balanced management?

Case 2: Vietnam

"Management of Mineral Resource Extraction in Hoa Binh Province – A Contribution to Sustainable Development in Vietnam"

Ngo Trung Hai, *General Director of the Vietnam Institute for Urban and Rural Planning, Ministry of Construction of Vietnam (VIUP)*

Brief Description of Project/Case[3]

MAREX is a joint German-Vietnamese (BMBF) project in applied research of spatial development. The project exposes the growth of megacities and its impacts on the environment. Scientific investigations are directed towards the building industry which is dependent on local finite resources, taking into consideration mainly the activities in the field of extraction and processing of aggregates (sand, gavel, stone), but also reflecting transport, construction sector as well as potential recycling of construction and demolition waste. The metropolitan region of Hanoi (with almost 10 million inhabitants) and Hoa Binh Province serve as a comprehensive model basis for wider application within and outside of Vietnam. Negative impacts of mining activities include change of soil structure and water flow regime, pollution and loss of resources for agriculture, forestry, and biodiversity conservation. Better management is sought to be implemented via a business-policy interface. First examples of rehabilitation of post-mining areas include a lake and a golf course.

Geographic Location

Metropolitan region of Hanoi and Hoa Binh Province, Vietnam

Nexus Orientation

MAREX is connected with all components of the UNU-FLORES Nexus Approach. Firstly, the extraction of aggregates for the building industry of large cities like Hanoi/Vietnam leads to increasing land degradation in the urban hinterland, in particular the loss of fertile soil and the displacement of agriculture. Secondly, the water balance is affected by contamination and changing of the flow rates of surface and underground water, causing pressure in agriculture and water supply of the inhabitants. Thirdly, extraction, construction, and demolition waste play an important role in the project. It is hardly used in Vietnam to reduce the consumption of new raw materials. Mainly the extractive and construction industry is addressed here.

SDG Orientation

Against this background, MAREX is connected mainly with SDG 11 (*Sustainable cities and communities*), and partly also with SDG 6 (*Clean water*), 8 (*Sustainable economic growth*), 12 (*Sustainable consumption and production*), and 15 (*Sustainable land management*).

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[3] Müller, Bernhard, Pham Ngoc Ho, Peter Wirth, Georg Schiller, and Anh Minh Vu, eds. 2016. MAREX – Management of Mineral Resource Extraction in Hoa Binh Province – A Contribution to Sustainable Development in Vietnam. Dresden: Leibniz Institute of Ecological Urban and Spatial Development. http://www.marex-project.de/events/EN_MAREX-ConfDoc-IOER.pdf.

Monitoring/Implementation Orientation

The MAREX project is monitoring the development of aggregates mining and its environmental impacts with an own monitoring module. This includes environmental (e.g., land consumption by mining), social (e.g., jobs in mining sector), and economic indicators (e.g., tax revenues of the provincial government).

The main governance challenge facing MAREX is the collaboration of actors in the field of aggregates extraction, processing, and use. In Vietnam two parallel planning and management systems can be found: the private, market-driven system depending on demand and supply, and the public, state-driven system based on political goals and strategies. As such structure plays also a decisive role in the aggregates extraction and construction industry. One of the crucial aims of the project is to develop and shape a tool for connecting both systems. We call it Business-Policy Interface (BPI). It consists of a cooperative management approach using all outputs of the MAREX project. The development of the BPI brings together the private sector (producers and customers), regional planning and environment development authorities as well as civil society organisations.

Stakeholder Involvement

Stakeholder involvement is explicitly addressed in MAREX. The main stakeholder groups are:

- Political players in mining, land-use planning, and environmental planning (national level)
- Provincial administration of Hoa Binh
- Local policymakers and administrations
- Companies in construction and raw materials industry
- NGOs in environmental protection and nature conservation as well as civil society organisations
- Universities and research institutes

Case 3: Kenya

"Payment for Ecosystem Services as a Catalyst for Sustainable Land Management in Sasumua Catchment, Kenya"

John M. Gathenya, *School of Biosystems and Environmental Engineering at Jomo Kenyatta University of Agriculture and Technology*

Brief Description of Project/Case[4]

Sasumua is a humid, 107 km2 multifunctional catchment that is partly under a national park, forest reserve, intensive agriculture and water supply reservoir (16 million m3) that serves 15% of Nairobi City's water requirements. Under the KAPSLM project, a Payment for Ecosystem Services (KAPSLM-PES) pilot project was initiated in June 2015 to promote sustainable land management (SLM) practices that would lead to reduced soil erosion and reservoir sedimentation, improved water quality, higher agricultural production, and household incomes. Three private companies were contracted to provide technical advice and training to farmers who were organised into three value chains with different common interest groups (CIGs) namely: fruit and vegetables (potato, tree tomato, strawberry), dairy and meat (cow, goat, poultry), and natural resource management (agroforestry, bee-keeping, fish farming). For registered farmers, a Land Management Plan (LMP) was drawn indicating responsibilities and timelines for implementation of recommended SLM practices. The project supported farmers with some of the needed inputs. After one year, about 1,000 farmers joined the PES project under one or more CIGs. A total of 79,101 m of drainage and retention ditches, 28,662 m of grass strips, 320,278 napier/vertiver grass splits, 38,962 agroforestry trees, 274 m of riverine protection, 173 beehives, and 8 fish ponds were implemented. A study is being done to estimate the impact of this adoption of SLM practices on soil erosion (22% reduction), sedimentation, and water quality.

Geographic Location

Sasumua catchment is located in Kenya at the outlet of the Sasumua dam; it has the coordinates Latitude -0.761186° and Longitude 36.681014°.

Nexus Orientation

Sasumua KAPSLM-PES project has three components: building capacity for SLM, investment in community SLM micro-projects, and strengthening the policy and institutional enabling environment for SLM. It focuses on sustainable use of soil, land, and water resources. The project aims to reduce the loss and transport of soil, nutrients, agro-chemicals, and water from productive agricultural land. This will lead to sustainable production and higher household incomes. It aims to reduce the contamination and sedimentation in streams and in Sasumua reservoir and hence improve water quality, reduce costs of water purification, and increase economic life of the

[4] FAO. 2014. "Implementing PES within Public Watershed Structures: A Case of the Sasumua Watershed in Kenya." http://www.fao.org/publications/card/en/c/d72f4740-f192-4399-a133-abc9d53139a1/.

Nduhiu, C., J. M. Gathenya, J. K. Mwangi, M. Aman, and T. Mutisya. 2016. "Assessment of the Effectiveness of Payment for Ecosystem Services (PES) in the Delivery of Desired Ecosystem Services in Sasumua Catchment, Kenya." *Hydrol. Earth Syst. Sci. Discuss. 2016* (November):1–20. doi:10.5194/hess-2016-541.

reservoir. Farmers are being trained to sustainably raise land productivity, add value to agricultural produce, and use natural resources sustainably to generate alternative livelihoods. This includes the use of water for aqua-culture and use of trees and other vegetation for bee-keeping.

SDG Orientation

The KAPSLM Project contributes to the SDG goals number 6, 2, 7, and 12:

- SDG 6 (*Clean Water and Sanitation*): It ensures availability of water to Nairobi City and promotes sustainable management of water resources in the source catchment.
- SDG 2 (*End Hunger*): It promotes food security and improved nutrition through sustainable land management practices, improved potato and dairy production, fish farming, and bee-keeping in a landscape that is important for food production.
- SDG 7 (*Affordable and Clean Energy*): It contributes to ensuring access to affordable, reliable, sustainable, and modern energy for all by promoting agroforestry to supply energy for household energy needs.
- SDG 12 (*Responsible Consumption and Production*): It supports sustainable consumption and production patterns by providing land owners with technical skills to produce more per unit of land and to add value to their products. It also promotes the use of natural resources to provide alternative livelihoods to the local community.

Monitoring/Implementation Orientation

Several measures are built into the project to facilitate monitoring of implementation. The service providers were paid based on targets set by KAPSLM towards meeting the goals and objectives of the project. These included number of SLM practises made, number of farmers trained, and progress made towards implementation of specific SLM practices. The KAPSLM project team also carried out its own internal monitoring and evaluation. Consultants from JKUAT have been contracted to develop a watershed model-based monitoring approach to assess the impact of the project to date and to project to the end of the project based on current rate of adoption and further assumptions of full adoption of recommended SLM practices by all land owners.

Stakeholder Involvement

The KAPSLM-PES Project is a partnership between the local community (represented by the Water Resources User Association (WRUA) and Community Forestry Association (CFA)), the World Bank, the national government of Kenya (Ministry of Environment and Natural Resources (MENR)), Nyandarua County Government (Ministry of Agriculture, Livestock, and Fisheries), parastatal organisations (National Environmental Management Authority, Water Resources Management Authority, Kenya Agricultural and Livestock Research Organization, Kenya Wildlife Service, and Kenya Forest Service), and the private sector (represented by three local NGOs (Agro Encon Enterprises, Sustainable Eco Technique Solutions, and Green Global Consortium) offering technical services to smallholder farmers. Jomo Kenyatta University of Agriculture and Technology has been offering research, technical advice, capacity building, and project monitoring services. MENR is the lead and coordinating agency.

Summary of Discussion

***Rattan Lal**, Ohio State University*

While the concrete examples were obviously quite specific and relevant for a certain community, the connection to the Sustainable Development Goals (SDGs) through aspects of monitoring and implementation meant that the content is broad and comprehensive enough to engage many participants. **Rattan Lal** in his comment emphasised the role of soils in the nexus and the options to improve soil-related ecosystem functions. The China example shows that the role of soils in the water-balance equation had been neglected while planning the afforestation measures, and impacts of residue mulch and compost on water losses and soil moisture as well as the impact of trees on deep drainage need to be considered. On the Kenya case it is important to emphasise that PES is not a subsidy, but should reflect the societal value (not the economic, which is myopic) for the service. Undervaluing a resource will lead to tragedy of the commons. The rural-urban interface shown in the Vietnam case provides another example of that the reduce-reuse-recycle principle should be followed. Not only for rural systems, but also for urban systems management should strive at keeping the water in the system, e.g., by enhancing urban green space and reusing wastewater.

***Ania Grobicki**, Ramsar Convention University*

In her commentary, **Ania Grobicki** raised the need to better convey that integrated solutions exemplified in the case studies exist in a more impactful manner in order to take such a conference further. To be able to really embody how case studies can be transformed into policies and solutions, she suggested that in future conferences, for every case study, a scientist be paired with a policymaker or an actor who can actually use the research. This creates dialogue and concretely structures the science-policy interface. Since global changes and associated resource use accelerate, transfer of solutions also needs to speed up. Practising transdisciplinarity is clearly required. Ultimately, addressing the Water-Soil-Waste Nexus will also help address SDG 14 (*Conserve and sustainably use the oceans, seas and marine resources*) by addressing issues such as sediment and nutrient loads as well as plastic carried to oceans.

Reflecting on these comments, the panel elaborated on various issues related to implementation. The Kenya case showed that overcoming a science-practice gap takes some time and efforts and to get started with PES it was more difficult to engage buyers than vendors. One of the shortcomings in the Kenyan PES approach was that the varying impacts of measures (e.g., terracing, tree-planting) on ecosystem services was not taken into account in the payment. A further challenge is to upscale the pilot project and ensure its continuity. The latter point was addressed in the current case by involving further players (mainly interested in water, such as hydropower sector, breweries, etc.) in a larger scale and long-term project. In any PES project the respective tariffs and the question of who pays need to be negotiated and this also relates to the scaling issue. For speeding up knowledge transfer, all parties have to be involved: science for providing solutions/options, as well as policymakers in providing frameworks and incentives and organisations such as UN and UNU in providing platforms, guiding the dialogue, and promoting good solutions.

RESOURCES MANAGEMENT IN RESILIENT CITIES

KEYNOTE SPEECHES

"Water Investments: Fundamental Social Means for Adapting to Climate Change and Building Resilience in our Cities. From Concepts/Theory to Implementation: Messages to Water and Climate Change Communities"

Jerome Delli Priscoli
Global Water Partnership, Chair of Technical Committee

Potential mitigation measures that may help us to deal with climate change lie in water-related events and their associated social impacts. Climate change has led to an increase in calamities such as floods, droughts, and a rise in sea level. Coastal areas are prone to such events and require the infrastructure to deal with the impacts of the vagaries of climate. Ultimately, it has been established that the management of water resources is critical towards adaptation to climate change.

A basic analytical reflection to start with on this issue is that **water resources investments are at the heart of adapting to Climate Change**. Although information on climate variability and its impacts on water-related events is available, existing climate models are not proficient in capturing extreme events at regional and local scale. When looking at impacts, it is difficult to separate the effects of climate change from other contemporary issues such as urbanisation and population growth. Even more cooperation between climate and hydrologic modeller needs to be encouraged to better forecast extreme events and their impacts. In resilient cities planning and design of water-related infrastructure has to take the high and likely increasing variability in precipitation into account.

A second basic analytical reflection on the issue is that **managing variability and risk, in water resources especially, is necessary to reduce poverty**. The most vulnerable cities with regard to natural disasters are located along coasts, most of them in developing countries or emerging economies and in particular the poor within these cities are at risk, being forced to settle in the more vulnerable areas. When looking at water disaster damages as percentage of GDP in relation to the Human Development Index (HDI) there is a clear negative relation: more damage at low HDI and vice versa. This indicates that investing in disaster risk reduction measures pays off and may limit socio-economic costs of disasters. Adaptation strategies should focus on the range of risks

associated with water services. In this context, Integrated Water Resources Management (IWRM) at basin (thus often trans-boundary) scale is a necessary tool for water adaptation measures. Furthermore, managing variability and risks is necessary to reduce poverty and create wealth by building platforms for growth.

Adaptive water resources strategies will require various forms of infrastructure and storage. Though absolute safety is not possible, we need to take measures to minimise the effects of natural disasters due to climate change. Based on the causal relationship of uncertainties between extreme weather events, social impact, and economic losses, the presenter advocates for several recommendations for pre- and post-disaster management. For instance, participation from all societal levels in operational decision is required to enable all available risk reduction tools to become effective. While infrastructure investments are very important, nature-based solutions and services e.g. by estuaries and wetlands are also valuable tools to counter water-related disasters: Multiple defences are needed to counter and minimise disaster risk. Additionally, hydro-meteorological data should be made available for public access.

In conclusion, to tackle the vagaries of climate are to place investments in water resources at the heart of adaptation measures for climate change. Moreover, managing the variability and risk in water resources is needed to mitigate poverty, break the fatalistic determinisms pervading intergenerational memories, and create wealth by building platforms for growth. Ultimately, adaptation to climate change is mainly about better water management.

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"Making Cities Inclusive, Safe, Resilient and Sustainable: The Need and Hunt for the Nexus"

Eugénie L. Birch
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The importance of the Nexus Approach for primary resource management is acknowledged by researchers, practitioners, and stakeholders. In simple terms, it is agreed that the Nexus Approach makes sense. In this context, the Dresden Nexus Conference is critical and proves the importance of a Nexus Approach.

Population increase and urbanisation are some of the major issues that threaten the existence and quality of human life. Despite the fact that we have technology and money to deal with and mitigate them, we still remain with major problems to solve. The main issue to deal with is accountability. With our limited resources we need to focus on people and elements such as water, cities, and health.

Trends in settlement patterns forecast an 82% increase in population and a 185% increase in urban land cover by 2030. Though these trends come embedded with primary resource management, the Nexus Approach is difficult to implement in such a setting. The global policy sequence includes, among others, Sustainable Development Goals (SDGs) and the new urban agenda transforming our world. For instance, SDG Goal 11 deals with making cities safe, resilient, and sustainable, and has seven targets. But where is the nexus thinking? It is implicitly present in the targets. However, the indicators for the targets are quite a lot, with almost 230 indicators.

The New Urban Agenda is a focal point and provides even a roadmap for SDG implementation. It has extensive coverage of technical elements and means of implementation. The SDGs and New Urban Agenda are linked in many aspects such as food security and ecosystem services. Currently, there is an emergence of new tools for governmental stakeholder monitoring activities. These tools are helpful for researchers as well as for monitoring and implementing the SDGs. The action framework for the New Urban Agenda includes five categories, 35 essential elements, relevant indicators, and lead actors. The basic ingredients for the implementation of the New Urban Agenda include who should lead, how the targets might be measured, and how they link to the provisions of the SDGs. Furthermore, other stakeholder activities such as capacity building, reporting, and comparisons should also be monitored to ensure that we are on the same page. It should be noted that approximately 60% of the built environment section anticipated in the next decades is yet to be built. The drivers of change for land-use change are, for example, construction of highways, railways, and changes in food distribution.

In conclusion, "Nexus 2.0" should strengthen the teams, stakeholders, common problem, common goal, translation, and application. The place matters and the nexus matters. The nexus is in a pretty weak form and we have to hunt for it. It is up to the researchers, practitioners, and stakeholders to strengthen the Nexus Approach and conceptual framework and prove the capability of the nexus. The Dresden Nexus Conference is the place to be for that.

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PARALLEL SESSIONS

B.1 Adaptation of Cities to Global Change for Urban Resilience

Conveners: David Vačkář (CzechGlobe Global Change Research Institute, Czech Academy of Sciences), Fabrice Renaud (United Nations University (UNU-EHS))

The aim of the session was to explore linkages between global change, urban resilience, and resource scarcity from a nexus and SDG perspective. Expected outcomes include learning and knowledge exchange among session participants through interdisciplinary discussions on urban resilience and resource use. Urban resilience has been proposed as a framework for capability to prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to public safety and health, the economy, and security. As a response to global-change impact, many cities have begun preparing adaptation strategies to reduce vulnerabilities and strengthen urban resilience. The session explored these issues from multiple perspectives. Interlinkages between adaptation to climate change, multiple risk reduction, sustainability in different sectors (food waste, water supply), and urban resilience were addressed at the session. Challenges for integrative governance and knowledge sharing by applying a nexus perspective to adaptive governance and sustainable resource use were also a subject of the session.

The role of green infrastructure is not usually taken into account in city planning processes (Klemm). The role of "Living Labs" can bridge some of the gaps in urban resilience planning. The role of mutual learning and knowledge transfer is critical in building urban resilience and the effective response to climate change. Social learning (group learning by process participants, organisational learning by participating organisations, network and societal learning by external actors) and participation (focus groups, interviews) were common aspects contributing to building urban resilience.

The Nexus Approach was manifested by projects on water supply and food waste. The AltWater project presented by Janez Susnik is focused on enabling the assessment of alternative water supply systems to promote urban water security in the global south. The aims of the project are

closely connected to the Nexus Approach, to assess current and potential future urban water supply and demand, and to assess the potential contribution of feasible alternative water supply systems, with contributions to resilience to future change, diversification of supply, and reducing pressures. Another perspective was provided by Ola Michalec, reporting on quantification of food waste in cities. The goal of reducing food waste in cities contributes towards implementation of the Nexus Approach and reduction of carbon footprint of food waste at the urban scale, as well as towards implementation of food waste policies in an equitable way (environmental justice).

The implementation of any (new) adaptation measure requires knowledge transfer and learning. Joanne Vinke de Kruif introduced a multi-level concept for mutual learning as an effective tool in this regard. She highlighted the importance of motivation of involved stakeholders for effective knowledge transfer.

Challenges of the implementation of SDGs were presented by Sebastian Eichhorn. He presented on the development of comprehensive sustainability strategies to contribute towards the implementation of the 2030 Agenda at the local level.

Some of the issues identified in the session include:

- Involvement of existing expertise, interests, and resources of important external stakeholders, leading to higher degree of acceptance among the actors involved and influence on the results of a planning process in a long-term orientation;
- Wider policy context is much more supportive of climate adaptation in cities in some countries than in others; this affects wider uptake of lessons learned and action generated.

Building urban resilience in the context of the Nexus Approach and SDGs is still challenging and mutual learning and knowledge transfer can effectively support future progress. It is difficult to address urban resilience as a whole; partial steps and focus on different sectors and cross-sectoral linkages are required (food waste, water, green infrastructure, etc.).

Oral Presentations:

Green Infrastructure for Climate-Responsive Urban Environments: Bridging the Gap Between Research and Implementation in Design Practice
Wiebke Klemm (Wageningen University & Research Centre, Netherlands)

AltWater: Assessing the Contribution of Alternative Water Supply Systems to Improving Water Security and Resilience in Developing Countries
Janez Susnik (UNESCO-IHE, Netherlands); Francoise Bichai (UNESCO-IHE, Netherlands); Assela Pathirana (UNESCO-IHE, Netherlands); Michael Hammond (UNESCO-IHE, Netherlands); Klaas Schwartz (UNESCO-IHE, Netherlands); Carlos Cossa (Aguas da Regiao de Maputo, Mozambique); Jose Ferrete (Aguas da Regiao de Maputo, Mozambique); Wahyono Hadi (Institut Teknologi Sepuluh Nopember, Indonesia); Adhi Yuniarto (Institut Teknologi Sepuluh Nopember, Indonesia); Warma Dewanti (Institut Teknologi Sepuluh Nopember, Indonesia)

Enhancing Urban Resilience Through Citizen Participation in Water-Energy-Food Nexus: Case Study of the Bristol Region
Aleksandra Ola Michalec (University of the West of England, United Kingdom); James Longhurst (University of the West of England, United Kingdom); Enda Hayes (University of the West of England, United Kingdom)

Cities Adapting to Climate Change: The Potential of Mutual Learning and Knowledge Transfer
Joanne Vinke-de Kruijf (University of Twente, Netherlands)

Global Sustainable Municipality: Explorative Strategic Management Approach to Implement the SDGs
Sebastian Eichhorn (Landesarbeitsgemeinschaft Agenda 21 NRW e.V., Germany); Martin Schön-Chanishvili (Landesarbeitsgemeinschaft Agenda 21 NRW e.V., Germany); Moritz Hans (ILS – Research Institute for Regional and Urban Development gGmbH, Germany); Melanie Schulte (Landesarbeitsgemeinschaft Agenda 21 NRW e.V., Germany)

Poster Presentations:

B.1.1 Local Institutions' Role in Enhancing Climate Change Adaptation of Rural Farmers in Semiarid Ecosystems in Northern Ghana Using Social Network Analysis
Mawulolo Yomo (West African Science Service Center on Climate Change and Adapted Land Use (WASCAL), Algeria)

B.2 Smart Green Cities and the Water-Soil-Waste-Energy Nexus

Conveners: Bernhard Müller (IOER), Simon Joss (University of Westminster)

Smart green cities combine principles of ecological sustainability, green building technologies, and the intelligent provision of services with an appropriate, well-balanced, and far-sighted application of high-tech and nature-based solutions for the well-being of human beings, i.e., urban dwellers, the urban workforce, and visitors. This requires integrated approaches of urban planning and development. Here, the nexus between water, soil, waste, and energy is of special relevance as it is related to land use and urban expansion as well as to the provision of both technical infrastructure and ecosystem services.

On this background, the objectives of session B.2 were: (1) to highlight the relevance of smart green cities for the implementation of the Sustainable Development Goals and the New Urban Agenda, (2) to contribute to the understanding of the connection between smart green cities and the water-soil-waste-energy nexus, and (3) to demonstrate how the water-soil-waste-energy nexus can be implemented in urban planning and development. The session addressed researchers and practitioners who are involved in urban planning and development.

In the beginning of the session, the conveners gave an introduction into the broader background of the topic. They explained that during the session the following questions were supposed to be taken into consideration: (1) Which types of relations exist between smart green cities and the water-soil-waste-energy nexus? (2) How is the water-soil-waste-energy nexus reflected in urban planning and development of smart green cities? (3) Which challenges exist in implementing the water-soil-waste-energy nexus and how do cities overcome them? (4) How can smart green cities contribute to implementing the UN Sustainable Development Goals and the New Urban Agenda in the future, especially with regard to social sustainability, such as inclusiveness and the principle "to leave no one behind"?

Afterwards, three presentations were given: Robert Knippschild asked whether only prospering cities may be smart and green. He shed light on experiences from declining and stagnating Central and Eastern European cities, taking the example of Görlitz, a middle-sized German city at the border to Poland. He demonstrated that creative solutions, involving a variety of stakeholders, are seen there as a way of compensating short financial and administrative capacities which are limiting the effectiveness of smart green cities concepts and the water-soil-waste-energy nexus for cities in transformation.

Babette Never analysed the interdependency of water and energy in India's wastewater sector. She also studied existing drivers of and barriers to the diffusion of energy-efficient technologies, uncovering ways how resource- and lifecycle-oriented solutions could be enhanced.

Finally, Daphne Gondhalekar presented ideas related to operationalising the urban water-soil-waste-energy nexus for climate change adaptation taking the example of Munich, Germany. Together with her co-author, Jörg E. Drewes, she emphasised that water, energy, and food need to be conserved, especially in cities, and that urban agriculture and urban water reclamation and reuse can significantly conserve water resources and generate energy.

In summary, and as a result of the discussion, it could be concluded that the water-soil-waste-energy nexus is relevant for the implementation of the Sustainable Development Goals (SDGs) of the United Nations and the New Urban Agenda (NUA) which was agreed upon during the Habitat III world conference in Quito in October 2016, and endorsed by the United Nations General Assembly in December of the same year. The concept of smart green cities can make a valuable contribution to its implementation combining technological and nature-based solutions. However, context matters. For example, there are noticeable differences between large and medium-sized to small cities, as well as between cities that are growing and those which are stagnating or shrinking. The most decisive factor for whether the water-soil-waste-energy nexus works or not, and whether cities are able to productively link smart technologies with green, i.e. nature-based solutions, is, however, the nexus between stakeholders, or in other words: good urban governance.

Oral Presentations:

Only Prospering Cities Smart and Green? How About the Water-Soil-Energy Nexus of Stagnating and Declining Cities?
Robert Knippschild (IOER, Germany)

Wastewater Systems and Energy Saving in Urban India
Babette Never (German Development Institute (DIE), Germany)

Nexus City: Operationalising the Urban Water-Energy-Food Nexus for Climate Change Adaptation in Munich, Germany
Daphne Gondhalekar (TU München, Germany); Jörg E. Drewes (TU München, Germany)

Poster Presentations:

B.2.1 Integrated Management of Organic Wastes for Sustainable Energy and Soil Fertility: Prospects and Problems – Case of Nigeria
Idi Audu (University of Freiburg, Germany); K.B. Ajoku (RMRDC Abuja, Nigeria); Mohammed Lawal Buga (Raw Materials Research and Development Council, FCT Abuja- Nigeria, Nigeria); Maria Nwanagu. Obi (Raw Materials Research and Development Council, FCT Abuja- Nigeria, Nigeria); P.A. Onwualu (AUST Abuja, Nigeria)

B.3 Water Scarcity and Urbanisation: Integrated Management of Water Supply and Sanitation

Conveners: Roland A. Müller (Helmholtz-Zentrum für Umweltforschung – UFZ), Peter Krebs (TU Dresden)

This session, organised by the Center for Advanced Water Research (CAWR), aimed at discussing innovative solutions for integrated urban water management under water-scarce conditions. It gave participants the opportunity to share strategies, concepts, policies, and technologies contributing to integrated urban water management, and to discuss their transfer potential to other regions and situations. Ultimately, the goal was to make better use of knowledge and experience generated by scientists, policymakers, and authorities in this diverse, interdisciplinary field worldwide.

In the first presentation, Martina Flörke concentrated on urban water deficits influenced by climate change and population growth. Cities become increasingly water-stressed, especially in Asia, and rely on water transfers from the surrounding regions. The key message was that population growth and agglomeration in cities were the main drivers of urban water scarcity, and that water transfers shift the problem to the source basins. The competition with other water users in the source basins will increase, in turn exacerbating urban water supply issues. Adaptation options require maintenance and improvement of city transfers, integrated water resources management including urban, source basin, and environmental water demands, and appropriate interventions mainstreaming into other sectoral water policies (e.g., on land-use and production patterns).

The management of a highly urbanised watershed in Istanbul with a circular economy approach was presented by Burcu Yazici. The Omerli Watershed provides one-third of the drinking water for Istanbul. Illegal developments with no wastewater treatment in place have led to severe water

quality problems, and emergency action had to be taken for safeguarding drinking water supply. A circular economy approach has been adopted by authorities and water companies in order to sustainably use water and other resources. Electricity and dried sludge (as fuel additive) are produced in the wastewater treatment process; reclaimed water is used to irrigate recreational areas; and treated wastewater is discharged into the river which is used for irrigation of crops.

Janez Sušnik presented an approach to quantify the urban water-energy nexus in Mexico City; there is a strong increase in demand for water as well as energy, which are closely linked. Energy is needed for pumping, treatment, distribution, and heating of water, linking it to climate change, while water is used for extraction, processing, and cooling in energy production. Potential carbon emissions and impacts of water system savings measured were assessed. The water demand in Mexico City is very high, with water losses of up to 50%. Water-saving and loss reduction measures are suggested, for example, by pricing reforms, as well as use of alternative sources such as rainwater harvesting, leading to potential water savings up to more than 50% with significant improvements also on energy demand and CO2 emissions.

Manfred van Afferden presented the implementation of a decentralised wastewater management policy in Jordan, a very water-scarce region where most rural areas are not connected to sewers and leaking cesspits threaten groundwater resources. Wastewater treatment solutions can be realised through a connection to the central WWTP, semi-centralised, or single household level solutions. As there was no experience with decentralised wastewater treatment in Jordan and it was not implemented in policies and regulations, an implementation office was established to compile recommendations and a national framework. This framework contributes to the implementation of Goal 6 of the SDGs, sustainable rural development, and establishment of a new wastewater sector providing energy- and cost-efficient solutions.

Catalin Stefan spoke about global problems of severe groundwater depletion and mitigation options. Managed aquifer recharge (MAR) is a method for introducing water from the surface back into the subsurface. Subsurface storage has many advantages, especially in urban regions; overexploited aquifers can be restored or further depletion prevented by introducing rainwater or reclaimed water. Another application is the prevention of saltwater intrusion in coastal areas. The main future task is to bring the technology, for instance, to Africa and other hotspots that need climate change mitigation.

The quantification of drivers for urban water scarcity was debated; population growth and urbanisation were identified as the main drivers; climate change and mismanagement play a role in some cases. Management approaches should focus on reducing water demand and efficiently allocating water of different qualities. Storm water should be harvested; potential volumes are high but the storage is difficult. The impact of pricing reforms on water demand was challenged, furthermore, it was pointed out that water is a human right. In the case of Istanbul, water supply and wastewater treatment are provided by private companies, working hand in hand with municipalities. Another model for intersectoral management is a holding incorporating water, wastewater, and energy operators. A question was raised on the role of the nexus perspective in the presented projects. In all cases, the nexus of water, energy, and agricultural production, and indirectly of human health and climate change, is apparent. The interdependencies of the agricultural sector and the urban areas must be in the focus of management of resilient cities.

Oral Presentations:

Urban Water Deficit Under Climate Change and Population Growth
Martina Flörke (University of Kassel, Germany); Christof Schneider (University of Kassel, Germany); Robert McDonald (The Nature Conservancy, United States)

Managing a Watershed with a "Circular-Economy" Perspective: Istanbul, Omerli Watershed Case
Burcu Yazici (Turkish Water Institute (SUEN), Turkey); Aslihan Kerc (Turkish Water Institute (SUEN), Turkey); Meltem Delibas (Turkish Water Institute (SUEN), Turkey)

The Urban Water-Energy Nexus: Understanding and Quantifying the Water-Energy Nexus in México City
Adrian Moredia-Valek (Erasmus University Rotterdam, Netherlands); Janez Susnik (UNESCO-IHE, Netherlands); Stelios Grafakos (Erasmus University Rotterdam, Netherlands)

Implementing a Decentralized Wastewater Management Policy in Jordan
Manfred van Afferden (Helmholtz-Centre for Environmental Research GmbH – UFZ, Germany); Mi-Yong Lee (Helmholtz-Centre for Environmental Research GmbH – UFZ, Germany); Ali Mohamed Subah (Ministry of Water and Irrigation, Jordan); Roland A. Müller (Helmholtz-Centre for Environmental Research GmbH – UFZ, Germany)

Managed Aquifer Recharge As a Tool for Adaptation of Cities to Global Change
Catalin Stefan (TU Dresden, Germany)

Poster Presentations:

B.3.1 Innovative Regeneration of Iron-Based Adsorbents for Phosphorus Removal in Small Wastewater Treatment Plants
Marco Kunaschk (TU Dresden, Germany); Viktor Schmalz (TU Dresden, Germany); Thomas Dittmar (TU Dresden, Germany); Carsten Bahr (GEH Wasserchemie GmbH & Co. KG, Germany); Eckhard Worch (TU Dresden, Germany)

B.3.2 Dynamics and Areal Pattern of Rainstorms During Early Rainy Season in Ibadan, Nigeria
Adesola Adediran (University of Ibadan, Nigeria)

B.3.3 Reserve Evaluation of Duhok Groundwater Basin via GIS tool
Jalal Younis (University of Duhok, College of Spatial Planning and Applied Sciences, Iraq)

B.4 Nature-Based Solutions for Resilient and Sustainable Cities

Conveners: Martina Artmann (IOER), Wolfgang Wende (IOER), Birguy Lamizana (UNEP), Thomas Hartmann (Utrecht University), Cristian Ioja (University Bucharest), Nobuko Kawaguchi (Nagoya-University), Mitchell Pavao-Zuckerman (University of Maryland), Irene Ring (TU Dresden - IHI Zittau), Alice Schröder (Bundesamt für Naturschutz)

In the light of the worldwide ongoing urbanisation, SDG 11 highlights the need to promote sustainable and resilient cities. However, municipalities are confronted with an increasing complexity of urban development calling for an integrated management of resources and urban structures. Nature-based solutions (NBS) have the capacity to deliver systemic solutions for challenges of urbanisation such as climate change, water flow regulation, or human well-being; and with this addressing the implementation of the Nexus Approach. By being copied from, inspired or supported by nature, NBS are argued to provide multiple strategies to support policy and administrations in managing and maintaining urban ecosystem services and biodiversity. The main question of the session was: "How can urban greening strategies such as major NBSs contribute to resilience and sustainability and/or at the same time offer positive effects on water, soil, and climate?" The contributions to the session focused on: (1) synergies provided by NBS, (2) monitoring of NBS, and (3) NBS implementation reflected by international case studies. Taking these issues into account the following take-home messages resulted from the session.

Nature based solutions (NBS) provide a nexus to the SDGs in manifold ways, helping to implement the Nexus Approach in practice. Urban green infrastructure stands out for its multifunctionality and can be considered as a major NBS supporting the supply of multiple ecosystem services and thereby contributing to the SDGs in manifold ways. By connecting different types of urban green spaces and establishing a green network, green infrastructure supports biodiversity which can contribute to SDG 15 aiming to halt biodiversity loss. By reducing the maintenance of meadows not only biodiversity can be promoted but also costs for municipalities decreased. In this regard, it also needs residents contributing to landscape management like an example from Japan showed. Urban green spaces are also important to learn from and experience with nature, in particular for children, showing a close link to SDG 4 focusing on education. NBS contribute to SDG 11 itself, highlighting the need of sustainable cities to mitigate and adapt to climate change and to reduce water-related disasters. Examples from the US and the Netherlands illustrated the important contribution of green infrastructure on harvesting stormwater and reducing extreme events such as flood. In Romania the protection of green infrastructure and its contribution to climate mitigation is emphasised. These examples illustrate the nexus of NBS to the SDGs, as well as a conceptual nexus between NBS, green infrastructure, and ecosystem services.

Monitoring NBS makes benefits of green infrastructure visible and can support planners and policy in developing integrative strategies. For making the multiple benefits of NBS visible assessments of ecological, social, and economic aspects are needed. This can include analysis of water demand for different kinds of urban green spaces design options in semi-arid cities, the costs for landscape management labor accounts, access to green spaces, nature awareness by different population groups which is differing in Germany between age groups, gender and city sizes. Such information can support urban planning and policy in formulating and adapting strategies to increase benefits provided by the urban ecosystem. However, effectively implementing NBS requires clear benchmarks which are coupled to monitoring systems. The concept of NBS can also support planning and policies in developing integrated greenings strategies. An analysis of environmental action plans in Romania showed that not all NBS were

reflected comprehensively. More efforts are necessary to mainstream concepts such NBS and ecosystem services and their monitoring in planning practice. The German report "Natural Capital Germany – TEEB DE, Ecosystem Services in the City–Protecting Health and Enhancing Quality of Life" aims to showcase benefits of the ecosystem service concepts for administrations and professionals.

Implementing NBS requires a governance nexus. To reflect the integrative value of NBS and its nexus to ecological, social and economic action areas it needs horizontal and vertical cooperation among actors. For implementing NBS such as for water management the implementation of a comprehensive multi-scale land-use policy is essential. To upscale NBS land-use policy has to take into account private land and land-use conflicts arising through property rights. It needs also a close cooperation between research, administrations and policy to implement NBS in an integrative way when developing plans. Thus, the lack of NBS in environmental action plans in Romania can be explained by missing representatives of research. To reflect multiple benefits of NBS it requires cross-sectoral cooperation at the city scale, including between departments dealing with planning, health, business and nature protection. All in all, for successfully implementing NBS it should always be taken into account what is possible and what is practical so that NBS are resource-efficient, adapted to local conditions, and reflect what is feasible from political, economic, and social concerns.

Oral Presentations:

Urban Green Infrastructure: Background, Aims, and Perspectives
Alice Schröder (Bundesamt für Naturschutz, Germany)

Ecosystem Services in the City: Protecting Human Health and Increasing Quality of Life
Irene Ring (TU Dresden - IHI Zittau, Germany); Ingo Kowarik(TU Berlin, Germany); Robert Bartz (TU Berlin, Germany); Miriam Brenck (Helmholtz Centre for Environmental Research – UFZ, Germany); Bernd Hansjürgens (Helmholtz Centre for Environmental Research – UFZ, Germany); Christoph Schröter-Schlaack (Helmholtz Centre for Environmental Research – UFZ, Germany)

Integrated Management of Green Spaces in Different Land Uses for Sustainable Cities
Nobuko Kawaguchi (Nagoya University, Japan); Chika Takatori (Nagoya University, Japan); Hiroyuki Shimizu (Nagoya University, Japan)

Connectivities in Designed Ecosystem Services: An Integrated Approach to Water Sustainability in Semiarid Cities
Mitchell Pavao-Zuckerman (University of Maryland, United States); Tom Meixner (University of Arizona, United States); Andrea Gerlak (University of Arizona, United States); Adam Henry (University of Arizona, United States); Gary Pivo (University of Arizona, United States)

Water Management on Private Land: Upscaling Nature-Based Solutions
Thomas Hartmann (Utrecht University, Faculty of Geosciences, Netherlands); Lenka Slavíková (Jan Evangelista Purkyně University in Ústí nad Labem, Czech Republic); Jiřina Jílková (Jan Evangelista Purkyně University in Ústí nad Labem, Czech Republic)

Nature-Based Solutions into Environmental Action Plans: Case Study Romania
Cristian Ioja (University of Bucharest, Romania); Mihai Nita (University of Bucharest, Romania); Diana Onose (University of Bucharest, Romania); Alina Hossu (University of Bucharest, Romania)

Poster Presentations:

B.4.1 Variation in Some Soil Characteristics Among Urban Green Spaces in Kumasi, Ghana
Bertrand Nero (Center for Development Research (ZEF), University of Bonn, Germany)

B.4.2 Tree Species and Trait Diversity of Urban Green Spaces and the Climate-Water Nexus in Kumasi, Ghana
Bertrand Nero (Center for Development Research (ZEF), University of Bonn, Germany); Daniel Callo-Concha (Center for Development Research (ZEF), University of Bonn, Germany); Manfred Denich (Center for Development Research (ZEF), University of Bonn, Germany); Christian Borgemeister (Center for Development Research (ZEF), University of Bonn, Germany)

B.4.3 Green and Blue Infrastructure: An Opportunity for Resilient and Sustainable Cities?
Jan Machac (University of J. E. Purkyne in Usti nad Labem, Faculty of Social and Economic Studies, Czech Republic); Jiri Louda (Charles University in Prague, Czech Republic); Lenka Dubova (University of J. E. Purkyne in Usti nad Labem, Faculty of Social and Economic Studies, Czech Republic)

B.4.4 Incorporating Biodiversity into Urban Realities as a Basis for Nature Based Solutions in Cities
Juliane Mathey (IOER, Germany); Stefanie Rößler (IOER, Germany); Anne Seiwert (IOER, Germany)

B.4.5 Interlinkages between ecosystem services and infrastructure provisioning in the urban resilience context
Nikolai Bobylev (Saint Petersburg State University, Russian Federation)

B.4.6 Linking smart growth and green infrastructure – visions for compact and green cities
Martina Artmann (IOER, Germany); Manon Kohler (IOER, Germany)

B.4.7 Landscape System as a Sustainable and Inclusive Strategy to Urban Management and Development
Wybe Kuitert (Seoul National University, South Korea)

B.4.8 The Issue of Scalability: Nexus Benefits of Constructed Wetlands in Different Settings
Tamara Avellan (United Nations University (UNU-FLORES), Germany); Fabio Masi (IRIDRA, Italy); Paul Gremillion (Northern Arizona University, United States)

B.4.9 Using Nature-Based Solutions for Sustainable Leisure Activities in Cities
Mihai Razvan Nita (University of Bucharest, Romania); Diana Andreea Onose (University of Bucharest, Romania); Athanasios Alexandru Gavrilidis (University of Bucharest, Romania); Denisa Lavinia Badiu (University of Bucharest, Romania); Irina Nastase (University of Bucharest, Romania)

B.4.10 Multifunctional Green Infrastructure for Resilient and Sustainable Cities by Means of Integrated RS Mapping Tools
Jingxia Wang (Technical University of Munich, Germany); Ellen Banzhaf (Helmholtz-Zentrum für Umweltforschung – UFZ, Germany)

B.5 Assessing Resilience at the City Level: Methods, Frameworks, Models, and Tools

Conveners: Christos Makropoulos (KWR Watercycle Research Institute), Mark Fletcher (Arup), David Butler (University of Exeter)

Resilience is a relatively novel concept, stemming from the realisation that uncertainty in long-term planning of infrastructure and cities is so significant, that we need to better understand the way our systems behave under failure, and identify the options that would allow them to behave 'better' and recover quickly. To this end we need performance indicators, tools, and models able to quantify resilience and support decision making. The session explored some of the most promising new approaches in quantifying resilience and considered similarities, differences, and synergies between them.

Mark Fletcher set the scene by discussing the ideas of recovery versus adaptation and underlining the key message: extremes are not as rare as we like to think, and our systems are not always designed to manage the resulting risk. He then proceeded to present two complementary tools: the city resilience index and the company resilience index and explained how these two allowed for an exposition of gaps in resilience planning, and therefore a prioritisation of actions. Christos Makropoulos then presented the resilience analysis profile method, which looks at the urban water cycle, from source to tap and allows for a comparison of alternative options for water company strategic planning, giving decision makers insights into both robustness and resilience of alternative urban water system configurations, and the trade-off between these and costs. Chris Sweetapple then looked at a method able to quantify the general resilience of a water system, including 'unknown unknowns', a concept that is key to resilience thinking. His method – based on exhaustively identifying and implementing all failure modes, irrespective of what caused them – allows water service providers to systematically stress test elements of their system under the full range of probable and extreme operational and structural pressures.

The session then moved to another critical aspect of resilience planning: that of governance, with Stef Koop (KWR) presenting the CityBlueprint method and showcasing the new JRC publication: the Urban Water Atlas, which is based on the method. He then presented a framework for assessing the governance capacity of a city, and for identifying both strong and weak points that can be bridged, by city-to-city learning and knowledge exchange. The session was wrapped up by Niels-Christian Fritsche (TU Dresden) who gave an architect's perspective to the debate, setting out key principles for the blue and green cities of tomorrow. He argued that mixing uses and stakeholders offers more possibilities for resilient cities, despite being less 'pure' in architectural terms.

The lively and productive discussion identified synergies between these approaches, and also highlighted the need to prepare these tools and methods both for large megacities but also for small and medium-sized cities, with possibly less capacity but more opportunities to become really resilient.

Oral Presentations:

Delivering Resilience for Water Systems in Practice: Experiences from Arup's Global Portfolio
Mark Fletcher (Ove Arup & Partners International Ltd, United Kingdom)

The Water-Wise Resilience Assessment Method and Tools
Christos Makropoulos (KWR Watercycle Research Institute, Netherlands)

Towards a Comprehensive, General Resilience Assessment for Intervention Development in Water Distribution Systems
Chris Sweetapple (University of Exeter, United Kingdom); Raziyeh Farmani (University of Exeter, United Kingdom); Guangtao Fu (University of Exeter, United Kingdom); David Butler (University of Exeter, United Kingdom)

Governance Capacity as Premise for Resilient Management of Water, Waste, and Climate Change
Steven Koop (KWR Watercycle Research Institute, Netherlands); Kees Van Leeuwen (KWR Watercycle Research Institute, Netherlands); Peter Driessen (Utrecht University, Netherlands); Carel Dieperink(Utrecht University, Netherlands); Laurence Koetsier (KWR Watercycle Research Institute, Netherlands); Alisa Doornhof (KWR Watercycle Research Institute, Netherlands)

Resilience as in a Garden City Paris Footprint: Paradigm Change from Satisfactory Objects to Resilient Neighbourhoods
Niels-Christian Fritsche (TU Dresden, Germany)

B.6 Monitoring and Assessment of Resource Use in Resilient Cities

Conveners: Graham Alabaster (UN-Habitat) and Mathew Kurian (UNU-FLORES)

From a resources perspective cities are major consumers of environmental resources and this high resources demand poses threats to their resilience. In a nexus context, resilient cities adapt by making trade-offs explicit and fostering synergies between sectors and resource use to increase sustainability. Monitoring of matter fluxes and availability of respective data is crucial for trade-offs to be made explicit and to assess the extent to which synergies are fostered. The session aimed at showcasing examples of monitoring and assessment systems and identify from presented case studies general principals as well as tools fostering resilience and advancing a Nexus Approach to management of environmental resources – water, soil and waste.

Oral Presentations:

A Contribution to the Monitoring Methodology of SDG Target 6.3 on Wastewater
Linda Veiga (University of Minho, Portugal); Mathew Kurian (United Nations University (UNU-FLORES), Germany); Rizaldi Boer (Bogor Agricultural University, Indonesia); Graham Alabaster (UN-HABITAT, Switzerland)

Scenario-Based Projection of Future Urban Water Environment: A Case Study in Jakarta, Indonesia
Yoshifumi Masago (United Nations University (UNU-IAS), Japan); Biyana Kumar Mishra (United Nations University (UNU-IAS), Japan); Ammar Rafiei Emam (United Nations University (UNU-IAS), Japan); Pankaj Kumar (United Nations University (UNU-IAS), Japan); Ram Krishna Regmi (United Nations University (UNU-IAS), Japan); Pingping Luo (United Nations University (UNU-IAS), Japan)

Localising Urban Food Systems and Its Climate Benefits
Prajal Pradhan (Potsdam Institute for Climate Impact Research (PIK), Germany); Steffen Kriewald (Potsdam Institute for Climate Impact Research (PIK), Germany); Luis Costa (Potsdam Institute for Climate Impact Research (PIK), Germany); Diego Rybski (Potsdam Institute for Climate Impact Research (PIK), Germany); Jürgen Kropp (Potsdam Institute for Climate Impact Research (PIK), Germany)

Urban Underground Space Resources: Assessment of the Environmental Potential for a Rational Use
Nikolai Bobylev (Saint Petersburg State University, Russian Federation); Wolfgang Wende (TU Dresden, Leibniz Institute of Ecological Urban and Regional Development, Germany)

Sustainable Urban Water Management Towards Health Improvement, Environmental Protection and Energy Security in Vietnam Cities
Nga Tran Thi Viet (National University of Civil Engineering, Viet Nam)

Poster Presentations:

B.6.1 Expected Water Demand in the Machuca River Basin, Costa Rica, and Potential Supply Sources
José Pablo Bonilla Valverde (TU Dresden, Germany); Catalin Stefan (TU Dresden, Germany); José Luis Arguedas Negrini (Costa Rican Institute of Water Supply and Wastewater Systems, Costa Rica)

PANEL DISCUSSION

Moderator: Fritz Holzwarth (IHE Delft Institute for Water Education)
Panellists: Christian Korndörfer (City of Dresden), Olfa Mahjoub (Tunisian National Research Institute for Rural Engineering, Water, and Forestry), David Vačkář (Global Change Research Institute)
Commenters: Rudolph Cleveringa (Global Water Partnership), Ruth Erlbeck (Deutsche Gesellschaft für Internationale Zusammenarbeit)

The main goal of the panel discussions was to use case studies to provide DNC participants with a more tangible and concise understanding of the implementation of a Nexus Approach. In particular, it should take on the more theoretical discussion of the keynote speech and synthesise the more specific discussions in the parallel sessions through examples. For both main themes of DNC2017, Resources Management in Resilient Cities and Multifunctional Land-use Systems, a set of three case studies were presented, which together should provide a comprehensive example of how a Nexus Approach can be developed and (at least partly) be implemented in different regional and political contexts. Two experts representing respectively the scientific/monitoring and governance/implementation perspectives were involved in the subsequent panel discussion to widen the view and facilitate generating some general conclusions and lessons learnt.

Case study presenters were asked to provide a brief overview of the case, highlighting:
- What kind of project and measures have been put in place and
- For what purpose (addressing which problems in relation to SDGs);
- How this has been done in terms of stakeholder involvement,
- How progress is monitored (both concerning the implementation of measures as well as their success with respect to the quality, quantity, and sustainable use of resources),
- What kind of governance challenges have been faced during implementation and how they were addressed.

The main points to be discussed during the panel after the brief introduction of cases were:
- Do presented cases represent suitable examples for the application of a Nexus Approach?
- Is monitoring of resource use and matter fluxes addressed adequately?
- Do they contribute to achieving SDGs in respective countries?
- Which lessons can be learned for implementation of integrated resources management?

Case 1: Germany

"Regional Climate Change Adaptation Programme for the Dresden Region (REGKLAM)"

Christian Korndörfer, *Head of the Environmental Office of the City of Dresden*

Brief Description of Project/Case[5]

In the years to come Dresden and its surroundings will have to deal with the direct and indirect impact of climate change. These are expected to bring challenges to practically all areas of public and private life. Triggered by a centennial flood in 2002 followed by a millenium drought in 2003 in Dresden and the region between 2008 and 2013, a large consortium of regional actors from politics, administration, business, and science therefore placed the city and region of Dresden at the heart of wide-ranging investigations.

Within the framework of the project "Development and Testing of an Integrated Regional Climate Change Adaption Programme for the Model Region Dresden" (REGKLAM), funded by BMBF with the lead partnership of IOER, and the participation of TU Dresden and the City of Dresden, these actors designed strategies to better cope with the regional impact of climate change. A key component of the resulting adaptation plan was the concept of a compact city within an ecological net; parts of this can be visited in one of the offered field trips (Weißeritz Green Belt).

Regional climate change not only carries a risk but also offers opportunities to Dresden and its surroundings. Thus a special challenge for the region has been to pinpoint and exploit these opportunities while reducing or indeed avoiding risks. REGKLAM was intended to help the Dresden region become a leading role model of regional adaptation. The project was one of seven model projects in Germany funded by the Federal Ministry of Education and Research within the framework of the KLIMZUG programme, which supported Germany's regions to develop and implement tailor-made measures of adaptation to climate change.

Geographic Location

Dresden, Germany, Capital of the Free State of Saxony and surrounding region

Nexus Orientation

REGKLAM is connected with all components of the Nexus Approach. The strategic issues of the project were urban development, green spaces and buildings, water supply and wastewater disposal, agriculture and forestry, regional economy, and nature protection. Particularly, module 3 of the project highlighted adaptation options for the region of Dresden along with three sub-modules on the topics of urban structure, water systems (especially supply and waste management) as well as land use (including e.g., issues of soil fertility and soil erosion as well as the relationship of water supply and agriculture and forestry).

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[5] Müller, Bernhard, and Alfred Olfert, eds. 2013. REGKLAM: Regional Climate Change Adaptation Programme Dresden Region. Dresden: Leibniz Institute of Ecological Urban and Spatial Development http://regklam.de/fileadmin/Daten_Redaktion/Publikationen/REGKLAM_Strategy-Concept_Regional-Climate-Adaption-Programme_FINAL_fuer-web.pdf.

SDG Orientation

With its comprehensive approach REGKLAM contributes to a number of UN Sustainable Development Goals in an integrated way. The project has a close connection to Goal 11 (*Make cities inclusive, safe, resilient and sustainable*). However, there are as well strong ties to other goals such as Goal 3 (*Ensure healthy lives and promote well-being for all at all ages*); Goal 6 (*Ensure availability and sustainable management of water and sanitation*); Goal 7 (*Ensure access to affordable, reliable, sustainable and clean energy for all*); Goal 8 (*Promote sustained, inclusive and sustainable economic growth, full and productive employment*); Goal 9 (*Build resilient infrastructure*); Goal 12 (*Ensure sustainable consumption and production patterns*); Goal 13 (*Take urgent action to combat climate change and its impacts*); Goal 15 (*Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss*); and Goal 17 (*Strengthen the means of implementation and revitalize the global partnership for sustainable development*).

Stakeholder Involvement

REGKLAM was supported by seven project partners. However, the specialist activities required the input of more actors from the worlds of politics, administration, business, and science. The partners jointly developed practical solutions for companies, municipal and state institutions as well as citizens of the model region. Step by step, new contacts were made between the various actors, close cooperation had been encouraged, and the regional network strengthened and formed a secure basis for the future. A steering group formed the executive body of the regional network, which decided about key questions and issues of cooperation and which officially represented the network. It consisted of major representatives from participating institutions aside from the project partners, e.g., the Regional Planning Association Upper Elbe Valley/Eastern Ore Mountains, the Saxony State Ministry for the Environment and Agriculture, the Saxony State Ministry for the Interior, and the Dresden Chamber of Commerce and Industry.

Monitoring/Implementation Orientation

The REGKLAM project includes aspects of monitoring as well of implementation. Monitoring climate change with a targeted, intelligent, and interlinked monitoring system as well as a regional network of key actors are the basis for raising our knowledge on regional climate change and for finding the right answers to regional adaptation. At the same time REGKLAM has been implementation-oriented. Its main result is the Climate Change Adaptation Programme for the Dresden region with a clear statement calling for action. State and municipal authorities have to set up the necessary framework conditions. Everyone is called upon to play their part in dealing with climate change, whether entrepreneur or scientist, conservationist or house owner, from pressure groups to individual citizens.

Case 2: Czech Republic

"Stakeholder Participation and Actual Implementation of Climate Change Adaptation Strategies in Czech Cities"

David Vačkář, *Head of the Department of Human Dimensions of Global Change at the Global Change Research Institute (CzechGlobe), Czech Academy of Sciences*

Brief Description of Project/Case[6]

The case study is based on the UrbanAdapt project (Development of urban adaptation strategies using ecosystem-based approaches to adaptation) aimed to initiate the process of preparation of urban adaptation strategies development in the three pilot cities in the Czech Republic (Prague, Brno, Pilsen), while proposing and evaluating suitable adaptation measures and actions with the support of ecosystem-based approaches. The intermediate goals of the project include climate change vulnerability assessment, identifying in collaboration with stakeholders relevant adaptation measures, evaluation of the preferred measures in terms of the costs and benefits, design and formulation of adaptation strategies for the three pilot cities, and initiating steps for their implementation.

Within a 2-year period, pilot cities launched adaptation cycles leading to the adaptation strategies. Currently, strategic documents are being discussed and implemented in cities. An important component of the UrbanAdapt project is the incorporation of the "green and blue infrastructure" as well as ecosystem services into the adaptation cycle and individual adaptation measures and adaptation alternatives. The EU Adaptation Strategy (2013) supports the ecosystem-based approaches to adaptation as cost-effective solutions that are easily accessible and provide a wide range of co-benefits.

UrbanAdapt incorporated a wide range of stakeholders who participated in the process of preparing strategies, vulnerability assessment, participatory sessions, information support, testing different approaches, etc. The case study presents the process of stakeholder participation and selected aspects of implementation of climate change adaptation strategies in cities.

Geographic Location

Czech Republic (Prague, Brno, Pilsen)

Nexus Orientation

The UrbanAdapt project was not primarily designed to use the nexus water-soil-waste approach in a strict sense, being specifically focused on selected aspects of climate change impacts in pilot cities, strategic adaptation planning, and implementation of ecosystem-based adaptation measures. The emphasis of project activities is given on the first component – water, dealing with water-related climate change-induced problems observed and further expected in the cities such as floods (especially flash floods affecting small urban catchments) on the one

[6] Lorencova, Eliska K., Blanka Louckova, Zusana V. Harmackova, Adam Emmer, and David Vačkář 2016. "Adaptation Pathways and Cost Assessment of Extreme Events for Prague City." In *Global Change & Ecosystems*, 133–46. Brno, Czech Republic: CzechGlobe. https://asepactivenode.lib.cas.cz/arl-cav/en/detail-cav_un_epca.1-0470827-Adaptation-pathways-and-cost-assessment-of-extreme-events-for-Prague-city/.

hand and droughts on the other. Strategic documents created as the main output of project activities (adaptation strategies), however, provide and further suggest cross-cutting multi-sectoral integrated views on this complex and challenging issue. There are some other synergies with the Nexus Approach. As one of the priorities for adaptation to climate change in cities has been identified problems associated with sustainable water management and water retention. Ecosystem-based approaches (EbA) can contribute to effective water and soil management and multiple benefits of adaptation.

SDG Orientation

Implementation of climate change adaptation strategies contributes primarily to SDG 13 (*Climate action*):

- *13.1. Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries*
- *13.2. Integrate climate change measures into national policies, strategies and planning*
- *13.3. Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning*

It also contributes to implementation of SDG 11 (*Sustainable cities and communities*):

- *11.7. By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities*
- *11.b. By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels*

Application of Ecosystem-based approaches (EbA) can help to implement SDG 15 (*Life on land*):

- *15.9. By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts*

Monitoring/Implementation Orientation

The UrbanAdapt project launched through the adaptation cycle planning the implementation of climate change adaptation strategies in cities. As a component of implementation, indicators and monitoring framework have been proposed and discussed in cities. Adaptation strategies are being streamlined within strategic planning processes of cities (e.g., "Strategy Brno 2050" or "Strategic plan of Prague capital city").

Stakeholder Involvement

Stakeholders were involved in all key stages of the adaptation cycle. The project UrbanAdapt involved all major stakeholders in the cities. Series of participative workshops consisting of focus group discussions, world cafés, and scenario planning were organised in pilot cities. Stakeholders significantly contributed to risk assessment, identification of suitable adaptation options, and their ranking from the perspective of feasibility and costs.

Case 3: Tunisia

"Use of Treated Wastewater and Sewage Sludge in Ouardanine, Tunisia: Current Status and Future Aspirations"

Olfa Mahjoub, *National Research Institute for Rural Engineering, Water and Forestry (INRGREF)*

Brief Description of Project/Case[7]

Irrigated agriculture and promotion of treated wastewater (TWW) use are part of the Tunisian water policy to guarantee food security in fragile areas. The region of Ouardanine, Center-East of Tunisia, was lacking water resources of acceptable quality and suffering low fertility of the soil (sandy with low organic matter content). Farmers were aware that the use of TWW and sewage sludge (SS) produced in the nearby wastewater treatment plant would improve soil quality, increase yield, diversify agricultural production, and guarantee the economic and social wealth in the region if used optimally. The present case study is managed by a farmer and his son, who is an agricultural engineer in horticultural sciences.

Both are combining the long field experience (of the father) and the scientific knowledge (of the son) for a better management of TWW, soil, and SS. Reuse of TWW for the irrigation of fruit trees to produce marketable fruits and forage for livestock have completely changed the profile of the region in the time span of 25 years and transformed the economic and social landscape. SS is used with precaution instead of manure. The project is supported by the Water Users' Association (an NGO) and the Ministry of Agriculture at the regional and central levels.

Geographic Location

The area of study in the region of Ouardanine, Tunisia

Nexus Orientation

This case study falls perfectly within the Water-Soil-Waste Nexus including how it is dealt with at local and regional levels to adapt to water shortage and climate change. It has three major components that can be described as follows: (i) Use of TWW in irrigation to meet the crops water requirements in a region where no water of acceptable quality and in adequate quantity is available for irrigation for securing agricultural production; (ii) Use of SS as fertiliser on degraded agricultural soils to restore structure, increase water holding capacity, and improve fertility for a sustainable agricultural system; (iii) The management of TWW and SS to preserve the environment from the discharge of liquid and solid waste to protect the ecosystem from pollution and mitigate the impacts on human health.

[7] Mahjoub, Olfa, Mohamed Mekada, and Najet Gharbi. 2016. "Case 6: Good Irrigation Practises in the Wastewater Irrigated Area of Ouardanine, Tunisia." In *Safe Use of Wastewater in Agriculture: Good Practice Examples*, edited by Hiroshan Hettiarachchi and Reza Ardakanian. Dresden: UNU-FLORES.

SDG Orientation

The case study falls within different SDGs that when put together they reflect on the positive transformation of the use of TWW and SS in the region. The following are some examples:

- SDG 1: It reduced poverty by supporting the agricultural activity in the region and provided economic benefit to the region.
- SDG 2: It guaranteed income to the farming community thereby reducing hunger.
- SDG 6: It promotes use of TWW and contributes to restoring the ecosystem.
- SDG 8: It has guaranteed jobs for the native farmers, their family members, labour hand (hired for harvesting, irrigation, etc.).
- This case study is also addressing the Goals 11 and 12 from the perspective of sustainable production.

Monitoring/Implementation Orientation

The governmental national and regional institutions are involved in the implementation of projects entailing large investments like the construction of storage basin for TWW, the installation of filters, the maintenance of the pumping station, and controlling the quality of the TWW and SS and the agricultural products.

The activities undertaken at the farm level are embedded in the economic sector of the region as the farm is serving the local and national market with fruits, plants, herbs, flowers, etc. The agricultural activities are all implemented and monitored by the farmer himself and his family members, more particularly his son who is a young agriculture engineer who studied horticultural sciences to guarantee the sustainability of the agricultural activity and to bring scientific outreach and connection with research. Innovative activities like the extraction of essential oils from geranium for industrial purposes were implemented and tested in collaboration with researchers, for instance.

Stakeholder Involvement

The project was born based on the farmers' claim to preserve and sustain the agricultural activity in the region. All the activities are undertaken by farmers and are involving various stakeholders at national, regional, and local levels. The Ministry of Agriculture and Water Resources, the Ministry of Public Health, and the Ministry of Environment were all committed to the success of the project and its expansion. The farmers are gathered under the Water Users' Association called Agricultural Development Group (GDA). The latter is selling the water and assuring its distribution and the maintenance of the irrigation network in addition to providing outreach. All these actors are working in coordination.

Summary of Discussion

When looking at case studies on nexus applications within the framework of Resilient Cities, it is very clear and eminent that addressing the nexus is not just an issue for developing countries, but also developed countries.

***Ruth Erlbeck**, Deutsche Gesellschaft für Internationale Zusammenarbeit*

Looking at the issue from the perspective of South and South East Asian cities, **Ruth Erlbeck** commented that, different from the presented cases of Dresden and Prague, a major problem in those parts of the world is the lack of autonomy and lack of capacity and resources. This includes also a problem with baseline data needed for modelling and SDG reporting. There are great opportunities and potential to come up with innovative technologies and infrastructure projects that apply the Nexus Approach in developing countries, where infrastructure is still lacking. This relates to wastewater use (as shown for Tunisia) or energy production. Especially in the context of the SDGs this is an opportunity because states are required to report on their implementation. Existing rules and laws – and their implementation – need to be improved in many countries. Resilience relates both to governance (software) and infrastructure (hardware), particularly with regard to flood resilience.

***Rudolph Cleveringa**, Global Water Partnership*

When looking more broadly at the DNC topic, **Rudolph Cleveringa** raised that we need a dialogue on how to translate our intentions and cases into a language that triggers a politician to secure investments into the agenda we are fostering. How can we reach out of the water box? The discussion is no longer about differences between a Nexus Approach and IWRM, but about how to reach out. Interaction with stakeholders and different levels of information is crucial. We need to ask ourselves who we have not been able to reach out to, e.g., parliamentarians, finance, and private sector. We have to make an effort to involve them more in the future. Shocks can trigger change, as shown by the Dresden case, but the enforcement of change requires political and financial support.

Panel and Q&A

The following discussion highlighted a few key issues with respect to implementation of a Nexus Approach for increasing resilience. First, on social acceptance and incentives: Taking the example of wastewater reuse there are quite a few examples where implemented systems failed because people did not accept food grown using wastewater. In the case of Tunisia acceptability by farmers of the project is very high, but social acceptability still needs to be addressed in detail. A key success factor is water scarcity because farmers feel the threat; they come up with new ideas on how to expand the project because they can see the economic/financial benefit. In addition, there were farmers taking the lead, showing a positive example to others. The Tunisian case is very powerful, because it addressed poverty, dignity, and innovation utilising local leaders as drivers for change. Fiscal incentives are just one means to trigger change; we also have to consider education and a better understanding of consumer behaviour.

Aiming at resource use efficiency we need to economise resources because they are becoming increasingly scarce (water, energy, land). People need to realise that resources are a precious good; cost recovery is needed (e.g., through tariffs), but needs to balance against challenges of poverty (e.g., subsidy schemes only for those in need).

A second issue addressed was how implementable truly integrated approaches are, which was only partially reflected on in the shown cases. Obviously, this is still a challenge and not happening – at least not at all levels and scales. At the local scale, stakeholders working on practical solutions for problems more easily form temporary associations of mutual interests (e.g., nexus task forces in Asian cities) and they work with a nexus mindset; resistance to nexus approaches is higher at the level of ministries which still are organised in silos. We need to learn and practise multi-stakeholder dialogues and to benefit from them. Complexity should not be used as an excuse to shy away from finding solutions. The question how we can ensure coherence between different measures to prevent unintended consequences/ collateral damage requires looking at the whole system, which may be complex.

Implementation and convincing stakeholders and the public to take decisions towards sustainability is in many cases not hindered by lack of money but translating knowledge for decision makers is a key challenge. Often only crises or shocks trigger action and investment (which may also go in the wrong directions), the same applies for political changes, e.g., after elections. Windows of opportunity are thus crucial, but you need champions of change and advertise success stories.

At national scales, given that SDGs were adopted by national governments, it may be the right time to get back to the question why the adoption of nexus approaches is almost impossible at this level. Will SDGs trigger nexus solutions at the national level? At least there is a chance.

SDGS AND THE NEXUS APPROACH

KEYNOTE SPEECHES

"How to Accelerate Achieving the SDGs? The Need for Integrated Analysis and Synthesis Across the 2030 Agenda"

Stefan Uhlenbrook
Director, World Water Assessment Programme (WWAP), UNESCO

It is well-known that the economic and social development of a country is directly dependent on its sustainable management of primary resources such as water and soil. The Sustainable Development Goals (SDGs) promote an exciting agenda and will reshape the way we design our policies and in particular how we manage our water resources. Aspects of water supply and sanitation have always been the focus of the Development Agenda, also pre 2015. However, SDG 6 goes further and aims to ensure availability and sustainable management of water and sanitation for all. There is clear recognition that water is not only part of other SDGs but a precondition in the realisation of the whole 2030 Agenda for Sustainable Development.

Around the world, more than 80% of wastewater is not properly collected, treated, and released back into the environment. However, if we want to achieve a circular economy, it is important to understand that water and wastewater have a central role in it. There is a need for science-based integrated resource management across sectors and regions and for balancing competing demands on our primary resources, as illustrated by two examples below.

The first example relates to the recovery of phosphorous. It is possible to alleviate wastewater treatment costs through the remarketing of recovered phosphorous and the reduction in maintenance costs related to struvite precipitation. This strategy can help to improve food security, diversify our sources for resources and thus, move towards a circular economy, reduce pollution of water, and reduce dependency of nations on each other for phosphorous security. Phosphorous recovery is directly related to the SDGs 2, 6, 12, 14, and 16.

The second example is on water-dependent jobs. Obviously, water is central to agro-based economies, as rainfall affects the economy and vulnerability of such countries. However, the water-dependency of economies go much further, for example, water-dependent jobs can be found in agriculture, forestry, fisheries, energy, service sector, tourism, recycling, building, transport, and resource-intensive manufacturing. In total, three out of four jobs that make up the entire global workforce are water-dependent.

It has been identified that the fragmentation of the water sector is not an issue at the national level, but also at the global level including the UN. There are and will be numerous reports that describe the SDGs and water management policies, but the policy impacts of these reports often limited because even though the number of papers/books published is enormous, it is impossible for policy and decision makers to consider it all. This demonstrates the need for synthesis.

Against this context, a SDG 6 Synthesis Report is currently produced by a Task Force of UN-Water with the aim of summarising the ongoing monitoring efforts and considering all relevant studies and consolidating them in one report. The Synthesis Report will have the following structure: (1) Global status for each SDG 6 target/indicator, (2) Analysing SDG 6 intra- and interlinkages, and (3) The way forward: policy perspectives and recommendations highlighting possible measures to handle challenges and opportunities.

Finally, assessing the implementation of the SDGs raises the question: Are there enough indicators or do we have too many indicators? In conclusion, the interlinkages between the SDGs are inherent to the system. Further, the monitoring and reporting of SDGs are an ongoing process of high policy relevance. However, the major challenge is implementation of related measures to achieve the SDGs. There is a need for science-based rethinking of the indicator framework and the SDG 6 Synthesis Report aims to support the implementation processes related to SDG 6 in the larger context of the 2030 Agenda.

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"Key Strategies to Achieve the SDGs and Consequences for Monitoring Resource Use"

Stefan Bringezu
Director, Center for Environmental Systems Research (CESR), University of Kassel

The Sustainable Development Goals (SDGs) can be categorised into four groups: goals for the conservation of Earth systems, goals addressing supply provided by resource sectors, goals for social-technical improvements of the economy, and goals concerning health, education and culture. The first three of these groups are directly and the fourth indirectly related to the use of natural resources. In other words, the use of natural resources is relevant for every SDG.

The production and consumption of resources are at the centre of our economy. Our societies take natural resources from the environment and in return release emissions and waste back in to the environment. Therefore, the resource flows resulting from our activities in production and consumption are key drivers to all the environmental problems that we are facing: increased material resource flows and water withdrawal, land-use change, and greenhouse gas (GHG) emissions. From this perspective, SDG 12 which is about sustainable production and consumption, is of central importance. If we do not have effective means to sustain our consumption of natural resources within a safe operating space, we will not be able to achieve the goals set out in the Paris Agreement or the SDGs.

We started to control human-induced pressures to the environment as early as the end of the 19th century. In the 1990s, resource policies were triggered in order to enhance resource efficiency, with the reasoning that we should decouple wealth generation from resource consumption. Quantitative targets were set in a variety of countries and policies and programmes implemented, at national and European levels.

However, despite these efforts, from 2003 onwards the total extraction of environmental resources worldwide increased faster than the world GDP, as shown recently by the International Resource Panel (IRP). In addition, there are a growing number of environmental legal conflicts concerning mining, forestry, and waste disposal. So, it's not just an environmental issue, now it's a social environmental issue, too.

In Germany, a net importer of materials, the material footprint is 22 tonnes per capita. The world status is about nearly 11 tonnes per capita and the target corridor is 5 tonnes per capita. This means that the German consumption of materials is two times above the average and four times beyond the long-term sustainable line. Obviously, intrinsic mechanisms towards increased resource use efficiency are not sufficient and improved policies are required to enter the sustainable corridor.

Among global trends in resource use are two main land-use trends: the expansion of settlement areas and the expansion of agriculture area. Net cropland expansion until 2050 is expected to be between 120 to 500 million hectares for food, biofuel, and biomaterial supply, while gross expansion could be between 320 to 850 million hectares. The European Union has a cropland footprint of about 0.29 hectares per person, whereas the inland availability is about 0.24 and the sustainable operating space level would be around 0.20. This means that we would have to decrease the cropland footprint by nearly a third in order to reach the so-called sustainable corridor. However, current energy policies heavily rely on bio-energy, resulting in exceeding sustainable thresholds of cropland today, and quite likely also in global forests in the coming years.

There are four key indicators, which should be monitored: materials, land, water, air; correspondingly, the material footprint, land footprint, water footprint, and greenhouse gas emissions footprint should be assessed. We can set these in relation to the GDP in order to measure productivity. These footprints determine more than 80% of the variance of all Life Cycle Assessments (LCA) impact categories.

The transition cycle is the knowledge base for informed resource governance, applicable across (spatial and organisational) scales. We have to monitor resource use, set targets, improve our policies and management, and learn and evaluate from these experiences. Transforming resource use in the anthroposhere implies that the material supply will need to largely be based on recycling, energy supply would come from renewable sources, material input and output stay within safe levels, and physical growth of the technosphere is controlled.

Sustainable resource management should be based on four key strategies: Industrial practices should be based in a circular economic model and use resources efficiently. Construction and deconstruction of buildings should be in equilibrium, and it would be better to construct solarised infrastructures. Finally, a balanced bio-economy is preferred. When making products, the product design offers the greatest potential for resource savings, while material substitution may just result in problem shifting. Also, by using captured carbon dioxide, carbon recycling can be another resource and can save a significant amount of greenhouse gas emissions.

In conclusion, monitoring and controlling the four footprints across scales is a precondition for enhanced systems-wide resource efficiency. To this end, we need a regular monitoring mechanism of global trends and country performances (based on a specified protocol) and a global resource database. The latter should be based on the databased developed by the International Resource Panel, hosted by UN Environment. An international competence centre for sustainable resource management would be helpful and is currently being explored. Finally, an international programme for sustainable resource management, including an international convention, should be considered.

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PARALLEL SESSIONS

X.1 Knowledge Management and Transfer for Adoption of a Nexus Approach and Achieving SDGs

Conveners: Chris Zevenbergen (UNESCO-IHE), Jürgen Pretzsch (TU Dresden)

With special reference to the global south, a broad gap has been identified between existing knowledge on rural and urban management and its transition towards sustainable development. Often local actors are hardly reached during implementation of mostly pre-designed technology packages. More interactions are necessary to facilitate the development and implementation of innovative technologies. The session refers to practices and models for multi-stakeholder analysis, participative technology development, and the implementation of innovations as an adaptive process.

Four presentations provided a good basis for the discussion of innovative methods and instruments. A research team from TU Dresden (Jürgen Pretzsch, Maxi Domke, Eckhard Auch, and Francois Jost) reported on the successful use of three methodological approaches, which allow for the investigation of local processes and for the implementation of multi-stakeholder action: (1) the knowledge communication analysis, (2) socioeconomic field laboratories (SLEs), and (3) Participative Innovation Platforms (PIPs). All instruments involve multiple stakeholders with a special focus on the interaction between scientific and local knowledge and very long-term cooperation. The instruments were successfully tested and applied in recent research projects on climate change adaptation in Peru, Bolivia, Ethiopia, and Sudan. Methodologies and respective workshops are composed of diagnosis and action, respectively innovation segments. Continuous monitoring and self-evaluation permit an adaptive long-term implementation process leading to transformations.

The second presentation, authored by Eike Luedeling and Keith Shepherd (World Agroforestry Centre), dealt with holistic land valuation. A system was developed, tested, and put in practice, which permits for the measurement of ecosystem services in a comparative approach, applying a holistic and relatively rapid appraisal method and taking into account tradeoffs between services. The information base for the decision analysis approaches are available statistical data and case study outcomes, complemented by a limited amount of empirically collected up-to-date data. This way costs can be minimised. The approach allows for the preparation of decisions with multi-stakeholders and makes the whole decision process transparent. A special focus is put on the monitoring of SDG implementation impacts. A comparative analysis of private and communal-based natural resource management demonstrated the practicability and relevance of the approach.

The presentation of Prof. Chris Zevenbergen and Wolfgang Haupt dealt with City-to-City learning to cater city needs for climate adaptation. Best practice experiences are shared in learning networks between cites, which permits the efficient use of existing knowledge. Besides the fully involved local public officials, broader networks of stakeholders may profit from this knowledge exchange. The involvement of business actors is still a critical question; they hardly dispose of a mandate to involve themselves in city management issues. Important is the creation of inter-city platforms for common learning.

The fourth presentation by Vicky Ariyanti, Peter Scholten, and Jurian Edelenbos outlined the potential of cultural ecological knowledge in resource management of a volcanic river basin. Special focus was put on the interrelation of water resources management and cultural ecological knowledge of the local community, embedded in a long tradition. Research is characterised by qualitative research instruments.

The extensive discussion demonstrated the need for innovative research approaches, which link theory to real world problems, in which multiple stakeholders are involved and which really reaches a local level, empowering rural and urban residents. Action research approaches need revision and further development. Special emphasis was put on inter-institutional and multi-stakeholder knowledge management and learning, which leads to motivation and empowerment of involved stakeholders towards sustainable rural and urban development and the achievements of the SDGs. It was also obvious that frequently experts deliver "solutions" which are just short-term and which are hardly adopted by local communities. The reality is much more complex and transformation towards sustainable development requires long-term adaptive instruments, which permit the involvement of multiple stakeholders in diagnosis, decision making, implementation, feedback, and monitoring. This cycle requires much more time than a conventional international development project lasts.

Oral Presentations:

Implementing Sustainable Natural Resource Management in the Tropics Under Increasing Complexity: Some Innovative Approaches
Jürgen Pretzsch (TU Dresden, Institute of International Forestry and Forest Products, Germany); Eckhard Auch (TU Dresden, Institute of International Forestry and Forest Products, Germany); Francois Jost (TU Dresden, Institute of International Forestry and Forest Products, Germany); Maxi Domke (TU Dresden, Institute of International Forestry and Forest Products, Germany)

Holistic Valuation of Land-Use Systems
Eike Luedeling (World Agroforestry Centre and Center for Development Research, Germany); Keith Shepherd (World Agroforestry Centre and Center for Development Research, Kenya)

City-to-City Learning to Cater City Needs for Climate Adaptation: Results of a Preliminary Study
Chris Zevenbergen (UNESCO-IHE, Netherlands); Wolfgang Haupt (Gran Sasso Science Institute, Italy)

The Potential of Cultural Ecological Knowledge Contribution in Resource Management of Volcanic River Basin
Vicky Ariyanti (Erasmus University Rotterdam, Netherlands); Jurian Edelenbos (Institute for Housing and Urban Development Studies (IHS), Netherlands); Peter Scholten (Institute for Housing and Urban Development Studies (IHS), Netherlands)

X.2 New and Refined Approaches Supporting the Implementation of a Nexus Approach

Conveners: Johan Bouma (Wageningen University), Mathew Kurian (United Nations University (UNU-FLORES))

The increasing availability and application in society of new information technologies, data systems, and social media require a critical analysis as to its relevance for the Nexus Approach, focusing on the water-soil-waste nexus. In this session a variety of approaches and their implementation were discussed.

When considering approaches, a major concern was expressed about lack of cooperation between different scientific arenas. Many of them still operate in isolated "silos" and social network analysis (SNA) can effectively be applied to create better communicative and interacting conditions. The density structure of networks as well as their centrality, avoiding a very broad and ineffective span-of-control, can be effective within a multi-level framework. Common observatories (presented and discussed elsewhere during the conference) are seen as an effective means to help tear down the silos mentioned above (Kurian). The enormous existing and daily increasing volume of data, information, and knowledge on nexus-related issues present a real challenge to researchers, stakeholders, and policymakers. If not careful, we see only trees, not the forest. The SDGs are very effective in providing overall goals to focus actions to be taken. Cooperation among different disciplines can be realised when performing joint studies and precision farming was used as an example where soil scientists and agronomists worked together effectively. As researchers address the policy arena they would be well advised to define a series of options rather than "solutions" because environmental problems require a Nexus Approach since these problems are "wicked": there is no single magic solution and actions will always represent a compromise between conflicting interests (Bouma).

While most approaches described during the session are well-known, and certainly subject to improvement, the visualisation of crowd-sourced spatial photo data offered a new intriguing perspective. When certain landscape features are photographed by different people, they "see" different things! Acknowledgement of this phenomenon of personal perception can result in better integration of public values into planning processes and political acceptance. This is also highly relevant for the Nexus Approach where different disciplines and stakeholder groups have different visions, based on different perceptions. Their visualisation can help to remove barriers to the acceptance of certain proposed measures (Dunkel).

Implementation received emphasis in a Vietnam case study, emphasising the important role of a business-policy interface in handling conflicts associated with, in this case study, extraction of limestone for building purposes with negative environmental effects in terms of loss of nature and a decrease of water quality. The MAREX project focuses on sustainable extraction processes of limestone. Rather than "muddling through" by creating yet more small extractions without regulations, companies are encouraged to join in a business-policy interface, combining expertise and exchanging experiences to the effect that new economically attractive approaches are developed that are commercially successful and environmentally feasible (Müller). Successful experiences from Ethiopia on developing and implementing sustainable management measures in terms of economically attractive crop-lifestock systems were analysed showing local successes but also lack of implementation elsewhere. Labour shortages form an increasing problem inhibiting labour-intensive land conservation. Education efforts, with particular emphasis on no-nonsense farmers field days, were effective in communicating positive results but this needs more emphasis in future.

Also, inclusion of successful case studies in university curricula would be desirable (Tesfahunegn). A key question in the discussion focused on the gap between research on the one hand and effective action on the other. We certainly need more time as researchers to communicate our findings, different modes of cooperation have to be explored, and there should be more awareness that different rationalities are experienced by the different scientific, societal, and political partners involved.

To realise a Nexus Approach, cooperation between scientists of different disciplines, stakeholder groups, and policymakers is crucial. By now there is an overwhelming volume of data, information, and knowledge available, allowing for a wide range of approaches. The SDGs can act as a welcome guide ("a point at the horizon") allowing effective selection of data. But social aspects are crucial for implementation: explore effects of different perceptions of participants, recognise the important catalysing role that business-policy interfaces can have, and promote no-nonsense interactive presentations at stakeholder level.

Oral Presentations:

Governance of Water-Energy-Food Nexus: A Social Network Analysis Approach
Mathew Kurian (United Nations University (UNU-FLORES), Germany); Solomon Hailu Gebrechorkos (United Nations University (UNU-FLORES), Germany); Kent Portney (Texas A&M University, United States); Bryce Hannibal (Texas A&M University, United States); Gerhard Rappold (Deutsche Gesellschaft für internationale Zusammenarbeit GIZ, Germany)

The Increasingly Important Role of Information Technology to Design and Implement Multifunctional Land-Use Systems
Johan Bouma (Wageningen University, Netherlands)

Identifying Perceived Characteristics and the Collective Attribution of Values and Meaning Through Visualisation of Crowdsourced Spatial Photo data
Alexander Dunkel (TU Dresden, Germany)

Business Policy Interface (BPI) as a Platform for the Sustainable Management of the Extraction of Aggregates: The Case of Hoa Binh Province, Vietnam
Bernhard Müller (IOER, Germany); Paulina Schiappacasse (TU Dresden, Germany); Peter Wirth (IOER, Germany)

Opportunities and Constraints to Sustainable Land and Watershed Management in Crop-Livestock Systems: An Overview of Experiences from Ethiopia
Gebreyesus Brhane Tesfahunegn (United Nations University (UNU-INRA), Ghana); Elias T. Ayuk (United Nations University (UNU-INRA), Ghana)

Poster Presentation:

X.2.1 Institutional Arrangements and Management of Environmental Resources in Ethiopia
Sisay Nune (Addis Ababa University, Ethiopia); Teshome Soromessa (Addis Ababa University, Ethiopia); Demel Teketay (University of Botswana, Botswana)

X.3 A Systematic Approach to Map SDG Interactions for Practical Decision-Making

Conveners: Bettina Schmalzbauer (German Committee Future Earth, lead convenor), Måns Nilsson (Stockholm Environment Institute), Sabine Fuss (Mercator Research Institute on Global Commons and Climate Change), Imme Scholz (German Development Institute), Martin Visbeck (GEOMAR and Kiel University / German Committee Future Earth)

The 2030 Agenda explicitly recognises that sustainability challenges are fundamentally interrelated. Hence, implementing measures to allow progress on one goal means one should always be aware of the whole SDG framework because other goals and targets could be influenced in a supportive or counteracting manner. For nations this issue of policy coherence in their development agenda is much debated these days. While the debate has been more focused on the trade-offs in the past, this session encouraged interventions to highlight positive interactions as well and to promote a more systematic and comprehensive approach towards understanding and implementing the SDG framework.

Over the past decades, research has contributed to a better understanding both of specific sectors of sustainable development and of the interlinkages between the three dimensions of sustainability. As there is still a lack of understanding about the numerous possible SDG interactions on different levels, the implementation of SDGs will benefit from continuing scientific analysis. However, creating an integrated knowledge base for SDG implementation that is societally relevant requires robust partnerships that encourage mutual learning and fewer barriers between academic disciplines (e.g., social science, natural science, engineers, humanities) and administrative units within and across relevant ministries (e.g., ministry responsible for environment, agriculture, economic development, energy). This is important as each SDG also refers to at least two of the three dimensions of sustainability and thus defies the dimensional separation between economic, environmental, and social issues common to the division of labour between ministries.

The SDG interaction concept, introduced by Måns Nilsson, rates seven possible types of interactions from the most positive (indivisible; scoring +3) to the most negative (cancelling; scoring -3). This scoring concept can be applied at any level — to goals and targets, to indi¬vidual policies or to actions, to nations, regions or at the global level (Nilsson et al. 2016). The position and characterisation of the interaction depend on the context within which the interaction occurs, including geographical context-dependency, governance-dependency, technology-dependency, reversibility, time sensitivity. For practical policymaking, the assessment should start from a specific SDG — in line with a minister's mandate — and map out, score, and qualify interactions in relation to the other 16 goals and their targets.

In our session we focused on SDG 13 (climate action), introduced by Sabine Fuss. SDG 13 can influence land-related SDGs such as SDG 2 on ensuring food security, SDG 7 on providing access to clean energy to all, and SDG 15 on safeguarding terrestrial ecosystems. With increased ambitions after the Paris Agreement land is playing a more and more important role: forests and soils will be needed to sequester CO2, low-carbon bioenergy can replace fossil-based energy, and combining it with carbon capture and storage allows for removing CO2 from the atmosphere (Fuss et al. 2016). At the same time, land is central in providing space for satisfying an ever increasing food demand and is host to key ecosystems. Further sectoral examples on how to map out positive and negative SDG interactions with focus on SDG 2, 3, 7, and 14 have been published recently in a comprehensive study by Griggs et al. (2017).

To achieve economic, social, and environmental objectives of SDGs a fourth element is of great importance – the cross-sectoral nexus governance. Imme Scholz drew on long-term experience, for example, with the integrated water resource management (IWRM) approach, to highlight the main barriers of multi-sector and multi-level policy coordination. The barriers include intersectoral externalities, generalisation of approaches, silo thinking, power asymmetries, and institutional weaknesses (including lack of resources and data (see Bhaduri et al. 2017; Scholz 2017)). Future guiding research questions should therefore focus on: "How can intersectoral interdependencies in resource use be better considered in incentive structures, governance mechanisms, and policy instruments in order to increase water, energy, and food security?"

Finally, Martin Visbeck argued that science can make significant contributions for successful monitoring and review of SDG implementation not only in the area of indicators, but also to further develop integrated methods to improve integrated scientific assessments as well as to analyse interlinkages and interactions embedded in the SDG framework (Schmalzbauer and Visbeck 2016). International research programmes such as Future Earth and its Knowledge-Action Networks, for example, can support and facilitate this cross-sectoral knowledge exchange between sciences, nations, and actors. But cross-sectoral approaches and formats for dialogue also need to be stimulated on the national level. In Germany, for instance, the "Science Platform Sustainability 2030" was recently launched; it builds not only on the excellent research in the German community, but also on support from across federal ministries. As such, the platform is best placed to contribute to the implementation of the German Sustainable Development Strategy.

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Oral Presentations:

A New Framework to Better Understand SDG Interactions
Måns Nilsson (Stockholm Environment Institute (SEI), Sweden); Dave Griggs (Monash University, Australia); Martin Visbeck (German Committee Future Earth, Germany)

Governance at the Water-Energy-Food Nexus: Towards the Integrated Achievement of Social, Economic, and Environmental Objectives
Imme Scholz (German Development Institute (DIE), Germany)

Implications of Deep Decarbonization for Other SDGs: Land-Energy Interactions
Sabine Fuss (Mercator Research Institute on Global Commons and Climate Change (MCC) gGmbH, Germany)

Challenges and Opportunities in SDG Implementation and Monitoring
Martin Visbeck (German Committee Future Earth, Germany)

X.4 Building Up Monitoring and Reporting on SDGs Based on Subnational and National Efforts

Conveners: Laszlo Pinter (IISD and CEU), Tamara Avellan (United Nations University (UNU-FLORES)), Christian Kroll (Bertelsmann Stiftung), Sami Pirkkala (Prime Minister's Office & Ministry of Foreign Affairs, Finland)

In 2015, the Member States of the United Nations agreed on the 2030 Agenda for Sustainable Development and a set of Sustainable Development Goals (SDGs) applicable to all UN Member States. As part of the follow-up and review mechanisms of this agenda, Member States are encouraged to conduct regular reviews of progress made towards achieving the SDGs at the national and subnational levels. These reviews are country-led and country-driven. They aim to provide input to the annual High Level Political Forum (HLPF). Against this background, the session focused on SDG monitoring and reporting with particular attention to indicators.

The session started off with a presentation by Tamara Avellan. In the study she introduced, Tamara and colleagues prepared an inventory of indicators used for tracking water quality. As a next step, they aim to investigate the practical applicability of these indicators and to identify capacity building needs. At the moment, no less than 474 water quality indicators are in use. Their study both showed that SDG performance measurement can build on a good base of existing tools and methods, but also illustrated their diversity. While helpful and necessary to measure what matters in different contexts, diversity also represents a challenge for standardisation and comparability. The same obviously applies to SDG indicators.

Christian Kroll provided a presentation of SDG country performance index and dashboard released by Bertelsmann Stiftung last year. The index and dashboard are based on a selected set of indicators and show, respectively, the overall performance of countries on all indicators included and how well countries perform on specific goals. The index contributes to raising awareness, promotes the exchange of best practices, and can be used as a research tool. Researchers at the Foundation are currently working on a new report, which will focus on international spillover effects (i.e. countries achieving their own goals at a cost to other countries e.g., by outsourcing polluting production or exporting waste).

Laszlo Pinter introduced IISD's new web-based tool to track SDG indicator reporting practices of countries and cities[8]. Piloted for nine countries and selected Canadian cities, the tool provides a high-level overview of reporting on various SDGs and the similarity of indicators to the official set defined by the UN Statistical Commission (UNSC). Analysis of the data shows that while countries are good at reporting socioeconomic indicators, reporting of environmental indicators are often lacking. The use of indicators reflects both the political commitment to the implementation of the SDGs and capacity constraints.

[8] https://sustainable-development-goals.iisd.org/country-data

Finally, Sami Pirkkala provided an account of the progress made with the implementation of the SDGs in Finland. Finland is a forerunning country that has over twenty years of experience with implementing sustainable development using various policy frameworks. Sami stressed the role of national governments, who are responsible and accountable for the implementation and monitoring of SDGs and national parliaments. In Finland, a national implementation plan was recently submitted and will be reported on on an annual basis by the government to Parliament. Every four years, there will be an independent review and an evaluation of national implementation. Sets of indicators, which are linked to existing institutions, are being developed to support monitoring. Some of these indicators are global whereas others are country-specific. As for implementation at the regional and the local level, some cities in Finland are very proactive creating a huge potential for city-to-city learning. According to Finland's experience, indicators are very much wanted but less often used.

Following the presentations there was a lively discussion about the use of indicators and indices. The index and dashboard developed by the Bertelsmann Stiftung was applauded but some of its aspects also challenged. For the Finnish government the index proved to be very useful since it provided insights into where Finland is doing well. However, participants questioned the equal weighting of goals and raised the need for making sure that low ranked countries are not demotivated. Also, as long as very few indicators are currently in use for the goals covered by the index, its reliability can be questioned. This also raises the question how to avoid cherry-picking of indicators.

Several suggestions were raised with respect to communicating and using the SDG index and similar indices:

- When presenting an index pay attention not only to performance but also to efforts and actual progress made.
- Provide users with an online platform where they can apply user-specific weightings (as is the case with the Better Life Index of the OECD or the earlier Dashboard of Sustainability tool of IISD and the JRC).
- Attach stories to the indicator scores to complement numbers with qualitative information in the form of a narrative.
- Explore the use of indicators to support 'back-casting' (reasoning back from future goals). Some countries are currently experimenting with this approach.
- Overall, developing fully functional SDG indicator suites and an SDG index will require an extended process of experimentation, testing, and learning.

Oral Presentations:

Indices in the World of Water Quality Assessment: Lessons Learned
Tamara Avellán (United Nations University (UNU-FLORES), Germany), Sabrina Kirschke (United Nations University (UNU-FLORES), Germany); Kenneth Irvine (UNESCO-IHE, Netherlands); Stefan Uhlenbrook (United Nations World Water Assessment Programme, Italy)

The SDG Index and Dashboards: Tools to Facilitate SDG Policy Implementation and Research
Christian Kroll (Bertelsmann Stiftung, Germany)

Building a Monitoring, Reporting, and Verification Practice with Indicators for SDGs at the Sub-Global Scale
Laszlo Pinter (Central European University, Hungary)

National Follow-Up and Review in the 2030 Agenda: How to Increase Policy Relevance and Make Indicators Matter? Case Finland
Sami Pirkkala (Prime Minister's Office & Ministry for Foreign Affairs, Finland)

WORLD CAFÉ

Scientific conferences rarely offer room for discussion across disciplines, stages of knowledge, or careers. At DNC2017 we wanted to propose exactly that: a space for free discussion for the almost 50% of participants that had no 'role' at the conference, be it as an oral or poster presenter or speaker. We gave the floor to the audience and listened to them.

On Day 3 of the conference thirty round tables with up to 10 participants each were moderated by selected experts from science to practice from over 10 nationalities and over 20 different institutions. The discussions at the tables of the World Café were clustered along the two main conference topics (see box below). Each Cluster addressed questions related to the two main structural themes of the conference, namely 'Monitoring' and 'Implementation'. Each of these structural themes was sub-divided into sub-categories; for monitoring 'indicators/indices' and 'data', and for implementation 'management options', 'governance', and 'capacity development'. There were, hence, a total of 10 sub-categories. Each sub-category was discussed at three tables in parallel[9], with one table per sub-category being dedicated to early career scientists.

Multifunctional Land-Use Systems

A.I Monitoring I – Data: Cezary Kabala (Wroclaw University of Environmental and Life Sciences) (*early career scientists' table*); Rabi Mohtar (Texas A&M University); Alice Schröder (Bundesamt für Naturschutz)

A.II Monitoring II – Indicators and indices: Johan Bouma (Formerly Wageningen University) (*early career scientists' table*); Eike Luedeling (World Agroforestry Centre); Kai Schwärzel (United Nations University (UNU-FLORES))

A.III Implementation I – Management options: Birguy Lamizana (UN Environment); Maria Ubierna (International Hydropower Association (IHA)); Gerald Kapp (TU Dresden) (*early career scientists' table*)

A.IV Implementation II – Governance: Nina Hagemann (TU Dresden) (*Practitioners' table*); Sabine Fuss (Mercator Research Institute on Global Commons and Climate Change (MCC) gGmbH); Ines Dombrowsky (German Development Institute (DIE))

A.V Implementation III – Capacity development: Manzoor Qadir (United Nations University (UNU-INWEH)) (*early career scientists' table*); Anna Görner (TU Dresden); Junko Mochizuki (International Institute for Applied Systems Analysis (IIASA))

Resources Management in Resilient Cities

B.I Monitoring I – Data: Christos Makropoulos (KWR Watercycle Research Institute); Graham Alabaster (UN-Habitat); Jochen Schanze (Leibniz Institute of Ecological Urban and Regional Development (IOER)) (*early career scientists' table*)

B.II Monitoring II – Indicators and indices: Clemens Deilmann (Leibniz Institute of Ecological Urban and Regional Development (IOER)); Fabrice Renaud (United Nations University (UNU-EHS)) (*early career scientists' table*); Andreas Otto (Leibniz Institute of Ecological Urban and Regional Development (IOER))

B.III Implementation I – Management options: Christina Dornack (TU Dresden) (*early career scientists' table*); Marc Fletcher (Ove Arup & Partners International Ltd); Petra Schneider (Hochschule Magdeburg)

B.IV Implementation II – Governance: David Vačkář (CzechGlobe); Anne-Karen Hüske (TU Dresden); Christian Bruchatz (TU Dresden) (*early career scientists' table*)

B.V Implementation III – Capacity development: Danka Thalmeinerova (Global Water Partnership); Chris Zevenbergen (UNESCO-IHE) (*early career scientists' table*); Ruth Erlbeck (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ))

[9] In some cases parallel tables were merged. Due to a last-minute change, Dipak Gyawali (Nepal Academy of Science and Technology) replaced Graham Alabaster as moderator in B.I.

Some tables decided to merge, such that in the end discussion took place at a total of 26 tables.

Monitoring
- 12 tables on monitoring
- 4 early career scientist tables

Implementation
- 15 tables on implementation
- 2 early career scientist tables
- 1 practitioners table

The enthusiasm at the tables could be felt in the room. Besides the pieces of art that were created on the table cloths where participants were encouraged to map their thoughts and ideas, discussions were barely stoppable after the assigned 60 minutes. Some of them lasted well into the subsequent coffee break.

Quotes from Participants

I enjoyed the Dresden Nexus Conference as well as moderating the World Café. It was an interesting table in that two of the three young scientist poster prize winners were at our table and the summary by the rapporteur which you picked up in your summary presentation – i.e. data democratization, something that I have been pushing for – was also immediately picked up as interesting and important by your young scientists.

– Dipak Gyawali

Thanks for giving me the opportunity to be part of it! It was fun and I learned a lot. Thanks also to Johan for stimulating this interesting and fruitful discussion!

– Mareike Braeckevelt, TU Dresden

The World Café was a nice and interesting experience. Many thanks for organising it.

– Gerd Lintz, TU Dresden

Thank you very much for inviting me to the Conference as well as for inviting to me to be a moderator of the World Café. I really enjoyed participating.

– Ruth Erlbeck, GIZ

Thank you for the great organization of this event.

– Martina Artmann, IOER

Thank you very much for such an interesting and perfectly organized event :-)

– Eliška K. Lorencová, CzechGlobe - Global Change Research Institute

Quite stimulating to hear highly perceptive comments from young scientists in developing countries. The roundtable idea needs to be continued! Good to have been part of this! Best wishes to all.

– Johan Bouma

Rapporteurs were asked to summarise the discussions at their table in one key message, as well as bullets on highlighting (i) existing achievement, (ii) existing bottlenecks, (iii) future research needs, and (iv) future implementation needs.

DNC 2017 World Café | Wrap-up, Main Points from Rapporteurs´ Summaries.

Data
- Data harmonisation and democratisation beyond physical data
- Policy coherence for effective monitoring

Indicators/Indices
- Connect to needs of people
- Consumption based
- Usable and user-friendly

Management Options
- Linkages (rural-urban)
- Communication and acceptance by actors

Governance
- Multi-level
- Open and transparent
- Focus on benefit for all

Capacity Development
- Stronger transdisciplinary dialogue
- Change of flow of information through society
- Packaging

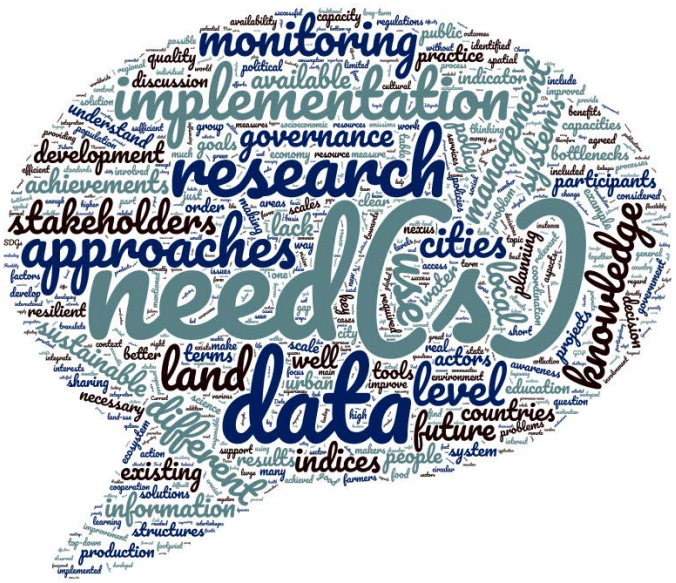


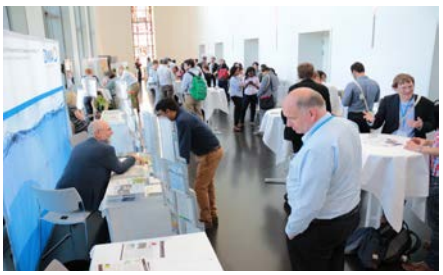
Figure: Word Cloud Emerging from Key Messages Provided by Table Moderators

One key aspect of organising the World Café was to also gather inputs for topics for the next Dresden Nexus Conference in 2019. Based on the half-page reports from the rapporteurs sent to organisers after the conference, the following topics emerged as potential issues to be addressed:

- How can monitoring and data collection beyond the physical nexus (e.g., politics, economy and education, social and cultural interlinkages) including also informal collection systems (traditional knowledge, citizen science) and addressing aspects of scale (local vs. global, spatial and temporal resolutions) be achieved?
- How can understanding political processes and when/how decisions are made help derive the 'right' communication strategies within and between different types of actors and at different scales? How can inclusive participation be achieved that leads to true transdisciplinarity?
- Should indicators be simplified (for an easier translation) or made more complex (in order to receive more precise results)? Can alternative indicators of well-being, happiness, and inclusiveness help overcome biases?
- What are the risks and benefits of formal vs. informal governance structures? What are strategies to keep governments and the public motivated and engaged in transformational processes?

A GROWING NEXUS COMMUNITY

EXHIBITION HALL



IISD
International Institute for Sustainable Development

Springer

ELSEVIER

Korea Environment Corporation

German Committee Future Earth

TEXAS A&M UNIVERSITY

DWA
Clear Concepts. Clean Environment.

UNITED NATIONS UNIVERSITY
UNU-FLORES
Institute for Integrated Management of Material Fluxes and of Resources

Leibniz Institute of Ecological Urban and Regional Development

TECHNISCHE UNIVERSITÄT DRESDEN

CAWR
Center for Advanced Water Research

CIPSEM

UNITED NATIONS UNIVERSITY
UNU-INRA
Institute for Natural Resources in Africa

UNITED NATIONS UNIVERSITY
UNU-INWEH
Institute for Water, Environment and Health

UNITED NATIONS UNIVERSITY
UNU-EHS
Institute for Environment and Human Security

SIDE EVENTS

MAREX Workshop Aggregates Mining – Managing the Impacts on Environment and Regional Development

Convener: Leibniz Institute of Ecological Urban and Regional Development (IOER)

One important aspect of urbanisation, the extraction of aggregates (sand, gravel, and stone) for building activities, is addressed in the joint German-Vietnamese project MAREX. Supported by the German Federal Ministry of Education and Research and the Ministry of Science and Technology in Vietnam, the project deals with the extraction and processing of aggregates, and also reflecting improvements in the related fields of transport, construction, and recycling of construction and demolition waste. The capital region of Hanoi and Hoa Binh province serve as a comprehensive model for application within and outside of Vietnam. As a side event of the Dresden Nexus Conference 2017, the workshop provided a precious opportunity for participants to exchange ideas with the MAREX team and to discuss challenging questions on aggregates mining for urban growth, environmental reclamation, and post-mining perspectives.

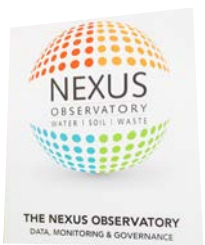
40 Years of the UNEP/UNESCO/BMUB Course Programme – Postgraduate Training Towards More Sustainable Development

Convener: Center for International Postgraduate Studies of Environmental Management

The Center for International Postgraduate Studies of Environmental Management (CIPSEM) celebrated 40 years of the UNEP/UNESCO/BMUB Course Programme for Developing and Emerging countries at TU Dresden. So far, more than 2,200 experts from 139 countries have engaged in interdisciplinary postgraduate training, covering many aspects that are at the heart of sustainable development. CIPSEM enjoyed celebrating with current and former participants, contributors, staff members, and all who felt connected to the programme. This side event of the Dresden Nexus Conference also addressed the role of education for achieving the Sustainable Development Goals, with plenty of opportunity for informal exchange between guests.

The Nexus Observatory Meets the Nexus Resource Platform: Launch Event of UNU-FLORES and GIZ Collaboration

Conveners: UNU-FLORES and GIZ



The Nexus Observatory is an important initiative of UNU-FLORES that seeks to bring scientific analysis to bear on pressing challenges decision makers face with regard to the environment and development. The GIZ Nexus Resources Platform showcases the latest news, publications, and trends on the Nexus Approach. GIZ and UNU-FLORES recognise the complementarities between these two platforms. In collaboration, they are developing a prototype of the Nexus Observatory and exploring further synergies that could emerge from greater integration of both platforms. At the Dresden Nexus Conference 2017, participants had the opportunity to attend a launch event that reported on the initial results emerging from the computing effort that is currently underway to build synergies between the UNU-FLORES Nexus Observatory and GIZ Nexus Resources Platform.

Gaming Session: Water-Energy Nexus Game

Convener: International Institute for Applied Systems Analysis (IIASA)

In an interactive and fun format, the Water-Energy Nexus Game gave participants a unique opportunity to get insights into managing the water needs of energy production/generation and improve water management to reduce water systems vulnerability. The game gave players a strategic overview of the interconnections between water and energy supply and consumption.

Book Launch: Multifunctional Land-Use Systems for Managing the Nexus of Environmental Resources

Convener: UNU-FLORES and Springer

Speaker: Luca Montanarella (European Commission – Joint Research Centre Institute for Environment and Sustainability, Scientific Action Leader)

Environmental decline and deteriorating conditions of environmental resources are endangering food and water security globally. In China, the world's largest afforestation and land restoration programme in decades are raising doubts about sustainability. In a new book launched at DNC2017, UNU-FLORES together with partners present the state of the art in forest management and land-use policy, with reference to the case of the Loess Plateau region in China.

Panel Discussion: Sustainability Assessment for the Water-Soil-Waste Nexus

Convener: PRISMA Centre for Sustainability Assessment and Policy

Panellists: Ms. Kei Ohno-Woodall (UNEP/FAO Secretariat of the Basel, Rotterdam and Stockholm Conventions); Rattan Lal (Professor at Ohio State University); Stefan Bringezu (Director of Center for Environmental Systems Research (CESR)); Tran Viet Nga (Professor at National University of Civil Engineering); Peter Saling (Director BASF)

Moderator: Jochen Schanze (Member of the PRISMA board and Professor at TU Dresden, Dresden German)

The panel discussion brings together the views of international institutions, scientists, producers, and consumers. It sheds light on the state of the art of sustainability assessment and explores future perspectives. The panellists represent the international expertise of distinguished bodies and figures in the fields of sustainability assessment and research on the resources water, soil, and waste. After initial statements they elaborated on recent developments and further opportunities for advancements of sustainability assessment. The discussion leaves room for questions from the audience.

EXCURSIONS

A. Post-Mining Area of the Upper Lusatian Region, Germany

Conducted by Vattenfall/TU Dresden

Mining for brown coal, especially by open-cast mining, changes landscapes dramatically. This field trip gave an impression of the planning and management of active mining in the Upper Lusatian brown field. It provided participants the opportunity to see an open-cast mine and discuss water and soil management. The challenge not only for the scientific community but also in planning and implementing the reuse of the newly emerging landscape was shown on a site with agricultural reuse, forest reuse, and reuse for natural succession. The social impact is also enormous. Thousands of people have had to be resettled as a result of the advancing mining. The trip dealt with this topic through a visit to a resettlement.

Since the brown field of the Lusatian region comprises an area of about 850 km² the whole region has faced many structural changes. We visited a site where recreational reuse is pronounced, to give people a working alternative. In line with the intention to develop this region with a sustainable perspective the "Internationale Bauausstellung (IBA) Fürst-Pückler-Land" was founded. Projects like the Energy Heritage Route were initiated. During the trip participants had the opportunity to talk to the project manager (K. Feucht) at the last stop before returning to Dresden.

B. Wastewater Treatment Plant, Sewage Purification and Sludge Processing (Dresden-Kaditz)

Conducted by Stadtentwässerung Dresden

The Stadtentwässerung Dresden (SEDD, municipal drainage and sewage treatment company of Dresden) runs the largest and one of the most modern wastewater treatments plants in Eastern Germany. Wastewater from 650,000 people is purified with various mechanical, biological, and chemical processes. This corresponds to 120,000 cubic metres per day. The consumption of electric and thermal energy poses a substantial expense factor for the operation of the sewage purification and sludge processing plants. A modern sludge processing plant of the SEDD produces a daily output of 16,000 cubic metres of sewage gas.

The focus of the excursion were the subjects of sewage purification and the usage of energy. Participants visited the plants of the various cleaning stages as well as some sites of energy production. A competent representative of SEDD explained the procedures and processes involved.

C. Flood Pumping Station and Stormwater Overflow Tank (Dresden Johannstadt)

Conducted by Stadtentwässerung Dresden

In 2002 an unexpected extreme flood hit Dresden with full force. Large parts of the town were affected – settlement areas as well as industrial and commercial areas, and the historic city centre with its famous buildings (e.g., Semper Opera and Zwinger). This flood caused damage of more than one billion Euro.

As one of the consequences, Stadtentwässerung Dresden (SEDD, municipal drainage and sewage treatment company of Dresden) built a flood discharge pumping station close to an existing stormwater overflow tank in order to make Dresden's sewage system more resilient. Both facilities are installed at Dresden's largest sewer. If the sewer's capacity is going to be exceeded due to heavy rainfall, the tank collects mixed water which otherwise would flow into the river Elbe. After rainfall, the wastewater goes back to the main sewer to be treated at the wastewater treatment plant. In case of very heavy rainfalls exceeding even the capacity of the underground stromwater overflow tank, or a significant flood, the flood pumping station transports wastewater from the sewer system into the river Elbe, to avoid a collapse of the sewer system, causing inner city areas to be flooded by wastewater. The entire construction was built underground and is covered with topsoil. An appropriate seeding with endemic weeds and other plants ensures a semi-natural adaptation to the nature of the landscape zone Elbwiesen. The excursion guided participants to the meadows along river Elbe in Dresden-Johannstadt. A representative from SEDD gave a tour of the flood pumping station and explained the functioning of these two plants as part of a modern drainage management system.

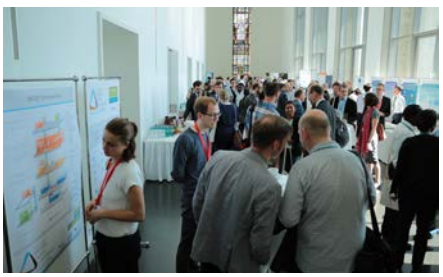
D. Weißeritz Green Belt (Dresden Plauen)

Conducted by City Planning Office, City of Dresden

The Weißeritz green belt is a former riverscape between the inner City and the southwest of Dresden. This area had an industrial character for a long period until the late 1990s. After the political change in Eastern Germany and the German Reunification, most of the industry along the river Weißeritz broke down leaving abandoned brownfield sites. Subsequently, several studies were conducted aiming at the development of a green belt. The City of Dresden, finally, formulated the superordinate target of the district development project "Weißeritz" in 2002 (funded by European Regional Development Fund (ERDF)). Priority was the removal of partially contaminated brownfield sites and the restoration of the scenic and recreational potential of the riverscape. As the Weißeritz riverscape was strongly affected by the unexpected flood in Dresden in 2002, aspects of flood risk management were likewise involved in the development of the Weißeritz green belt. The significance of the green belt in regard of climate adaptation is becoming more and more important. A representative of the City Planning Office together with a representative of Dresden's Environmental Office gave a tour of different projects realised along the former riverside implemented in the past. Furthermore, participants got information on future (sub-) projects planned for the further development of the Weißeritz green belt.

FURTHER IMPRESSIONS


A.I
Monitoring I - Data
DNC2017




#DNC2017
#NexusApproach
Dresden Nexus Conference 2017.
@unuflores
@UNU_FLORES
ARUP
IISD

WRAP-UP & CLOSING

KEY LISTENERS

János Bogárdi

Senior Fellow, Center for Development Research, University of Bonn

From the scientific perspective, the SDGs and the Nexus Approach, their monitoring and implementation, can be compared with the difficult task of taming a leopard. It is a very special leopard. Its spots are steadily growing and its fur is not in good shape. You have probably realised already, that this leopard to be tamed is like our planet. It shows the signs of incessant urbanisation and generally the less-than-sustainable use of its multifunctional landscapes.

Do we know this "animal" well enough? Can we wage this task? Yes we can, and yes, we have to. We observe its movements, monitor its temper and habits, and capture many syndromes and complexities. But are we aware of its internal drives? How much more stress can it absorb and ultimately would we be able to reach its senses, make it jump through the nexus triangles water, energy, food or land, water, soil, waste, climate change, and many more? Would it reach our mandated SDGs? Would it ever be docile enough to respect and live by the rules and practice of what we call "sustainability"?

This conference gave us the opportunity to take stock of what has been achieved and to reflect upon what is still ahead of us. There are numerous promising modelling applications. Various case studies show interesting results and provide guidance towards layer scale and long-term implementations.

We can be confident to have the tools and the technical solutions, but it was echoed that "nexus science" so far achieved its results at "laboratory scale" rather than in the "real world". DNC2017 demonstrated through many examples that nexus science is easier applied at local scale than on national or even transnational scale(s).

We had good debates over data requirements and availability. Some people claimed that the databases were sufficient to rely on for nexus and SDG monitoring, but data accessibility and sharing were still seen as neuralgic issues.

This conference also revealed that the nexus is, at least for the time being, markedly science-driven – food, land/soils, waste, climate and environmental change have been impressively showcased – but frequently there is no feedback yet from its audience to the "knowledge curators". This would be essential as without the ultimate reality check and wide-scale buy-in and feedback from the governance and administrative communities the breakthrough could be postponed.

Nexus is claimed to be the concept to tackle SDGs. But nexus is also a mutual, long-term learning process. This has to involve all stakeholders. Science is on a good track, but no opportunity should be left out to continue convincing people about the feasibility and power of nexus.

The selection of over 230 official SDG indicators to be monitored and reported at the national level gave us a challenge. But the indicators are also opportunities for science. How can they be measured and interpreted across different scales? Most likely, that at different scales, like at household, municipal, and regional levels, additional indicators will be needed and used. How can this multiscale monitoring be synchronised? How and when will scale transitions in this field be possible? How can the multitude of indicators be assessed, influenced, and the results of this demanding exercise formulated in concise and concrete policy-relevant messages? No doubt, that the Nexus Approach, but also the SDGs imply adaption. Scientific support and guidance in this process will itself be an adaptive 'trial-and-error' exercise.

We talk about science, but the science which is needed for successful nexus approaches is not a single-disciplinary homogenous science. Vocabulary and concepts of the nexus are likely to be wickedly unknown in a number of scientific disciplines. DNC is an excellent networking platform but we need to extend the dialogue in order to develop what is needed, an inter- and transdisciplinary nexus science. It should involve more and more social scientists, representatives of governance, legal and political sciences, and other relevant stakeholders.

We talk about nexus and nexi and almost automatically contain ourselves to 3 dimension: W-E-F and W-S-W are the outstanding examples. Additionally there are good reasons not to overboard ourselves with even higher-order complexities. But adding health to the hitherto frequented nexus concerns could open the way towards a more explicitly human and society-centred Nexus Approach. Spelling out this recommendation in a Museum of Health is not inappropriate I believe.

The nexus or nexi follow a common philosophy but manifest themselves though different tools, methods, and solutions. Scientific guidance to find the matching tool for a problem is, and will remain an eminent task for the scientific community. Much to be done to facilitate that our "consumers" – policy makers, professionals, and the public – buy in nexus and seek sustainable cooperation with science. Stakeholder involvement is essential, but should be a well-designed and underrated process. "Whom to involve, how, and what level?" is an essential field on its own.

The SDGs, as decided by the Member States focus on the national level. Through nexus considerations national achievements can be linked across borders. Water, but also food and energy security along a great river links these aspirations of the riparian countries. This phenomenon occurs at least as many times as the number of large transboundary river barriers and/or aquifers in the world. Thus we need to consider the transboundary scale for all encompassing nexus consideration. How far globalisation, trade links, and more will even require yet higher scales: I leave it to your imagination.

Nexus science is new and those covered here in Dresden come with different "pre-nexus" disciplinary backgrounds. We are more or less pioneers of a new emerging science. Do we need, and if we do, how to educate "nexus-ready" professionals? We certainly will need new curricula and those that are more interdisciplinary. But as much as we need the new type of professionals and scientists we need also to evolve institutionally. The hitherto prevailing fragmented "silos" in policymaking and governance are counterproductive for nexus implementation. But do we have the "silver bullet" model for governance of the nexus and sustainability? That would still be an intellectual and political challenge.

Ladies and gentlemen, these are not only intriguing questions, but also not-so-hidden proposals to be considered as topics for the future Dresden Nexus Conference.

Birguy Lamizana

Programme Officer, Global Programme of Action for the Protection of the Marine Environment from Land Based Activities (GPA)
Ecosystems Division, UN Environment

The first question I was asked to address as a key listener is: Did DNC2017 reach its expected outcomes?

The DNC2017 had four expected outcomes. I will try to go through them one by one, providing examples from sessions I attended and the exchange I had with participants.

The first expected outcomes was in the showcase of the state-of-the-art of adopting the Nexus Approach. 450 participants from 50 countries shared experiences from different regions of what they are doing under the two overarching themes: *Multifunctional Land-Use Systems* and *Resources Management in Resilient Cities*.

Examples from Munich and Tunisia have shown how the Nexus Approach and the SDGs are applied at the local level, highlighting the importance of stakeholder involvement. The SDGs offer a great opportunity to come up with innovative technology and infrastructure projects that apply the Nexus Approach. These need good governance, monitoring, and innovative financial mechanisms.

Several case studies show that the Nexus Approach is already happening, that technology is out there. For instance, water reuse for drinking and aquifer recharge in the case of Namibia, nutrient reuse for agriculture in the case of Tunisia, and energy reuse in the case of Japan.

With these examples, the answer to this question is yes.

The second expected outcomes were in the provision of scientific evidence. Keynote speakers, parallel sessions, and the World Café, all provided reason and argument of the benefits from applying a Nexus Approach. The take-home message is that various resources are interconnected and their management needs also to be done in a more integrated, nexus way. Soil management has to take into account water management and vice versa and the waste produced which needs to be taken care off.

Silos need to be broken and synergies and bridges need to be built. This is also relevant for international organisations, including the UN, which needs to apply the Nexus Approach to ourselves to break the silos/"mandate approach".

The third expected outcomes were in identifying knowledge gaps and priorities.

Priorities identified include the importance of the Nexus Approach in helping us get out of our comfort zone and boxes and sharing experience and making the link, building synergies. The nexus needs to target the water cycle but also the continuum from source to sea.

Complex problems that require integrated solutions need to be prioritised. How case studies successfully applied at the local level can be transformed into national solutions should also be considered particularly in terms of upscaling and adapting.

There is a need to build science-policy interface/bridge, to decouple wealth generation and depletion of resource, and to decouple urbanisation and resource pollution and deforestation. Gaps that have been identified include know-how to apply Nexus Approach at the national level. It was also noted that SDG 5 on *Gender equality* was very silent in this conference and needs to be taken into account for sustainability.

The finance/economy side need also to be more prominent if we want the Nexus Approach to reach its objective. Gaps also still exist in terms of regulatory measures and incentives to increase acceptance for wastewater reuse.

The fourth expected outcome relates to the needed individual and institutional capacities. These include interlinkages of the global goal and national priorities, development agendas; reporting and monitoring; dialogue among sector-nexus; data acquisition, and support to effectively implement the SDGs.

The second question is: From the perspective of international agencies and organisations dealing with resources management, have there been convincing examples of projects and case studies demonstrating downscaling of global goals at country and regional level? Vice versa, are there advances in upscaling local projects demonstrating nexus implementation?

I managed to speak to quite a number of participants and most of them were happy about how DNC2017 was organised. The varieties of contents and the format in which the conference has been delivered were very useful. It was not monotonous, involving various elements: keynote speeches, parallel sessions, poster sessions, and World Café.

Some participants were expecting more good examples at the national level. A number of participants have found that convincing examples have been shared: the case of Tunisia showing how wastewater can be seen has untapped resource providing a concrete example on how to apply what the WWDR17 has put as a way forward and the importance of stakeholder involvement for ownership and sustainability; the example from regulations side with WaterLex where good practices from six cases studies were provided, highlighting how policies, rules, and regulations can be a lever for a Nexus Approach; examples of how wastewater can be reused shifting from linear approach to circular one, adopting the circular economy approach, business model, and income generation; and the example from Munich, Germany and Tucson, Arizona in USA for extreme event management: flood and scarcity. We still have to overcome some challenges, such as governance, innovative financial mechanisms, disconnection between global and national levels. Even for international organisations and the UN, break the silos! Here, the WWAP is a good example. The Safe Use of Wastewater in Agriculture (SUWA) is another one.

There are very few examples of advances in upscaling local projects demonstrating nexus implementation at national level. Very good case studies are happening at the local level but there is still the scale issue; the national level remains a challenge. There is a need for countries to come out from one-dimensional driven approach to embrace the Nexus Approach. The SDGs themselves can be conflicting. Hence, we need to be careful in their implementation to avoid achieving one SDG and jeopardising others. For example, reaching food security (SDG2) can severely impact SDG 6, if done in a 'siloed' approach.

Kwang Kook Park

President, Korea Environment Institute

It is my greatest pleasure to attend this year's Dresden Nexus Conference 2017 and I would like to congratulate all organisers, speakers, and participants for this truly meaningful conference to advance the sustainable development agenda and the Nexus Approach to resource management. The productive and open discussions throughout the conference will undoubtedly serve as a meaningful step forward in advancing our understanding of and tackling the emerging issues for our global sustainability.

The constituents of the nexus concept of our conference – water, soil, and waste – each holds intrinsic characteristics that make it highly sensitive to and dependent on multi-level governance. Coping with the various forms of environmental and social challenges raises not only the question of 'What to do?', 'Who does what?', 'At which level of government?', 'How?', but also and most importantly, as Simon Sinek's TED talk has stressed on is the importance of starting with 'Why we are doing it?', 'Why Nexus Approach?' Policy responses will only be viable if they are coherent, if stakeholders are properly engaged, if well-designed regulatory frameworks are in place, if there is adequate and accessible information, and if there is sufficient capacity, integrity, and transparency. In order to respond to our challenges, institutions need to adapt to changing circumstances, and political will and policy continuity are key in the transition towards more inclusive and sustainable practices.

For this wrap-up session, I was particularly requested to address whether there have been good examples of how scientific evidence has been taken up in the governance of environmental resources. As pointed out by the two keynote speakers on Day 1, Dr. Jerome Delli Priscoli and Dr. Nicola Fohrer, the nexus or the integrated and interdisciplinary modeling approach, however you wish to name it, is important in managing the uncertainties and assessing the risks in our interconnected world. Thus, scientific evidence must be the key to allow better decision-making for our complex challenges.

Indeed, the presentations and discussions throughout the different sessions at DNC2017 have pointed out the governance gaps hindering policy design and implementation and even suggested a set of policy responses and good practices for overcoming them.

Just to recall a few presentations, the project on the Management of Mineral Resource Extraction in Hoa Binh Province in Vietnam by IOER and VIUP of Vietnam is jointly developing modelling tools and guidelines for sustainable and responsible use of natural resources, which is a perfect example of North-South international cooperation seeking for scientific evidence to contribute to the governance of natural resource management in Vietnam. Scientific research by SEI to develop a new framework to better understand SDG interactions has proposed a seven-point scale of SDG interactions to organise evidence and support the decision-making considering national priorities. As discussed in the session, the findings of the research can set the framework to start the dialogue with the government, policymakers, and other stakeholders.

Despite the efforts for scientific evidence, gaps remain and there is still much to be done from all sides. There have been numerous case studies throughout the conference demonstrating efforts for the Nexus Approach in different contexts. However, the different scientific evidence shows that there is not a one-size-fits-all solution to the environmental resource management challenges worldwide, but rather a large diversity of situations within and across countries, and even at local levels. Governance responses should therefore be adapted to territorial specificities, and recognising that governance is highly context-dependent and demand-driven. Only with such an approach can we set viable policy that can improve the quality of our lives starting at the community level, which can then lay the foundation for global sustainability. In fact, there is now an enhanced recognition that bottom-up and inclusive decision-making is the key to effective resource management policies.

The Dresden Nexus Conference has given me and my team from KEI many important lessons and insights; brimming with fresh new ideas to bring back home. I also sense that you are also feeling the same way. I would like to thank the organisers, UNU-FLORES, Technical University of Dresden, and IOER, and, in particular, I would like to thank Dr. Bernhard Müller for inviting me here for this fascinating opportunity.

Thank you very much for your attention.

Ambassador Csaba Kőrösi

Director, Office of the President of the Republic of Hungary and Co-Chair of the UN Open Working Group on Sustainable Development Goals

Thank you for the exceptional opportunity to participate at DNC2017. It was solution-oriented, inspiring, and full of lessons.

The 2030 Agenda for Sustainable Development is an attempt to model real life's interdependencies. It is relatively easy to accept that the SDGs are interlinked. It is also an acceptable idea that an integrated agenda offers possibilities for more cost-efficient solutions. But it is harder to design implementation. The world is looking for ways and means to assist the transformation. DNC has been a useful forum.

The task is not lesser than changing the mindsets and the meaning of development. For thousands of years, development and progress was measured by how we were able to increase the pace of extraction and use of new natural resources. From now on, progress means how to secure our further development with decreased extraction of new natural resources.

DNC has done a remarkable job in developing toolkits for design and implementation of (certain aspects of) sustainability transformation. Now it is time to step out of the lab and go to the field of application of the knowledge.

Why is it harder to design the implementation? Scientific methodologies to explore nexus effects are being developed by many institutions, but there is no single recipe for it; the implementation is to be carried out in very different national circumstances. Even nexus effects might work in different ways in different social, natural, and economic environments.

We are using the existing institutions, channels of collaborations, treaties, rules of the game, budgeting, though present systems of implementation, institutions, budgeting rules are built on stand-alone mandates, competences, projects. There is a shortage of trained experts, bureaucrats, and politicians who can efficiently handle nexus knowledge in decision-shaping.

We are racing against time: we have a 15–20 years window to carry out transformation. Present trends show acceleration in the rise of challenges in some areas (water, soil, urbanisation, biodiversity), while we experience a true revolution in some other spheres (energy, scientific aspects of healthcare).

If sustainability were to be compared to a bus journey the task is fourfold: change the course of cruising, accelerate, fix the bus *en route*, and retrain the bus drivers. Not a small task, but doable. Trade-off effects are mostly calculated within the national implementation plans. But in some areas, transboundary impacts of trade, natural resource management are very significant. Some of these impacts are regulated by international treaties; some others are still not and represent hot potatoes in international relations.

DNC is a high quality platform for knowledge generation. It is a forum to synthesise science-based knowledge on interdependencies and translates them into the language of political and economic decision-shaping. DNC helps our understanding of what it would take to shift the meaning of development.

Some recommendations, based on the suggestions voiced during the sessions of DNC2017 are as follows:

The Nexus Approach offers a toolkit and methodology for the design and implementation of the sustainability transformation. The 17 SDGs represent an integrated system. It might be reasonable to extend the scope of nexus research beyond the food-water-land-energy-climate-cities nexus.

The community of material science has done good work. The next DNC could benefit from the inclusion of economists, financing experts, representatives of humanitarian sciences, and practitioners.

Expansion of the scope may rightly pose the question: would the huge number of issues and indicators not be too complicated? It could, but we have the methods of big data analyses that can be successfully applied. Anyway, in other spheres of life we regularly deal with the exponentially increased incoming data. (Just think about how many indicators we measure without difficulty during a blood test and integrate the result with other examinations to answer the simple question: how is my health?)

It has been reconfirmed by many that the natural field of cross-sectoral actions is the municipalities. But let us not give up the notion that institutions at national level – such as governments, parliaments – should also be able to benefit from nexus knowledge. They are responsible for designing national implementation strategies, budgets, laws, and regulations.

It was said loud and clear: let us be aware of the fact that new challenges can emerge. The combination of factors can create situations forcing increasing parts of the population to abandon their communities and livelihoods. The Nexus Approach might offer a good service to understand the reasons and prevent aggravation.

An appeal has been made: let us not be afraid to question some axioms if necessary – for example, on the process and simplified objectives of urbanisation. I thank the organisers for the opportunity to learn and congratulate them on the excellent work done.

POSTER AWARD FOR EARLY-CAREER SCIENTISTS

Early-career scientists – PhD students or researchers who completed their PhD within the past five years – had the opportunity to participate in the poster competition. Awardees were selected by conference participants in a voting process. The three posters with the most votes were recognised during the closing and received a book prize and a voucher from Springer.

The winning posters are highlighted with the  *in their respective session report.*

CLOSING COMMENTS FROM ORGANISERS (EXCERPTS)

Jakob Rhyner

United Nations University (UNU), Vice-Rector in Europe

"There is a growing appreciation of this event. And we have grown qualitatively as well. The timing (of DNC2017) is a good one. After the development and launching of many goals and agendas, now it is the time of implementation. The Dresden Nexus Conference places a hugely important role because it has at its core the interconnectedness of these different goals. Without the recognition of which, failure is guaranteed. It calls for more. We are waiting already for the next conference!"

Hans Georg Krauthäuser

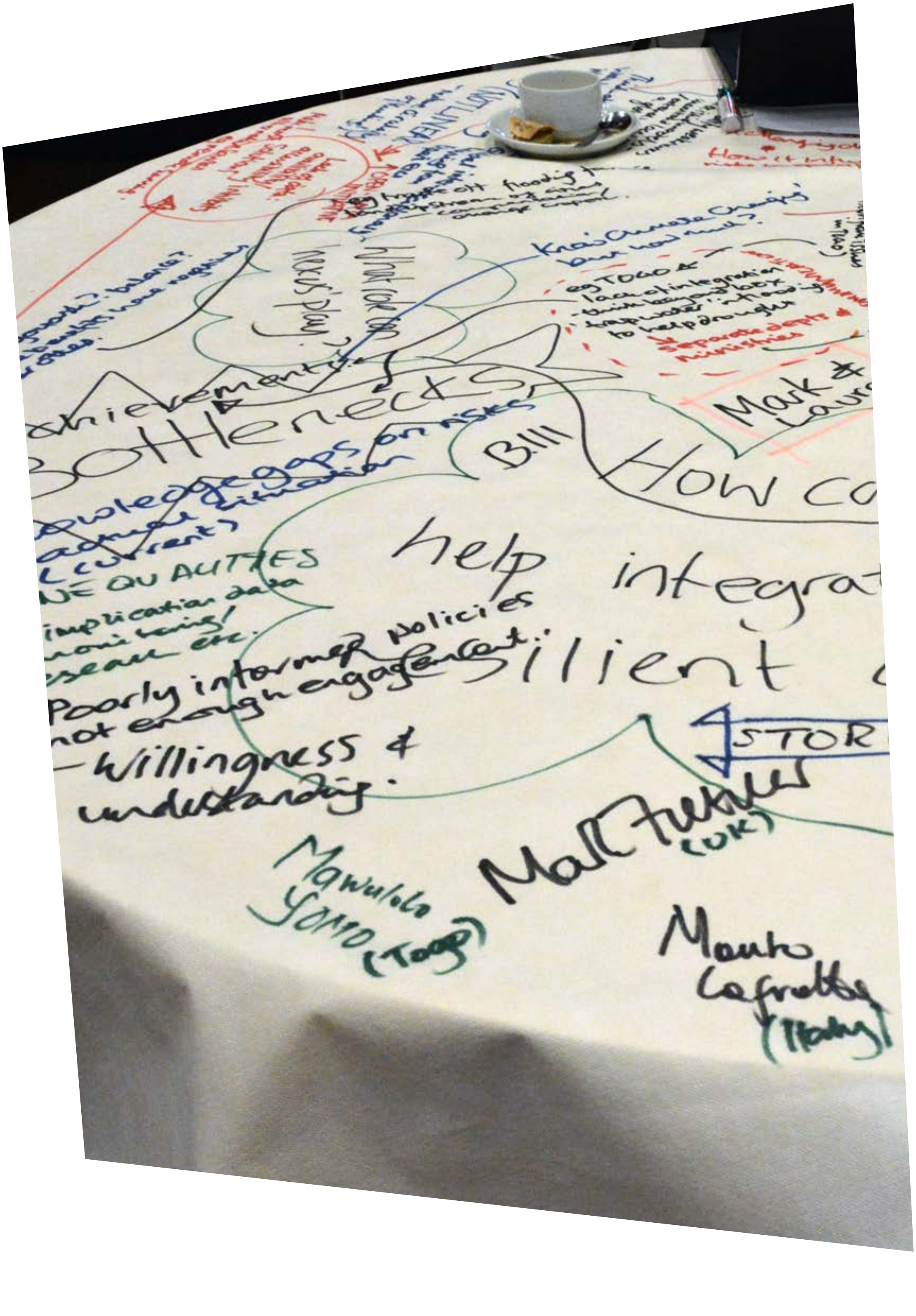
Technische Universität Dresden (TU Dresden), Vice-Rector for Academic and International Affairs

"This conference offered many opportunities for exchange and discussion on current research and initiatives applying a Nexus Approach to resource management and the benefits for achieving the Sustainable Development Goals. ... I would like to express three wishes: I wish that the Dresden Nexus Conference will be even more successful in the coming year; I wish that the three organising Institutes continue to cooperate so constructively and successfully; and, finally, that the conference participants keep the implementation of the SDGs close to their hearts and continue to drive the process which was launched at this conference."

Bernhard Müller

Leibniz Institute of Ecological Urban and Regional Development (IOER), Director

"For whomever the nexus or the interconnection between the Sustainable Development Goals and the Nexus Approach was not clear, I think it should be clear now. We had many possibilities to discuss and clarify it. ... What we also have shown here is that the Nexus Approach is an excellent opportunity to overcome the challenge of the urban-rural divide. ... However: What really matters in these interconnections and the related processes is people, is stakeholders. Nexus is about the interconnection between people, businesses, policymakers, etc.. In other words, it is governance. ..."



What role can nexus play?
Bottlenecks
Achievements
knowledge gaps on risks
How can
help integrat
silient
Poorly informed policies
not enough engagement
Willingness &
understanding
eg TOGO &
lack of integration
Separate depts
ministries
Mark &
Bill
STOR
Matt (UK)
Mawuloko Yomo (Togo)
Mauro Lafratta (Italy)

SUMMARY & OUTLOOK

At the core of DNC2017 was the question, how the Nexus Approach can contribute to the implementation of the Sustainable Development Goals (SDGs) and the New Urban Agenda of the United Nations, and how monitoring measures are involved. The contributions for science and policy focused on examples related to multifunctional land-use systems and resource management in resilient cities and urban areas, as well as cross-thematic content.

DNC2017 undoubtedly has taken another step to establish the biannual Dresden Nexus Conference as one of the main international fora to discuss issues related to sustainable management of environmental resources, promote a Nexus Approach, and explore the links to the SDGs. A clear indication in support of this evaluation was the increased number of participants compared to DNC2015 (demonstrating also the need for this platform), including key organisations and figures from the "nexus community". DNC2017 has also attracted several side events organised by partner organisations and introduced new items in its agenda, mainly aimed at increasing the level of involvement of all participants (e.g., World Café, gaming session, more time for poster sessions) and putting more emphasis on practical implementation of the Nexus Approach (e.g., Case Study Panel Discussions, field visits). Based on feedback received, these items will be evaluated and further refined for future DNCs.

In addition to the many positive impulses the participants took home with them, the challenges identified during the conference were clearly linked to the topic. The integrated management of environmental resources is still, above all, a topic discussed in science. However, for the broad implementation of linked strategies in practice, it really comes down to the people, as mentioned in one of the final speeches. Above all, the findings from science, the good initiatives and ideas must be communicated to the right actors – political decision makers as well as local stakeholders and representatives of the business community. In science itself, the discussion around the approach should be more interdisciplinary and, for example, the social sciences should also be more closely involved.

It is not just a matter of linking different professional topics. At least as important is the cooperation of different stakeholder groups. From the beginning, they must be involved in the deliberations and planned implementation projects – appropriate integrated formats and governance structures are also required.

"The Nexus Approach must now leave the scientific laboratories and be put into practice," also urged Ambassador Kőrösi in conclusion. The organisers of the conference, UNU-FLORES, the Faculty of Environmental Sciences of the TU Dresden and the IOER are aware: till the next DNC in 2019, many challenges remain that scientists can only tackle together with stakeholders from practice.

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TU Dresden
Technische Universität
Dresden

IOER
Leibniz Institute of
Ecological Urban and
Regional Development

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